CAMTECH MANUFACTURING

US LOCATIONS

West Coast • Mid West • South • East Coast



CAMTECH
MANUFACTURING

GEORGIA

Atlanta Metro Area • Fulton County

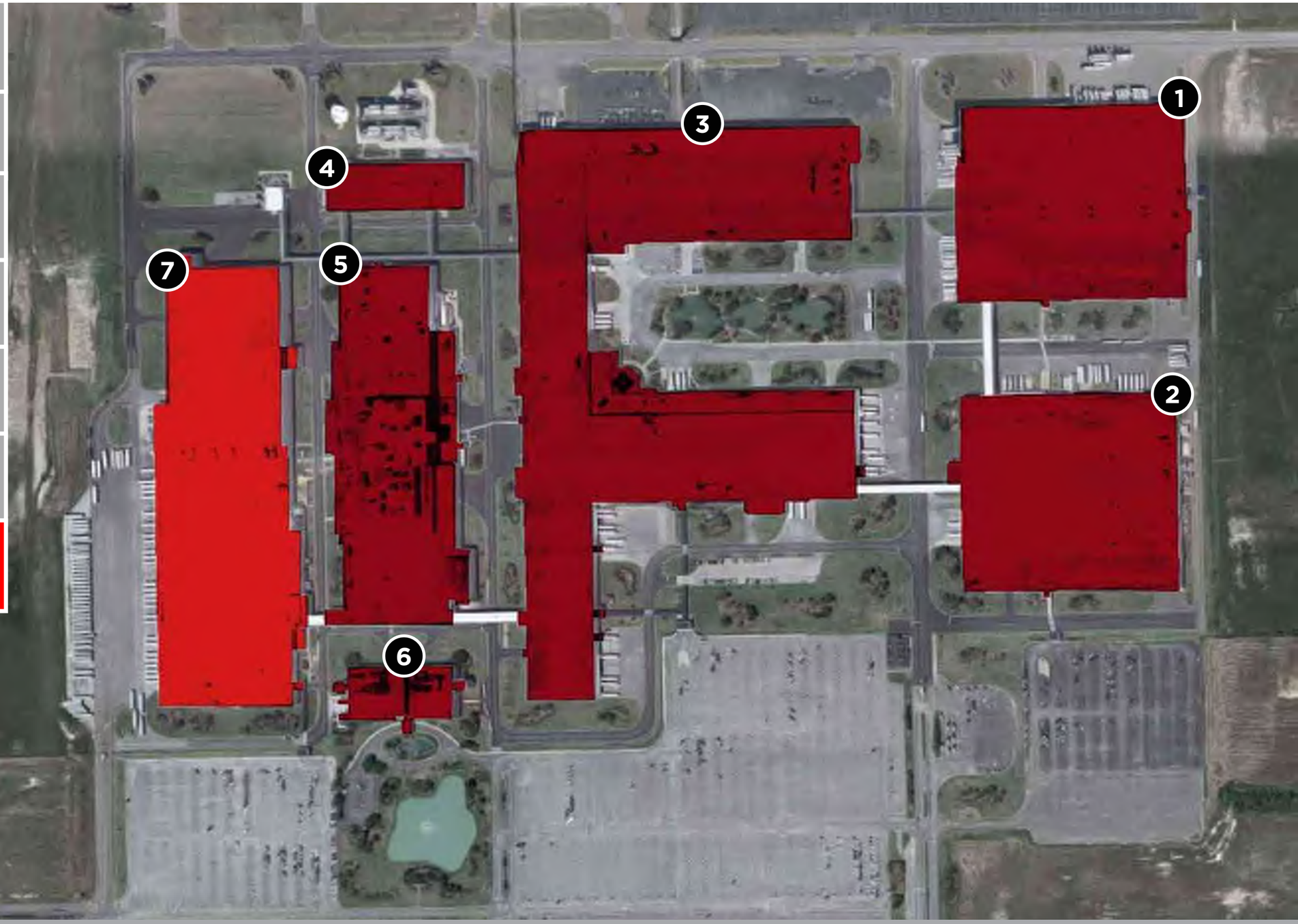


CAMTECH
MANUFACTURING

CAMPUS MAP

7809 Industrial Boulevard, Atlanta, GA 30301

- HI-TECH PRODUCT PRODUCTION 1
- 3D PRINTING AND FINISHING AREA 2
- PRODUCT DESIGN & DEVELOPMENT 3
- PACKAGING AND COMPONENTS 4
- MANUFACTURING AND ASSEMBLY 5
- ADMINISTRATION & CUSTOMER CARE 6
- DISTRIBUTION AND MAIN WAREHOUSE 7



CAMTECH
MANUFACTURING

BUILDING 7

7809 Industrial Boulevard, Atlanta, GA 30301

- As-Builts
- Floor Plans
- O&M Manuals
- Warranties
- Shut-Offs
- Emergency



CAMTECH MANUFACTURING

BUILDING 7

7809 Industrial Boulevard, Atlanta, GA 30301

As-Builts Log Sheet

DATE	DESCRIPTION
2017-07-03	Basic Floor Plans, Interior Details
2017-04-28	Fire Protection Drawings
2000-06-18	Occupational Health Services Relocation
2000-02-19	WAN-LAN IT Upgrade
1995-11-14	Front Office and Main Lobby Remodel
1995-05-04	IT Department Remodel
1991-03-08	Accounting and Billing Office Expansion (Level 2)
1991-01-12	Records Room Upgrade
1984-09-09	Men's and Women's Restroom Remodel (Level 1)
1984-05-01	Main Loading Dock Renovation and Upgrade
1978-02-30	Meeting Room Remodel
1978-07-21	Main Warehouse Material Storage Area Expansion
1972-04-15	Production Line and Conveyors Expansion

CAMTECH MANUFACTURING

BUILDING 7

7809 Industrial Boulevard, Atlanta, GA 30301

As-Builts Log Sheet

DATE	DESCRIPTION
1972-01-29	President's Office Remodel
1967-12-03	Industrial Ventilation Upgrade
1966-10-20	Roll-Up Door Replacement (Area 2)
1966-08-17	HVAC System Exhaust Remodel
1961-12-15	Device and PA System Drawings
1954-01-28	Records Department Water Leak
1953-03-29	Site Utility Package

CAMTECH MANUFACTURING

BUILDING 7

7809 Industrial Boulevard, Atlanta, GA 30301

Floor Plan Log Sheet

FLOOR	DESCRIPTION
Level 1	Entrance, Customer Service, Plant Management, Manufacturing, Warehouse and Docks.
Level 2	Administration, Accounts Payable, Billing, Administration, Sales Management and Support Staff.

CAMTECH MANUFACTURING

BUILDING 7

7809 Industrial Boulevard, Atlanta, GA 30301

O&M Manual Log Sheet

DATE	DESCRIPTION	CONTRACTOR
2017-07-03	Boiler Installation O&M Manual	Gray Bear Construction
2017-04-28	HVAC System O&M Manual	Air Systems Inc.
2016-04-22	Fire Damper Inspection	Prevent Fire Safety Solutions
2015-02-12	Hazardous Materials Storage Area Expansion	Southeast Engineering Service, Inc.
2014-03-01	Hazardous Materials Storage Expansion Environmental Survey	Southwest Engineering Service, Inc.
2000-08-18	Occupational Health Services Relocation	Fortis Constructions, Inc
2000-02-23	LAN/WAN IT Upgrade	Skanska U.S.A. Building - Georgia Division
1999-06-12	Men's and Women's Restroom Remodel (Level 1)	Fortis Construction, Inc
1995-11-14	Front Office, Main Lobby and Exterior Remodel	P&C Construction
1995-05-04	IT Department Remodel	Turner Construction
1993-05-23	Production Line and Conveyor Expansion	P&C Construction
1991-01-29	Accounting and Billing Office Expansion (Level 2)	CK Industries, Inc.
1984-09-09	Building 7 Roof Restoration - Mechanical Closeout	Total Mechanical, Inc.

CAMTECH MANUFACTURING

BUILDING 7

7809 Industrial Boulevard, Atlanta, GA 30301

O&M Manual Log Sheet

DATE	DESCRIPTION	CONTRACTOR
1980-05-28	Sales Department Remodel	Total Mechanical, Inc.
1979-03-15	Main Warehouse Expansion (Level 1)	Spacesaver Speciaists, Inc
1978-02-30	Meeting Room Remodel	Turner Construction
1972-12-15	President's Office Expansion	Howard S. Wright Constructors
1967-10-20	Main Loading Dock Renovation and Upgrade	Skanska U.S.A. Building, Inc.
1966-08-17	HVAC System Exhaust Remodel	Skanska U.S.A. Building, Inc.
1954-01-28	Water Risk Remediation	Schommer & Sons

Accurate Partitions Corp.

PO Box 287
Lyons, Illinois 60534

8000 Joliet Rd.
McCook, IL 60525

Telephone: 708.442.6800
Facsimile: 708.442.7439
www.accuratepartitions.com

Project: Camtech Manufacturing - Building 7
7809 Industrial Boulevard, Atlanta, GA 30301
Date of Substantial Completion: 10-25-2016
Warranty Expiration Date: 10-25-2026

Accurate Partitions Corp.

Black Core Phenolic Warranty
Color-thru Phenolic Warranty

ACCURATE PARTITIONS CORP. guarantees that the restroom partitions shall be fabricated in accordance with ACCURATE'S approved drawings and specifications.

ACCURATE PARTITIONS CORP. guarantees its phenolic partitions, properly maintained, against delamination, breakage, or corrosion, for 10 YEARS from date of Material Completion. If material is found defective during that period, the material shall be replaced free of charge. No credits or allowances shall be issued for any labor or expenses relating to the replacement of components covered under the warranty plan.

This warranty shall not be applicable if vandalism or improper cleaning/maintenance of partition has contributed as just cause for partition failure.

ACCURATE PARTITIONS CORP.
LYONS, ILLINOIS

Air Systems

An EMCOR Company

08/01/2016

SC Builders
910 Thompson Place
Sunnyvale, Ca 94085

SC Builders Project No. 115031-20

Start Date: 06/14/2016

Expiration Date: 06/14/2017

Recently Air Systems Inc. modified the HVAC and plumbing system at 7809 Industrial boulevard, Atlanta, GA 30301. The modifications we made to the system are warranted to be free from defects in workmanship and material for a period of one year from the date of completion 06/14/2016. In order to keep this warranty in effect, regular preventative
maintenance must be provided to the entire system. The warranty is limited to repair and replacement of defective materials. The warranty does not cover any consequential damages.

The following are items not covered under the warranty:

1. Thermostat setting caused by power failure or daylight saving time.
2. Thermostat setting after initial setting or recalibration of controls.
3. Individual comfort air balance once initial air balance is completed.
4. Re-setting manual re-set controls on safety circuits caused by power failure or brown-outs.
5. External electrical components such as disconnect switches of breaker panels.
6. Failures caused by lack of maintenance, including but not limited to, dirty filters, broken belts, worn bearings, etc.
7. Parts damaged by power failure or variations in voltage.

THIS LIMITED WARRANTY IS GIVEN IN LIEU OF ANY AND ALL OTHER EXPRESS OR IMPLIED WARRANTIES.

Sincerely,
AIR SYSTEMS INC.

April Hagopian
MEP Division

PLEASE ACKNOWLEDGE RECEIPT OF THIS WARRANTY LETTER BY SIGNING BELOW AND RETURNING ONE (1) FULLY EXECUTED COPY AS SOON AS POSSIBLE.

By_____ Date:_____

940 Remillard Court, San Jose, California 95122 Phone (408) 280-1666 Fax (408) 280-1020
www.airsystemsinc.com www.emcorgroup.com

PROUDLY SERVING ALL OF AMERICA SINCE 1975

Thursday, February 02, 2017

SUBCONTRACT WARRANTY

We the undersigned hereby warrant the Stairs & Railings work which we have installed at the following location:

CAMTECH MANUFACTURING
7809 INDUSTRIAL BOULEVARD
ATLANTA, GA 30301
JOB: 115031-23

Warranty Start Date: 06/25/2016
Warranty End Date: 06/25/2018

All work has been performed in accordance with the Drawing and specifications, and that the work as installed will fulfill the requirement of the Warranty included in the specifications. We agree to repair or replace any or all of our work, together with any other work which may be damaged or displaced by so doing, that may prove to be defective in its workmanship or material or that may fail to conform to contract provisions and requirements within a period of TWO years from the date 06/25/2016, the substantial completion date of the above named Project by Owner without any expense whatsoever to the Owner, ordinary wear and tear and unusual abuse or neglect excepted.

In the event of our failure to comply with the above mentioned conditions within (7) calendar days after being notified in writing by Owner, we, collectively and separately, do hereby authorize the Owner to proceed to have said defects repaired and corrected at our expense, and we will honor and pay the costs and charges there from upon demand.

Signed__AMERICAN STEEL & STAIRWAYS, INC._ Date: __07/25/2016__
Sub-contractor

By _____
Jeffrey K Dame
CFO – American Steel & Stairways, Inc.

King Curb Span Construction
1841 Howard Road
Portland, OR 97035

Re: P O # 11113
BILCO Invoice 912896 Items:
2 ME-20 (MRS320001) Invoice
Date 07/23/16
Project: *Camtech Manufacturing*
7809 Industrial Boulevard
Atlanta, GA 30301

Warranty Date: 07/23/16
Expiration Date: 07/23/26

Dear Sir or Madam:

BILCO Products are guaranteed to be free from defects in material and workmanship for a period of ten years from date of purchase any part fail to function or break in normal use during this period, a new part will be furnished at no charge. Electrical operating mechanisms, smoke detectors, and other special equipment are separately warranted.

Very truly yours,

THE BILCO COMPANY

Charleen Belco
Customer Service Representative
Architectural Products

CB:p11

Gray Bear Construction

ONE YEAR WARRANTY AND GUARANTEE

Project: Boiler
Installation

Owner: Camtech Manufacturing
7809 Industrial Boulevard
Atlanta, GA 30301

Work Completed: 08/03/17
Expiration of Warranty: 08/03/18

We, the undersigned, hereby warrant and/or guarantee the work at the above mentioned project has been performed in accordance with the contract documents and that the work, as installed, will fulfill all of the warranty/guarantee requirements included in these contract documents. We hereby agree to replace at our sole cost and expense, any or all materials adjadged not in accordance with the contract documents or improperly installed, as well as guarantee the Owner and Contractor against liability, losses or damage to any or all parts of the work arising from said installation during the period of one (1) year from the date of the Notice of Completion. If the period of guarantee is stipulated in excess of one (1) year by the contract documents, subcontractor shall be bound as specified. All guarantees will insure to the benefit of the Contractor, Owner, successors or assigns. Exempt from the guarantee/warranty is ordinary wear and tear and unusual abuse.

In the event of failure to comply with the above mentioned conditions within a reasonable time as determined by the Owner, after being notified in writing, we, the undersigned, so hereby authorize the Owner to have said defect, repairs, and/or replacements made good and we will refund to the Owner, on demand, all costs and charges therefore, including all collection costs and reasonable attorney's fees.

The above warranty does not supersede the Latent and Patent Defect Laws.

Gray Bear Construction Co

By: John F. Witty
Title: President
Date: 2/1/17

State License No: 158733
Expiration Date: 08/03/18

Local Representative to be contacted for maintenance, repair and/or replacement service:

Firm Name: Gray Bear Construction Co, Contact: John F Witty

Address: 4548 N. Albina Avenue
Atlanta, GA 30301

Telephone: 404-282-2116

Bristolite Skylights
401 E. Goetz Ave., Santa Ana, CA 92707

Date: October 20, 2016 Exp. Date: October 20, 2041

BRISTOLITE WARRANTY

ENERGY STAR SKYLIGHTS

LIMITED **Twenty Five**, (25) Year Warranty

Project: **CAMTECT MANUFACTURING - BUILDING 7, 7809 Industrial Blvd., Atlanta, GA 30301**

Purchased Through: **SPAN CONSTRUCTION & ENGINEERING, Inc.**

All BRISTOLITE products are warranted to Costco against defects in materials and workmanship and against leaking for Twenty Five (25) years, provided that such Bristolite PRODUCTS ARE INSTALLED IN ACCORDANCE WITH BRISTOLITE'S RECOMMENDATIONS. The sole liability of BRISTOLITE under this guarantee shall be to repair or replace the defective unit or item exclusive of shipping expense and installation charge. This warranty does not cover damage caused by misuse and is void if the purchaser makes any material alteration to the structure or finish of the product. This warranty does not cover incidental or consequential damages to persons or property caused directly or indirectly by a BRISTOLITE skylight product.

This warranty gives you specific legal rights. There are no other warranties, expressed or implied, concerning the products except as specifically set forth above. This is a manufacturers warranty by BRISTOLITE SKYLIGHTS.

BRISTOLITE SKYLIGHTS
By: Brett Gravely
Title: Customer Service Supervisor

BRISTOLITE SKYLIGHTS, SERVICE DEPARTMENT
401 E. Goetz Avenue, Santa Ana, CA 92707
Tel: 714-540-8950 Fax: 714-540-5415

C&O PAINTING INC
1500 N. 4TH ST
SAN JOSE CA 95112
TEL 408.279.8011
FAX 408.279.3032

GUARANTEE/WARRANTY LETTER FOR

C & O Painting Inc.

We hereby guarantee/warranty that the Painting which we have provided at **Camtech Manufacturing (SCBI #115031)** located at **7809 Industrial Boulevard, Atlanta, GA 30301** has been completed in accordance with the Specifications and the other Contract Documents. **Start Date:** 07/05/2016 **End Date:** 07/05/2026

We agree to repair or replace any or all of our work, together with any other adjacent work which may be displaced by so doing, that may prove to be defective in its workmanship or material within a period of TEN year(s) from the date of acceptance **07/05/2016** of the above named project by the Owner; and we also agree to repair any and all damages resulting from such defects, all without any expense to the Owner, ordinary wear and tear and unusual abuse or neglect excepted.

In the event of our failure to comply with the above mentioned conditions within ten (10) DAYS AFTER BEING NOTIFIED IN WRITING BY THE Owner, we collectively or separately do hereby authorize the Owner to proceed to have such defective work repaired or replaced and made good at our expense, and we will honor and pay the costs and charges therefore upon demand.

C & O Painting Inc.
Company

Signature 7/6/16
Date

Carlisle Coatings & Waterproofing Incorporated

900 Hensley Lane • Wylie, TX 75098 • (972-442-6545)

MIRADRI 860/861 5 YEAR WATERMARK MATERIAL WARRANTY

Job #: 102307 **Warranty #:** 102601

Owner Name: CAMTECT MANUFACTURING

Address, City and State: 7809 INDUSTRIAL BOULEVARD, ATLANTA, GA

Waterproofing Applicator: METRO WATERPROOFING INC

Address, City & State: 2935 ALCOVE DRIVE, SCOTTDALE, GA

Name of Project: CAMTECT MANUFACTURING - BUILDING 7

Address, City and State: 7809 INDUSTRIAL BOULEVARD, ATLANTA, GA

Square Footage: 9,100 EFFECTIVE DATE: 01/31/2016 THIS WARRANTY EXPIRES: 01/30/2021.

Carlisle Coatings & Waterproofing Incorporated ("Carlisle"), warrants the Carlisle membrane product installed at the above project in accordance with the following terms and conditions:

Carlisle warrants to the Buyer of the membrane product that the membrane product will be free from manufacturing defects at the time of its delivery to the job site. Any claim by Buyer of a manufacturing defect in the membrane product must be given to Carlisle, in writing, within thirty (30) days of delivery of the membrane product to the job site. If, upon inspection by Carlisle, the membrane evidences manufacturing defects, Carlisle's liability and Buyer's exclusive remedy shall be limited to the replacement of the defective membrane product at the F.O.B. point in the original contract of sale.

Carlisle further warrants that subject to the terms and conditions of this warranty, water will not leak directly through the membrane for a period of 5 years from the date of issuance of this warranty, if properly installed, maintained and used for the purpose intended by Carlisle. See above for the expiration date of this warranty.

This warranty does not apply to any part of the membrane product unless installed by an authorized applicator by Carlisle. Further, this warranty does not cover any cost or expenses associated with the removal, excavation or replacement of concrete or other materials covering the membrane product incurred to test, repair, inspect, remove or replace the membrane product.

If upon inspection by Carlisle, the membrane product shows water leaking directly through the membrane within the 5 year period stated herein, Carlisle's sole liability and the Buyer's exclusive remedy are limited, at Carlisle's option, to the providing of repair material for the original membrane product or the granting of credit to be applied towards the purchase of a new membrane product, the value of these remedies being determined by Carlisle based upon the number of remaining months of the warranty period used to pro-rate the value allowed by Carlisle for the repairs or credit. In no event shall the cost of the repair material or the credit exceed the original purchase price for the membrane product.

This warranty against leakage directly through the membrane applies only to the membrane product and does not cover flashings, adhesives and other accessories contained in a membrane system.

Any claim or leakage directly through the membrane must be made, in writing, to Carlisle within thirty (30) days of the date of discovery or by the expiration date of this warranty, whichever shall first occur.

Carlisle shall not be liable for any consequential or incidental damages related, directly or indirectly, to the presence of any irritants, contaminants, vapors, fumes, molds, fungi, bacteria, spores, mycotoxins or the like in the building or in the air, land or water serving or coming in contact with the building.

Carlisle shall have no obligation under the Warranty while any bills for installation, supplies, service, and warranty charges have not been paid in full to the authorized applicators, Carlisle or material suppliers. This warranty shall become null and voids, except for the disclaimers and limitations of liability herein, if any of the following shall occur:

-repairs or alterations are made to the membrane product after installation by anyone not expressly authorized by Carlisle;

-the membrane is damaged by intentional or negligent acts, accidents, misuse, abuse, vandalism, civil disobedience or the like;

- the membrane product is damaged by natural disasters Including, but not limited to, fire, insect infestations, earthquake, tornado, hail or hurricane.

-deterioration or failure of building components damage the membrane product

-acids or harmful chemicals come in contact with the membrane product; or

-gaps or cracks exist in the structural base which exceed 1/16 inch in width.

This warranty is not assignable by operation of law or otherwise.

CARLISLE DOES NOT WARRANT PRODUCTS UTILITZED IN THIS INSTALLATION WHICH IT HAS NOT FURNISHED; AND SPECIFICALLY DISCLAIMS LIABILITY, UNDER ANY THEORY OF LAW, ARISING OUT OF THE INSTALLATION AND PERFORMANCES OF, OR DAMAGES SUSTAINED BY OR CAUSED BY PRODUCTS NOT FURNISHED BY CARLISLE.

THE REMEDIES STATED HEREIN ARE THE SOLE AND EXCLUSIVE REMEDIES FOR FAILURE OF THE CARLISLE MEMBRANE PRODUCT. THERE ARE NO WARRANTEIS EITHER EXPRESSED OR IMPLIED, INCLUDING THE IMPLIED WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY WHICH EXTEND BEYOND THE FACE HEREOF. CARLISLE SHALL NOT BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL OR OTHER DAMAGES INCLUDING, BUT NOT LIMITED TO, LOSS OF PROFITS OR DAMAGE TO THE BUILDING OR ITS CONTENTS UNDER ANY THEORY OF LAW.

Authorized Signature: David Bruen Date: January 21, 2016.

DE ANZA TILE CO., INC.
45755 Northport Loop West, Fremont, CA 94538
P: (510) 933-7600 F: (510) 933-7650
State License 402306

WARRANTY

Camtech Manufacturing
7809 industrial Boulevard
Atlanta, GA 30301

Contractor Project No. 115031 **DTC Project No. 80412-A**

Warranty for (Scope of Work and Specification Section(s)):

09300 Tile

We hereby warrant that the contract work which we have installed or furnished for the above referenced project has been done in accordance with the Drawings, Specifications, and other Contract Documents; and that the work as installed will fulfill the requirements of the warranty included in the contract documents. We agree to repair or replace any or all of our work, together with any other adjacent work, which may be displaced or damaged by doing, that prove to be defective in its workmanship or materials within a period of
One (1) year from the date of substantial completion of **June 22, 2016** until June **22, 2017**.
De Anza Tile Co., Inc. work has been accepted by owner for this project, without any expenses to the owner, allowing for ordinary wear and tear and unusual abuse or neglect excepted.

In the event of our failure to comply with the above mentioned conditions within thirty (30) days after being notified in writing by the owner, we collectively or separately, do hereby authorize the owner to proceed to have said defects repaired and made good at our expense and we will honor and pay the costs and charges thereof upon demand.

De Anza Tile Co., Inc.

Signature
Jeanette Frain-Kim
Vice President

July 12, 2016
Date

DOW CORNING

Dow Corning
Your partner in building the future
CONSTRUCTION SOLUTIONS



05 February 2016
Document Id - 91506

DOW CORNING® SILICONE BUILDING SEALANTS
WEATHERSEAL LIMITED WARRANTY

Project
Project Name: 14-001094 - Camtech Manufacturing
Project Address: 7809 Industrial Boulevard
Atlanta, GA 30301
United States

Dow Corning
Dow Corning Corporation
2200 W. Salzburg Road
Auburn, Michigan 48611
United States
(hereafter referred to as "Dow Corning")

Warranty Recipient / Contractor
Metro Waterproofing Inc
2935 Alcove Drive
Scottdale, Georgia 30079
United States

Building Owner
Camtech Manufacturing
7809 Industrial Boulevard
Atlanta, GA 30301
United States

Applicable terms and conditions on the following pages.



05 February 2016
Document Id - 91506

DOW CORNING® SILICONE BUILDING SEALANTS WEATHERSEAL LIMITED WARRANTY

Warranty Number:	9912
Warranty Effective Date:	31 January 2016
Warranty Expiration Date:	31 January 2036 (20 Years) **hereafter referred to as "Warranty Duration Period"**
Dow Corning® Product(s):	Dow Corning® 790 Silicone Building Sealant Dow Corning® 795 Silicone Building Sealant **hereafter referred to as "Dow Corning® Product"**

Thank you for selecting DOW CORNING® brand silicone products for your project.

When tested and installed as outlined in Section A below, Dow Corning warrants to you, the Building Owner, that the Dow Corning® silicone building sealants indicated above will provide a watertight weatherseal for the Warranty Duration Period from the Warranty Effective Date.

A. GENERAL REQUIREMENTS

In order to obtain this warranty, the building owner is responsible to ensure:

a. The Dow Corning product is applied in strict compliance with Dow Corning's published or electronic recommended application procedures and in accordance with any project specific recommendations from Dow Corning.
b. The Dow Corning product is used with compatible materials and substrates (testing/evaluation is required to obtain this warranty if the surface is not recommended in the Dow Corning Surface Preparation Guide which is available in published or electronic form).
c. The Dow Corning product is applied within its stated shelf life.
d. Field adhesion tests are made, documented, retained, and submitted to Dow Corning upon written request as outlined in the Dow Corning Field Adhesion Test Procedure in order to confirm adhesion under site conditions.

B. LIMITATIONS

This warranty specifically excludes adhesive and/or cohesive failure of the sealant due to:

a. Use of the sealant as a structural or load-bearing sealant.
b. Natural causes including but not limited to lightning, earthquake, hurricane, flooding, tornado, and fire.
c. Improper installation.
d. Movement of the structure resulting in stresses on the sealant which exceed Dow Corning's published specifications for elongation and/or compression for the sealant, including but not limited to structural settlement, design error, or construction error.
e. Use on single-family residential structures.



05 February 2016
Document Id - 91506

DOW CORNING® SILICONE BUILDING SEALANTS WEATHERSEAL LIMITED WARRANTY

And does not cover damage to, or failure of, the sealant due to:

a. Disintegration, deterioration, or failure of the underlying substrates (including but not limited to cracking, blistering, or peeling).
b. Mechanical damage caused by, including but not limited to, surface abrasion, individuals, tools, vandalism or other outside agents.
c. Changes in the appearance of the sealant, including but not limited to, natural weathering (whitening, chalking, fading, staining), the accumulation of dirt or other contaminants deposited on the sealant from the atmosphere, or from incompatible substrates.

This warranty excludes costs and damages attributed to mold, mildew and/or fungus.

The warranty also specifically excludes costs and damages resulting from the presence of any hazardous materials in the existing sealants, coatings, substrates, or the environment/location in which the sealant is installed or applied, including but not limited to:

a. Establishing appropriate safe handling procedures for the removal of sealants and/or coatings.
b. Removal or disposal of the existing sealants and/or coatings.
c. Removal or disposal of Dow Corning silicone sealants and/or coatings after installation.

Dow Corning sealants are not intended for encapsulating any hazardous materials.

Dow Corning's warranty does not cover faults attributable to workmanship.

This warranty will be null and void if Dow Corning or the Dow Corning distributor has not received payments for the products used.

REMEDIES

In the event of a claim under this warranty, you must notify Dow Corning within 30 days of the claimed defect and provide Dow Corning with the opportunity to inspect. Dow Corning shall, for the Warranty Duration Period from the Warranty Effective Date, be responsible for the cost of replacement sealant to make any warranty-related repairs.

DOW CORNING SHALL NOT BE LIABLE FOR AND EXPRESSLY DISCLAIMS ANY LIABILITY FOR ANY DAMAGE TO THE CONTENTS OF THE STRUCTURE OR FOR ANY CONSEQUENTIAL OR INCIDENTAL DAMAGE, WHETHER IN CONTRACT OR IN TORT, INCLUDING NEGLIGENCE. THIS WARRANTY SUPERSEDES ALL OTHER WRITTEN OR ORAL, EXPRESS OR IMPLIED WARRANTIES AND DOW CORNING SPECIFICALLY DISCLAIMS ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR PURPOSE.

This warranty agreement is governed by and construed in accordance with Michigan law.

Transfer of this warranty to a new Owner may be made only if the transfer is acknowledged in writing by Dow Corning to the new Owner. Dow Corning must be notified in writing at time of sale to the new Owner. Dow Corning must be satisfied that the intended use of the structure by the new Owner will not cause detriment to the Dow Corning product(s). If these conditions are not met, then this warranty will be rendered null and void.



05 February 2014
Document Id - 91506

DOW CORNING® SILICONE BUILDING SEALANTS
WEATHERSEAL LIMITED WARRANTY

The product is sold to you upon and subject to Dow Corning's standard Terms and Conditions of Sale or supply agreement, as applicable (collectively, the "Standard Terms"). However, to the extent there may be a conflict between the terms of any warranty in the Standard Terms and the provisions of this warranty, the provisions of this warranty shall prevail. This Agreement may be modified only in writing signed by both parties. Note: Warranty not in effect unless signed by Dow Corning Corporation.



EDWARD SOMERVILLE
Business Support Group
Tel: 989-496-5237
Email: ed.somerville@dowcorning.com
Date: 05 February 2016

For questions on this or any other warranty you have with Dow Corning Corporation, please contact the Warranty Administration Department at 989-496-3295 or Fax: 989-496-5324.

Effective from March 23, 2017 until March 23, 2018.

Span Construction and Engineering, Inc.
1841 Howard Road
Madera, CA 93637

Re: Camtech Manufacturing
7809 Industrial Boulevard
Atlanta, GA 30301

Dear Sirs:

Evergreen Construction Specialties, Inc. does hereby warrant all Hollow Metal Doors/Frames and Finish Hardware not covered by a manufacturer's warranty, against defects in material and workmanship for a period of twelve (12) months from the date of substantial completion. This warranty covers replacement of defective material only.

Evergreen Construction Specialties, Inc. disclaims all liability for labor, transportation and other costs directly or indirectly sustained. This warranty shall be null and void if products are subject to abuse, accident, misapplication, or installation not in accordance with manufacturer's specifications and instructions.

Sincerely,

EVERGREEN CONSTRUCTION SPECIALTIES, INC.

Lance M. Stretch

Lance M. Stretch
President

1410 37th Street NW, Suite A
Auburn, WA 98001
www.evconspec.com
Tel: 253-288-8455
Fax: 253-288-8456

GAYLE
MANUFACTURING
COMPANY

1455 E. KENTUCKY AVE., WOODLAND, CA 95776 :SHIPPING
PO BOX 1365, WOODLAND, CA 95776 :MAILING

530 - 662 - 0284 :TEL
530 - 662 - 4376 :FAX

WARRANTY

We hereby warrant that the structural steel which we have installed at Camtech Manufacturing, Building 7 - Job No. 115031, 7809 Industrial Boulevard, Atlanta, GA 30301 has been done in strict accordance with the plans and specifications, and that the work installed will fulfill the requirements of those specifications.

We agree to repair or replace, or cause to be repaired or replaced, any or all of our work which may prove to be defective in workmanship or materials, together with any adjacent work which require repair or replacement because of our defective work within a period of five years from June 29, 2016. This Warranty expires on June 29, 2021.

If we fail to commence to comply with above paragraph within ten (10) days after receipt of written notice, or fail to pursue such compliance with diligence, we jointly, and severally, do hereby authorize the Owner or the General Contractor to proceed to have the defects repaired and made good at our sole expense, and we will honor and pay the costs and charges for it together with interest at a maximum rate permitted by law upon demand. If we fail to fulfill the preceding obligations, and if Owner or General Contractor bring an action to enforce this Warranty, we agree to pay Owner or General Contractor reasonable attorney's fees incurred in connection therewith.

SUBCONTRACTOR:

GAYLE MANUFACTURING COMPANY

BY: _____
Gary W. Glenn, President

DATE: June 26, 2016

LICENSE NO. 293530

CONTRACTOR:

SC Builders, Inc.

BY: _____

DATE: _____

LICENSE NO. _____

LOCAL REPRESENTATIVE TO BE CONTACTED FOR SERVICE:

NAME: Gayle Manufacturing Company

ADDRESS: 1455 E. Kentucky Avenue
Woodland, CA 95776

TELEPHONE: (530) 662-0284

Guarantee / Warranty FIRE

ALARM - ICS JOB NO 15-958

Guarantee / Warranty of the fire alarm system scope of work at the following location:

Camtech Manufacturing
7809 Industrial Boulevard
Atlanta, GA 30301

ICS agrees to repair or replace any or all of our work, together with any other adjacent work which may be displaces by doing so, that may prove to be defective in the workmanship or material for a period of three (3) years from the substantial completion date of the above named project by the Owner; and ICS also agrees to repair any and all damages resulting from such defects, all without any expense to the Owner, ordinary wear and tear and unusual abuse or neglect excepted.

In the event of ICS failure to comply with the above mentioned conditions within ten (10) days after being notified in writing by the Owner, ICS collectively or separately do hereby authorize the Owner to proceed to have such defective work repaired or replaced and made good at ICS expense, and ICS will honor and pay the costs and charges therefore upon demand.

Date of Substantial Completion: 05-26-16

Guarantee Expires: 05-26-19

SUBCONTRACTOR:

ICS – Integrated Communication Systems



By: _____
Michelle Barajas, Administrator

Date: May 26, 2016

License: C-10 814203

Johns Manville

Peak Advantage Guarantee

PEAK ADVANTAGE Johns Manville

Building Owner:
Camtech Manufacturing
7809 Industrial Boulevard
Atlanta, GA 30301

Building Name:
Camtech Manufacturing - Building 7
7809 Industrial Boulevard
Atlanta, GA 30301

Guarantee Number: ANT147211253
Expiration Date: January 31, 2035
Job Name: Camtech Manufacturing - Building 7

Date of Completion: January 31, 2015

Approved Roofing Contractor:

TIP TOP ROOFERS INC.
3151 Elizabeth Lane, SE
Smyrna, GA 30080

Terms & Maximum Monetary Obligation to Maintain a Watertight Roofing System.

Years: 20 Year **$** No Dollar Limit

Coverage:
The components of the Roofing System covered by this Guarantee are:

Total Squares: 950

Sec.	Sqs.	Roof Type	Membrane Spec.	Insulation Type Layer 1	Layer 2	Layer 3	Cover Board
1	950	TPO	ST6RA	ENRGY 3			

Accessories:

Type	Product Name	Quantity	
Expand-O-Flash (1) Style:		0	lin. ft.
Expand-O-Flash (2) Style:		0	lin. ft.
Expand-O-Flash (3) Style:		0	lin. ft.
Drains (1) Style:		0	ea.
Drains (2) Style:		0	ea.
Vents Style:		0	ea.
Fascia Style:		0	lin. ft.
Copings Style:		0	lin. ft.
Gravel Stop Style:		0	lin. ft.

These Johns Manville Guaranteed components are referred to above as the "Roofing System" and ALL OTHER COMPONENTS OF THE OWNER'S BUILDING ARE EXCLUDED FROM THE TERMS OF THIS GUARANTEE, including any amendments thereto.

Johns Manville* guarantees to the original Building Owner that during the Term commencing with the Date of Completion (as defined above), JM will pay for the materials and labor reasonably required in Johns Manville's sole and absolute discretion to repair the Roofing System to return it to a watertight condition if leaks occur due to: ordinary wear and tear, or deficiencies in any or all of the Johns Manville component materials of the Roofing System, or workmanship deficiencies only to the extent they arise solely out of the application of the Roofing System. Non-leaking blisters are specifically excluded from coverage. Should any investigation or inspection reveal the cause of a reported leak to be outside the scope of coverage under this Guarantee, then all such investigation and inspection costs shall be borne solely by the Building Owner.

WHAT TO DO IF YOUR ROOF LEAKS

If you should have a roof leak please refer to directions on the reverse side. Failure by the Building Owner to comply with any of the directions on the reverse side of this document will render the coverage provided under this Guarantee, including any applicable amendments and/or riders, null and void.

LIMITATIONS AND EXCLUSIONS

This Guarantee is not a maintenance agreement or an insurance policy; therefore, routine inspections and maintenance are the Building Owner's sole responsibility (see reverse side of this document). Failure to follow the Maintenance Program on the reverse side of this document will void the Guarantee in its entirety. This Guarantee does not obligate JM to repair or replace the Roofing System, or any part of the Roofing System, for leaks or appearance issues resulting, in whole or in part, from one or more of the following (a) natural disasters including but not limited to the direct or indirect effect of lightning, flood, hail storm, earthquake, tornados, hurricanes or other extraordinary natural occurrences and/or wind speeds in excess of 55 miles per hour; (b) misuse, abuse, neglect or negligence; (c) installation or material failures other than those involving the component materials expressly defined above as the Roofing System or exposure of the Roofing System components to damaging substances such as oil, fertilizers, or solvents or to damaging conditions such as vermin; (d) any and all (i) changes, alterations, repairs to the Roofing System, including, but not limited to, structures, penetrations, fixtures or utilities (including vegetative and solar overlays) based upon or through the Roofing System as well as any (ii) changes to the Building's usage that are not pre-approved in writing by JM; (e) failure of the Building substrate (mechanical, structural, or otherwise and whether resulting from Building movement, design defects or other causes) or improper drainage; (f) defects in or faulty/improper design, specification construction or engineering of the Building or any area over which the Roofing System is installed; (g) defects in or faulty/improper architectural, engineering or design flaws of the Roofing System or Building, including, but not limited to, design issues arising out of improper climate or building code compliance; or (h) in instances of a recover project, Johns Manville is not responsible for the performance of pre-existing materials that predated the recover. Instead, Johns Manville's sole responsibility in recover systems where JM materials are adhered to existing materials is limited to the installed recover JM Roofing materials up to the wind speed listed herein. Guarantee coverage is limited to replacing recover JM Roofing materials only (and not the pre-existing materials – which is the Owner's responsibility) as required to return the roofing system to a watertight condition due to a claim covered under the terms and conditions herein. Johns Manville is not responsible for leaks, injuries or damages resulting from any water entry from any portion of the Building structure not a part of the Roofing System, including, but not limited to, deterioration of the roofing substrate, walls, mortar joints, HVAC units and all other non-Johns Manville materials and metal components. Moreover, the Building Owner is solely and absolutely responsible for any removal and/or replacement of any overburdens, super-strata or overlays, in any form whatsoever, as reasonably necessary to expose the Roofing System for inspection and/or repair.

This Guarantee becomes effective when (1) it is delivered to Owner; and (2) all bills for installation, materials, and services have been paid in full to the Approved Roofing contractor and to JM. Until that time, this Guarantee is not in force, has no effect – and JM is under no obligation whatsoever to perform any services/work.

The Parties agree that any controversy or claims relating to this Guarantee shall be first submitted to mediation under the Construction Industry Arbitration and Mediation Rules of the American Arbitration Association (Regular Track Procedures) or to such other mediation arrangement as the parties mutually agree. No court or other tribunal shall have jurisdiction until the mediation is completed. In any action or proceeding brought against the Building Owner to enforce this Guarantee or to collect costs due hereunder, Johns Manville shall be entitled to recover its reasonable costs, expenses and fees (including expert witness' fees) incurred in any such action or proceeding, including, without limitation, attorneys' fees and expenses, and the Building Owner shall pay it.

TO THE FULLEST EXTENT PERMITTED BY LAW, JM DISCLAIMS ANY IMPLIED WARRANTY, INCLUDING THE WARRANTY OF MERCHANTABILITY AND THE WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, AND LIMITS SUCH WARRANTY TO THE DURATION AND TO THE EXTENT OF THE EXPRESS WARRANTY CONTAINED IN THIS GUARANTEE.

THE EXCLUSIVE RESPONSIBILITY AND LIABILITY OF JM UNDER THIS GUARANTEE IS TO MAKE REPAIRS NECESSARY TO MAINTAIN THE ROOFING SYSTEM IN A WATERTIGHT CONDITION IN ACCORDANCE WITH THE OBLIGATIONS OF JM UNDER THIS GUARANTEE. JM AND ITS AFFILIATES WILL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES TO THE BUILDING STRUCTURE (UPON WHICH THE ROOFING SYSTEM IS AFFIXED) OR ITS CONTENTS AND OR OCCUPANTS, LOSS OF TIME OR PROFITS OR ANY INCONVENIENCE, INJURY. JM SHALL NOT BE LIABLE FOR ANY CLAIM MADE AGAINST THE BUILDING OWNER BY ANY THIRD PARTY AND THE BUILDING OWNER SHALL INDEMNIFY AND DEFEND JM AGAINST ANY CLAIM BROUGHT BY ANY THIRD PARTY AGAINST JM RELATING TO OR ARISING OUT OF THE ROOFING SYSTEM OR JM'S OBLIGATIONS UNDER THIS GUARANTEE. JM AND ITS AFFILIATES SHALL NOT BE LIABLE FOR ANY DAMAGES WHICH ARE BASED UPON NEGLIGENCE, BREACH OF WARRANTY, STRICT LIABILITY OR ANY OTHER THEORY OF LIABILITY OTHER THAN THE EXCLUSIVE LIABILITY SET FORTH IN THIS GUARANTEE. THIS GUARANTEE DOES NOT COVER, AND EXPLICITLY EXCLUDES, ANY AND ALL INJURIES, CLAIMS AND/OR DAMAGES RESULTING, IN WHOLE OR IN PART, FROM ANY WATER ENTRY FROM ANY PORTION OF THE BUILDING STRUCTURE INCLUDING, BUT NOT LIMITED TO, THE ROOFING SYSTEM.

No one is authorized to change, alter, or modify the provision of this Guarantee other than the Manager, Guarantee Services or authorized delegate. JM's delay or failure in enforcing the terms and conditions contained in this Guarantee shall not operate as a waiver of such terms and conditions. This Guarantee is solely for the benefit of the Building Owner identified above and Building Owner's rights hereunder are not assignable. Upon sale or other transfer of the Building, Building Owner may request transfer of this Guarantee to the new owner, and JM may transfer this Guarantee, in its sole and absolute discretion only after receiving satisfactory information and payment of a transfer fee, which must be paid no later than 30 days after the date of Building ownership transfer.

In the event JM pays for repairs which are required due to the acts or omissions of others, JM shall be subrogated to all rights of recovery of the Building Owner to the extent of the amount of the repairs.

Because JM does not practice Engineering or Architecture, neither the issuance of this Guarantee nor any review of the Building's construction or inspection of roof plans (or the Building's roof deck) by JM representatives shall constitute any warranty by JM of such plans, specifications, and construction or in any way constitute an extension of the terms and conditions of this Guarantee. Any roof inspections are solely for the benefit of JM.

JM does not supervise nor is it responsible for a roofing contractor's work except to the extent stated herein, and roofing contractors are not agents of JM.

[1]JOHNS MANVILLE ("JM") is a Delaware corporation with its principal mailing address at P.O. Box 5108, Denver, Colorado 80217-5108.

By: Robert Wamboldt
Title: Vice President & General Manager
Roofing Systems Group

Jim Nunns
Attorney-in-Fact

Maintenance Program

In order to continue the coverage of this Guarantee, the following Maintenance Program must be implemented and followed:

1. Building Owner must notify JM Guarantee Services Unit (see below) immediately upon discovery of the leak and in no event later than ten (10) days after initial discovery of the leak, time being of the essence. Failure of the Building Owner to provide timely notice to JM Guarantee Services of any leak is a material ground for termination of the Guarantee.

2. In response to timely notice, JM will arrange to inspect the Roofing System, and
   (i) If, in JM's sole and absolute opinion, the leak(s) is/are the responsibility of JM under this Guarantee (see Limitations and Exclusions), then JM will take prompt appropriate action to return the Roofing system to a watertight condition, or
   (ii) If, in JM's sole and absolute opinion, the leak(s) is/are not the responsibility of JM under this Guarantee, then JM will advise the Building Owner within a reasonable time of the minimum repairs that JM believes are required to return the Roofing System to a watertight condition. If the Building Owner, at his expense, promptly and timely makes such repairs to the Roofing System (time being of the essence) then this Guarantee will remain in effect for the unexpired portion of its Term. Failure to make any of these repairs in a timely and reasonable fashion will void any further obligation of JM under this Guarantee as to the damaged portion of the Roofing System as well as any other areas of the Roofing System impacted by such failure.

3. In the event an emergency condition exists which requires immediate repair to avoid damage to the Building, its contents or occupants, then Building Owner may make reasonable, essential temporary repairs. JM will reimburse Building Owner for those reasonable repair expenses only to the extent such expenses would have been the responsibility of JM under the Guarantee.

There are a number of items not covered by this Guarantee that are the sole, exclusive responsibility of the Building Owner. In order to ensure that your new roof will continue to perform its function and to continue JM's obligations under the Guarantee, you must examine and maintain these items on a regular basis:

- Maintain a file for your records on this Roofing System, including, but not limited to, this Guarantee, invoices, and subsequent logs of all inspections performed and repairs that are made to the Roofing System.
- Inspect your Roofing System at least semi-annually. This is best done in the spring, after the Roofing System has been exposed to the harsh winter conditions, and, in the Fall after a long hot summer. It is also a good idea to examine the Roofing System for damage after severe weather conditions such as hailstorms, heavy rains, high winds, etc.
- Since these types of Roofing Systems typically have a low slope, they are easily examined. However, care must be taken to prevent falling and other accidents. JM expressly disclaims and assumes no liability for any inspections performed on the Roofing System.

When checking the Roofing System:

- Remove any debris such as leaves, small branches, dirt, rocks, etc. that have accumulated.
- Clean gutters, down spouts, drains and the surrounding areas. Make certain they allow water to flow off the Roofing System. Positive drainage is essential.
- Examine all metal flashings and valleys for rust and damage that may have been caused by wind or traffic on the Roofing System, and make certain they are well attached and sealed. Any damaged, loose, or poorly sealed materials must be repaired by a JM Approved Roofing Contractor only.
- Examine the areas that abut the Roofing System. Damaged masonry, poorly mounted counter flashing, loose caulking, bad mortar joints, and any loose stone or tile coping can appear to be a membrane leak. Have these items repaired by a JM Approved Roofing Contractor if found to be defective.
- Examine the edges of the Roofing System. Wind damage often occurs in these areas. Materials that have been lifted by the wind need to be corrected by a JM Approved Roofing Contractor.
- Examine any roof top equipment such as air conditioners, evaporative coolers, antennas, etc. Make certain they do not move excessively or cause a roof problem by leaking materials onto the Roofing System.
- Check the building exterior for settlement or movement. Structural movement can cause cracks and other problems which in turn may lead to leaks in your Roofing System.
- Examine protective coatings; any cracked, flaking, or blistered areas must be recoated.

Protecting your investment:

- Avoid unnecessary roof top traffic.
- If you allow equipment servicemen to go onto the Roofing System, advise them to be careful. Dropped tools, heavy equipment, etc. can damage the membrane. Log all such trips to the Roofing System.
- Do not allow service personnel to make penetrations into the Roofing System; these are to be made only by a JM Approved Roofing Contractor.

All the terms and conditions of this Guarantee shall be construed under the internal law of the state of Colorado without regard to its conflicts of law principles. Invalidity or unenforceability of any provisions herein shall not affect the validity or enforceability of any other provision which shall remain in full force and effect to the extent the main intent of the document is preserved.

This form is not to be copied or reproduced in any manner. This Guarantee is valid only in the United States of America.

Guarantee Services
(800) 922-5922
E-mail: gsu@jm.com
www.jm.com/roofing

Mailing Address:
Johns Manville
Guarantee Services
P.O. Box 625001
Littleton, CO 80162-5001

Shipping Address:
Johns Manville
Guarantee Services
10100 West Ute Avenue
Littleton, CO 80127

September 2, 2016

Re: Marlite Fiberglass Reinforced Plastic (FRP) Warranty

Marlite offers a five (5) year warranty for the following product and project – Marlite FRP P199 Bright White supplied to Marin Brothers, installed at:

Camtech Manufacturing - Building 7
7809 Industrial Boulevard
Atlanta, GA 30301

The panels are warranted to:

1. Be free from substantial defects in material and workmanship.
2. Be equal to or exceed the applicable requirements of the standard specification per ASTM Specifications
3. Not rot, rust, corrode, develop structural surface cracks or require painting or refinishing (normal pigmentation change excepted) when kept reasonably clean from accumulated dirt and debris.

The warranty is that for five (5) years from date of installation. Marlite will provide upon verification of failure, the necessary materials to repair the defect. Marlite will not be responsible for the fabrication and/or the installation.

The warranty applies only to panels stored, applied, installed and used in accordance with the manufacturer's written recommendations and with recognized standards of construction. The warranty does not cover defects caused by:

- Improper installation.
- Damage (not resulting from defects) while in possession of the customer.
- Unreasonable use (including failure to provide reasonable and necessary maintenance.
- An adhesive bonding agent causing panel failure.

Installation Date: September 2, 2016
Expiration Date: September 2, 2021

Sincerely,



TJ Rine
Director of Development – Chain Products

202 Harger St., Dover, Ohio 44622
800-377-1221
www.marlite.com info@marlite.com

METRO WATERPROOFING, INC.
2935 ALCOVE DRIVE · P.O. BOX 867 · SCOTTDALE, GA 30079
PHONE (404) 292-8013
FAX (404) 292-0270

WARRANTY

Metro Waterproofing, Inc. shall and hereby does warrant and guarantee that all work executed by them will be free from defects of workmanship for a period of TWO (2) Years beginning January 31, 2016 and ending January 30, 2018.

Job Name: Camtech Manufacturing
7809 Industrial Boulevard
Atlanta, GA 30301

Description of Work: 079200: Joint Sealants

Metro Waterproofing, Inc. further agrees that they will promptly at their own expense, repair and replace all such defective work upon notice to them from the Property Owner during the term of the Guaranty-Warranty.

This warranty excludes abuse, misuse, Acts of God, violence, or casualty not the fault of Metro Waterproofing, Inc.

METRO WATERPROOFING, INC.

By S. Michael Strickland

S. Michael Strickland
Vice President
January 20, 2016

Limited Warranty for Air Conditioner & Heat Pump Condensing Units

FOR WARRANTY SERVICE OR REPAIR:

Contact the installer or a Payne dealer. You may find their name on the product or in your Owner's Packet.

For help, contact: Payne Heating & Cooling, Consumer Relations, P.O. Box 4808, Syracuse, New York 13221, Phone 1-888-417-2963

PRODUCT REGISTRATION: Register your product online at *www.payne.com*.

Model No. GUH-21 1CA-7

Unit Serial No. HVGUH21-ICA72000

Date of Installation 04/28/2017

Installed by Air Systems, Inc.

Name of Owner Camtech Manufacturing

Address of Installation 7809 Industrial Bl., Atlanta, GA

Payne Heating & Cooling (hereinafter "Company") warrants this product against failure due to defect in materials or workmanship under normal use and maintenance as follows. Warranty periods begin on the date of original installation. If a part fails due to defect during the applicable warranty period Company will provide a new or remanufactured part, at Company's option, to replace the failed defective part at no charge for the part. Alternatively, and at its option, the Company will allow a credit in the amount of the then factory selling price for a new equivalent part toward the retail purchase price of a new Company product. Except as otherwise stated herein, those are Company's exclusive obligations under this warranty for a product failure. This limited warranty is subject to all provisions, conditions, limitations and exclusions listed below and on the reverse (if any) of this document.

OWNER-OCCUPIED, RESIDENTIAL APPLICATIONS
This warranty is to the original purchasing owner only and is not transferable. Except as otherwise stated, **if the product is installed in an owner-occupied residence and is properly registered within 90 days after original installation (see Warranty Conditions below for registration instructions), then the warranty period will be ten (10) years from the date of installation. Otherwise the warranty period is five (5) years from the date of installation**.

OTHER RESIDENTIAL APPLICATIONS (Apartments, Rental Properties, etc.)
The warranty period is five (5) years all parts and is not transferable.

OTHER APPLICATIONS
This warranty is non-transferable. The warranty period is five (5) years on the compressor, and one (1) year on all other parts.

LEGAL REMEDIES: The owner **must** notify the Company in writing, by certified or registered letter to Payne Heating & Cooling, Warranty Claims, P.O. Box 4808, Syracuse, New York 13221, of any defect or complaint with the product, stating the defect or complaint and a specific request for repair, replacement, or other correction of the product under warranty, mailed at least thirty (30) days before pursuing any legal rights or remedies.

Always Ask for FACTORY AUTHORIZED PARTS

WARRANTY CONDITIONS:

1. To obtain a ten-year warranty the product must be properly registered at *www.payne.com* within ninety (90) days of original installation. In jurisdictions where warranty terms conditioned on registration are prohibited by law, registration is not required and the warranty period will be 10 years.
2. Where a product is installed in a newly constructed home, the date of installation is the date the homeowner purchased the home from the builder.
3. If the date of original installation cannot be verified, then the warranty period begins ninety (90) days from the date of product manufacture (as indicated by the model and serial number).
4. Product must be installed properly and by a licensed HVAC technician.
5. The warranty applies only to products remaining in their original installation location.
6. Installation, use, care, and maintenance must be normal and in accordance with instructions contained in the Installation Instructions, Owner's Manual and Company's service information.
7. Defective parts must be returned to the distributor through a registered servicing dealer for credit.

LIMITATIONS OF WARRANTIES: ALL IMPLIED WARRANTIES AND/OR CONDITIONS (INCLUDING IMPLIED WARRANTIES OR CONDITIONS OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR USE OR PURPOSE) ARE LIMITED TO THE DURATION OF THIS LIMITED WARRANTY. SOME STATES OR PROVINCES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY OR CONDITION LASTS, SO THE ABOVE MAY NOT APPLY TO YOU. THE EXPRESS WARRANTIES MADE IN THIS WARRANTY ARE EXCLUSIVE AND MAY NOT BE ALTERED, ENLARGED, OR CHANGED BY ANY DISTRIBUTOR, DEALER, OR OTHER PERSON WHATSOEVER.

THIS WARRANTY DOES NOT COVER:

1. Labor or other costs incurred for diagnosing, repairing, removing, installing, shipping, servicing or handling of either defective parts, or replacement parts, or new units.
2. Any product purchased over the Internet.
3. Normal maintenance as outlined in the installation and servicing instructions or Owner's Manual, including filter cleaning and/or replacement and lubrication.
4. Failure, damage or repairs due to faulty installation, misapplication, abuse, improper servicing, unauthorized alteration or improper operation.
5. Failure to start due to voltage conditions, blown fuses, open circuit breakers, or damages due to the inadequacy or interruption of electrical service.
6. Failure or damage due to floods, winds, fires, lightning, accidents, corrosive environments (rust, etc) or other conditions beyond the control of Company.
7. Parts not supplied or designated by Company, or damages resulting from their use.
8. Products installed outside the U.S.A. or its territories and Canada.
9. Electricity or fuel costs, or increases in electricity or fuel costs from any reason whatsoever, including additional or unusual use of supplemental electric heat.
10. Any cost to replace, refill or dispose of refrigerant, including the cost of refrigerant.
11. **ANY SPECIAL, INDIRECT OR CONSEQUENTIAL PROPERTY OR COMMERCIAL DAMAGE OF ANY NATURE WHATSOEVER**. Some states or provinces do not allow the exclusion of incidental or consequential damages, so the above limitation may not apply to you.

This Warranty gives you specific legal rights, and you may also have other rights which vary from state to state or province to province.

Always Ask for FACTORY AUTHORIZED PARTS

PrestonPipelines
General Engineering Contractor

SC BUILDERS, Inc.

WARRANTY/GUARANTEE

We hereby warranty/guarantee that the installation of ***Underground Utilities (Sanitary Sewer, Storm Drain, Onsite Fire, Onsite Domestic Water, Reclaimed Water)***, which we provided at ***Camtech Manufacturing***, located at ***7809 Industrial Boulevard, Atlanta, GA 30301*** has been performed in accordance with the requirements of the plans, specifications and Contract Documents.

We agree to repair or replace any or all of our work, in strict accordance with the contract requirements, together with any other adjacent work which may be displaced by so doing, that may prove to be defective in its workmanship and/or material within a period of one (1) year from the date of Preston Pipelines notice of substantial completion on the above-named project by the Owner and Contractor, and we also agree to repair any and all damage resulting from such defects, all without any expense to the Owner or Contractor, ordinary wear and tear and unusual abuse or neglect excepted.

Warranty period shall commence upon Preston Pipelines notice of substantial completion and will only be honored upon payment in full up to and including all work completed at the time of issuance. Furthermore, failure to keep payments current in no way extends or tolls the warranty period which shall begin to run on the date of substantial completion as noted above.

In the event of our failure to comply with the above-mentioned conditions and when payment condition as been met, within fourteen (14) calendar days after being notified in writing by the Owner or Contractor (unless an imminent threat of property damage requires immediate repair and/or replacement, in which case no written notice is required), we collectively, or separately, do hereby authorize the Owner or Contractor to proceed to have such defective work repaired or replaced and made good at our expense, and we will honor and pay the reasonable costs and charges therefore upon demand.

Jordan Thomas, Project Executive
Preston Pipelines, Inc.
Contractors License/Class: 367660/A

Warranty Date: June 12, 2016
Expiration Date: June 12, 2017
PPI Job #15-045

Central Valley Office
12833 S. Manthey Road
Lathrop, CA 95330
(209) 983-6500
(209) 983-6508 Fax

Corporate Office
133 Bothelo Avenue
Milpitas, CA 95035
(408) 262-1418
(408) 262-1870 Fax

Sacramento Office
3780 Commerce Drive
West Sacramento, CA 95691
(916) 386-1500
(916) 386-7531 Fax

www.PrestonPipelines.com
CA #367660 // NEV #0080158
DIR #100000092

ITT

WARRANTY
ITT WATER & WASTEWATER U.S.A., INC

For the period defined, ITT WATER & WASTEWATER offers a commercial warranty to the original End Purchaser against defects in workmanship and material on Flygt Products. Warranty covers Flygt parts and labor as outlined in **ADDENDUM – A**.

COVERAGE:
ITT WATER & WASTEWATER will pay the cost of parts and labor during the warranty period, provided that the Flygt product, with cable attached, is returned prepaid to an ITT WATER & WASTEWATER Authorized Service Facility for Flygt Product repairs. Coverage for Flygt parts and labor will be provided for the period shown in **ADDENDUM - A.** The warranty period will begin from date of shipment or date of a valid Start-up (For permanently installed pumps only). In cases where the Start-up date is used as the beginning of the warranty on a permanently installed Flygt pump, a Start-up Report completed by an approved service technician from an ITT WATER & WASTEWATER Authorized Service Facility for Flygt products must be received by the ITT WATER & WASTEWATER Area Service Manager for Flygt Products within thirty (30) days of the initial onset of the unit placed into service. If not received, the beginning of the warranty coverage will default to the Flygt product ship date. A Start-up for a permanently installed Flygt pump must occur within one (1) year from the date of shipment from an ITT WATER & WASTEWATER authorized facility for Flygt Products or warranty will automatically default to ship date as start of warranty. (See **STORAGE** section) When using the start-up date as the beginning of the warranty, a copy of the Start-up Report will be required to support any Warranty Claims. Warranty on Flygt Dewatering pumps will begin with ship date only. No other date on Flygt Dewatering pumps will be considered.

ITT WATER & WASTEWATER'S sole obligation under this Warranty for Flygt Products shall be to replace, repair or grant credit for Flygt Products upon ITT WATER & WASTEWATER'S exclusive determination that the Flygt Product does not conform to the above warranty. In the event that the Flygt product is replaced, warranty on the replacement product will be equal to the balance remaining on the original product or ninety (90) days, which ever is greater.

MISUSE:
This Warranty shall not apply to any Flygt product or part of Flygt product which (i) has been subjected to misuse, misapplication, accident, alteration, neglect, or physical damage (ii) has been installed, operated, used and/or maintained in a manner which is in an application that is contrary to ITT WATER & WASTEWATER'S printed instructions as it pertains to installation, operation and maintenance of Flygt Products, including but without limitation to (iii) operation of equipment without being connected to monitoring devices supplied with specific products for protection; or (iv) damaged due to a defective power supply, improper electrical protection, faulty installation or repair, ordinary wear and tear, corrosion or chemical attack, an act of God, an act of war or by an act of terrorism; or (v) has been damaged resulting from the use of accessory equipment not sold by ITT WATER & WASTEWATER or not approved by ITT WATER & WASTEWATER in connection with Flygt products.

WEAR PARTS:
This warranty does not cover costs for standard and/or scheduled maintenance performed, nor does it cover Flygt parts that, by virtue of their operation, require replacement through normal wear (aka: Wear Parts), unless a defect in material or workmanship can be determined by ITT WATER & WASTEWATER. Wear Parts are defined as Cutters, Cutting Plates, Impellers, Agitators, Diffusers, Wear Rings (Stationary or Rotating), Volutes (when used in an abrasive environment), oil, grease, cooling fluids and/or any items deemed necessary to perform and meet the requirements of normal maintenance on all Flygt equipment.

ITT

WARRANTY
ITT WATER & WASTEWATER U.S.A., INC

DISCLAIMERS:
(i) ITT WATER & WASTEWATER'S warranties are null and void when Flygt Products are exported outside of the United States of America without the knowledge and written consent of ITT WATER & WASTEWATER U.S.A., INC.; (ii) ITT WATER & WASTEWATER makes no independent warranty or representation with respect to parts or products manufactured by others and provided by ITT WATER & WASTEWATER (however, ITT WATER & WASTEWATER will extend to the Purchaser any warranty received from ITT WATER & WASTEWATER'S supplier for such parts or products).

LIMITATIONS:
ITT WATER & WASTEWATER NEITHER ASSUMES, NOR AUTHORIZES ANY PERSON OR COMPANY TO ASSUME FOR ITT WATER & WASTEWATER, ANY OTHER OBLIGATION IN CONNECTION WITH THE SALE OF ITS FLYGT EQUIPMENT. ANY ENLARGEMENT OR MODIFICATION OF THIS WARRANTY BY A FLYGT PRODUCT DISTRIBUTOR, OR OTHER SELLING AGENT SHALL BECOME THE EXCLUSIVE RESPONSIBILITY OF SUCH ENTITY.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ANY AND ALL OTHER EXPRESS OR IMPLIED WARRANTIES, GUARANTEES, CONDITIONS OR TERMS OF WHATEVER NATURE RELATING TO FLYGT PRODUCT(S), INCLUDING AND WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE WHICH ARE HEREBY EXPRESSLY DISCLAIMED AND EXCLUDED. PURCHASER'S EXCLUSIVE REMEDY AND ITT WATER & WASTEWATER'S AGGREGATE LIABILITY FOR BREACH OF ANY OF THE FOREGOING WARRANTIES IS LIMITED TO REPAIRING OR REPLACING FLYGT PRODUCTS AND SHALL IN ALL CASES BE LIMITED TO THE AMOUNT PAID BY THE PURCHASER HEREUNDER. IN NO EVENT IS ITT WATER & WASTEWATER LIABLE FOR ANY OTHER FORM OF DAMAGES, WHETHER DIRECT, INDIRECT, LIQUIDATED, INCIDENTAL, CONSEQUENTIAL, PUNITIVE, EXEMPLARY OR SPECIAL DAMAGES, INCLUDING BUT NOT LIMITED TO LOSS OF USE, LOSS OF PROFIT, LOSS OF ANTICIPATED SAVINGS OR REVENUE, LOSS OF INCOME, LOSS OF BUSINESS, LOSS OF PRODUCTION, LOSS OF OPPORTUNITY OR LOSS OF REPUTATION.

ITT WATER & WASTEWATER WILL NOT BE HELD RESPONSIBLE FOR TRAVEL EXPENSES, RENTED EQUIPMENT, OUTSIDE CONTRACTOR'S FEES, OR ANY EXPENSES ASSOCIATED WITH A FLYGT PRODUCT REPAIR SHOP NOT AUTHORIZED BY ITT WATER & WASTEWATER U.S.A., INC. REIMBURSEMENT COSTS FOR CRANES AND/OR ANY SPECIAL EQUIPMENT USED IN CONJUNCTION FOR THE REMOVAL AND/OR REINSTALLATION OF ANY FLYGT EQUIPMENT IS NOT COVERED UNDER THIS WARRANTY.

ANY UNAUTHORIZED ALTERATIONS TO SUPPLIED FLYGT EQUIPMENT USED WITHOUT ITT WATER & WASTEWATER SUPPLIED FLYGT BRAND CABLE OR CONTROLS WILL NOT BE COVERED UNDER THIS WARRANTY, UNLESS IT CAN BE PROVEN SUCH ANCILLARY EQUIPMENT IS SUITABLE FOR THE PURPOSE AND EQUAL TO ITT WATER & WASTEWATER SUPPLIED FLYGT BRAND CABLES OR CONTROLS THAT WOULD ORIGINALLY HAVE BEEN SUPPLIED WITH THE TYPE OF EQUIPMENT IN USE.

REQUIREMENTS:
A copy of Electrical System Schematics of the Control used (including a Control's Bill of Material) could be required to support a Warranty Claim when a non Flygt Brand Control is used. In addition, a written record, hereby known as "the log", will be associated with each unit serial number and must be maintained by the organization having product maintenance responsibility. The log must record each preventative maintenance activity and any repair activity during the life of the warranty or verification that an ITT Water & Wastewater authorized Service Contract for Flygt Products is in force and must be available for review and/or auditing. Failure to meet these conditions could render this warrant null and void. Such logs could be required to determine warranty coverage.

ITT

WARRANTY
ITT WATER & WASTEWATER U.S.A., INC

STORAGE:
Should a delay occur between ship date and the date of start-up, maintenance as outlined in ITT WATER & WASTEWATER'S Care & Maintenance Manual for Flygt Products must be performed by the "CONTRACTOR" and/or "OWNER" during any such period of storage. Documentation providing proof and outlining what maintenance was performed must be provided to ITT WATER & WASTEWATER or its Flygt Products representative within thirty (30) days of said maintenance, or the ITT WATER & WASTEWATER warranty for Flygt Products could be considered void.

CONTROLS:
Warranty coverage for permanently installed controls will start for the end purchaser on the date of shipment.. This warranty does not apply to controls that have been damaged due to a defective and/or improper input power supply, improper electrical protection, accidental damage, improper or unauthorized installation and/or repair, unauthorized alteration, negligence, environmental corrosion or chemical attack, improper maintenance or storage of control, any act of God, an act of war, an act of terrorism or damage resulting from the use of accessory equipment not approved by ITT WATER & WASTEWATER. Further, this warranty does not apply in the event an adjustment is found to correct the alleged defect.

Solid state devices will be covered for a period of one (1) year. Electrical control panels containing controllers, PLC's, drives, soft starts, and other computerized equipment will require Transient Voltage Surge Suppression (TVSS) protection in order to satisfy the requirements of this warranty. The protection equipment associated with the control must be kept in working condition during the life of the warranty. Auxiliary equipment supplied with the control (air-conditioners etc.) is limited by the respective original equipment manufacturer's warranty offered. Consumable items such as: light bulbs, fuses, and relays are covered under normal operating conditions. Electrical surges experienced during startups and/or during normal operating use of the control panel will cause the consumable items not to be covered under this warranty policy. Components not supplied by ITT WATER & WASTEWATER will not covered by this warranty.

TOP (The Optimum Pump Station)
ITT WATER & WASTEWATER will warrant the Flygt TOP pre-engineered fiberglass pump station components against defects in material and workmanship for a period of one (1) year from date of start-up or eighteen (18) months from date of shipment and is valid only to the original owner of the station. Warranty shall cover the cost of labor and materials required to correct any warrantable defect, excluding any removal and reinstallation costs, FOB ITT WATER & WASTEWATER'S authorized warranty service location for Flygt's TOP.

Flygt Products contained within a TOP pre-engineered fiberglass pump station will carry the standard ITT WATER & WASTEWATER warranty for Flygt products and/or accessories installed in the TOP pre-engineered fiberglass pump station.

All Flygt Product restrictions and/or limitations as outlined and described within the context of this warranty are germane to all sections of this ITT WATER & WASTEWATER Warranty document.

ITT WATER & WASTEWATER US - WWW
National Quality Assurance - US Corporate
prodqual@itt.com

ITT

WARRANTY
ITT WATER & WASTEWATER U.S.A., INC

ADDENDUM – WARRANTY COVERAGE BY PRODUCT

PRODUCT	PRODUCT SERIES AND CONFIGURATION	Months 1 - 12	Months 13 - 18	Months 19 - 36	Months 37 - 39	Months 40 - 60
Axial Flow/ Mixed Flow/ Centrifugal Pumps & Mixers	3000 Series (CP, NP, DP, CT, NT, CZ, LL) 4000 Series (SR, PP) 7000 Series (PL) 8000.180 Series (DP, DT, DZ)	100%		50%		25%
Electrical Control Panels (permanently installed)	WWW Manufactured Control Panels - 3 - Years	100% - 1 YR	LIMITED - 2 - YR			
Abrasion/Corrosion Resistant & Chopper/ Grinder Pumps	3000 Series (MP, MF, MH, FS, FP, HP, HS) 5000 Series (HP, HS) 8000.280 Series (DP, DZ, DT, DS, DF) 8000.180 Series (HS)	100%				
Dewatering Pumps	2000 Series (BS, KS) 3000 Series (CS, NS, DS) 8000 Series (DS, DF)	100% (From Ship Date)				
TOPS	Fiberglass Pump Station	100% (From Ship Date)				
Accessories	Permanent / Portable	100% (From Ship Date)				
Robot Branded Pumps Sold By W&WW (Flygt)	RW, RD, BW, BD, etc.	100% (From Ship Date)				
Hydro ejectors/ Aerators	HE, JA	100%				
Portable Pump Controls	Control Boxes (Nolta, MSHA etc,)	100% (From Ship Date)				
Small Pumps	3045, 3057, SX	100% (From Ship Date)				
Parts - *	All new spare parts	100% (From Ship Date)				

- - Parts that fail where used in a repair are warranted for one (1) year from the date of the repair for the failed part only – no labor.

Quality Door Service Inc.
434 SE 5th Avenue
Hillsboro, OR. 97123

Phone (503) 526-3462
Fax (503) 526-3464

Limited Lifetime Warranty

Quality Door Service warrants the automatic and manual door equipment at the below referenced location. Quality Door Service does herewith guarantee that the automatic door equipment furnished and installed has been done in accordance with the drawings and specifications and that the work will fulfill the requirements of those specifications.

This warranty includes all material, plus labor during normal working hours of 8:00am – 4:30pm, Monday through Friday. An additional charge will be applied for service calls outside the normal business hours. It does not include work required due to neglect, abuse or misuse of the products furnished, nor does it include maintenance and/or normal repairs required due to acts of God.

It is the owner's responsibility to inspect the automatic doors daily according to procedures in the Stanley Daily Safety Check affixed to each door. If the equipment is malfunctioning or and unsafe condition exists, the owner shall immediately turn off the door operating equipment and notify Quality Door Service by calling 503-526-3462. Otherwise, resulting damages are the responsibility of the owner.

Job Name: Camtech Manufacturing - Loading Dock Roll-Up Doors

Warranty Start Date: 04/07/2017

Warranty Ending Date: No Expiration

STANLEY®

REDWOOD
ELECTRIC GROUP

GUARANTEE FORM

PROJECT: Camtech Manufacturing - Building 7
7809 Industrial Boulevard
Atlanta, GA 30301
REG Job # 9953 / SC Builders #115032

OWNER: Camtech Manufacturing
7809 Industrial Boulevard
Atlanta, GA 30301

We, the undersigned, hereby warrant and/or guarantee that the electrical work which we have furnished and/or installed for the above mentioned project has been performed in accordance with the contract documents and that the work as installed will fulfill all of the warranty or guarantee requirements. Any or all materials determined defective or improperly installed during a period of one year from the date of substantial completion (7/07/16) will be replaced at the expense of Redwood Electric Group. If, however, the period of guarantee is stipulated in excess of one year by the contract documents, subcontractor shall be bound as specified. All guarantees will inure to the benefit of the Contractor, Owner, their successors or assigns, including equipment warranties. Ordinary wear and tear and unusual abuse or neglect excepted.

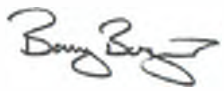
In the event of our failure to comply with the above mentioned conditions within a reasonable time after being notified in writing, we the undersigned, do hereby authorize the Owner to have said defects repaired, and/or replacements made good and we will refund to the Owner on demand all costs and charges therefore, including all collection costs and reasonable attorney's fees.

Throughout this one year warranty period, if any other electrical company changes, damages, or interferes with the original installation, our warranty becomes null and void.

Start: July 7, 2016

Ends: July 7, 2017

Redwood Electric Group, Inc.



By: Barry Bozarth
Title: Project Manager
State License: 318433
Local representative to be contacted for maintenance, repair, and/or replacement service.

Firm Name: Redwood Electric Group, Inc.
Attention: **Barry Bozarth**
Address: 2775 Northwestern Parkway
Santa Clara, CA 95051
Phone: (408) 450-4800
Cell: (408) 710-6589

BUILDING TRUST

Sika Corporation USA · 201 Polito Avenue · Lyndhurst, NJ 07071 · USA WAR15-1224

For: MG2
1101 Second Avenue, Suite 100
Seattle, WA 98101

Project: Camtech Manufacturing – Building 7
7809 Industrial Boulevard
Atlanta, GA 30301

STANDARD LIMITED WARRANTY December 29, 2015

Commencing on: 11/1/2016 Terminating on: 11/1/2017

Product(s): Sikaflex 2c SL

Manufacturer: Sika Corporation

Sika warrants its products to be free of manufacturing defects and that they will meet Sika's current published physical properties when applied in accordance with Sika's directions and tested in accordance with ASTM and Sika standards. engineer. User determines suitability of product for use and assumes all risk. Upon inspection, if the Product(s) fails to meet the technical properties set forth in the Technical Data Sheet due to a manufacturing defect Sika will, at its exclusive option, either replace the Product(s) or reimburse the cost of the Product(s) when used as directed within shelf life. This Warranty shall be governed by, and construed in accordance with, the laws of the State of New Jersey, without regards to its conflicts of laws principles. The parties submit to the exclusive jurisdiction of the federal and state courts in the State of New Jersey to resolve any disputes arising out of, or in connection with, this Warranty. This Warranty supersedes any and all other warranties, or other representations, whether written or oral, heretofore made between the parties. Any claim for breach of this warranty must be brought two (2) year/s of the date of installation.

THERE ARE NO OTHER WARRANTIES BY SIKA OF ANY NATURE WHATSOEVER, EXPRESSED OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE IN CONNECTION WITH THIS PRODUCT. SIKA CORPORATION SHALL NOT BE LIABLE FOR DAMAGES OF ANY SORT, INCLUDING REMOTE OR CONSEQUENTIAL DAMAGES, RESULTING FROM ANY CLAIMED BREACH OF ANY WARRANTY, BREACH OF CONTRACT, NEGLIGENCE OR ANY OTHER LEGAL THEORY. SUCH DAMAGES INCLUDE BUT ARE NOT LIMITED TO LOSS OF USE OR DAMAGE TO PROPERTY, LOSS OF SERVICES, BUSINESS INTERRUPTION, USE OF SUBSTITUTE FACILITIES, DOWNTIME COSTS, OR CLAIMS OF CUSTOMERS OF THE PURCHASER FOR SUCH DAMAGES. THE REMEDY SET FORTH HEREIN SHALL BE THE OWNER'S SOLE AND EXCLUSIVE REMEDY AGAINST SIKA WITH RESPECT TO THE SIKA PRODUCT COVERED BY THIS WARRANTY. SIKA SHALL ALSO NOT BE RESPONSIBLE FOR USE OF THIS PRODUCT IN A MANNER TO INFRINGE ON ANY PATENT OR OTHER INTELLECTUAL PROPERTY RIGHTS HELD BY OTHERS

Sika Corporation
By: _____
V.P. Technical Service, Authorized Representative for Sika Corporation

SIKA CORPORATION USA
201 Polito Avenue · Lyndhurst, NJ 07071 · USA
Phone: 800 933 SIKA · Fax: 201 507 7107 · www.usa.sika.com

TEL 559.661.1111
FAX 559.673.0600
LICENSE# 395853

SPAN
CONSTRUCTION & ENGINEERING, INC.

WWW.SPANCONSTRUCTION.COM

1841 HOWARD ROAD
MADERA, CA 93637

Guaranty

Project
Camtech Mfg. - Building 7
7809 Industrial Blvd.
Atlanta, GA 30301

General Contractor
Robinson Construction Co.
320-120th Avenue NE Suite B201
Bellevue WA 98005

Owner
Camtech Mfg.
7809 Industrial Blvd.
Atlanta, GA 30301

We, the undersigned, hereby warrant and guarantee that the work which we have furnished and/or installed for the above mentioned project has been performed in accordance with the contract documents and that the work as installed will fulfill all of the warranty or guarantee requirements included in the contract documents. We hereby agree to replace at our sole cost and expense all materials adjudged defective or improperly installed for a period of (2) years from the date of the Substantial Completion or Notice of Completion, whichever is appropriate. Our guarantee does not include repair or replacement of adjoining construction materials provided by others or repair or replacement of goods or merchandise stored within the building. All guarantees will insure to the benefit of the Contractor, Owner, their successors or assigns, including equipment warranties.

In the event of our failure to comply with the above mentioned conditions within a reasonable time as determined by the Owner, after being notified in writing, we, the undersigned, do hereby authorize the Owner to have said defects, repairs, and/or replacements made good, and we will refund to the Owner on demand all costs and charges therefor, including all collection costs and reasonable attorney's fees.

Start Date: 10-20-2015

Expiration: 10-20-2017

FIRM NAME: Span Construction & Engineering, Inc.

BY: _____
Ernie Brandi

TITLE: Costco Account Manager

STATE LICENSE NO: SPANCEI088L

Firm Name: Span Construction & Engineering, Inc.
Address: 1841 Howard Road
Madera, CA 93637
Telephone: (559) 661-1111

State of: California
County of: Madera

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

On October 16, 2015 before me, Tamera Fox ,Notary Public
personally appeared Ernie Brandi
who proved to me on the basis of satisfactory evidence to be the person~~(s)~~ whose name~~(s)~~ is~~/are~~ subscribed to the within instrument and acknowledged to me that he~~/she/they~~ executed the same in his~~/her/their~~ authorized capacity~~(ies)~~, and that by his~~/her/their~~ signature~~(s)~~ in the instrument the person~~(s)~~, or the entity upon behalf of which the person~~(s)~~ acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature _____

TAMERA FOX
COMM # 2072017
MADERA COUNTY
NOTARY PUBLIC-CALIFORNIA
MY COMMISSION EXPIRES
JUNE 20, 2018

SUNBELT CONTROLS

Start Date: February 2, 2017
End Date: February 2, 2018

To: Katie Hunter
SC Builders
910 Thompson Place
Sunnyvale, CA 94085

Re: Camtech Manufacturing
7809 Industrial Blvd.
Atlanta, GA 30301

Sunbelt Job No. 895800

Dear Ms. Katie Hunter:

The direct digital control (DDC) system installed by Sunbelt Controls has been placed in operation for beneficial usage on **February 2, 2017** the "Effective Date". The Effective Date establishes the start date of the equipment manufacturers' and Sunbelt Controls' one (1) year limited warranty. Please transmit this letter to the proper parties for safekeeping, as it is proof of warranty.

Warranty Coverage
The warranty covers systems, equipment and materials furnished and installed by Sunbelt Controls. The coverage includes parts and labor associated with the repair of defects in materials and workmanship for a period of one (1) year after the Effective Date. The warranty does not cover system, equipment or material failures arising from improper operation, or inadequate preventive maintenance, setpoint changes, or equipment or systems not included in the original scope of work. SUNBELT's warranty also excludes remedy for damage or defect caused by normal wear and tear, normal use, abuse, or modifications not executed by SUNBELT. Any such modifications will terminate SUNBELT's warranty coverage for the system referenced in this letter.

Warranty Protection
Please note that in order to obtain warranty coverage from the equipment manufacturer and Sunbelt Controls, the OWNER must establish a reasonable and proper routine maintenance program performed by qualified technicians. Please note that routine maintenance also includes the cleaning and protection of all system surfaces.

If desired, Sunbelt Controls can provide the required maintenance services with supporting documentation. This service is available at an additional cost and will ensure optimum system performance and warranty protection.

If your system requires repair or if you are interested in further information or a quotation on Sunbelt Controls' maintenance programs please contact us at one of the following numbers: Greater Los Angeles and Central California 1-877-786-2332, Northern California and Sacramento 1-888-786-2332, San Diego 1-858-292-8642, Washington and Oregon 1-425-988-2688. Warranty repair work is performed during our normal business hours. After hours warranty work is available at a premium.

System Modifications
Please note that your systems have been approved by the Building Department and Authorities having jurisdiction. Modifications to these systems will void our warranty.

Additional details of the owner's responsibilities are included in the Equipment Submittals and the Operation and Maintenance manuals.

Control Systems
Any time controls are added, modifications are required to the existing system that include, but not limited to the following:

- Modifying the system software database provided by Sunbelt Controls
- Adding software to the Server provided by Sunbelt Controls
- Rewiring of the communications network provided by Sunbelt Controls
- Adding hardware to the same communications network provided by Sunbelt Controls

All of the above tasks are major modifications to the system we have provided. Any of these tasks or modifications to the system done by others will void our warranty.

Warning to Building Occupants
Please be aware that improper use or maintenance of the system and its components can affect the health and safety of building occupants. Improperly maintained Control systems may expose persons to hazardous conditions. Air Quality, Chemical Treatment and Life Safety systems and components must be maintained and tested.

Warranty Limitations
The warranty set forth herein and as provided by the equipment manufacturers supersedes and is in lieu of all other warranties and liabilities, express or implied, including implied warranties of merchantability and fitness for a particular use. In no event shall Sunbelt Controls be liable for any incidental or consequential damages.

Thank you for selecting Sunbelt Controls as the provider of your Direct Digital Control system.

Sincerely,

Hugh Palmer
Warranty Administrator

HP:hr

cc: Brandon Bayer – Sunbelt Controls Project Manager

TSC JOB #15-22988
SCBI JOB: #115031

WARRANTY FOR INSTALLATION/MATERIALS

PROJECT: CAMTECH MANUFACTURING, 7809 INDUSTRIAL BLVD., ATLANTA, GA 30301

GENERAL CONTRACTOR: SC BUILDERS INC, 910 THOMPSON PLACE, SUNNYVALE, CA 94085

WARRANTY FOR: CORNELL MODEL - ESD20 INSULATED COILING DOOR

The Smith Company (TSC) will hereby warrant that the Coiling Insulated Door's we have provided for the above-named project has been supplied in accordance with Project Specifications, including any approved changes, the approved submittals, and the contract documents.

TSC will agree to repair or replace, at our cost, any or all of our work which may prove to be either patently defective in its workmanship or materials within the period of time not to exceed **2 calendar year** from date **June 1, 2016** until **June 1 2018**, Owner's acceptance of named structure, ordinary wear and tear and unusual abuse or neglect excluded. If the Owner's acceptance date is more than 3 months after the installation date, the installation date will become the start of the **2-year warranty**. The Smith Company and/or the original Manufacturer will verify and validate the claim to determine if the work to correct the problem will be considered warranty work or billable work (problem/damage caused by an outside force beyond TSC's or the Manufacturer's control) and attempt to notify the Owner's representative upon that decision and before continuing with billable work.

If a problem is encountered with the above referenced material the Owner's representative must first attempt to determine the cause of the problem and state, the nature of the problem in a written document to be faxed or mailed to The Smith Company. The Smith Company will then have a minimum of five (5) working days to respond with personnel on-site and thirty (30) work days to complete all warranty work required. If persons other than those employed by The Smith Company or the Manufacturer perform repairs, tampers with, or continues to operate the equipment before The Smith Company (916.772.3777) can inspect the stated problem the warranty will not be honored. If The Smith Company does not respond within thirty days the Owner may elect to have the items repaired or replaced, at a reasonable rate, and The Smith Company agrees to pay for said repairs.

This Warranty Agreement specifically excludes any costs incurred (if any) for security, emergency service, lost wages or income, or any other costs above and beyond The Smith Company's internal costs to warrant the products provided by The Smith Company, to include travel port-to-port, will be charged at The Smith Company's applicable rates to and owed by the Owner if The Smith Company and/or the Manufacturer find that the initial problem was caused by outside forces beyond The Smith Company's or The Manufacturer's control. All billable work is due net 30 day terms and any delay or non-payment will result in the immediate termination of this warranty agreement.

Signed: _____ Date: June 1, 2016
Greg Boom - Estimator

Signed: _____ Date: _____
Owner

This form must be signed by all parties and a copy returned to our office. It must include the date of Owner's acceptance or Occupancy which ever come first. If this form is not returned with signature and date of acceptance warranty in null and void. If the materials, we have supplied have been used excessively or improperly prior to Owner's acceptance the warranty is null and void.

CORNELL

SAFE AND SECURE

Product Warranty

Cornell Iron Works warrants its products and electrical components against defects in material or workmanship for a period of 24 months from the date of shipment. Every Cornell operator has been tested for proper operation prior to shipment. Cornell Iron Works agrees to repair or replace, at Cornell's discretion, any parts which are determined, by Cornell, to be defective. This warranty does not include materials or labor that may be required due to site conditions, adjacent construction, incorrect installation, lack of maintenance, lack of access, ordinary wear, abuse or neglect.

Finish

Cornell's GalvaNex™ Coating System and SpectraShield® Powder Coat finishes shall be warranted against fading, cracking, blistering, flaking or peeling, and be free of corrosion when the material is subjected to salt spray resistance test ASTM B-117 for 1000 hours. The design of coiling products, by nature, will abrade virtually any applied finish and this warranty excludes normal wear, impact damage, abusive conditions or products installed in abrasive, chemical or other exceedingly corrosive environments. In order to help preserve the integrity of the door's finish, cleaning of the door curtain is recommended during construction of the project and as part of the door's preventative maintenance program.

Electrical Components

The use of "motor by others" may void the product warranty if it is deemed that the electrical components not supplied by Cornell Iron Works caused damage to the door / closure product.

The following exceptions apply to the electrical warranty:

Incoming line voltages are required to fall within ranges established by ANSI C84.1 (ANSI Standard for Electrical Power Systems and Equipment) and wiring must be connected in accordance with applicable standards established by the current edition of NFPA-70 (NEC) for commercial rolling door operators.

Electrical components supplied from LiftMaster, Micanan, Miller Edge and Simu will be subject to their manufacturers' standard warranties. Overloads, transformers, and logic boards are not subject to warranty as these items are subject to improper field wiring and or line voltage fluctuations.

Unauthorized modifications or damage as a result of improper wiring or line voltage fluctuations will void all electrical and possibly the product warranties.

Labor

Labor charges relating to electrical issues will be excluded from any job that was ordered as "motor by others". All labor requests must be made by an authorized Cornell dealer. Unauthorized labor to troubleshoot, repair components and or attempt to correct field issues will void all warranties.

Replacement Material

Replacement warranty material will be shipped via standard ground transportation. Expedited delivery charges will not be the responsibility of Cornell Iron Works.

Warranty Support

For assistance with warranty issues, please contact Cornell Iron Works' Customer Service Department at 800-233-8366.

Tremco Incorporated
3735 Green Road • Beachwood, Ohio 44122 • 216-292-5000 www.tremcosealants.com

TREMCO
Commercial Sealants & Waterproofing

Warranty No: 31148
Date Issued: 12/27/2015
Exp: 1/31/2021

Air Barrier Warranty

PROJECT NAME	Camtech Manufacturing - Building 7 7809 Industrial Boulevard Atlanta, GA 30301	**APPLICATOR**	Metro Waterproofing Inc. 2935 Alcove Drive Scottdale, GA 30079
ARCHITECT/ ENGINEER	CDH Partners, Inc. 675 Tower Rd. Marietta, GA 30060	**GENERAL CONTRACTOR**	Brasfield & Gorrie, LLC 1990 Vaughn Rd, Suite 100 Kennesaw, GA 30144
OWNER	Camtech Manufacturing 7809 Industrial Boulevard Atlanta, GA 30301	**DATE OF SUBSTANTIAL COMPLETION**	1/31/2016
PRODUCT(S)	ExoAir 110; ExoAir 120	**TYPE OF WORK**	Air Barrier 137000 Square Feet New Project Exterior

ExoAir® Air Barrier Membranes, when applied according to the procedures, instructions and conditions of Tremco Incorporated's data sheets and application instructions, are covered by the following warranty:

Tremco Incorporated ("Tremco") warrants that for a period of *5 year(s)* following the date of substantial completion, the Tremco ExoAir Air Barrier Membranes will be free of defects in materials. Tremco shall, at its option, either refund the purchase price of, or provide replacement for, that portion of the ExoAir Air Barrier Membranes which fail within said *5-year* period to perform in accordance with the Warranty, and such refund or replacement shall constitute the limit of the Tremco's liability and obligation for any such failure.

The Warranty shall not apply if the ExoAir Air Barrier Membrane is subject to misuse or abnormal use or conditions. Tremco makes no warranty with respect to appearance or color.

Tremco's obligations under this Warranty shall only become effective upon receipt of full payment for all ExoAir Air Barrier Membranes and related materials supplied on the Project. Any delay in Tremco's receipt of full and final payment shall not extend the Warranty term.

This Warranty is issued to the above-named Owner and is transferable with the written consent of an authorized representative of Tremco. No representative of Tremco has the authority to make any representations or provisions except as stated herein.

THE ABOVE WARRANTY IS IN LIEU OF ANY AND ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY, EXCEPT AS EXPRESSLY PROVIDED HEREIN. TREMCO SHALL NOT BE LIABLE FOR DAMAGE TO THE PROJECT STRUCTURE OR INTERIOR CONTENTS OR FOR ANY OTHER CONSEQUENTIAL, SPECIAL OR OTHER DAMAGES ARISING FROM OR RELATED TO, DIRECTLY OR INDIRECTLY, THIS WARRANTY OR THE PERFORMANCE OF THE MATERIALS COVERED BY THIS WARRANTY, WHETHER BASED ON BREACH OF WARRANTY, NEGLIGENCE OR OTHER THEORY OF LIABILITY.

TREMCO INCORPORATED
Commercial Sealants & Waterproofing

Michael J. Soeder, VP Sales, NA

TO EXPEDITE PROCESSING, THIS DOCUMENT WILL BE COMPLETED AND DELIVERED IN ELECTRONIC FORM ONLY. AN ELECTRONIC SIGNATURE FROM A TREMCO REPRESENTATIVE ON A COMPLETED WARRANTY DOCUMENT IS VALID AND BINDING AND IS ENFORCEABLE TO THE SAME EXTENT AS A PENNED SIGNATURE.

June 14, 2016

SC Builders
910 Thompson Pl.
Sunnyvale, CA 94085

Subject: ***Warranty / Guarantee***
Camtech Manufacturing
7809 Industrial Boulevard
Atlanta, GA 30301
Job #5265-10

Warranty: ***Start Date:***
June 14, 2016
End Date:
June 14, 2017

Recently United Mechanical, Inc. installed your air conditioning and heating system for the subject job**.** As you know**,** the system was designed specifically for your building to provide you with comfort and economy.

Your system is covered by a limited and conditional warranty provided by the manufacturer. The system is warranted to be free from defects in workmanship and material for a period of **one year** from the date of start-up **June 14, 2016.** In order to keep this warranty in effect you must provide regular preventative maintenance, which will not only help to keep your equipment in operation, but will also assure your continued comfort and economy. The warranty is void if regular preventive maintenance is not commenced within sixty (60) days of the initial start-up. Regular preventative maintenance includes at least checking and adjusting belts, changing air filters, testing and checking electronics components, lubing and oiling bearings and motors. The warranty is limited to repair and replacement of defective materials. The warranty does not cover any consequential damages. Warranty excludes owner supplied equipment.

The following are items not covered under the warranty:

1. Time clock setting caused by power failure or daylight saving time.
2. Room thermostat setting after initial setting or recalibration of controls.
3. Individual comfort air balance once initial air balance is completed.
4. Re-setting manual re-set controls on safety circuits caused by power failure or brown-outs.
5. External electrical components such as disconnect switches of breaker panels.
6. Failures caused by lack of maintenance, including but not limited to, dirty filters, broken belts, worn bearings, etc.
7. Parts damaged by power failure or variations in voltage.

THIS LIMITED WARRANTY IS GIVEN IN LIEU OF ANY AND ALL OTHER EXPRESS OR IMPLIED WARRANTIES.

Very truly yours,

Bruce Wilcox
Service Construction Superintendent / Warranty Manager
408.228.1926
BWilcox@umi1.com

CAMTECH MANUFACTURING

BUILDING 7

7809 Industrial Boulevard, Atlanta, GA 30301

Warranty Log Sheet

START	DESCRIPTION	EXPIRATION
2017-07-03	Boiler Installation Warranty	2018-07-03
2017-04-28	Payne HVAC Unit Warranty	2022-04-28
2017-02-21	Christenson Electric, Inc.	2018-02-21
2016-12-16	Total Mechanical Equipment	2017-12-16
2016-01-22	Delta Fire, Inc.	2017-01-22
2015-03-01	Caughlin's Commercial Floor Covering	2016-03-01
2014-01-29	Turner Construction Company	2015-03-01
2000-12-17	Fortis Construction - Occupational Health Conference Room	2001-12-17
1995-11-14	Faustollean Fixture Company	2000-11-14
1991-04-29	Howard S. Wright Contractors - Accounting and Billing Office Expansion	1992-04-29
1991-01-12	Turner Construction - IT Department Remodel	1992-01-12
1984-09-09	Restroom Remodel Plumbing Fixtures	1985-09-09
1984-08-15	W.E. Given Construction - Men's & Women's Restrooms Remodel (Level1)	1985-08-15

CAMTECH MANUFACTURING

BUILDING 7

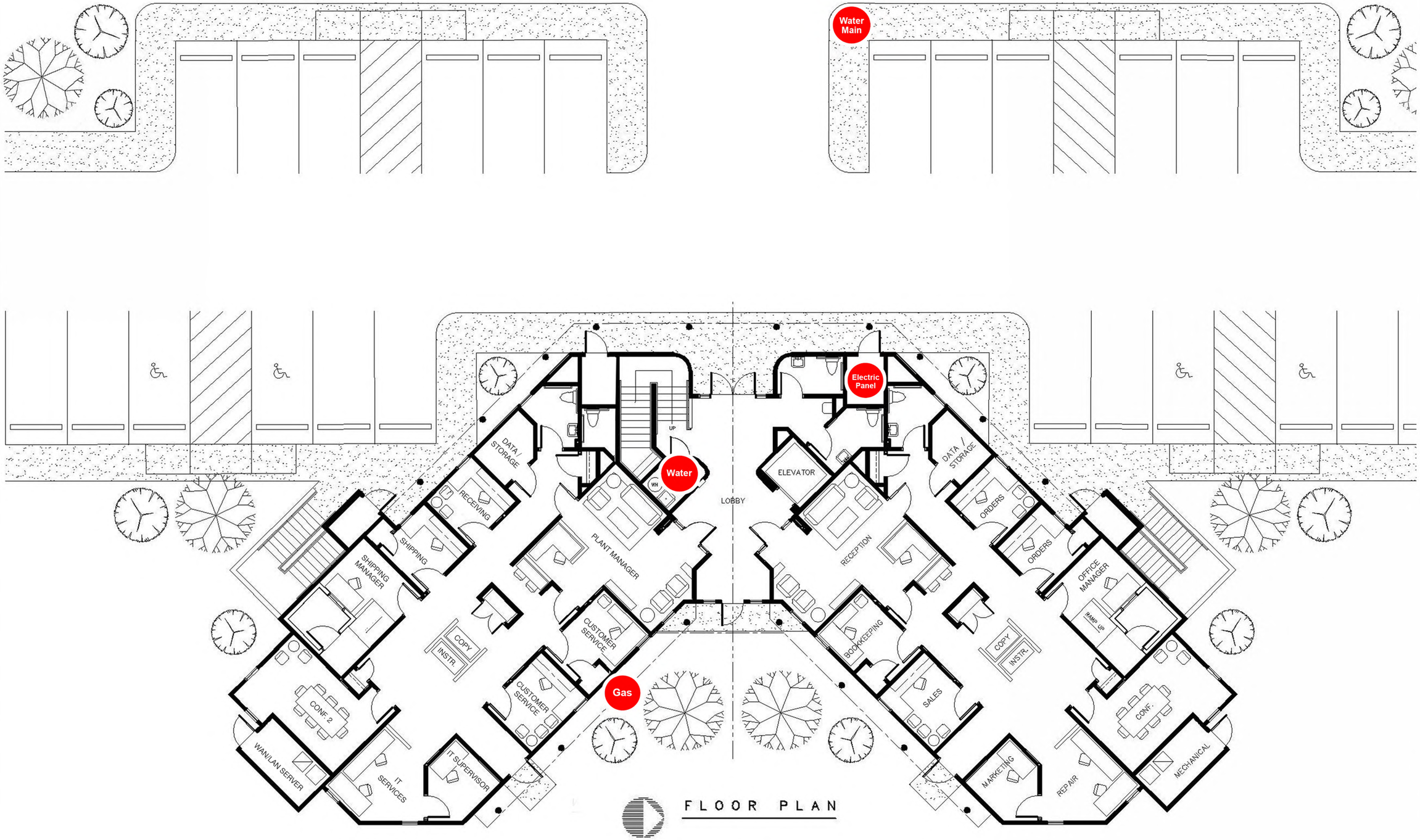
7809 Industrial Boulevard, Atlanta, GA 30301

Warranty Log Sheet

START	DESCRIPTION	EXPIRATION
1980-04-15	Rixson Door Controls	1981-03-15
1980-03-15	Kawneer Doors	LIFETIME
1978-12-15	Integrated Flooring Systems - Meeting Room Upgrade	1979-12-15
1972-05-30	Accuride International, Inc. - Records Room Drawer Slides	LIFETIME
1972-04-15	Williamsen & Bleid Painting	1973-04-15
1967-03-20	Spectra Contract Flooring	1968-03-20
1966-08-17	Atlanta Mechanical Contractors, Inc.	1967-08-17

CAMTECH MANUFACTURING

INDUSTRIAL BOULEVARD



FLOOR PLAN

BOUCHER MOUCHKA LARSON Architects

209 S.W. Oak
Portland, Oregon
503/223-4886

EFK MOB AND PARKING AREAS

Drawing:
FLOOR PLAN
LEVEL L1

Job. No. 8019-0

Sheet:
A2.8

CAMTECH
MANUFACTURING

BUILDING 7

7809 Industrial Boulevard, Atlanta, GA 30301

EMERGENCY



Emergency Plan



Safe Refuge Areas



Shut-Offs



Evacuation Map



Fire System/ Sprinklers



Emergency Contacts



Enhanced E&LS

EMERGENCY & LIFE SAFETY

VALLEY MEDICAL
2800 Medical Center Drive, Portland, OR 97035

EMERGENCY

- Emergency Plan
- Safe Refuge Areas
- Shut-Offs
- Floor Plans
- Evacuation Map
- Equipment Maps
- Fire System/ Sprinklers
- Emergency Contacts
- Training

ACTION PLAN

- Active Shooter
- Bomb Threat
- Earthquake
- Evacuation
- Fire
- Flood
- Hurricane
- Incident Response
- Lockdown
- Lockout
- Reverse Evacuation
- Shelter-In-Place
- Tsunami

GRAPHIC SCALES: 1/16" = 1'-0" | 1/8" = 1'-0" | 1/4" = 1'-0" | 1/2" = 1'-0" | 3/4" = 1'-0" | 1" = 1'-0" | 1-1/2" = 1'-0" | 3" = 1'-0"

If this sheet is not 24" x 36" it is a reduced print

CODE SUMMARY

CODE

INTERNATIONAL BUILDING CODE, 2009 EDITION with 2010 OREGON SPECIALTY CODE AMENDMENTS

OCCUPANCY TYPE: I-1.2, S
CONSTRUCTION TYPE: 1 FR

TENANT AREA

FIRST FLOOR: 4,461 USF

OCCUPANT LOAD

OCC LOAD FACTOR: 100 SF/ OCC
OCCUPANCY LOAD:
(xxx/100=xx OCC) 45 OCCUPANTS

– MAXIMUM DEADEND CORRIDOR = 50 FT.

PROPERTY INFORMATION

Property ID R139494
County MULTNOMAH
Stote ID 1N1E27BB 1900
Alt Account # R176900010
Map Number 2729 OLD

ZONING IRd

FIRE PROTECTION

100% SPRINKLERED
SMOKE DETECTION SYSTEM
SMOKE CONTROL SYSTEM
NON-RATED, SMOKE TIGHT EXIT CORRIDORS

EGRESS

NUMBER OF CODE REQUIRED EXITS: 2

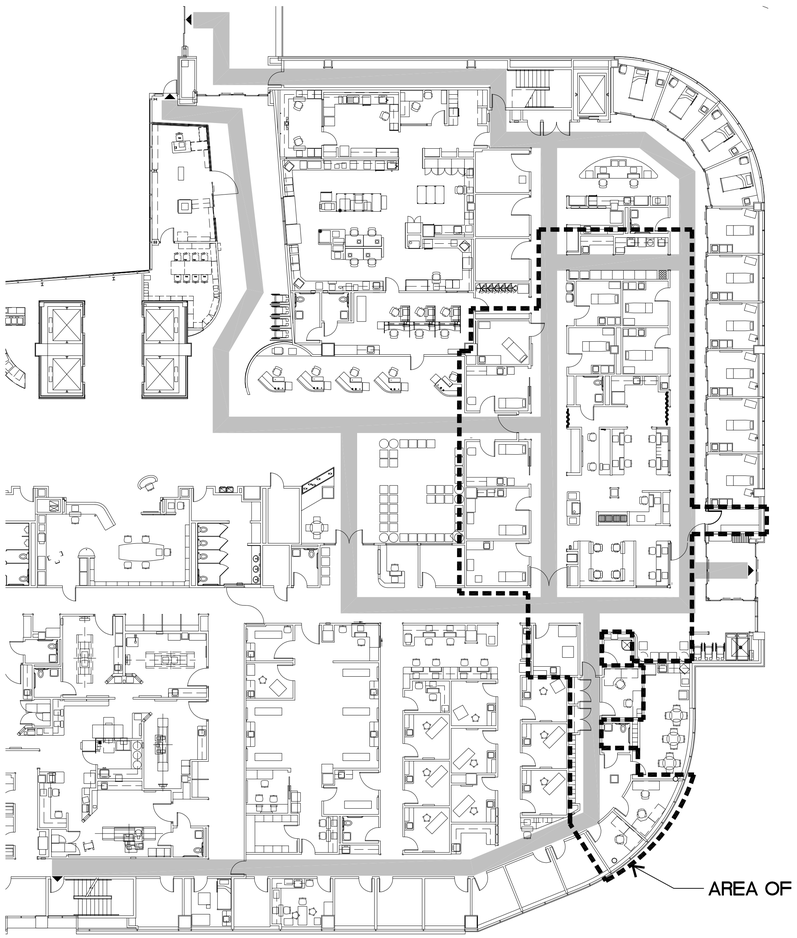
WORK IS PART OF FACILITIES PERMIT PROGRAM
PLANS REVIEW/INSPECTOR: JOE DISCIASCIO

LEGEND

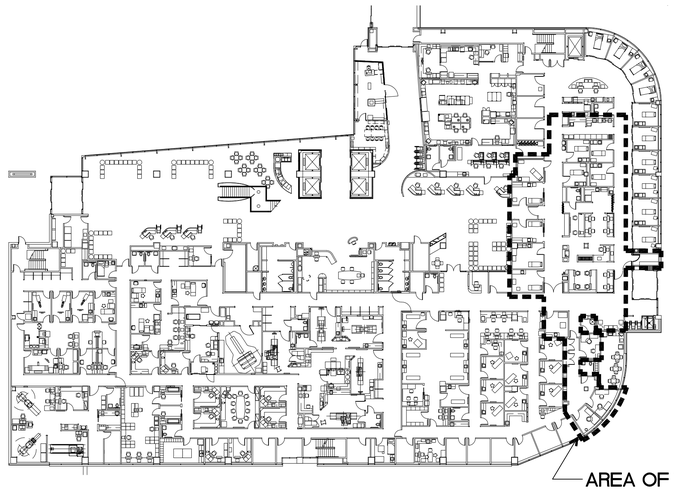
⊗ BUILDING STANDARD EXIT SIGN

▲ INDICATES EXIT

44" WIDE DESIGNATED EGRESS PATH (PATH TO BE ILLUMINATED TO CODE MINIMUM LEVELS)



2 FIRST FLOOR - TENANT EGRESS PLAN
1/16"=1'-0"



1 FIRST FLOOR - KEY PLAN
1/32"=1'-0"

National Facilities Services
Post Office Box 12916
Oakland, California 94604

Revisions

No.	Revisions	By	Date	Appr.

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Architect/Engineer Of Record:

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REGISTERED ARCHITECT · CRAIG L. DAVIS · PORTLAND, OREGON 3008 · STATE OF OREGON

GBD PROJECT No.: 20111806

Facility

CALTECH MANUFACTURING, BLDG 7
1950 PARKSIDE DRIVE
ATLANTA, GEORGIA 30301

Project

OCCUPATIONAL HEALTH RELOCATION
TENANT IMPROVEMENT
FIRST FLOOR

Sheet Title

EGRESS & CODE INFORMATION

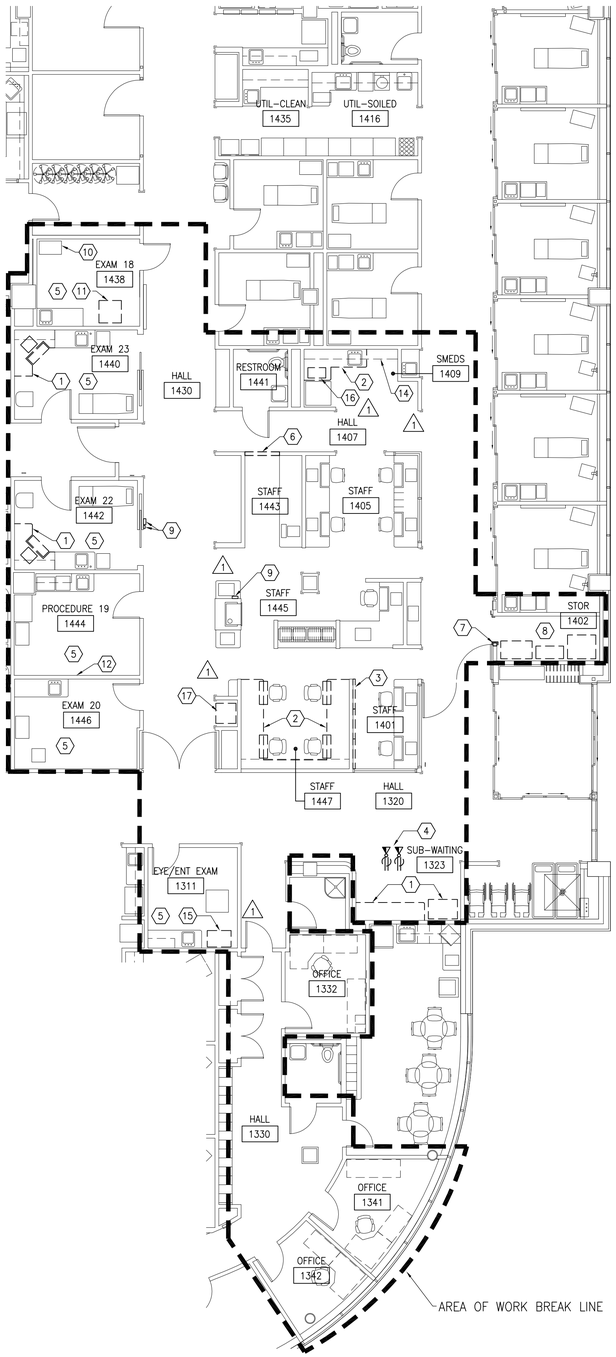
Building ID: TBD Floor Lev: 01 Section:

Scale	As Indicated	Proj. No.	TBD
Drwn By	em	Permit No.	TBD
Chckd By	ms	Sheet	A0.01
Issue Date	12-15-2016	Of 7 Sheets	

AS-BUILT SET

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If this sheet is not 24" x 36" It is a reduced print



1 PARTIAL FIRST FLOOR PLAN - DEMOLITION

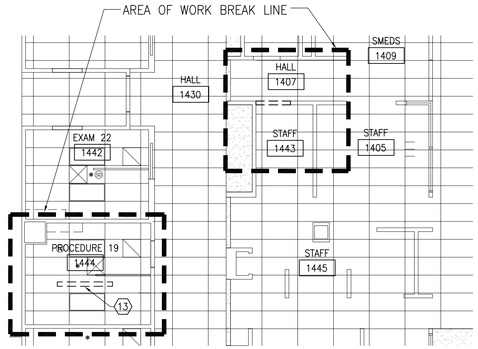
1/8"=1'-0" **SHOWN FOR REFERENCE**

GENERAL DEMO NOTES:

1. REMOVE ITEMS SHOWN DASHED – CONFIRM SALVAGE OF EQUIPMENT, FIXTURES, AND HARDWARE FOR POTENTIAL RE-USE WITH BUILDING MANAGER.
2. UNUSED OFFICE EQUIPMENT, FIXTURES AND EXPOSED CABLING LEFT BY PRIOR TENANT TO BE REMOVED BY OWNER PRIOR TO OCCUPANCY.
3. CONTRACTOR TO REMOVE LABELS AND CLEAN SURFACES OF ALL REUSED CASEWORK.

DEMO REFERENCE NOTES:

1. REMOVE AND SALVAGE CASEWORK AND EQUIPMENT FOR POSSIBLE RE-USE. CONFIRM STORAGE LOCATION WITH OWNER.
2. REMOVE PLASTIC LAMINATE COUNTERTOP. BASE CABINETS TO REMAIN.
3. REMOVE AND SALVAGE WALL MOUNTED LITERATURE RACKS FOR RE-USE.
4. REMOVE ELEC. FLOOR BOXES AND REPLACE WITH FLUSH COVER PLATES.
5. REMOVE WALL MOUNTED EQUIPMENT AND FIXTURES IN PROCEDURE/EXAM ROOMS PRIOR TO PAINTING AND SALVAGE FOR REUSE.
6. REMOVE PORTION OF PARTITION AS INDICATED.
7. REMOVE PORTION OF PARTITION TO ACCOMMODATE 3'-0" DOOR.
8. REMOVE EQUIPMENT AND SALVAGE FOR POSSIBLE RE-USE. CONFIRM STORAGE LOCATION WITH OWNER.
9. REMOVE WALL MOUNTED FIXTURES.
10. STORAGE CART TO REMAIN.
11. EXAM CHAIR/TABLE TO BE REMOVED BY OWNER.
12. WALL MOUNTED EQUIPMENT RAIL TO REMAIN.
13. REMOVE AND SALVAGE EXISTING CEILING MOUNTED PROCEDURE LIGHT FOR POSSIBLE RE-USE. CONFIRM STORAGE LOCATION WITH OWNER.
14. REMOVE ADJUSTABLE SHELF AND TRACKS. FIXED SHELF TO REMAIN.
15. RELOCATE STORAGE CART TO MEDS 1409.
16. ICE MACHINE TO BE REMOVED BY OWNER.
17. TRASH TOTE TO BE REMOVED BY OWNER.

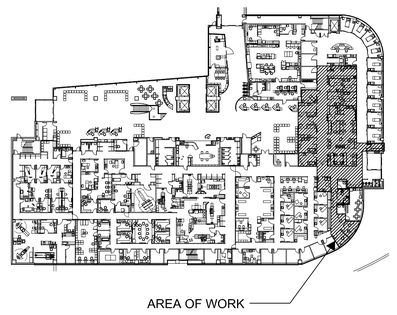


2 PARTIAL FIRST FLOOR CEILING PLAN - DEMOLITION

1/8"=1'-0" **SHOWN FOR REFERENCE**

LEGEND

- OFFICE 1518 — ROOM TAG AND NUMBER
- 1 — PLAN REFERENCE NOTE
- 1 — EQUIPMENT TAG, SEE SCHEDULE (A8.01)
- 18.01 — ELEVATION SYMBOL
- SWITCH
- DUPLEX ELEC OUTLET
- QUADPLEX ELEC OUTLET
- COMBINATION VOICE/DATA
- COMBINATION POWER/VOICE/DATA, FLUSH FLOOR OUTLET
- FURNITURE OUTLET / POWER POLE – COORDINATE WITH TENANT'S VENDOR
- CR — CARD READER
- C — CABLE TV
- T — THERMOSTAT
- FIRE ALARM STROBE
- N — DENOTES NEW OUTLET
- EXISTING WALL TO BE REMAIN
- WALL WITH 1 HOUR FIRE RATING
- WALL OR OBJECT TO BE REMOVED
- NEW BUILDING STANDARD WALL TO UNDERSIDE OF EXISTING CEILING
- EXISTING DOOR
  (E) DENOTES EXISTING DOOR
- NEW DOOR LOCATION
  (N) DENOTES NEW DOOR
  (R) DENOTES RELOCATED DOOR
- EXISTING 2X4 ACOUSTIC CEILING GRID AND TILE
- EXISTING 2X4 TENANT STANDARD LIGHT FIXTURE
- EXISTING WALL SCONCE LIGHT FIXTURE
- EXISTING DOWN LIGHT FIXTURE
- NEW OR NEW LOCATION OF OH PROCEDURE LIGHT FIXTURE
- EXISTING SPRINKLER HEAD (SHOWN FOR REFERENCE)
- EXISTING HVAC DIFFUSER (SHOWN FOR REFERENCE)
- SP — EXISTING SPEAKER (SHOWN FOR REFERENCE)
- SD — EXISTING SMOKE DETECTOR (SHOWN FOR REFERENCE)
- EXISTING EXIT SIGN (SHOWN FOR REFERENCE)



FIRST FLOOR KEY PLAN

NTS

NORTH

National Facilities Services
Post Office Box 12916
Oakland, California 94604

Revisions

No.	Revisions	By	Date	Appr.
1	ASI 1	GBD	01.10.14	

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Facility

CALTECH MANUFACTURING, BLDG 7
1950 PARKSIDE DRIVE
ATLANTA, GEORGIA 30301

Project

OCCUPATIONAL HEALTH RELOCATION
TENANT IMPROVEMENT
FIRST FLOOR

Sheet Title

FLOOR AND CEILING PLANS - DEMOLITION

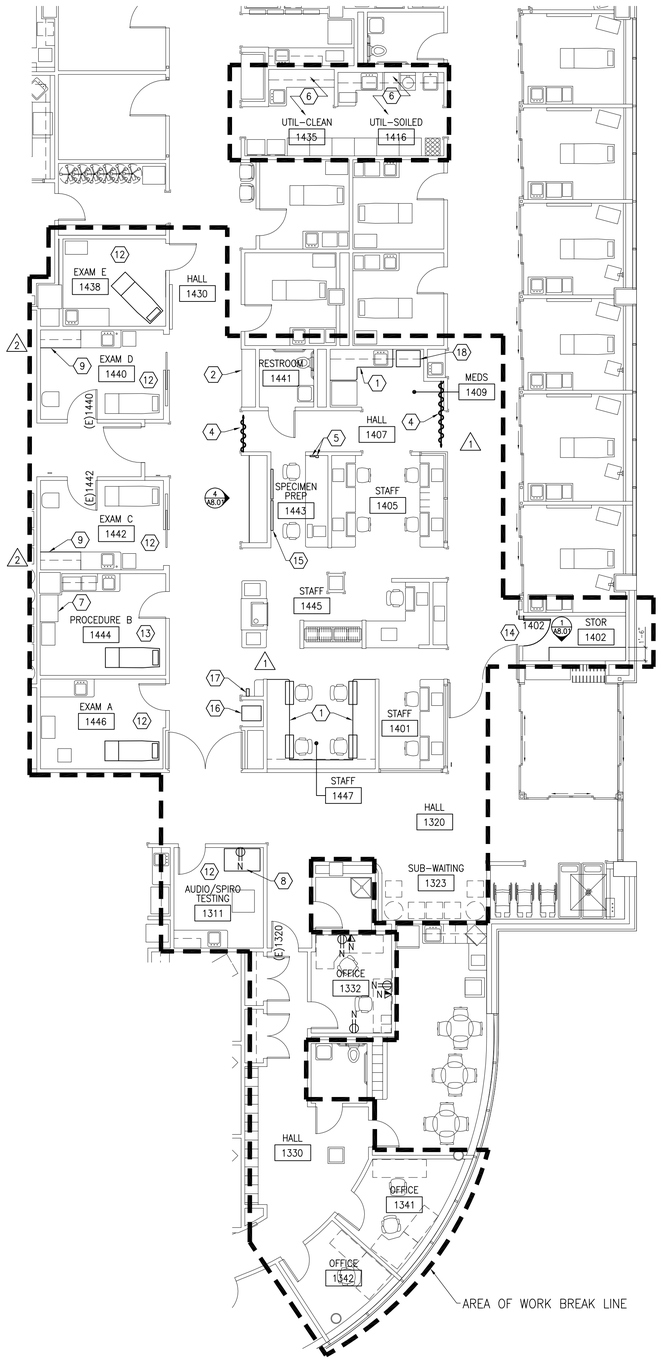
Building ID: TBD | Floor Lev: 01 | Section:

Scale	1/8" = 1'-0"	Proj. No.	TBD
Drwn By	em	Permit No.	TBD
Chckd By	ms	Sheet	A2.01
Issue Date	12-15-2016	Of 7 Sheets	

AS-BUILT SET

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1 PARTIAL FIRST FLOOR PLAN – NEW CONSTRUCTION

1/8"=1'-0"

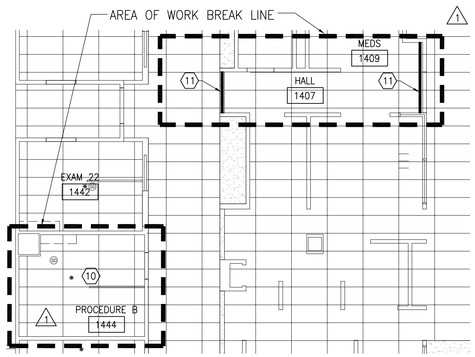
GENERAL PLAN NOTES:

1. OWNER PROVIDED FURNITURE & EQUIPMENT SHOWN DASHED FOR REFERENCE ONLY
2. SEE A9.01 FOR FINISH LEGEND AND FINISH PLAN.
3. COORDINATE SWITCHES, STROBE AND T–STAT LOCATIONS WITH ARCHITECT
4. EXISTING POWER/DATA IN SPACE TO BE REVIEWED BY CONSTRUCTION TEAM AND SUPPLEMENTED AS NECESSARY TO MEET REQUIREMENTS INDICATED ON PLAN.
5. ALL REUSED SPACES TO BE FULLY CLEANED PRIOR TO OCCUPANCY.
6. DAMAGED PLASTIC LAMINATE ON REUSED CASEWORK TO BE PATCHED/REPAIRED TO MATCH EXISTING.
7. REUSED CASEWORK DRAWERS AND DOORS TO BE ADJUSTED AS NEEDED BY OWNER (KAISER ENGINEERING) PRIOR TO OCCUPANCY. 1

PLAN REFERENCE NOTES:

1. PROVIDE AND INSTALL NEW PLASTIC LAMINATE COUNTERTOP TO MATCH EXISTING.
2. PROVIDE AND INSTALL WF–1 WINDOW FILM ON GLASS DOOR INSERTS. SEE FINISH LEGEND ON SHEET A9.01.
3. NOT USED.
4. INSTALL NEW F–1 CURTAIN PANELS ON CEILING MOUNTED TRACKS. SEE FINISH LEGEND ON SHEET A9.01.
5. INSTALL NEW WALL MOUNTED HAND SANITIZER DISPENSER AND GLOVE BOX. CONFIRM LOCATION WITH OWNER.
6. PROVIDE FULL CLEANING OF AREA.
7. REPAIR/REPLACE RUBBER BASE AT CABINET TO MATCH EXISTING.
8. AUDIO BOOTH TO BE RELOCATED FROM EXISTING CIN LOWER LEVEL OCC HEALTH SUITE BY OWNER. LOCATION OF AUDIO BOOTH AND POWER CONNECTION TO BE REVIEWED ON SITE WITH OWNER AND ARCHITECT. 1
9. PROVIDE AND INSTALL NEW PLASTIC LAMINATE COUNTERTOP TO MATCH EXISTING ADJACENT COUNTERTOP. SURFACE HEIGHT TO BE SET JUST BELOW ADJACENT COUNTERTOP SURFACE HEIGHT. 2
10. REPLACE CEILING TILE AS NEEDED WHERE OVERHEAD PROCEDURE LIGHT WAS REMOVED. 1
11. INSTALL NEW CEILING MOUNTED CURTAIN TRACKS.
12. INSTALL EQUIPMENT PER EXAM ROOM EQUIPMENT SCHEDULE ON SHEET A9.01.
13. INSTALL EQUIPMENT PER PROCEDURE ROOM EQUIPMENT SCHEDULE ON SHEET A9.01.
14. PROVIDE NEW DOOR AND ANY NECESSARY WALL IN–FILL FOR NEW ROOM ENCLOSURE. WALL AND DOOR TO MATCH EXISTING SUITE TYPE.
15. RELOCATE TWO EXISTING WALL MOUNTED LITERATURE RACKS FROM STAFF 1401. CONFIRM LOCATION WITH OWNER. PATCH AND PAINT WALL AS NECESSARY, AFTER REMOVAL.
16. OWNER FURNISHED SCALE LOCATION.
17. INSTALL WALL MOUNTED STADIOMETER.
18. RELOCATE STORAGE CART FROM AUDIO/SPIRO 1311.

1

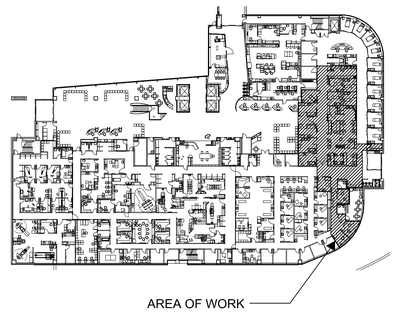


2 PARTIAL FIRST FLOOR CEILING PLAN – NEW CONSTRUCTION

1/8"=1'-0"

LEGEND

- OFFICE 1518 — ROOM TAG AND NUMBER
- 1 — PLAN REFERENCE NOTE
- 1 — EQUIPMENT TAG, SEE SCHEDULE (A8.01)
- 18.01 — ELEVATION SYMBOL
- SWITCH
- DUPLEX ELEC OUTLET
- QUADPLEX ELEC OUTLET
- COMBINATION VOICE/DATA
- COMBINATION POWER/VOICE/DATA, FLUSH FLOOR OUTLET
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- EXISTING DOOR
  (E) DENOTES EXISTING DOOR
- NEW DOOR LOCATION
  (N) DENOTES NEW DOOR
  (R) DENOTES RELOCATED DOOR
- EXISTING 2X4 ACOUSTIC CEILING GRID AND TILE
- EXISTING 2X4 TENANT STANDARD LIGHT FIXTURE
- EXISTING WALL SCONCE LIGHT FIXTURE
- EXISTING DOWN LIGHT FIXTURE
- NEW OR NEW LOCATION OF OH PROCEDURE LIGHT FIXTURE
- EXISTING SPRINKLER HEAD (SHOWN FOR REFERENCE)
- EXISTING HVAC DIFFUSER (SHOWN FOR REFERENCE)
- SP — EXISTING SPEAKER (SHOWN FOR REFERENCE)
- SD — EXISTING SMOKE DETECTOR (SHOWN FOR REFERENCE)
- EXISTING EXIT SIGN (SHOWN FOR REFERENCE)



FIRST FLOOR KEY PLAN

NTS

NORTH

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Revisions

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Project

OCCUPATIONAL HEALTH RELOCATION
TENANT IMPROVEMENT
FIRST FLOOR

Sheet Title

FLOOR AND CEILING PLANS - NEW CONSTRUCTION

Building ID: TBD | Floor Lev: 01 | Section:

Scale	1/8" = 1'-0"	Proj. No.	TBD
Drwn By	em	Permit No.	TBD
Chckd By	ms	Sheet	A2.02
Issue Date	12-15-2016	Of	7 Sheets

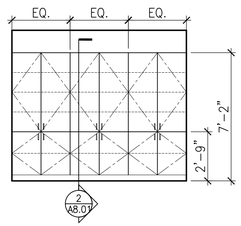
AS-BUILT SET

GRAPHIC SCALES: 1/16" = 1'-0" | 1/8" = 1'-0" | 1/4" = 1'-0" | 1/2" = 1'-0" | 3/4" = 1'-0" | 1" = 1'-0" | 1-1/2" = 1'-0" | 3" = 1'-0"

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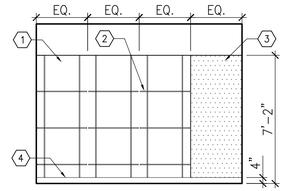
REFERENCE NOTES:

1. PROVIDE AND INSTALL 3/4" PLYWOOD FASTENED TO METAL STUD. PAINT TO MATCH EXISTING WALL SURFACE.
2. PROVIDE AND INSTALL ADJUSTABLE SHELVES, BRACKETS AND TRACKS.
3. PROVIDE AND INSTALL PEG BOARD.
4. RUBBER BASE TO MATCH EXISTING.



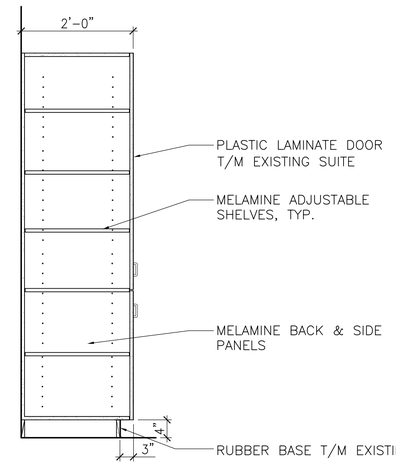
4 HALL 1430 - INTERIOR ELEVATION

1/4"=1'-0"



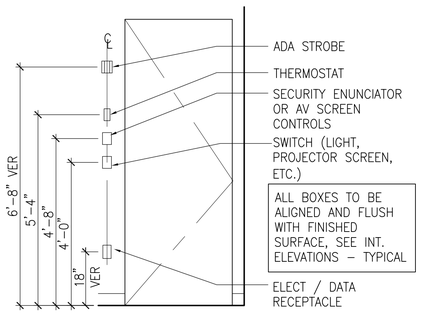
1 STORAGE 1402 - INTERIOR ELEVATION

1/4"=1'-0"



2 FULL HEIGHT CABINET

3/4"=1'-0"



3 ELECTRICAL HEIGHTS - TYP.

1/2" = 1'-0"

National Facilities Services
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Oakland, California 94604

Revisions

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Project

OCCUPATIONAL HEALTH RELOCATION
TENANT IMPROVEMENT
FIRST FLOOR

Sheet Title

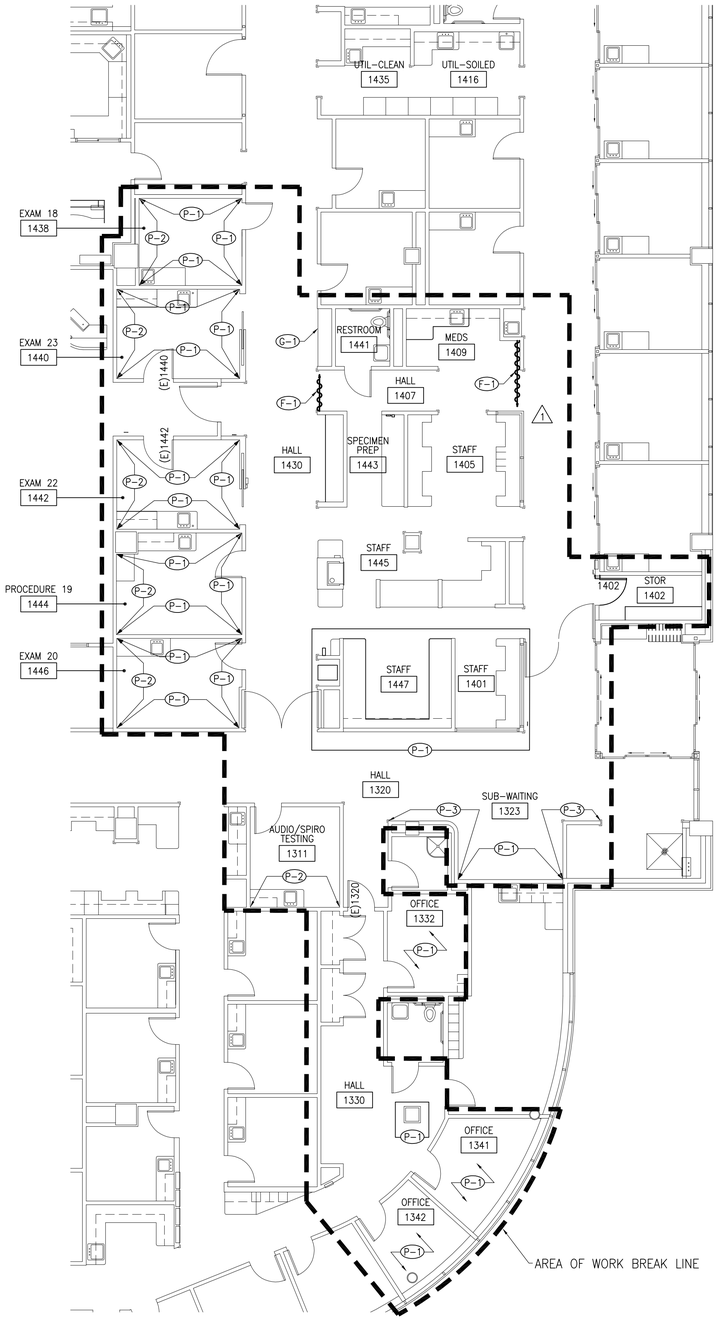
INTERIOR ELEVATIONS & DETAILS

Building ID: TBD	Floor Lev: 01	Section:
Scale		Proj. No. TBD
Drwn By em		Permit No. TBD
Chckd By ms		Sheet A8.01
Issue Date 12-15-2016		Of 7 Sheets

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1 FIRST FLOOR FINISH PLAN

1/8"=1'-0"

FINISH LEGEND

CODE	PRODUCT	DESCRIPTION	LOCATION / COMMENTS
P–1	GENERAL PAINT	MATCH EXISTING GENERAL PAINT	SEE FINISH PLAN FOR LOCATION
P–2	ACCENT PAINT	MATCH EXISTING ACCENT PAINT	SEE FINISH PLAN FOR LOCATION
P–3	ACCENT PAINT	MATCH EXISTING ACCENT PAINT	SEE FINISH PLAN FOR LOCATION
GF–1	GLASS FILM	3M FASARA GLACE GLASS FINISH, COLOR: TRANSPARENT/OPAQUE 2	HALL 1430 GLASS STORAGE DOOR INSERTS
F–1	CURTAIN FABRIC	T/M EXISTING EXAM ROOM CURTAINS	SEE FINISH PLAN FOR LOCATION

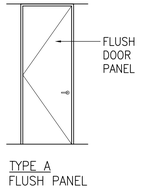
DOOR SCHEDULE

NUMBER	HARDWARE	DOOR TYPE	LEAF No.	SIZE	DOOR MAT'L	DOOR FINISH	FRAME MAT'L	FRAME FINISH	COMMENTS
(E)1320	EXISTING	EX	1	EXISTING	EX	EX	EX	EX	EXISTING DOOR. PROVIDE NEW MAGNETIC DOOR HOLDER.
1402	BEST CYLINDRICAL STORE ROOM FUNCTION LOCK #9K–D	A	1	F.V. – 3'–0"XFULL HT.	WV	CLR	AL	T/M EXISTING	HARDWARE FINISH T/M EXISTING SUITE
(E)1440	BEST CYLINDRICAL PASSAGE FUNCTION LOCK #9K–N	EX	1	EXISTING	EX	EX	EX	EX	HARDWARE FINISH T/M EXISTING SUITE
(E)1442	BEST CYLINDRICAL PASSAGE FUNCTION LOCK #9K–N	EX	1	EXISTING	EX	EX	EX	EX	HARDWARE FINISH T/M EXISTING SUITE

NOTE 1: RE–USE SALVAGED DOOR, FRAME, HARDWARE IF FEASIBLE – SEE DEMO PLAN FOR ADDITIONAL INFORMATION
NOTE 2: EXISTING DOORS ARE SHOWN FOR REFERENCE ONLY – THEY ARE BEING MODIFIED ONLY IF CALLED OUT FOR IN COMMENTS

AT DOOR NUMBER: (R) = REUSED, (N) = NEW, (E) = EXISTING
RE = RE–USE EXISTING
EX = EXISTING
F.V. = FIELD VERIFY EXISTING CONDITION
CLR = CLEAR FINISH ON WOOD VENEER
AL = ALUMINUM
WD = WOOD DOOR (FOR PAINTED FINISH)
WV = WOOD VENEER DOOR (FOR CLEAR FINISH)

DOOR TYPES



TYPE A
FLUSH PANEL

EXAM ROOM EQUIPMENT SCHEDULE

CODE	DESCRIPTION MANUFACTURER	MEP REQUIREMENTS	RESPONSIBILITY	COMMENTS
1	SPHYGMOMANOMETER (WALL MT.)	NONE	O.F.C.I.	VERIFY LOCATION WITH TENANT PRIOR TO INSTALLATION
2	OTOSCOPE/OPTHALMOSCOPE (WALL MT.)	POWER	O.F.C.I.	VERIFY LOCATION WITH TENANT PRIOR TO INSTALLATION
3	COMPUTER (WALL MT.)	POWER/DATA	O.F.C.I.	VERIFY LOCATION WITH TENANT PRIOR TO INSTALLATION
4	PHONE (WALL MT.)	TELEPHONE	O.F.C.I.	VERIFY LOCATION WITH TENANT PRIOR TO INSTALLATION
5	SHARPS CONTAINER (WALL MT.)	NONE	O.F.C.I.	VERIFY LOCATION WITH TENANT PRIOR TO INSTALLATION
6	GLOVE BOX (WALL MT.)	NONE	O.F.C.I.	VERIFY LOCATION WITH TENANT PRIOR TO INSTALLATION
7	SOAP DISPENSER (WALL MT.)	NONE	O.F.C.I.	VERIFY LOCATION WITH TENANT PRIOR TO INSTALLATION
8	PAPER TOWEL DISPENSER (WALL MT.)	NONE	O.F.C.I.	RE–USE EXISTING. VERIFY LOCATION WITH TENANT PRIOR TO INSTALLATION
9	COAT HOOK RACK (WALL MT.)	NONE	O.F.C.I.	RE–USE EXISTING. VERIFY LOCATION WITH TENANT PRIOR TO INSTALLATION
10	EXAM TABLE	NONE	O.F.O.I.	VERIFY LOCATION WITH TENANT PRIOR TO INSTALLATION
11	ROLLING EXAM STOOL	NONE	O.F.O.I.	
12	MAYO STAND	NONE	O.F.O.I.	2–3 TOTAL STANDS FOR ENTIRE SUITE

PROCEDURE ROOM EQUIPMENT SCHEDULE

CODE	DESCRIPTION MANUFACTURER	MEP REQUIREMENTS	RESPONSIBILITY	COMMENTS
1	SPHYGMOMANOMETER (WALL MT.)	NONE	O.F.C.I.	VERIFY LOCATION WITH TENANT PRIOR TO INSTALLATION
2	OTOSCOPE/OPTHALMOSCOPE (WALL MT.)	POWER	O.F.C.I.	VERIFY LOCATION WITH TENANT PRIOR TO INSTALLATION
3	COMPUTER (WALL MT.)	POWER/DATA	O.F.C.I.	VERIFY LOCATION WITH TENANT PRIOR TO INSTALLATION
4	PHONE (WALL MT.)	TELEPHONE	O.F.C.I.	VERIFY LOCATION WITH TENANT PRIOR TO INSTALLATION
5	SHARPS CONTAINER (WALL MT.)	NONE	O.F.C.I.	VERIFY LOCATION WITH TENANT PRIOR TO INSTALLATION
6	GLOVE BOX (WALL MT.)	NONE	O.F.C.I.	VERIFY LOCATION WITH TENANT PRIOR TO INSTALLATION
7	SOAP DISPENSER (WALL MT.)	NONE	O.F.C.I.	VERIFY LOCATION WITH TENANT PRIOR TO INSTALLATION
8	PAPER TOWEL DISPENSER (WALL MT.)	NONE	O.F.C.I.	RE–USE EXISTING. VERIFY LOCATION WITH TENANT PRIOR TO INSTALLATION
9	COAT HOOK RACK (WALL MT.)	NONE	O.F.C.I.	RE–USE EXISTING. VERIFY LOCATION WITH TENANT PRIOR TO INSTALLATION
10	EXAM TABLE	NONE	O.F.O.I.	VERIFY LOCATION WITH TENANT PRIOR TO INSTALLATION
11	ROLLING EXAM STOOL	NONE	O.F.O.I.	
12	MAYO STAND	NONE	O.F.O.I.	2–3 TOTAL STANDS FOR ENTIRE SUITE
13	MOBILE PROCEDURE LIGHT	POWER	O.F.O.I.	

National Facilities Services
Post Office Box 12916
Oakland, California 94604

Revisions

No.	Revisions	By	Date	Appr.
1	ASI 1	GBD	01.10.14	
2	ASI 2	GBD	XX.XX.XX	

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Project Architect Approval:

Architect/Engineer Of Record:

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REGISTERED ARCHITECT · CRAIG L. DAVIS · PORTLAND, OREGON 3008 · STATE OF OREGON

GBD PROJECT No.: 20111806

Facility

CALTECH MANUFACTURING, BLDG 7
1950 PARKSIDE DRIVE
ATLANTA, GEORGIA 30301

Project

OCCUPATIONAL HEALTH RELOCATION
TENANT IMPROVEMENT
FIRST FLOOR

Sheet Title

FINISHES, DOOR SCHEDULE & EQUIPMENT SCHEDULE

Building ID: TBD | Floor Lev: 01 | Section:

Scale	NTS	Proj. No.	TBD
Drwn By	em	Permit No.	TBD
Chckd By	ms	Sheet	A9.01
Issue Date	12-15-2016	Of	7 Sheets

AS–BUILT SET

GRAPHIC SCALES: 1/16" = 1'-0" | 1/8" = 1'-0" | 1/4" = 1'-0" | 1/2" = 1'-0" | 3/4" = 1'-0" | 1" = 1'-0" | 1-1/2" = 1'-0" | 3" = 1'-0"

If this sheet is not 24" x 36" It is a reduced print

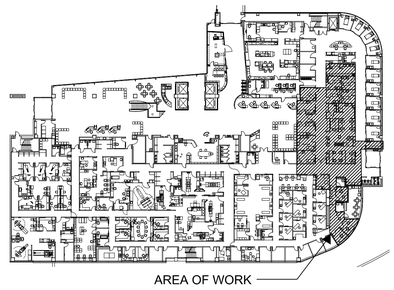


1 PARTIAL FIRST FLOOR SIGNAGE LOCATION PLAN

1/8"=1'-0"

PLAN REFERENCE NOTES:

1. REMOVE WALL MOUNTED EXAM ROOM NUMBER SIGNAGE OVER DOOR. PATCH/REPAIR AND PAINT WALL, AS NECESSARY. (1)
2. REPLACE SIGNAGE WITHIN SUITE TO MATCH EXISTING. COORDINATE CONTENT AND LOCATION WITH OWNER AND ARCHITECT.
3. PUBLIC AREA DIRECTIONAL SIGNAGE UPDATES TO BE COORDINATED AND IMPLEMENTED BY KAISER WAYFINDING TEAM (NOT IN PROJECT CONTRACT)



FIRST FLOOR KEY PLAN

NTS

NORTH

National Facilities Services
Post Office Box 12916
Oakland, California 94604

Revisions

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1950 PARKSIDE DRIVE
ATLANTA, GEORGIA 30301

Project

OCCUPATIONAL HEALTH RELOCATION
TENANT IMPROVEMENT
FIRST FLOOR

Sheet Title

SIGNAGE LOCATION PLAN

Building ID: TBD | Floor Lev: 01 | Section:

Scale	NTS	Proj. No.	TBD
Drwn By	em	Permit No.	TBD
Chckd By	ms	Sheet	A9.02
Issue Date	12-15-2016	Of	7 Sheets

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DRAWING INDEX

ARCHITECTURAL

A0.00	COVER SHEET
A0.01	EGRESS & CODE INFORMATION
A2.01	FLOOR AND CEILING PLANS - DEMOLITION
A2.02	FLOOR AND CEILING PLANS - NEW CONSTRUCTION
A8.01	INTERIOR ELEVATIONS AND DETAILS
A9.01	FINISHES, DOOR SCHEDULE AND EQUIPMENT SCHEDULE
A9.02	SIGNAGE LOCATION PLAN

MECHANICAL

1. MECHANICAL AND FIRE SYSTEM WORK INDICATED IS FOR INFORMATION ONLY. CONTRACTORS SHALL VERIFY SIZES AND LOCATIONS OF ALL EQUIPMENT, BOTH EXISTING AND NEW. THESE SYSTEMS ARE SUB-CONTRACTOR DESIGN/BUILD AND ARE TO BE SUBMITTED UNDER SEPARATE PERMIT. IT IS THE RESPONSIBILITY OF THE DESIGN/BUILD SUB-CONTRACTOR TO OBTAIN THESE PERMITS.

ELECTRICAL

1. ELECTRICAL WORK INDICATED IS FOR INFORMATION ONLY. CONTRACTORS SHALL VERIFY SIZES AND LOCATIONS OF ALL EQUIPMENT, BOTH EXISTING AND NEW. THESE SYSTEMS ARE SUB-CONTRACTOR DESIGN/BUILD AND ARE TO BE SUBMITTED UNDER SEPARATE PERMIT. IT IS THE RESPONSIBILITY OF THE DESIGN/BUILD SUB-CONTRACTOR TO OBTAIN THESE PERMITS.
2. EXISTING ELECTRICAL OUTLETS, LIGHT SWITCHES, THERMOSTATS AND ADA STROBE TO BE REVIEWED BY CONTRACTOR. CONTRACTOR TO COORDINATE CHANGES WITH OWNER AND ARCHITECT.
3. ALL NEW ELECTRICAL OUTLETS TO BE MOUNTED AT +18" A.F.F. UNLESS NOTED OTHERWISE.
4. ALL ELECTRICAL AND TELECOMMUNICATIONS DEVICE COVER PLATES ARE TO BE SELECTED BY TENANT. DEVICES AND DEVICE COVER PLATES SHALL BE COLOR COORDINATED / MATCHING.
5. SWITCHING FOR ALL LIGHT FIXTURES TO BE COORDINATED BETWEEN ARCHITECTURAL AND ELECTRICAL DRAWINGS PRIOR TO BEGINNING OF WORK.
6. MODIFY EMERGENCY EGRESS LIGHTING AS NECESSARY TO MATCH PRESCRIBED PATH AND TO CONFORM WITH THE CITY OF PORTLAND FIRE MARSHALL.
7. WHERE EXISTING SWITCHES AND/OR OUTLETS ARE ABANDONED, PULL CONNECTION WIRING BACK TO SOURCE, REMOVE WALL BOXES, AND PATCH/REPAIR WALL OPENINGS.

CAMTECH MANUFACTURING, BUILDING 7

Occupational Health Relocation

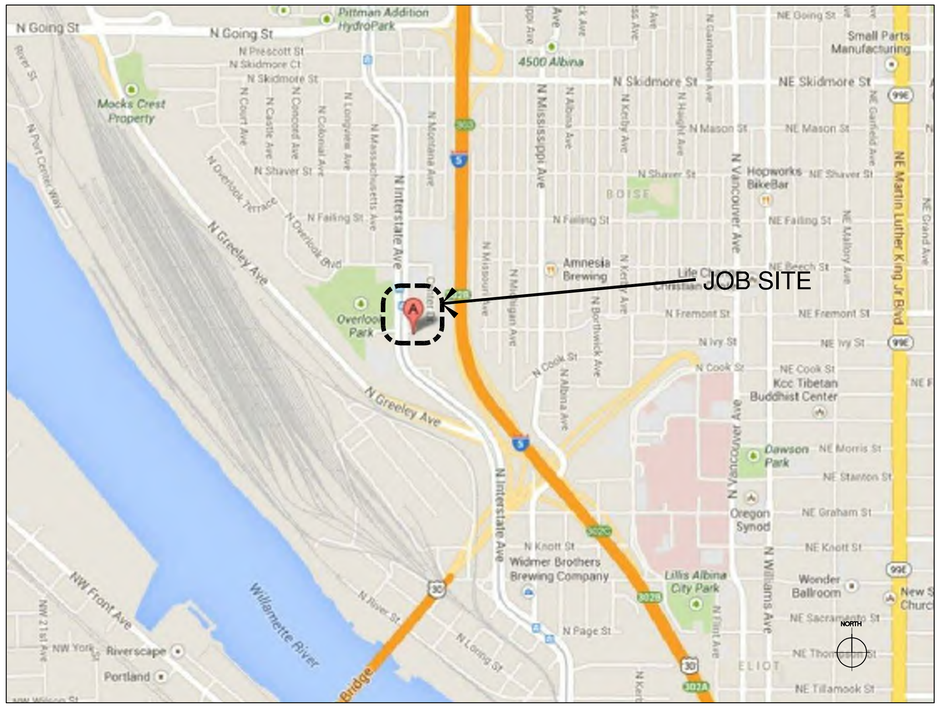
TENANT IMPROVEMENT PACKAGE

First Floor

7809 Industrial Boulevard ATLANTA, GEORGIA 30301

June 2000

VICINITY MAP



DEMOLITION

THESE GENERAL NOTES APPLY TO EACH DRAWING IN THIS PACKAGE. THEY DO NOT REAPPEAR ON THE INDIVIDUAL SHEETS.

A. SALVAGE / RECYCLE REMOVED MATERIAL AS PRACTICAL. FOLLOW KAISER STANDARD CONSTRUCTION WASTE MANAGEMENT POLICY.

B. ALL WALLS, COLUMNS, DOORS, DOOR FRAMES, FLOORS, CEILINGS WITHIN SCOPE OF WORK ARE TO BE VOID OF ANY FINISH OR ATTACHMENTS. (SUCH AS CORNER GUARDS, WALL COVERINGS, BASE FINISHES AND SIGNAGE.)

C. MANY WALL MOUNTED EQUIPMENT ITEMS TO BE SALVAGED FOR RE-USE. SALVAGE AND PROTECT DURING CONSTRUCTION AND RE-MOUNT TO WALL AFTER WORK IS COMPLETE.

D. EXISTING STRUCTURE TO BE LEFT UNDISTURBED AND INTACT. PERFORM NO DEMOLITION THAT MAY COMPROMISE THE STRUCTURAL INTEGRITY OF THE BUILDING WITHOUT WRITTEN APPROVAL OF THE ARCHITECT.

E. PROTECT ALL INTERIOR CORE AREAS FROM DAMAGE DURING DEMOLITION. SUB-CONTRACTOR TO BE HELD RESPONSIBLE FOR ANY DAMAGES ASSOCIATED WITH THIS WORK. PROTECT ALL AREAS THAT ARE TO REMAIN SUCH AS ELEVATOR AND DOOR FRAMES, DRINKING FOUNTAINS, ETC.

F. MAINTAIN 100% SPRINKLER COVERAGE THROUGHOUT DEMOLITION.

CONSTRUCTION

1. ALL WORK SHALL CONFORM TO APPLICABLE BUILDING CODES AND ORDINANCES, AS MODIFIED FOR THIS BUILDING BY APPEALS ON RECORD AT THE CITY OF PORTLAND DEPT. OF DEVELOPMENT SERVICES. IN CASE OF CONFLICT WHERE THE METHODS OR STANDARDS OF INSTALLATION OR THE MATERIALS SPECIFIED DO NOT EQUAL OR EXCEED THE REQUIREMENTS OF THE LAWS OR ORDINANCES, THE LAW OR ORDINANCE SHALL GOVERN. NOTIFY ARCHITECT OF CONFLICTS.
2. FIELD VERIFY ALL CONDITIONS SHOWN AS EXISTING. FIELD VERIFY ALL DIMENSIONS AND CONDITIONS. NOTIFY ARCHITECT OF ANY DISCREPANCIES.
3. ALL DIMENSIONS ARE TO FACE OF FINISHED SURFACE UNLESS NOTED OTHERWISE.
4. MECHANICAL, ELECTRICAL AND FIRE SYSTEM WORK INDICATED IS FOR INFORMATION ONLY. CONTRACTORS SHALL VERIFY SIZES AND LOCATIONS OF ALL MECHANICAL AND ELECTRICAL EQUIPMENT, BOTH EXISTING AND NEW. THESE SYSTEMS ARE SUB-CONTRACTOR DESIGN/BUILD AND ARE TO BE SUBMITTED UNDER SEPARATE PERMIT. IT IS THE RESPONSIBILITY OF THE DESIGN/BUILD SUB-CONTRACTOR TO OBTAIN THESE PERMITS.
5. ALL EXISTING REMAINING/REUSED WALLS, DOORS, FLOORS, CEILINGS ARE TO BE PATCHED, PLASTERED, SANDED AND PREPARED READY FOR THE NEW FINISH AS NOTED. REFER TO FINISH PLAN ON SHEET A9.01.
6. PROVIDE ANY NECESSARY BUILDING STANDARD LED EXIT SIGNS AND EMERGENCY LIGHTING SYSTEM IN CONFORMANCE WITH CITY FIRE MARSHALL REQUIREMENTS.
7. SEAL ALL THROUGH FLOOR / RATED-WALL PENETRATIONS WITH RATED ASSEMBLIES AS REQUIRED TO MAINTAIN THE INTEGRITY OF FLOOR / WALL ASSEMBLY.
8. PROVIDE MINIMUM 4" BUILT WALL RETURN AT EDGE OF ALL NEW DOOR OPENINGS, TYPICAL.
9. PAINT FULL EXTENT OF WALLS AT ALL LOCATIONS WHERE PATCH/REPAIR WORK HAS BEEN DONE.
10. ALL WORK SHALL CONFORM TO KAISER NATIONAL FACILITIES STANDARDS (NFS). INFORMATION ON STANDARDS ARE PROVIDED ON KAISER'S INFOZONE WEBSITE.

FACILITIES PERMIT - GENERAL NOTES

A. PROVIDE 100% SPRINKLER COVERAGE WITH NEW RENOVATION CONSTRUCTION. ADJUST SPRINKLER HEAD LOCATIONS AS NECESSARY FOR NEW DESIGN LAYOUT.

B. THE DESIGN OF ALL SEISMIC BRACING AND SUPPORTS FOR CEILING, MECHANICAL AND ELECTRICAL ITEMS AND PARTITIONS IS THE RESPONSIBILITY OF THE RESPECTIVE CONTRACTOR/VENDOR TO MEET CITY OF PORTLAND BUILDING CODE.

C. PROVIDE CEILING SPEAKERS AND FIRE STROBES FOR EMERGENCY ANNUNCIATION SYSTEM IN CONFORMANCE WITH REQUIREMENTS OF CITY OF PORTLAND FIRE MARSHALL.

D. ALL DESIGN/BUILD SYSTEMS ARE UNDER SEPARATE PERMIT. IT IS THE RESPONSIBILITY OF THE DESIGN/BUILD SUB-CONTRACTOR TO OBTAIN THESE PERMITS THROUGH THE CITY OF PORTLAND FACILITIES PERMIT PROGRAM

E. MODIFY EMERGENCY EGRESS LIGHTING AS NECESSARY TO MATCH PRESCRIBED PATH AND TO CONFORM WITH THE CITY OF PORTLAND FIRE MARSHALL. SEE EGRESS PLAN FOR EGRESS PATH.

PROJECT INFORMATION

TENANT:

CAMTECH MANUFACTURING
7809 Industrial Boulevard
Atlanta, Georgia 30301
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Fax: 404/555-1213
Contact: Facility Manager
Email: facility.manager@camtechmfg.com

CONTRACTOR:

WALSH CONSTRUCTION CO.
2905 SW First Avenue
Portland, Oregon 97201
Phone: 503/222-4375
Contact: Matt Godt
Email: mgodt@walshconstructionco.com
CCB No. 147267

FACILITIES PERMIT:

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1900 SW 4th Avenue
Portland, OR 97201
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Fax: 503/823-7425
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Oakland, California 94604

Revisions

No.	Revisions	By	Date	Appr.
1	ASI 1	GBD	01.10.14	
2	ASI 2	GBD	01.24.14	

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GBD PROJECT No.: 20111806

REGISTERED ARCHITECT · CRAIG L. DAVIS · PORTLAND, OREGON 3008 · STATE OF OREGON

Facility

CALTECH MANUFACTURING, BLDG 7
1950 PARKSIDE DRIVE
ATLANTA, GEORGIA 30301

Project

OCCUPATIONAL HEALTH RELOCATION
TENANT IMPROVEMENT
FIRST FLOOR

Sheet Title

COVER SHEET

Building ID: TBD | Floor Lev: 01 | Section:

Scale	NTS	Proj. No.	TBD
Drwn By	em	Permit No.	TBD
Chckd By	ms	Sheet	A0.00
Issue Date	12-15-2016	Of	7 Sheets

AS-BUILT SET

CAMTECH

MANUFACTURING

1/2" WHITE QUICK RESPONSE RECESSED PENDENT SPRINKLER 165°F - "K" FACTOR 5.6 - VIKING MICROFAST MODEL "M" (SIN VK302) WITH MICROMATIC MODEL "E-1" RECESSED WHITE ESCUTCHEON.

R 1/2" WHITE RESIDENTIAL RECESSED PENDENT SPRINKLER 155°F - "K" FACTOR 5.5 - VIKING RESIDENTIAL MODEL "M-5" (SIN VK432).

R 1/2" WHITE RESIDENTIAL HORIZONTAL SIDEWALL SPRINKLER 155°F - "K" FACTOR 5.5 - VIKING MICROFAST MODEL "M-5" (SIN VK442).

DS 1/2" WHITE QUICK RESPONSE RECESSED HORIZONTAL DRY SIDEWALL SPRINKLER 155°F - "K" FACTOR 8.0 - VIKING (SIN VK279).

1/2" WHITE QUICK RESPONSE CONCEALED SIDEWALL SPRINKLER 165°F - "K" FACTOR 5.6 - VIKING WITH COLOR OF COVER PLATE TO BE DETERMINED BY ARCHITECT 135°F (SIN VK481). PROVIDE ADDITIONAL 15% SUPPLY OF COVER PLATES.

1/2" WHITE QUICK RESPONSE CONCEALED PENDENT SPRINKLER 165°F - "K" FACTOR 5.6 - VIKING HORIZON MIRAGE "B-2" WITH COLOR OF COVER PLATE TO BE DETERMINED BY ARCHITECT 135°F (SIN VK462). PROVIDE ADDITIONAL 15% SUPPLY OF COVER PLATES.

1/2" BLACK STANDARD RESPONSE UPRIGHT SPRINKLER 155°F - "K" FACTOR 5.6 - VIKING MICROFAST MODEL "M" (SIN VK300) POLYESTER COATED.

1/2" WHITE ADJUSTABLE QUICK RESPONSE CONCEALED DRY PENDENT SPRINKLER 155°F - "K" FACTOR 5.6 - STANDARD COVERAGE RELIABLE MODEL "F3QR" WITH WHITE COVER PLATE 135°F (SIN R5714). PROVIDE ADDITIONS 15% SUPPLY OF COVER PLATES.

BRANCH PIPING
MAIN PIPING
PRESSURE GAUGE
O.S. & Y. GATE VALVE WITH TAMPER SWITCH
FLOW SWITCH
STANDPIPE
F.C. FLUSHING CONNECTION
PIPE CAPPED
PIPE BELOW
PIPE ABOVE
PIPE BELOW
DRAWING REFERENCE NOTE
POINT OF CONNECTION

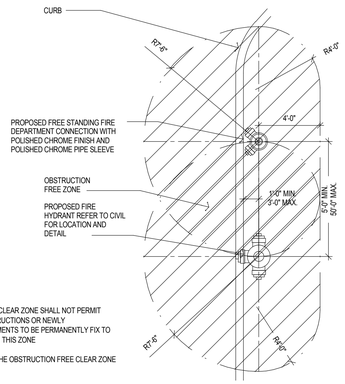
J | SCALE: N.T.S.

F | FIRE PROTECTION SYMBOL LEGEND | SCALE: N.T.S.

1. FIRE PROTECTION SYSTEM TO COMPLY WITH NFPA # 13, 14, 20, 24, 25, 2001 AND ALL APPLICABLE STATE AND LOCAL CODES.
2. FINAL INSPECTION AND APPROVAL BY LOCAL FIRE DEPARTMENT, BLDG. DEPT., AND ARCHITECT/ENGINEER.
3. A VISIT TO THE SITE TO CHECK AND VERIFY ALL EXISTING CONDITIONS PRIOR TO BIDDING TO INSURE THE COORDINATION OF THE FIRE SERVICES WITH EXISTING CONDITIONS.
4. CUTTING OF STRUCTURAL AND/OR ARCHITECTURAL MEMBERS TO BE DONE ONLY WITH THE WRITTEN APPROVAL OF THE ARCHITECT AND STRUCTURAL ENGINEER.
5. PIPE ROUTING SHOWN SHALL BE USED AND ANY ADDITIONAL OFFSETS OR FITTINGS REQUIRED FOR PROPER INSTALLATION, COORDINATION WITH OTHER TRADES, AND/OR TO MAINTAIN PROPER CLEARANCES SHALL BE PROVIDED. VERIFY STRUCTURAL, MECHANICAL, ELECTRICAL INSTALLATIONS AND AVOID ALL OBSTRUCTIONS OR INTERFERENCES.
6. REFER TO ARCHITECTURAL REFLECTED CEILING PLANS AND ELECTRICAL LIGHTING DRAWINGS FOR CEILING DESCRIPTIONS AND HEIGHTS.
7. FLOW TEST DATA IS 71 PSI STATIC PRESSURE WITH RESIDUAL PRESSURE OF 59 PSI @ 1870 GPM PERFORMED BY MILWAUKEE WATER WORKS ON 05/25/2006CONTRACTOR SHALL PER PERFORM UP TO DATE FLOW TEST AS PART OF HYDRAULIC CALCULATIONS
8. FIRE STOP ALL PENETRATIONS OF SMOKE/FIRE WALLS, CEILINGS, FLOORS, ROOFS, ETC., FLASH AND COUNTERFLASH ROOF PENETRATIONS.
7. PROVIDE ACCESS PANELS TO ALL VALVES ABOVE NON-ACCESSIBLE CEILINGS AND CHASES.
8. SPRINKLER HEADS ARE TO BE COORDINATED WITH ALL DIFFUSERS, SPEAKERS, LIGHTING FIXTURES, CEILING SYSTEMS AND STRUCTURAL SYSTEM.
9. INDICATE CENTER-TO-CENTER DIMENSIONS AND/OR PIPE CUT LENGTHS AND NOMINAL PIPE DIAMETERS ON ALL PIPING.
10. INDICATE PIPE TYPE, SCHEDULE OF WALL THICKNESS AND METHOD OF JOINING ON SHOP DRAWING.
11. PROVIDE STOCK OF EXTRA SPRINKLERS IN ACCORDANCE WITH N.F.P.A.-13.
12. PROVIDE DETAIL AND INDICATE TYPE OF HANGER TO BE INSTALLED FOR SPRINKLER PIPING. METHODS OF HANGING PIPES, HEADERS AND BRANCHES SHALL BE IN ACCORDANCE WITH N.F.P.A. 13. HANGERS SHALL NOT INTERFERE WITH ANY OTHER TRADE. POWDER DRIVEN STUDS SHALL NOT BE USED.
13. ALL GROOVED & SCREWED FITTING SHALL BE APPROVED PRIOR TO ANY INSTALLATION BY ENGINEER WHO RESERVES THE RIGHT TO DISAPPROVE ANY FITTING.
14. ALL SPRINKLER PIPING & FITTINGS SHALL BE INSTALLED RUST-FREE.
15. AUTOMATIC SPRINKLER TEMPERATURE RATINGS OF GLASS BULB ELEMENTS TO BE IN ACCORDANCE WITH N.F.P.A. 13. ALL SPRINKLERS SHALL HAVE CORROSIVE-RESISTANT COATING.
16. ALL VALVES FOR FIRE SERVICE SHALL BE LISTED BY THE UNDERWRITER'S LABORATORIES, INC. AND THE FACTORY MUTUAL LABORATORIES. VALVES SHALL BE FACTORY MARKED "UL" AND "FM", 175 WORKING PRESSURE, AND 300 WORKING PRESSURE WHERE APPLICABLE.
17. ALL VALVES ON THE FIRE PROTECTION SYSTEM TO BE ELECTRICALLY SUPERVISED. TYPE AND EXACT LOCATION OF FLOW AND SUPERVISORY SWITCHES SHALL BE ACCOMPLISHED/COORDINATED BETWEEN THE DIFFERENT RESPONSIBLE TRADES. ADDITIONAL WIRING OR ADDITIONAL SWITCHES REQUIRED SHALL BE PROVIDED.
18. BE ADVISED THAT PIPING SHOWN IS ARRANGED TO ALLOW FOR FIRE ALARM ZONING. FIRE PROTECTION PIPING ARRANGEMENT SHALL REFLECT AND ALLOW SAME ZONING AS SHOWN.
19. CAUTION: FINAL SPRINKLER SHOP DRAWINGS SHALL BE SUBMITTED TO ENGINEER THROUGH ARCHITECT. NO INSTALLATION SHALL BE PERMITTED UNTIL SPRINKLER SHOP DRAWINGS HAVE BEEN APPROVED.
20. SPRINKLERS SHALL COVER THE ENTIRE AREA OF ALL STRUCTURAL MEMBERS. SPRAY SHALL NOT BE BLOCKED BY WALLS, PARTITIONS OR STRUCTURAL COMPONENTS.
21. IMMEDIATELY NOTIFY THE ARCHITECT/ENGINEER OF ANY DISCREPANCIES FOUND BETWEEN THESE PLANS, OTHER ENGINEERING PLANS, THE ARCHITECTURAL PLANS AND/OR FIELD CONDITIONS PRIOR TO FINAL BID PRICE OR FINAL PERMITTING.
22. IN CASE OF DISPUTE OR DOUBT AS TO INTENT OF DRAWINGS OR SPECIFICATIONS, OBTAIN ARCHITECT/ENGINEER'S WRITTEN DECISION BEFORE PROCEEDING WITH BID INVOLVED.
23. BEFORE SUBMITTING PROPOSAL OR BID, EXAMINE ALL DRAWINGS AND SPECIFICATIONS RELATING TO THIS PROJECT, THE AMOUNT OF SPACE AVAILABLE FOR PIPING, EQUIPMENT AND CONNECTING SERVICES, THE SITE OF THE WORK, THE REQUIREMENTS TO CORRELATE THE FIRE PROTECTION WORK WITH THAT OF OTHER TRADES AND THE TIME SCHEDULE NECESSARY TO PERFORM THAT WORK.
24. AFTER EXAMINATION OF ALL PLANS AND SPECIFICATIONS, INCLUDE ALL THE COSTS NECESSARY FOR ALTERATION, MODIFICATIONS AND/OR ADDITIONS TO THE FIRE PROTECTION SYSTEM(S) NECESSARY TO MAKE A COMPLETE, APPROVED AND FINISHED INSTALLATION IN ALL ASPECTS. IT IS THE INTENT THAT ALL COSTS REQUIRED BE INCLUDED IN THE BID OF THIS TRADE.
25. PIPE SHALL BE REAMED AND CLEANED BEFORE ASSEMBLY, AND AFTER ASSEMBLY. THE ENTIRE PIPING SYSTEM SHALL BE FLUSHED CLEAN.
26. ADJUST NEW/EXISTING SPRINKLER PIPING AND SPRINKLER HEAD PLACEMENT TO ACCOMMODATE NEW/EXISTING CEILING HEIGHTS AND STRUCTURAL CONFIGURATIONS.
27. PROVIDE SYSTEM(S) WITH FLUSHING CONNECTION(S).
28. PROVIDE SPRINKLERS ABOVE AND BELOW EXPOSED DUCTWORK, AN OBSTRUCTION, OR COMBINATIONS OF OBSTRUCTIONS 4 FEET OR WIDER.
29. INDICATE THE ROOM FUNCTIONS FOR EACH AREA ON THE SHOP DRAWINGS.
30. INDICATE THE LOCATION AND SIZE OF BLIND SPACES AND CLOSETS ON THE SHOP DRAWINGS.
31. INDICATE THE TOTAL SQUARE FOOT AREA PROTECTED BY SYSTEM(S) ON EACH FLOOR(S) ON THE SHOP DRAWINGS.
32. INDICATE THE NUMBER OF SPRINKLERS ON EACH RISER PER FLOOR ON THE SHOP DRAWINGS.
33. PROVIDE HEAD GUARDS ON SPRINKLER HEADS IN ELECTRIC, TELEPHONE AND MECHANICAL ROOMS.
34. ALL PENDENT SPRINKLERS SHALL BE CENTER-OF-TILE, UNLESS MAXIMUM DISTANCES FROM WALLS OR BETWEEN HEADS IS EXCEEDED. ALL SPRINKLER HEADS MOUNTED IN CEILING SHALL BE LOCATED A MINIMUM OF 4" AWAY FROM ANY WALLS, CEILING GRID MEMBERS, CEILING HEIGHT CHANGES OR ANY OTHER VERTICAL INTERSECTING STRUCTURAL SURFACE.
35. INSPECTOR'S TEST VALVE SHALL NOT EXCEED 7 FEET ABOVE THE FINISHED FLOOR. STYLE OF TEST SHALL BE VICTAULIC TESTMASTER II #720.
36. PROVIDE SMOOTH BORE CORROSION RESISTANT OUTLET FOR INSPECTOR'S TEST GIVING FLOW EQUIVALENT TO 1 SPRINKLER.
37. FIRE PROTECTION CONTRACTOR SHALL ASSIST IN PREPARATION OF COORDINATION DRAWINGS FOR ALL LEVELS WHICH INDICATE ALL THE ENGINEERING DISCIPLINES & FIRE PROTECTION PIPING. THESE DRAWINGS SHALL BE PREPARED & APPROVED BY THE ENGINEER PRIOR TO ANY INSTALLATION. REFER TO SPECIFICATION SECTION 15002 - COORDINATION DRAWINGS.
38. FIRE SPRINKLER PIPING SHALL NOT TRAVEL WITHIN 6 FEET OVER THE TOPS OF ELECTRICAL PANEL BOARDS PER N.F.P.A 70 NEC ARTICLE 110-26-F-1-A, 1999 EDITION.
39. PROVIDE ADDITIONAL SPRINKLER HEADS, FITTINGS, APPURTENANCES, AND ALL OTHER WORK NECESSARY TO ACCOMMODATE A MINIMUM OF AN ADDITIONAL 15% OF THE TOTAL CONTRACT PRICE AS INDICATED ON THE CONTRACT DOCUMENTS. THE 15% OF THE TOTAL CONTRACT PRICE SHALL BE USED TO PROVIDE ANY ADDITIONAL FIRE PROTECTION SPRINKLER COVERAGE WHICH MAY BE NEEDED TO ACCOMMODATE ANY INTERIOR DESIGN LAYOUTS, OR CHANGES TO SUCH LAYOUTS WHICH ARE OR MAY BE INCLUDED IN THE WORK. THESE SPRINKLERS AND ASSOCIATED WORK SHALL BE PROVIDED WHERE REQUIRED TO RESOLVE ANY CONFLICTS OR OTHER LAYOUT CHANGES NEEDED TO ACCOMMODATE ALL MISCELLANEOUS ITEMS (I.E., CEILING OFFSETS, SOFFITS, COVES, CODE CORRECTIONS/INTERPRETATIONS, STRUCTURAL SYSTEM CONFLICTS, OR RELATED INTERIOR DESIGN CONFIGURATIONS). AT PROJECT COMPLETION, A CREDIT WILL BE DUE TO THE OWNER FOR ALL UNUSED PORTION OF THE 15% OF THE TOTAL CONTRACT PRICE AND THIS CREDIT WILL BE INCORPORATED INTO THE FINAL PAY APPLICATION AT A RATE ESTABLISHED IN THE BID PROPOSAL AS TWO SEPARATE LINE ITEMS. ONE LINE ITEM WILL IDENTIFY THE TOTAL COST OF THE REQUIRED 15% TOTAL CONTRACT PRICE, AND THE SECOND LINE ITEM WILL IDENTIFY AN INDIVIDUAL COST PER SPRINKLER HEAD AND ALL ASSOCIATED PIPING, FITTINGS AND HANGERS.
40. ALL SPRINKLERS SHALL MEET WITH NFPA #13 TEMPERATURE RATINGS FOR FIRE SPRINKLERS (i.e. SPRINKLERS LOCATED IN A HIGH TEMPERATURE ZONE SHALL HAVE HIGH-TEMPERATURE CLASSIFICATION SPRINKLERS AND SPRINKLERS LOCATED IN AN INTERMEDIATE ZONE SHALL HAVE INTERMEDIATE TEMPERATURE CLASSIFICATION SPRINKLERS).

ALL PUBLIC AREA DIFFUSERS, LIGHT FIXTURE TRIMS, CAMERA TRIMS, AND SPEAKER TRIMS/GRILLES SHALL BE FIELD PAINTED BY THE GC PER THE DEVICE COLOR SCHEDULE TO BE ISSUED BY THE ARCHITECT. ALL PUBLIC AREA SPRINKLER HEADS, ELECTRICAL, LOW VOLTAGE DEVICES AND COVERPLATES SHALL BE PRICED ASSUMING A CUSTOM COLOR, WHICH WILL BE PROVIDED AT A LATER DATE BY THE ARCHITECT. FOR THE THEMED SUITES, CONTRACTOR TO ALLOW FOR CUSTOM COLORS FOR ALL WALL AND CEILING DEVICES IN PRICING. FINAL COLORS WILL BE PROVIDED IN FUTURE ADDENDUM

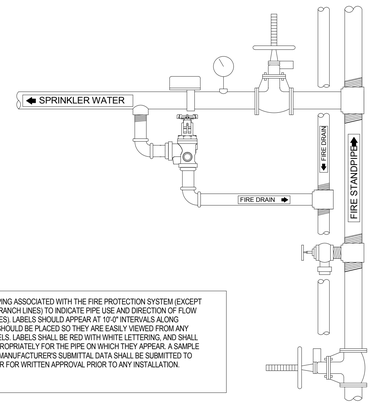
B | FIRE PROTECTION GENERAL NOTES | SCALE: N.T.S.



NOTES:

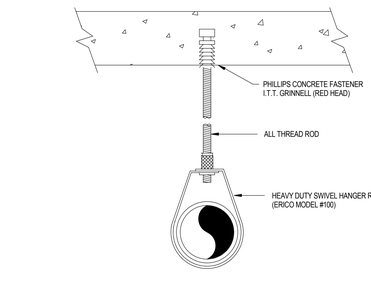
1. OBSTRUCTION FREE CLEAR ZONE SHALL NOT PERMIT ANY EXISTING OBSTRUCTIONS OR NEWLY CONSTRUCTION ELEMENTS TO BE PERMANENTLY FIX TO THE GROUND WITH IN THIS ZONE
2. NO PLANTING OF IN THE OBSTRUCTION FREE CLEAR ZONE

L | PLANTING ADJACENT TO FIRE HYDRANTS & CONNECTIONS | SCALE: N.T.S.



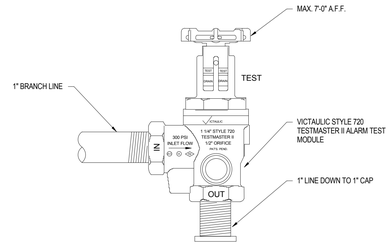
LABEL ALL PIPING ASSOCIATED WITH THE FIRE PROTECTION SYSTEM (EXCEPT SPRINKLER BRANCH LINES) TO INDICATE PIPE USE AND DIRECTION OF FLOW (SEE EXAMPLES). LABELS SHOULD APPEAR AT 15'-0" INTERVALS ALONG PIPING, AND SHOULD BE PLACED SO THEY ARE EASILY VIEWED FROM ANY ACCESS PANELS. LABELS SHALL BE RED WITH WHITE LETTERING, AND SHALL BE SIZED APPROPRIATELY FOR THE PIPE ON WHICH THEY APPEAR. A SAMPLE ALONG WITH MANUFACTURER'S SUBMITTAL DATA SHALL BE SUBMITTED TO THE ENGINEER FOR WRITTEN APPROVAL PRIOR TO ANY INSTALLATION.

H | FIRE PROTECTION SYSTEM LABELING | SCALE: N.T.S.

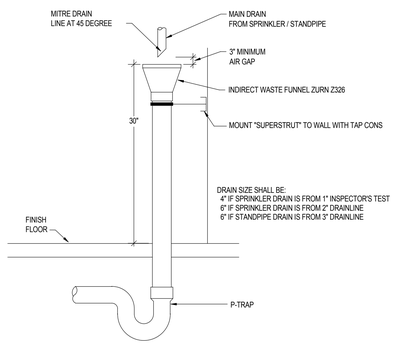


(U.L./F.M. APPROVED)

E | CONCRETE INSERT PIPE HANGER DETAIL | SCALE: N.T.S.

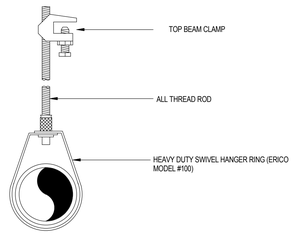


K | NEW INSPECTORS TEST CONNECTION - DRY SYSTEM | SCALE: N.T.S.



FOR REFERENCE ONLY

G | INDIRECT WASTE CONNECTION FOR FIRE PROTECTION DRAIN | SCALE: N.T.S.



A | TOP BEAM CLAMP PIPE HANGEAR DETAIL (U.L./F.M. APPROVED) | SCALE: N.T.S.

ABOVE FINISHED FLOOR	AFF	GALLONS PER MINUTE	GPM
BACK FLOW VALVE	BFV	GROOVED	GRV'D
BELOW FINISHED FLOOR	BFF	NOT IN CONTRACT	NIC
CONTINUATION	CONT.	NOT TO SCALE	NTS
DOWN	DN	OPEN STEM & YOKE	OS&Y
DRAWING	DWG.	POST INDICATOR VALVE	P.I.V.
ELECTRIC	ELEC	POUNDS / SQUARE INCH	PSI
EXISTING	EX.	STANDPIPE	STP
FIRE DEPARTMENT CONNECTION	FDC	UNDERGROUND	UNDG.
FIRE EXTINGUISHER	FE	UNLESS NOTED OTHERWISE	UNO
FIRE VALVE CABINET	FVC	VICTAULIC REDUCING COUPLING	VRC
FLOW SWITCH	FS	EXISTING TO REMAIN	ETR
TAMPER SWITCH	TS		

D | FIRE PROTECTION ABBREVIATIONS | SCALE: N.T.S.

Sheet List 1

Sheet Number	Sheet Name
FP001	FIRE PROTECTION LEGEND
FP002	FIRE PROTECTION DETAILS
FP003	FIRE PROTECTION - ENLARGED ROOMS
FP101	FIRE PROTECTION PLAN - LEVEL 1
FP102	FIRE PROTECTION PLAN - LEVEL 2
FP103	FIRE PROTECTION PLAN - LEVEL 3
FP104	FIRE PROTECTION PLAN - LEVEL 4
FP105	FIRE PROTECTION PLAN - LEVEL 5-15

A | SHEET INDEX | SCALE: N.T.S.

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Revisions

No.	Date	Description
1	6/14/2013	Bulletin #14

Document Phase: CD
Date: 03/29/2016
PIC / AIC: PVK
Drawn By: CMZ
Checked By: MAN
Comm. No.: 11-0033

Project Title

PHASE 1

Package

Bulletin #8
Construction Package #3
Interiors

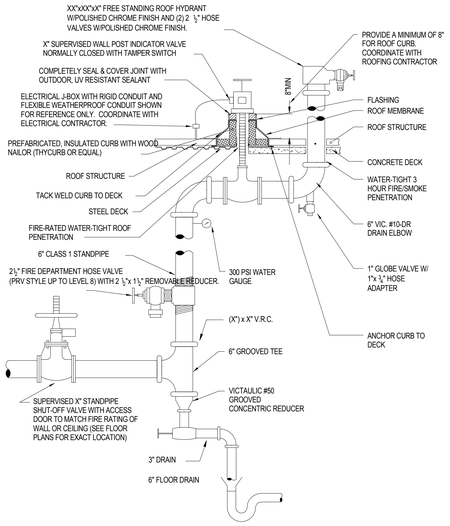
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FIRE PROTECTION LEGEND

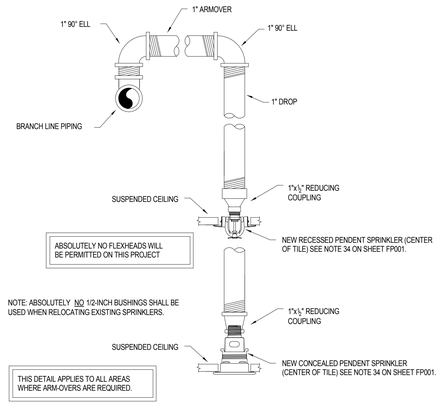
Sheet Number

FP001

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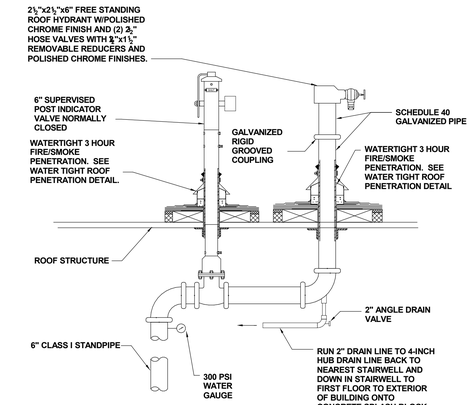


L | STANDPIPE RISER DETAIL | SCALE: N.T.S.

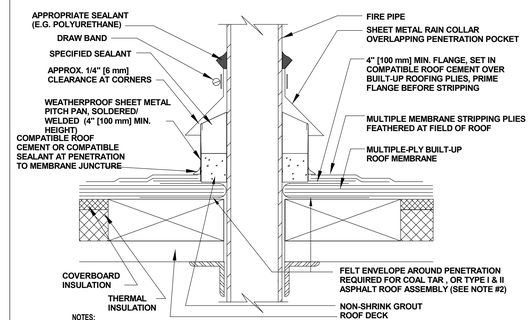


H | NEW TYPICAL SWING JOINT | SCALE: N.T.S.

H | STANDPIPE W/ROOF HYDRANT & DRAIN DETAIL - STAIR A | SCALE: N.T.S.



F | FREE STANDING ROOF HYDRANT & POST INDICATOR | SCALE: N.T.S.



NOTES:
1. PRIOR TO INSTALLATION, SEAL PENETRATION WITH ELASTIC FILL.
2. INSTALL ENVELOPE (BITUMEN-STOP) FOR A CONTINUOUS EDGE SEAL AT THE PERIMETER AND AT PENETRATIONS BY EXTENDING PERFORMANCE PLY, PIKA PLY SS-2, OR TWO PLIES OF NON-PERFORATED ORGANIC ASPHALT SATURATED FELT BEYOND THE EDGE OF THE MEMBRANE FIELD PLIES. AFTER ALL OVERLAPPING FIELD PLIES ARE IN PLACE, THE EXTENDED PLY IS TURNED BACK INTO THE MEMBRANE AND ADHERED. THE ENVELOPE IS INTENDED TO PREVENT BITUMEN SEEPAGE FROM THE EDGE OF THE MEMBRANE.
3. DO NOT USE MODIFIED COAL TAR ON SLOPES THAT EXCEED 1/2" PER FOOT
4. DO NOT USE TYPE I TAR WITH POLYESTER OR TARRED GLASS FELTS ON SLOPES THAT EXCEED 1/4" PER

F | WATER TIGHT ROOF PENETRATION POCKET | SCALE: N.T.S.



1. GYPSUM WALL ASSEMBLY (UL/ULC CLASSIFIED U300 OR U400 SERIES) (1-HR OR 2-HR FIRE-RATING) (2-HR SHOWN).

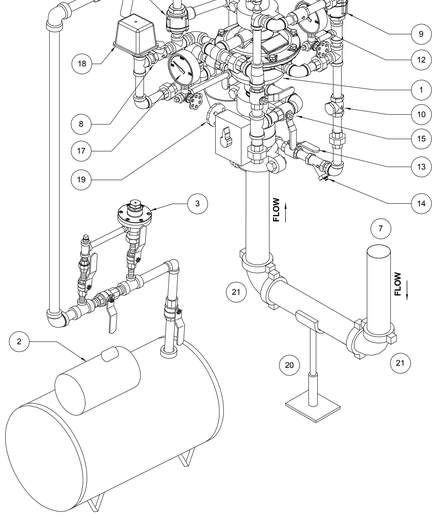
2. PENETRATING ITEM TO BE ONE OF THE FOLLOWING:
A. MAXIMUM 30" NOMINAL DIAMETER STEEL PIPE (SCHEDULE 10 OR HEAVIER).
B. MAXIMUM 30" NOMINAL DIAMETER CAST IRON PIPE.
C. MAXIMUM 6" NOMINAL DIAMETER COPPER PIPE.
D. MAXIMUM 6" NOMINAL DIAMETER STEEL CONDUIT.
E. MAXIMUM 4" NOMINAL DIAMETER EMT.

3. HILTI FS-ONE INTUMESCENT FIRESTOP SEALANT:
A. MINIMUM 5/8" DEPTH, FOR A 1-HR FIRE-RATING.
B. MINIMUM 1-1/4" DEPTH, FOR A 2-HR FIRE-RATING.

4. MINIMUM 1/2" BEAD HILTI FS-ONE INTUMESCENT FIRESTOP SEALANT AT POINT OF CONTACT.

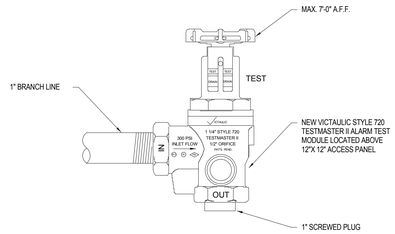
NOTES : 1. MAXIMUM DIAMETER OF OPENING:
A. 32-1/4" FOR STEEL STUD WALLS.
B. 14-1/2" FOR WOOD STUD WALLS.
2. ANNULAR SPACE = MINIMUM 0", MAXIMUM 2-1/4".

E | METAL PIPE THROUGH 1-HR. OR 2-HR GYPSUM WALL ASSEMBLY | SCALE: N.T.S.

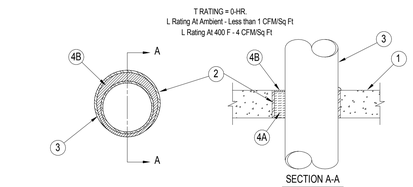


REFERENCE NOTES:
1. DRY PIPE VALVE
2. TANK MOUNTED AIR COMPRESSOR _VAC, _HP, _HZ, SINGLE PHASE
3. AIR MAINTENANCE DEVICE WITH BYPASS TRIM
4. OPTIONAL ACCELERATOR CONNECTION
5. AIR PRESSURE SUPERVISORY SWITCH _V
6. PNEUMATIC OPERATING RELEASE VALVE
7. _" FROM SUPPLY MAIN
8. DRAIN CHECK VALVE
9. A-1 DIFFERENTIAL VALVE
10. SWING CHECK VALVE
11. 300 PSI AIR PRESSURE GAUGE & VALVE
12. 300 PSI PRIME PRESSURE GAUGE & VALVE
13. PRIME VALVE
14. STRAINER
15. FLOW TEST VALVE
16. CHECK VALVE (SOFT SEAT)
17. 300 PSI SUPPLY PRESSURE GAUGE & VALVE
18. WATERFLOW PRESSURE SWITCH _V (CONNECT TO FIRE ALARM SYSTEM)
19. BUTTERFLY VALVE
20. ADJUSTABLE PIPE STAND
21. GROOVED 90° ELL WITH RIGID GROOVED COUPLINGS

A | DRY PIPE RISER DIAGRAM - EMERGENCY ELEC ROOM | SCALE: N.T.S.



K | NEW INSPECTORS TEST CONNECTION - WET SYSTEM | SCALE: N.T.S.



1. FLOOR OR WALL ASSEMBLY - MIN 4-1/2 IN. THICK REINFORCED LIGHTWEIGHT OR NORMAL WEIGHT (100-150 PCF) CONCRETE. WALL MAY ALSO BE CONSTRUCTED OF ANY UL CLASSIFIED CONCRETE BLOCKS. MAX DIA OF OPENING IS 32 IN. SEE CONCRETE BLOCKS (CAZT) CATEGORY IN THE FIRE RESISTANCE DIRECTORY FOR NAMES OF MANUFACTURERS.

2. METALLIC SLEEVE - (OPTIONAL) NOM 32 IN. DIA (OR SMALLER) SCHEDULE 40 (OR HEAVIER) STEEL SLEEVE CAST OR GROUTED INTO FLOOR OR WALL ASSEMBLY, FLUSH WITH FLOOR OR WALL SURFACES.

3. THROUGH PENETRANT - ONE METALLIC PIPE OR CONDUIT TO BE INSTALLED EITHER CONCENTRICALLY OR ECCENTRICALLY WITHIN THE FIRESTOP SYSTEM. THE ANNULAR SPACE BETWEEN PIPE OR CONDUIT AND PERIPHERY OF OPENING SHALL BE MIN 0 IN. (POINT CONTACT) TO MAX 1-7/8 IN. PIPE OR CONDUIT TO BE RIGIDLY SUPPORTED ON BOTH SIDES OF FLOOR OR WALL ASSEMBLY. THE FOLLOWING TYPES AND SIZES OF METALLIC PIPES OR CONDUITS MAY BE USED:
A. STEEL PIPE - NOM 30 IN. DIA (OR SMALLER) SCHEDULE 10 (OR HEAVIER) STEEL PIPE.
B. COPPER PIPE - NOM 6 IN. DIA (OR SMALLER) REGULAR (OR HEAVIER) COPPER PIPE.
C. COPPER TUBING - NOM 6 IN. DIA (OR SMALLER) TYPE L (OR HEAVIER) COPPER TUBING.
D. CONDUIT - NOM 6 IN. DIA (OR SMALLER) STEEL CONDUIT. E. CONDUIT - NOM 4 IN. DIA (OR SMALLER) STEEL ELECTRICAL METALLIC TUBING (EMT).

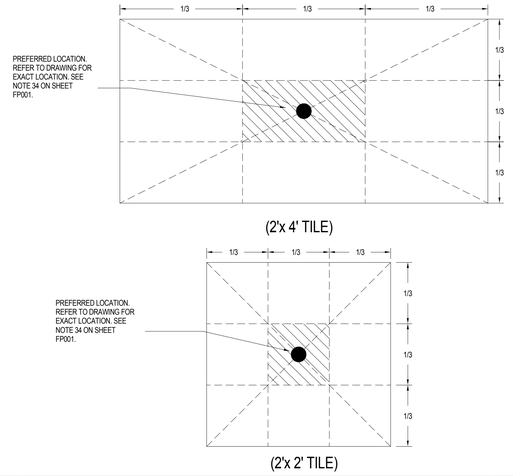
4. FIRESTOP SYSTEM - THE FIRESTOP SYSTEM SHALL CONSIST OF THE FOLLOWING:
A. PACKING MATERIAL - MIN 4 IN. THICKNESS OF MIN 4 PCF MINERAL WOOL BATT. INSULATION FIRMLY PACKED INTO OPENING AS A PERMANENT FORM. PACKING MATERIAL TO BE RECESSED FROM TOP SURFACE OF FLOOR OR FROM BOTH SURFACES OF WALL AS REQUIRED TO ACCOMMODATE THE REQUIRED THICKNESS OF FILL MATERIAL.

B. FILL, VOID OR CAVITY MATERIAL - SEALANT - MIN 1/4 IN. THICKNESS OF FILL MATERIAL APPLIED WITHIN THE ANNULUS, FLUSH WITH TOP SURFACE OF FLOOR OR WITH BOTH SURFACES OF WALL, AT THE POINT CONTACT LOCATION BETWEEN PIPE AND CONCRETE. A MIN 1/4 IN. DIA BEAD OF FILL MATERIAL SHALL BE APPLIED AT THE CONCRETE/PIPE INTERFACE ON THE TOP SURFACE OF FLOOR AND ON BOTH SURFACES OF WALL.

HILTI, INC. - FS-ONE SEALANT

BEARING THE UL CLASSIFICATION MARKING

G | PIPE THRU A SLEEVE IN CONCRETE FLOOR/WALL OR BLOCK WALL | SCALE: N.T.S.



D | TYPICAL CENTER OF TILE | SCALE: N.T.S.

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Revisions

No.	Date	Description

Document Phase:	CD
Date:	03/29/2016
PIC / AIC:	PVK
Drawn By:	CMZ
Checked By:	MAN
Comm. No.:	11-0033

Project Title

PHASE 1

Package

Bulletin #14
Construction Package #3
Interiors

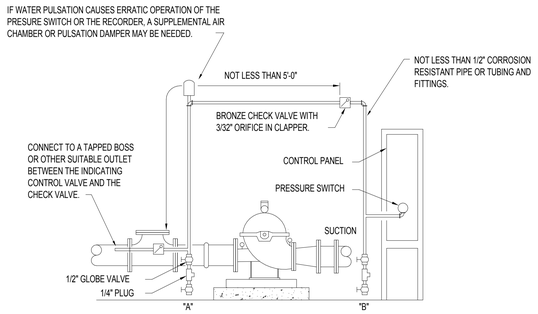
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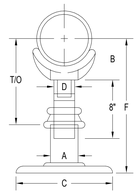
FIRE PROTECTION DETAILS

Sheet Number

FP002

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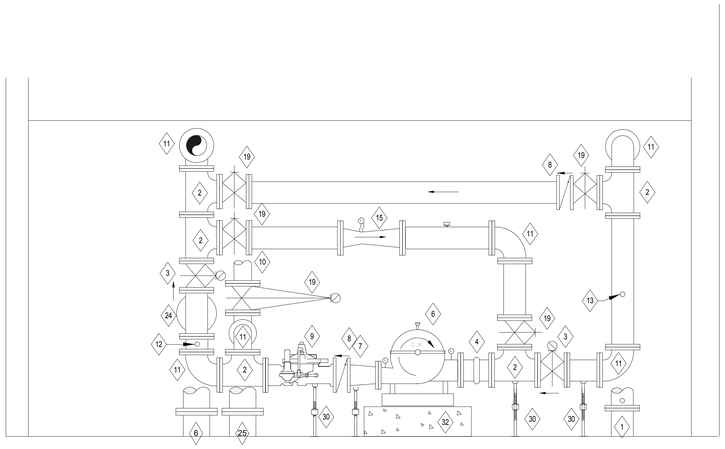




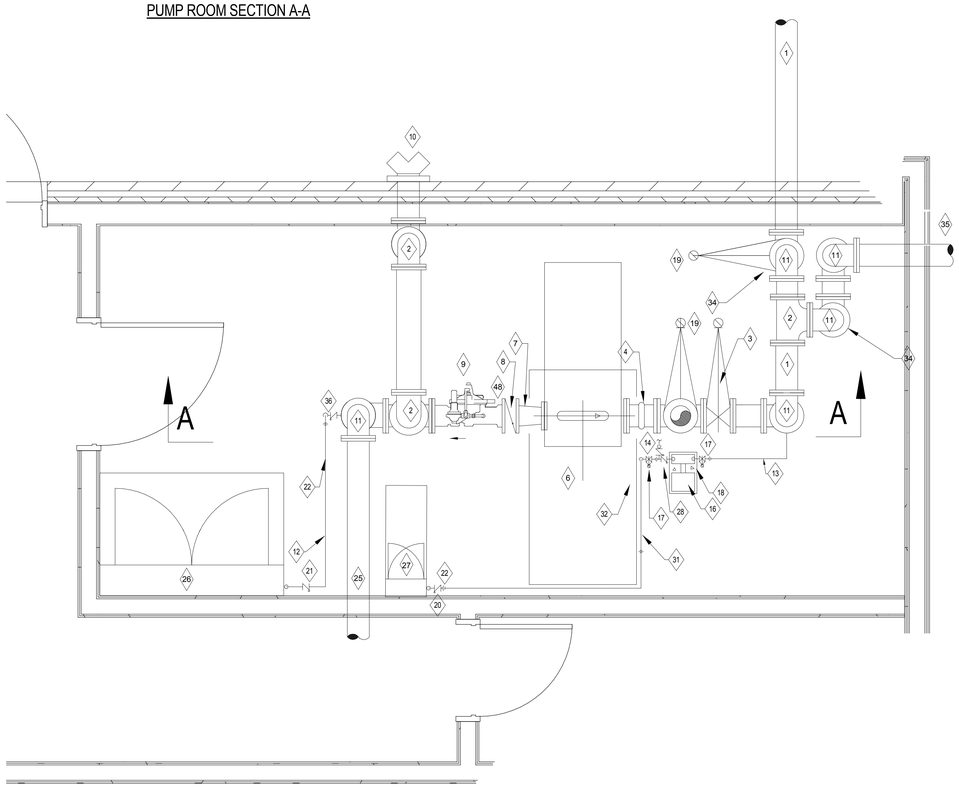
PIPE SIZE	DIMENSIONS IN INCHES										
	A	C	D MIN.	T/O	A	B	C	D	F MIN.	T/O DIM. T/O	T/O DIM. ADJ. ±
2 1/2	NOT AVAILABLE					3 1/2			11 1/2	8 1/4	
3	FOR PIPE SIZES				2 1/2	3 3/4		1 1/2	11 3/4	8 1/2	2 3/4
3 1/2	SMALLER THAN 4"					4			12	8 3/4	
4	3	9	7 1/4	4 1/4	3	4 1/4	9	2 1/2	12 1/4	8 3/4	2 1/2
5			7 7/8	4 7/8		4 7/8			12 7/8	9 3/8	
6			8 1/2	5 1/2		5 1/2			13 1/2	10	
8			9 7/8	6 7/8		6 7/8			14 7/8	11 3/8	
10			11 1/2	8 1/2		8 1/2			16 1/2	13	
12			13	10		10			18	14 1/2	

FIRE PUMP LEGEND EXTRA HEAVY RATED

1. 8" FIRE PUMP SUCTION MAIN
2. 8" FLGD. TEE (CLASS 250xH)
3. 8" FLGD O.S.&Y WITH TAMPER SWITCH (CLASS 250)NORMALLY OPEN
4. 8" FLGD FLEXIBLE SPOOL PIECE
5. 300 P.S.I. WATER GAUGE (xH)
6. 6"x 6" ELECTRIC FIRE PUMP PATTERSON DMD (xH) 160 P.S.I. @ 1000 G.P.M. 125 H.P. , 1800 R.P.M. , 460V 3-PHASE (250 xH)
7. 4"x 8" FLGD. CONCENTRIC INCREASER
8. 8" SPRING LOADED WAFER CHECK VALVE (CLASS 250)
9. 8" FLGD FIRE PUMP SUCTION CONTROL VALVE CLA-VAL # 50B-5KG (ONLY)(CLASS 300)
10. 8" OUT TO WALL MOUNTED FIRE PUMP TEST HEADER. SEE SHEET FP101 FOR LOCATION
11. 8" FLGD. ELL (CLASS 250xH)
12. 1/2" FIRE PUMP TEST SENSING LINE (xH)
13. JOCKEY PUMP SUCTION LINE (xH)
14. JOCKEY PUMP DISCHARGE LINE (xH)
15. 8" FLGD FLOW METER xH(GERAND ONLY) (CLASS 250)
16. JOCKEY PUMP 255 P.S.I. @ 12 G.P.M. GRUNDFROS ONLY #CRN1-21 460V AC 5 H.P. 3 PHASE (xH)
17. JOCKEY PUMP SUCTION AND DISCHARGE GATE VALVE W/T SWITCH (CLASS 250)
18. CONCRETE PAD FOR JOCKEY PUMP
19. 8" O.S.&Y. GATE VALVE NORMALLY CLOSED WITH TAMPER SWITCH , CHAIN & LOCK CLOSED(CLASS 250)
20. 1/2" JOCKEY PUMP TEST SENSING LINE CHECK VALVE (CLASS 250)
21. 1/2" FIRE PUMP TEST SENSING LINE CHECK VALVE (CLASS 250)
22. 1/2" GROUND JOINT UNION
23. 8" FLOW SWITCH (xH)
25. 8" OUT TO STANDPIPE/SPRINKLER SYSTEM
26. ELECTRICAL FIRE PUMP CONTROLLER REDUCED VOLTAGE SOLID STATE SOFT START WITH AUTOMATIC TRANSFER SWITCH
27. JOCKEY PUMP CONTROLLER
28. JOCKEY PUMP DISCHARGE CHECK VALVE (CLASS 250)
29. AIR VENT
30. ADJUSTABLE PIPE STAND
31. 1/2" JOCKEY PUMP TEST SENSING LINE (xH)
32. CONCRETE PAD FOR FIRE PUMP
33. 6" FLGD. ELL (CLASS 250xH)
34. 8" BACK FLOW PREVENTOR IN VERTICAL
35. 8" O/W PIPING FROM PLUMBING CONTRACTOR, SEE PLUMBING DRAWINGS FOR CONTINUATION



PUMP ROOM SECTION A-A



Enlarged Fire Pump
1/2" = 1'-0"

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Revisions

No.	Date	Description

Document Phase:	CD
Date:	03/29/2016
PIC / AIC:	PVK
Drawn By:	CMZ
Checked By:	MAN
Comm. No.:	11-0033

Project Title

PHASE 1

Package

Bulletin #14
Construction Package #3
Interiors

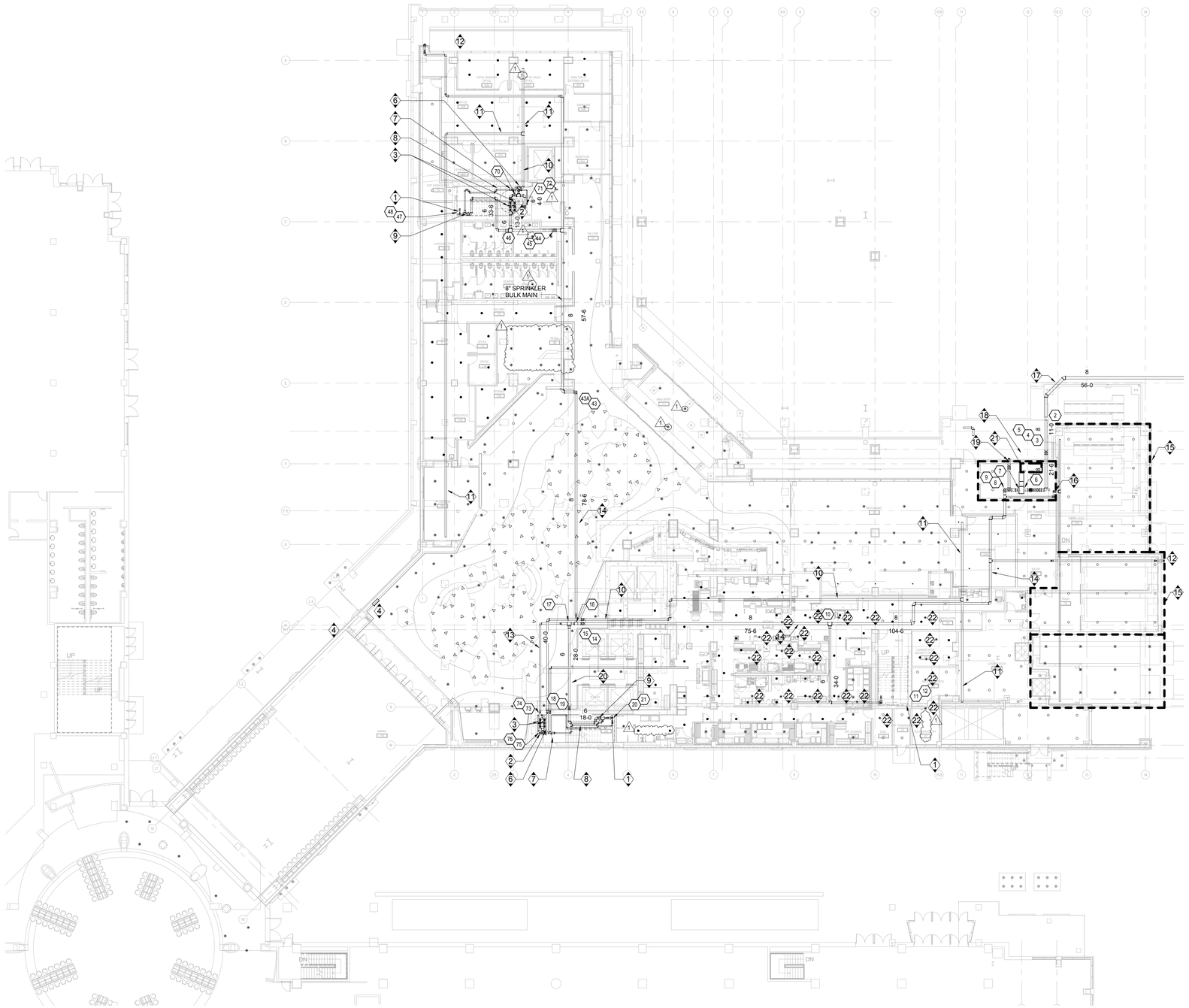
Sheet Title

FIRE PROTECTION - ENLARGED ROOMS

Sheet Number

FP003

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1 Level 1 - Fire Protection(Overall)
1/16" = 1'-0"

N

GENERAL NOTES:

1. SPRINKLER LOCATIONS ARE OF HIGH AESTHETIC IMPORTANCE. ANY DEVIATION FROM SPRINKLER LOCATION FROM THAT SHOWN IN PUBLIC SPACE SHALL BE APPROVED BY ENGINEER

REFERENCE NOTES:

1. 6" STANDPIPE UP WITH 2-1/2" PRESSURE REGULATING HOSE VALVE (PRESSURE REGULATING HOSE VALVE TYPE ONLY USED FOR LEVELS 1 TO 8) AND 3" DRAIN RISER (DRAIN RISER IS ON LEVELS 1 TO 8)
2. 6" SPRINKLER RISER UP AND 2" MAIN DRAIN RISER
3. 6" REDUNDANT PRESSURE REDUCING VALVES SET TO 165 PSI WITH BUTTERFLY ISOLATION VALVES
4. FIRE RATED FIRE VALVE CABINET WITH 2-1/2" HOSE VALVE SERVING HORIZONTAL EXIT
5. IDF ROOM SHALL BE PROTECTED BY NOVEC 1230 CLEAN AGENT FIRE SUPPRESSION SYSTEM
6. 6" SPRINKLER CONTROL VALVE ASSEMBLY
7. 3" BUTTERFLY VALVE AND 3" CHECK VALVE
8. 3" PRV TEST LINE
9. 6" BUTTERFLY VALVE
10. 6" SPRINKLER CROSS MAIN
11. 4" SPRINKLER CROSS MAIN
12. 2-1/2" x 2-1/2" x 6" WALL MOUNTED FIRE DEPARTMENT CONNECTION
13. 6" SPRINKLER BULK MAIN
14. 10" SPRINKLER BULK MAIN
15. GENERATOR ROOM SHALL BE PROTECTED BY 2% HIGH EXPANSION FOAM SYSTEM
16. 4" DRY SPRINKLER RISER ASSEMBLY SERVING TRASH ROOM AND LOADING DOCK
17. 10" UNDERGROUND FIRE PUMP SUPPLY LINE
18. SEE SHEET FP400 FOR ENLARGED FIRE PUMP ROOM
19. 2-1/2" x 2-1/2" x 2-1/2" x 8" WALL MOUNTED FIRE PUMP TEST HEADER
20. 6" SPRINKLER BULK MAIN
21. HIGH EXPANSION FOAM GENERATOR WITH 50 GALLON VERTICAL BLADDER TANK SERVING EMERG. ELEC 133A
22. SPRINKLER TO BE INSTALLED WITHIN GREASE DUCT

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Revisions

No.	Date	Description
1	7/02/2013	Bulletin #16

Document Phase:	CD
Date:	03/29/2016
PIC / AIC:	PVK
Drawn By:	MGU
Checked By:	CMZ
Comm. No.:	11-0033

Project Title

PHASE 1

KEYPLAN

Package

Bulletin #14
Construction Package #3
Interiors

Sheet Title

FIRE PROTECTION
PLAN - LEVEL 1

Sheet Number

FP101

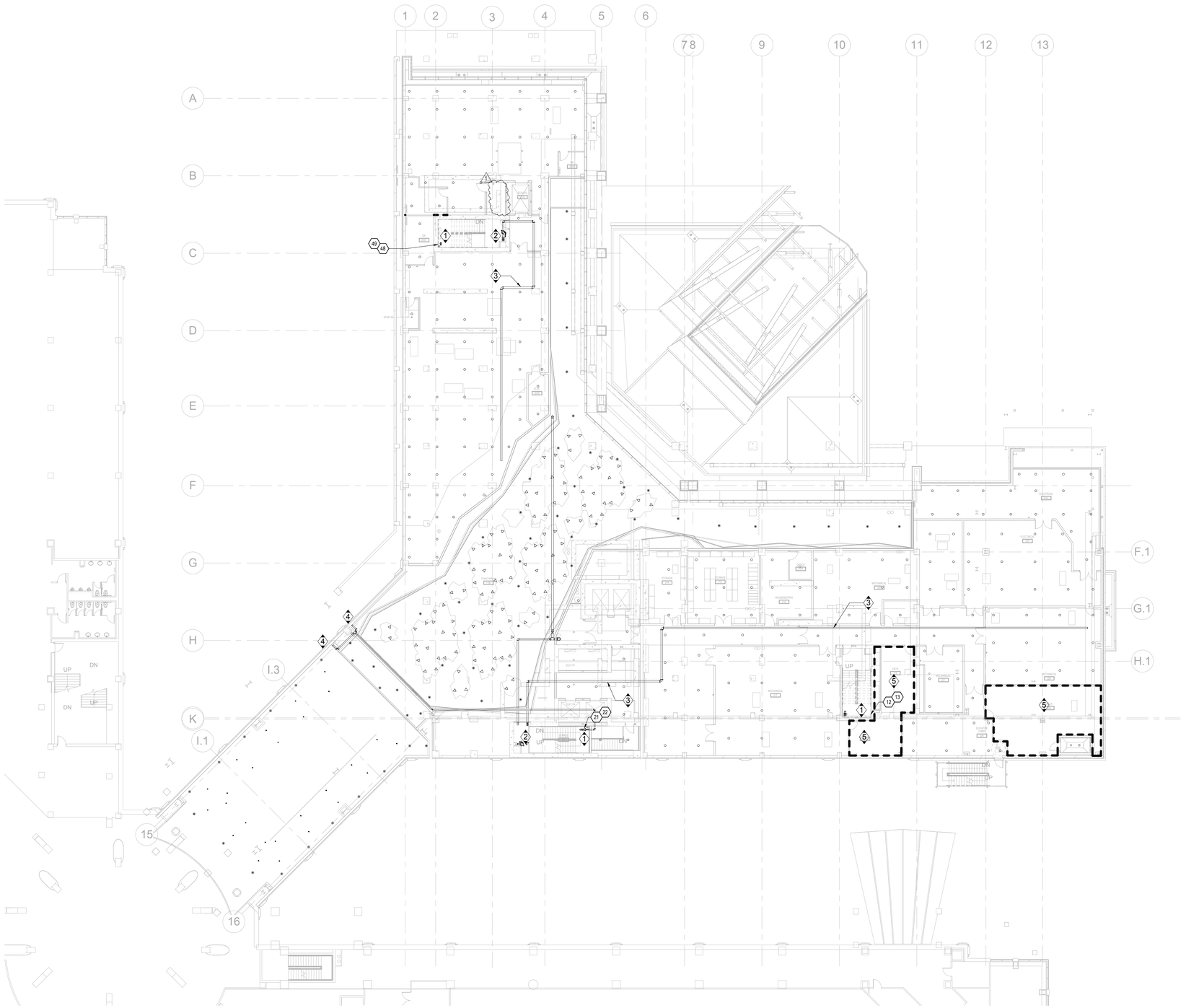
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GENERAL NOTES:

1. SPRINKLER LOCATIONS ARE OF HIGH AESTHETIC IMPORTANCE. ANY DEVIATION FROM SPRINKLER LOCATION FROM THAT SHOWN IN PUBLIC SPACE SHALL BE APPROVED BY ENGINEER

REFERENCE NOTES:

1. 6" STANDPIPE UP WITH 2-1/2" PRESSURE REGULATING HOSE VALVE (PRESSURE REGULATING HOSE VALVE TYPE ONLY USED FOR LEVELS 1 TO 8) AND 3" DRAIN RISER (DRAIN RISER IS ON LEVELS 1 TO 8)
2. 6" SPRINKLER RISER UP AND 2" MAIN DRAIN RISER
3. 6" SPRINKLER CROSS MAIN
4. FIRE RATED FIRE VALVE CABINET WITH 2-1/2" HOSE VALVE SERVING HORIZONTAL EXIT
5. IDF ROOM SHALL BE PROTECTED BY NOVEC 1230 CLEAN AGENT FIRE SUPPRESSION SYSTEM



1 Level 2 - Mezzanine - Fire Protection(Overall)
1/16" = 1'-0"

N

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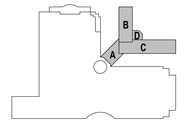
Revisions

No.	Date	Description
1	7/02/2013	Bulletin #16

Document Phase:	CD
Date:	03/29/2016
PIC / AIC:	PVK
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Comm. No.:	11-0033

Project Title

PHASE 1



KEYPLAN

Package

Bulletin #14
Construction Package #3
Interiors

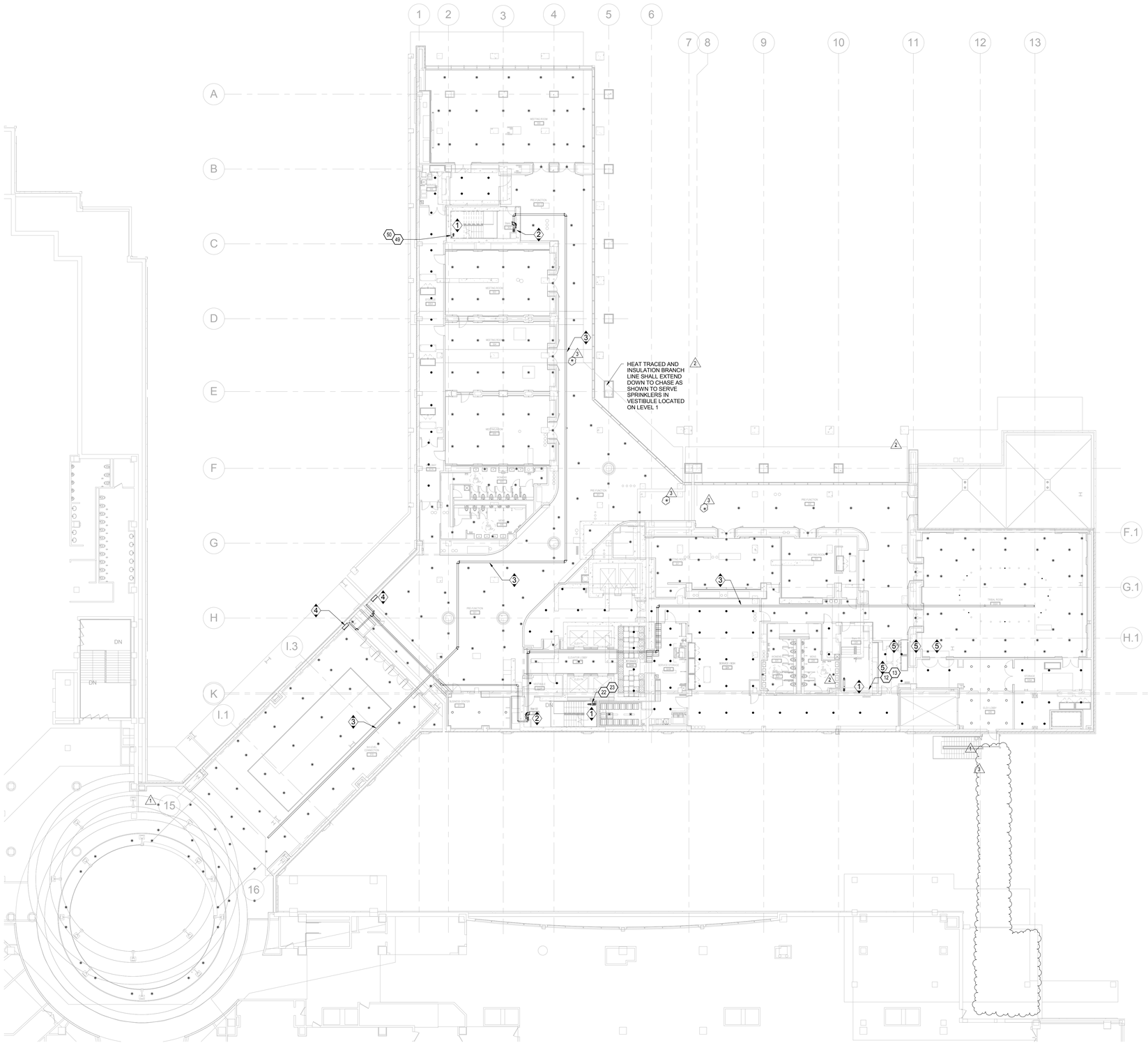
Sheet Title

FIRE PROTECTION
PLAN - LEVEL 2

Sheet Number

FP102

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1 Level 3 Meeting - Fire Protection(Overall)
1/16" = 1'-0"

GENERAL NOTES:

1. SPRINKLER LOCATIONS ARE OF HIGH AESTHETIC IMPORTANCE. ANY DEVIATION FROM SPRINKLER LOCATION FROM THAT SHOWN IN PUBLIC SPACE SHALL BE APPROVED BY ENGINEER

REFERENCE NOTES:

1. 6" STANDPIPE UP WITH 2-1/2" PRESSURE REGULATING HOSE VALVE (PRESSURE REGULATING HOSE VALVE TYPE ONLY USED FOR LEVELS 1 TO 8) AND 3" DRAIN RISER (DRAIN RISER IS ON LEVELS 1 TO 8)
2. 6" SPRINKLER RISER UP AND 2" MAIN DRAIN RISER
3. 6" SPRINKLER CROSS MAIN
4. FIRE RATED FIRE VALVE CABINET WITH 2-1/2" HOSE VALVE SERVING HORIZONTAL EXIT
5. SPRINKLER TO BE INSTALLED WITHIN GREASE DUCT

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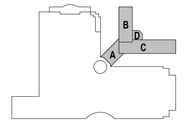
Revisions

No.	Date	Description
1	3/18/2013	Bulletin #10
2	6/14/2013	Bulletin #14
3	7/02/2013	Bulletin #16

Document Phase:	CD
Date:	03/29/2016
PIC / AIC:	PVK
Drawn By:	MGU
Checked By:	CMZ
Comm. No.:	11-0033

Project Title

PHASE 1



KEYPLAN

Package

Bulletin #8
Construction Package #3
Interiors

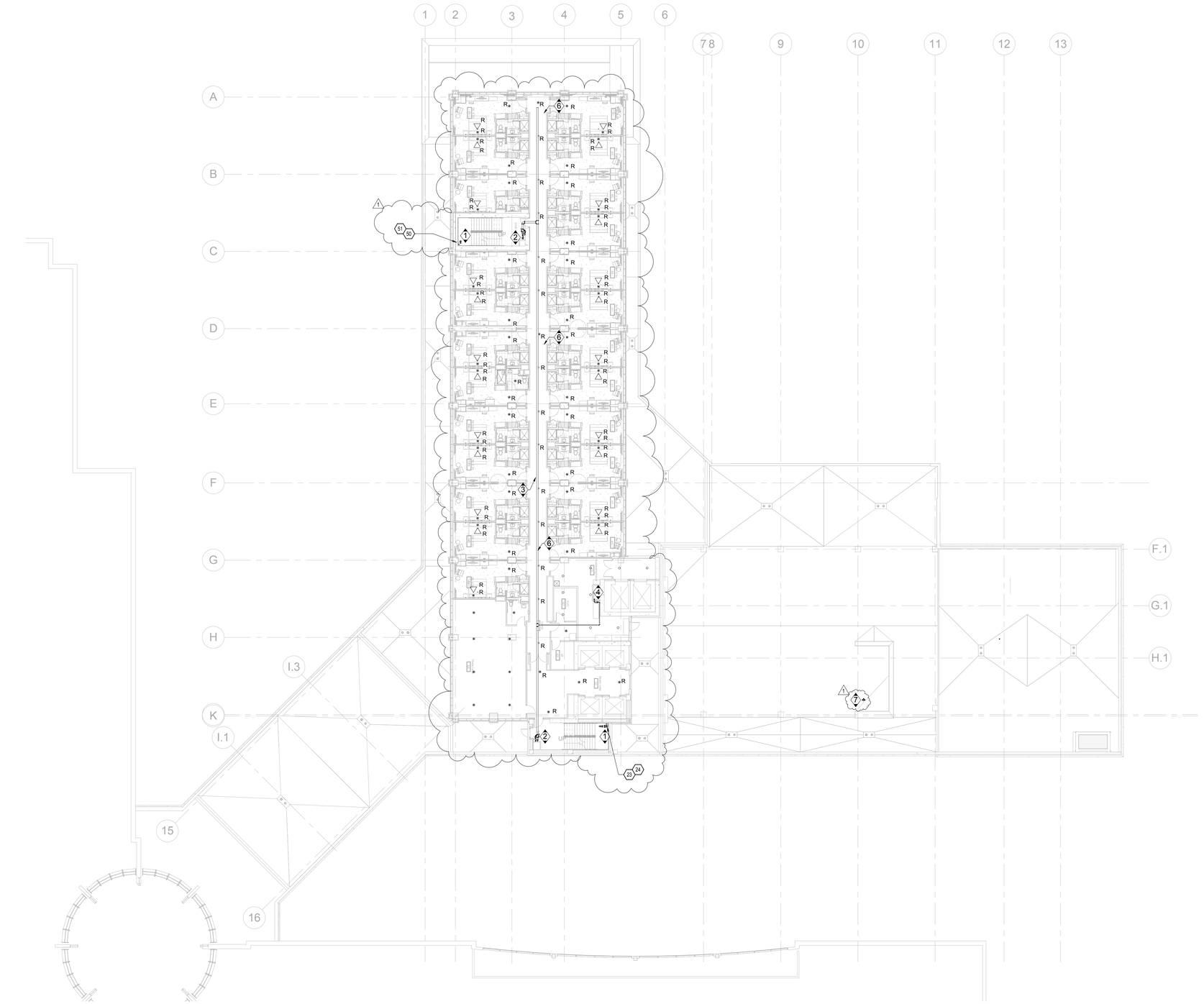
Sheet Title

FIRE PROTECTION
PLAN - LEVEL 3

Sheet Number

FP103

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1 Level 4 SPA - Fire Protection(Overall)
1/16" = 1'-0"

N

GENERAL NOTES:

1. SPRINKLER LOCATIONS ARE OF HIGH AESTHETIC IMPORTANCE. ANY DEVIATION FROM SPRINKLER LOCATION FROM THAT SHOWN IN PUBLIC SPACE SHALL BE APPROVED BY ENGINEER

REFERENCE NOTES:

1. 6" STANDPIPE UP WITH 2-1/2" PRESSURE REGULATING HOSE VALVE (PRESSURE REGULATING HOSE VALVE TYPE ONLY USED FOR LEVELS 1 TO 8) AND 3" DRAIN RISER (DRAIN RISER IS ON LEVELS 1 TO 8)
2. 6" SPRINKLER RISER AND 2" MAIN DRAIN RISER
3. 2" SPRINKLER CROSS MAIN
4. TRASH CHUTE SPRINKLER RISER WITH TAMPERED CONTROL VALVE
5. NEW 3" DRY SPRINKLER RISER
6. NEW 3" DRY SPRINKLER MAIN
7. NEW 2 1/2" X 2 1/2" X 2 1/2" X 6" FREE STANDING ROOF MOUNTED FIRE DEPARTMENT CONNECTION WITH 6" ROOF PIV NORMALLY CLOSED.

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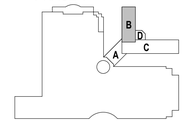
Revisions

No.	Date	Description
1	6/14/2013	Bulletin #14

Document Phase:	CD
Date:	03/29/2016
PIC / AIC:	PVK
Drawn By:	CMZ
Checked By:	MAN
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Project Title

PHASE 1



KEYPLAN

Package

Bulletin #8
Construction Package #3
Interiors

Sheet Title

FIRE PROTECTION
PLAN - LEVEL 4

Sheet Number

FP104

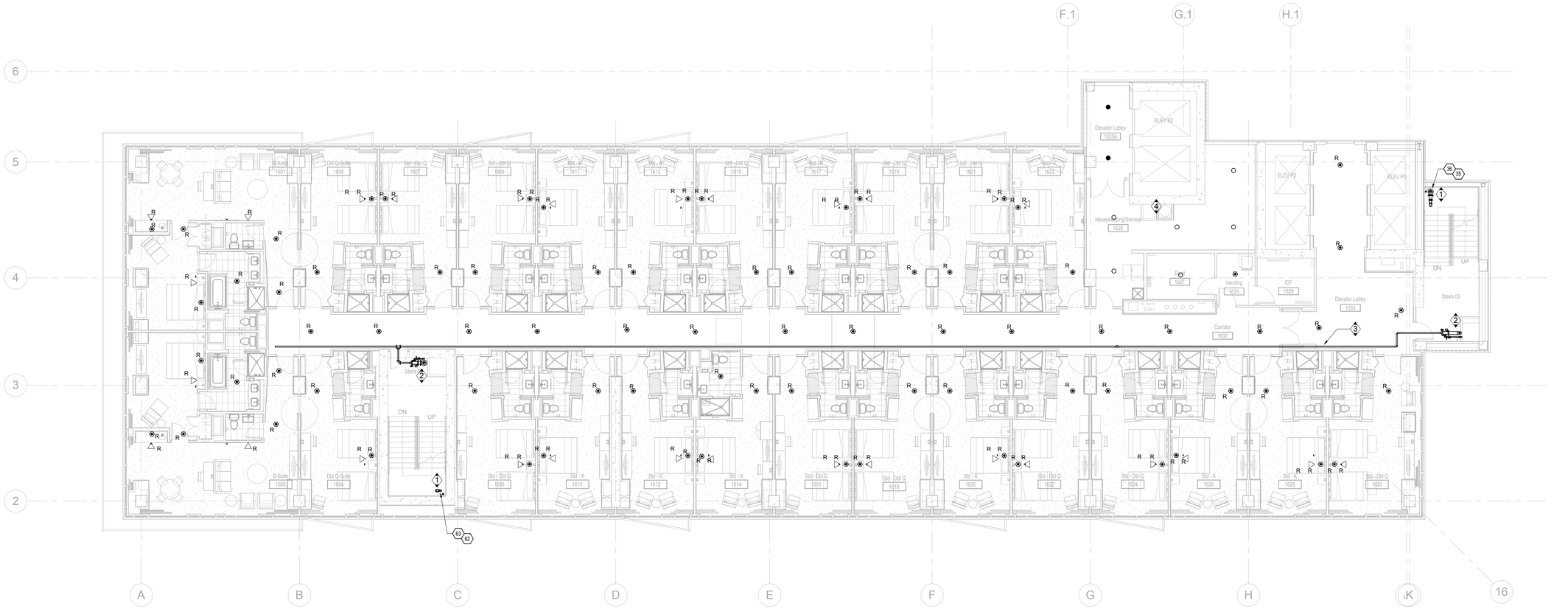
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GENERAL NOTES:

1. SPRINKLER LOCATIONS ARE OF HIGH AESTHETIC IMPORTANCE. ANY DEVIATION FROM SPRINKLER LOCATION FROM THAT SHOWN IN PUBLIC SPACE SHALL BE APPROVED BY ENGINEER

REFERENCE NOTES:

1. 6" STANDPIPE WITH 2-1/2" HOSE VALVE
2. 6" SPRINKLER RISER AND 2" MAIN DRAIN RISER
3. 1 1/2" SPRINKLER CROSS MAIN
4. TRASH CHUTE SPRINKLER RISER



1 Fire Protection Plan - Level 16
1/8" = 1'-0"

N

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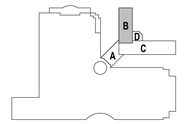
Revisions

No.	Date	Description

Document Phase:	CD
Date:	03/29/2016
PIC / AIC:	PVK
Drawn By:	MGU
Checked By:	CMZ
Comm. No.:	11-0033

Project Title

PHASE 1



KEYPLAN

Package

Bulletin #14
Construction Package #3
Interiors

Sheet Title

FIRE PROTECTION
PLAN - LEVELS 5-15

Sheet Number

FP105

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Date: JAN. 10, 1997
PACKAGE "C.2"

Revision No.:

1 DCVR #163
JUNE 5, 1997

2 DCVR #1110
AUG. 27, 1998

3 PROP. REQ. #28
NOV. 5, 1998

4 RECORD DRAWING
MAR. 29, 1999

EFK MOB AND PARKING STRUCTURE



PARKING

TOTAL :128 SPACES

LEGEND:

- CONCRETE WALL
- C.M.U. WALL
- EXTERIOR FINISH OVER MTL. STUD BACK-UP
- LOUVER
- INTERIOR PARTITION PER PARTITION TYPES (SEE ENLARGED PLANS AND A 9.1)
- PLANTED
- TRAFFIC PATTERN MARKINGS (YELLOW)

North

0 2 8 16 32 48

RECORD DRAWINGS AS REPORTED

These record drawings have been prepared, in part, on the basis of information compiled and furnished by others. The Architect has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result.

Drawing:
FLOOR PLAN
PARKING
LEVEL – P3

Job. No. 8019-01

Sheet:
A2.1

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Date: JAN. 10, 1997
PACKAGE "C.2"

Revision No.:
1 DCVR #?? FEB. 11, 1997
2 PROP. REQ. #15 MAR. 5, 1998
3 DCVR #1110 AUG. 27, 1998
4 PROP. REQ. #28 NOV. 5, 1998
TRAFFIC PATTERN MARKINGS
5 RECORD DRAWING MAR. 29, 1999

EFK MOB AND PARKING STRUCTURE



RECORD DRAWINGS AS REPORTED

These record drawings have been prepared, in part, on the basis of information compiled and furnished by others. The Architect has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result.

PARKING

TOTAL : 226 SPACES

LEGEND:

- CONCRETE WALL
- C.M.U. WALL
- EXTERIOR FINISH OVER MTL. STUD BACK-UP
- LOUVER
- INTERIOR PARTITION PER PARTITION TYPES (SEE ENLARGED PLANS AND A 9.1)
- PLANTED
- TRAFFIC PATTERN MARKINGS – (YELLOW)

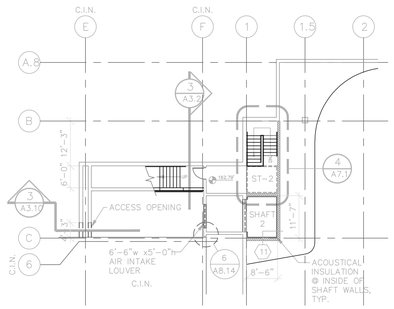
North

0 2 8 16 32 48

Drawing:
FLOOR PLAN
PARKING
LEVEL – P2

Job. No. 8019-01

Sheet:
A2.2



1 STAIR ST-2 EGRESS LEVEL FLOOR PLAN
SCALE: 1/16" = 1'-0"

NORTH

CIN LEVEL LL
F.F. 158.00'

CIN LEVEL II
F.F. 159.19'

WORK EAST OF E.I.N. WEST WALL N.I.C.- COORDINATE WITH WORK ADDRESSED UNDER SEPARATE PACKAGE

WORK SHOWN HERE TO BE ISSUED UNDER SEPARATE PACKAGE

E.I.N. STAFF LOUNGE

PLANTED TERRACE

LINE OF VALLEY AT TAPERED ROOF INSULATION

ROOF DRAIN SEE PLUMBING

PLANTER DRAIN SEE PLUMBING

FOUNDATION DRAINAGE PIPE (4" DIA. TYP.) CONNECTED TO FOUNDATION DRAINAGE PIPE AT CO. LINE B, P3 LEVEL

SLOPE DOWN FROM 158.50'

SLOPE DOWN FROM ABOVE

TRENCH DRAIN

TYP. PARKING SPACE (263 SF)

COMPACT PARKING SPACES

ACOUSTICAL INSULATION AT INSIDE OF SHAFT WALLS (TYP.)

STOP

1'x8" YELLOW STRIPING, TYP.

PIPE ELEV. OBBY

P101

P101A

HC VAN

SLOPE DOWN FROM 155.00'

6" YELLOW STRIPING, TYP.

4" YELLOW STRIPING, TYP.

SLOPE UP FROM 154.50' (@ CO. LINE G)

6" CURB

INSTALL BIKE RACKS PER OWNERS INSTRUCTIONS

TOP OF ACOUSTIC BAFFLE - SEE 1/A3.12

6" CURB ALIGN W/ EDGE OF EXISTING STRIPING

T.O. PLANTER WALL EL. 158.50'

STRUCTURAL FILL SUPPORTING REAL G. (SEE STRUCTURAL DWGS)

EXISTING - REF.: PR-07 (RE-PAINT THESE IN YELLOW)

N. INTERSTATE AVE.

RECORD DRAWINGS AS REPORTED

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PARKING

TOTAL :151 SPACES

14 HANDICAP SPACES

LEGEND:

- CONCRETE WALL
- C.M.U. WALL
- EXTERIOR FINISH OVER MTL. STUD BACK-UP
- LOUVER
- INTERIOR PARTITION PER PARTITION TYPES (SEE ENLARGED PLANS AND A 9.1)
- PLANTED
- TRAFFIC PATTERN MARKINGS (YELLOW)

North

0 2 8 16 32 48

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Date: JAN. 10, 1997
PACKAGE "C.2"

Revision No.:

1 DCVR #?? MAR. 4, 1997
2 PROP. REQ. #12 JAN. 16, 1998
3 PROP. REQ. #19 APR. 10, 1998
4 DCVR #1110 AUG. 27, 1998
5 PROP. REQ. #28 NOV. 5, 1998
TRAFFIC PATTERN MARKINGS
6 RECORD DRAWING MAR. 29, 1999

EFK MOB AND PARKING STRUCTURE

Drawing:
FLOOR PLAN
PARKING
LEVEL - P1

Job. No. 8019-01

Sheet:
A2.3

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Date: JAN. 10, 1997
PACKAGE "C.2"

Revision No.:

1 PROP. REQ. #4
MAY 29, 1997

2 PROP. REQ. #19
APR. 10, 1998

3 RECORD DRAWING
MAR. 29, 1999

EFK MOB AND PARKING STRUCTURE

EIN LEVEL 1
F.F. 172.33'

CIN LEVEL 1
F.F. 171.00'

N. KAISER CTR. DR.

PROPOSED EXIT CANOPY

WORK EAST OF E.I.N. WEST WALL N.I.C.- COORDINATE WITH WORK ADDRESSED UNDER SEPARATE PACKAGE

PEDESTRIAN LINK 1022

ENTRY 1021

PLAZA

CONCOURSE

N. ENTRY VESTIBULE 1001

ELEV. LOBBY

EMERGENCY VEHICLE ENTRANCE

TRENCH DRAIN

4% RAMP

SLOPE 12.5%

SLOPE 7.8%

SLOPE 8.0%

SLOPE 9.0 %

1.74% SLOPE

2.74% SLOPE

PLANTER DRAINS SEE PLUMBING

PROVIDE EMBED CENTERED ON T.S., TYP. SEE 20/A9.3

ENTRY VEST 1301

1321C

MENS 1011

WOMENS 1014

BDF 1007

JAN 1009

ELEC 1227

IDF 1013

ELEC 1301

NOTES:
1. ALL SPOT ELEVATIONS ALONG EMERGENCY VEHICLE RAMP AND ENTRANCE DRIVE ARE TO TOP OF DRIVE WAY.

RECORD DRAWINGS AS REPORTED

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PARKING

TOTAL :11 SPACES

2 HANDICAP SPACE

LEGEND:

- CONCRETE WALL
- C.M.U. WALL
- EXTERIOR FINISH OVER MTL. STUD BACK-UP
- LOUVER
- INTERIOR PARTITION PER PARTITION TYPES (SEE ENLARGED PLANS AND A 9.1)
- PLANTED

North

0 2 8 16 32 48

Drawing:
FLOOR PLAN
LEVEL L1
(PLAZA)

Job. No. 8019-01

Sheet:
A2.4

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Architects

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Portland, Oregon
503/223-4886

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Date: JAN. 10, 1997
PACKAGE "C.2"

Revision No.:
1 PROP. REQ. #4
MAY 29, 1997
2 DCVR #699
APR. 3, 1998
3 RECORD DRAWING
MAR. __, 1999

EFK MOB AND PARKING STRUCTURE

EIN LEVEL 2
F.F. 185.92'

CIN LEVEL 2
F.F. 184.00'

CONCOURSE

ROOF

ELEV. LOBBY

MENS

WOMENS

ELEC.

OPEN TO BELOW

ROOF & OVER-FLOW DRAIN - SEE PLUMB.

ROOF DRAIN (TYP.)

ROOF & OVER-FLOW DRAIN (TYP.) - SEE PLUMBING

SCUPPER @ ENTRY ROOF

EQ. SPACES (TYP.)

17 EQ. SPACES

TYPICAL

SIM.

RECORD DRAWINGS AS REPORTED

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LEGEND:

- CONCRETE WALL
- C.M.U. WALL
- EXTERIOR FINISH OVER MTL. STUD BACK-UP
- LOUVER
- INTERIOR PARTITION PER PARTITION TYPES (SEE ENLARGED PLANS AND A 9.1)
- PLANTED

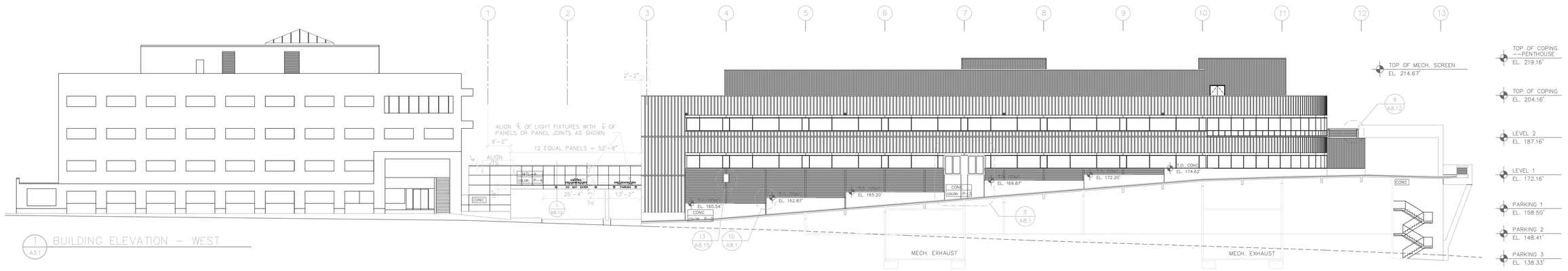
North

0 2 8 16 32 48

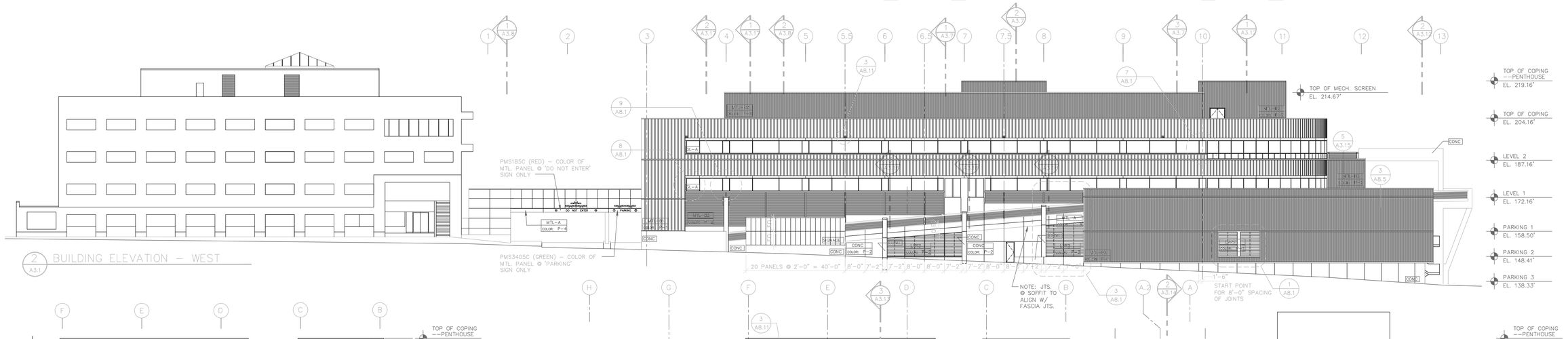
Drawing:
FLOOR PLAN
LEVEL L2

Job. No. 8019-01

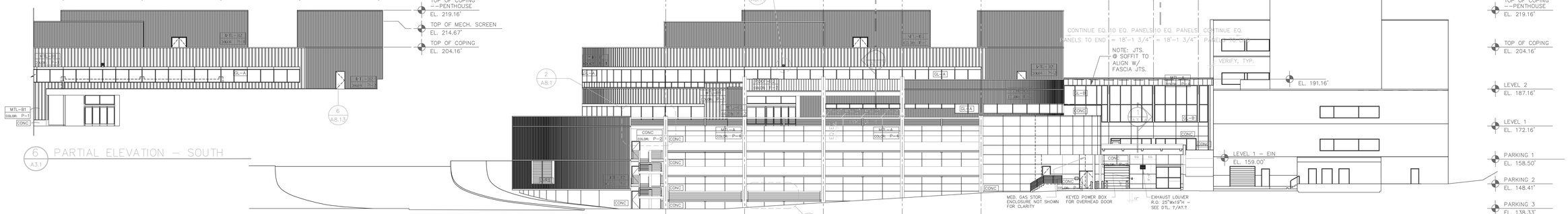
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1 A3.1 BUILDING ELEVATION — WEST

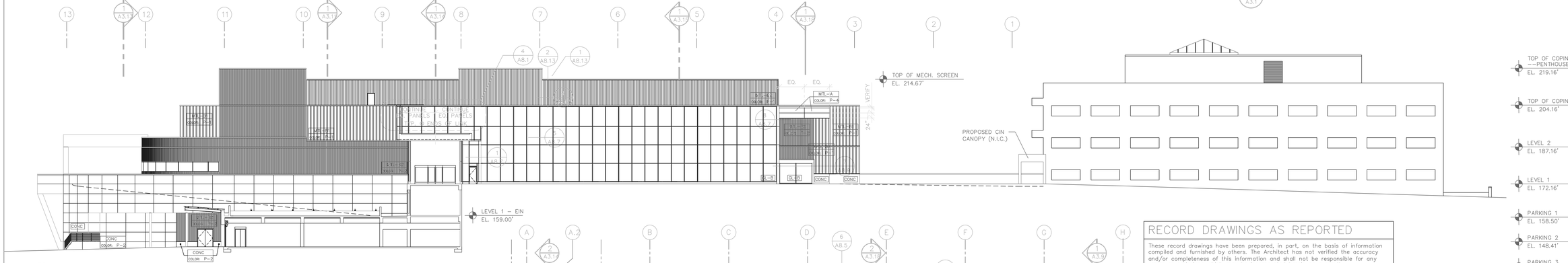


2 A3.1 BUILDING ELEVATION — WEST

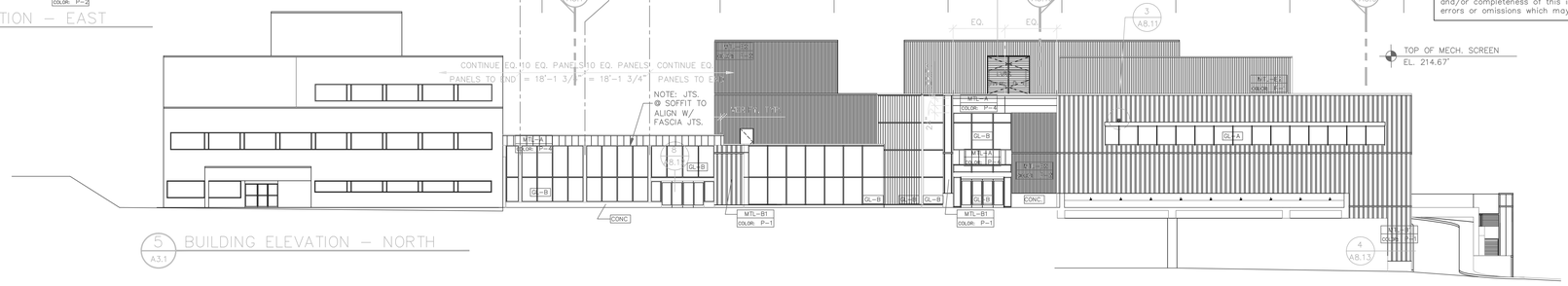


6 A3.1 PARTIAL ELEVATION — SOUTH

3 A3.1 BUILDING ELEVATION — SOUTH



4 A3.1 BUILDING ELEVATION — EAST



5 A3.1 BUILDING ELEVATION — NORTH

RECORD DRAWINGS AS REPORTED

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MATERIAL LEGEND

MTL-A	MTL. WALL SYSTEM A
MTL-B1	MTL. WALL SYSTEM B1
MTL-B2	MTL. WALL SYSTEM B2
GL-A	GLAZING SYSTEM A
GL-B	GLAZING SYSTEM B
LVRS	PTD ALUM. LOUVERS
CONC	CONC.
ROOF-B2	MTL. WALL SYSTEM B2 ROOF

GENERAL NOTES

1. ALL EXPOSED CONCRETE TO BE PAINTED P-4 UNLESS NOTED OTHERWISE.

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Revision No.:

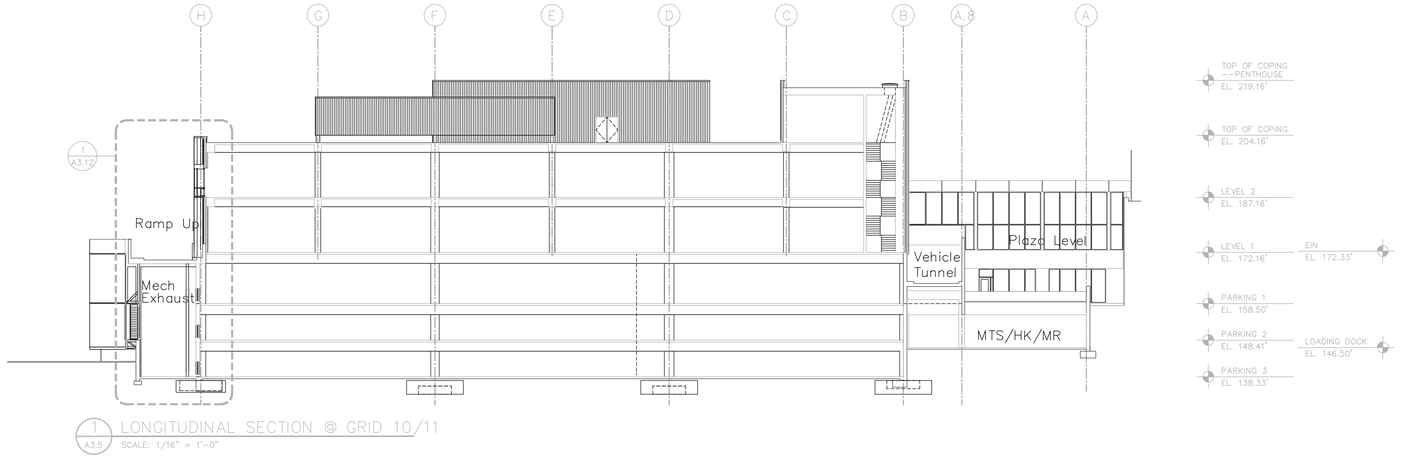
1 PROP. REQ. #4 MAR. 29, 1997
2 REVISION SEPT. 15, 1997
3 PROP. REQ. #15 MAR. 4, 1998
4 DCVR 699 APRIL 3, 1998
5 DCVR 780 APRIL 27, 1998
6 DCVR 993 JULY 20, 1998
7 RECORD DRAWING MAR. 29, 1999

EFK MOB AND PARKING STRUCTURE

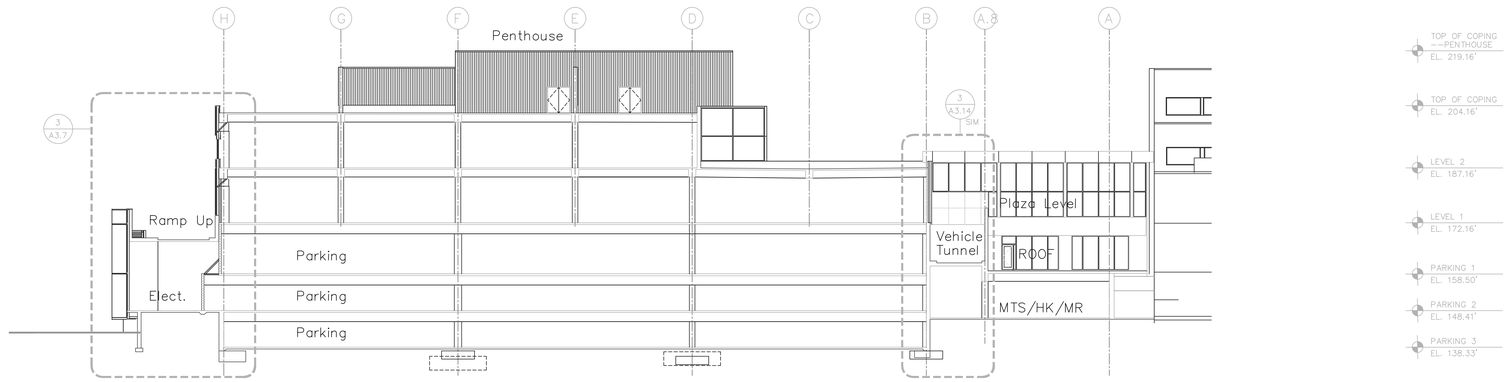
Drawing:
BUILDING ELEVATIONS

Job. No. 8019-01

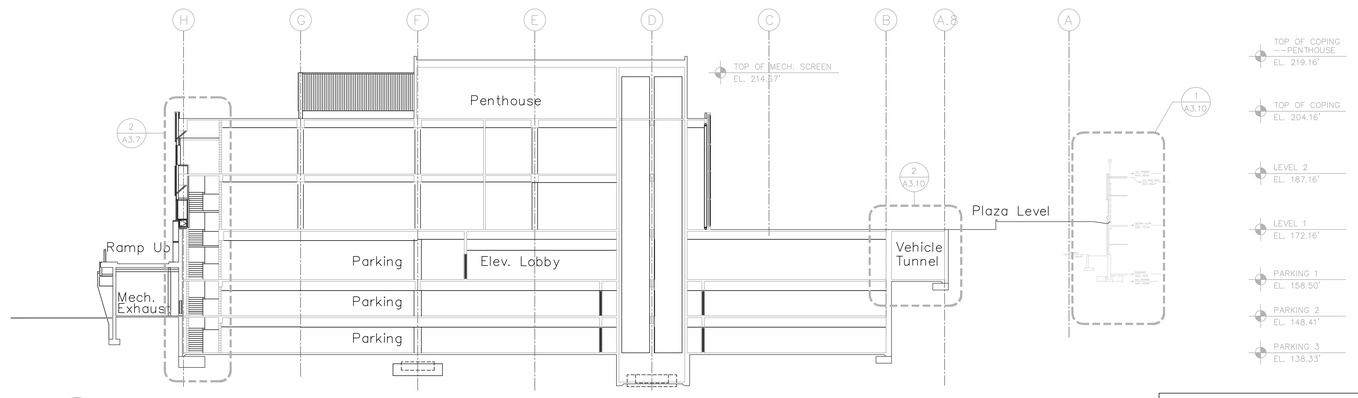
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A3.1



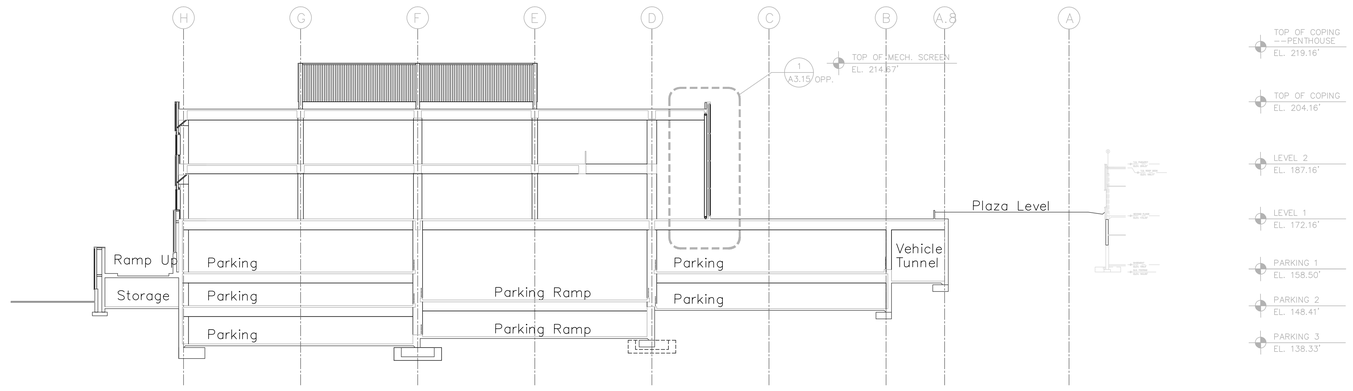
1 A3.5 LONGITUDINAL SECTION @ GRID 10/11
SCALE: 1/16" = 1'-0"



2 A3.5 LONGITUDINAL SECTION @ GRID 8/9
SCALE: 1/16" = 1'-0"



3 A3.5 LONGITUDINAL SECTION @ GRID 7/8
SCALE: 1/16" = 1'-0"



4 A3.5 LONGITUDINAL SECTION @ GRID 5/6
SCALE: 1/16" = 1'-0"

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0 2 8 16 32 48

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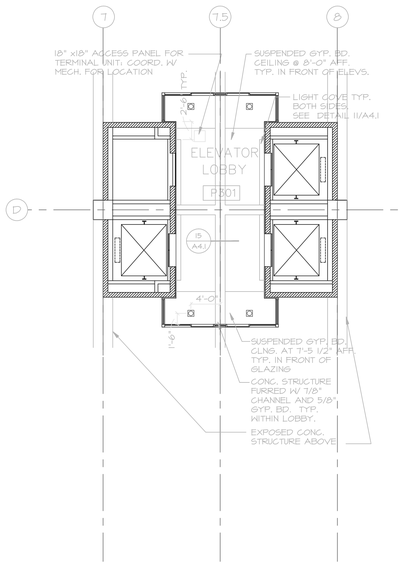
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PACKAGE "C.2"
Revision No.:
RECORD DRAWING
⚠ MAR. 29, 1999

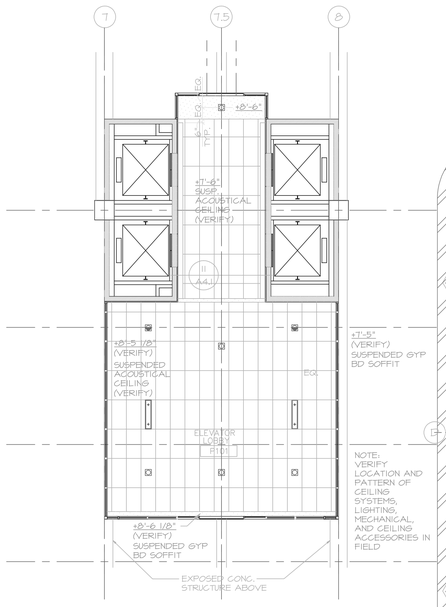
EFK MOB AND PARKING STRUCTURE

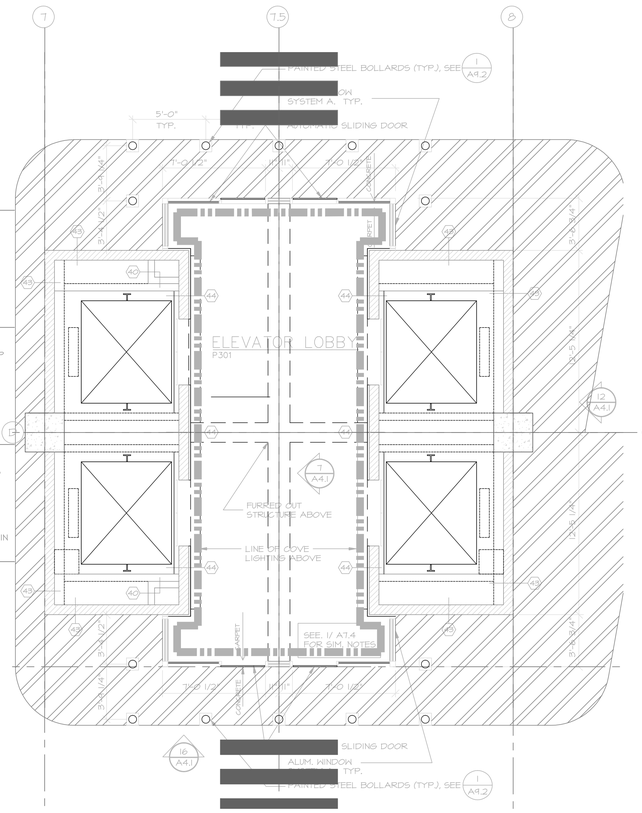
Drawing:
BUILDING
SECTIONS

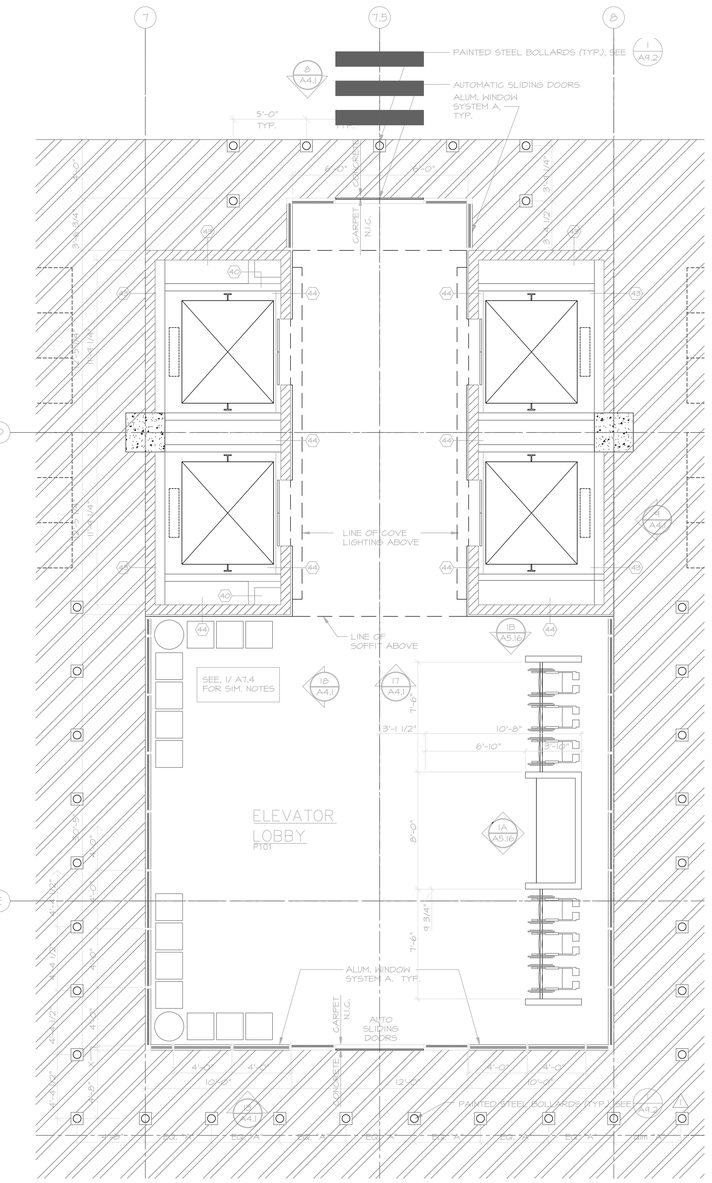
Job. No. 8019-01

Sheet:
A3.5









14 A4.1 LEVEL P3 – ELEVATOR LOBBY REF. CEILING PLAN (P2 SIM)
SCALE: 1/8" = 1'-0"

10 A4.1 LEVEL P1– ELEVATOR LOBBY REF. CEILING PLAN
SCALE: 1/8" = 1'-0"

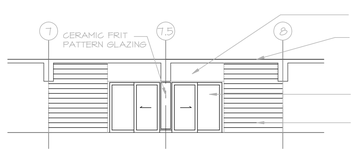
5 A4.1 LEVEL P3 ELEVATOR LOBBY [LEVEL P2--SIM]
SCALE: 1/4" = 1'-0"

1 A4.1 LEVEL P1 ELEVATOR LOBBY
SCALE: 1/4" = 1'-0"

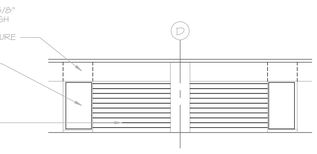
15 A4.1 CEILING DETAIL @ ELEV. LOBBY
SCALE: 3/4" = 1'-0" INT-018

11 A4.1 LIGHTING COVE DETAIL
SCALE: 1-1/2" = 1'-0" INT-020

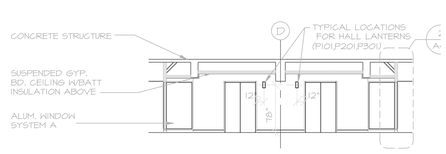
6 A4.1 WINDOW HEAD @ LOBBY DETAIL
SCALE: 1-1/2" = 1'-0" INT-015



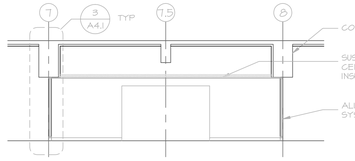
16 A4.1 P301 – ELEVATOR LOBBY EXT. ELEVATION – NORTH & SOUTH
SCALE: 1/8" = 1'-0"



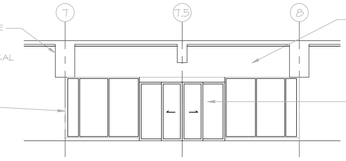
12 A4.1 P301 – ELEVATOR LOBBY EXT. ELEVATION – EAST & WEST
SCALE: 1/8" = 1'-0"



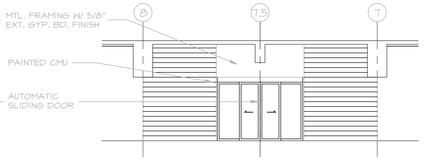
7 A4.1 P301 – ELEVATOR LOBBY INT. ELEVATION – NORTH
SCALE: 1/8" = 1'-0"



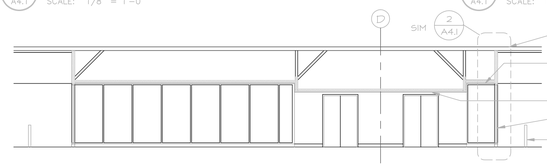
17 A4.1 P101 – ELEVATOR LOBBY INT. ELEVATION – EAST
SCALE: 1/8" = 1'-0"



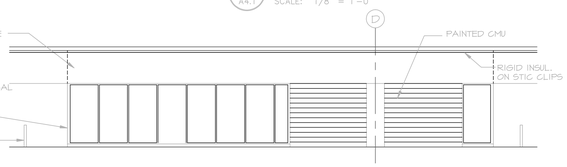
13 A4.1 P101 – ELEVATOR LOBBY EXT. ELEVATION – WEST
SCALE: 1/8" = 1'-0"



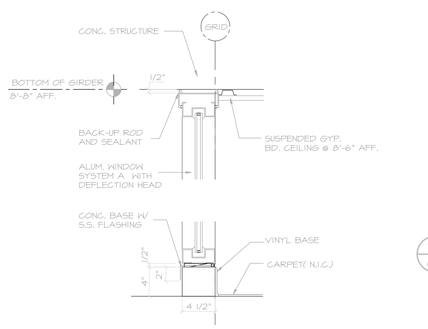
8 A4.1 P101 – ELEVATOR LOBBY EXT. ELEVATION – EAST
SCALE: 1/8" = 1'-0"



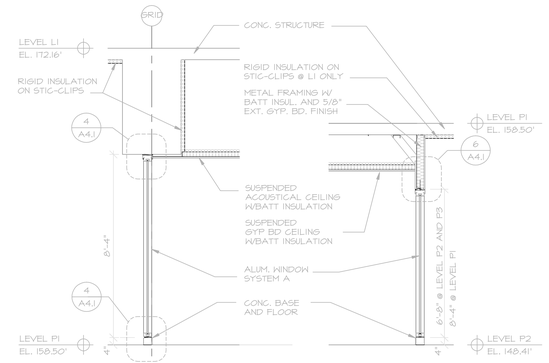
18 A4.1 P101 – ELEVATOR LOBBY INT. ELEVATION – NORTH
SCALE: 1/8" = 1'-0"



9 A4.1 P101 – ELEVATOR LOBBY EXT. ELEVATION – NORTH
SCALE: 1/8" = 1'-0"



4 A4.1 WINDOW HEAD/SILL @ LOBBY
SCALE: 1-1/2" = 1'-0" INT-024



3 A4.1 WALL SECTION – LOBBY
SCALE: 3/8" = 1'-0"

2 A4.1 WALL SECTION – LOBBY
SCALE: 3/8" = 1'-0"

GENERAL NOTE:
NO EXPANSION ANCHORS OR OTHER PNEUMATICALLY - DRIVEN FASTENERS ARE PERMITTED AT PT STRUCTURE. ALL ANCHORAGE AND FASTENING TO OCCUR AT EMBEDDED STEEL ANGLES, PLATES OR CHANNELS. SEE ARCHITECTURAL DETAILS, STRUCTURAL NOTES, AND SPECIFICATIONS.

RECORD DRAWINGS AS REPORTED

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GENERAL NOTE
1. ALL EXTERIOR WALL METAL STUDS TO BE 600I6I8 STUDS @ 16" O.C. UNLESS NOTED OTHERWISE.
2. ALL DIAGONAL BRACES FOR EXTERIOR WALL STUDS TO BE 600I6I6 STUDS @ 48" O.C. UNLESS NOTED OTHERWISE.

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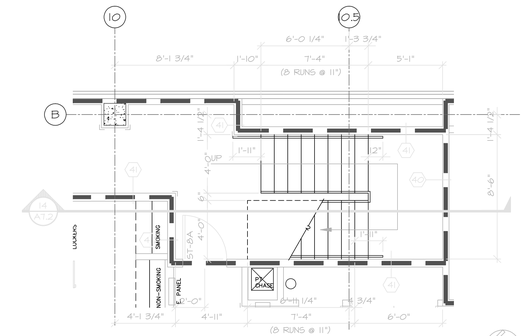
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1 DCVR MOB-86 FEB. 4, 1997
2 PROP. REQ. #12 JAN. 16, 1998
3 DCVR MOB-534 MAR. 3, 1998
4 DCVR MOB-1039 AUG. 6, 1998
5 RECORD DRAWING MAR. 29, 1999

EFK MOB AND PARKING STRUCTURE

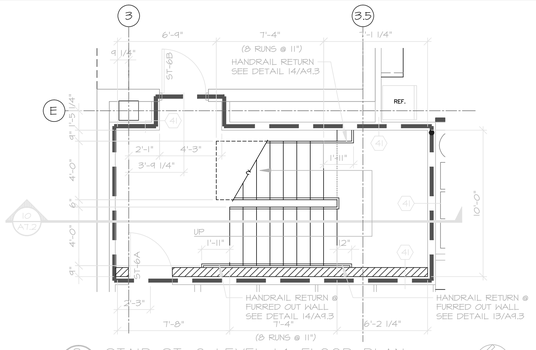
Drawing:
ENLARGED PLANS/DETAILS, ELEVATOR LOBBIES

Job. No. 8019-01

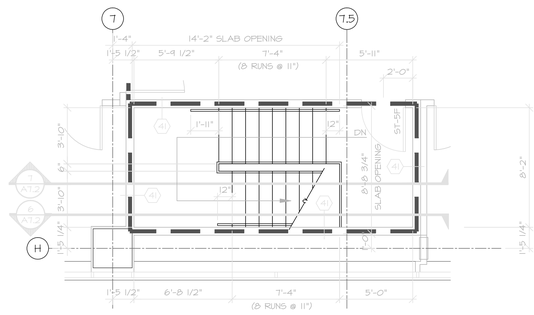
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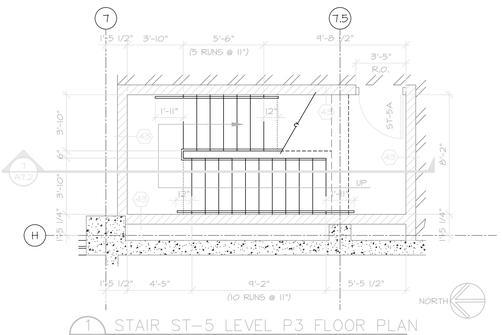
11 A7.2 STAIR ST–8 LEVEL L1 FLOOR PLAN
SCALE: 1/4" = 1'-0"



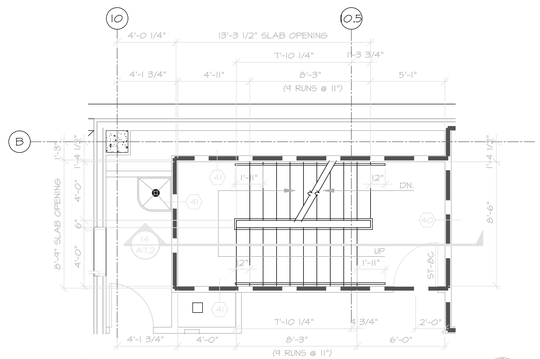
8 A7.2 STAIR ST–6 LEVEL L1 FLOOR PLAN
SCALE: 1/4" = 1'-0"



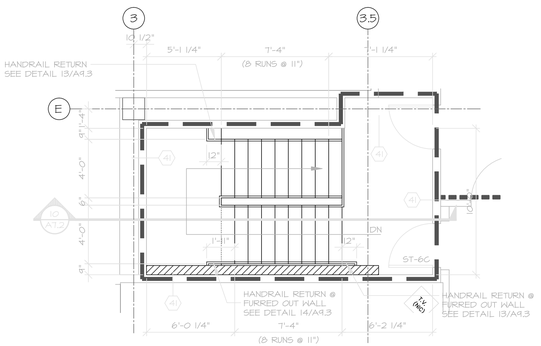
5 A7.2 STAIR ST–5 LEVEL L2 FLOOR PLAN
SCALE: 1/4" = 1'-0"



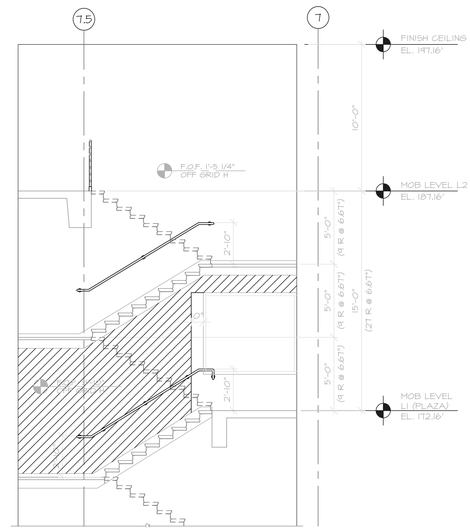
1 A7.2 STAIR ST–5 LEVEL P3 FLOOR PLAN
SCALE: 1/4" = 1'-0"



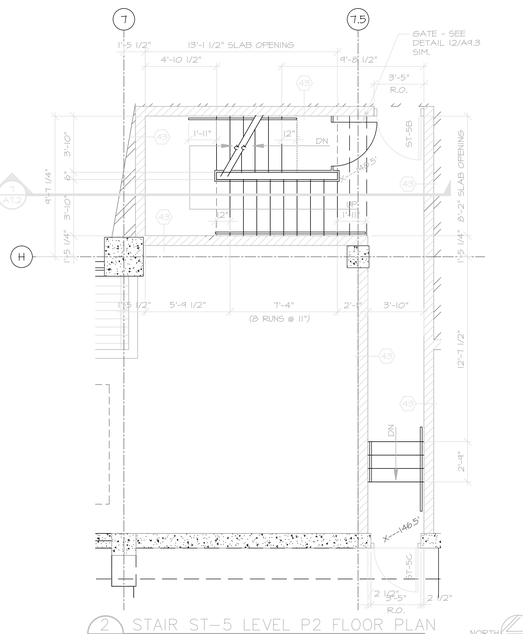
12 A7.2 STAIR ST–8 LEVEL L2 FLOOR PLAN
SCALE: 1/4" = 1'-0"



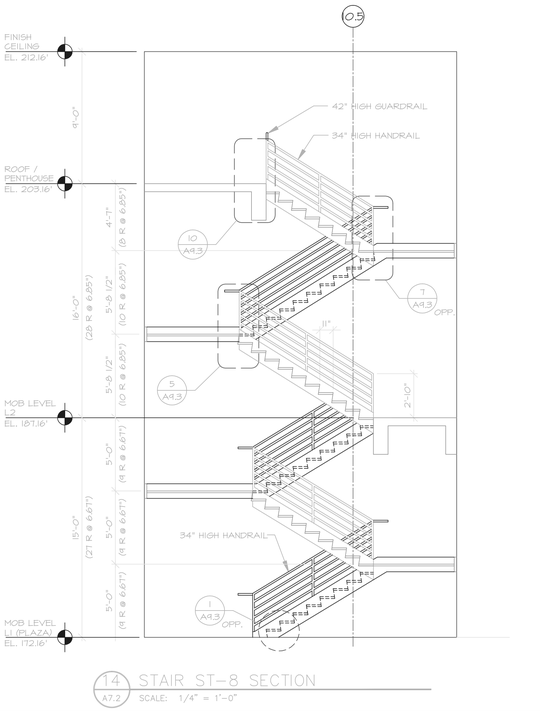
9 A7.2 STAIR ST–6 LEVEL L2 FLOOR PLAN
SCALE: 1/4" = 1'-0"



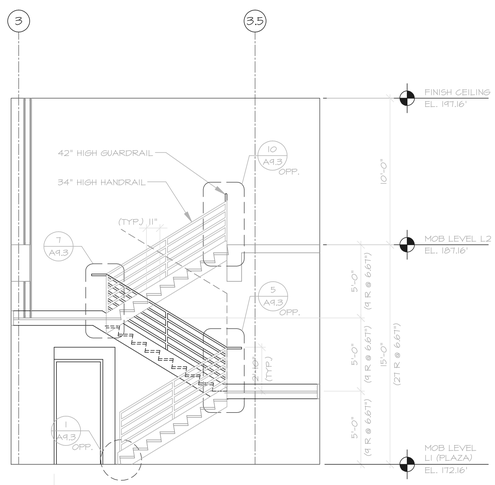
6 A7.2 STAIR ST–5 ELEVATION
SCALE: 1/4" = 1'-0"



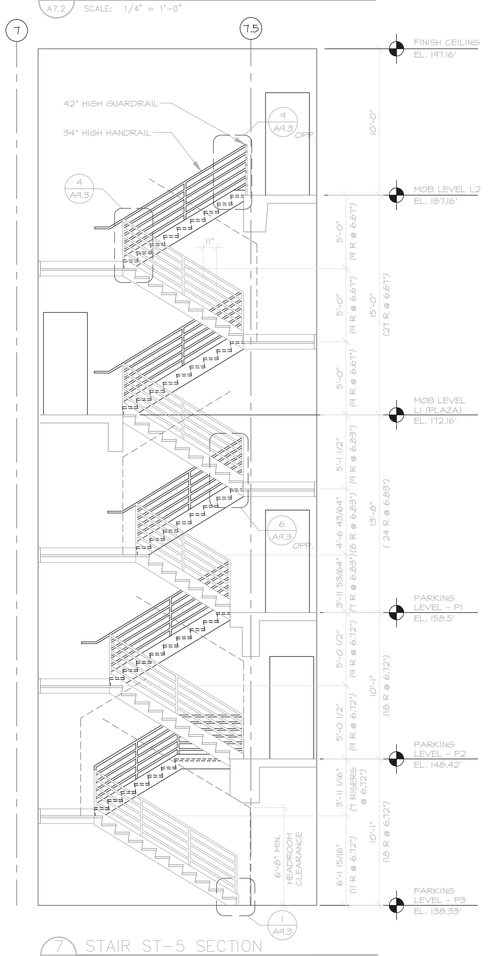
2 A7.2 STAIR ST–5 LEVEL P2 FLOOR PLAN
SCALE: 1/4" = 1'-0"



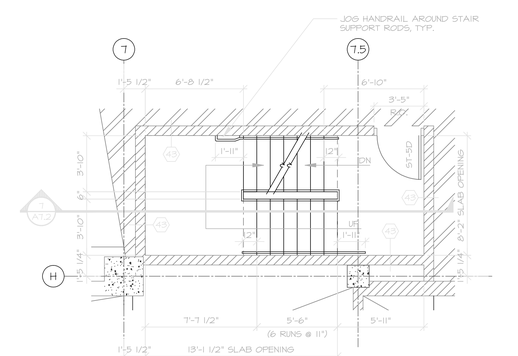
14 A7.2 STAIR ST–8 SECTION
SCALE: 1/4" = 1'-0"



10 A7.2 STAIR ST–6 SECTION
SCALE: 1/4" = 1'-0"



7 A7.2 STAIR ST–5 SECTION
SCALE: 1/4" = 1'-0"



3 A7.2 STAIR ST–5 LEVEL P1 FLOOR PLAN
SCALE: 1/4" = 1'-0"

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4 A7.2 STAIR ST–5 LEVEL L1 FLOOR PLAN
SCALE: 1/4" = 1'-0"

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LARSON
Architects

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Date: JAN. 10, 1997
PACKAGE "C.2"

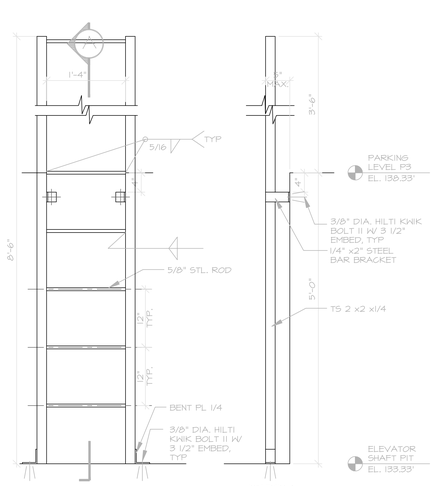
Revision No.:
1 ADDENDUM NO.1 1/27/97
2 RECORD DRAWING MAR. 29, 1999

EFK MOB AND PARKING STRUCTURE

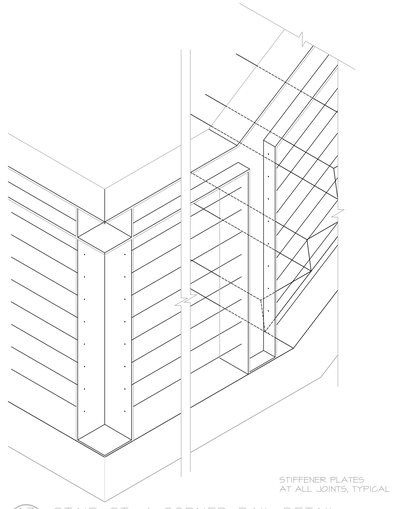
Drawing:
STAIR SECTIONS

Job. No. 8019-01

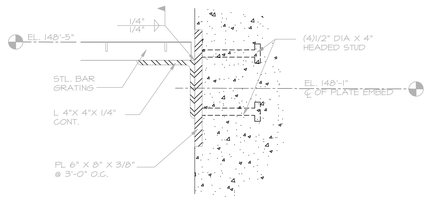
Sheet:
A7.2



17 A9.2 PIT ACCESS LADDER
SCALE: 1" = 1'-0" INT-062

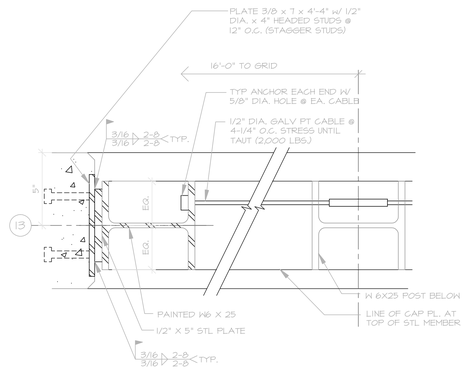


13 A9.2 STAIR ST-4 CORNER RAIL DETAIL
N.T.S EX-064B

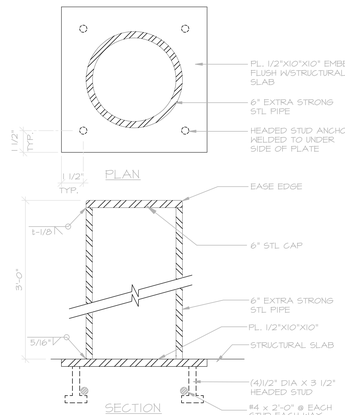


9 A9.2 STL GRATING @ MECH EXHAUST P207 LEVEL P2
SCALE: 3" = 1'-0" INT-045

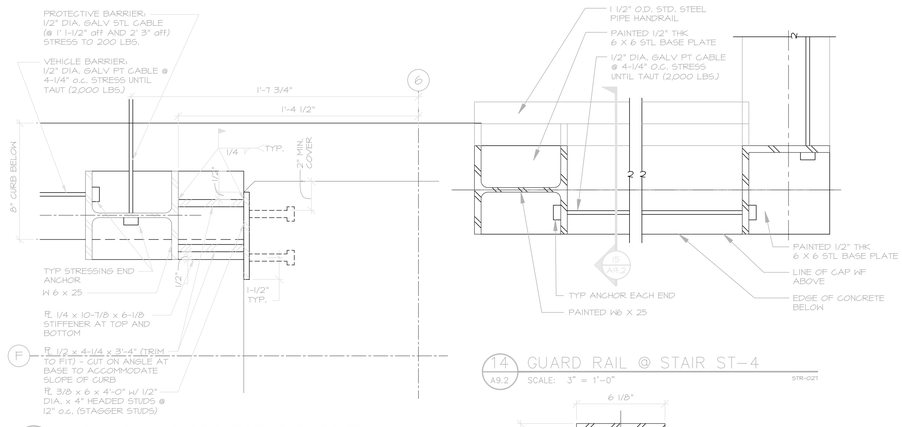
E WALL SHAFT S-3 @ LEVEL L2 - SIM.



5 A9.2 SECURITY BARRIER @ SOUTH GARAGE OPENINGS, LEVEL P3
SCALE: 3" = 1'-0" INT-046



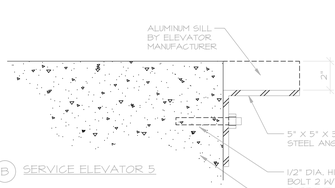
1 A9.2 TYP. BOLLARD @ PARKING LEVEL
SCALE: 3" = 1'-0" INT-040



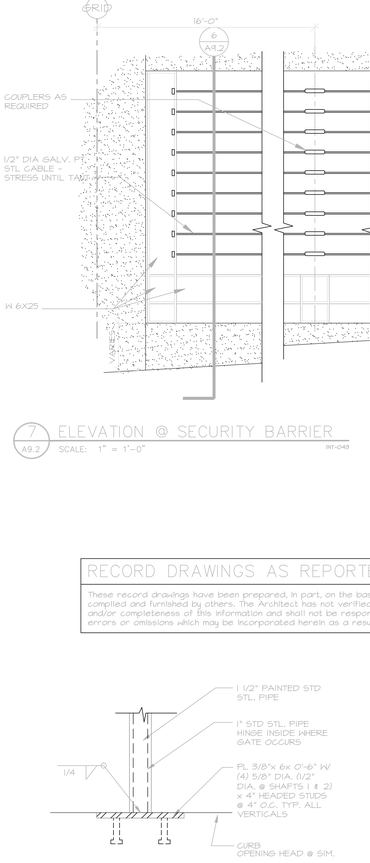
18 A9.2 CABLE RAIL @ PROTECTIVE BARRIER
SCALE: 3" = 1'-0" INT-064

KEYED AT A2.2

14 A9.2 GUARD RAIL @ STAIR ST-4
SCALE: 3" = 1'-0" STR-027

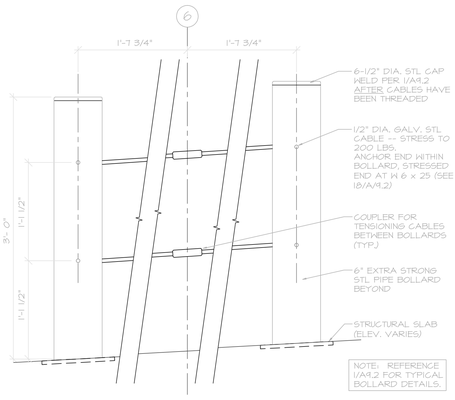


10 A9.2 STL GRATING @ DOOR OPENING MECH EXHAUST P207 LEVEL P2
SCALE: 3" = 1'-0" INT-044



6 A9.2 SECTION @ SECURITY BARRIER
SCALE: 1" = 1'-0" INT-042

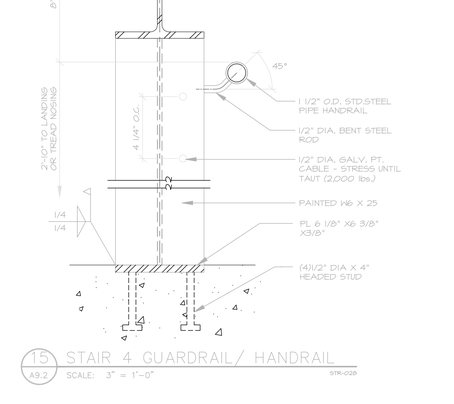
2 A9.2 TYP. ANCHOR PLATE FOR BICYCLE RACKS
SCALE: 3" = 1'-0" INT-039



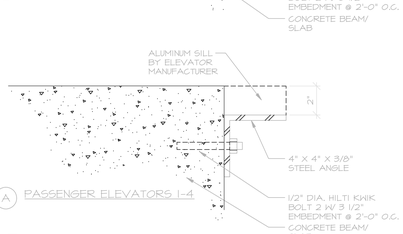
NOTE: REFERENCE 1/A9.2 FOR TYPICAL BOLLARD DETAILS.

19 A9.2 BOLLARDS @ PROTECTIVE BARRIER
SCALE: 1-1/2" = 1'-0" INT-065

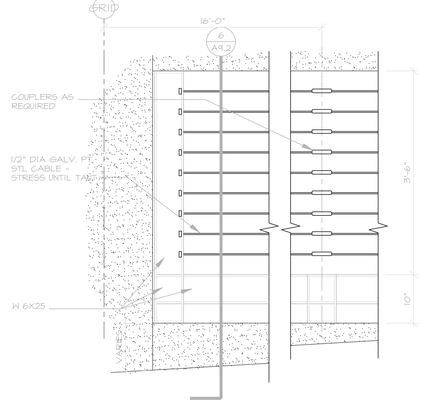
KEYED AT A2.2



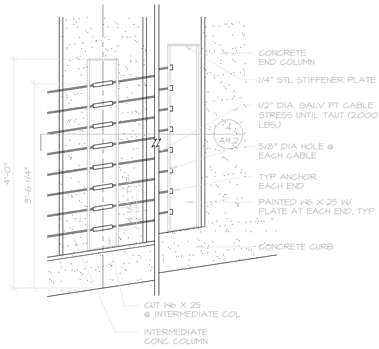
15 A9.2 STAIR 4 GUARDRAIL/ HANDRAIL
SCALE: 3" = 1'-0" STR-028



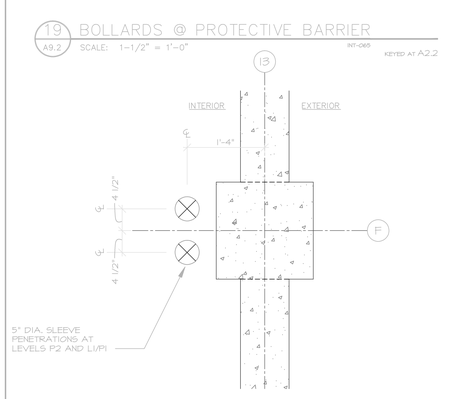
11 A9.2 ELEVATOR SILL DETAILS
SCALE: 3" = 1'-0" INT-030



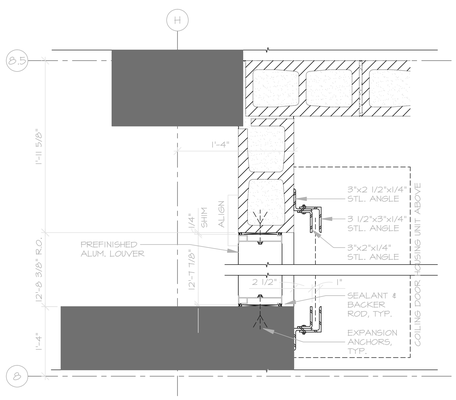
7 A9.2 ELEVATION @ SECURITY BARRIER
SCALE: 1" = 1'-0" INT-043



3 A9.2 CABLE GUARD RAIL ELEVATION
SCALE: 1" = 1'-0" EX-128C



20 A9.2 SLEEVE PENETRATIONS AT PT-DECKS -- LEVELS P2 AND P1
SCALE: 1" = 1'-0" INT-077

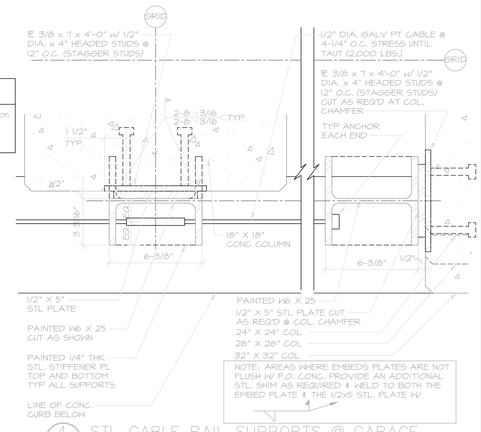


16 A9.2 COILING DOOR/LOUVER JAMB @ GENERATOR ROOM
SCALE: 1-1/2" = 1'-0" EX-115

RECORD DRAWINGS AS REPORTED

These record drawings have been prepared, in part, on the basis of information compiled and furnished by others. The Architect has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result.

8 A9.2 PIPE CONNECTION @ MECH. EXHAUST
SCALE: 3" = 1'-0" INT-024



4 A9.2 STL CABLE RAIL SUPPORTS @ GARAGE
SCALE: 3" = 1'-0" INT-041

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Date: JAN. 10, 1997
PACKAGE "C.2"
Revision No.:
1 ADDENDUM NO. 1 JAN. 27, 1997
2 DCVR 98 FEB. 17, 1997
3 DCVR 135 APR. 15, 1997
4 RECORD DRAWING MAR. 29, 1999

EFK MOB AND PARKING STRUCTURE

Drawing: INTERIOR DETAILS
Job. No. 8019-01
Sheet: A9.2

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- E2.10 LEVEL L2 POWER & SIGNAL PLAN
- E2.11 LEVEL L2 POWER & SIGNAL PLAN
- E2.12 LEVEL L1 AND L2 LOBBY POWER & SIGNAL PLANS
- E2.13 PENTHOUSE / ROOF POWER & SIGNAL PLAN
- E3.7 LEVEL L1 LIGHTING PLAN
- E3.8 LEVEL L2 LIGHTING PLAN
- E3.9 PENTHOUSE / ROOF LIGHTING PLAN
- E4.1 ELECTRICAL PARTIAL PLANS
- E4.2 ELECTRICAL PARTIAL PLANS
- E4.3 ENLARGED FLOOR PLAN - SECURITY - LEVEL P1
- E5.1 ONE LINE DIAGRAM
- E5.2 ELECTRICAL DETAILS
- E5.3 ELECTRICAL DETAILS
- E6.1 ELECTRICAL SYMBOLS, FIXTURES, SCHEDULE, DETAILS
- E6.2 ELECTRICAL DETAILS
- E6.3 ELECTRICAL DETAILS

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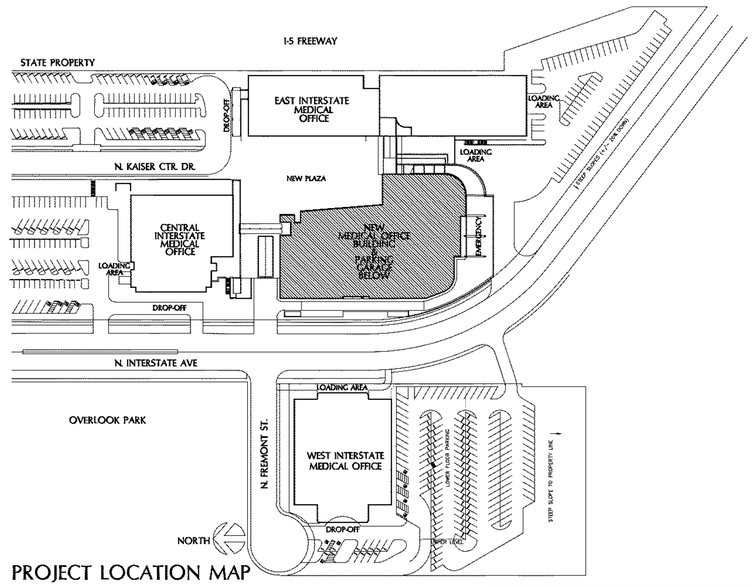
MANUFACTURING BUILDING 7 AND MAIN PARKING AREA

RECORD DRAWINGS

July 3, 2017

BOUCHER MOUCHKA LARSON ARCHITECTS

BML #8019-01



PROJECT LOCATION MAP

RECORD DRAWINGS AS REPORTED

These record drawings have been prepared, in part, on the basis of information compiled and furnished by others. The Architect has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result.

BOUCHER
MOUCHKA
LARSON
Architects

209 S.W. Oak
Portland, Oregon
503/223-4886

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RECORD DRAWINGS AS REPORTED

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Date: AUG. 15, 1997
PACKAGE "D"

Revision No.:
1 ADDENDUM #1 AUG. 28, 1997
2 PROP. REQ. #10 NOV. 25, 1997
3 PROP. REQ. #12 JAN. 16, 1998
REISSUED: 1/27/98
4 PROP. REQ. #14 JAN. 30, 1998
RECORD DRAWINGS
5 MAR. 29, 1999

EFK MOB AND PARKING STRUCTURE

1995 Main Entrance Exterior Renovation

1995 Main Office Expansion

1995 IT Department Remodel

2000 WAN-LAN IT Upgrade

2000 Occupational Health Relocation

2000 Customer Service Area Remodel

1999 Men's & Women's Restroom Remodel - First Floor

1979 Material Storage Area Expansion

1980 Hazardous Material Storage Area Expansion

2017 WAN-LAN IT Upgrade

1966 HVAC System Exhaust Remodel

1967 Industrial Ventilation Upgrade

1993 Production Line and Conveyor Expansion

1954 Records Department Water Leak

1972 Production and Conveyor Expansion and Upgrade

WALL RATING LEGEND

1 HOUR RATED SMOKE WALL SYSTEM

2 HOUR RATED WALL SYSTEM

SHEET A4.8
SHEET A4.7
SHEET A4.5
SHEET A4.6
SHEET A4.6
SHEET A4.7

1 A2.7 LEVEL L1 FLOOR PLAN
SCALE: 1/8" = 1'-0"

Drawing: FLOOR PLAN LEVEL L1

Job. No. 8019-01

Sheet: A2.7

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MOUCHKA
LARSON
Architects

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Portland, Oregon
503/223-4886

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Date: AUG. 15, 1997
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Revision No.:

1 PROP. REQ. #10
NOV. 25, 1997

2 PROP. REQ. #12
JAN. 16, 1998

3 PROP. REQ. #14
JAN. 30, 1998

4 RECORD DRAWING
MAR. 29, 1999

EFK MOB AND PARKING STRUCTURE

1978 Meeting Room Remodel

1972 President's Office Remodel

1972 President's Office Expansion

1980 Sales Department Office Remodel

2000 WAN-LAN IT Upgrade

2016 2nd Level Non-Combustible Storage Upgrade

2017 Security Enhanced Supply Door

1991 Accounting and Billing Department Expansion

1995 IT Department Remodel

2013 Administration Office Remodel

1991 Records Office Upgrade

1991 Records Room Upgrade

2000 LAN/WAN Equipment Upgrade

WALL RATING LEGEND

1 HOUR RATED SMOKE WALL SYSTEM

2 HOUR RATED WALL SYSTEM

SHEET A4.9

SHEET A4.10

NORTH

1 / A2.8 LEVEL L2 FLOOR PLAN
SCALE: 1/8" = 1'-0"

Drawing:
FLOOR PLAN
LEVEL L2

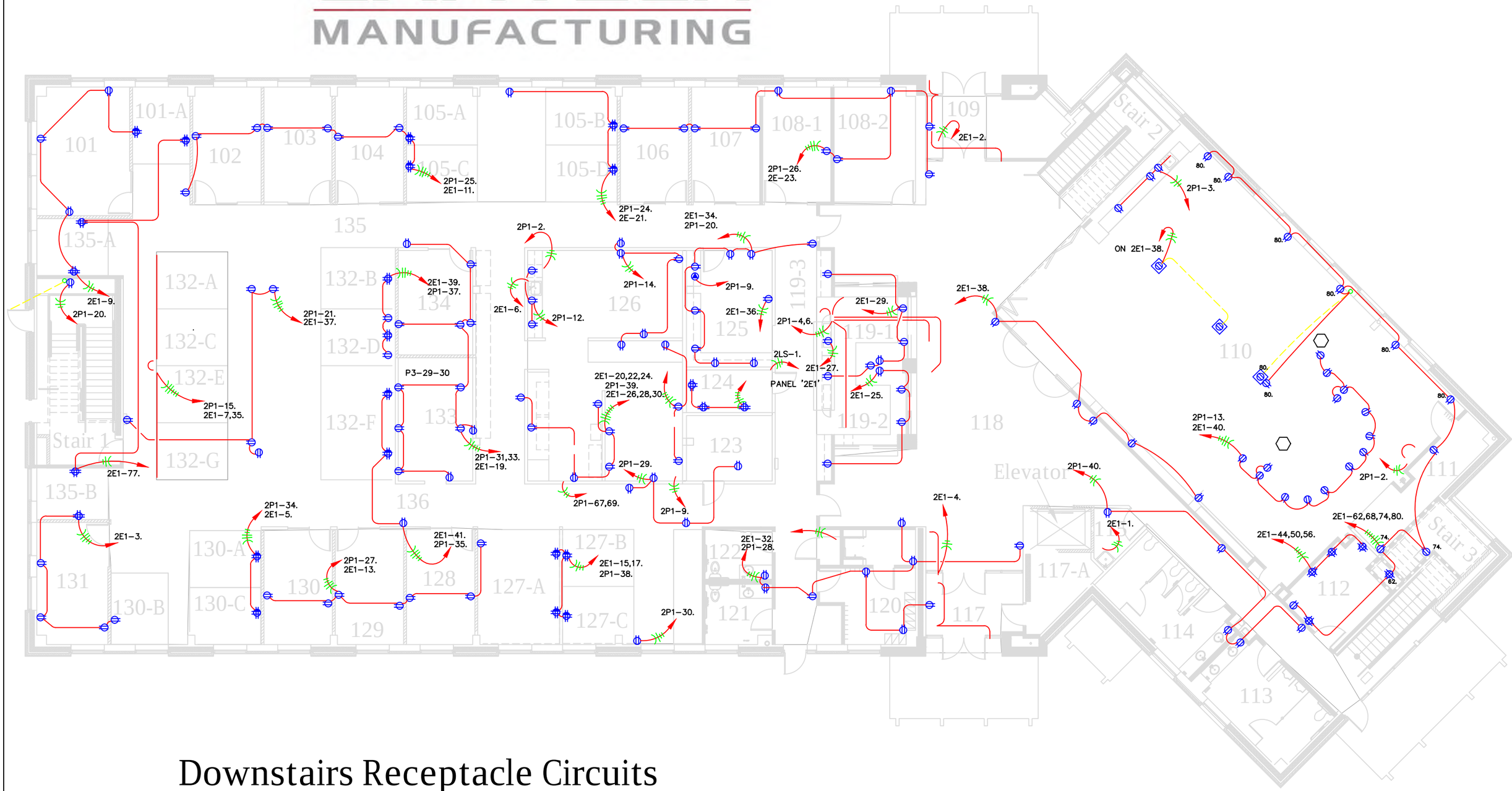
Job. No. 8019-01

Sheet:
A2.8

RECORD DRAWINGS AS REPORTED

These record drawings have been prepared, in part, on the basis of information compiled and furnished by others. The Architect has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result.

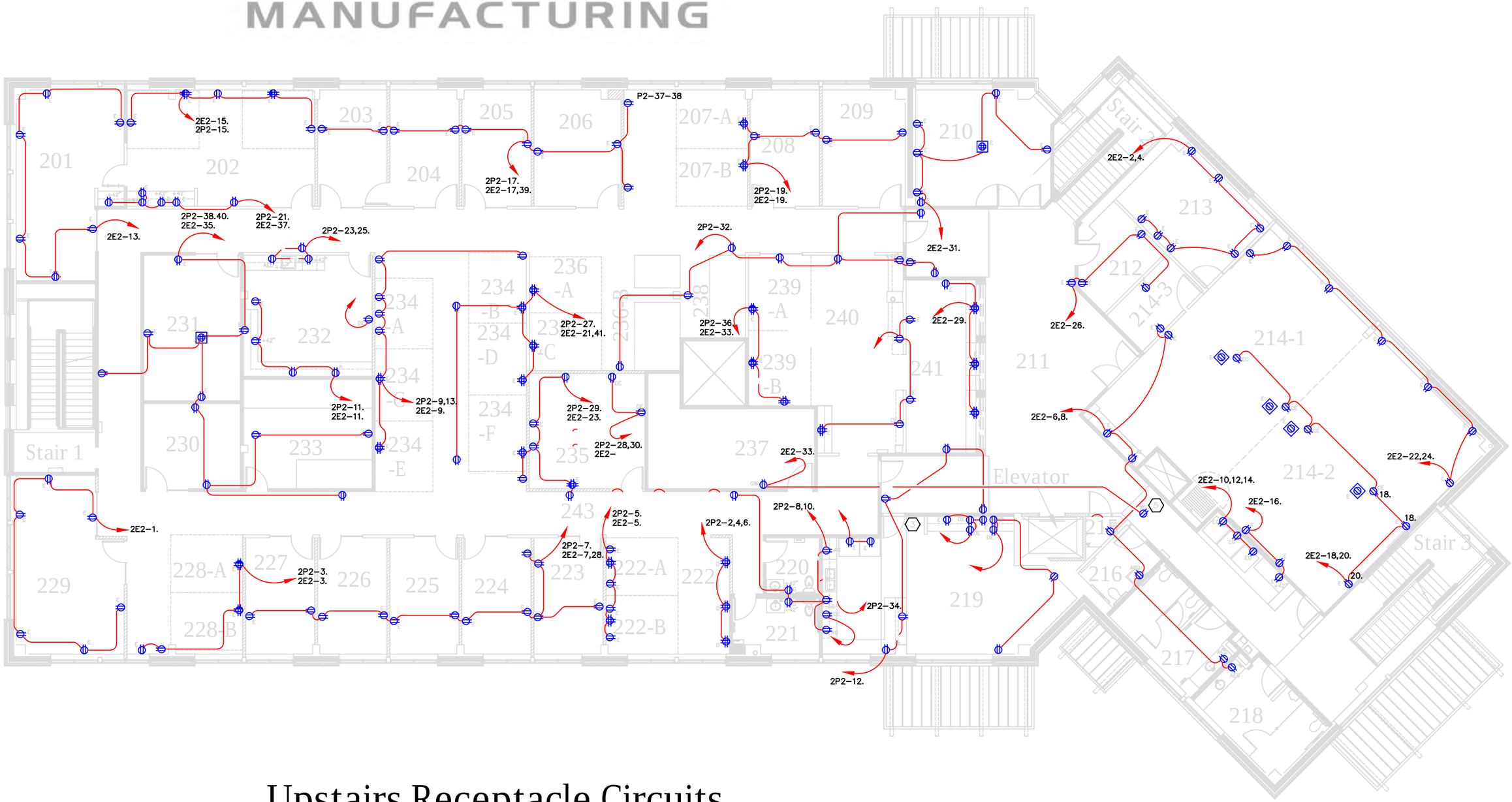
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Downstairs Receptacle Circuits

Building 7 - Downstairs	12/18/16	N.T.S.	Drawn By: SR	Camtech Manufacturing E-Power Circuit Layout

CAMTECH
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Upstairs Receptacle Circuits

Building 7 - Upstairs	12/18/16	N.T.S	Drawn By: SR	Camtech Manufacturing E-Power Circuit Layout

QUICKTRONIC® PROStart® T5HO Universal High Ambient Temp.

<10% THD Electronic T5HO Fluorescent Programmed Rapid Start Ballasts Normal Ballast Factor HT

Professional Series

Lamp / Ballast Guide

54W T5 - PENTRON® HO
1 or 2 lamp
QTP2x54T5HO/UNV PSN HT
QTP4x54T5HO/UNV PSN HT W

3 or 4 lamp
QTP4x54T5HO/UNV PSN HT W

Also operates:
FT50DL, FT55DL, FPC55, L58

Four lamp switchable model can be wired for four, three, two or one lamp operation.

Two lamp fixed output model can be wired for one lamp operation.

Key System Features

- 90°C maximum case temp.
- Universal voltage (120-277V)
- Low-profile (1.00" High)
- 100% Ballast factor
- QUICKSENSE ballast technology (end-of-lamp-life sensing)
- PROStart programmed rapid start
- UL type CC rated
- -20°F (-29C) Min. Starting Temp.
- Operates at >40 kHz to reduce potential interference with infrared control systems
- High power factor
- Low harmonic distortion
- Lightweight
- UL, CSA, FCC



Application Information

SYLVANIA QUICKTRONIC PHO HT is ideally suited for:

- Industrial high-bay
- Commercial
- Retail
- Hospitality
- Institutional
- New construction
- Direct lighting
- Indirect lighting
- Surface mount
- Cove lighting

SYLVANIA QUICKTRONIC HIGH AMBIENT (HT) PHO operates PENTRON HO, PENTRON HO Circline, and DULUX® L T5 lamps with full lumen output and optimal system performance.

SYSTEM PHO High Ambient Temperature ballasts are specifically designed for applications where the ballast is subjected to higher ambient temperatures, as in high bay industrial installations. The four lamp UNV (120-277V) ballast system provides 18,600 mean lumens, which, when factoring in lumen maintenance and typical T5HO fixture efficiency, can be considered as a direct replacement for standard 400W MH. As such, the family is ideally suited to replace 250W and 400W metal halide installations.

Unique to the family is the 120-277V 4-lamp "switching" ballast, designed to switch from 4- to 2-, 3- to 2-, 3- to 1- or 2- to 1-lamps. The switching feature can be accessed through a second input power terminal. This feature allows for a range of control interfaces, including an occupancy sensor, mounted inside a fixture.



SYSTEM PHO HT ballasts contain QUICKSENSE® ballast technology, a patented circuitry designed to shut down the system reliably and safely when lamps reach end-of-life.

Setting the standard for quality, SYSTEM PHO HT is also covered by our QUICK 60+® warranty, the first and most comprehensive system warranty in the industry.

SYSTEM PHO HT is available in four and two lamp models to cover a wide range of applications.

System Information

System PHO HT operates on 120V through 277V, 50 or 60Hz current, eliminating "wrong voltage" wiring errors and reducing the number of ballast models in inventory by half.

PROStart ballasts provide optimum starting conditions and provide up to 100,000 switching cycles for use on occupancy sensors and building control systems.

QUICKSENSE ballast technology helps to protect against overheated bases and sockets, as well as cracking of the lamp glass wall, and uses dynamic end-of-lamp-life sensing to avoid false shutdowns caused by some static sensing methods. QUICKSENSE ballast technology will auto reset when spent lamps are replaced with new ones.

System Type	Input Power (W)	Initial System Lumens	System Efficacy LPW
F40T12 - E.S. Magnetic Ballast (4-lamp)	172	11590	67
F34T12 - E.S. Magnetic Ballast (4-lamp)	144	9500	66
FO32T8/XP - QT4x32IS (4-lamp)	114	10800	95
FP54T5HO - QTP2x54T5HO/UNV PSN HT (2-lamp)	121	10000	83
FP54T5HO - QTP4x54T5HO/UNV PSN HTW (4-lamp)	241	20000	83

The four lamp unit can be wired for four, three, two or one lamp operation. The two lamp unit can be wired for one lamp operation, allowing for an additional 50% reduction in inventory model numbers.

SYSTEM PHO HT has a 25.4H (mm) profile. PENTRON T5 lamps are designed to provide peak performance at 35°C fixture ambient, allowing for smaller and more innovative fixtures.

SPECIFICATION DATA

Catalog #	Date	Type
Project	Prepared by	
Comments		

High Ambient Universal Voltage (120-277V)

Item Number	Description	Input Current (AMPS)	Lamp[1] Type	Rated[1] Lumens (lm)	No. of Lamps	Ballast[1] Factor (BF)	System[1] Lumens	Mean[1] Lumens	Input[1] Power (Watts)	System Efficacy (lm/W)	BEF[2]
QTP 2x54 T5HO Fixed Output BF 1.0											
49136	QTP 2x54T5HO/UNV PSN HT	1.00/0.43	FP54T5HO	5000	2	1.00	10000	9300	121/118	83/85	0.85
*(49135)**					1	1.00	5000	4650	61	82	1.64
QTP 4x54 T5HO Switchable Model											
49161	QTP 4x54T5HO/UNV PSN HTW	2.00/0.85	FP54T5HO	5000	4	1.00	20000	18,600	241/236	83/85	0.42
*(49160)***					3	1.00	15000	13,950	182/178	83/85	0.56
					2	1.00	10000	9300	121/118	83/85	0.85
					1	1.00	5000	4650	61	82	1.64

1: At 35°C lamp ambient temperature.

2: Ballast Efficiency Factor (BEF) shown = (Ballast Factor x 100) divided by Input Power (Note: calculation based on lowest wattage value).

**(49135) QTP 2x54T5HO/UNV PSN HT: same as 49136, with leads.*

***(49160) QTP 4x54T5HO/UNV PSN HTW: same as 49161, with leads.*

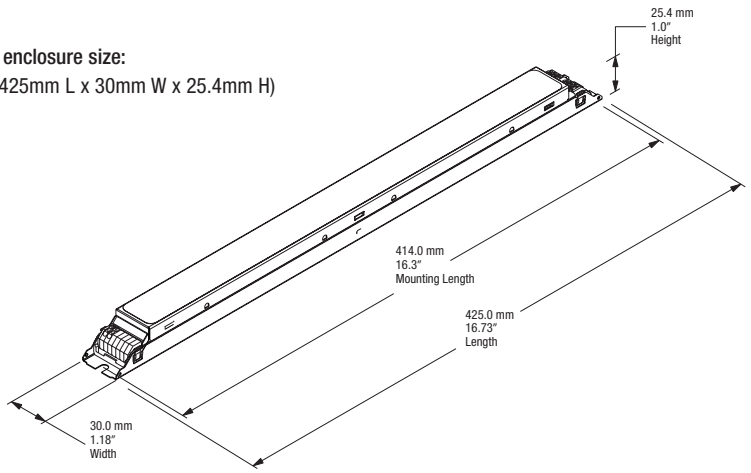
Installation Notes

Switching: Simultaneously disconnect all ungrounded line conductors. Install in accordance with National & Local Electric Code. Ground ballast case.

Dimensions:
Model QTP2x54 T5HO/UNV PSN HT enclosure size:
Overall: 16.73"L x 1.18"W x 1.0"H (425mm L x 30mm W x 25.4mm H)
Mounting: 16.34" (415mm)

Wiring:
Push-in connectors
Use 18AWG solid copper wire only
See page 66 for wiring diagram.

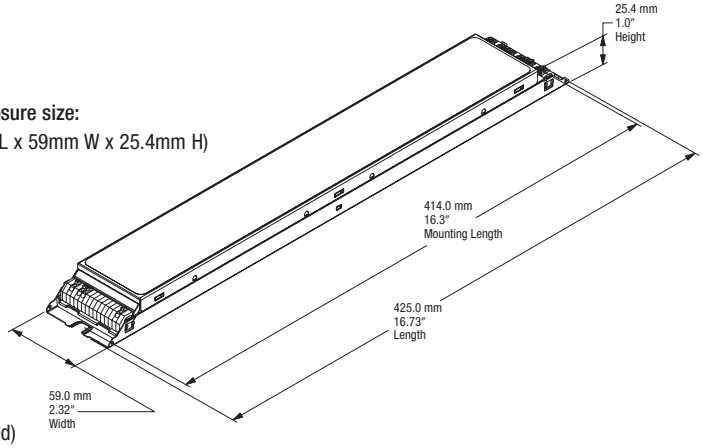
Packaging:
Quantity: 20 (2-lamp)
Weight: 2L: 0.88 lbs each (approx)



Dimensions:
Model QTP4x54 T5HO/UNV PSN HT W enclosure size:
Overall: 16.73"L x 2.32"W x 1.0"H (425mm L x 59mm W x 25.4mm H)
Mounting: 16.34" (415mm)

Wiring:
Push-in connectors
Use 18AWG solid copper wire only
See page 67 for wiring diagram.

Packaging:
Quantity: 2-Lamp: 20 (no leads)
10 (with leads)
4-Lamp: 10 (leaded and non-leaded)
Weight: 2L: 0.88 lbs, 0.40kg each (approx)
4L: 1.68 lbs, 0.76kg each (approx)



Item Number — **49161 QTP 4 x 54 T5HO / UNV PSN HTW** — High Ambient Temperature (Case)
QUICKTRONIC PROFESSIONAL — Starting/Ballast Factor
Number of Lamps — Line Voltage (120-277V)
Primary Lamp Wattage

Performance Guide

Data based upon SYLVANIA PENTRON® HO lamps shown. QUICKTRONIC® PHO HT ballasts are also compatible with other lamp manufacturers equivalent lamp types that meet ANSI specifications.

Specifications[3]

Starting Method: Programmed Rapid Start
Ballast Factor: 1.00
Circuit Type: Series
Lamp Frequency: >40 kHz
Lamp CCF: Less than 1.6
Starting Temp: -20°F (-29°C) min.[4]
Input Frequency: 50/60 Hz
Low THD: <10%
Power Factor: >98%
Voltage Range: ±10% of 120-277V rated line (108-305V)

UL Listed Class P, Type 1, Outdoor,
UL Type CC Rated
CSA Certified
High Ambient Applications:
90°C Max. Case Temp. (3 yr. warranty)
Standard Ambient Applications:
70°C Max. Case Temp. **(5 yr. warranty)**
FCC 47CFR Part 18 Non-Consumer
Class A Sound Rating
ANSI C62.41 Cat. A Transient Protection
Dynamic End-of-Lamp-Life Sensing
Remote Mounting (Max. wire length from ballast case to lampholder): up to 18 feet[4]

3 Data based on PENTRON HO lamp types for primary ballast application.

4 Operation below 50°F (10°C) may affect light output or lamp operation – see "Low Temp. Starting" definition. Remote red and brown leads up to 18 feet. Keep blue and yellow (for 4-lamp model only) leads <10 ft.

System Life / Warranty

QUICKTRONIC® products are covered by our QUICK 60+® warranty, a comprehensive lamp and ballast system warranty. For additional details, refer to our QUICK 60+ warranty bulletin.

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Service and Sales Center
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Specifications subject to change without notice.

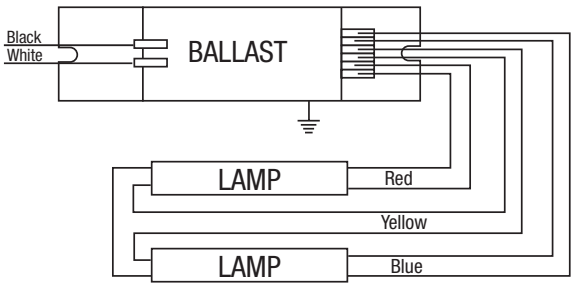
SPECIFICATION DATA

Catalog #	Date	Type
Project	Prepared by	
Comments		

<10% THD Electronic 2 Lamp T5HO High Ambient Fluorescent Systems

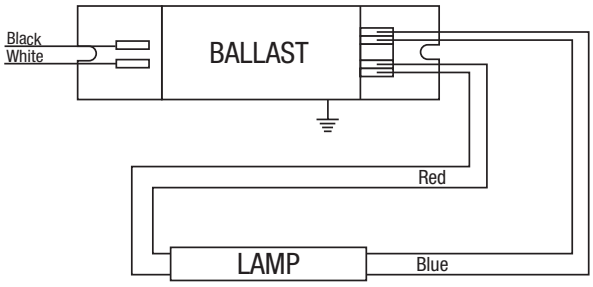
High ambient model (90°C case temp.)
49136 QTP 2x54T5HO/UNV PSN HT

Wiring diagram for 2-Lamp model



2 LAMP

2-Lamp model can be wired for one lamp operation.



1 LAMP

Item Number — **49136 QTP 2 x 54 T5HO / UNV PSN HT** — High Ambient Temperature (Case)
QUICKTRONIC PROFESSIONAL — Starting/Ballast Factor
Number of Lamps (1, 2) — Line Voltage (120-277V)
Primary Lamp Wattage



Installation Notes

- Install in accordance with National & Local Electric Code
- Ground ballast case
- Switching: Simultaneously disconnect all ungrounded line conductors

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Specifications subject to change without notice.

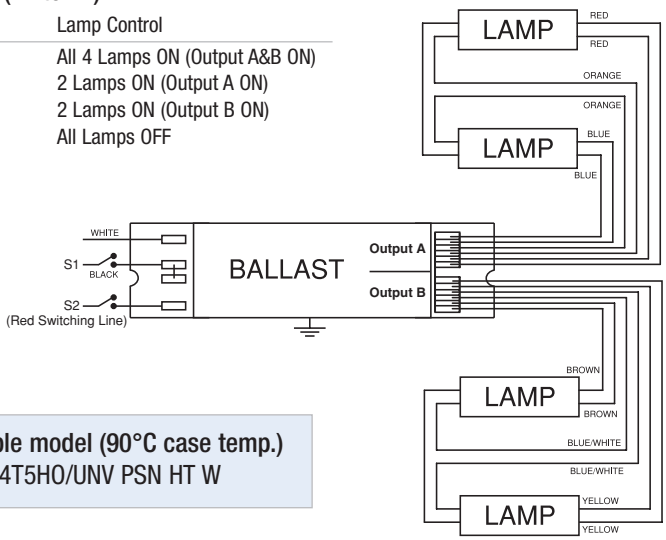
SPECIFICATION DATA

Catalog #	Date	Type
Project	Prepared by	
Comments		

<10% THD Electronic 4 Lamp T5HO High Ambient Fluorescent Systems

4-Lamp Switching Wiring Diagram (4L to 2L)

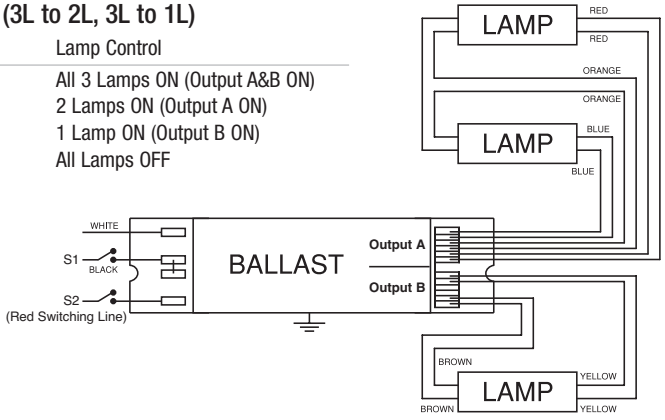
S1 (Output A)	S2 (Output B)	Lamp Control
Closed (ON)	Closed (ON)	All 4 Lamps ON (Output A&B ON)
Closed (ON)	Open (OFF)	2 Lamps ON (Output A ON)
Open (OFF)	Closed (ON)	2 Lamps ON (Output B ON)
Open (OFF)	Open (OFF)	All Lamps OFF



High ambient switchable model (90°C case temp.)
49161 QTP 4x54T5HO/UNV PSN HT W

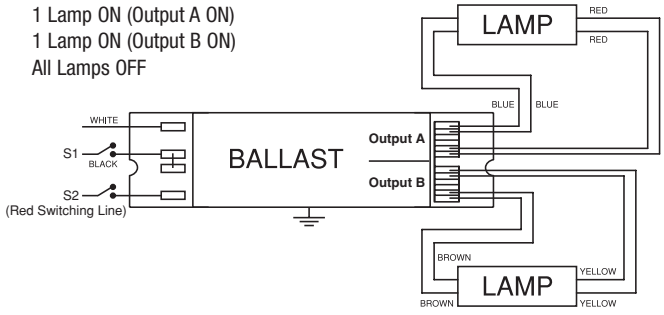
3-Lamp Switching Wiring Diagram (3L to 2L, 3L to 1L)

S1 (Output A)	S2 (Output B)	Lamp Control
Closed (ON)	Closed (ON)	All 3 Lamps ON (Output A&B ON)
Closed (ON)	Open (OFF)	2 Lamps ON (Output A ON)
Open (OFF)	Closed (ON)	1 Lamp ON (Output B ON)
Open (OFF)	Open (OFF)	All Lamps OFF



2-Lamp Switching Wiring Diagram (2L to 1L)

S1 (Output A)	S2 (Output B)	Lamp Control
Closed (ON)	Closed (ON)	2 Lamps ON (Output A&B ON)
Closed (ON)	Open (OFF)	1 Lamp ON (Output A ON)
Open (OFF)	Closed (ON)	1 Lamp ON (Output B ON)
Open (OFF)	Open (OFF)	All Lamps OFF



Item Number — **49161 QTP 4 x 54 T5HO / UNV PSN HTW**
- QUICKTRONIC PROFESSIONAL
- Number of Lamps
- High Ambient Temperature (Case)
- Starting/Ballast Factor
- Line Voltage (120-277V)
- Primary Lamp Wattage

4 LAMP T5HO UNV HT Switchable Ballast

Professional Series

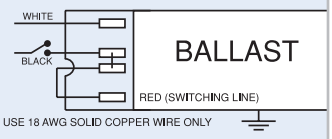
Switching Schematics



Installation Notes

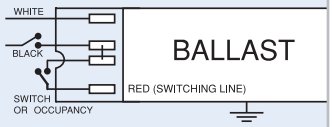
- Install in accordance with National & Local Electric Code
- Ground ballast case
- Switching: Simultaneously disconnect all ungrounded line conductors
- The AC line inputs must be connected to the same phase of the line voltage
- DO NOT CONNECT two separate phases of line voltage to the input of the ballast

Input wiring for non-switching operation
(Install jumper between black & red switching line terminals)



USE 18 AWG SOLID COPPER WIRE ONLY

Input wiring for occupancy sensors
(Install occupancy sensor/switch between black & red line terminals)



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T5HO PSN HT

Specifications subject to change without notice.



Panel 4E — **PANEL SCHEDULE** — PROJECT: IEI 2005-0059

277/480V, 3Ph, 4W. 250A Bus M.L.O. SURFACE MOUNTED 8-Feb-16

Ckt. No.	Description / Location	Load (VA)	Load Type	C.B. Amp	C.B. Pole	Phase	C.B. Amp	C.B. Pole	Load (VA)	Load Type	Description / Location	Ckt. No.
1	LIGHTING – 1ST FLOOR OUTER OFFICES	2,790	L	20	1	A	20	1	2976	L	LIGHTING – 2ND FLOOR OUTER OFFICES	2
3	LIGHTING – 1ST FLOOR INNER OFFICES	2,517	L	20	1	B	20	1	2974	L	LIGHTING – 2ND FLOOR INNER OFFICES	4
5	LIGHTING – 1ST FLOOR INNER OFFICES	2,426	L	20	1	C	20	1	2669	L	LIGHTING – 2ND FLOOR INNER OFFICES	6
7	LIGHTING – 1ST FLOOR LOBBY	1,231	L	20	1	A	20	1	1830	L	LIGHTING – 2ND FLOOR EAC	8
9	LIGHTING – 1ST FLOOR EAC	2,760	L	20	1	B	20	1	1,150	L	LIGHTING – 2ND FLOOR LOBBY	10
17	LIGHTING 1ST FLOOR BATHROOMS	960	L	20	1	C	20	1			SPARE	18

Panel 4LS — **PANEL SCHEDULE** — PROJECT: IEI 2005-0059

277/480V, 3Ph, 4W. 100A Bus M.L.O. SURFACE MOUNTED 28-Jun-16

Ckt. No.	Description / Location	Load (VA)	Load Type	C.B. Amp	C.B. Pole	Phase	C.B. Amp	C.B. Pole	Load (VA)	Load Type	Description / Location	Ckt. No.
1	EMERGENCY LTG – 1ST FLOOR	1,204	L	20	1	A	20	1	1,247	L	EMERGENCY LTG – 2ND FLOOR	2

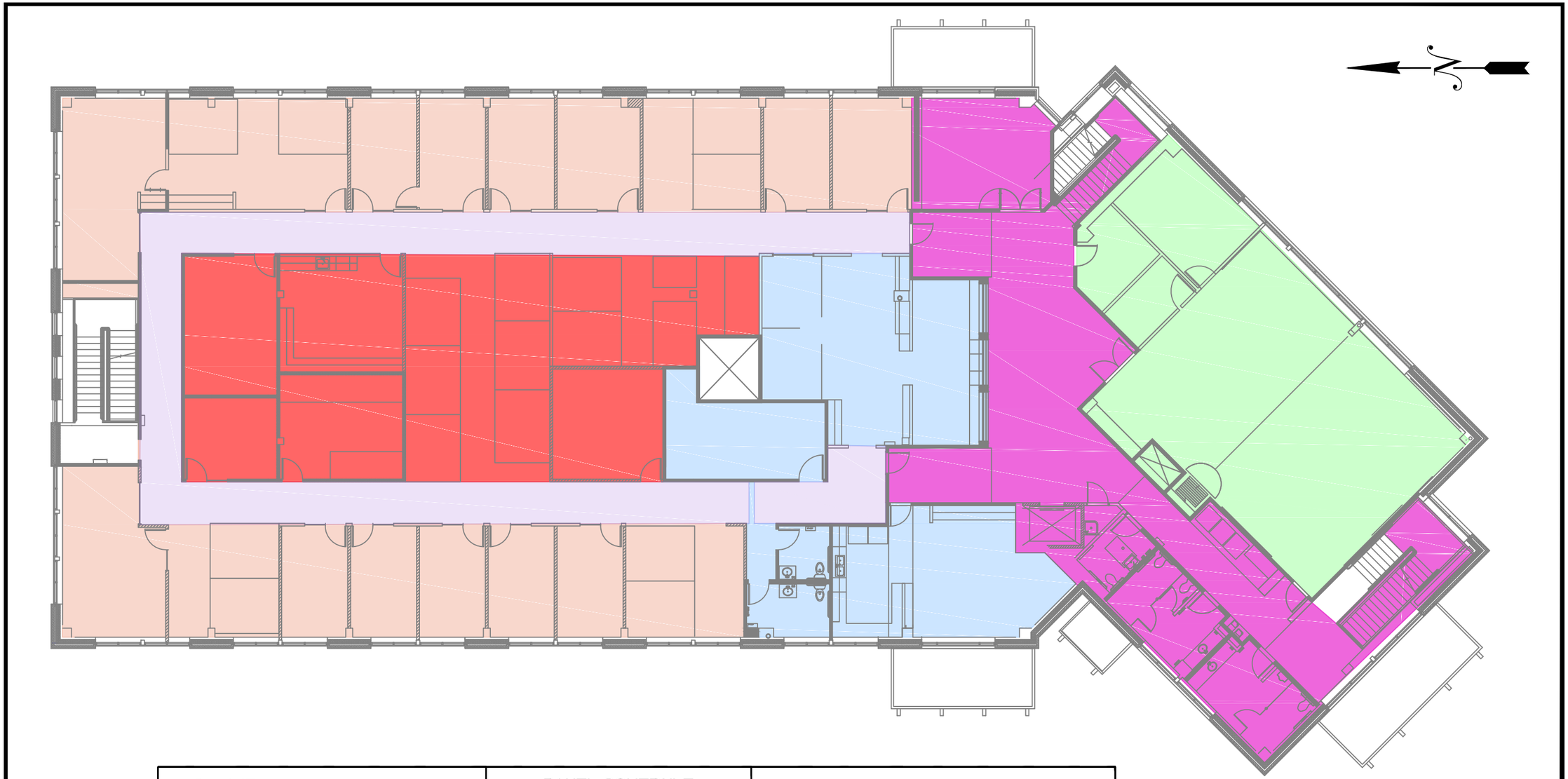
Panel 4M1 — **PANEL SCHEDULE** — PROJECT: IEI 2005-0059 6

277/480V, 3Ph, 4W. 250A Bus M.L.O. SURFACE MOUNTED 7-Sep-16

Ckt. No.	Description / Location	Load (VA)	Load Type	C.B. Amp	C.B. Pole	Phase	C.B. Amp	C.B. Pole	Load (VA)	Load Type	Description / Location	Ckt. No.
37	LIGHTING – PARKING	2,576	L	20	1	A	60	3		L	DIMMING PANEL	38

CAMTECH MANUFACTURING

Building 7 - Upstairs Electrical	12/18/16	N.T.S.	Drawn By: SR	Camtech Manufacturing	Lighting Plan



Panel 4E			PANEL SCHEDULE						PROJECT:	IEI 2005-0059		
277/480V, 3Ph, 4W.		250A Bus	M.L.O.			SURFACE MOUNTED						8-Feb-16
Ckt. No.	Description / Location	Load (VA)	Load Type	C.B. Amp	C.B. Pole	Phase	C.B. Amp	C.B. Pole	Load (VA)	Load Type	Description / Location	Ckt. No.
1	LIGHTING - 1ST FLOOR OUTER OFFICES	2,790	L	20	1	A	20	1	2976	L	LIGHTING - 2ND FLOOR OUTER OFFICES	2
3	LIGHTING - 1ST FLOOR INNER OFFICES	2,517	L	20	1	B	20	1	2974	L	LIGHTING - 2ND FLOOR INNER OFFICES	4
5	LIGHTING - 1ST FLOOR INNER OFFICES	2,426	L	20	1	C	20	1	2669	L	LIGHTING - 2ND FLOOR INNER OFFICES	6
7	LIGHTING - 1ST FLOOR LOBBY	1,231	L	20	1	A	20	1	1830	L	LIGHTING - 2ND FLOOR EAC	8
9	LIGHTING - 1ST FLOOR EAC	2,760	L	20	1	B	20	1	1,150	L	LIGHTING - 2ND FLOOR LOBBY	10
11	RTU-1	11,085	M	70	3	C	20	1			SPARE	12

Panel 4LS			PANEL SCHEDULE						PROJECT:	IEI 2005-0059		
277/480V, 3Ph, 4W.		100A Bus	M.L.O.			SURFACE MOUNTED						28-Jun-16
Ckt. No.	Description / Location	Load (VA)	Load Type	C.B. Amp	C.B. Pole	Phase	C.B. Amp	C.B. Pole	Load (VA)	Load Type	Description / Location	Ckt. No.
1	EMERGENCY LTG - 1ST FLOOR	1,204	L	20	1	A	20	1	1,247	L	EMERGENCY LTG - 2ND FLOOR	2

CAMTECH MANUFACTURING

Building 7 - Downstairs Electrical	12/18/16	N.T.S.	Drawn By: SR	Camtech Manufacturing	Lighting Plan

CAMTECH MANUFACTURING

Manufacturing and Administration Building 7 – First Floor			Quantity	Reference Documents
Main Office	**Light Panel/Circuit**	4E1-1		Lighting Quick Ref p 1-2
	Light Type	FineLite, trough, Series 12-P, S12-I	1	
	Light Bulb	F54T5HO/850	2	
	Light Ballast	QTP 2X54T5HO/Unv Psn	1	T58-29799 p 59-60
	Light Switch			
	Outlet Circuit #	2LS-21		T58-29799 p 61-62
	E-Power Circuit #	2E1-9		T58-29799 p 61-62
	HVAC Zone	FTU1-1		
	Network	P1-5-10 (9-10 covered);TV-2		
	Flooring	Armstrong 51836-031 1'x1' Std Excelon Floor Tile Wh/Gr		
	Ceiling	USG Radar #2742		
	North Wall	Sherwin Williams Flat White Ceiling Paint		
	East Wall	BEHR Premium Plus Ultra Pure White Satin Enamel		
	South Wall	Chalk Type Paint HTP by Heirloom Traditions		
	West Wall	Valspar Optimus Interior – Flat White		
	Hardware			
	Door	Solid Wood Vir. Grain Fir; 8ft non-rated	1	
	Door Frame	Timely	1	
	Door Closer	n/a		
	Door Handle	Schlage L9050 Office Lock	1	
	Door Hinge	Ives 5BB1 Hinge	4	
	Door Misc			
	Miscellaneous			
	Plumbing			

NOTES:

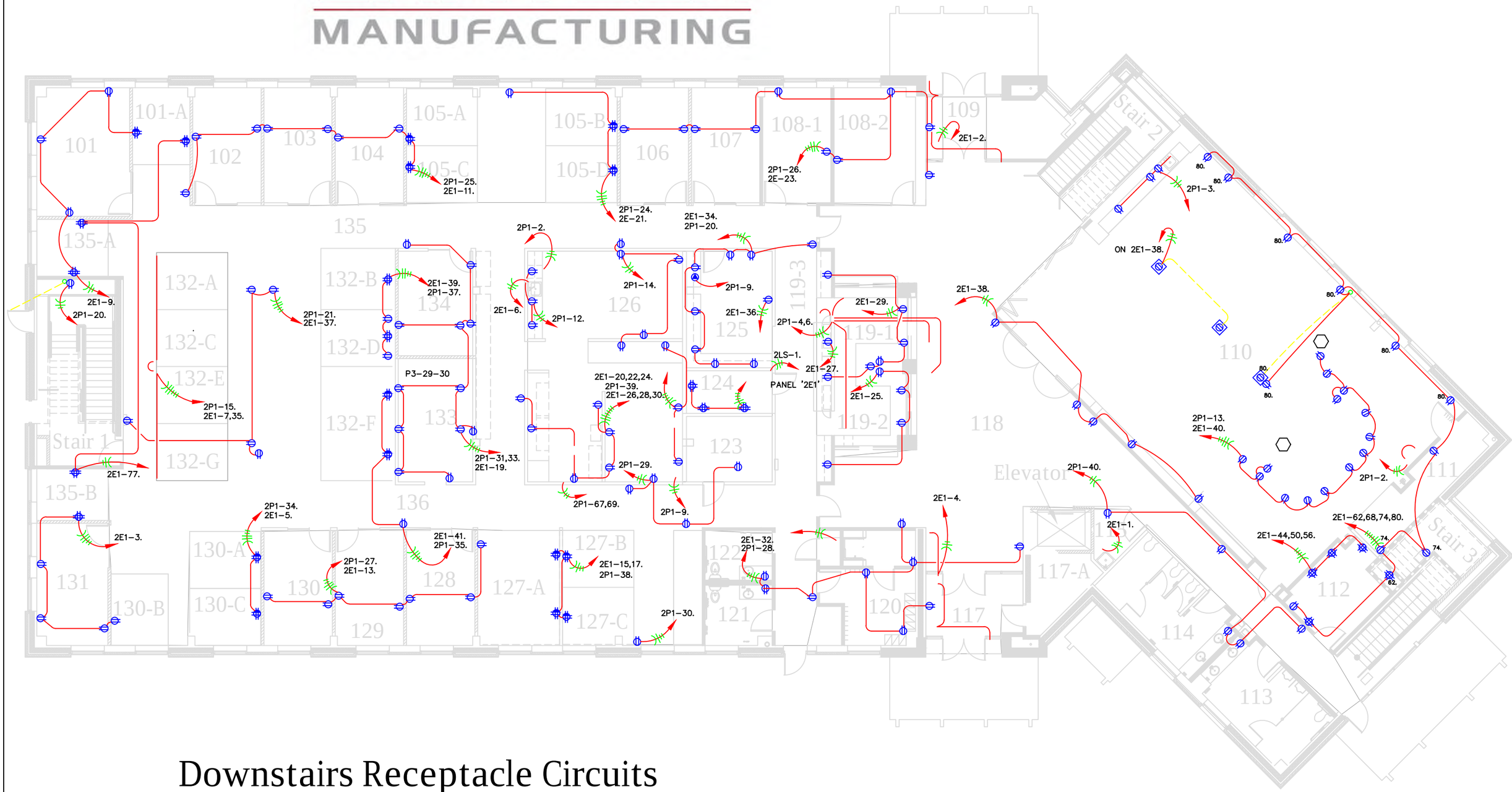
Manufacturing and Administration Building 7 – First Floor

Main Office		
	Light Panel/Circuit	4E1-1
	Light Type	FineLite, trough, Series 12-P, S12-I
	Light Bulb	F54T5HO/850
	Light Ballast	QTP 2X54T5HO/Unv Psn
	Light Switch	
	Outlet Circuit #	2LS-21
	E-Power Circuit #	2E1-9
	HVAC Zone	FTU1-1
	Network	P1-5-10 (9-10 covered);TV-2
	Flooring	Armstrong 51836-031 1'x1' Std Excelon Floor Tile Wh/Gr
	Ceiling	USG Radar #2742
	North Wall	Sherwin Williams Flat White Ceiling Paint
	East Wall	BEHR Premium Plus Ultra Pure White Satin Enamel
	South Wall	Chalk Type Paint HTP by Heirloom Traditions
	West Wall	Valspar Optimus Interior – Flat White
	Hardware	
	Door	Solid Wood Vir. Grain Fir; 8ft non-rated
	Door Frame	Timely
	Door Closer	n/a
	Door Handle	Schlage L9050 Office Lock
	Door Hinge	Ives 5BB1 Hinge
	Door Misc	
	Miscellaneous	
	Plumbing	

NOTES:

Quantity
1
2
1
1
1
1
4

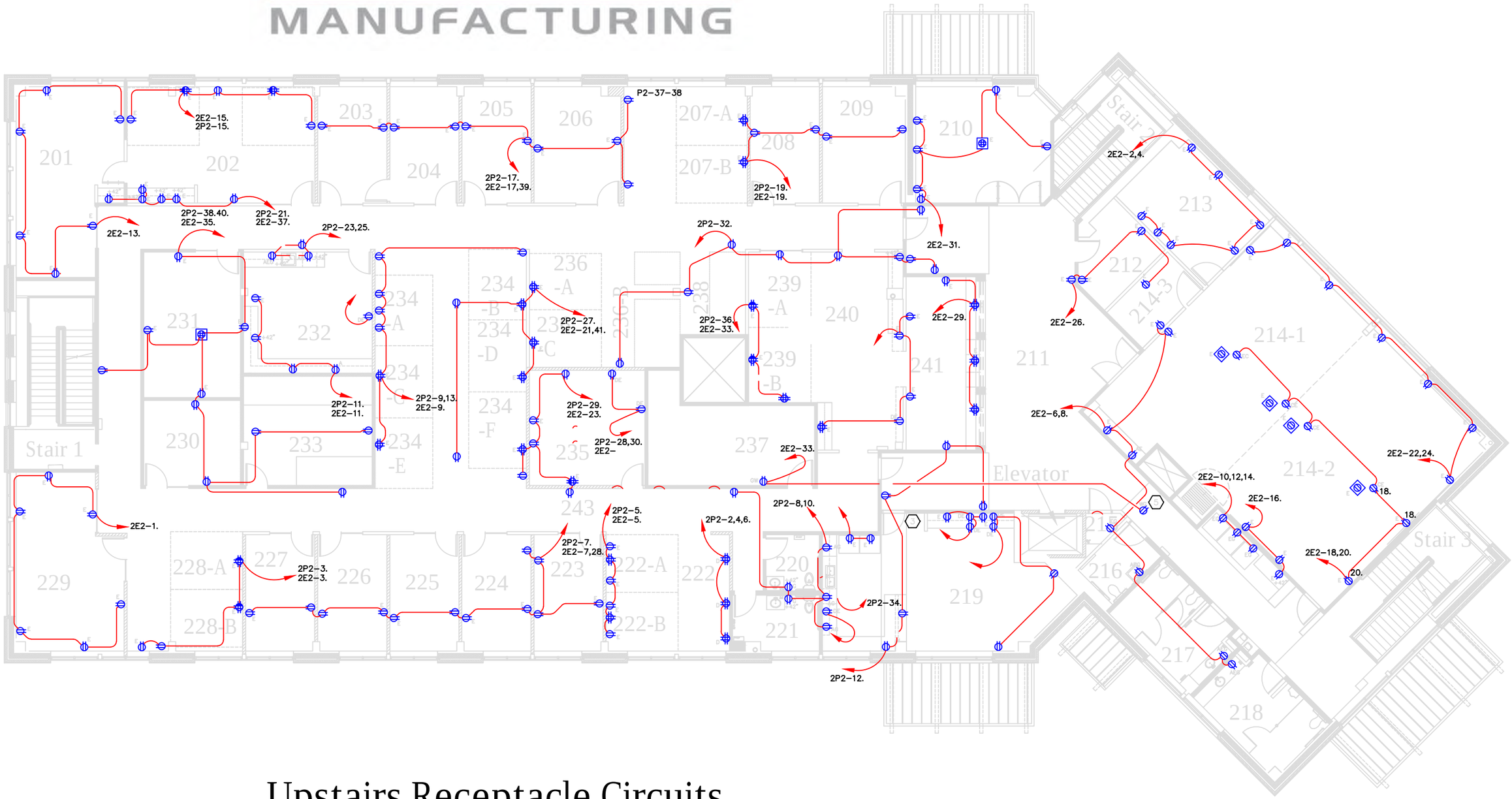
CAMTECH
MANUFACTURING



Downstairs Receptacle Circuits

Building 7 - Downstairs	12/18/16	N.T.S.	Drawn By: SR	Camtech Manufacturing Outlet Circuit Layout

CAMTECH
MANUFACTURING



Upstairs Receptacle Circuits

Building 4 - Upstairs	12/18/16	N.T.S	Drawn By: SR	Camtech Manufacturing Outlet Circuit Layout

Gray Bear Construction

CAMTECH
MANUFACTURING

BOILER

O & M MANUAL

7809 Industrial Boulevard
Atlanta, GA 30301

P.O. Box 4365
Atlanta, GA 30301

Gray Bear Construction

TABLE OF CONTENTS

1. City of Atlanta Permit
2. CSD-1 Reports
3. Air Balancing Report
4. American Marsh End Suction Pumps
5. Controls
6. Boiler Flue
7. Warranty

P.O. Box 4568 * Atlanta, GA 30301 * 404.555.1212 * Fax 404.555.1313

Fulton County Government
Department of Planning & Community Services
Fulton County Government Service Center
5440 Fulton Industrial Boulevard
Atlanta, GA 30336
O: 404-612-7800
W: http://www.fultoncountyga.gov/fcpcsd-home

Date: 03/29/2016

Building Permit: # X

Sewer Permit: #

Set: # N/A

FACILITY PERMIT

06-183646-000-00-FA

Site Address: 7809 Industrial Boulevard, Atlanta, Georgia 30301 **Issued:** 03/29/2016

MW-Boiler Install:Boiler 2624901:Interstate S:Interstate

PROJECT INFORMATION		Occ. Group	Const. Type
Mechanical	Alteration		

Project Description: F6/PR# Boiler/Boiler Install

APPLICANT	GRAY BEAR CONSTRUCTION CO	Phone	(404) 282-2116
PROPERTY OWNER	CAMTECH MANUFACTURING	Phone	
CONTRACTOR	ONEILL ELECTRIC INC.	Phone	

Project Details

Building/Mechanical Inspector	FAIRBAND
Code Edition Commercial (Year)	1999
Fire Marshal	BOYLESG
Plumbing Inspector	SHABAZZM
Zoning - Property (1)	TBD

Project Details

Code Edition (Year)	1997
Electrical Inspector	RISERJ
Folder Name	Emergency Boiler In
Project Reference Number	Boiler

FOR INSPECTION CONTACT Fairbanks,Don at 404-823-2310. Fire protection systems shall be maintained according to the original installation standards. Such system shall not be extended, altered, renovated or repaired without prior approval from the Fire Marshal's Office. Fire alarm notification shall comply with adopted codes and standards at time of new work. For information contact Gary Boyles at 404-209-8228..

This permit expires if, at any time, 180 days pass without an approved inspection. If you are not able to obtain an inspection approval within 180 days, you may request a one-time only extension of 180 days by calling 404-823-5521.

BEFORE YOU DIG

ATTENTION: Oregon law requires you to follow rules adopted by the Oregon Utility Notification Center. Those rules are set forth in OAR 952-001-0010 through OAR 952-001-0090. You may obtain copies of the rules by calling the center. (Three business days, not including weekends and holidays, before excavation.)

CITY CONTACT

E-Mail:

Phone:

Fax: (404) 823-4172

INSPECTION REQUEST PHONE NUMBERS

TDD: (404) 823-6868

IVR Inspection Request Number:

Contact your inspector directly for inspection requests.

BOILER # 1

APPENDIX C
MANUFACTURER'S/INSTALLING CONTRACTOR'S REPORT FOR ASME CSD-1

(a)

CERTIFICATION AND REPORTING (CG-500)
CONTROLS AND SAFETY DEVICES

(This Form is a guideline and is not part of ASME CSD-1)

UNIT MANUFACTURER
Name GASMASTER
Address BLDG-8 15050 54A AVE. SURREY BC Zip V3S5X7
Telephone _____ FAX _____

UNIT IDENTIFICATION (Boiler)
Manufacturer's Model # GM14M Year Built 30/11/2015
ASME # _____ Nat. Bd. # 648
UL # _____ AGA # _____
Jurisdiction _____

STEAM		HOT WATER	
Max. W.P.	psig	Max. W.P. 160	psig
Min. Safety Valve Cap.	PPH	Max. temp. 210	deg. F
		Min. Safety Relief Valve Cap. 5212	PPH or Btu

BOILER UNIT DESCRIPTION (TYPE) HOT WATER
If Modular (No. of Modules) _____
BOILER UNIT CAPACITY (OUTPUT) 3,800,000 BTU/HR

Burner - Manufacturer RIELLO Model RS100
UL or AGA # MP3252 UL Serial # 06W 952530922042

FUELS (as shipped) NATURAL GAS

INSTALLATION LOCATION (if known)
Customer Name _____
Address _____
City _____ State _____ Zip _____
Telephone _____ FAX _____

Control/Device	Manufacturer	Model #	Operational Test Performed, Date
OPERATING CONTROLS			
Low-Water Fuel Cutoff CW-120 (a), CW-140	NA		
Forced Circulation CW-210(a)	NA		
Steam Pressure CW-310 (b)	NA		
Water Temperature CW-410 (b)	SIEMENS	RWF40	12-30-06
SAFETY CONTROLS			
Low-Water Fuel Cutoff CW-120(a), CW-120(b), CW-130, CW-140	ITT	PS851M-120	12-30-06
Forced Circulation CW-210(b)	NA		
High Steam Pressure Limit CW-310(c)	NA		
High Water Temperature Limit CW-410(c)	HONEYWELL	L4006E-1042	12-30-06
* Fuel Safety Shutoff Valve, Main CF-180(b)(2), CF-180(b)(3)	HONEYWELL	V4055A 1031	12-30-06
Pilot Safety Shutoff Valve CW-180(2), CW-180(3)	ASCO	SV311A02V6LFS	12-30-06
Atomizing Medium Switch CF-450(b)	NA		
Combustion Air Switch CF-220	DUNGS		12-30-06
High Gas Pressure CF-162	DUNGS		12-30-06
Low Gas Pressure CF-162	ANTUNES		12-30-06
Low Oil Pressure CF-450(a)	NA		
High Oil Temperature CF-450(c)	NA		
Low Oil Temperature CF-450(d)	NA		
Purge Air Flow CF-210	SIEMENS		12-30-06
Flame Safeguard (primary) CF-310, CF-320	SIEMENS	LFL1.335-110V	12-30-06
Flame Detector CF-310, CF-320	FLAME ROD		12-30-06
LOW FIRE START			
Low Fire Start Switch CF-610	SIEMENS		12-30-06

* SECONDARY MAIN FUEL SAFETY SHUT-OFF — HONEYWELL U4055A 1031

CONTROLS AND SAFETY DEVICES
FOR AUTOMATICALLY FIRED BOILERS

ASME CSD-1a-1993

SAFETY OR SAFETY RELIEF VALVE(S)
CW-510, CW-520

Manufacturer CONBRACO
Model 10-606
Size 1¼"
Capacity 2,390,000 PPH/Btu/hr

OPERATIONAL TEST
PERFORMED, DATE NEW

Representing Equipment Manufacturer, Name GARY JAECKEL GVA NORTHWEST LLC
Signature Gary Jaeckel
Date

Representing Installing Contractor, Name
Signature
Date

GENERAL NOTE: Units with capacities of 400,000 Btuh or less comply with Part CR-110 and CR-200.

FORM H-3 MANUFACTURER'S DATA REPORT FOR WATERTUBE BOILERS
As Required by the Provisions of the ASME Code Rules, Section IV

1-Manufactured and certified by GASMASTER INDUSTRIES INC. Bldg. 8,15050 54a Avenue,Surrey, BC,Canada V3S 5X7
(name and address of manufacturer)

2-Manufactured for STOCK
(name and address of purchaser)

3-Location of Installation UNKNOWN
(name and address)

4-Unit Identification BOILER MODEL GMI 4M C (complete boiler,superheater,waterwall,etc) | 279.03 (mfr's serial no.) | K2841.1257890YTN (CRN) | GM4M.01.00.00 AD(C) REVISION 32 (Drawing no.) | 648 (Nat'l Bd no) | 2006 (Year built)

5-The chemical and physical properties of all parts meet the requirements of material specifications of the ASME BOILER AND PRESSURE VESSEL CODE. The design,construction and workmanship conform to ASME Code,Section IV. 2004 (year) July1,2005 (addenda(date)) N/A (Code Case no.)

6-(a) Drums: N/A

No.	Inside Diameter in	Inside Length ft in	Shell Plates Mat'l Spec Grade	Shell Plates Thickness (in)	Shell Plates Inside Radius (in)	Tube Sheets Thickness (in)	Tube Sheets Inside Radius (in)	Tube Hole Ligament Efficiency % Longitudinal	Tube Hole Ligament Efficiency % Circumferential
1									
2									

No.	Longitudinal Joints* No. & Type*	Longitudinal Joints* Effi-ciency	Circum. Joints No. & Type*	Circum. Joints Effi-ciency	Heads Mat'l Spec Grade	Heads Thickness (in)	Heads Type**	Heads Radius of Dish	Hydrostatic Test, psi
1									
2									

*Indicate if (1)seamless,(2)fusion welded **Indicate if (1)flat,(2)dished,(3)ellipsoidal,(4)hemispherical

6-(b) Boiler tubes:

Diameter	Thickness	Mat'l Spec. Grade	No.	How Attached
1.25" OD	0.065"	SA249 TP 316/316L	12 COILS	WELDED

6-(c) Headers no. 2 PIPE 6"sch 40,SA312-TP316 /316L
(box,or sinuous or round, mat'l spec no. thickness)
Heads or ends Cap Sch40,SA403,WP-W TP 316/316L Hydro test, psi 240
(shape, mat'l spec no. thickness)

6-(d) Stay bolts N/A
(mat'l spec no. diameter, size telltale, net area)
Pitch in. Net area sq. in. Design pressure psi
(supported by one bolt)

6-(e) Mud drum: N/A (for sect header boilers state size shape mat'l spec no thickness) Heads or ends N/A (shape mat'l spec no thickness) Hydro test, psi

7-Waterwall headers: N/A

No.	Size and Shape	Material Spec No. Gr.	Thickness in	Shape	Thickness in	Material Spec No. Gr.	Hydro Test psi	Diameter in	Thickness in	Material Spec No. Gr.
1										
2										
3										

8-(a) Other parts (1)Tube Sheet (2) (3) 8-(b) Tubes for other parts N/A

No.	Shape	Material Spec. No. Gr.	Thickness in	Hydro test psi	Diameter in	
1	Round	ASME SA 240 TP316/316L	3/4	240	27	
2						

9-Nozzles, Inspection and safety valve openings

Purpose (inlet,outlet,drain,etc)	No.	Dia or Size	Type	How Attached	Mat'l	Nom Thickness	Reinforcement Mat'l	Location
Handhole up to 3"x 4"	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Manhole	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
RELIEF VALVE	2	1-1/2"	FPT	NPT				TOP MANIFOLD
INLET	1	4"	Flange	Welded				
OUTLET	1	4"	Flange	Welded				

FORM H-3 (Back)

10-

		MAWP	Maximum Water Temp.	Shop Hydro Test psi	Heating Surface sq ft
a	Boiler	160 PSI	210 deg F	240	521.2
b	Waterwall				
c	Superheater				
d	Other parts				

{ Heating surface to be stamped on drum heads

{ This heating surface not to be used for determining minimum safety valve capacity

11 - Field Hydro Test psi

12-Manufacturer's Partial Data Reports properly identified and signed by Commissioned Inspectors have been furnished for the following items of this report:

(name of part, item number, mfr's name, and identifying stamp)

13-Remarks: A=46.4 SQuare mater

CERTIFICATE OF SHOP COMPLIANCE

We certify that the statements made in this data report are correct and that all details of design, material, construction and workmanship of this boiler conform to Section IV of the ASME BOILER AND PRESSURE VESSEL CODE.

H Certificate of Authorization no. #31,367 expires SEPTEMBER 15,2008

Date 2006/10/18 Signed _____ (by representative) Name GASMASTER INDUSTRIES INC. (manufacturer that constructed and certified boiler)

CERTIFICATE OF SHOP INSPECTION

Boiler constructed by GASMASTER INDUSTRIES INC. at BLDG. 8,15050 64a AVE.SURREY,BC,CANADA

I, the undersigned holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and/or the state or province of BRITISH COLUMBIA and employed by British Columbia Safety Authority

have inspected parts of this boiler referred to as data items 6.(b), 6.(c), 9.(a), 9 and

have examined Manufacturer's Partial Data Reports for items

and state that, to the best of my knowledge and belief, the manufacturer has constructed this boiler in accordance with Section IV of the ASME BOILER and PRESSURE VESSEL CODE.

By signing this certificate neither the inspector nor his employer makes any warranty, expressed or implied, concerning the boiler described in this manufacturer's Data Report. Furthermore, neither the inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date 2006/11/08 Signed _____ (Authorized Inspector) Commissions #12347A BC#75 (Nat'l Bd (incl. endorsements) state, prov. and no.)

CERTIFICATE OF FIELD ASSEMBLY COMPLIANCE

We certify that the field assembly construction of all parts of this boiler conforms with the requirements of SECTION IV of the ASME BOILER AND PRESSURE VESSEL CODE.

H Certificate of Authorization no. _____ expires _____

Date _____ Signed _____ (by representative) Name _____ (assembler that certified and constructed field assembly)

CERTIFICATE OF FIELD ASSEMBLY INSPECTION

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and/or the state or province of _____ and employed by _____

have compared statements in this Manufacturer's Data Report with the described boiler and state that the parts referred to as data items _____ not included in the certificate of shop inspection, have been inspected by me and that to the best of my knowledge and belief the manufacturer and/or the assembler has constructed and assembled this boiler in accordance with Section IV of the ASME BOILER AND PRESSURE VESSEL CODE. The described boiler was inspected and subjected to a hydrostatic test of _____ psi.

By signing this certificate neither the inspector nor his employer makes any warranty, expressed or implied, concerning the boiler described in this manufacturer's Data Report. Furthermore, neither the inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date _____ Signed _____ (Authorized Inspector) Commissions _____ (Nat'l Bd (inc endorsement) state, prov. and no.)

Boiler #2

APPENDIX C
MANUFACTURER'S/INSTALLING CONTRACTOR'S REPORT FOR ASME CSD-1

(a)

CERTIFICATION AND REPORTING (CG-500) CONTROLS AND SAFETY DEVICES

(This Form is a guideline and is not part of ASME CSD-1)

UNIT MANUFACTURER
Name GASMASTER
Address Bldg. 8 15050 54A. AVE. SURREY BC Zip V3S5X7
Telephone _____ FAX _____

UNIT IDENTIFICATION (Boiler)
Manufacturer's Model # GMH4M Year Built 30/11/06
ASME # _____ Nat. Bd. # _____
UL # _____ AGA # _____
Jurisdiction _____

STEAM
Max. W.P. _____ psig
Min. Safety Valve Cap. _____ PPH

HOT WATER
Max. W.P. 160 psig
Max. temp. 210 deg. F
Min. Safety Relief Valve Cap.
5212 PPH or ~~Btu~~

BOILER UNIT DESCRIPTION (TYPE) HOT WATER
If Modular (No. of Modules) _____
BOILER UNIT CAPACITY (OUTPUT) 3,822,000 BTU/HR

Burner - Manufacturer RIELLO Model RS100
UL or AGA # MB3352AN Serial # 06L9253 0000015

FUELS (as shipped) NATURAL GAS

INSTALLATION LOCATION (if known)
Customer Name _____
Address _____
City _____ State OR Zip _____
Telephone _____ FAX _____

Control/Device	Manufacturer	Model #	Operational Test Performed, Date
OPERATING CONTROLS			
Low-Water Fuel Cutoff CW-120 (a), CW-140	NA		
Forced Circulation CW-210(a)	NA		
Steam Pressure CW-310 (b)	NA		
Water Temperature CW-410 (b)	SIEMENS	RWF40	12-30-06
SAFETY CONTROLS			
Low-Water Fuel Cutoff CW-120(a), CW-120(b), CW-130, CW-140	ITT	PS851M-120	12-30-06
Forced Circulation CW-210(b)	NA		
High Steam Pressure Limit CW-310(c)	NA		
High Water Temperature Limit CW-410(c)	HONEYWELL	L4006E-1042	12-30-06
* Fuel Safety Shutoff Valve, Main CF-180(b)(2), CF-180(b)(3)	HONEYWELL	V4055A 1031	12-30-06
Pilot Safety Shutoff Valve CW-180(2), CW-180(3)	ASCO	SV311A02N6LF5	12-30-06
Atomizing Medium Switch CF-450(b)	NA		
Combustion Air Switch CF-220	DUNGS		12-30-06
High Gas Pressure CF-162	DUNGS		12-30-06
Low Gas Pressure CF-162	ANTUNES		12-30-06
Low Oil Pressure CF-450(a)	NA		
High Oil Temperature CF-450(c)	NA		
Low Oil Temperature CF-450(d)	NA		
Purge Air Flow CF-210	SIEMENS		12-30-06
Flame Safeguard (primary) CF-310, CF-320	SIEMENS	LFL1.335-110V	12-30-06
Flame Detector CF-310, CF-320	FLAME ROD		12-30-06
LOW FIRE START			
Low Fire Start Switch CF-610	SIEMENS		12-30-06

* SECONDARY MAIN FUEL SAFETY SHUT-OFF — HONEYWELL — V4055A 1031

B-2

CONTROLS AND SAFETY DEVICES
FOR AUTOMATICALLY FIRED BOILERS

ASME CSD-1a-1993

SAFETY OR SAFETY RELIEF VALVE(S)
CW-510, CW-520
Manufacturer CONBRACO
Model 10-606
Size 1½"
Capacity 4,396,000 PPH/Btu/hr

OPERATIONAL TEST
PERFORMED, DATE NEW

Representing Equipment Manufacturer, Name GARY JAECKEL GVA NORTHWEST LLC
Signature
Date 12-30-06

Representing Installing Contractor, Name
Signature
Date

GENERAL NOTE: Units with capacities of 400,000 Btuh or less comply with Part CR-110 and CR-200.

FORM H-3 MANUFACTURER'S DATA REPORT FOR WATERTUBE BOILERS
As Required by the Provisions of the ASME Code Rules, Section IV

1-Manufactured and certified by GASMASTER INDUSTRIES INC, Bldg. 8,15050 54a Avenue,Surrey, BC,Canada V3S 5X7
(name and address of manufacturer)

2-Manufactured for STOCK
(name and address of purchaser)

3-Location of installation UNKNOWN
(name and address)

4-Unit Identification BOILER MODEL GMI 4M C (complete boiler,superheater,waterwall,etc) | 252.04 (mfr's serial no.) | K2641.1 (CRN) | GM4M.01.00.00 AD(C) REVISION 24 (Drawing no.) | 619 (Nat'l Bd no) | 2008 (Year built)

5-The chemical and physical properties of all parts meet the requirements of material specifications of the ASME BOILER AND PRESSURE VESSEL CODE. The design,construction and workmanship conform to ASME Code,Section IV. 2004 (Year) | July1,2008 (addenda(date)) | N/A (Code Case no.)

6-(a) Drums : N/A

No.	Inside Diameter in	Inside Length Ft	Inside Length in	Shell Plates Mat'l Spec Grade	Shell Plates Thickness (in)	Shell Plates Inside Radius (in)	Tube Sheets Thickness (in)	Tube Sheets Inside Radius (in)	Tube Hole Ligament Efficiency % Longitudinal	Tube Hole Ligament Efficiency % Circumferential
1										
2										

No.	Longitudinal Joints No. & Type*	Longitudinal Joints Effi-ciency	Circum. Joints No. & Type*	Circum. Joints Effi-ciency	Heads Mat'l Spec Grade	Heads Thickness (in)	Heads Type**	Heads Radius of Dish	Hydrostatic Test, psi
1									
2									

*Indicate if (1)seamless,(2)fusion welded **Indicate if (1)flat,(2)dished,(3)ellipsoidal,(4)hemispherical

6-(b) Boiler tubes :

Diameter	Thickness	Mat'l. Spec. Grade	No.	How Attached
1.25" OD	0.065"	SA249 TP 316/316L	12 COILS	WELDED

6-(c) Headers no. 2 PIPE 6"sch 40,SA312-TP316 /316L (box,or sinuous or round, mat'l spec no. thickness)
Heads or ends Cap Sch40,SA403,WP-W TP 316/316L (shape, mat'l spec no, thickness) Hydro test, psi 240

6-(d) Stay bolts N/A (mat'l spec no. diameter, size fe/tale, net area)
Pitch ____ in. Net area ____ sq. in. (supported by one bolt) Design pressure ____ psi

6-(e) Mud drum : N/A (for sect header boilers state size shape mat'l spec no thickness) Heads or ends N/A (shape mat'l spec no thickness) Hydro test, psi ____

7-Waterwall headers : N/A

No.	Size and Shape	Material Spec No. Gr.	Thickness in	Shape	Thickness in	Material Spec No.Gr.	Hydro Test psi	Diameter in	Thickness in	Material Spec No. Gr.
1										
2										
3										

8- (a) Other parts (1) Tube Sheet (2) _____ (3) _____ 8- (b) Tubes for other parts N/A

No.	Shape	Material Spec. No. Gr.	Thickness in	Hydro test psi	Diameter in	
1	Round	ASME SA 240 TP316/316L	3/4	240	27	
2						

9- Nozzles, inspection and safety valve openings

Purpose (inlet,outlet,drain,etc)	No.	Dia or Size	Type	How Attached	Mat'l	Nom Thickness	Reinforcement Mat'l	Location
Handhole up to 3"x 4"	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Manhole	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
RELIEF VALVE	1	1-1/4"	FPT	NPT				TOP MANIFOLD
INLET	1	4"	Flange	Welded				
OUTLET	1	4"	Flange	Welded				

FORM H-3 (Back)

10-

		MAWP	Maximum Water Temp.	Shop Hydro Test psi	Heating Surface sq ft	
a	Boiler	160 PSI	210 deg F	240	521.2	Heating surface to be stamped on drum heads
b	Waterwall					This heating surface not to be used for determining minimum safety valve capacity
c	Superheater					
d	Other parts					

11 Field Hydro Test psi

12-Manufacturer's Partial Data Reports properly identified and signed by Commissioned Inspectors have been furnished for the following items of this report:

(name of part, item number, mfr's name, and identifying stamp)

13-Remarks: A=48.4 Square meter

CERTIFICATE OF SHOP COMPLIANCE

We certify that the statements made in this data report are correct and that all details of design, material, construction and workmanship of this boiler conform to Section IV of the ASME BOILER AND PRESSURE VESSEL CODE.

H" Certificate of Authorization no. #31,367 expires SEPTEMBER 15,2008

Date 2006/05/14 Signed (by representative) Name GASMASTER INDUSTRIES INC. (manufacturer that constructed and certified boiler)

CERTIFICATE OF SHOP INSPECTION

ler constructed by GASMASTER INDUSTRIES INC. at BLDG. 8,15050 64a AVE.SURREY,BC,CANADA

ie undersigned holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and/or the state or province of BRITISH COLUMBIA and employed by British Columbia Safety Authority

have inspected parts of this boiler,referred to as data items 6(b), 6(c), 8(a), 9 and

have examined Manufacturer's Partial Data Reports for items

and state that, to the best of my knowledge and belief, the manufacturer has constructed this boiler in accordance with Section IV of the ASME BOILER and PRESSURE VESSEL CODE.

By signing this certificate neither the Inspector nor his employer makes any warranty, expressed or implied,concerning the boiler described in this manufacturer's Data Report. Furthermore neither the Inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date Aug. 14/06 Signed (Authorized Inspector) Commissions 8994A BC77 (Nat'l Bd.(incl. endorsements) state, prov. and no.)

CERTIFICATE OF FIELD ASSEMBLY COMPLIANCE

We certify that the field assembly construction of all parts of this boiler conforms with the requirements of SECTION IV of the ASME BOILER AND PRESSURE VESSEL CODE.

H" Certificate of Authorization no. expires

Date Signed (by representative) Name (assembler that certified and constructed field assembly)

CERTIFICATE OF FIELD ASSEMBLY INSPECTION

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and/or the state or province of and employed by

have compared statements in this Manufacturer's Data Report with the described boiler and state that the parts referred to as data items not included in the certificate of shop inspection, have been inspected by me and that to the best of my knowledge and belief the manufacturer and/or the assembler has constructed and assembled this boiler in accordance with Section IV of the ASME BOILER AND PRESSURE VESSEL CODE. The described boiler was inspected and subjected to a hydrostatic test of psi.

By signing this certificate neither the Inspector nor his employer makes any warranty, expressed or implied, concerning the boiler described in this manufacturer's Data Report. Furthermore, neither the Inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date Signed (Authorized Inspector) Commissions (Nat'l Bd (inc endorsement) state, prov. and no.)

PACIFIC COAST AIR BALANCING

32637 NE HAUGEN RD., ATLANTA GA 30301

Phone: 404-537-0826 Fax: 404-537-0832

LIC # 134375 OR LIC # PACIFCA012JR WA

December 25, 2016

Camtech Manufacturing
Boiler Installation

BALANCING SUMMARY

In January 2007, PCAB met with Gray Bear Construction and Johnson Controls to test and balance HWP-3 and HWP-4 on the new boilers installed. As sown on PCAB's balancing log, these pumps were set to four different conditions. The pump Htz/speed and GPMs are recorded on the following pump report page.

Please contact our office if you have any questions.

Vern Hudson
TAB Technician

PACIFIC COAST AIR BALANCING

32637 NE HAUGEN RD., NEWBERG, OR 97132

Phone: 503-537-0826 Fax: 503-537-0832

LIC # 134375 OR LIC # PACIFCA012JR WA

TEST AND BALANCE REPORT

Project Name: Medical Center and Hospital Boilers

Location: Wellness City, OR

Architect: N/A

Engineer: Munro & Associates

Contractor: Gray Bear Construction

This is to certify that Pacific Coast Air Balancing has balanced the systems described herein to their optimum performance capabilities. The testing and balancing has been performed in accordance with the standard requirements and procedures of the Associated Air Balance Council and the results of these tests are herein recorded, except where footnoted.

Associated Air Balance Council Certification Number: 04-02-02

Date: December 15, 2016

Pacific Coast Air Balance Co. ASSOCIATED AIR BALANCE COUNCIL TBE 04-02-02 Denny Whitzel

Denny N. Whitzel
Test and Balance Engineer

AABC

Associated Air Balance Council

Annual Certificate

Awarded to

Denny Whitzel

Pacific Coast Air Balance Co.

In recognition of his qualifications as a

Certified Test and Balance Engineer

under the rules, regulations, and requirements of the Associated Air Balance Council. The above named is fully authorized to perform total system balance in accordance with the standards as established by the AABC and as a member of the Associated Air Balance Council for the year

2016

This registration number 04-02-02 is fully recognized by the bylaws and charter of this professional association. Certification is renewable on an annual basis after examination of the agency's record for the preceding year. This certificate expires December 31, 2017.

ASSOCIATED AIR BALANCE COUNCIL ★ AABC ★ 2007 ★

Mike Young
President

Kenneth M Duffka
Executive Director

PACIFIC COAST AIR BALANCING

CIRCULATING WATER PUMP DATA

JOB NAME MEDICAL CENTER AND HOSPITAL BOILERS		PAGE # 1
TECHNICIANS DW, VH, SV	P.C.A.B. JOB # 1347	DATE 01/07

	1	2	3	4	5	6	7	8
PUMP #	(#2) HWP-3	(#2) HWP-4	(#3) HWP-3	(#3) HWP-4	(#4) HWP-3	(#4) HWP-4	(#5) HWP-3	(#5) HWP-4
SERVING	BOILERS	BOILERS	BOILERS	BOILERS	BOILERS	BOILERS	BOILERS	BOILERS
PUMP MFG	MARSH	MARSH	MARSH	MARSH	MARSH	MARSH	MARSH	MARSH
MODEL #	3X37REI	3X37REI	3X37REI	3X37REI	3X37REI	3X37REI	3X37REI	3X37REI
SPEC. GPM	56	56	256	256	256	256	256	256
SPEC. TDH FT	29'	29'	29'	29'	29'	29'	29'	29'
MTR MFG	INDUSTRAIL	INDUSTRAIL	INDUSTRAIL	INDUSTRAIL	INDUSTRAIL	INDUSTRAIL	INDUSTRAIL	INDUSTRAIL
HP	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
RPM	12 HTZ	15 HTZ	49 HTZ	50 HTZ	49 HTZ	50 HTZ	49 HTZ	50 HTZ
VOLTAGE	460/3	460/3	460/3	460/3	460/3	460/3	460/3	460/3
SPEC. AMPS	3.86	3.86	3.86	3.86	3.86	3.86	3.86	3.86
ACT. AMPS	0.90	0.80	2.60	2.60	2.60	2.70	2.90	2.90
SUCT. PSI	(#1)	(#1)	5.40	5.50	1.20	1.30	7.00	7.20
DISC. PSI	(#1)	(#1)	17.9	7.20	10.6	10.9	17.1	17.2
DELTA PSI	(#1)	(#1)	12.5	12.7	9.40	9.60	10.1	10.0
ACT. GPM	56	56	258	254	200	208	132	129
ACT. TDH FT	N/A	N/A	28.8'	29.3'	21.7'	22.2'	23.4'	23.2'
BLOCK OFF TDH	N/A	N/A	38.3	38.5	N/A	N/A	N/A	N/A
IMPELLAR SIZE	6.0"	6.0"	6.0"	6.0"	6.0"	6.0"	6.0"	6.0"

REMARKS: N/A = NON APPLICABLE/ACCESSIBLE THE FOLLOWING ARE THE CONDITIONS THAT WERE USED TO MEASURE THESE PUMPS/BOILERS. (#1) PCAB COULD NOT CALCULATE THE LOW FLOW USING PUMP CURVE. PCAB USED THE B&G 4" CIRCUIT SETTER TO OBTAIN FLOW RATES. THE B&G CIRCUIT SETTER WAS AT A 50% OPEN SETPOINT. HWP-3 HAD 0.5' = 56 GPM, HWP-4 HAD 0.5' = 56 GPM. (#2) THIS WAS THE MINIMUM FLOW FOR HWP-3 & HWP-4, THE VAV's HEATING WATER VALVES WERE CLOSED. (#3) ONE BOILER PUMP RUNNING, ONE SECONDARY PUMP RUNNING. (#4) ONE BOILER PUMP RUNNING, THREE SECONDARY PUMPS RUNNING. (#5) TWO BOILER PUMPS RUNNING, ONE SECONDARY PUMP RUNNING.

GVA NW

PUMP DATA SHEET

American-Marsh Pumps

11/01/06

Selection list: —

Search Criteria:
Flow: 256 US gpm
Head: 29 ft
Tolerance: — % of head

Fluid: Water
Temperature: 60 °F
SG: 1
Viscosity: 1.105 cP
Vapor pressure: 0.2563 psi a
Atm pressure: 14.7 psi a

NPSHa: — ft

Advanced Criteria:
Preferred Operating Area: —
Secondary Operating Point: —
Max temperature: — °F
Max suction pressure: — psi g
Max sphere size: — in
Max power: — bhp
Max suction specific speed: — (Nss)
Min trim: — % of max diameter
Min head rise: — % to shutoff

Curve Corrections: none

Catalog: WTRWKS60 vers 2.2

Pump: 3x3-7 REI
Type: 310_REI
Synch speed: 1800 rpm
Speed: 1750 rpm
Dia: 6 in
Curve no.: CS-17046

Specific Speeds
Ns: 987 Nss: 3908

Dimensions:
Suction: 3 in Discharge: 3 in

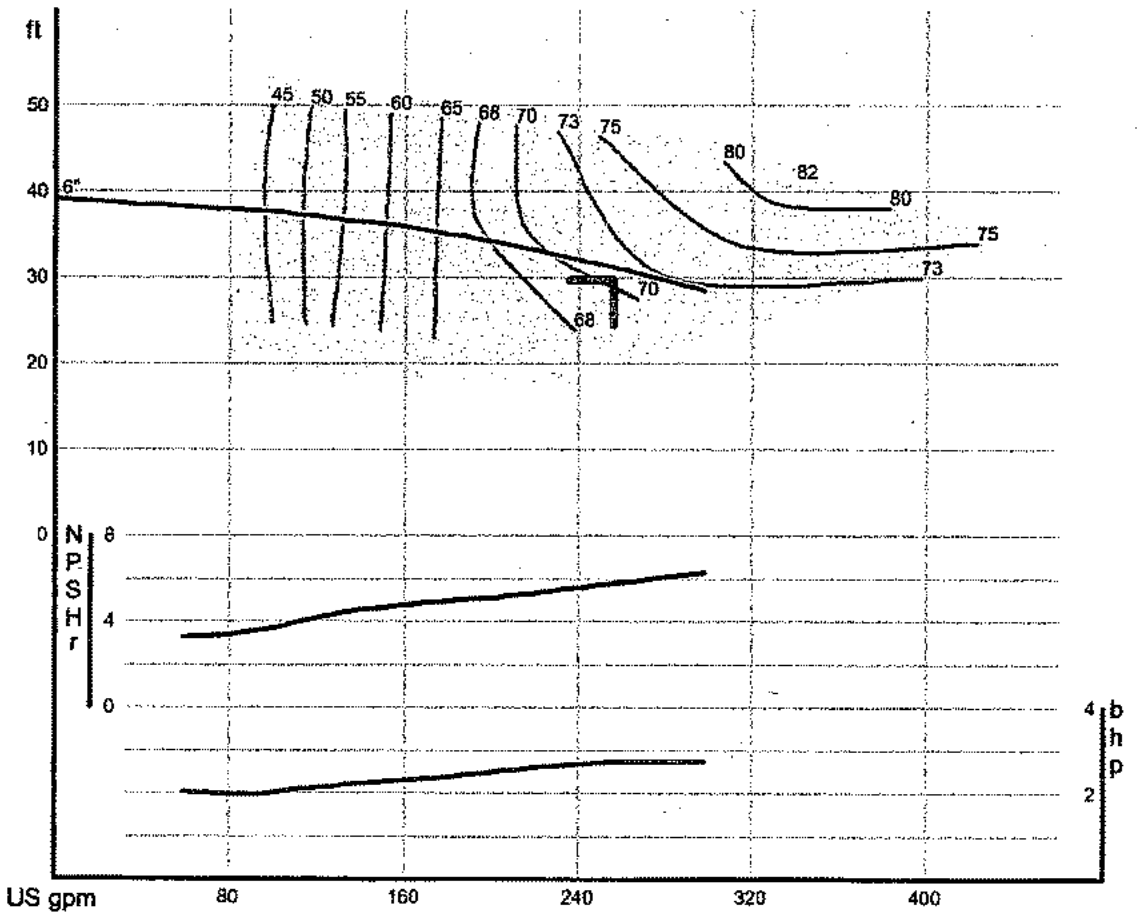
Pump Limits:
Temperature: 250 °F
Pressure: 250 psi g
Sphere size: 0.0625 in
Power: 7.5 bhp

Motor: 3 hp
Speed: 1800
Frame: 182T
Standard: NEMA
Enclosure: ODP
Sizing criteria: Max Power on Design Curve

— Data Point —
Flow: 256 US gpm
Head: 30.4 ft
Eff: 73%
Power: 2.65 bhp
NPSHr: 5.67 ft

— Design Curve —
Shutoff Head: 38.3 ft
Shutoff dP: 16.6 psi
Min Flow: 59.6 US gpm
BEP: 77% eff
@ 298 US gpm
NOL Pwr: 2.71 bhp
@ 298 US gpm

— Max Curve —
Max Pwr: 4.71 bhp
@ 422 US gpm



Water Works vers 7.1

American-Marsh Pumps

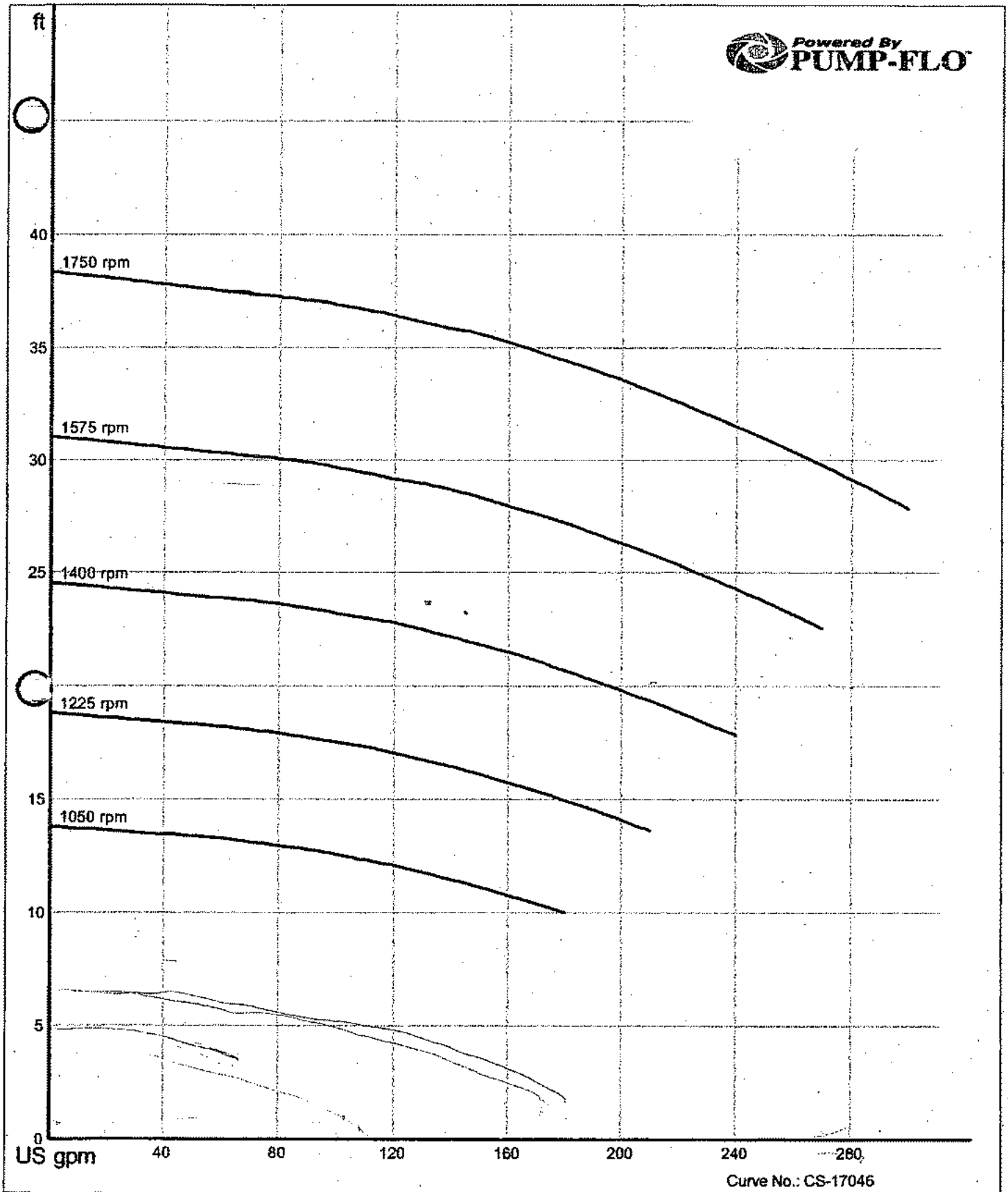
Selection list: —

Catalog: WTRWKS60 vers 2.2

Pump: 3x3-7 REI

Performance Evaluation:

Flow US gpm	Speed rpm	Head ft	Pump %eff	Power bhp	NPSHr ft	Motor %eff	Motor kW	Hrs/yr	Cost /kWh
307	Flow Rate is Out of Range for this pump								
256	1750	30.4	73	2.65	5.67				
205	1750	33.2	69	2.5	5.06				
154	1750	35.4	61	2.26	4.57				
102	1750	36.8	47	2.02	3.65				



Curve No.: CS-17046

GVA Northwest LLC	American-Marsh Pumps	Size: 3x3-7 REI
Kaiser South Interstate	Catalog: WTRWKS60, vers 2.2	Speed: 1050 - 1750 rpm
10/[illegible]06	310_REI - 1800	Dia: 6 in
.ufs		

HDM-300 HYDRODATA MULTIMETER CERTIFICATE OF RECALIBRATION

CO ID: 012747 S/N: W97132

Customer: PACIFIC COAST AIR BALANCING City: NEWBERG State: OR

PO #: Customer Eqpt ID#: Calibration Due Date: Order #: R061699

AS-Received By	FINAL Test By	Test By
Date 6-12-06 Rh 10 16 %	Date 7-14-06 Rh 50 %	Date Rh N/A %
Ambient Temperature 74 °F	Ambient Temperature 79 °F	Ambient Temperature N/A °F
Barometric Pressure 28.39 in Hg	Barometric Pressure 28.31 in Hg	Barometric Pressure N/A in Hg
Within spec (YES) NO NA	Within spec (YES) NO	Within spec YES NO

HDM Pressure Standard Heise #1-L: S/N: 41744/42459 Calibration Date: 09/02/05 Calibration Due Date: 09/2006 (As-Rcvd) (Test 2) Test 3
HDM Pressure Standard Heise #3-L: S/N: 41745/42460 Calibration Date: 02/16/06 Calibration Due Date: 02/2007 As-Rcvd Test 2 Test 3
Model PPM-1 Manufactured by Dresser Industries Rated Accuracy: 0.06% fs Range: 0.0 to 15.0 in wc Res: 0.001 in wc Uncertainty: < 0.00651 in wc
Used at Set Points: 3.0; 14.0

HDM Pressure Standard Heise #1-R: S/N: 41744/42457 Calibration Date: 09/02/05 Calibration Due Date: 09/2006 As-Rcvd (Test 2) Test 3
HDM Pressure Standard Heise #3-R: S/N: 41745/42458 Calibration Date: 02/16/06 Calibration Due Date: 02/2007 As-Rcvd Test 2 Test 3
Model PPM-1 Manufactured by Dresser Industries Rated Accuracy: 0.06% fs Range: 0.0 to 150.0 in wc Res: 0.01 in wc Uncertainty: < 0.07540 in wc
Used at Set Points: 25.0; 31.0; 140.0

HDM Pressure Standard Heise #2-L: S/N: 41747/42464 Calibration Date: 08/31/05 Calibration Due Date: 09/2006 As-Rcvd (Test 2) Test 3
HDM Pressure Standard Heise #4-L: S/N: 41746/42463 Calibration Date: 02/16/06 Calibration Due Date: 02/2007 As-Rcvd Test 2 Test 3
Model PPM-2 Manufactured by Dresser Industries Rated Accuracy: 0.05% fs Range: 0.0 to 50.0 psi Res: 0.1 in wc Uncertainty: < 0.479 in wc
Used at Set Points: 225.0; 275.0; 1025

HDM Pressure Standard Heise #2-R: S/N: 41747/42462 Calibration Date: 08/31/05 Calibration Due Date: 09/2006 As-Rcvd (Test 2) Test 3
HDM Pressure Standard Heise #4-R: S/N: 41745/42461 Calibration Date: 02/16/06 Calibration Due Date: 02/2007 As-Rcvd Test 2 Test 3
Model PPM-2 Manufactured by Dresser Industries Rated Accuracy: 0.05% fs Range: 0.0 to 300 psi Res: 1 in wc Uncertainty: <2.77 in wc
Used at Set Points: 1620; 2000; 4500; 8300

DIFFERENTIAL PRESSURE TEST (in wc)

TEST METER TOLERANCE = ± 2.0 % ± .28 in wc AS-RCVD TEST WITHIN SPEC (YES) NO N/A

Approx Set Pt	Standard	Test Meter	% Diff	Standard	Test Meter	% Diff	Standard	Test Meter	% Diff
3.0	3.07	3.1	.98	3.10	3.1	0			
14.0	14.27	14.3	.21	14.36	14.4	.28			
25.0	25.32	25.4	.32	25.24	25.2	-.16			
31.0	31.70	31.7	0	31.54	31.5	-.13		N/A	
140.0	141.90	141.9	0	145.90	145.7	-.14		N/A	
225.0	222.7	223.2	.22	224.3	224.5	.09			
275.0	284.7	284.7	0	282.0	282.0	0			
1025	1011.4	1011	-.04	1011.0	1011	0			
1620	1666	1665	-.06	1626	1623	-.18			
2000	2164	2158	-.28	2080	2074	-.29			
4500	4509	4510	.02	4517	4513	-.09			
8300	8316	8314	-.02	8313	8307	-.07			

GAGE PRESSURE (P_2) TEST (in wc)

TEST METER TOLERANCE = ± 2.0 % ± .28 in wc AS-RCVD TEST WITHIN SPEC (YES) NO N/A

Approx Set Pt	Standard	Test Meter	% Diff	Standard	Test Meter	% Diff	Standard	Test Meter	% Diff
3.0	3.06	3.0	-1.96	3.09	3.1	.32			
14.0	14.29	14.1	-1.33	14.36	14.5	.97			
25.0	25.33	24.9	-1.70	25.24	25.2	-.16			
31.0	31.76	31.3	-1.45	31.55	31.5	-.16		N/A	
140.0	141.11	140.5	-.43	145.66	145.9	.16		N/A	
225.0	232.0	231.7	-.13	223.3	224.1	.36			
275.0	284.6	283.9	-.25	281.4	282.0	.21			
1025	1011.4	1011	-.04	1010.8	1011	.02			
1620	1665	1662	-.18	1627	1624	-.18			
2000	2016	2013	-.15	2020	2018	-.10			
4500	4528	4523	-.11	4518	4512	-.13			
8300	8309	8299	-.12	8301	8295	-.07			

Shortridge Instruments, Inc.
7855 East Redfield Road Scottsdale, Arizona 85260
(480) 991-6744 • Fax (480) 443-1267 • www.shortridge.com • info@shortridge.com

HDM-300 HYDRODA[illegible] MULTIMETER CERTIFICATE OF REC[illegible]LIBRATION

S/N: 197137
Order #:

TEMPERATURE TEST - HYDRODATA MULTIMETER (° F)

TEST METER TOLERANCE = ± 0.2° F AS-RCVD TEST WITHIN SPEC (YES) NO N/A

[illegible]D Simulator: S/N 249	Calibration Date: 03/10/06	Calibration Due Date: 03/2008	(As-Rcvd) Test 2 Test 3	Set Point: 35.6° F	95° F 154[illegible]
[illegible]D Simulator: S/N 250	Calibration Date: 03/10/06	Calibration Due Date: 03/2008	(As-Rcvd) Test 2 Test 3	Set Point: 35.6° F	(95° F) 154.4° F
[illegible]D Simulator: S/N 253	Calibration Date: 03/10/06	Calibration Due Date: 03/2008	(As-Rcvd) Test 2 Test 3	Set Point: 35.6° F	95° F (154.4° F)
[illegible]D Simulator: S/N 254	Calibration Date: 04/13/04	Calibration Due Date: 04/2006	As-Rcvd Test 2 Test 3	Set Point: 35.6° F	95° F 154.4° F
[illegible]D Simulator: S/N 256	Calibration Date: 04/13/04	Calibration Due Date: 04/2006	As-Rcvd Test 2 Test 3	Set Point: 35.6° F	95° F 154.4° F
[illegible]D Simulator: S/N 257	Calibration Date: 04/13/04	Calibration Due Date: 04/2006	As-Rcvd Test 2 Test 3	Set Point: 35.6° F	95° F 154.4° F
[illegible]D Simulator: S/N 292	Calibration Date: 12/20/05	Calibration Due Date: 12/2007	As-Rcvd Test 2 Test 3	Set Point: 35.6° F	95° F 154.4° F
[illegible]D Simulator: S/N 293	Calibration Date: 12/20/05	Calibration Due Date: 12/2007	As-Rcvd Test 2 Test 3	Set Point: 35.6° F	95° F 154.4° F
[illegible]D Simulator: S/N 294	Calibration Date: 12/20/05	Calibration Due Date: 12/2007	As-Rcvd Test 2 Test 3	Set Point: 35.6° F	95° F 154.4° F

[illegible]D Simulators Model RTD-1000/500 Manufactured by General Resistance . Rated Accuracy: 0.025% of setting Range: 100 Ω to 11111.10 Ω
solution: 0.01 Ω Uncertainty: < 32 ppm

RTD Simulator Temperature

Equivalent Set Point	Test Meter	Diff	Test Meter	Diff	Test Meter	Diff
35.60	35.6	0	35.6	0		
95.00	95.0	0	95.0	0		
154.40	154.4	0	154.4	0		

TEMPERATURE TEST OF CUSTOMER'S TEMPROBE

TEMPROBE TOLERANCE = ± 0.3° F AS-RCVD TEST WITHIN SPEC YES NO (N/A)

[illegible]rmometer #1	S/N 8A089/Thermistor	S/N A410660	Calibration Date: 03/30/06	Cal Due Date: 03/2008	Set Point: 35° F 95° F 155° F
[illegible]rmometer #2	S/N 8B104/Thermistor	S/N 871507	Calibration Date: 10/21/04	Cal Due Date: 10/2006	Set Point: 35° F 95° F 155° F
[illegible]rmometer #3	S/N 92142/Thermistor	S/N A560303	Calibration Date: 06/15/05	Cal Due Date: 06/2007	Set Point: 35° F 95° F 155° F
[illegible]rmometer #4	S/N 92143/Thermistor	S/N A310867	Calibration Date: 08/03/05	Cal Due Date: 08/2006	Set Point: 35° F 95° F 155° F

[illegible]ed Accuracy(combined): 0.023° F/0.018° F Mfgd by Hart Scientific Range: 32° F-176° F Resolution: 0.001° F Combined Uncertainty: < 0.025° F

[illegible]perature Standard AirData Multimeter S/N M00136 Calibration Date: 03/10/06 Cal Due Date: 03/2007 Set Point: 35° F 95° F 155
[illegible]perature Standard AirData Multimeter S/N M96100 Calibration Date: 03/10/06 Cal Due Date: 03/2007 Set Point: 35° F 95° F 155
[illegible]ed Accuracy: 0.03° F Manufactured by Shortridge Instruments, Inc. Range: 33° F-158° F Resolution: 0.01° F Uncertainty: < 0.023° F
[illegible]al combined Uncertainty for TemProbe testing : < 0.039° F

NEW TEMPROBE

[illegible]pprox Set Point	Standard	TemProbe	Diff	Standard	TemProbe	Diff	Standard	TemProbe	Diff
35.0									
95.0									
155.0									

[illegible]neters are set to zero prior to taking pressure readings.

[illegible]ES:

[illegible]edure used: Procedure for Differential Pressure, Gage Pressure, and Temperature Recalibration of HydroData Multimeters SIP-CP11 Revision: 03 Dated: 03/31/06

instrument has been calibrated using Calibration Standards which are traceable to NIST (National Institute of Standards and Technology). Quality Assurance [illegible]gram and calibration procedures meet the requirements for ANSI/NCSL Z540-1-1994; MIL-STD 45662A and manufacturer's specifications. Calibration accuracy [illegible]rtified when meters are used with properly functioning accessories only. Uncertainties are expressed in expanded terms (twice the calculated uncertainty). This [illegible]rt shall not be reproduced, except in full, without the written approval of Shortridge Instruments, Inc. Results relate only to the item calibrated.

[illegible]tations on use: See Shortridge Instruments, Inc. Instruction Manual for the use of HydroData Multimeters

[illegible]bration Technician(s): Lonnie Normand Calibration Date: 7-13-2006 (14) Tpw 7-14-2006

[illegible]bration Approved by: Lonnie Normand Title: QA Mgr. Date: 07-12-2006

Shortridge Instruments, Inc.
7855 East Redfield Road Scottsdale, Arizona 85260
(480) 991-6744 • Fax (480) 443-1267 • www.shortridge.com • info@shortridge.com

GAS-FIRED CONDENSING BOILERS

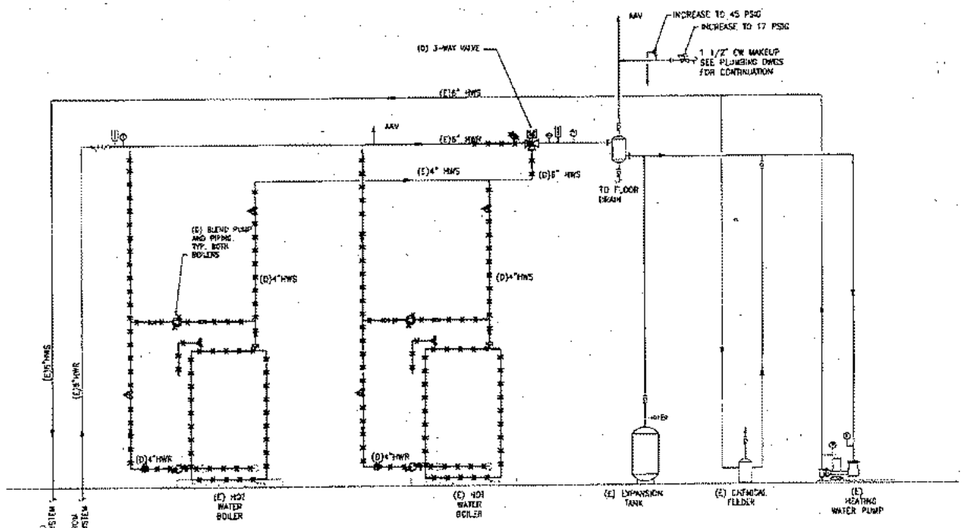
TAG NO.	LOCATION	AREA SERVED	INPUT (MBH)	OUTPUT (MBH)	DESIGN BASIS MANUF	DESIGN BASIS MODEL	EWT (DEG. F)	LWT (DEG. F)	FLOW RATE (GPM)	MIN FLOW RATE (GPM)	W.C.F.H. (LBS)	MAX MOP	ELECTRICAL NO. OF CIRCUITS	ELECTRICAL VOLTAGE	EMERGENCY POWER	NOTES
HWB-1	MECHANICAL ROOM	HEATING WATER SYSTEM	4000	3,840	CASMASTER	CMA 4W	170LG	200LG	256	57	3100	10	1	480-3-60	YES	1
HWB-2	MECHANICAL ROOM	HEATING WATER SYSTEM	4000	3,840	CASMASTER	CMA 4W	170LG	200LG	256	57	3100	10	1	480-3-60	YES	1

NOTES:
1. PROVIDE METAL-FAB DOOR/GUARD WITH ALPHA STAINLESS STEEL INTERIOR AND ALUMASTER EXTERIOR.

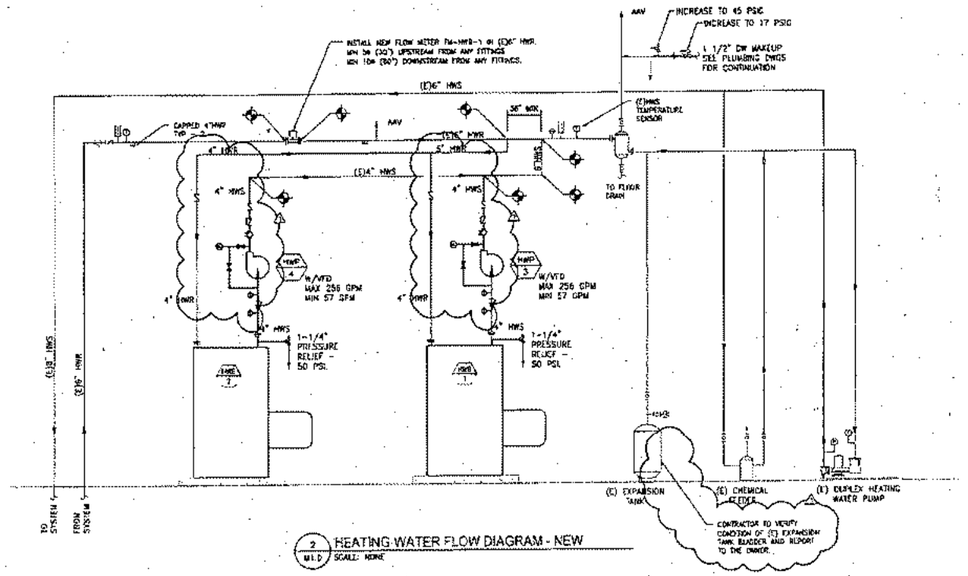
PUMPS

TAG NO.	SYSTEM	TYPE	FLOW RATE (GPM)	HEAD (FT.H.O.)	BHP	PUMP RPM	MAX MOTOR (HP)	MIN EFF	DESIGN BASIS MANUF	DESIGN BASIS MODEL	ELECTRICAL MOP	ELECTRICAL VOLTAGE	EMERGENCY POWER	NOTES
HWP-3	HEATING WATER	IN-LINE	256	75	2.58	1750	5	73%	BELL & GOSSETT	SERIES 60 4382	3	415	YES	1,2,3
HWP-4	HEATING WATER	IN-LINE	256	75	2.58	1750	5	73%	BELL & GOSSETT	SERIES 60 4382	3	415	YES	1,2,1

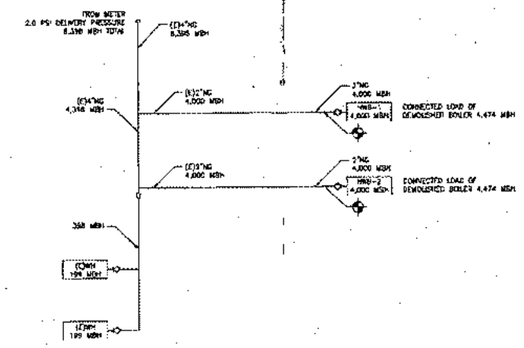
NOTES:
1. PROVIDE BRONZE FITTED PUMP WITH MECHANICAL SEALS.
2. PROVIDE PREMIUM HIGH EFFICIENCY MOTOR.
3. PROVIDE WITH VFD.



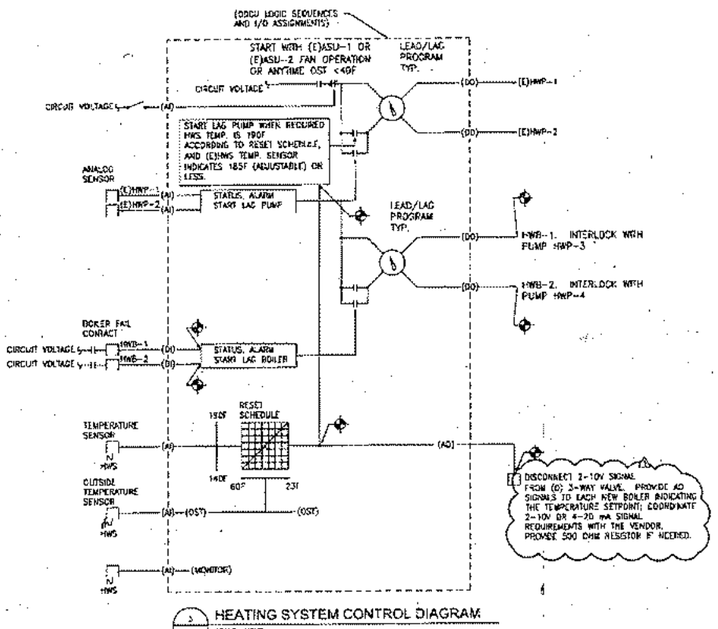
1 M1.0 HEATING WATER FLOW DIAGRAM - DEMOLITION
SCALE: NONE



2 M1.0 HEATING WATER FLOW DIAGRAM - NEW
SCALE: NONE



3 M1.0 GAS PIPING SCHEMATIC
SCALE: NONE



4 M1.0 HEATING SYSTEM CONTROL DIAGRAM
SCALE: NONE

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SCHEDULES AND DIAGRAMMATICS
BOILER REPLACEMENT

October 20, 2006
September 25, 2006
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SECTION 15182

HYDRONIC PIPING
PART 1 GENERAL
1.01 SECTION INCLUDES
A. Pipe and pipe fittings for:
1. Heating water piping system.
B. Valves:
1. Gate valves.
2. Ball valves.
3. Butterfly valves.
4. Check valves.
5. Calibrated Balance Valves.
1.02 SYSTEM DESCRIPTION
A. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
B. Use unions, flanges, and couplings downstream of valves and of equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.
C. Provide pipe hangers and supports in accordance with ASME B31.9 unless indicated otherwise.
D. Use gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.
PART 2 PRODUCTS
2.01 HEATING WATER PIPING, ABOVE GROUND
A. Steel Pipe: ASTM A 53/A 53M, Schedule 40, black.
1. Fittings: ASTM B 16.3, malleable iron or ASTM A 234/A 234M, wrought steel welding type fittings.
2. Joints: Threaded, or ANS D1.1 welded.
2.02 EQUIPMENT DRAINS AND OVERFLOWS
A. Copper Tube: ASTM B 88 (ASTM B 88M), type K (A), drawn.
1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
2. Joints: Solder, lead free, ASTM B 32, HB alloy (95-5 tin-antimony), or tin and silver.
2.03 PIPE HANGERS AND SUPPORTS
A. Conform to ASME B31.9.
B. Hangers for Hot Pipe Sizes 2 to 4 inches (50 to 100 mm): Carbon steel, adjustable, clevis.
C. Hangers for Hot Pipe Sizes 6 inches (150 mm) and Over: Adjustable steel yoke, cast iron roll, double hanger.
D. Vertical Support: Steel riser clamp.
2.04 UNIONS, FLANGES, AND COUPLINGS
A. Unions for Pipe 2 Inches (50 mm) and Under:
1. Ferrous Piping: 150 psig (1034 kPa) malleable iron, threaded.
2.05 GATE VALVES
A. Manufacturers:
1. Conbraco Industries: www.conbraco.com.
2. Nibco, Inc: www.nibco.com.
3. Milwaukee Valve Company: www.milwaukeevalve.com.
B. Over 2 Inches (50 mm):
1. Iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged ends.
2.06 BALL VALVES
A. Manufacturers:
1. Conbraco Industries: www.conbraco.com.
2. Nibco, Inc: www.nibco.com.
3. Milwaukee Valve Company: www.milwaukeevalve.com.
B. Up To and Including 2 Inches (50 mm):
1. Bronze one piece body, chrome plated brass ball, teflon seals and stuffing box ring, lever handle with balancing stops, solder ends with union.
C. Over 2 Inches (50 mm):
1. Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, flanged.
2.07 BUTTERFLY VALVES
A. Manufacturers:
1. Hammond Valve: www.hammondvalve.com.
2. Crane Valve: www.cranevalve.com.
3. Milwaukee Valve Company: www.milwaukeevalve.com.
B. Body: Cast or ductile iron with resilient replaceable EPDM seal, wafer or lug ends, extended neck
C. Disc: Aluminum bronze.
D. Operator: 10 position lever handle.
2.08 SWING CHECK VALVES
A. Manufacturers:
1. Hammond Valve: www.hammondvalve.com.
2. Nibco, Inc: www.nibco.com.
3. Milwaukee Valve Company: www.milwaukeevalve.com.
B. Over 2 Inches (50 mm):
1. Iron body, bronze trim, bronze or bronze faced rotating swing disc, renewable disc and seat, flanged ends.
2.09 CALIBRATED BALANCE VALVE
A. A. Manufacturers:
1. Bell & Gossett Circuit Setter or equal
B. 1/2 to 3 inch, NPT
1. Body: Bronze.
2. Ball: Brass
3. Seats: Glass and carbon filled TFE
4. Readout Valves: Brass with EPT check valve
5. Stem O-Ring: EPDM
6. Maximum operating pressure: 300 psig at 250 deg F.
C. 1/2 to 2 inch, Sweat
1. Body: Bronze.
2. Ball: Brass
3. Seats: Glass and carbon filled TFE
4. Readout Valves: Brass with EPT check valve
5. Stem O-Ring: EPDM
6. Maximum operating pressure: 300 psig at 250 deg F.
D. 2-1/2 to 4 inch, Flanged, Straight Pattern
1. Body: Cast iron.
2. Ball: Brass
3. Seats: Glass and carbon filled TFE
4. Readout Valves: Brass with EPT check valve
5. Stem O-Ring: EPDM
6. Maximum operating pressure: 175 psig at 250 deg F.
E. 4 to 12 inch, Angle Pattern
1. Body and Bonnet
a. Flanged: cast iron, with 125 psi ANSI flange connections.
b. Grooved: ductile iron, with grooved end connections for mechanical couplings.
2. Disc: Bronze with EPDM insert.
3. Stem: Stainless steel.
4. Packing: Teflon-Graphite (Asbestos-Free)
5. Gasket: Synthetic fiber - Nitrile binder
6. Seat Ring: EPDM
7. Bushing: Zinc Plated Steel
8. Max operating pressure: 175 psig at 250 deg F.
F. General description: calibrated balancing valve - combination variable orifice meter and balancing valve, with calibrated nameplate and memory stop indicator; capable of providing balance pre-sets, and proving positive shut-off at rated maximum operating pressure.
G. Maximum operating temperature: 250 deg F.
PART 3 EXECUTION
3.01 PREPARATION
A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
B. Remove scale and dirt on inside and outside before assembly.
C. Prepare piping connections to equipment with flanges or unions.
D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
E. After completion, fill, clean, and treat systems. Refer to Section 15189 for additional requirements.
3.02 INSTALLATION
A. Install in accordance with manufacturer's instructions.
B. Install heating water piping to ASME B31.9 requirements
C. Route piping in orderly manner, parallel to building structure, and maintain gradient.
D. Install piping to conserve building space and to avoid interfere with use of space.
E. Group piping wherever practical at common elevations.
F. Slope piping and arrange to drain at low points.
G. Pipe Hangers and Supports:
1. Install in accordance with ASME B31.9.
2. Install hangers to provide minimum 1/2 inch (13 mm) space between finished covering and adjacent work.
3. Place hangers within 12 inches (300 mm) of each horizontal elbow.
4. Use hangers with 1-1/2 inch (38 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
5. Provide copper plated hangers and supports for copper piping.
END OF SECTION

SECTION 15183

HYDRONIC SPECIALTIES
PART 1 GENERAL
1.01 SECTION INCLUDES
A. Air vents.
B. Strainers.
C. Combination fittings.
D. Flow indicators, controls, meters.
E. Relief valves.
1.02 DELIVERY, STORAGE, AND HANDLING
A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.
PART 2 PRODUCTS
2.01 AIR VENTS
A. Manufacturers:
1. Armstrong International, Inc: www.armstrong-intl.com.
2. ITT Bell & Gossett: www.bellgossett.com.
3. Taco, Inc: www.taco-hvac.com.
B. Washer Type:
1. Brass with hygroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring loaded ball check valve.
2.02 STRAINERS
A. Manufacturers:
1. Armstrong International, Inc: www.armstrong-intl.com.
2. Green Country Filtration: greencountryfiltration.com.
B. Size 2 inch (50 mm) and Under:
1. Screwed brass or iron body for 175 psi (1200 kPa) working pressure, Y pattern with 1/32 inch (0.8 mm) stainless steel perforated screen.
C. Size 2-1/2 inch (65 mm) to 4 inch (100 mm):
1. Flanged iron body for 175 psi (1200 kPa) working pressure, Y pattern with 3/64 inch (1.2 mm) stainless steel perforated screen.
D. Size 5 inch (125 mm) and Larger:
1. Flanged iron body for 175 psi (1200 kPa) working pressure, basket pattern with 1/8 inch (3.2 mm) stainless steel perforated screen.
2.03 COMBINATION PUMP DISCHARGE VALVES
A. Manufacturers:
1. Crane Valve: www.cranevalve.com.
2. Taco, Inc: www.taco-hvac.com.
3. Victaulic Company of America: www.victaulic.com.
B. Valves: Straight or angle pattern, flanged cast-iron valve body with ball-on bonnet for 175 psi (1200 kPa) operating pressure, non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation.
2.04 FLOW METERS
A. Manufacturers:
1. Dwyer Instruments, Inc: www.dwyer-inst.com.
2. EMCO Flow Systems: www.emcoflow.com.
3. GE Infrastructure Sensing/GE Panametrics: www.gesensing.com.
B. Orifice principle by-pass circuit with direct reading gage, soldered or flanged piping connections for 125 psi (860 kPa) working pressure, with shut off valves, and drain and vent connections.
C. Direct reading with insert pitot tube, threaded coupling, or 150 psi (1034 kPa) working pressure, maximum 240 degrees F (115 degrees C), 5 percent accuracy.
D. Cast iron or bronze, globe style, balance valve with handwheel with vernier type ring setting and memory stop, drain connection, readout valves equipped with integral check valves and gasketed caps.
E. Furnish with transmitter to send 2-10V signal to the building automation system.
PART 3 EXECUTION
3.01 INSTALLATION
A. Install specialties in accordance with manufacturer's instructions.
END OF SECTION

SECTION 15188

HVAC PUMPS
PART 1 GENERAL
1.1 SECTION INCLUDES
A. In-line circulators.
1.2 REFERENCES
A. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association; 2003.
B. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; National Electrical Manufacturers Association; 2003.
C. NFPA 70 - National Electrical Code; National Fire Protection Association; 2005.
D. UL 778 - Standard for Motor-Operated Water Pumps; Underwriters Laboratories Inc.; 2002.
1.3 PERFORMANCE REQUIREMENTS
A. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
1.4 SUBMITTALS
A. See Section 01300 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.
1.5 QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacture, assembly, and field performance of pumps, with minimum three years of documented experience.
PART 2 PRODUCTS
2.1 MANUFACTURERS
A. Armstrong Pumps Inc: www.armstrongpumps.com.
B. ITT Bell & Gossett: www.bellgossett.com.
C. Taco: www.taco-pumps.com
2.2 IN-LINE CIRCULATORS
A. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 125 psi (860 kPa) maximum working pressure
B. Casing: Cast iron, with flanged pump connections.
C. Impeller: Non-ferrous keyed to shaft.
D. Bearings: Oil-lubricated bronze sleeve.
E. Shaft: Alloy steel with bronze sleeve, integral thrust collar.
F. Seal: Mechanical seal, 225 degrees F (107 degrees C) maximum continuous operating temperature.
G. Drive: Flexible coupling.
PART 3 EXECUTION
3.1 PREPARATION
A. Verify that electric power is available and of the correct characteristics.
3.2 INSTALLATION
A. Install in accordance with manufacturer's instructions.
B. Provide access space around pumps for service. Provide no less than minimum space recommended by manufacturer.
C. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For close coupled or base mounted pumps, provide supports under elbows on pump suction and discharge five sizes 4 inches (102 mm) and over. Refer to Section 15072.
D. Lubricate pumps before start-up.
END OF SECTION

SECTION 15950

TESTING, ADJUSTING, AND BALANCING
PART 1 GENERAL
1.1 SECTION INCLUDES
A. Testing, adjustment, and balancing of hydronic systems.
1.2 REFERENCES
A. AABC MN-1 - AABC National Standards for Total System Balance. Associated Air Balance Council; 2002.
B. ASHRAE Std 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 1988.
1.3 SUBMITTALS
A. Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.
B. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
1. Revise TAB plan to reflect actual procedures and submit as part of final report.
2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
3. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
4. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
5. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111
6. Units of Measure: Report data in both I-P (inch-pound) units.
7. Include the following on the title page of each report:
a. Name of Testing, Adjusting, and Balancing Agency.
b. Address of Testing, Adjusting, and Balancing Agency.
c. Telephone number of Testing, Adjusting, and Balancing Agency.
d. Project name.
e. Project location.
f. Project Contractor.
g. Report date.
PART 2 PRODUCTS - NOT USED
PART 3 EXECUTION
3.1 GENERAL REQUIREMENTS
A. Perform total system balance in accordance with one of the following:
1. AABC MN-1, AABC National Standards for Total System Balance.
B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
C. TAB Agency Qualifications:
1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
2. Having minimum of three years documented experience.
3. Certified by one of the following:
a. AABC, Associated Air Balance Council. www.aabchq.com; upon completion submit AABC National Performance Guaranty.
D. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.
E. Pre-Qualified TAB Agencies:
1. Northwest Engineering.
2. Pacific Coast Air Balancing.
3. Neudorfer Engineers.
3.2 EXAMINATION
A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
1. Systems are started and operating in a safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Hydronic systems are flushed, filled, and vented.
5. Pumps are rotating correctly.
6. Proper strainer baskets are clean and in place.
7. Service and balance valves are open.
B. Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.
3.3 INSTALLATION TOLERANCES
A. Hydronic Systems: Adjust to within plus or minus 10 percent of design.
3.4 RECORDING AND ADJUSTING
A. Ensure recorded data represents actual measured or observed conditions.
B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set end lock memory stops.
C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
3.5 WATER SYSTEM PROCEDURE
A. Adjust water systems to provide required or design quantities.
END OF SECTION

SEQUENCE OF OPERATION

GENERAL:
The two existing cast iron boilers, existing blend pumps and existing three-way heating water control valve are all to be demolished and replaced by two new condensing type boilers and two new in-line booster pumps with variable frequency drives. The primary purpose of the two new booster pumps is to overcome the additional head loss associated with the new boilers. The new boilers and booster pumps will interface with the existing Johnson Controls Metasys (R) Building Automation System (BAS).

BOILER CONTROL:
The BAS will enable the lead boiler and associated booster pump when the heating water system has been enabled (maintaining the same logic previously used to start and shutdown the heating water system).

The booster pump speed(s) will be controlled based on input from the BAS system. Inputs shall be in the form of 2-10V. The booster pump speeds will be reset based on the signal from the new water flow meter FM-HWR-1 (located in the heating water return line). For single boiler operation, the booster pump speed will vary between 20 percent and 85 percent (adj) in proportion to the system water flow varying between 20 gpm and 265 gpm (adj). For two boiler operation, the booster pump speeds will vary between 20 percent and 75 percent (adj).

The booster pump speed settings will be determined by a joint effort of the control subcontractor, mechanical contractor and the TAB subcontractor. During system commissioning, with all zone calling for heat and the boilers off, measure the water flow with a single system pump running and with two system pumps running. The booster pump flow rates should meet or exceed the primary system flow rates (preferably exceeding the flow rates by 10 to 15 percent) for single and two pump operation. The minimum booster pump speeds should equate to the minimum recommended flow rate from the pump manufacturer (56 gpm, approx.).

The BAS system shall monitor the booster pump VFD status, and disable a boiler if the associated booster pump fails.

The lead boiler will modulate its firing rate to maintain the heating water supply (HWS) temperature at the setpoint temperature plus or minus 4 deg F, subject to the limits of its minimum firing rate. The BAS system will reset the HWS temperature setpoint based on the outside temperature (OST). The HWS setpoint temperature will vary inversely between 140 deg F (adj) when the OST is 60 deg F (adj) or warmer, and 190 deg F (adj) when the OST is 23 deg F or colder (adj).

The BAS will enable the lag boiler, associated booster pump and lag system heating water pump when the OST drops below 23 deg F (adj) and the HWS temperature drops below 185 deg F (adj) for more than 5 minutes (adj). The lag boiler, lag booster pump and lag system heating water pump will cycle off when the OST rises above 35 deg F (adj) for 30 minutes (adj).

The lag boiler and booster pump will be enabled if the lead boiler or booster pump fail.

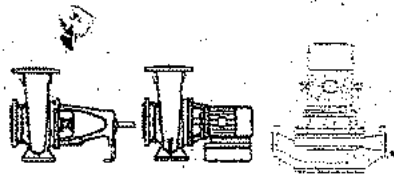
The existing BAS programming or operator interface used to determine which boiler is lead and which is lag will be retained

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HVAC
SPECIFICATIONS
BOILER REPLACEMENT

October 20, 2006
September 26, 2006
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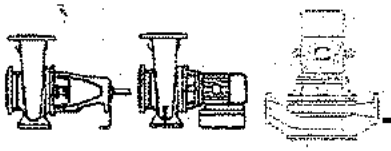


AMERICAN-MARSH PUMPS

INSTALLATION, OPERATION & MAINTENANCE MANUAL FOR SERIES 300 & 310 REF, REC & REI END SUCTION PUMPS

04 OCTOBER 2004

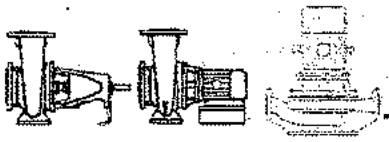
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AMERICAN-MARSH PUMPS

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SAFETY CONSIDERATIONS

The American-Marsh REF, REC & REI end suction pumps have been designed and manufactured for safe operation. In order to ensure safe operation, it is very important that this manual be read in its entirety prior to installing or operating the pump. American-Marsh Pumps shall not be liable for physical injury, damage or delays caused by a failure to observe the instructions for installation, operation and maintenance contained in this manual.

Remember that every pump has the potential to be dangerous, because of the following factors:

- parts are rotating at high speeds
- high pressures may be present
- high temperatures may be present
- highly corrosive and/or toxic chemicals may be present

Paying constant attention to safety is always extremely important. However, there are often situations that require special attention. These situations are indicated throughout this book by the following symbols:

⚠DANGER

DANGER - Immediate hazards which WILL result in severe personal injury or death.

⚠WARNING

WARNING – Hazards or unsafe practices which COULD result in severe personal injury or death.

⚠CAUTION

CAUTION – Hazards or unsafe practices which COULD result in minor personal injury or product or property damage.

Maximum Lifting Speed: 15 feet/second.

If in a climate where the fluid in the casing could freeze, never leave liquid in the pump casing. Drain the casing completely. During winter months and cold weather, the liquid could freeze and damage the pump casing.

Do not run the equipment dry or start the pump without the proper prime (casing flooded).

Never operate the pump for more than a short interval with the discharge valve closed. The length of the interval depends on several factors including the nature of the fluid pumped and its temperature. Contact American-Marsh Engineering for additional support if required.

Never operate the pump with a closed suction valve.

Excessive pump noise or vibration may indicate a dangerous operating condition. The pump must be shutdown immediately.

Do not operate the pump for an extended period of time below the recommended minimum flow. See Figure 6, page 13.

The pump shaft MUST turn clockwise when viewed from the motor end. It is absolutely essential that the rotation of the motor be checked before installation of the coupling spacer and starting the pump. Incorrect rotation of the pump for even a short period of time can unscrew the impeller nut, which can cause severe damage.

If the liquid is hazardous, take all necessary precautions to avoid damage and injury before emptying the pump casing.

Residual liquid may be found in the pump casing, head and suction line. Take the necessary precautions if the liquid is hazardous, flammable, corrosive, poisonous, infected, etc.

Always lockout power to the driver before performing pump maintenance.

Never operate the pump without the coupling guard and all other safety devices correctly installed.

Do not apply heat to disassemble the pump or to remove the impeller. Entrapped liquid could cause an explosion.

If any external leaks are found while pumping hazardous product, immediately stop operations and repair.

PUMP IDENTIFICATION

MANUFACTURER

American-Marsh Pumps
185 Progress Road
Collierville, TN 38017
United States of America

TYPE OF PUMP

The American-Marsh REF, REC & REI end suction pumps are end suction, single stage centrifugal pumps. REF pumps are of the flex-coupled, center-line discharge type. The REC pumps are of the close-coupled, center-line discharge type. The REI pumps are of the close-coupled, inline discharge type

DATE OF MANUFACTURE

The date of manufacture is indicated on the pump data plate.

INSTALLATION, OPERATION & MAINTENANCE MANUAL IDENTIFICATION

Prepared: October, 2004 **Edition:** 01
Revision: **Date of Revision:**

NAMEPLATE INFORMATION

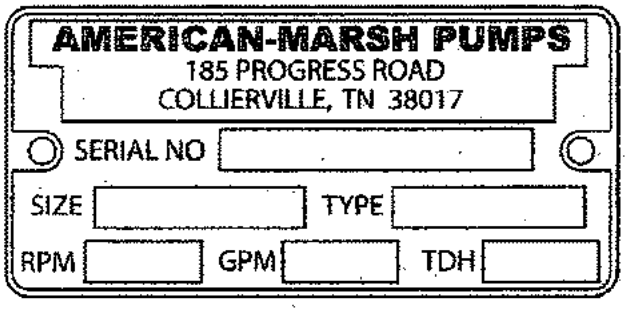


FIGURE 1 – Pump Data Plate

SERIAL NUMBER	: Serial Number of pump unit (issued by Production Control).
SIZE	: Size designation of pump (3x4-10)
TYPE	: Pump type (REF, REC or REI).
RPM	: Speed of pump.
GPM	: Rated capacity of pump.
TDH	: Rated Total Dynamic Head of pump.

WARRANTY

American-Marsh Pumps guarantees that only high quality materials are used in the construction of our pumps and that machining and assembly are carried out to high standards.

The pumps are guaranteed against defective materials and/or faulty craftsmanship for a period of one year from the date of shipment unless specifically stated otherwise.

Replacement of parts or of the pump itself can only be carried out after careful examination of the pump by qualified personnel.

The warranty is not valid if third parties have tampered with the pump.

This warranty does not cover parts subject to deterioration or wear and tear (mechanical seals, pressure and vacuum gauges, rubber or plastic items, bearings, etc.) or damage caused by misuse or improper handling of the pump by the end user.

Parts replaced under warranty become the property of American-Marsh Pumps.

Contact the American-Marsh Pumps' factory:

American-Marsh Pumps
185 Progress Road
Collierville, TN 38017
United States Of America

Phone: **(901) 860-2300**
Fax: **(901) 860-2323**
www.american-marsh.com

GENERAL INSTRUCTIONS

The pump and motor unit must be examined upon arrival to ascertain any damage caused during shipment. If damaged immediately notify the carrier and/or the sender. Check that the goods correspond exactly to the description on the shipping documents and report any differences as soon as possible to the sender. Always quote the pump type and serial number stamped on the data plate.

The pumps must be used only for applications for which the manufacturers have specified:

- **The construction materials**
- **The operating conditions (flow, pressure, temperature, etc.)**
- **The field of application**

In case of doubt, contact the manufacturer.

HANDLING AND TRANSPORT

METHOD OF TRANSPORT

The pump must be transported in the horizontal position

INSTALLATION

During installation and maintenance, all components must be handled and transported securely by using suitable slings. Handling must be carried out by specialized personnel to avoid damage to the pump and persons. The lifting rings attached to various components should be used exclusively to lift the components for which they have been supplied.



Maximum lifting speed: 15 feet/second

STORAGE

SHORT-TERM STORAGE

Normal packaging is designed to protect the pump during shipment and for dry, indoor storage for up to two months or less. The procedure followed for this short-term storage is summarized below:
Standard Protection for Shipment :

a. Loose unmounted items, including, but not limited to, oilers, packing, coupling spacers, stilts, and mechanical seals are packaged in a water proof plastic bag and placed under the coupling guard. Larger items are cartoned and metal banded to the base plate. For pumps not mounted on a base plate, the bag and/or carton is placed inside the shipping carton. All parts bags and cartons are identified with the American-Marsh sales order number, the customer purchase order number, and the pump item number (if applicable).
b. Inner surfaces of the bearing housing, shaft (area through bearing housing), and bearings are coated with Cortec VCI-329 rust inhibitor, or equal.
Note: **Bearing housings are not filled with oil prior to shipment.**
c. Regreasable bearings are packed with grease (Royal Purple NLGI#2).
d. After a performance test, if required, the pump is tipped on the suction flange for drainage (some residual water may remain in the casing). Then, internal surfaces of ferrous casings, covers,

flange faces, and the impeller surface are sprayed with Calgon Vestal Labs RP-743m, or equal. Exposed shafts are taped with Polywrap.

e. Flange faces are protected with plastic covers secured with plastic drive bolts. 3/16 in (7.8 mm) steel or 1/4 in (6.3 mm) wood covers with rubber gaskets, steel bolts, and nuts are available at extra cost.
f. All assemblies are bolted to a wood skid which confines the assembly within the perimeter of the skid.
g. Assemblies with special paint are protected with a plastic wrap.
h. Group 1 and Group 2 bare pumps, when not mounted on base plates, are packed in hard paper cartons mounted on wood skids.
i. Group 3 bare pumps, when not mounted on base plates, are bolted to wood skids.
j. All pump assemblies utilizing polycrete base plates are mounted on wood skids.
k. All assemblies having external piping (seal flush and cooling water plans), etc. are packaged and braced to withstand normal handling during shipment. In some cases components may be disassembled for shipment. The pump must be stored in a covered, dry location.

LONG-TERM STORAGE

Long-term storage is defined as more than two months, but less than 12 months. The procedure American-Marsh follows for long-term storage of pumps is given below. These procedures are in addition to the short-term procedure.

Solid wood skids are utilized. Holes are drilled in the skid to accommodate the anchor bolt holes in the base plate, or the casing and bearing housing feet holes on assemblies less base plate. Tackwrap sheeting is then placed on top of the skid and the pump assembly is placed on top of the Tackwrap. Metal bolts with washers and rubber bushings are inserted through the skid, the Tackwrap, and the assembly from the bottom of the skid and are then secured with hex nuts. When the nuts are "snugged" down to the top of the base plate or casing and bearing housing feet, the rubber bushing is expanded, sealing the hole from the atmosphere. Desiccant bags are placed on the Tackwrap. The Tackwrap is drawn up around the assembly and hermetically (heat) sealed across the top. The assembly is completely sealed from the atmosphere and the desiccant will absorb any entrapped moisture. A solid wood box is then used to cover the assembly to provide protection from the elements and handling. This packaging will provide protection up to twelve months without damage to mechanical seals, bearings, lip seals, etc. due to humidity, salt laden air, dust, etc. After unpacking, protection will be the responsibility of the user. Addition of oil to the bearing housing will remove the inhibitor. If units are to be idle for extended periods after addition of lubricants, inhibitor oils and greases should be used.

Every three months, the shaft should be rotated approximately 10 revolutions.

INSTALLATION & ALIGNMENT

FACTORY PRELIMINARY ALIGNMENT PROCEDURE

The purpose of factory alignment is to ensure that the user will have full utilization of the clearance in the motor holes for final job-site alignment. To achieve this, the factory alignment procedure specifies that the pump be aligned in the horizontal plane to the motor, with the motor foot bolts centered in the motor holes. This procedure ensures that there is sufficient clearance in the motor holes for the customer to field align the motor to the pump, to zero tolerance. This philosophy requires that the customer be able to place the base in the same condition as the factory. Thus the factory alignment will be done with the base sitting in an unrestrained condition on a flat and level surface. This standard also emphasizes the need to ensure the shaft spacing is adequate to accept the specified coupling spacer. The factory alignment procedure is summarized below:

1. The base plate is placed on a flat and level work bench in a free and unstressed position.
2. The base plate is leveled as necessary. Leveling is accomplished by placing shims under the rails (or, feet) of the base at the appropriate anchor bolt hole locations. Levelness is checked in both the longitudinal and lateral directions.
3. The motor and appropriate motor mounting hardware is placed on the base plate and the motor is checked for any planar soft-foot condition. If any is present it is eliminated by shimming.
4. The motor feet holes are centered around the motor mounting fasteners.
5. The motor is fastened in place by tightening the nuts on two diagonal motor mounting studs.
6. The pump is put onto the base plate and leveled. The foot piece under the bearing housing is adjustable. It is used to level the pump, if necessary. If an adjustment is necessary, we add or delete shims (#109A) between the foot piece and the bearing housing.
7. The spacer coupling gap is verified.

8. The parallel and angular *vertical* alignment is made by shimming under the motor.
9. All four motor feet are tightened down.
10. The pump and motor shafts are then aligned *horizontally*, both parallel and angular, by *moving the pump* to the fixed motor. The pump feet are tightened down.
11. Both horizontal and vertical alignment are again final checked as is the coupling spacer gap.

RECOMMENDED PROCEDURE FOR BASE PLATE INSTALLATION & FINAL FIELD ALIGNMENT

NEW GROUTED BASE PLATES

1. The pump foundation should be located as close to the source of the fluid to be pumped as practical. There should be adequate space for workers to install, operate, and maintain the pump. The foundation should be sufficient to absorb any vibration and should provide a rigid support for the pump and motor. Recommended mass of a concrete foundation should be three times that of the pump, motor and base. Note that foundation bolts are imbedded in the concrete inside a sleeve to allow some movement of the bolt.
2. Level the pump base plate assembly. If the base plate has machined coplanar mounting surfaces, these machined surfaces are to be referenced when leveling the base plate. This may require that the pump and motor be removed from the base plate in order to reference the machined faces. If the base plate is without machined coplanar mounting surfaces, the pump and motor are to be left on the base plate. The proper surfaces to reference when leveling the pump base plate assembly are the pump suction and discharge flanges. DO NOT stress the base plate. Do not bolt the suction or discharge flanges of the pump to the piping until the base plate foundation is completely installed. If equipped, use leveling jackscrews to level the base plate. If jackscrews are not provided, shims and wedges should be used (see Figure 2). Check for levelness in both the longitudinal and lateral directions. Shims should be placed at all base anchor bolt locations, and in the middle edge of the base if the base is more than five feet long. Do not rely on the bottom of the base plate to be flat. Standard base plate bottoms are not machined, and it is not likely that the field mounting surface is flat.

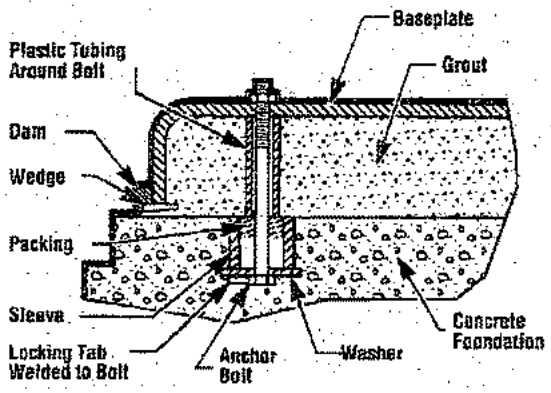


FIGURE 2 – Base Plate Foundation

3. After leveling the base plate, tighten the anchor bolts. If shims were used, make sure that the base plate was shimmed near each anchor bolt before tightening. Failure to do this may result in a twist of the base plate, which could make it impossible to obtain final alignment. Check the level of the base plate to make sure that tightening the anchor bolts did not disturb the level of the base plate. If the anchor bolts did change the level, adjust the jackscrews or shims as needed to level the base plate. Continue adjusting the jackscrews or shims and tightening the anchor bolts until the base plate is level.
4. Check initial alignment. If the pump and motor were removed from the base plate proceed with step 5 first, then the pump and motor should be reinstalled onto the base plate using American-Marsh's Factory Preliminary Alignment Procedure, and then continue with the following. As described above, pumps are given a preliminary alignment at the factory. This preliminary alignment is done in a way that ensures that, if the installer duplicates the factory conditions, there will be sufficient clearance between the motor hold down bolts and motor foot holes to move the motor into final alignment. If the pump and motor were properly reinstalled to the base plate or if they were not removed from the base plate and there has been no transit damage, and also if the above steps where done properly, the pump and driver should be within 0.015 in (0.38 mm) FIM (Full Indicator Movement) parallel, and 0.0025 in/in (0.0025 mm/mm) FIM angular. If this is not the case first

check to see if the driver mounting fasteners are centered in the driver feet holes. If not, recenter the fasteners and perform a preliminary alignment to the above tolerances by shimming under the motor for vertical alignment, and by moving the pump for horizontal alignment.

5. Grout the base plate. A non-shrinking grout should be used. Make sure that the grout fills the area under the base plate. After the grout has cured, check for voids and repair them. Jackscrews, shims and wedges should be removed from under the base plate at this time. If they were to be left in place, they could rust, swell, and cause distortion in the base plate.
6. Run piping to the suction and discharge of the pump. There should be no piping loads transmitted to the pump after connection is made. Recheck the alignment to verify that there are no significant loads.
7. Perform final alignment. Check for soft-foot under the driver. An indicator placed on the coupling, reading in the vertical direction, should not indicate more than 0.002 in (0.05 mm) movement when any driver fastener is loosened. Align the driver first in the vertical direction by shimming underneath its feet. When satisfactory alignment is obtained the number of shims in the pack should be minimized. It is recommended that no more than five shims be used under any foot. Final horizontal alignment is made by moving the driver. Maximum pump reliability is obtained by having near perfect alignment. American-Marsh recommends no more than 0.002 in (0.05mm) parallel, and 0.0005 in/in (0.0005 mm/mm) angular misalignment.
8. Operate the pump for at least an hour or until it reaches final operating temperature. Shut the pump down and recheck alignment while the pump is hot. Piping thermal expansion may change the alignment. Realign pump as necessary.

EXISTING GROUTED BASE PLATES

When a pump is being installed on an existing grouted base plate, the procedure is somewhat different from the previous section "New Grouted Base Plates."

1. Mount the pump on the existing base plate.
2. Level the pump by putting a level on the discharge flange. If not level, add or delete shims (#109A) between the foot piece and the bearing housing.
3. Check initial alignment. (Step 4 above)
4. Run piping to the suction and discharge flanges of the pump. (Step 6 above)
5. Perform final alignment. (Step 7 above)
6. Recheck alignment after pump is hot. (Step 8 above)

All piping must be independently supported, accurately aligned and preferably connected to the pump by a short length of flexible piping. The pump should not have to support the weight of the pipe or compensate for misalignment. It should be possible to install suction and discharge bolts through mating flanges without pulling or prying either of the flanges. All piping must be tight. Pumps may air-bind if air is allowed to leak into the piping. If the pump flange(s) have tapped holes, select flange fasteners with thread engagement at least equal to the fastener diameter but that do not bottom out in the tapped holes before the joint is tight.

PIPING CONNECTION – SUCTION & DISCHARGE

All piping must be independently supported, accurately aligned and preferably connected to the pump by a short length of flexible piping. The pump should not have to support the weight of the pipe or compensate for misalignment. It should be possible to install suction and discharge bolts through mating flanges without pulling or prying either of the flanges. All piping must be tight. Pumps may air-bind if air is allowed to leak into the piping. If the pump flange(s) have tapped holes, select flange fasteners with thread engagement at least equal to the fastener diameter but that do not bottom out in the tapped holes before the joint is tight.

⚠WARNING

Piping Forces: *Take care during installation and operation to minimize pipe forces and/or moments on the pump casing.*

SUCTION PIPING

To avoid NPSH and suction problems, suction pipe sizes must be at least as large as the pump suction connection. **Never** use pipe or fittings on the suction that are smaller in diameter than the pump suction size. Figure 3 illustrates the ideal piping configuration with a minimum of 10 pipe diameters between the source and the pump suction. In most cases, horizontal reducers should be eccentric and mounted with the flat side up as shown in figure 6 with a maximum of one pipe size reduction. Never mount eccentric reducers with the flat side down. Horizontally mounted concentric reducers should not be used if there is any possibility of entrained air in the process fluid. Vertically mounted concentric

reducers are acceptable. In applications where the fluid is completely deaerated and free of any vapor or suspended solids, concentric reducers are preferable to eccentric reducers.

Avoid the use of throttling valves and strainers in the suction line. Start up strainers must be removed shortly after start up. When the pump is installed below the source of supply, a valve should be installed in the suction line to isolate the pump and to permit pump inspection and maintenance. However, never place a valve directly on the suction nozzle of the pump.

Refer to the American-Marsh Pump Engineering Manual and the Centrifugal Pump IOM Section of the Hydraulic Institute Standards for additional recommendations on suction piping.

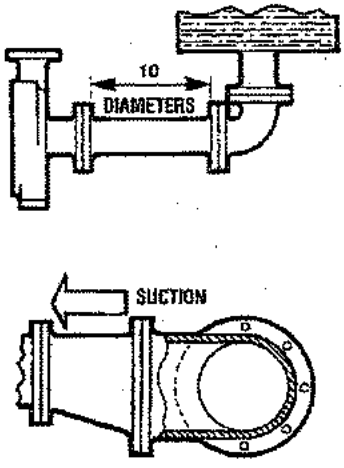


FIGURE 3 – Good Piping Practices

DISCHARGE PIPING

Install a valve in the discharge line. This valve is required for regulating flow and/or to isolate the pump for inspection and maintenance.

⚠WARNING

When fluid velocity in the pipe is high, for example, 10 ft/s (3 m/s) or higher, a rapidly closing discharge valve can cause a damaging pressure surge. A dampening arrangement should be provided in the piping.

PUMP AND SHAFT ALIGNMENT CHECK

After connecting piping, rotate the pump drive shaft clockwise (view from motor end) by hand several complete revolutions to be sure there is no binding and that all parts are free. Recheck shaft alignment. If piping caused unit to be out of alignment, correct piping to relieve strain on the pump.

IMPELLER CLEARANCES

REF model pumps do not have impeller clearances that need to be adjusted. The design and assembly of the unit ensure that the impeller is placed in the proper position within the casing assembly.

REC and REI model pumps have impeller clearances that need to be adjusted during the motor installation process. All REC and REI models have a two-part, rubber spacer ring that is installed in the pump prior to shipment. This two-part spacer ring is held together with a zip tie. This ring's thickness spaces the shaft assembly in such a way that the impeller clearance is set properly with the spacer in place.

REC & REI MOTOR ASSEMBLY

See section step 6, page 27 for proper motor assembly procedure.

MECHANICAL SEAL

When the pump is intended to be equipped with a mechanical seal, it is American-Marsh's standard practice to install the mechanical seal in the pump prior to shipment. Specific order requirements may specify that the seal be shipped separately, or none be supplied. It is the pump installer's responsibility to determine if a seal was installed. If a seal was supplied but not installed, the seal and installation instructions will be shipped with the pump.

⚠WARNING

Failure to ensure that a seal is installed may result in serious leakage of the pumped fluid.

Seal and seal support system must be installed and operational as specified by the seal manufacturer.

The stuffing box/seal chamber/gland may have ports that have been temporarily plugged at the factory to keep out foreign matter. It is the installer's responsibility to determine if these plugs should be removed and external piping connected. Refer to the seal drawings and/or the

local American-Marsh representative for the proper connections.

PACKING

When the pump is intended to be equipped with shaft packing, it is not American-Marsh's standard practice to install the packing in the stuffing box prior to shipment. The packing is shipped with the pump. It is the pump installer's responsibility to install the packing in the stuffing box.

⚠WARNING

Failure to ensure that packing is installed may result in serious leakage of the pumped fluid.

PIPING CONNECTION –SEAL/PACKING SUPPORT SYSTEM

⚠WARNING

If the pump has a seal support system, it is mandatory that this system be fully installed and operational before the pump is started.

Packing Lubrication – All REF pumps have a plan 1 flush (from the discharge) standard. Water, when compatible with the pumpage, can be introduced into Tap V (Figure 4) at pressure 10 to 15 lbf/in^2 (69 to 103 kPa) above the stuffing box pressure.

The gland should be adjusted to give a flow rate of 20 to 30 drops per minute for clean fluid. For abrasive applications, the regulated flow rate should be 1-2 gpm (0.06-0.13 l/s).

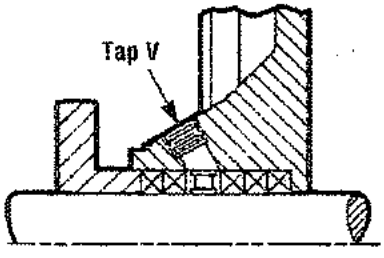


FIGURE 4 – Packing Housing Arrangement

Grease lubrication, when compatible with the pumpage, may be used. Again, introduced into Tap V. In non-abrasive applications the pumpage itself may be sufficient to lubricate the packing without need for external lines. Tap V should be plugged.

Abrasive Packing Arrangement – The installation procedures are the same as the standard packing with some exceptions. A special lip seal is installed first, followed by two lantern ring assemblies, then two of the packing rings provided (Figure 5).

A flush line from a clean external source should be connected via Tap V, in the top of the stuffing box.

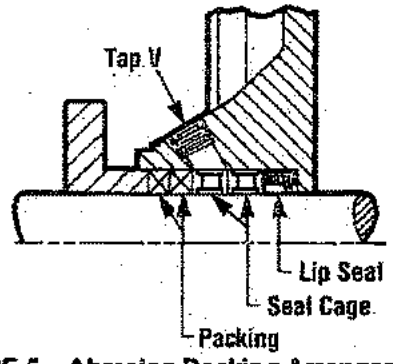


FIGURE 5 – Abrasion Packing Arrangement

BEARING LUBRICATION

Reasonable care and proper lubrication of American-Marsh Pump bearings will result in many years of service.

OIL LUBRICATED BEARINGS

REF Oil lubricated pumps are shipped from the factory without oil in the bearing housings. Before the pump is started the oil reservoir must be filled with Royal Purple Synfilm 68, Shell Tellus 68, Texaco Rhonda 68, or equivalent high quality ISO 68 grade oil with anti-wear additives. The oil should be drained and replaced every 3 to 6 months depending on operating conditions.

REF pumps can be supplied with grease packed bearings and are shipped from the factory pre-lubricated. Before the pump is started the bearings must be filled with Royal Purple NLGI #2 or other high quality equivalent grease.

REC & REI pumps depend on the driver bearings for support and therefore should be cared for as the manufacturer of the driver recommends.

DRIVER BEARINGS

Consult the driver manufacturer's maintenance instructions for lubricants and re-lubrication procedures for the driver.

COUPLING

A direction arrow is cast on the front of the casing and on the Bearing Housing. Make sure the motor rotates in the same direction before coupling the motor to the Pump.

⚠CAUTION

It is absolutely essential that the rotation of the motor be checked before connecting the shaft coupling. Incorrect rotation of the pump, for even a short time, can dislodge the impeller which may cause serious damage to the pump. All RE pumps turn clockwise as viewed from the motor end or, conversely, counterclockwise when viewed from the suction end.

The coupling should be installed as advised by the coupling manufacturer. Pumps are shipped without the spacer installed. If the spacer has been installed to facilitate alignment, then it must be removed prior to checking rotation. Remove protective material from the coupling and any exposed portions of the shaft before installing the coupling.

PUMP OPERATION

ROTATION CHECK

⚠CAUTION

It is absolutely essential that the rotation of the motor be checked before connecting the shaft coupling. Incorrect rotation of the pump, for even a short time, can dislodge and damage the impeller, casing, shaft and shaft seal.

All RE pumps turn clockwise as viewed from the motor end. A direction arrow is cast on the front of the casing. Make sure the motor rotates in the same direction.

PRE START-UP CHECKS

Prior to starting the pump it is essential that the following checks are made. These checks are all described in detail in the Maintenance Section of this booklet.

- Pump and Motor properly secured to the base plate
- All fasteners tightened to the correct torques
- Coupling guard in place and not rubbing
- Rotation check, see above

THIS IS ABSOLUTELY ESSENTIAL.

- Shaft seal properly installed
- Seal support system operational
- Bearing lubrication
- Bearing housing cooling system operational
- Impeller clearances properly set
- Pump instrumentation is operational
- Pump is primed
- Rotation of shaft by hand

As a final step in preparation for operation, it is important to rotate the shaft by hand to be certain that all rotating parts move freely, and that there are no foreign objects in the pump.

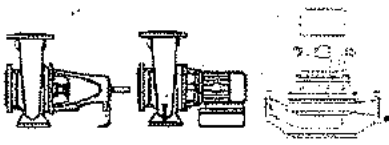
ENSURING PROPER $NPSH_A$

Net Positive Suction Head – Available ($NPSH_A$) is the measure of the energy in a liquid above the vapor pressure. It is used to determine the likelihood that a fluid will vaporize in the pump. It is critical because a centrifugal pump is designed to pump a liquid, not a vapor. Vaporization in a pump will result in damage to the pump, deterioration of the Total Differential Head (TDH), and possibly a complete stopping of pumping. Net Positive Suction Head – Required ($NPSH_R$) is the decrease of fluid energy between the inlet of the pump, and the point of lowest pressure in the pump. This decrease occurs because of friction losses and fluid accelerations in the inlet region of the pump, and particularly accelerations as the fluid enters the impeller vanes. The value for $NPSH_R$ for the specific pump purchased is given in the pump data sheet, and on the pump performance curve.

For a pump to operate properly the $NPSH_A$ must be greater than the $NPSH_R$. Good practice dictates that this margin should be at least 5 ft (1.5 m) or 20%, whichever is greater.

⚠CAUTION

Ensuring that $NPSH_A$ is larger than $NPSH_R$ by the suggested margin will greatly enhance pump performance and reliability. It will also reduce the likelihood of cavitation, which can severely damage the pump.



MINIMUM FLOW

Minimum continuous stable flow is the lowest flow at which the pump can operate and still conform to the bearing life, shaft deflection and bearing housing vibration limits. Pumps may be operated at lower flows, but it must be recognized that the pump may not conform to one or more of these limits. For example, vibration may exceed the limit set by the ASME standard. The size of the pump, the energy absorbed, and the liquid pumped are some of the considerations in determining the minimum flow.

Typically, limitations of 10% of the capacity at the best efficiency point (BEP) should be specified as the minimum flow. However, American-Marsh has determined that several pumps must be limited to higher minimum flows to provide optimum service. The following are the recommended minimum flows for these specific pumps:

Pump Size	60 Hz		50 Hz	
	RPM	Minimum Flow (% of BEP)	RPM	Minimum Flow (% of BEP)
All 5" Impellers	3500	25%	2900	21%
All 7" Impellers	3500	25%	2900	21%
All 8" Impellers	3500	25%	2900	21%
All 10" Impellers	3500	33%	2900	28%
All 13" Impellers	1750	50%	1450	42%
All Other Sizes	ANY	20%	ANY	20%

FIGURE 6 - Minimum Continuous Safe Flow

Note: "Minimum intermittent flow" value of 50% of the "minimum continuous flow" as long as that flow is greater than the "minimum thermal flow."

All RE pumps also have a "Minimum Thermal Flow." This is defined as the minimum flow that will not cause an excessive temperature rise. Minimum Thermal Flow is application dependent.

⚠WARNING

Do not operate the pump below Minimum Thermal Flow, as this could cause an excessive temperature rise. Contact an American-Marsh Sales Engineer for determination of Minimum Thermal flow.

STARTING THE PUMP AND ADJUSTING FLOW

1. Open the suction valve to full open position. It is very important to leave the suction valve open while the pump is operating. Any throttling or adjusting of flow must be done through the discharge valve. Partially closing the suction valve can create serious NPSH and pump performance problems.

⚠DANGER

Never operate pump with both the suction and discharge valves closed. This could cause an explosion.

2. A standard centrifugal pump will not move liquid unless the pump is primed. A pump is said to be "primed" when the casing and the suction piping are completely filled with liquid. Open discharge valve a slight amount. This will allow any entrapped air to escape and will normally allow the pump to prime, if the suction source is above the pump. When a condition exists where the suction pressure may drop below the pump's capability, it is advisable to add a low pressure control device to shut the pump down when the pressure drops below a predetermined minimum.
3. All cooling, heating, and flush lines must be started and regulated.
4. Start the driver (typically, the electric motor).
5. Slowly open the discharge valve until the desired flow is reached, keeping in mind the minimum flow restrictions listed above.

⚠DANGER

It is important that the discharge valve be opened within a short interval after starting the driver. Failure to do this could cause a dangerous build up of heat, and possibly an explosion.

6. *Reduced capacity*
   Avoid running a centrifugal pump at drastically reduced capacities or with discharge valve closed for extended periods of time. This can cause severe temperature rise and the liquid in the pump may reach its boiling point. If this occurs, the mechanical seal will be exposed to vapor, with no lubrication, and may score or seize to the stationary parts. Continued running under these conditions when the suction valve is also closed, can create an explosive condition due to the confined vapor at high pressure and temperature. Thermostats may be used to

safeguard against over heating by shutting down the pump at a predetermined temperature.

Safeguards should also be taken against possible operation with a closed discharge valve, such as installing a bypass back to the suction source. The size of the bypass line and the required bypass flow rate is a function of the input horsepower and the allowable temperature rise.

7. *Reduced Head*
   Note that when discharge head drops, the pump's flow rate usually increases rapidly. Check motor for temperature rise as this may cause overload. If overloading occurs, throttle the discharge.
8. *Surging Condition*
   A rapidly closing discharge valve can cause a damaging pressure surge. A dampening arrangement should be provided in the piping.

OPERATION IN SUB-FREEZING CONDITIONS

When using the pump in sub-freezing conditions where the pump is periodically idle, the pump should be properly drained or protected with thermal devices which will keep the liquid in the pump from freezing.

SHUTDOWN CONSIDERATIONS

When the pump is being shutdown, the procedure should be the reverse of the start-up procedure. First, slowly close the discharge valve, shutdown the driver, then close the suction valve. Remember, closing the suction valve while the pump is running is a safety hazard and could seriously damage the pump and other equipment.

TROUBLESHOOTING

The following is a guide to troubleshooting problems with American-Marsh pumps. Common problems are analyzed and solutions are offered. Obviously, it is impossible to cover every possible scenario. If a problem exists that is not covered by one of the examples, then contact a local American-Marsh Sales Engineer or Distributor/Representative for assistance.

PROBLEM	POSSIBLE CAUSE	RECOMMENDED REMEDY
Problem #1 Pump not reaching design flow rate.	1.1 Insufficient $NPSH_A$. (Noise may not be present)	Recalculate NPSH available. It must be greater than the NPSH required by pump at desired flow. If not, redesign suction piping, holding number of elbows and number of planes to a minimum to avoid adverse flow rotation as it approaches the impeller.
	1.2 System head greater than anticipated.	Reduce system head by increasing pipe size and/ than or reducing number of fittings. Increase impeller diameter. NOTE: Increasing impeller diameter may require use of a larger motor.
	1.3 Entrained air. Air leak from atmosphere on suction side.	1. Check suction line gaskets and threads for tightness. 2. If vortex formation is observed in suction tank, install vortex breaker. 3. Check for minimum submergence.
	1.4 Entrained gas from process.	Process generated gases may require larger pumps.
	1.5 Speed too low.	Check motor speed against design speed.
	1.6 Direction of rotation wrong.	After confirming wrong rotation, reverse any two of three leads on a three phase motor. The pump should be disassembled and inspected before it is restarted.
	1.7 Impeller too small.	Replace with proper diameter impeller. NOTE: Increasing impeller diameter may require use of a larger motor.
	1.8 Plugged impeller, suction line or casing which may be due to a product or large solids.	1. Reduce length of fiber when possible. 2. Reduce solids in the process fluid when possible. 3. Consider larger pump.
	1.9 Wet end parts (casing cover, impeller) worn, corroded or missing.	Replace part or parts.
Problem #2.0 Pump not reaching design head (TDH).	2.1 Refer to possible causes under Problem #1.0.	Refer to remedies listed under Problem #1.0 and #3.0.
Problem #3.0 No discharge or flow	3.1 Not properly primed.	Repeat priming operation, recheck instructions. If pump has run dry, disassemble and inspect the pump before operation.
	3.2 Direction of rotation wrong.	After confirming wrong rotation, reverse any two of three leads on a three phase motor. The pump should be disassembled and inspected before operation.

PROBLEM	POSSIBLE CAUSE	RECOMMENDED REMEDY
Cont., Problem #3.0 No discharge or flow	3.3 Entrained air. Air leak from atmosphere on suction side.	Refer to recommended remedy under Problem #1.0, Item #1.3.
	3.4 Plugged impeller, suction line or casing which may be due to a fibrous product or large solids.	Refer to recommended remedy under Problem #1.0, Item #1.8.
	3.5 Damaged pump shaft, impeller.	Replace damaged parts.
Problem #4.0 Pump operates for short period, then loses prime.	4.1 Insufficient NPSH.	Refer to recommended remedy under Problem #1.0, Item #1.1.
	4.2 Entrained air. Air leak from atmosphere on suction side.	Refer to recommended remedy under Problem #1.0, Item #1.3.
Problem #5.0 Excessive noise from wet end.	5.1 Cavitation - insufficient NPSH available.	Refer to recommended remedy under Problem #1.0, Item #1.1.
	5.2 Abnormal fluid rotation due to complex suction piping.	Redesign suction piping, holder number of elbows and number of planes to a minimum to avoid adverse fluid rotation as it approaches the impeller.
	5.3 Impeller rubbing.	1. Check outboard bearing assembly for axial end play (REF Models). 2. Reset impeller clearance (REC & REI Models).
Problem #6.0 Excessive noise from power end.	6.1 Bearing contamination appearing on the raceways as scoring, pitting, scratching, or rusting caused by adverse environment and entrance of abrasive contaminants from atmosphere.	1. Work with clean tools in clean surroundings. 2. Remove all outside dirt from housing before exposing bearings. 3. Handle with clean dry hands. 4. Treat a used bearing as carefully as a new one. 5. Use clean solvent and flushing oil. 6. Protect disassembled bearing from dirt and moisture. 7. Keep bearings wrapped in paper or clean cloth while not in use. 8. Clean inside of housing before replacing bearings. 9. Check oil seals and replace as required. 10. Check all plugs and tapped openings to make sure that they are tight.
	6.2 Brinelling of bearing identified by indentation on the ball races, usually caused by incorrectly applied forces in assembling the bearing or by shock loading such as hitting the bearing or drive shaft with a hammer.	When mounting the bearing on the drive shaft use a proper size ring and apply the pressure against the inner ring only. Be sure when mounting a bearing to apply the mounting pressure slowly and evenly.

PROBLEM	POSSIBLE CAUSE	RECOMMENDED REMEDY
Cont. Problem #6.0 Excessive noise from power end.	6.3 False brinelling of bearing identified again by either axial or circumferential indentations usually caused by vibration of the balls between the races in a stationary bearing.	1. Correct the source of vibration. 2. Where bearings are oil lubricated and employed in units that may be out of service for extended periods, the drive shaft should be turned over periodically to re-lubricate all bearing surfaces at intervals of one-to three months.
	6.4 Thrust overload on bearing identified by flaking ball path on one side of the outer race or in the case of maximum capacity bearings, may appear as a spalling of the races in the vicinity of the loading slot. (Please note: maximum capacity bearings are not recommended in REF pumps.) These thrust failures are caused by improper mounting of the bearing or excessive thrust loads.	1. Follow correct mounting procedures for bearings.
	6.5 Misalignment identified by fracture of ball retainer or a wide ball path on the inner race and a narrower cocked ball path on the outer race. Misalignment is caused by poor mounting practices or defective drive shaft. For example bearing not square with the centerline or possibly a bent shaft due to improper handling.	Handle parts carefully and follow recommended mounting procedures. Check all parts for proper fit and alignment.
	6.6 Bearing damaged by electric arcing identified as electro-etching of both inner and outer ring as a pitting or cratering. Electrical arcing is caused by a static electrical charge eminating from belt drives, electrical leakage or short circuiting.	1. Where current shunting through the bearing cannot be corrected, a shunt in the form of a slip ring assembly should be incorporated. 2. Check all wiring, insulation and rotor windings to be sure that they are sound and all connections are properly made. 3. Where pumps are belt driven, consider the elimination of static charges by proper grounding or consider belt material that is less generative.

PROBLEM	POSSIBLE CAUSE	RECOMMENDED REMEDY
Cont.: **Problem #6.0** Excessive noise from power end.	6.7 Bearing damage due to improper lubrication, identified by one or more of the following: 1. Abnormal bearing temperature rise. 2. A stiff cracked grease appearance. 3. A brown or bluish discoloration of the bearing races.	1. Be sure the lubricant is clean. 2. Be sure proper amount of lubricant is used. The constant level oiler supplied with REF pumps will maintain the proper oil level if it is installed and operating properly. In the case of greased lubricated bearings, be sure that there is space adjacent to the bearing into which it can rid itself of excessive lubricant, otherwise the bearing may overheat and fail prematurely. 3. Be sure the proper grade of lubricant is used.

MAINTENANCE

PREVENTIVE MAINTENANCE

The following sections of this manual give instructions on how to perform a complete maintenance overhaul. However, it is also important to periodically repeat the "Pre start-up checks" listed on page 13. These checks will help extend pump life as well as the length of time between major overhauls.

NEED FOR MAINTENANCE RECORDS

A procedure for keeping accurate maintenance records is a critical part of any program to improve pump reliability. There are many variables that can contribute to pump failures. Often long term and repetitive problems can only be solved by analyzing these variables through pump maintenance records.

NEED FOR CLEANLINESS

One of the major causes of pump failure is the presence of contaminants in the bearing housing. This contamination can be in the form of moisture, dust, dirt and other solid particles such as metal chips. Contamination can also be harmful to the mechanical seal (especially the seal faces) as well as other parts of the pumps. For example, dirt in the impeller threads could cause the impeller to not be seated properly against the shaft. This, in turn, could cause a series of other problems. For these reasons, it is very important that proper cleanliness be maintained. Some guidelines are listed below.

After draining the oil from the bearing housing, periodically send it out for analysis. If it is contaminated, determine the cause and correct. The work area should be clean and free from dust, dirt, oil, grease, etc. Hands and gloves should be clean. Only clean towels, rags, and tools should be used.

DISASSEMBLY

Refer to the parts list shown in Figures 16, 17 & 18 for item number references used throughout this section.

REF MODELS

1. Before performing any maintenance, disconnect the driver from its power supply and lock it off line.

⚠DANGER

Lock out power to driver to prevent personal injury.

2. Close the discharge and suction valves, and drain all liquid from the pump.
3. Close all valves on auxiliary equipment and piping, then disconnect all auxiliary piping.
4. Decontaminate the pump as necessary. If American-Marsh pumps contain dangerous chemicals, it is important to follow plant safety guidelines to avoid personal injury or death.
5. Remove the coupling guard.
6. Remove the spacer from the coupling (if supplied).
7. Remove casing fasteners (#383F).
8. Remove the fasteners holding the bearing housing foot to the base plate.
9. Move the power frame (#2B) and rear cover (#2D) assembly away from the casing (#1A). Discard the casing/cover gasket (#351A).

⚠DANGER

The power frame and rear cover assembly is heavy. It is important to follow plant safety guidelines when lifting it.

10. Inspect the casing (#1A) and the case wear ring (#15A) for damage. If the casing (#1A) shows any signs of damage, replace it. If the case wear ring (#15A) is damage, pry it from the casing (#1A). Press new case wear ring (#15A) into casing (#1A) by using equal force around the case wear ring (#15A) until it is seated securely in casing (#1A).
11. Transport the back pull-out assembly to the maintenance shop.
12. Remove the coupling hub from the pump shaft (#41A).
13. Bend the impeller washer (#27A) flat so that the impeller nut (#24B) can be loosened. Loosen and remove the impeller nut (#24B) and the impeller washer (#27A). Discard the impeller washer (#27A). The impeller (#11A) should be free to remove from the shaft (#41A). Remove the impeller key (#24A) from the shaft (#41A).

⚠CAUTION

Do not apply heat to the impeller. If liquid is entrapped in the hub, an explosion could occur.

INTERNAL COMPONENT MECHANICALLY SEALED PUMPS

If pump is of the packed orientation, skip to step 19.

14. Remove the mechanical seal (#331B) from the shaft (#41A).
15. Remove the shaft sleeve (#42A) from the shaft (#41A). Discard the shaft sleeve o-ring (#331C).
16. Remove rear cover nuts (#385F) and carefully remove the rear cover (#2D) from the power frame.
17. Carefully press the stationary part of the mechanical seal out of the rear cover (#2D). Discard and replace the mechanical seal (#331B) if damaged.
18. Inspect the rear cover (#2D) for damage or excessive wear and replace if necessary. Be sure to inspect and clean the internal flush port. It is critical that this flush port is clear of all debris due to the fact that it lubricates the mechanical seal (#331B).

EXTERNAL MECHANICALLY SEALED OR PACKED PUMPS

19. Loosen and remove the gland nuts (#72D).
20. If a cartridge type mechanical seal is used, loosen the set screws which lock the unit to the shaft and remove the complete seal assembly. If the seal is to be reused, the spacing clips or tabs should be reinstalled prior to loosening the set screws. This will ensure that the proper seal compression is maintained.
21. If a component type outside mechanical seal is used, remove the gland and the stationary seat from the rear cover (#2D). Once the rear cover (#2D) has been removed, remove the stationary seat from the gland. Loosen the set screws in the rotating unit and remove it. Discard all O-rings and gaskets.
22. Remove rear cover nuts (#385F) and carefully remove the rear cover (#2D) from the power frame.
23. If packing (#331A) is used, remove it and the lantern ring (#73A). Remove the gland (#71A).
24. Remove the shaft sleeve (#42A) from the shaft (#41A). Discard the shaft sleeve o-ring (#331C).
25. If the power frame is oil lubricated, remove the drain plug and drain the oil from the bearing housing (#2B).
26. Remove the shaft deflector (#46A).
27. Remove the inboard bearing cap cap screws (#384B). Remove the inboard bearing cap (#85P). Remove and discard the inboard bearing cap gasket (#359A). Remove and discard the inboard bearing cap oil lip seal ((#104P). If bearing isolators are used, refer to Appendix XXX. If magnetic seals are used, maintain the seals as specified by the manufacturer.
28. Remove the outboard bearing cap cap screws (#384B). Remove the outboard bearing cap (#85N). Remove and discard the outboard bearing cap gasket (#359A). Remove and discard the outboard bearing cap oil lip seal (#104P). If bearing isolators are used, refer to Appendix XXX. If magnetic seals are used, maintain the seals as specified by the manufacturer.
29. Press the shaft assembly (consisting of the shaft (#41A), the inboard bearing (#81P) and the outboard bearing (#81N)) out of the bearing housing (#2B).
30. An arbor or hydraulic press may be used to remove the bearings (#81N and #81P) from the shaft. It is extremely important to apply even pressure to the inner bearing race only. Never apply pressure to the outer race as this exerts excess load on the balls and causes damage.

⚠CAUTION

Applying pressure to the outer race could permanently damage the bearings.

31. If present, the Trico oiler should be removed from the bearing housing.
32. The sight gage should be removed from the bearing housing.

REC & REI MODELS

1. Before performing any maintenance, disconnect the driver from its power supply and lock it off line.

⚠DANGER

Lock out power to driver to prevent personal injury.

2. Close the discharge and suction valves, and drain all liquid from the pump.
3. Close all valves on auxiliary equipment and piping, then disconnect all auxiliary piping.
4. Decontaminate the pump as necessary. If American-Marsh pumps contain dangerous chemicals, it is important to follow plant safety guidelines to avoid personal injury or death.
5. Remove casing fasteners (#383F).
6. Move the rear cover (#2D) and shaft & bracket assembly away from the casing (#1A). Discard the casing/cover gasket (#351A).

⚠DANGER

The rear cover assembly and shaft & bracket assembly is heavy. It is important to follow plant safety guidelines when lifting it.

7. Inspect the casing (#1A) and the case wear ring (#15A) for damage. If the casing (#1A) shows any signs of damage, replace it. If the case wear ring (#15A) is damage, pry it from the casing (#1A). Press new case wear ring (#15A) into casing (#1A) by using equal force around the case wear ring (#15A) until it is seated securely in casing (#1A).
8. Transport the back pull-out assembly to the maintenance shop.
9. Bend the impeller washer (#27A) flat so that the impeller nut (#24B) can be loosened. Loosen and remove the impeller nut (#24B) and the impeller washer (#27A). Discard the impeller washer (#27A). The impeller (#11A) should be free to remove from the shaft (#41A). Remove the impeller key (#24A) from the shaft (#41A).

⚠CAUTION

Do not apply heat to the impeller. If liquid is entrapped in the hub, an explosion could occur.

10. Remove the mechanical seal (#331B) from the shaft (#41A).
11. Remove the shaft sleeve (#42A) from the shaft (#41A). Discard the shaft sleeve o-ring (#331C).
12. Remove rear cover nuts (#385F) and carefully remove the rear cover (#2D) from the bracket assembly (#2E).
13. Carefully press the stationary part of the mechanical seal out of the rear cover (#2D). Discard and replace the mechanical seal (#331B) if damaged.
14. Inspect the rear cover (#2D) for damage or excessive wear and replace if necessary. Be sure to inspect and clean the internal flush port. It is critical that this flush port is clear of all debris due to the fact that it lubricates the mechanical seal (#331B).
15. If the motor is to be removed from the bracket (#2E) and shaft (#41A), loosen and remove the shaft set screws (#47A). Carefully pull the motor off of the bracket (#2E) and shaft (#41A).

CLEANING/INSPECTION

All parts should now be thoroughly cleaned and inspected. New bearings, O-rings, gaskets, and lip seals should be used. Any parts that show wear or corrosion should be replaced with new genuine American-Marsh parts.

⚠WARNING

It is important that only non-flammable, non-contaminated cleaning fluids are used. These fluids must comply with plant safety and environmental guidelines.

ASSEMBLY

Note: Refer to Figure 7 for all bolt torque information.

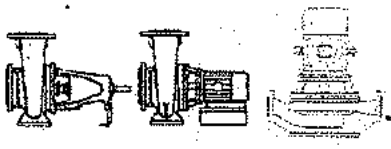
It is very important that all pipe threads be sealed properly. PTFE tape provides a very reliable seal over a wide range of fluids, but it has a serious shortcoming if not used properly. If, during application to the threads, the tape is wrapped over the end of the male thread, strings of the tape will be formed off when threaded into the female fitting. This string can then tear away and lodge in the piping system. If this occurs in the seal flush system, small orifices can become blocked effectively shutting off flow. For this reason, American-Marsh does not recommend the use of PTFE tape as a thread sealant.

American-Marsh has investigated and tested alternate sealants and has identified two that provide an effective seal, have the same chemical resistance as the tape, and will not plug flush systems. These are La-co SlicTite and Bakerseal. Both products contain finely ground PTFE particles in an oil based carrier. They are supplied in a paste form which is brushed on the male pipe threads. American-Marsh recommends using one of these paste sealants.

Full thread length engagement is required for all fasteners.

BOLT SIZE		TIGHTENING TORQUE	
Metric	Standard	Lbf ft	Nm
4 mm	5/32"	2.7	3.6
5 mm	3/16"	5.2	7.0
6 mm	1/4"	8.9	12.0
7 mm	9/32"	14.6	19.8
8 mm	5/16"	21.8	29.6
9 mm	11/32"	28.0	38.0
10 mm	3/8"	38.7	52.5
12 mm	1/2"	65.6	89.0
14 mm	9/16"	99.6	135
16 mm	5/8"	151	205
18 mm	11/16"	190	257
20 mm	3/4"	264	358
22 mm	7/8"	321	435
24 mm	15/16"	411	557

FIGURE 7 - Bolt & Cap Screw Torque Ratings



REF POWER FRAME ASSEMBLY

BEARING INSTALLATION

Mounting of bearings on shafts must be done in a clean environment. Bearing and power end life can be drastically reduced if even very small foreign particles work their way into the bearings.

Bearings should be removed from their protective packaging only immediately before assembly to limit exposure to possible contamination. After removing the packaging they should only come in contact with clean hands, fixtures, tools and work surfaces.

The chart shown in Figure 8 gives the SKF part numbers for bearings in American-Marsh REF pumps. Note that the term "inboard bearing" refers to the bearing nearest to the casing. "Outboard bearing" refers to the bearing nearest to the motor.

1. Install the inboard bearing (#81P) on the shaft (#41A). The inboard bearing must be positioned against the shoulder. If the power end is equipped with single shield re-greaseable bearings, the shields should be placed next to the shaft shoulder.

Power Frame	Type of Bearings	Inboard Single Row, Deep Groove⑤	Outboard Single Deep Groove⑤	Optional Outboard Duplex Angular Contact⑤
25A 25B	Oil bath/mist – Open①	6305-C3	6305-C3	7305-BECBY
	Regreasable – Single Shielded②	6305-ZC3	6305-ZC3	NA⑥
	Greased for life – Double Shielded③	6305-2ZC3	6305-2ZC3	NA⑦
	Sealed for life – Double Sealed④	6305-2RSIC3	6305-2RSIC3	NA⑦
35	Oil bath/mist – Open①	6307-C3	6307-C3	7307-BECBY
	Regreasable – Single Shielded②	6307-ZC3	6307-ZC3	NA⑥
	Greased for life – Double Shielded③	6307-2ZC3	6307-2ZC3	NA⑦
	Sealed for life – Double Sealed④	6307-2RSIC3	6307-2RSIC3	NA⑦
45	Oil bath/mist – Open①	6309-C3	6309-C3	7309-BECBY
	Regreasable – Single Shielded②	6309-ZC3	6309-ZC3	NA⑥
	Greased for life – Double Shielded③	6309-2ZC3	6309-2ZC3	NA⑦
	Sealed for life – Double Sealed④	6309-2RSIC3	6309-2RSIC3	NA⑦
55	Oil bath/mist – Open①	6311-C3	6311-C3	7311-BECBY
	Regreasable – Single Shielded②	6311-ZC3	6311-ZC3	NA⑥
	Greased for life – Double Shielded③	6311-2ZC3	6311-2ZC3	NA⑦
	Sealed for life – Double Sealed④	6311-2RSIC3	6311-2RSIC3	NA⑦
60	Oil bath/mist – Open①	6312-C3	6312-C3	7312-BECBY
	Regreasable – Single Shielded②	6312-ZC3	6312-ZC3	NA⑥
	Greased for life – Double Shielded③	6312-2ZC3	6312-2ZC3	NA⑦
	Sealed for life – Double Sealed④	6312-2RSIC3	6312-2RSIC3	NA⑦
70	Oil bath/mist – Open①	6314-C3	6314-C3	7314-BECBY
	Regreasable – Single Shielded②	6314-ZC3	6314-ZC3	NA⑥
	Greased for life – Double Shielded③	6314-2ZC3	6314-2ZC3	NA⑦
	Sealed for life – Double Sealed④	6314-2RSIC3	6314-2RSIC3	NA⑦

FIGURE 8 – AMP REF Bearings

①These bearings are open on both sides. They are lubricated by oil bath or oil mist.

②These bearings are pre-greased by American-Marsh. Replacement bearings will generally not be pre-greased, so grease must be applied by the user. They have a single shield, which is located on the side next to the grease buffer, or reservoir. The bearings draw grease from the reservoir as it is needed. The shield protects the bearing from getting too much grease, which would generate heat. The grease reservoir is initially filled with grease by American-Marsh. Lubrication fittings are provided, to allow the customer to periodically replenish the grease, as recommended by the bearing and/or grease manufacturer.

③These bearings are shielded on both sides. They come pre-greased by the bearing manufacturer. The user does not need to re-grease these bearings. The shields do not actually contact the bearing race, so no heat is generated.

④These bearings are sealed on both sides. They come pre-greased by the bearing manufacturer. The user does not need to re-grease these bearings. The seals physically contact and rub against the bearing race, which generates heat. These bearings are not recommended at speeds above 1750 RPM.

⑤The codes shown are SKF codes. Inboard and outboard bearings have the C3, greater than "Normal" clearance. These clearances are recommended by SKF to maximize bearing life.

⑥Re-greasable – Single Shielded bearings are not available in the duplex configuration; however, open oil bath-type bearings can be used for the re-greasable configuration. These bearings must be pre-greased during assembly. Lubrication fittings are provided, to allow the user to periodically replenish the grease, as recommended by the bearing and/or grease manufacturer.

⑦Not available.

BEARING INSTALLATION
FOR POWER END ASSEMBLY (CONT'D)

Both bearings have a slight interference fit which requires that they be pressed on the shaft with an arbor or hydraulic press. Even force should be applied to the inner race only. Never press on the outer race, as the force will damage the balls and races. An alternate method of installing bearings is to heat the bearings to 200°F (93°C) in an oven or induction heater. Then place them quickly in position on the shaft.

⚠CAUTION

Never heat the bearings above 230°F (110°C). To do so will likely cause the bearing fits to permanently change, leading to early failure.

2. Using clean gloves, install the outboard bearing (#121) firmly against the shoulder as shown in Figure 19. If hot bearing mounting techniques are used, steps must be taken to ensure the outboard bearing is firmly positioned against the shaft shoulder. The outboard bearing, while still hot, is to be positioned against the shaft shoulder. After the bearing has cooled below 100°F (38°C) the bearing should be pressed against the shaft shoulder. An approximate press force needed to seat the bearing is listed in Figure 19. This value may be used if the press has load measuring capability.

⚠CAUTION

It must be understood that fixtures and equipment used to press the bearing must be designed so no load is ever transmitted through the bearing balls. This would damage the bearing.

⚠CAUTION

Never heat the bearings above 230°F (110°C). To do so will likely cause the bearing fits to permanently change, leading to early failure.

Pump	Press Force lbf (N)
25A/25B	1300 (5,780)
35	
45	2500 (11,100)
55	
60	4500 (20,000)
70	

FIGURE 9 – Bearing Press Force

3. If the outboard bearing is cold pressed against the shaft shoulder, it should be pressed onto the shaft with the forces listed in Figure 9.
4. Duplex angular contact bearings must be mounted back to back with the wider thrust sides of the outer races in contact with each. Only bearings designed for universal mounting should be used. SKF's designation is "BECB". NTN's designation is "G".
   Note: A special shaft is required when using duplex angular contact bearings.

LIP SEALS

5. If lip seals (#104N & #104P) were used, install new lip seals in the bearing housing caps (#85N & 85P).
6. Bolt the inboard and outboard bearing housing caps (#85N & 85P) to the bearing housing (#2B) remembering to install new inboard and outboard bearing housing cap gaskets (#359A).

LABYRINTH SEALS

Refer to Appendix A.

MAGNETIC SEALS

Follow the installation instructions provided by the manufacturer.

7. Install a sight gage and or oil eye into the bearing housing.
8. If one was present, install a Trico oiler into the bearing housing. If not used, install a plug into the hole. When using a Trico oiler it is very important that a vent/breather be installed in the tapped hole on top of the bearing housing.
9. Install a drain plug into the bearing housing. Be sure to install the optional magnetic drain plug, if appropriate.
10. Install the shaft deflector (#46A).
11. Install a new shaft sleeve o-ring (#331C). Place the shaft sleeve (#42A) onto the shaft (#41A).

REF WET END ASSEMBLY

Refer to the appropriate section according to construction details.

INTERNAL COMPONENT MECHANICAL SEALS (STANDARD)

12. Press the stationary part of the mechanical seal into the rear cover (#2D) taking care not to damage the mechanical seal.
13. Install the rear cover plate (#2D) to the bearing housing (#2B) using studs (#385E) and nuts (#385F).
14. Install the rotating part of the mechanical seal onto the shaft sleeve using a seal guide following the seal manufacturer's instructions.
15. Install the impeller key (#24A). Install the impeller (#11A) onto the shaft (#41A). Install a new impeller washer (#27A) and impeller nut (#24B). Tighten the impeller nut (#24B) and bend the impeller washer (#27A) to lock into place.

CARTRIDGE MECHANICAL SEALS

16. Slide the cartridge seal onto the shaft using a seal guide until it lightly touches the bearing housing.
17. Install the rear cover (#2D). Tighten the rear cover (#2D) to the bearing housing (#2B). Install the cartridge seal gland to the rear cover plate (#2D) using studs (#72G) and nuts (#72D). Tighten set screws on the seal to lock the rotating unit to the shaft. Finally, remove centering clips from the seal.

EXTERNAL COMPONENT TYPE MECHANICAL SEAL

18. Install the rear cover (#2D) to the bearing housing (#2B).
19. Put blueing on the shaft in the area near the face of the seal chamber (rear cover #2D). Scribe a mark on the shaft at the face of the seal chamber. Now the location of the seal can be determined by referring to the seal drawing supplied by the seal manufacturer.
20. Remove the rear cover (#2D).
21. Install the mechanical seal gland and stationary seal components following the seal manufacturer's instructions. Slide the gland and stationary seal components onto the shaft until it lightly touches the bearing housing or adapter. Install the gland gasket into the gland.
22. Install the rotating part of the mechanical seal onto the shaft sleeve using a seal guide following the seal manufacturer's instructions.
23. Install the rear cover (#2D) to the bearing housing (#2B). Now, install the mechanical seal gland to the rear cover (#2D) using studs (#72G) and nuts (#72D).
24. Install the impeller key (#24A). Install the impeller (#11A) onto the shaft (#41A). Install a new impeller washer (#27A) and impeller nut (#24B). Tighten the impeller nut (#24B) and bend the impeller washer (#27A) to lock into place.

PACKING WITH SPLIT GLAND

25. Install the rear cover plate (#2D) to the bearing housing (#2B) using studs (#385E) and nuts (#385F).
26. Install the impeller key (#24A). Install the impeller (#11A) onto the shaft (#41A). Install a new impeller washer (#27A) and impeller nut (#24B). Tighten the impeller nut (#24B) and bend the impeller washer (#27A) to lock into place.
27. Install the packing rings (#331A) and lantern ring (#73A) into the stuffing box as shown in Figure 16. Always stagger the end gaps 90° to ensure a better seal. To speed installation of each ring, have an assistant turn the pump shaft in one direction. This movement of the shaft will tend to draw the rings into the stuffing box. A split gland (#71A) is an assembly of two matched gland halves that are bolted together. Unbolt the gland halves and install the gland halves around the shaft. Bolt the halves together to form a gland assembly. Now, install the gland assembly (#71A) using studs (#72G) and nuts (#72D). Lightly snug up the gland. Final adjustments must be made after the pump has begun operation.

PACKING WITH ONE PIECE GLAND

28. Slip gland over shaft and slide back to the bearing housing.
29. Install the rear cover plate (#2D) to the bearing housing (#2B) using studs (#385E) and nuts (#385F).
30. Install the impeller key (#24A). Install the impeller (#11A) onto the shaft (#41A). Install a new impeller washer (#27A) and impeller nut (#24B). Tighten the impeller nut (#24B) and bend the impeller washer (#27A) to lock into place.
31. Install the packing rings (#331A) and lantern ring (#73A) into the stuffing box as shown in Figure 16. Always stagger the end gaps 90° to ensure a better seal. To speed installation of each ring, have an assistant turn the pump shaft in one direction. This movement of the shaft will tend to draw the rings into the stuffing box. Now, attach the gland (#71A) to the rear cover using studs (#72G) and nuts (#72D). Lightly snug up

the gland. Final adjustments must be made after the pump has begun operation.

BEARING LUBRICATION

OIL BATH

The standard bearing housing bearings are oil bath lubricated and are not lubricated by American-Marsh. Before operating the pump, fill the bearing housing to the center of the oil sight glass with the proper type oil. (See Figure 10 for approximate amount of oil required – do not overfill.) The oil level in the bearing housing must be maintained at ±1/8 in (±3 mm) from the center of the sight glass. The sight glass has a 1/4 in (6 mm) hole in the center of its reflector. The bearing housing oil level must be within the circumference of the center hole to ensure adequate lubrication of the bearings.

Pump	OSD Oil Capacity
25A/25B	20 oz (590 ml)
35	30 oz (890 ml)
45	60 oz (1775 ml)
55	50 oz (1480 ml)
60	50 oz (1480 ml)
70	60 oz (1775 ml)

FIGURE 10 – Approximate Amount Of Oil Required

Mineral Oil	Quality mineral oil with rust and oxidation inhibitors. Mobil DTE Heavy/Medium ISO VG 68 or equivalent.
Synthetic	Royal Purple SynFilm 68, Conoco SYNCON 68 or equivalent. Some synthetic lubricants require Viton O-rings.
Grease	Royal Purple NLGI #2, Chevron SRI #2 (or compatible)

FIGURE 11 – Recommended Lubricants

Maximum Oil Temperature	ISO Viscosity Grade	Minimum Viscosity Index
Up to 160°F (71°C)	46	95
160-175°F (71°-80°C)	68	95
175-200°F (80°-94°C)	100	95

FIGURE 12 – Oil Viscosity Grades

See Figure 11 for recommended lubricants. DO NOT USE DETERGENT OILS. The oil must be free of water, sediment, resin, soaps, acid and fillers of any kind. It should contain rust and oxidation inhibitors. The proper oil viscosity is determined by the bearing housing operating temperature as given in Figure 12. To add oil to the housing, clean and then remove the vent plug at the top of the bearing housing, pour in oil until it is visually half way up in the sight glass. Fill the constant level oiler bottle (Trico), if used, and return it to its position. The correct oil level is obtained with the constant level oiler in its lowest position, which results in the oil level being at the top of the oil inlet pipe nipple, or half way up in the sight glass window. Oil must be visible in the bottle at all times. As stated above, proper oil level is the center of the "bull's eye" sight glass.

Lubrication	Temperature
Oil bath	180°F* (82°C)
Grease	200°F* (94°C)

* Assuming good maintenance and operation practices, and no contamination.

FIGURE 13 – Maximum External Housing Temperature

In many pumping applications lubricating oil becomes contaminated before it loses its lubricating qualities or breaks down. For this reason it is recommended that the first oil change take place after approximately 160 hours of operation, at which time, the used oil should be examined carefully for contaminants. During the initial operating period monitor the bearing housing operating temperature. Record the external bearing housing temperature. See Figure 13 for maximum acceptable temperatures. The normal oil change interval is based on temperature and is shown in Figure 14.

GREASE

Single shielded re-greasable bearings

When the grease lubrication option is specified, single shielded bearings, grease fittings and vent pipe plugs are installed inboard and outboard. The bearings are packed with Royal Purple NLGI #2 grease prior to assembly. For initial lubrication, apply grease through the fittings until it comes out of the vent holes, then reinstall the pipe plugs. For re-lubrication, a grease with the same type base (non-soap polyuride) and oil (mineral) should be used. To re-grease, remove the pipe plug from both the inboard and outboard bearing location.

⚠WARNING

To re-grease bearings under coupling guard, stop pump, lock the motor, remove coupling guard, then re-grease the bearings.

Lubricant	Under 160°F (71°C)	160-175°F (71-80°C)	175-200°F (80-94°C)
Grease	6 mo	3 mo	1.5 mo
Mineral Oil	6 mo	3 mo	1.5 mo
Synthetic Oil**	18 mo	18 mo	18 mo

FIGURE 14 – Re-lubrication Intervals

⚠CAUTION

Do not fill the housing with oil when greased bearings are used. The oil will leach the grease out of the bearings and the life of the bearings may be drastically reduced.

Double shielded or double sealed bearings
These bearings are packed with grease by the bearing manufacturer and should not be re-lubricated. Maintenance intervals for these bearings are greatly affected by their operating temperature and pump speed. However, the shielded bearing typically operates cooler, thus extending its life.

REC & REI FLUID ASSEMBLY

1. Press the stationary part of the mechanical seal into the rear cover (#2D) taking care not to damage the mechanical seal.
2. Install the rear cover plate (#2D) to the bracket assembly (#2E) using studs (#385E) and nuts (#385F).
3. Install a new shaft sleeve o-ring (#331C). Install the shaft (#41A) into the rear cover (#2D) using the rubber, two-part seal spacer. This rubber two-part spacer ensures that the shaft is in the proper axial position.
4. Place the shaft sleeve (#42A) onto the shaft (#41A). Install the rotating part of the mechanical seal onto the shaft sleeve using a seal guide following the seal manufacturer's instructions.
5. Install the impeller key (#24A). Install the impeller (#11A) onto the shaft (#41A). Install a new impeller washer (#27A) and impeller nut (#24B). Tighten the impeller nut (#24B) and bend the impeller washer (#27A) to lock into place.

REC & REI SHAFT AND BRACKET ASSEMBLY

6. Mount the motor to the bracket assembly (#2E) engaging the motor shaft into the pump shaft (#41A). It is extremely important that the keyways are engaged properly.
7. Dimple the motor shaft at one of the set screw locations (#47A). Install all shaft set screws (#47A) by applying a small amount of blue Loctite on the threads. Torque the set screws (#47A) to the appropriate values listed in Figure 15.

Size	Seating Torque	Holding Power
in.	in.-lbs.	lb.
0.2500	87	1000
0.3125	165	1500
0.3750	290	2000
0.4375	430	2500
0.5000	620	3000
0.5625	620	3500
0.6250	1325	4000
0.7500	2400	5000
0.8750	5200	6000
1.0000	7200	7000

Based on alloy steel set screw against steel shaft, class 3A course or fine threads in class 2B holes and cup point socket set screws.

FIGURE 15 – Set Screw Torque Values

PUMP REINSTALLATION

The pump is now ready to be returned to service. It should be reinstalled as described in the installation section.

SPARE PARTS

RECOMMENDED SPARE PARTS – STANDARD OSD PUMP

The decision on what spare parts to stock varies greatly depending on many factors such as the criticality of the application, the time required to buy and receive new spares, the erosive/corrosive nature of the application, and the cost of the spare part. Figures 16, 17 & 18 give the parts list for a typical REF, REC & REI pumps.

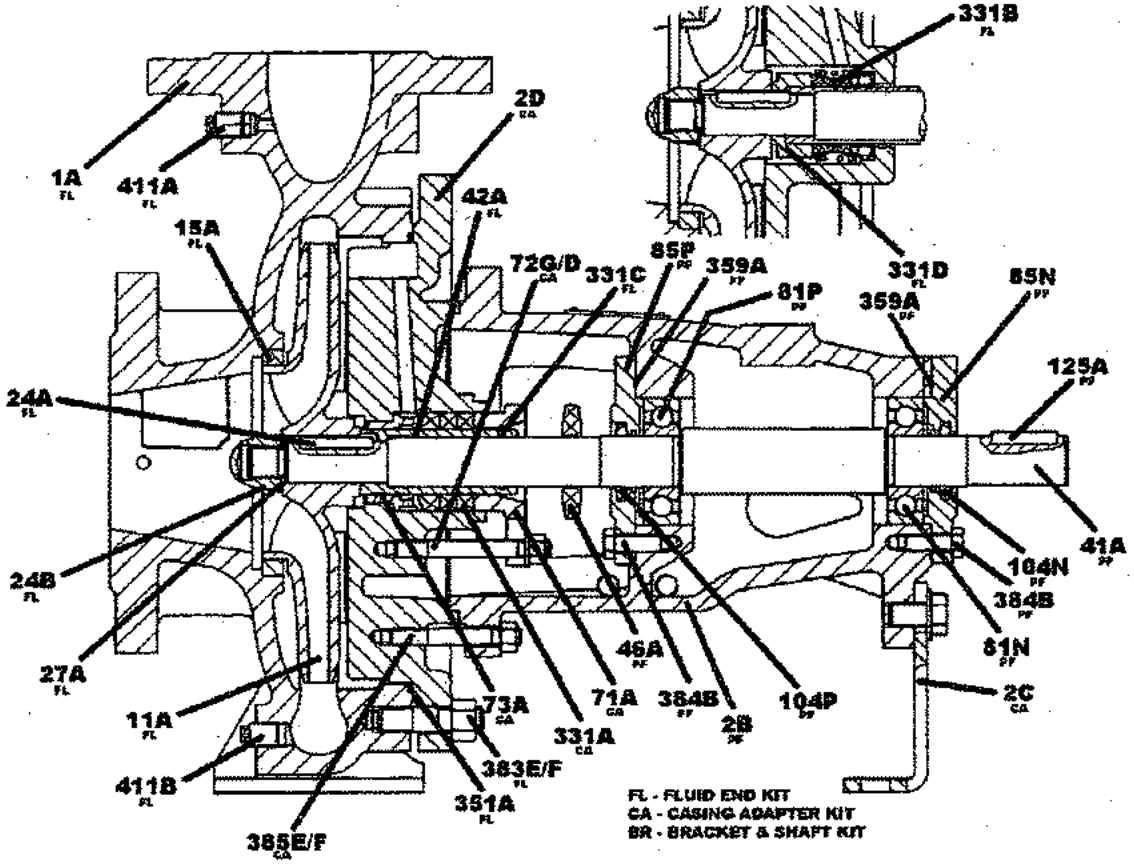
HOW TO ORDER SPARE PARTS

Spare parts can be ordered from the local American-Marsh Sales Engineer, or from the American-Marsh Distributor or Representative. The pump size and type can be found on the name plate on the bearing housing. See Figure 3. Please provide the item number, description, and alloy for the part(s) to be ordered.

To make parts ordering easy, American-Marsh has created a catalog titled "American-Marsh Pump Parts Catalog." A copy of this book can be obtained from the

local American-Marsh Sales Engineer or Distributor/Representative.

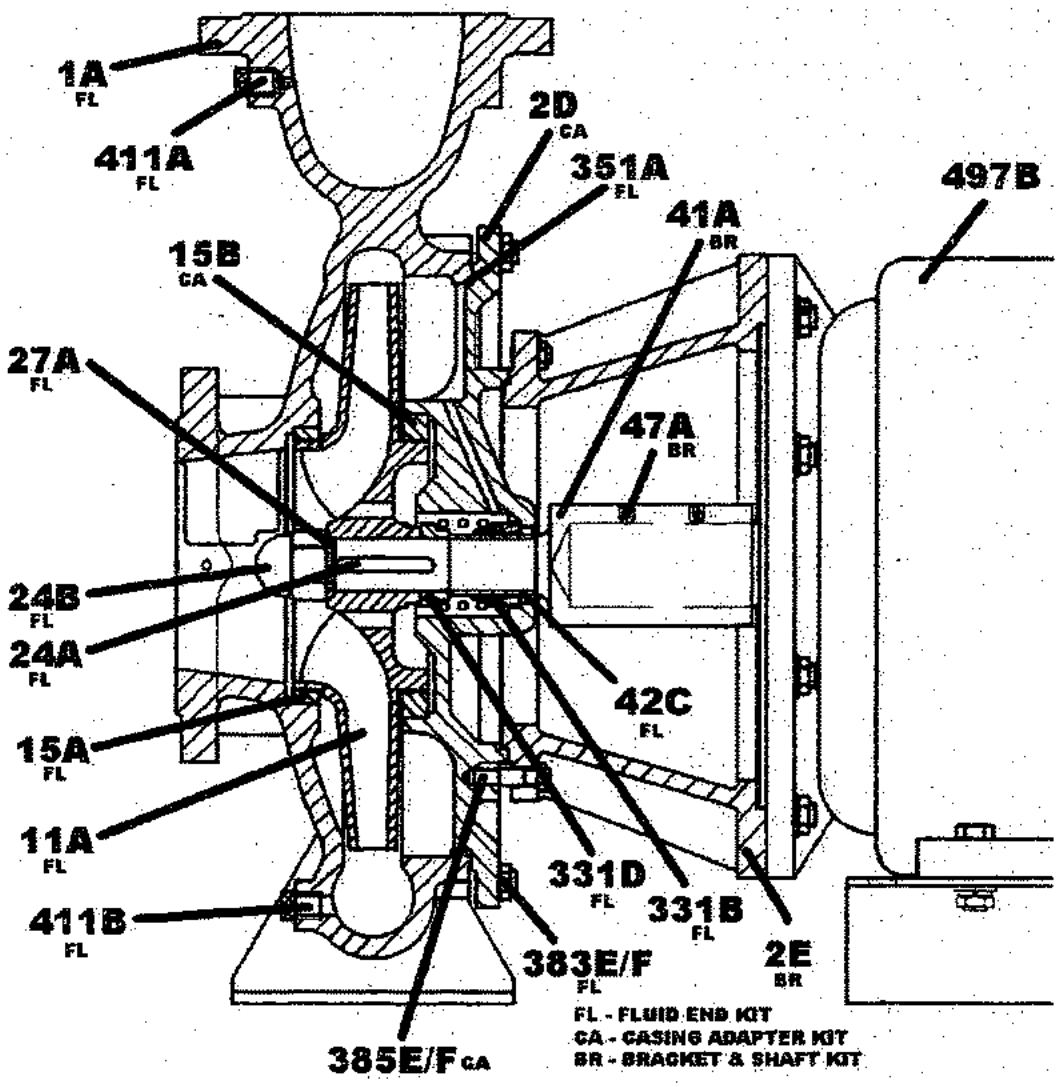
FIGURE 16 – REF Sectional Drawing



Item Number	Item Description	Num. Req.
1A	Casing	1
2B	Power Frame	1
2C	Foot, Power Frame	1
2D	Casing Adapter	1
11A	Impeller	1
15A	Case Wear Ring, Front	1
15B	Case Wear Ring, Rear	Varies
24A	Impeller Key	1
24B	Impeller Nut	1
27A	Impeller Washer	1
41A	Shaft	1
42A	Shaft Sleeve	1
46A	Water Slinger	1
71A	Stuffing Box Gland	1
72G/D	Hinge Bolt & Nut	2
73A	Lantern Ring	1
81N	Outboard Bearing, Thrust	1

Item Number	Item Description	Num. Req.
81P	Inboard Bearing, Radial	1
85N	Outboard Bearing Cap	1
85P	Inboard Bearing Cap	1
104N	Outboard Lip Seal	1
104P	Inboard Lip Seal	1
125A	Coupling Key	1
331A	Packing	1 Set
331B	Mechanical Seal	1
331C	Shaft Sleeve O-Ring	1
331D	Mechanical Seal Locking Collar	1
351A	Casing Gasket	1
359A	Bearing Housing Gasket	2
383E/F	Casing Stud & Nut	Varies
385E/F	Bearing Housing Stud & Nut	Varies
384B	Bearing Cap Capscrew	1
411A	Plug, Vent	1
411B	Plug, Drain	1

FIGURE 17 – REC Sectional Drawing

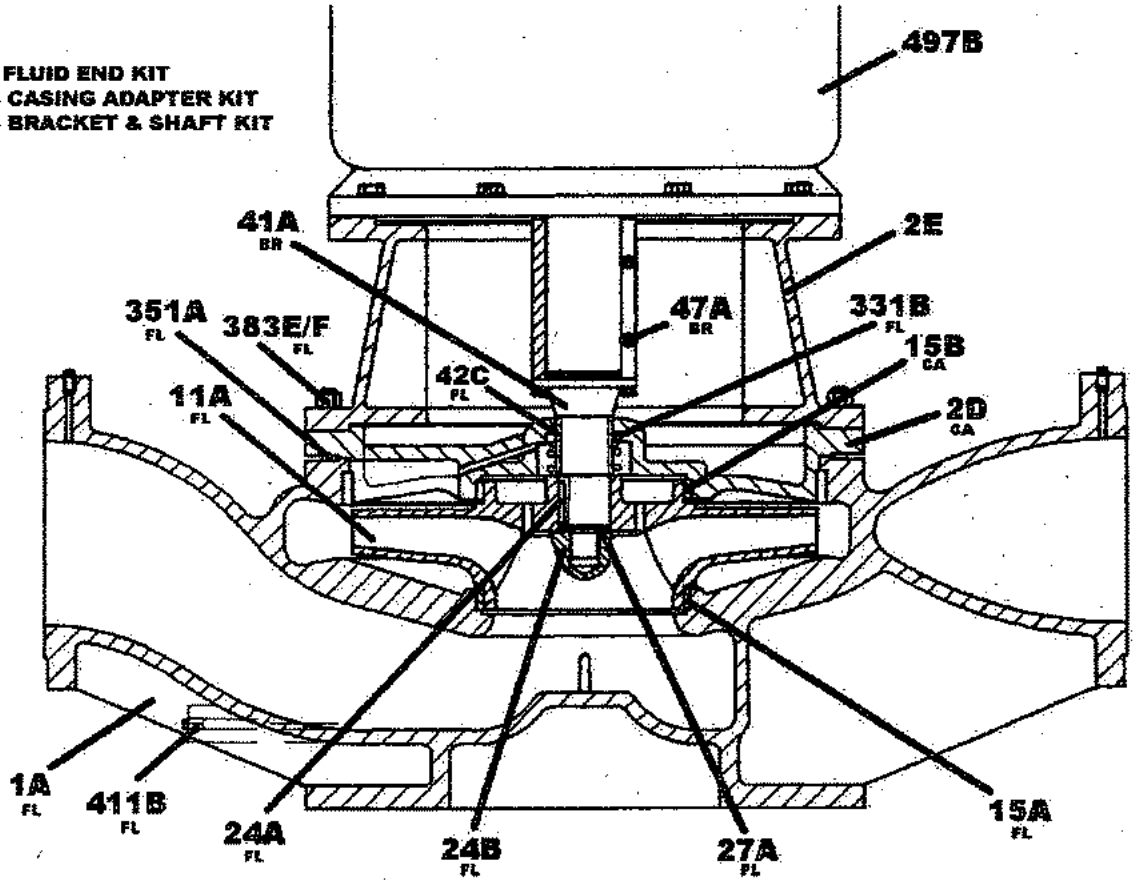


Item Number	Item Description	Num. Req.
1A	Casing	1
2D	Casing Adapter	1
2E	Motor Bracket	1
11A	Impeller	1
15A	Case Wear Ring, Front	1
15B	Case Wear Ring, Rear	Varies
24A	Impeller Key	1
24B	Impeller Nut	1
27A	Impeller Washer	1
41A	Shaft	1

Item Number	Item Description	Num. Req.
42C	Shaft Sleeve	1
47A	Shaft Set Screw	Varies
331B	Mechanical Seal	1
331D	Mechanical Seal Locking Collar	1
351A	Casing Gasket	1
383E/F	Casing Stud & Nut	Varies
385E/F	Motor Bracket Stud & Nut	Varies
411A	Plug, Vent	1
411B	Plug, Drain	1
497B	C-Face Motor	1

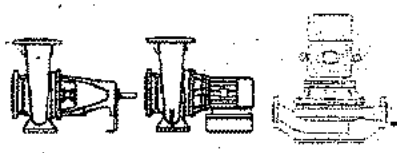
FIGURE 18 – REI Sectional Drawing

FL - FLUID END KIT
CA - CASING ADAPTER KIT
BR - BRACKET & SHAFT KIT



Item Number	Item Description	Num. Req.
1A	Casing	1
2D	Casing Adapter	1
2E	Motor Bracket	1
11A	Impeller	1
15A	Case Wear Ring, Front	1
15B	Case Wear Ring, Rear	Varies
24A	Impeller Key	1
24B	Impeller Nut	1
27A	Impeller Washer	1

Item Number	Item Description	Num. Req.
41A	Shaft	1
42C	Shaft Sleeve	1
47A	Shaft Set Screw	Varies
331B	Mechanical Seal	1
351A	Casing Gasket	1
383E/F	Casing Stud & Nut	Varies
411B	Plug, Drain	1
497B	C-Face Motor	1



APPENDIX A

CRITICAL MEASUREMENTS AND TOLERANCES FOR MAXIMIZING MTBPM

PARAMETERS THAT SHOULD BE CHECKED BY USERS

American-Marsh recommends that the user check the following measurements and tolerances whenever pump maintenance is performed. Each of these measurements is described in more detail on the following pages.

Topic	Suggested By Major Seal Vendors in (mm)	Suggested And/Or Provided By AMP in (mm)
Shaft		
Diameter tolerance, under bearings		0.0002 (0.005)
Impeller		
Balance		See Note 1
Bearing Housing		
Diameter (ID) tolerance at bearings		0.0005 (0.013)
Power End Assembly		
Shaft Runout	0.001 (0.03)	0.001 (0.03)
Shaft Sleeve Runout	0.002 (0.05)	0.002 (0.05)
Radial Deflection - Static	0.003 (0.076)	0.002 (0.05)
Shaft Endplay	0.002 (0.05)	0.002 (0.05)
Seal Chamber		
Face Squareness to Shaft	0.001 (0.03)	0.003 (0.08)
Register Concentricity	0.005 (0.13)	0.005 (0.13)
Complete Pump		
Shaft movement caused by pipe strain	0.002 (0.05)	0.002 (0.05)
Alignment		See Note 2
Vibration at bearing housing		See Note 3

FIGURE 19 - Measurements

N.S. = Not specified

Note 1: The maximum values of acceptable unbalance are: 1800 rpm: 0.021 oz-in/lb (1500 rpm: 40 g•mm/kg) of mass; 3600 rpm: 0.011 oz•in/lb (2900 rpm: 20 g•mm/kg) of mass. American-Marsh performs a single plane spin balance on most impellers. All balancing, whether single or two plane, is performed to the ISO 1940 Grade 6.3 tolerance criteria.

Note 2: American-Marsh recommends that the pump and motor shafts be aligned to within 0.002 in (0.05 mm) parallel F.I.M. (Full Indicator Movement) and 0.0005 in/in (0.0005 mm/mm) angular F.I.M. Closer alignment will extend MTBPM. For a detailed discussion of this subject see the Alignment section of this IOM.

Note 3: American-Marsh recommends the following peak velocities, in in/s (mm/second): 25A/25B & 35 = 0.1 (2.5), 45 & 55 = 0.15 (3.8), 60 & 70 = 0.25 (6.3).

ADDITIONAL PARAMETERS CHECKS BY AMERICAN-MARSH

The parameters listed below are somewhat more difficult to measure and/or may require specialized equipment. For this reason, they are not typically checked by our customers, although they are monitored by American-Marsh during the manufacturing and/or design process. These parameters are described at the end of this appendix.

Topic	Suggested By Major Seal Vendors	Suggested And/Or Provided By AMP
Shaft - Maximum roughness at seal chamber.		16µin (0.40 µm)
Bearing Housing - Bore Concentricity		0.001 in (0.025 mm)
Complete Pump – Dynamic Shaft Deflection*	0.002 in (0.05 mm)	0.002 in (0.05 mm)

FIGURE 20 – Specialized Measurements

*The ASME standard recommends 0.005 in (0.13 mm) max deflection at the impeller, while American-Marsh provides 0.002 in (0.05 mm) max deflection at the mechanical seal. The two recommendations are essentially equivalent.

IMPELLER BALANCING

Shaft whip is deflection where the centerline of the impeller is moving around the true axis of the pump. It is not caused by hydraulic force but rather by an imbalance with the rotating element. Shaft whip is very hard on the mechanical seal because the faces must flex with each revolution in order to maintain contact. To minimize shaft whip it is imperative that the impeller is balanced. All impellers manufactured by American-Marsh are balanced after they are trimmed. If for any reason, a customer trims an impeller, it must be re-balanced.

The maximum values of acceptable unbalance are:
1800 rpm: 0.021 oz•in/lb (1500 rpm: 40 g•mm/kg) of mass
3600 rpm: 0.011 oz•in/lb (2900 rpm: 20 g•mm/kg) of mass
The OD of the bearings should also be checked and should conform to the min/max values given above.

POWER END ASSEMBLY

Shaft/Shaft Sleeve Runout

Shaft runout is the amount the shaft is "out of true" when rotated in the pump. It is measured by attaching a dial indicator to a stationary part of the pump so that its contact point indicates the radial movement of the shaft surface as the shaft is rotated slowly. If a shaft sleeve is used then shaft sleeve runout must be checked. It is analogous to shaft runout.

Measurement of shaft runout/ shaft sleeve runout will disclose any out of roundness of the shaft, any

eccentricity between the shaft and the sleeve, any permanent bend in the shaft, and/or any eccentricity in the way the shaft or bearings are mounted in the bearing housing.

Shaft runout can shorten the life of the bearings and the mechanical seal. The following diagram shows how to measure shaft/shaft sleeve runout. Note that both ends need to be checked. The runout should be 0.001 in (0.025 mm) FIM or less.

Radial Deflection – Static
Radial movement of the shaft can be caused by a loose fit between the shaft and the bearing and/or the bearing and the housing. This movement is measured by attempting to displace the shaft vertically by applying an upward force of approximately ten pounds to the impeller end of the shaft. While applying this force, the movement of an indicator is observed as shown in the following diagram. The movement should be checked at a point as near as possible to the location of the seal faces. A movement of more than 0.002 in (0.05 mm) is not acceptable.

Shaft Endplay
The maximum amount of axial shaft movement, or endplay, on an American-Marsh pump should be 0.001 in (0.03 mm) and is measured as shown below. Observe indicator movement while tapping the shaft from each end in turn with a soft mallet. Shaft endplay can cause several problems. It can cause fretting or wear at the point of contact between the shaft and the secondary sealing element. It can also cause seal overloading or underloading and possibly chipping of the seal faces. It can also cause the faces to separate if significant axial vibration occurs.

SEAL CHAMBER

Face Squareness to Shaft
Also referred to as "Seal Chamber Face Run-Out." This runout occurs when the seal chamber face is not perpendicular to the shaft axis. This will cause the gland to cock, which causes the stationary seat to be cocked, which causes the seal to wobble. This runout should be less than 0.003 in (0.08 mm).

Register Concentricity
An eccentric seal chamber bore or gland register can interfere with the piloting and centering of the seal components and alter the hydraulic loading of the seal faces, resulting in reduction of seal life and performance. The seal chamber register concentricity should be less than 0.005 in (0.13 mm).

COMPLETE PUMP

Shaft Movement Caused by Pipe Strain
Pipe strain is any force put on the pump casing by the piping. Pipe strain should be measured as shown below. Install the indicators as shown before attaching the piping to the pump. The suction and discharge flanges should now be bolted to the piping separately while continuously observing the indicators. Indicator movement should not exceed 0.002 in (0.05 mm).

Alignment
Misalignment of the pump and motor shafts can cause the following problems:
- Failure of the mechanical seal
- Failure of the motor and/or pump bearings
- Failure of the coupling
- Excessive vibration/noise

The schematics below show the technique for a typical rim and face alignment using a dial indicator. It is important that this alignment be done after the flanges are loaded, and at typical operating temperatures. If proper alignment cannot be maintained a C-flange motor adapter and/or stilt/spring mounting should be considered.

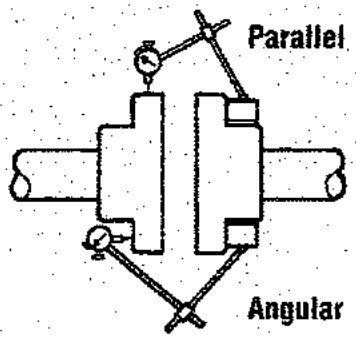


FIGURE 21 – Alignment

Many companies today are using laser alignment which is a more sophisticated and accurate technique. With this method a laser and sensor measure misalignment. This is fed to a computer with a graphic display which shows the required adjustment for each of the motor feet.

Vibration Analysis
Vibration Analysis is a type of condition monitoring where a pump's vibration "signature" is monitored on a regular, periodic basis. The primary goal of vibration analysis is extension on MTBPM. By using this tool American-Marsh can often determine not only the existence of a problem before it becomes serious, but also the root cause and possible the solution. Modern vibration analysis equipment not only detects if a vibration problem exists, but can also suggest the cause of the problem. On a centrifugal pump, these causes

can include the following: unbalance, misalignment, defective bearings, resonance, hydraulic forces, cavitation, and recirculation. Once identified, the problem can be corrected, leading to increased MTBPM for the pump.

American-Marsh does not make vibration analysis equipment, however American-Marsh strongly urges customers to work with an equipment supplier or consultant to establish an on-going vibration analysis program. The ASME standard for vibration at the bearing housing is 0.25 inches/second (6.35 mm/sec) peak velocity or 0.0025 inches (0.064 mm) peak-to-peak displacement. American-Marsh recommends the following peak velocities:

25A/25B & 35	0.1 in/s (2.5 mm/s)
45 & 55	0.15 in/s (3.8 mm/s)
60 & 70	0.25 in/s (6.4 mm/s)

for best practice of a properly installed and operated pump.

SPECIAL PARAMETERS CHECKED BY AMERICAN-MASH

SHAFT – MAXIMUM ROUGHNESS AT SEAL CHAMBER

American-Marsh shafts do not exceed 16 µin (0.4 µm) at these areas. American-Marsh audits smoothness by using a profilometer surface finish gauge.

BEARING HOUSING – BORE CONCENTRICITY

If the bore for holding the bearing is eccentric, the bearing will be shifted off center. This will contribute to shaft runout. American-Marsh measures this concentricity by using computerized measuring equipment. The concentricity should not exceed 0.001 in (0.03 mm).

COMPLETE PUMP – DYNAMIC SHAFT DEFLECTION

In regards to pump operation, a very important factor for maximizing pump MTBPM is the avoidance of off-design pump operation. In order to maximize the life of the seal and bearings, a process pump should be run as close as possible to its Best Efficiency Point (BEP).

Dynamic shaft deflection is a deflection of the shaft caused by unbalanced hydraulic forces acting on the impeller. Dynamic shaft deflection will change as the pump is operated on various points along the curve. When the pump is operated at BEP, the shaft deflection is zero. This deflection is very difficult to measure.

At a given point on the curve, the shaft deflection is constant and is constantly in the same direction. The centerline of the impeller, though bent from parallel, does not move. For this reason, in many cases, shaft deflection is not particularly hard on mechanical seals. It is, however, hard on bearings, since the force which causes shaft deflection can be a tremendous load on them. The amount of deflection depends on three factors: how the shaft is supported, the strength of the shaft and the amount of unbalanced hydraulic force experienced by the shaft/impeller. If there seems to be a shaft deflection problem, refer to the American-Marsh Pump Engineering Manual for a detailed discussion on how to calculate deflection.

APPENDIX B

AMERICAN-MARSH REF MAINTENANCE INSTRUCTIONS BEARING HOUSING OIL SEALS (LABYRINTH TYPE) INPRO/SEAL® VBXX BEARING ISOLATORS

INTRODUCTION

American-Marsh Pumps provides pumps fitted with a variety of labyrinth oil seals. While these instructions are written specifically for the Inpro/Seal VBXX labyrinth, they also apply to seals of other manufacturers. Specific installation instructions included with the seal, regardless of manufacturer, should be observed.

The Inpro "VBXX" Bearing Isolator is a labyrinth type seal which isolates the bearings from the environment (uncontaminated), and retains the oil in the bearing housing. The bearing isolator consists of a rotor and a stator. The rotor revolves with the shaft, driven by a close fitted drive ring that rotates with the shaft. The stator is a stationary component that fits into the housing bore with a press fit (nominal 0.002 in (0.05 mm) interference) and with an "O" ring gasket seal. The two pieces are assembled as a single unit, and are axially locked together by an "O" ring. There is no mechanical contact between the rotor and stator when the isolator is running.

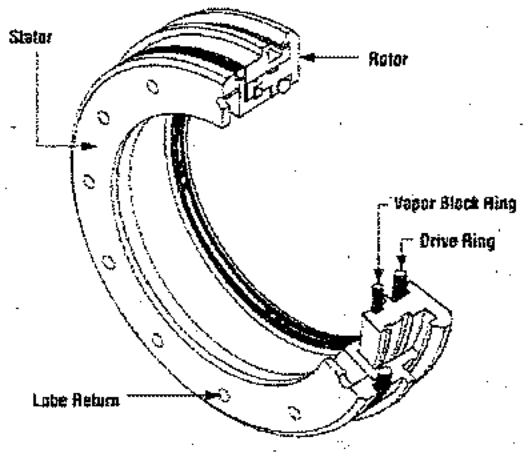


FIGURE 22 – Bearing Isolator

The VBXX *is not intended to be separated* from the bearing housing/adapter/carrier unless being replaced.

1. If the VBXX is removed from the housing, for any reason, it must be replaced with a new VBXX to ensure a perfect seal with the housing bore.
2. Repair or replacement of the seals is only necessary when excessive oil leakage is evident. However, if for any other reason, the bearing housing is to be disassembled or the pump shaft removed, it is recommended that the *rotor "O" rings* (which seal on the shaft) *be replaced*. Spare or replacement "O" rings may be obtained from "Inpro" distributors.

   The "Inpro" VBXX bearing isolator is a one piece assembly. The rotor must not pull out of the stator. If the rotor can be removed, the complete seal assembly must be replaced.
3. If the bearing housing or bearing carrier with *bronze* VBXX seals is washed or cleaned using a caustic type bath, the bronze material may discolor (turn black). If this happens, the complete seal assembly must be replaced. **Note**: This may occur if the housing is left in a caustic bath over a long period of time (more than 8 hours).
4. To remove the VBXX bearing isolator:
   A. Remove the pump shaft as described in the pump disassembly instructions.
   B. From the inside of the bearing housing or bearing carrier, place a bar (made from a soft material such as wood or plastic) against the inside face of the seal. Push the seal out by tapping the bar with a soft mallet or an arbor press.
5. To *install a new VBXX* bearing isolator, *in the impeller end of the bearing housing/adapter:*
   A. Position the impeller end (inboard) seal in the bore of the adapter or bearing housing with the **single expulsion port at the 6 o'clock position**, (carefully keep aligned with the bore).
   B. The seal stator O.D. press fits into the bore. Use an arbor press. Place a block or bar (large enough to protect the rotor flange) between the arbor press ram and seal face. Press the seal down into the bore stopping at the shoulder on the stator O.D.

   The elastomer "O" ring acts as a gasket to ensure damming up of small imperfections in the housing bore. The "O" ring is designed to be compressed to the point of overfilling its groove. The overfilled material is sheared off during assembly. Remove any sheared "O" ring material which may extrude from the bore.
6. To *install a new VBXX* bearing isolator in the *drive end (outboard) side of the bearing carrier:*
   A. Position the outboard seal in the bore of the bearing cap (no orientation of the

multiple expulsion ports is necessary) and carefully keep aligned with the bore. If the outboard seal has only one explusion port, that port must be oriented at the 6 o'clock position. Because the bearing carrier rotates for impeller adjustment, take the necessary steps to ensure the explusion port is oriented at 6 o'clock when the pump is installed and operating.

B. The seal stator O.D. press fits into the bore. Use an arbor press. Place a block or bar (large enough to protect the rotor flange) between the arbor press ram and seal face. Press the seal down into the bore stopping at the shoulder on the stator O.D. Remove any sheared o-ring material which may extrude from the bore.

7. Assemble the bearing carrier/VBXX bearing isolator on to the shaft:
   A. Using sand paper, remove burrs and break any sharp edges off the keyway at end of the shaft.
   B. It is important to prevent the corners of the keyway from cutting the "O" rings during assembly. This can be accomplished with the use of a half key or a thin flexible sleeve. Lightly lubricate the shaft and slide the bearing cap on to the shaft, pushing on the VBXX rotor, until the bearing is seated.
   C. Check the position of the rotor (make sure rotor and stator have not separated) and seat the rotor snugly into the stator by hand.

JOHNSON CONTROLS

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OPERATION & MAINTENANCE MANUAL

PROJECT: Camtech Manufacturing - Building 7 Boiler

PREPARED FOR: **Gray Bear Construction**
P.O. BOX 4365
Atlanta, GA 30301

PREPARED BY:
Johnson Controls, Inc.
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Ph: 503.654.8422 / Fax: 503.654.1158
DATE: December 15, 2016

SALESMAN: Mark Lemke
PROJECT MANAGER: Woodrow Howell
PROJECT ENGINEER: Woodrow Howell

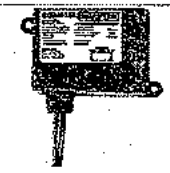
PROJECT NUMBER: 7084-0015

Bill of Materials

Tag	Type	Qty	Part	Description
HWS				
BLR1-C,BLR2-C	Field	2	RIB2401SB	SPDT,20A,HC=24 VAC/DC,W/LED,W/OVRD
DC-7	Panel	1	DX-9100-8454	CNTRLR,DIG,DX,8AI,8AO,6BO,8BI
DC-7	Panel	1	DX-9100-8990	CNTRLR,DIG,DX,MTG BASE,F/ DX-9120-8454
EN-7	Panel	1	PAN-96VAXFR	120VAC/24VAC,SPLIT,96VA
EN-7	Panel	1	PAN-ENC1216WDP	12X16X6.62 ENC+DOOR+PANEL
HWP3-C,HWP4-C	Panel	2	RH2B-UAC24-L	DPDT,10A,HC=24 VAC,W/LED
HWP3-C,HWP4-C	Panel	2	SH2B-05	DPDT RELAY BASE FOR RH2B
HWR-F	Field	1	F-1111	FLOW METER, SINGLE TURB, ISO-ANA OUT

JOHNSON CONTROLS
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Catalog

Part Name	Image	Additional Description
DX-9100-8454		The DX-9100 Extended Digital Controller is the ideal digital control solution for multiple chiller or boiler plant applications, air handling units, or distributed lighting control.As a standalone controller, the DX-9100 provides a real-time clock, extendable I/O, and graphic software programming to target a variety of applications. Individual point monitoring and control is available through the front panel LED display.The DX-9100 also connects to the system over the N2 Bus, integrating its point and control information with the entire controller network.
DX-9100-8980		The DX-9100 Extended Digital Controller is the ideal digital control solution for multiple chiller or boiler plant applications, air handling units, or distributed lighting control.As a standalone controller, the DX-9100 provides a real-time clock, extendable I/O, and graphic software programming to target a variety of applications. Individual point monitoring and control is available through the front panel LED display.The DX-9100 also connects to the system over the N2 Bus, integrating its point and control information with the entire controller network.
F-1111		The model F-1111 Single Turbine Insertion Flow Meter provides integral 4-20mA and 0-10VDC isolated analog outputs highly accurate over a wide 50:1 flow range. The standard hot tap design allows for easy installation without system shutdown. Electronic impedance sensing combined with engineered bearing systems provide excellent long-term reliability. Typical applications include HVAC and process water measurement.
PAN-96VAXFR		Transformer, Panel Mount, 120 V Primary, 24 V, Secondary, 96 VA, Split Bobbin, Secondary Circuit Breaker
PAN-ENC1216WDP		12X16X6.62 ENCLOSURE SOLID DOOR PERFORATED SUB-PANEL STEEL UL TYPE 1
RH2B-UAC24-L		RH Series General Purpose Midget Relays include a Compact midget size which saves space, High switching capacity (10A), Choice of blade or PCB style terminals, Relay options include indicator light, check button, and top mounting bracket DIN rail, surface, panel, and PCB type sockets available for a wide range of mounting applications.
RIB2401SB		SPDT,20A @ 277VAC,COIL=24 VAC/DC,WITH LED INDICATION,WITH OVERRIDE,POWER COMSUMPTION=1.8VA
SH2B-05		DPDT RELAY BASE FOR RH2B

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JOHNSON CONTROLS

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DX-9100 Extended Digital Plant Controller (Including DX-912x LONWORKS®, Version 3)

Introduction

In this document, Facility Management System (FMS) is a generic term, which refers to the Metasys® Network, Companion™, and Facilitator™ supervisory systems. The specific system names are used when referring to system-specific applications.

This document covers all three versions of the DX-9100 Extended Digital Controller, including the DX-912x LONWORKS® version.

The DX-9100 is the ideal digital control solution for multiple chiller or boiler plant control applications, for the Heating, Ventilating, and Air Conditioning (HVAC) process of Air Handling Units (AHUs) or for distributed lighting and related electrical equipment control applications. It provides precise Direct Digital Control as well as programmed logic control.

In a standalone configuration, the DX-9100 controller has both the hardware and software flexibility to adapt to the variety of control processes found in its targeted applications. Along with its outstanding control flexibility, the controller can expand its input and output point capability by communicating with I/O Extension Modules on an extension bus, and provides monitoring and control for all connected points via its built-in Light-Emitting Diode (LED) display. Versions 1 and 2 can communicate on the Metasys N2 Bus, providing point control to the full FMS. The Version 3 controller uses the LONWORKS (Echelon®) N2E Bus of the Metasys Control Module (NCM311 or NCM361 in Europe, NCM300 or NCM350 elsewhere) in place of the N2 Bus.

The DX-9100 has two packaging styles. In *Version 1*, all terminals for field wiring are located within the controller enclosure. *Versions 2 and 3* require a separate field wiring mounting base or cabinet door mounting frame, which enables all field wiring to be completed before the controller is installed.

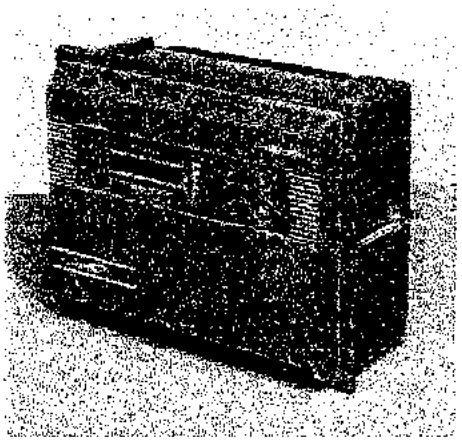


Figure 1: Version 1 (DX-9100-8154)

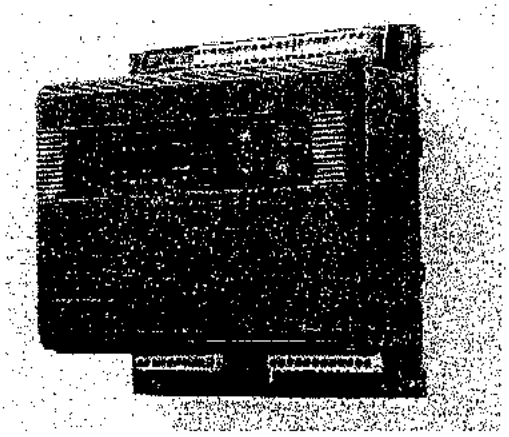


Figure 2: DX-9100-8454 or FA-DX9100-8454 (Version 2)/ DX-912x-8454 (Version 3) with Mounting Base

The DX-9100 processes the analog and digital input signals it receives, using 12 multi-purpose programmable function modules, a software-implemented Programmable Logic Controller (PLC), time schedule modules, and optimal start/stop modules to produce the required outputs (depending on the module configuration), operating parameters, and programmed logic.

All versions of the DX-9100 controller are configured by using a Personal Computer (PC) with GX-9100 Graphic Configuration Tool software supplied by Johnson Controls. Changes to the configuration can also be made by using an SX-9120 Service Module.

Versions 1 and 2 (N2 Bus)

The DX-9100 can accept eight analog inputs and eight digital inputs.

Version 1 of the controller (DX-9100-8154) provides up to eight output modules, which are configured to give two analog outputs and six digital outputs (triacs). The triacs can be separately configured to provide six on/off or pulse outputs, three duration adjust outputs, three position adjust (incremental) outputs, three start/stop outputs, or any combination using up to six triacs.

Version 2 of the controller (DX-9100-8454 or FA-DX9100-8454) provides six additional analog output modules, giving a total of eight analog outputs.

The DX-9100 unit (Versions 1 and 2) has two communication links. One is called the N2 Bus or Bus 91 (the term "Bus 91" is not used in North America) and is used to interface to a supervisory unit. The other link is called the XT Bus and is used to expand the DX-9100 input/output capability by interfacing up to eight XT-9100 or XTM-905 extension modules. The DX-9100 input/output can be extended by up to 64 remote input/outputs, analog or digital, depending on the type of the connected extension modules and XP expansion modules. Point connections are made on XP modules, which are monitored and controlled by the XT-9100 or XTM-905 modules. Refer to the *XT-9100 Technical Bulletin (LIT-6364040)* and the *XTM-905 Extension Module, XPx-xxx Expansion Modules Technical Bulletin (LIT-6364210)*. One XP module can provide either eight analog points or eight digital points. Two XP modules connected to one extension module can provide eight analog and eight digital points, or sixteen digital points.

Version 1 or 2 of the DX-9100 can be used as a standalone controller or it can be connected to an FMS through the RS-485 serial communications bus (N2 Bus or Bus 91).

Version 3 (LONWORKS-Compatible N2E Bus)

Version 3 of the controller (DX-912x-8454) brings peer-to-peer communication to the already rich feature set of the Version 2 controller, and enhanced alarm reporting capability when used as an integral part of an FMS.

The new communications features are provided by the LONWORKS network, which enables Version 3 controllers to pass data between each other and to send event-initiated data to the NCM300 or NCM350 (NCM311 or NCM361 in Europe) Network Control Module (NCM) in the FMS. The LONWORKS (Echelon) N2E Bus is used in place of the N2 Bus, and the NCM300 or NCM350 (NCM311 or NCM361 in Europe) must be fitted with a LONWORKS driver card.

The Version 3 controller retains all the input/output point and control capabilities of the Version 2 controller, including the point expansion feature using extension modules and expansion modules.

In addition to the Version 2 features, the Version 3 controller has network input and output points, which can be configured to transmit and receive data over the LONWORKS Bus. Each controller may have up to 16 network analog input modules, 16 network analog output modules, 8 network digital input modules, and 8 network digital output modules. While network analog input and output modules each contain a single analog value, the network digital input and output modules each contain 16 digital states, which are transmitted as a block between controllers. The transmission of point data is managed by the LONWORKS network and is independent of the supervisory functions of the FMS Network Control Module. A network of Version 3 controllers can be installed to share analog and digital data between controllers on a peer-to-peer basis; a Network Control Module is not required unless the network is to be supervised by an FMS.

Complex control strategies may now be performed in multiple DX-912x controllers without the need for network data exchange routines in a supervisory controller. Applications include the control of multiple, interrelated air handling units, and large hot water or chilled water generating plants with components distributed in various locations within the building.

Where should the DX-912x be used?

The DX-912x is the newest member of the very successful family of DX controllers and uses the 78K baud peer-to-peer LONWORKS communication bus. To support many additional Metasys N2 device features, the DX-912x is also designed to respond to polled N2 messages. The result is that the DX-912x performs exceptionally well in certain applications, and slower than standard DX-9100s in others. In particular, the user may notice this slower performance when trying to display system summaries and graphics on an FMS Operator Workstation (OWS).

Use the DX912x in:

- *Small buildings controlled by two or three DX controllers, without an FMS.* Small, standalone systems are the best applications for the DX-912x. For control operations, the DX-912x can share data on a peer-to-peer basis. By adding the DX LCD Display Terminal (DT-9100), you can provide a local user interface that can be configured to give the users the specific data they need to see.

- *Networked systems with peer-to-peer communications required by the specification that share data between controllers.* In this case, you must make sure that the DX-912x meets the performance requirements. See a list of the most important points to consider below.
- *Networked systems where the majority of data traffic is in peer-to-peer communication between DX-912x controllers and the number of points on the OWS screen is limited to below 30 points.*

Do not use the DX-912x in:

- Systems that require a large number of DXs (typically more than five per N2E trunk) and are likely to have frequent change-of-state reports (sent at a rate of more than one per second for an extended time) See *Appendix A: LONWORKS N2E Bus Poll Estimation Worksheet* at the end of this document to calculate the maximum number of DX controllers to use in a particular system.
- Systems that require the gathering of trend or point history data from a large number of points in the DX-912x controllers or from a few points at a very fast rate.
- Systems that require many or frequently running Graphic Programming Language (GPL) processes in the NCM, which need to poll the controllers for data.
- It is not recommended to add DX-912xs to NCMs that already have N2 devices connected.
- Process automation and pharmaceutical applications that use NCMs are generally not good candidates for using the DX-912x because of the requirement for a high volume of communication traffic between the controllers and the NCM for data gathering and global process interaction.

LONMARK® Compatibility

The Version 3 controller has been approved as a LONMARK device and conforms to the LONMARK specification for network data transmission.



LONMARK®

Figure 3: LONMARK Logo

Related Information

Refer to Table 1 for additional information on DX controllers:

Table 1: Related Literature

Document Title	Code Number	FAN
DX-9100 Configuration Guide	*LIT-6364030*	*636.4* *1628.4*
GX-9100 Software Configuration Tool for Windows User's Guide	*LIT-6364060*	*636.4* *1628.4*
LONWORKS N2E Bus Technical Bulletin	*LIT-6364100*	*636.4*
DX LCD Display User's Guide	*LIT-6364120*	*636.4* *1628.4*

About This Manual

This manual contains details of the hardware configuration of the DX-9100 series of controllers. This includes information on mounting, installation, and startup.

This manual also gives an overview of the internal operation and the software functional modules. Refer to the *DX-9100 Configuration Guide (LIT-6364030)* for detailed programming information on these modules.

A guide to the operation of the front panel and keyboard is included at the end of this manual.

Features

The following lists some of the DX-9100 Extended Digital Controller features:

- fully configurable, using GX-9100 Graphic Configuration software
- communications bus (RS-485 port for N2 Bus) for FMS ***(DX-9100, Versions 1.x and 2.x)***
- LONWORKS TP78 transceiver for network communications ***(DX-9120, Versions 3.0, 3.1, 3.2 and 3.4)***
- LONWORKS FTT10a transceiver for network communications. ***(DX-9121, Version 3.4)***
- automatic reporting of alarms and changes-of-logic states on LONWORKS network ***(Version 3)***
- socket for service module (SX-9120) connection
- RS-232-C port for loading controller configurations and for connection of the DT-9100 DX LCD Display ***(Versions 2 and 3)***
- eight high resolution (13-bit) analog inputs
- eight digital inputs from potential-free contacts, each with transition counter
- two isolated analog outputs ***(Version 1 only)***
- eight isolated analog outputs ***(Versions 2 and 3 only)***

- six isolated digital outputs
- twelve programmable function modules, selected from a library of functions, including:
  - P, PI, PID or on/off control, dual PID, dual on/off control
  - numeric calculation modules for programmed mathematical function
  - sequencer modules
  - totalization modules for analog or digital inputs
- programmable logic control module with a set of logic functions including:
  - AND, ANDNOT, OR, ORNOT, COS (Change-of-State), OUT, OUTNOT, SET, RESET, AND LOGIC BLOCK, and OR LOGIC BLOCK
- eight time schedule modules
- two optimal start/stop modules
- eight extension/expansion I/O module sets, each supporting up to eight inputs/outputs
- sensor readings updated every second (including inputs from up to eight extension modules with analog inputs/outputs)
- inputs and outputs via the LONWORKS network ***(Version 3)***. There are 16 network analog inputs, 16 network analog outputs, 8 network digital input blocks of 16 inputs, and 8 network digital output blocks of 16 outputs
- built-in isolating transformer
- integral display panel with keypads
- enclosure material of self-extinguishing ABS/polycarbonate
- surface or DIN rail mounting
- field wiring mounting base ***(Versions 2 and 3)***
- cabinet door mounting frame ***(Versions 2 and 3)***

Version 1
(DX-9100-8154)

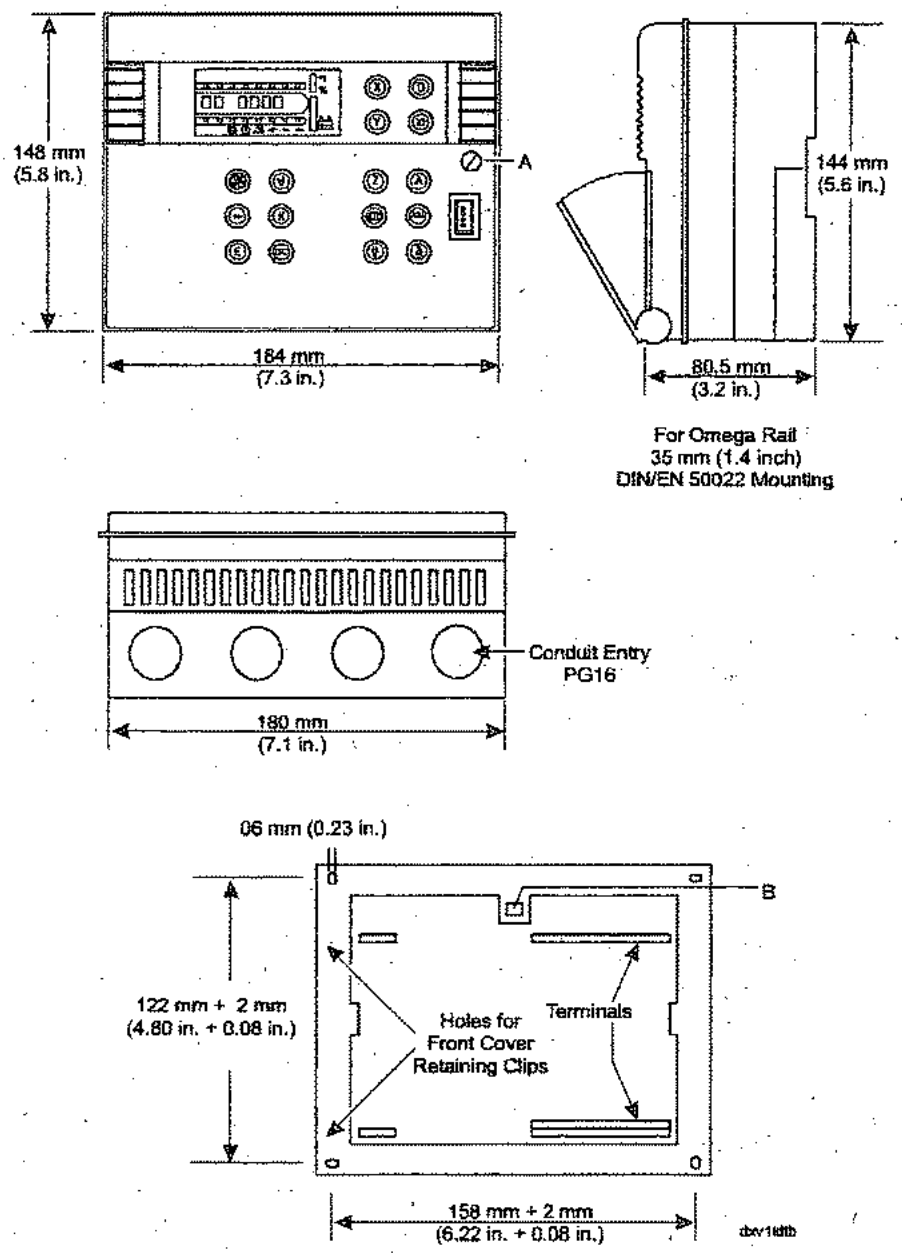


Figure 4: Installation Details of Version 1

Note: The Version 1 controller (DX-9100-8154) is not available in North America.

Mounting Instructions

Mount the DX-9100-8154 (Version 1) as follows:

1. Remove front cover by releasing Screw A (Figure 4), lifting the cover, and detaching it from the base. The cover may be hooked onto the base in the open position by engaging the two lugs on the left of the controller cover into the corresponding holes in the base. Alternatively, it may be completely removed by detaching the ribbon cable from the PC board in the cover.
2. For surface mounting, use four (4.2 mm diameter) screws. (Four 25 mm long screws are supplied with the controller.)
3. For DIN rail mounting, snap the controller onto the 35 mm (1 3/8 inch) rail. To release the controller, insert a screwdriver in Slot B (Figure 4) and lift the retaining clip.
4. The retaining clip is spring-loaded, you can also remove the controller without a screwdriver by carefully pushing the controller up against the clip and then tilting the top forward to release the top lug from the DIN rail.
5. To connect the wiring:

   Terminations are made via the terminal blocks on the lower circuit board, which accept 1 x 1.5 mm^2 (16 AWG) cable. See Figure 5 for connection details.

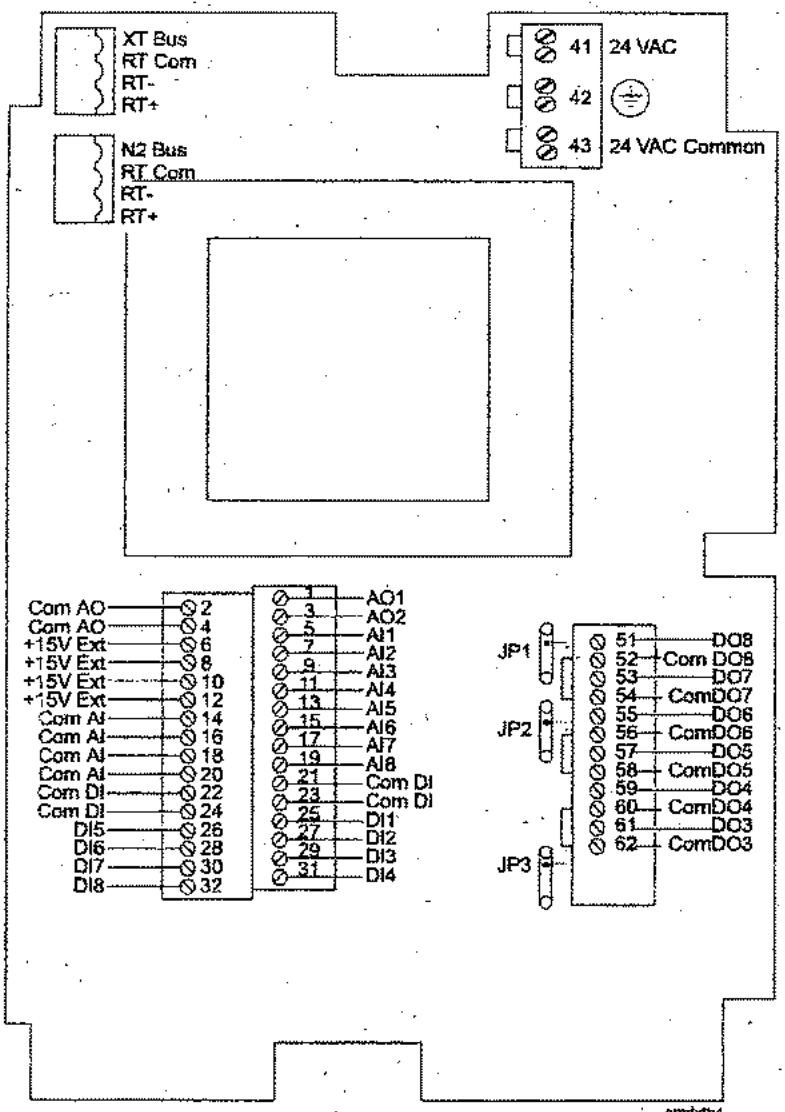
   Terminations of the communications bus cable and extension bus cable are made via the connectors provided with the controller.



CAUTION: The CMOS circuits in the controller are sensitive to static electricity. Take suitable precautions.

Note: The connection, wiring, and jumper information that follows is valid only for Version 1 controllers.

Connection Details (Version 1 Only)



Cut Jumper JP1 to separate Com DO8 and Com DO7.
Cut Jumper JP2 to separate Com DO5 and Com DO6.
Cut Jumper JP3 to separate Com DO3 and Com DO4.

Figure 5: Connection Details for Version 1

Note: The following commons are electrically independent:

- Analog Input Common (for AI1 to 8)
- Analog Output Common (for AO1 and 2)
- 24V Common/Digital Input Common (for DI1 to 8)*
- Digital Output 3 and 4 Common (can be separated by cutting JP3)
- Digital Output 5 and 6 Common (can be separated by cutting JP2)
- Digital Output 7 and 8 Common (can be separated by cutting JP1)
- N2 Bus/XT Bus Common (Reference)

*24V Common and Digital Input Common are electrically connected.

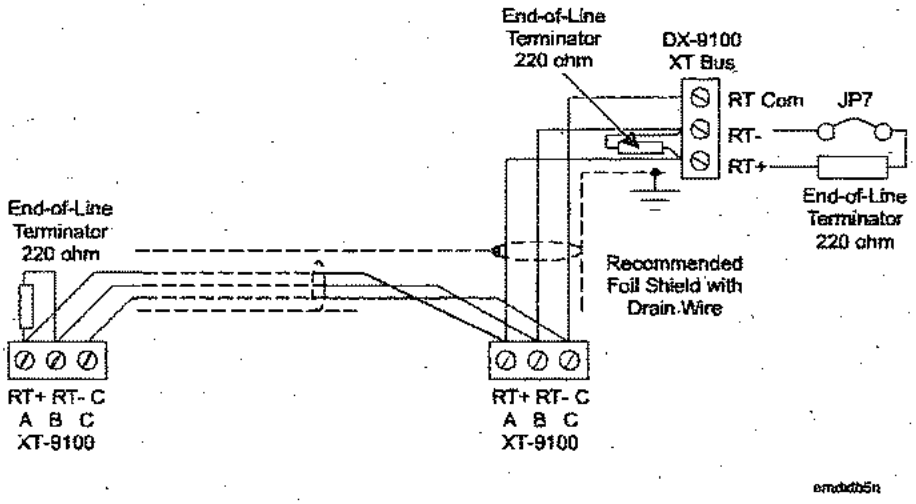


Figure 6: Connection Details for the XT Bus (Version 1)

Maximum: Eight XT-9100s or XTM-905s

Maximum bus length: 1,200 meters (4,000 ft)

Version 1 Only—Install 220 ohm end-of-line resistors at each end of the XT Bus line when the bus length is greater than 100 meters (330 feet). When the DX-9100 is at one end of the bus, the end-of-line resistor may be connected by inserting JP7 inside the controller. (See the *Jumper Details* section further in this document.) When the bus length is less than 100 meters (330 feet), install one 220 ohm end-of-line resistor at the DX-9100 only, or insert JP7 inside the controller.

Connection Details for Download/Upload

For download and upload via the N2 Bus as shown below, the Version 1 DX-9100 controller is connected to a PC containing GX-9100 software.

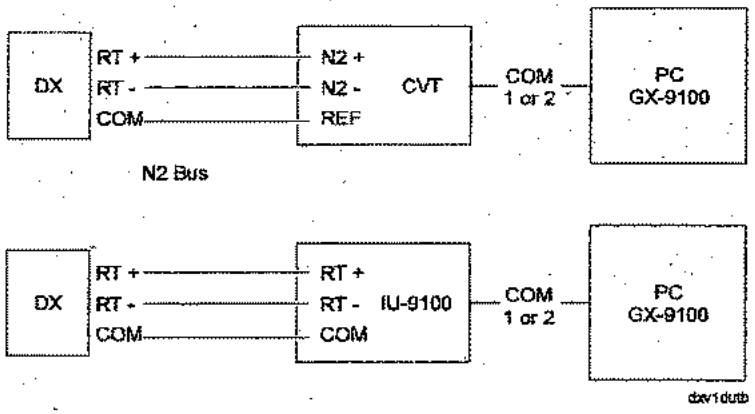


Figure 7: Connection Details for Download/Upload of Version 1 Controller

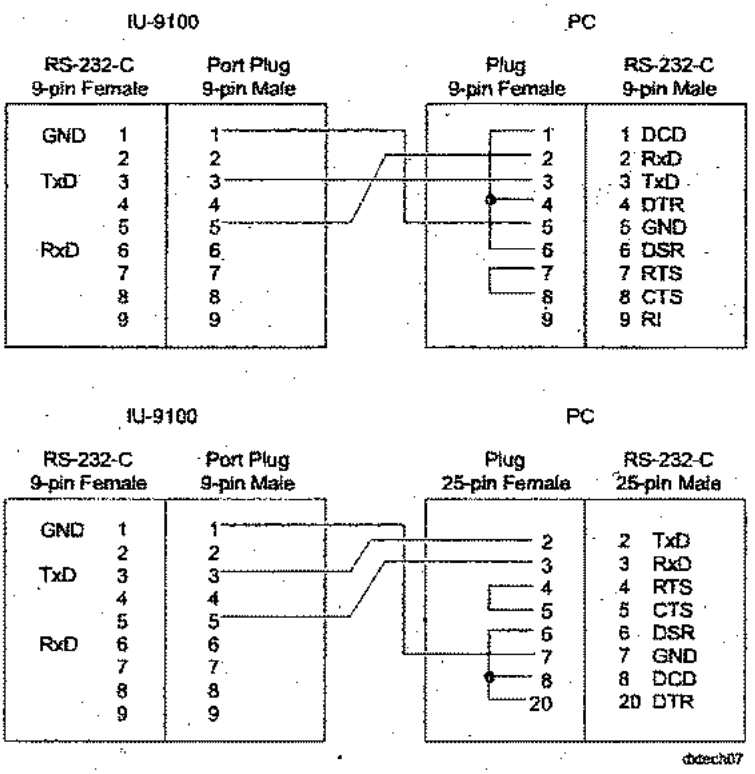


Figure 8: PC to IU-9100 Cabling Details, Version 1

Jumper Details

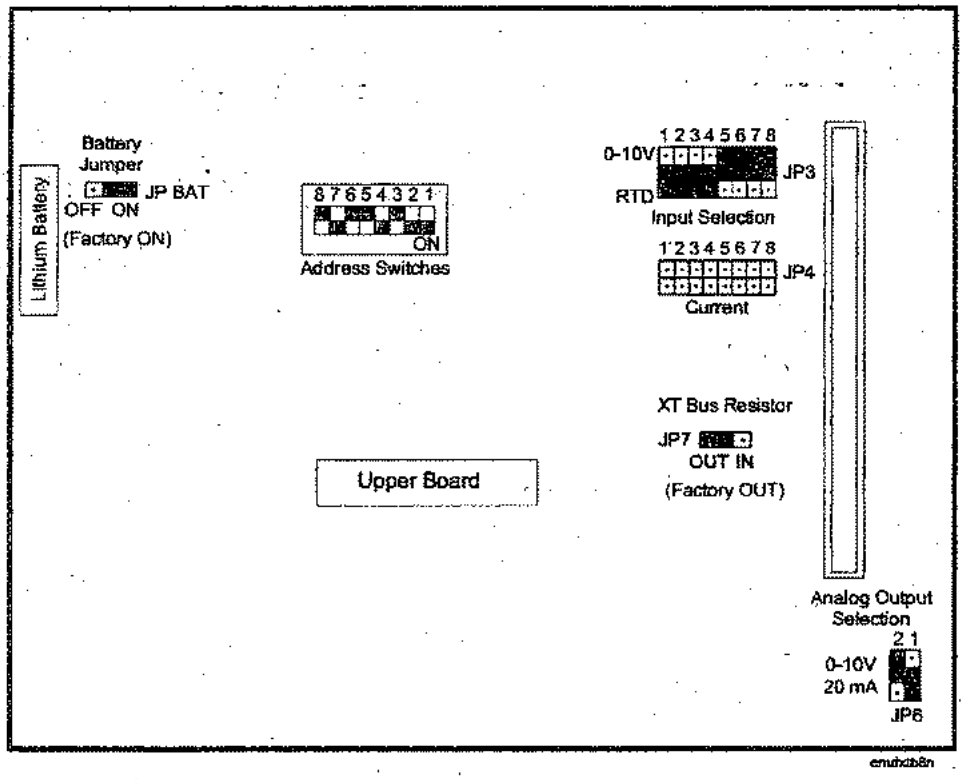


Figure 9: Jumper Details for Version 1

> CAUTION: Do not change the jumper position of JP2, as it is for internal use only and is preset at the factory.

The following are general guidelines for setting jumpers on Version 1 controllers:

1. All jumper selections must be made **before** power is applied to the controller.
2. Select **analog input type** using one jumper per input in the respective position for the input number in JP3 or JP4.

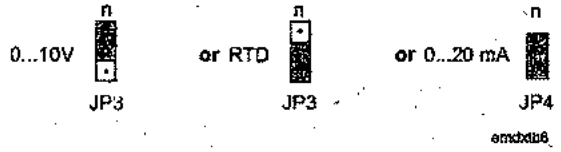


Figure 10: Jumper Positions for Analog Inputs

3. A maximum of four 0-20 mA transmitters can be powered by the controller. (Maximum current from 15V supply is 100 mA.)

4. Use jumpers JP6 to select **Analog Output Type**.

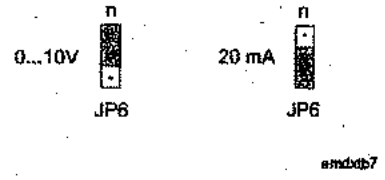


Figure 11: Jumper Positions for Analog Outputs

5. Select the **Controller Address** (for the FMS) on the address switches in 8-bit binary format.

Switch Number	8	7	6	5	4	3	2	1
Decimal Equivalent	128	64	32	16	8	4	2	1

Example for switch settings:

8	7	6	5	4	3	2	1	
Off	On	Off	Off	On	Off	On	On	Address 75
-	64	-	-	8	-	2	1	

(64 + 8 + 2 + 1 = 75)

6. Jumper JP BAT is set to On at the factory and should only be set to Off if the controller is to be kept in storage without power for an extended period of time. The jumper must be set to On before the controller is installed and powered up.
7. Jumper JP7 allows the termination of the XT Bus with a 220 ohm resistor within the controller such that no external resistor on the XT Bus terminal block is required.

Typical Wiring

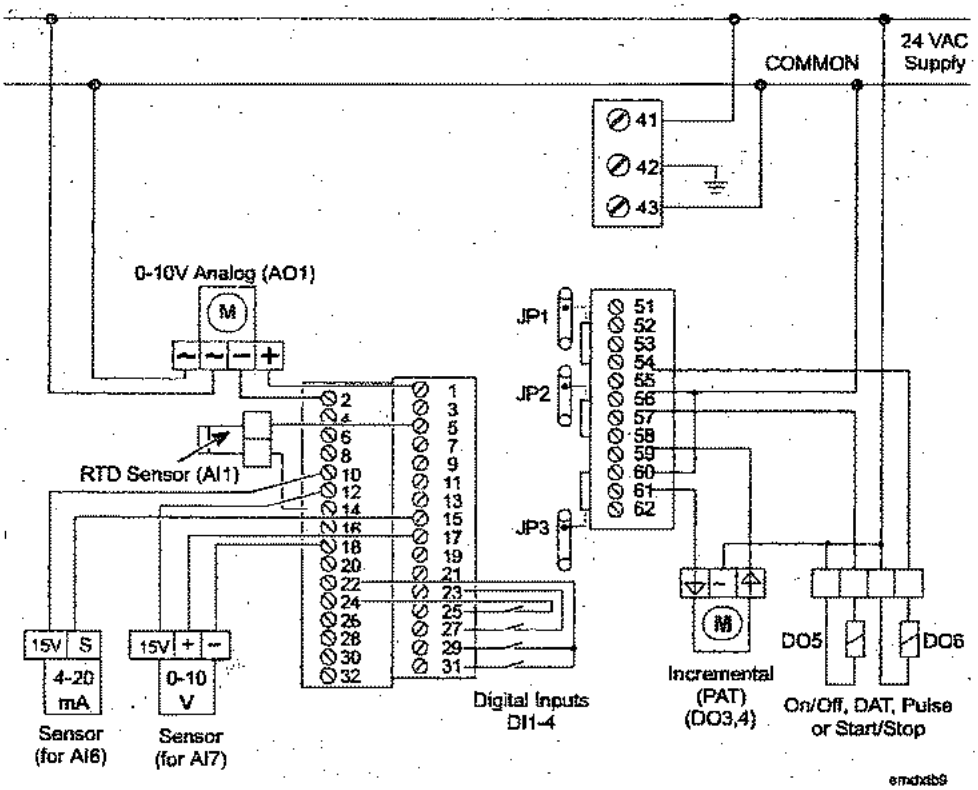
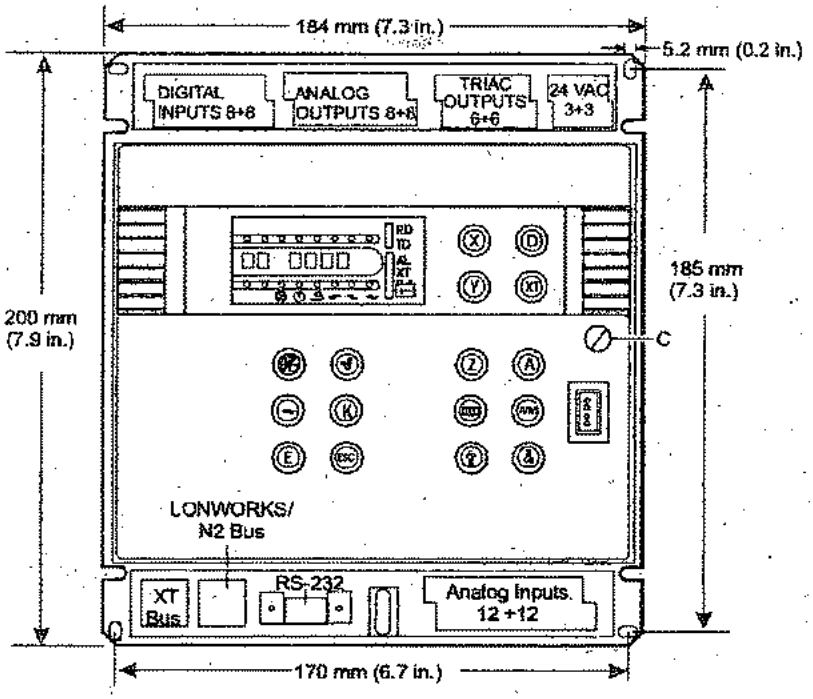


Figure 12: Typical Wiring Diagram of Version 1

Note: The diagram shows the wiring using a common transformer for controller supply, and input and output devices. If required, separate transformers can be used.

Version 2 (DX-9100-8454 or FA-DX9100-8454) and Version 3 (DX-912x-8454)



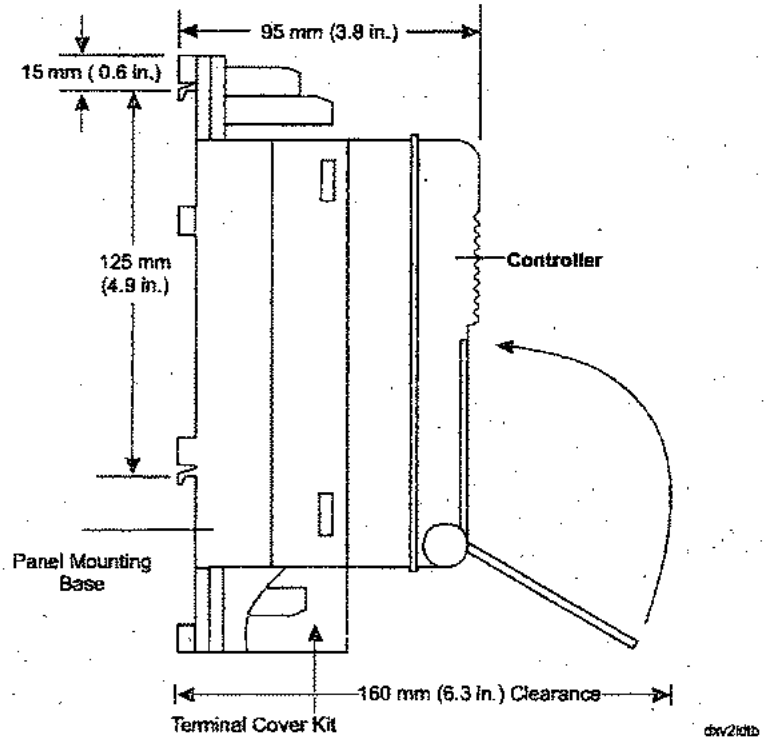


Figure 13: Installation Details of Versions 2 and 3 with Panel Mounting Base

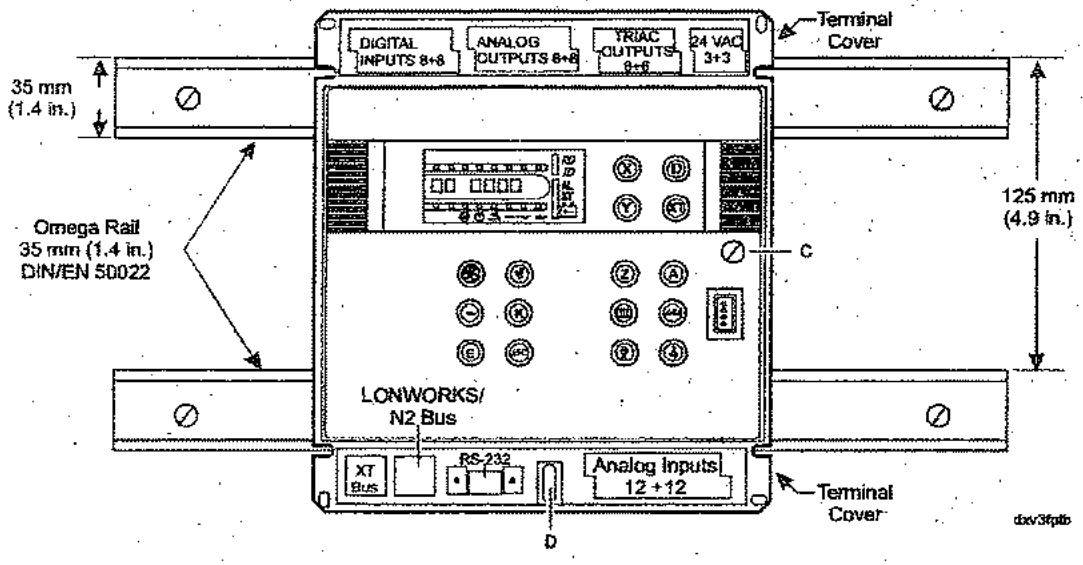


Figure 14: Version 2 or 3 with Panel Mounting Base on DIN Rails

Mounting Instructions

DX Controller with Panel Mounting Base

To mount the Version 2 or 3 DX controller with panel mounting base:

1. Remove the snap-on, transparent, plastic terminal covers if installed, from the top and bottom of the base. Place in a safe location.
2. If the controller has already been attached to the base, proceed as follows to detach it:

   Open the front panel flap. Release Screw C. Pull the right side of the controller away from the base until it is free. Then completely remove the controller from the base, detaching the lugs on the left side. Place the controller in a safe location.

3. *For surface mounting:*

   Use four screws (4.2 mm diameter) to fix the controller to the surface. (Four 25 mm long screws are supplied with the base.)

   For DIN rail mounting:

   Install two DIN rails as shown in Figure 14.

   Loosen Screw D in the oval slot and pull the metal plate downwards as far as it will go. Place the base over the DIN rails so that the channels on the back of the base cover the DIN rails, and pull the base downward to engage it in position.

   Lock the base in position by sliding the metal plate upwards until it covers the lip of the lower DIN rail, and tighten Screw D. Check to be sure the base is tightly attached to the rails.

4. Wiring terminations are made via the terminal blocks, which accept 1 x 1.5 mm^2 (16 AWG) cable, on the top and bottom part of the base. See Figure 16. Terminations of the LONWORKS, N2 or XT communications bus cables are made via the connectors provided with the base.

5. Replace or install the terminal covers.

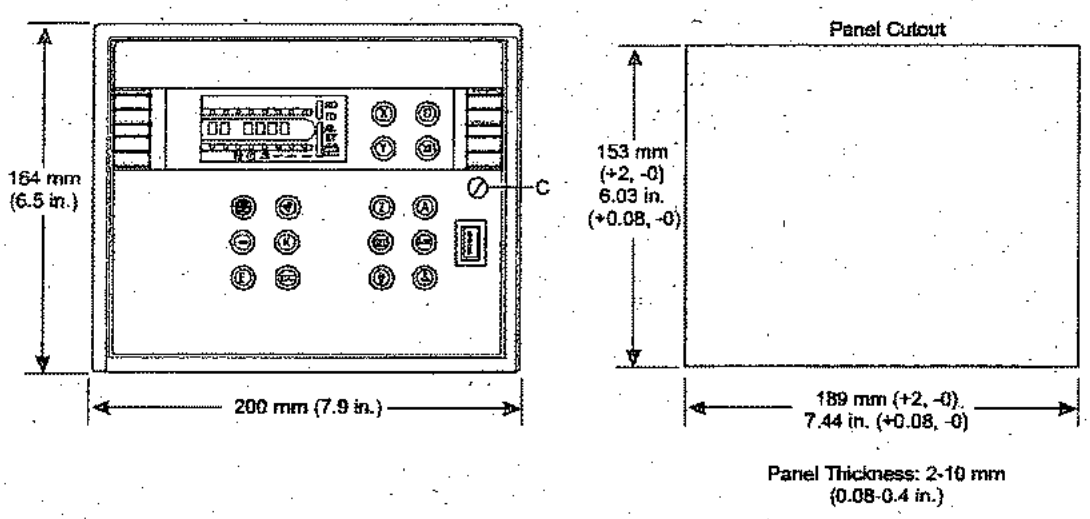
   Note: This is mandatory in Europe for CE Directive compliance when the base is not mounted inside a metal cabinet; optional elsewhere.

   The side wall of the terminal cover is designed such that part of it can be removed to allow more space for the wiring to the upper row of terminals. Remove sections of the side wall as necessary.

6. Verify that the wiring to the base has been correctly installed, and that voltage levels are appropriate for the various input signals according to the application.

7. Set the jumpers and address switches at the back of the controller as required. See *Jumper Details*, Figure 22.

8. Attach the controller to the base, by first fitting the lugs on the left side of the controller into the base, and then by pressing the controller firmly against the base on the right side. Open the front panel flap and secure the controller to the base by tightening Screw C.



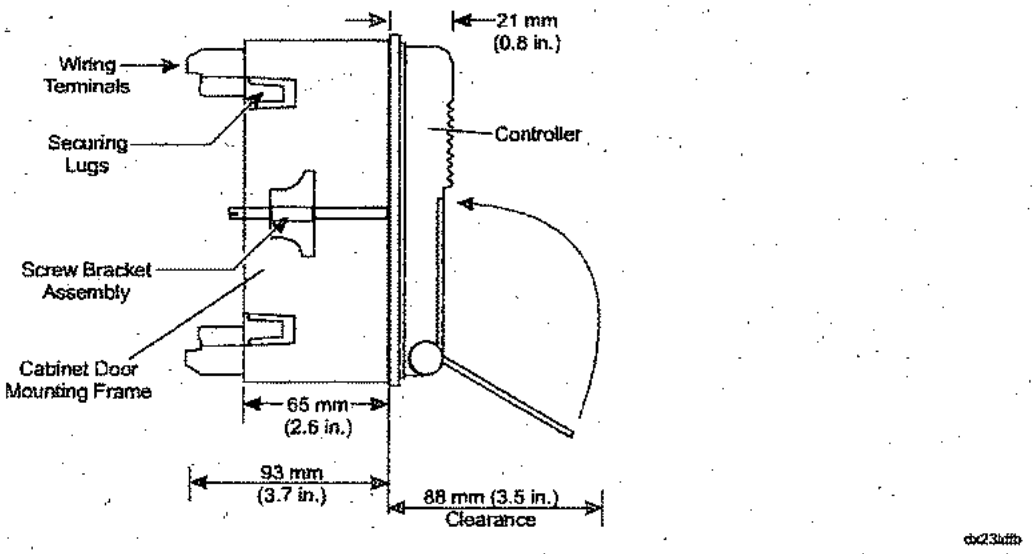


Figure 15: Installation Details of Versions 2 and 3 with Cabinet Door Mounting Frame

DX Controller, Cabinet Door Mounting Frame

To mount the Version 2 or 3 DX controller DX-9100-8996 cabinet door mounting frame:

1. If the controller has already been installed in the frame, proceed as follows to remove it:

   Open the front panel flap. Release Screw C. Slide the controller out of the frame until it is free. Place the controller in a safe location.

2. Make a panel cutout in the cabinet door as shown in Figure 15. Note that the frame may be mounted in a panel with a thickness of 2-10 mm.

   Slide the frame into the cutout and secure using the two screw bracket assemblies provided.

3. Wiring terminations are made via the terminal blocks, which accept 1 x 1.5 mm^2 (16 AWG) cable at the back of the frame. See Figure 17. Terminations of the LONWORKS N2 and XT communications bus cables are made via the connectors provided with the base.

4. Verify that the wiring to the frame has been correctly installed, and that voltage levels are appropriate for the various input signals according to the application.

5. Set the jumpers and address switches at the back of the controller as required. See *Jumper Details*, Figure 22.

6. Slide the controller into the frame until the lugs on the left hand side of the frame engage the controller. Open the front panel flap and secure the controller to the frame by tightening Screw C (see Figure 15).

Notes: The Version 2 DX-9100-8454 or FA-DX9100-8454 controller must be connected to an RS-485/N2 Bus.

The Version 3 DX-9120-8454 controller with the TP78 transceiver must be connected to a LONWORKS N2E Bus where all the controllers on the bus are fitted with a TP78 transceiver and the NU-NET201-0 LONWORKS network card is installed in the NCM.

The Version 3 DX-9121-8454 controller with the FTT10a transceiver must be connected to a LONWORKS N2E Bus where all the controllers on the bus are fitted with a FTT10 or FTT10a transceiver and the NU-NET202-0 LONWORKS network card is installed in the NCM.

The Version 3 controller with the FTT10a transceiver requires a different mounting base or frame from the controller with the TP78 transceiver. See Table 2.

Table 2: Order Codes for Controller Mounting Bases and Frames

Controller	Panel Mounting Base	Cabinet Door Mounting Frame
DX-9100-8454 Version 2	North America: DX-9100-8990 DX-9100-8990 (UL 864 [Underwriters Laboratories®]) Europe: DX-9100-8997	DX-9100-8996
DX-9120-8454 Version 3 (TP78)	North America: DX-9100-8990 DX-9100-8990 (UL 864) Europe: DX-9100-8997	DX-9100-8996
DX-9121-8454 Version 3 (FTT10)	DX-9121-8997 (UL 864)	DX-9121-8996

See Tables 7 through 11 for the full range of DX-related items and accessories and their ordering codes.

Connection Details

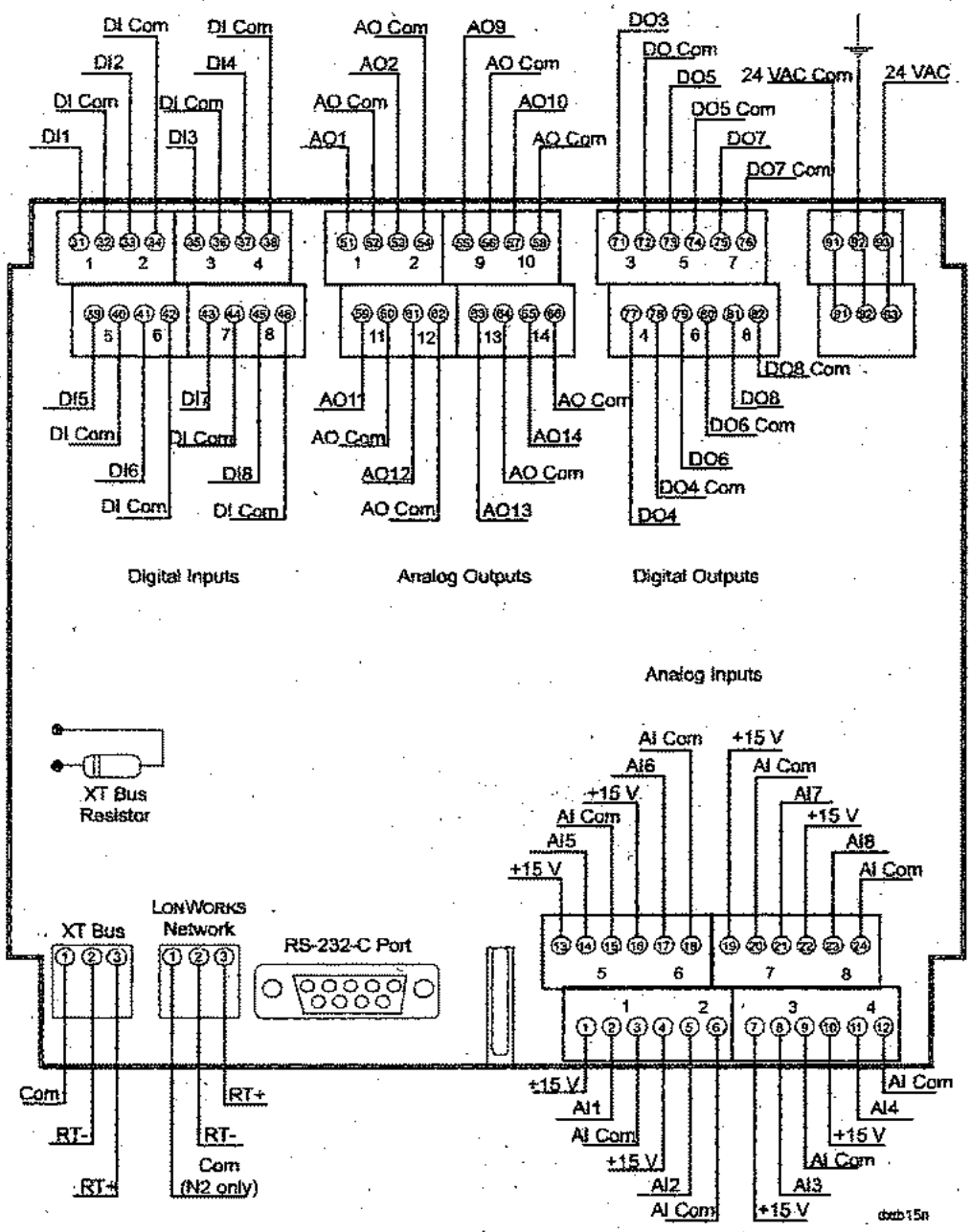


Figure 16: Connections at the Top and Bottom of the Panel Mounting Base

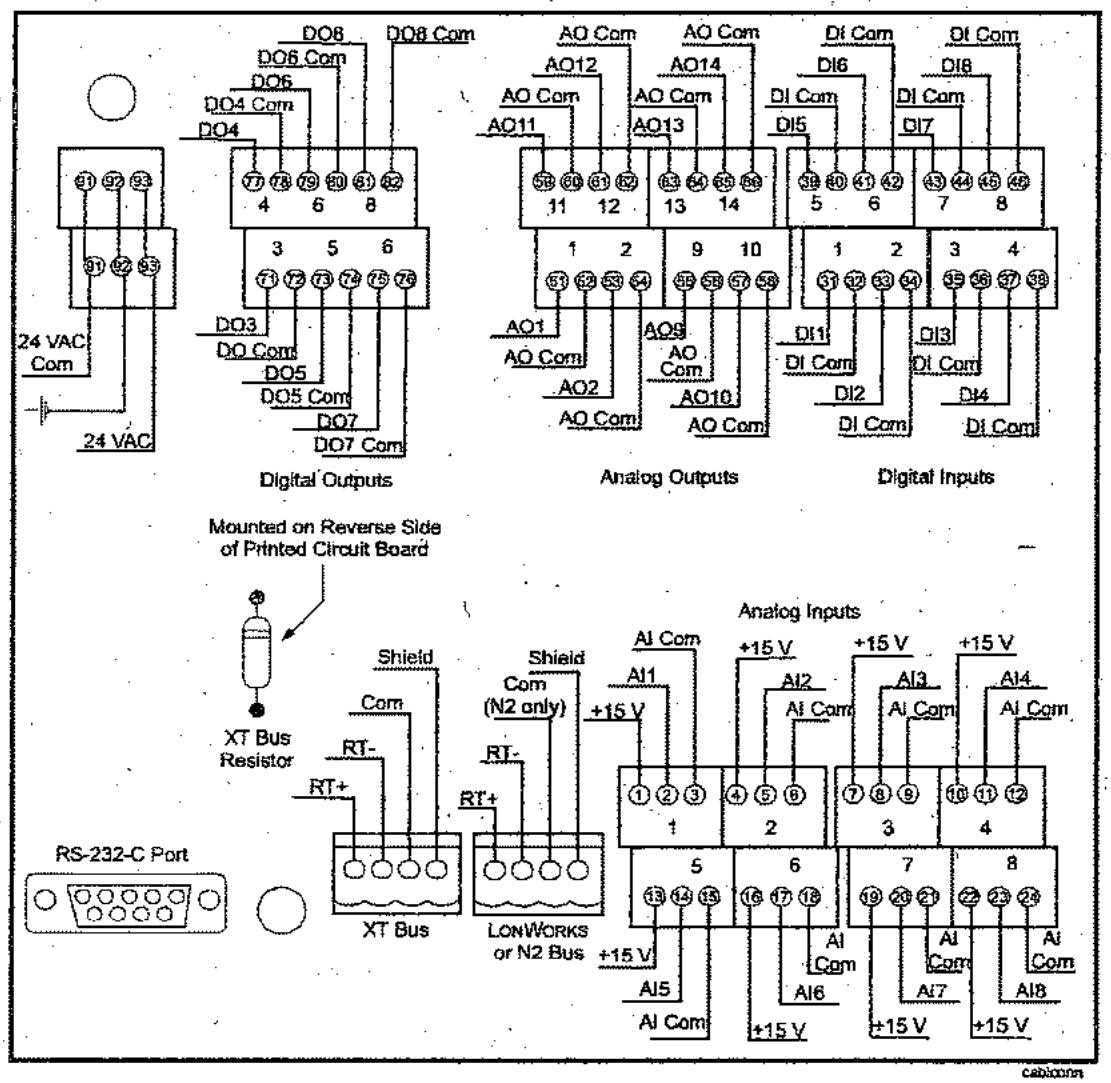


Figure 17: Connections at the Top and Bottom of the Cabinet Door Mounting Frame

Notes: The connection, wiring, and jumper information that follows is valid for Version 2 and 3 controllers with either type of mounting: panel mounting base or cabinet door mounting frame.

The following commons are electrically independent:

- Analog Input Common (for AI1 to AI8)
- Analog Output Common (for AO1, AO2, AO9 to AO14)
- 24 VAC Common/Digital Input Common (for DI1 to DI8)*
- Digital Output 3 Common
- Digital Output 4 Common
- Digital Output 5 Common
- Digital Output 6 Common
- Digital Output 7 Common
- N2 Bus/XT Bus Common (Reference)

*24V Common and Digital Input Common are electrically connected.

If required by local electrical codes, the 24 VAC Common/Digital Input Common may be connected to a clean earth/ground termination. The Analog Common may be connected to the 24 VAC Common at the controller for activating devices with a single common terminal for 24 VAC Common and Analog Signal Common. Under no circumstances should the 24 VAC or any of the Analog Outputs (AO1 through AO14) be connected to an earth/ground termination.

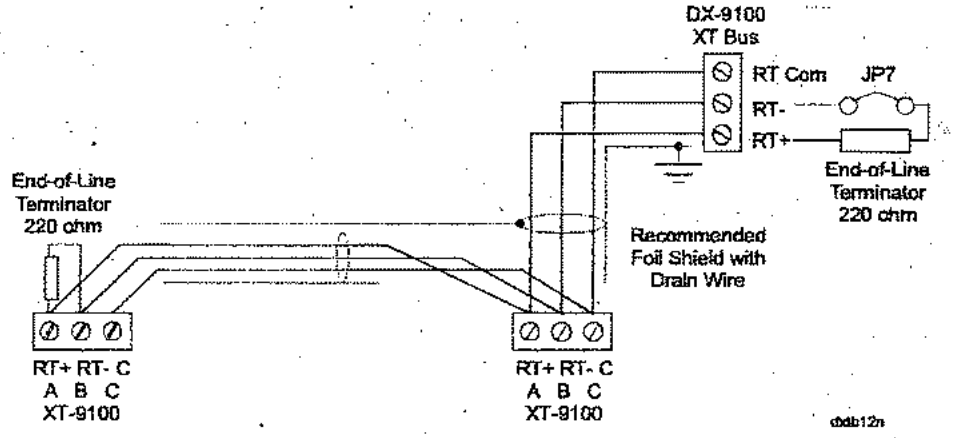


Figure 18: Connection Details for the XT-Bus for Connection to Version 2 or 3 DX

Maximum: Eight XT-9100s or XTM-905s

Maximum bus length: 1,200 meters (4,000 feet)

Install 220 ohm end-of-line resistors at each end of the XT Bus line when the bus length is greater than 100 meters (330 feet). When the DX-9100 is at one end of the bus, the end-of-line resistor is already installed in the mounting base or frame. When the DX-9100 is not at one end of the bus, install two resistors externally, and use side-cutters to remove the XT Bus resistor on the mounting base or frame. (See Figures 16 and 17.) When the bus length is less than 100 meters (330 feet), no external resistors are required, but the end-of-line resistor in the mounting frame must ***not*** be removed.

Connection Details for Download/ Upload

The connection between the PC and the Version 2 DX-9100 controller is made via an IU-9100 or MM-CVT-101 converter unit, which in turn must be connected to drive the N2 Bus (Bus 91) on which the DX-9100 controller resides. With this connection configuration, each DX-9100, with its connected extension modules, and any XT-9100 or XTM-905 modules on the bus can be downloaded, one after the other, by entering the appropriate address in the GX-9100 Configuration Tool. The DX controller must be disconnected from the supervisory system to use this method.

The DX-9100 Version 2 or 3 controller, with its connected extension modules, may be downloaded directly via its RS-232 port. With this connection configuration, only this one DX-9100 and its extension modules can be downloaded.

Note: The Version 3 controller may be connected to a PC only via its RS-232-C port.

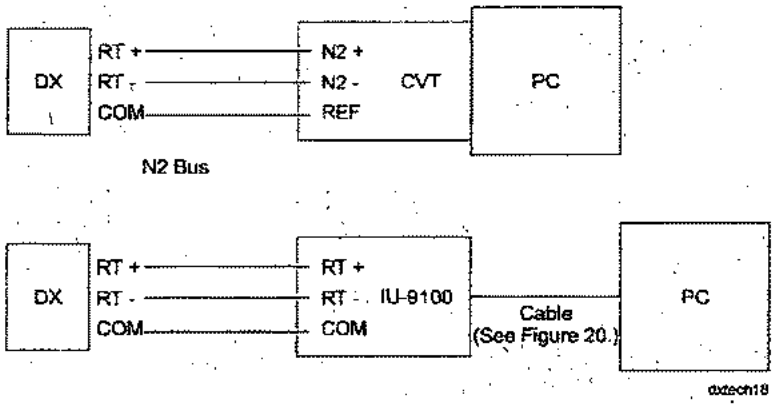


Figure 19: Connection Details for Download/Upload of DX-9100, Version 2

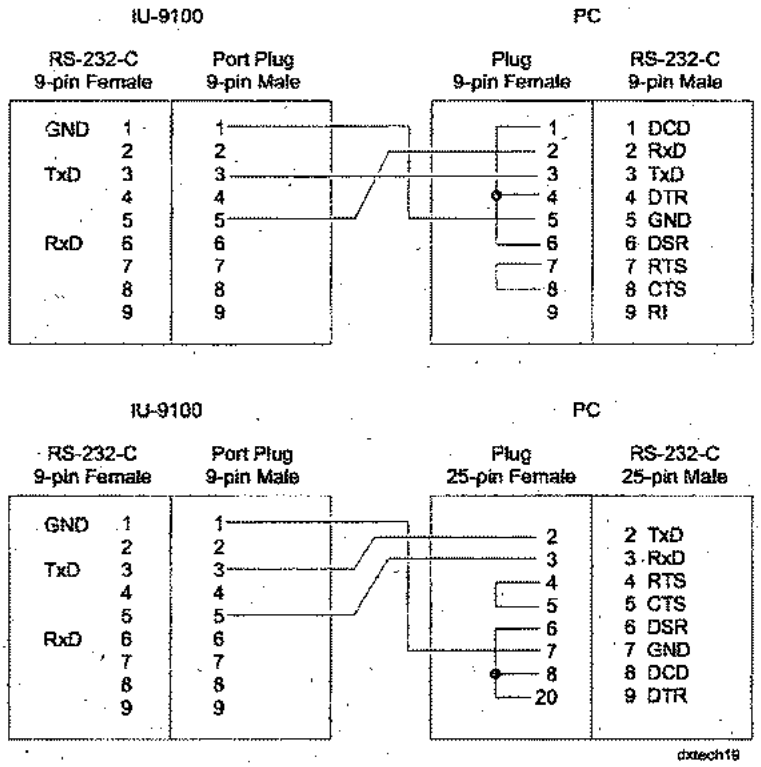


Figure 20: IU-9100 to PC Connection Details, Version 2

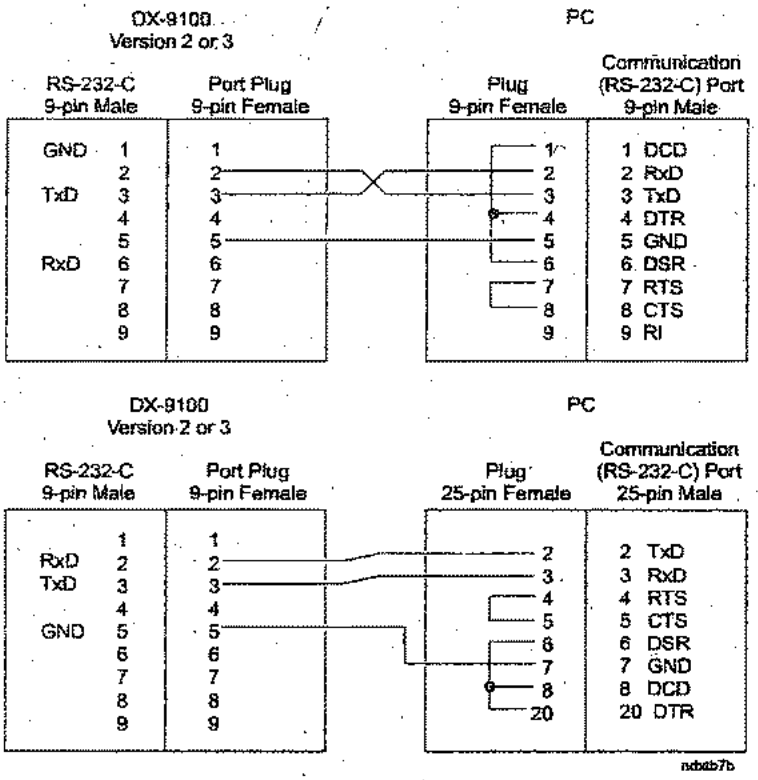


Figure 21: Direct Download, Version 2 or 3 Controller

Note: This is a null modem cable available at most electronic stores. However, make sure it has the above configuration, as there is no universal null modem cable standard. You can also use a straight through cable with a null modem adapter.

Jumper Details

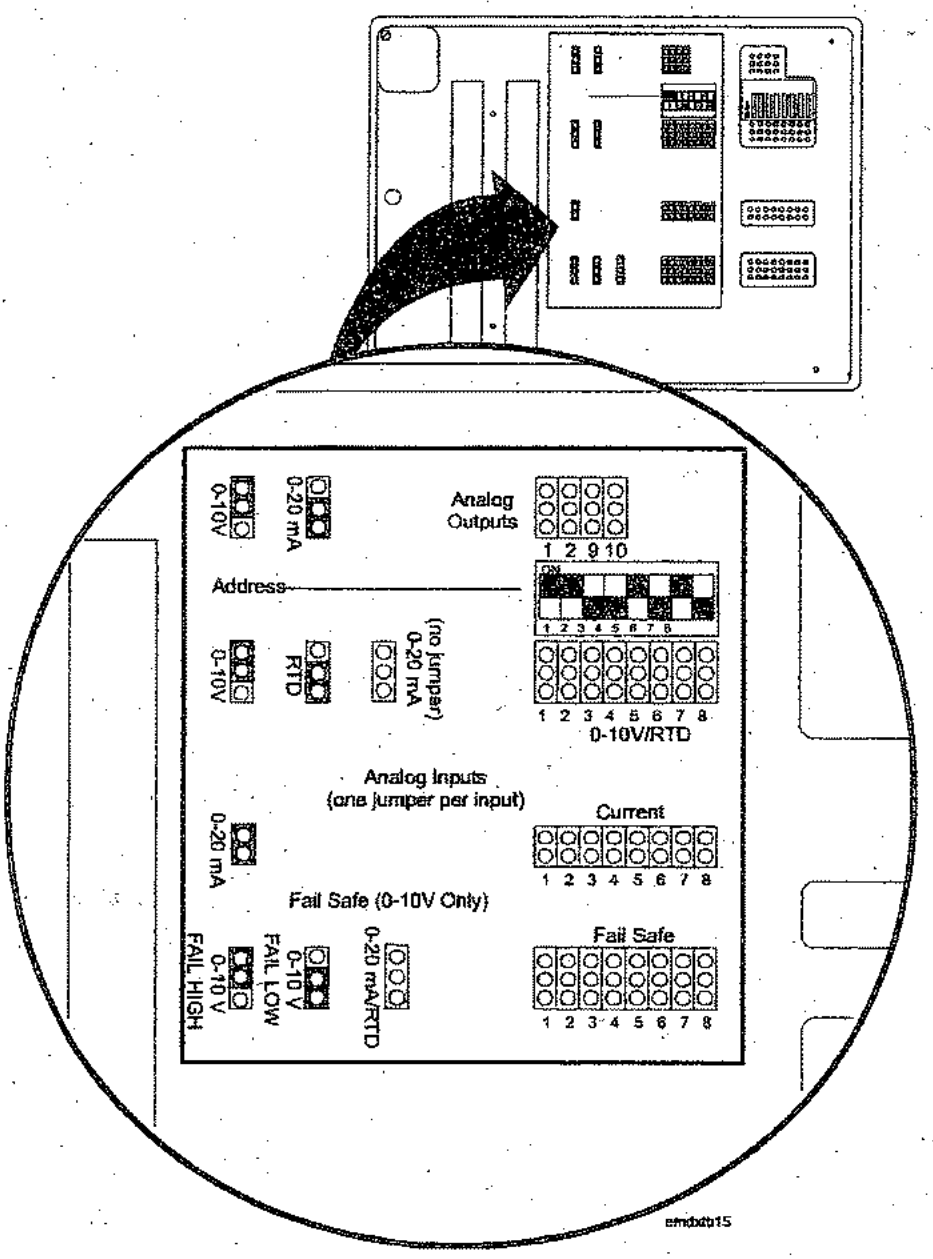


Figure 22: Jumper Details for Versions 2 and 3

The following are guidelines for setting jumpers on Version 2 or 3 controllers:

1. Make all jumper selections **before** fixing the controller to the base.
2. Select the analog input type using one jumper per input in the 0-10V/RTD jumper field or Current jumper field.

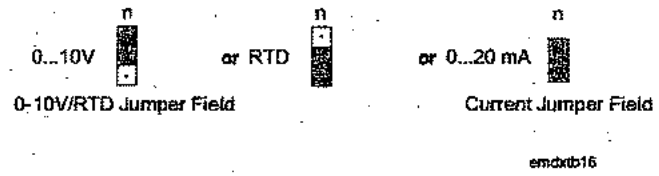


Figure 23: Jumper Positions

For 0-10V inputs only, install a jumper in the fail high or fail low position if fail safe operation is required. Fail high means that the controller assumes a 10V input when there is no input signal, and fail low means that the controller assumes a 0V input when there is no input signal (open circuit). If the input signal fails, this gives the programmer the ability to fail the signal so that the controller assumes a Fail Safe mode.

3. Select the analog output type using one jumper per output. Note that analog outputs AO11 to AO14 are 0-10V only and require no jumper setting.
4. Select the controller address (for FMS) on the address switches in 8-bit binary format.

Switch Number	1	2	3	4	5	6	7	8
Decimal Equivalent	1	2	4	8	16	32	64	128

Example for switch settings:

1	2	3	4	5	6	7	8	
Off	Off	On	On	Off	On	Off	On	Address 172
-	-	4	8	-	32	-	128	

(4 + 8 + 32 + 128 = 172)

Typical Wiring

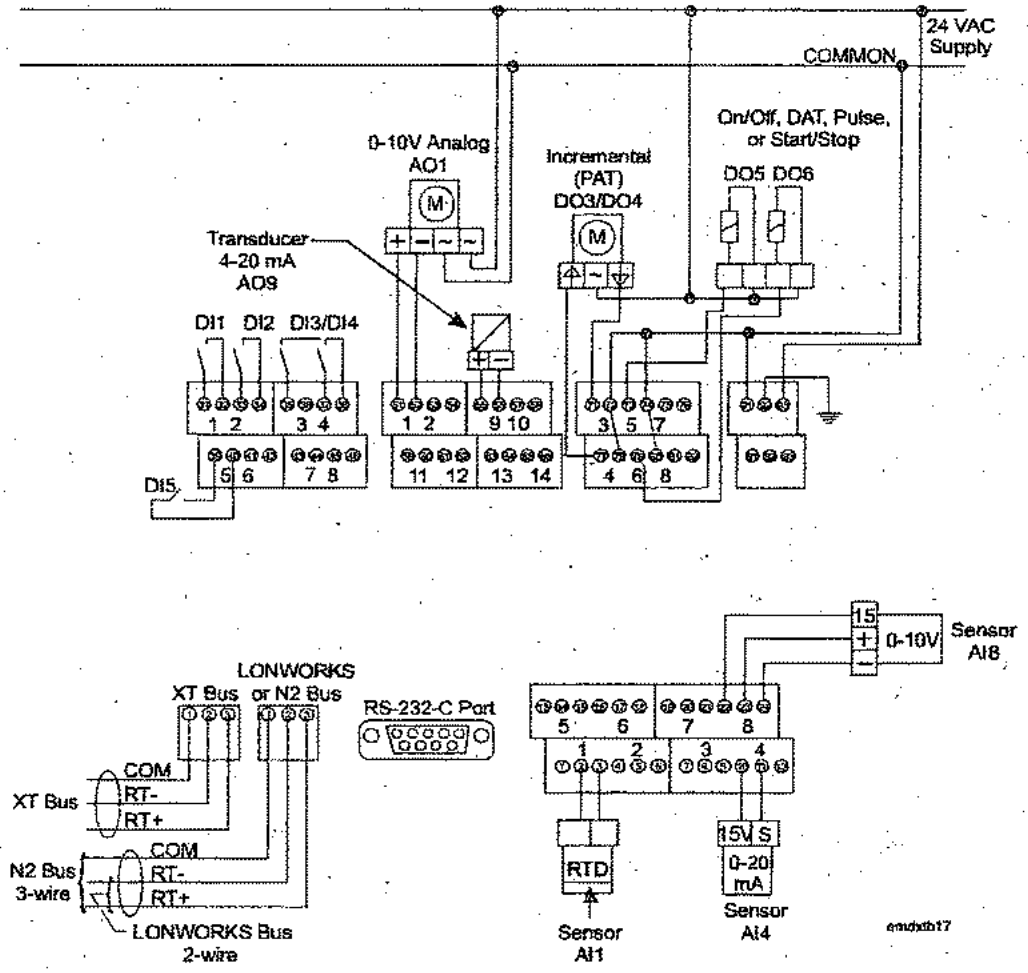


Figure 24: Wiring Example for Versions 2 and 3 (Panel Mounting Base Terminals Shown)

Note: The diagram shows the wiring using a common transformer for controller supply, and input and output devices. Separate transformers can be used.

General Wiring Guidelines

Every reasonable precaution has been taken to prevent electrical disturbances from adversely affecting the operation of the controller, and the controller complies with appropriate local codes for Electromagnetic Compatibility (EMC). However, lack of attention to generally accepted control wiring installation practices can lead to controller problems in high electromagnetic field environments. In general, follow the guidelines below.

- Do not mount the controller in heavy duty switch gear cabinets or in cabinets with frequency-converting or phase-cutting equipment.
- Low voltage wiring in electrical cabinets must be physically separated from line voltage and power wiring, and a distinctive color of wire (e.g., white or pink) is recommended.
- To avoid electrical interference in field cables:
  - Keep input and output point cable runs as short as possible (less than 50 m [165 ft]).
  - Use twisted pair cables.
  - Run low voltage cables separately from line voltage/power cables, and use a minimum of 30 cm (12 in.) separation for 230V 30A circuits.
  - Do not run low voltage cables parallel to power cables for long distances (greater than 3 m [10 ft]).
  - Do not run cables close to transformers or high frequency generating equipment.
  - In high electromagnetic field environments, use shielded cable, grounding the drain wire at the controller cabinet only.
  - Use a cable recommended for RS-485 transmission for the N2 Bus (Bus 91) (communications buses), and the XT Bus (extension module bus). If the cable is shielded, it must be grounded at one point only (normally at one end of the bus). (See the technical bulletin on the N2 Bus or System 91 Bus Converter and Repeater). If a 2-wire cable is installed, the shield may be used for the RS-485 common (or reference) signal.
  - For the LONWORKS communications bus, use a balanced 110 ohm twisted pair cable. If the cable is shielded, it must be grounded at one point only (normally at one end of the bus).
- Do not connect switched inductive loads to the 24V transformer, which supplies the controller. When multiple loads are connected to one transformer, cable each connected load from the transformer separately so that any possible disturbances from one load will have minimal affect on other loads.

Figure 25 shows the correct way to wire the controller to the transformer. Figure 26 illustrates the incorrect way.

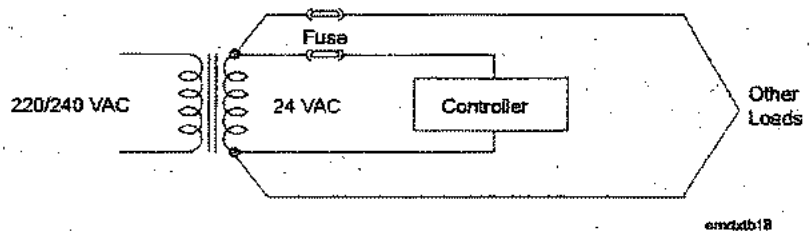


Figure 25: *Correct* Wiring of Controller to 24V Transformer

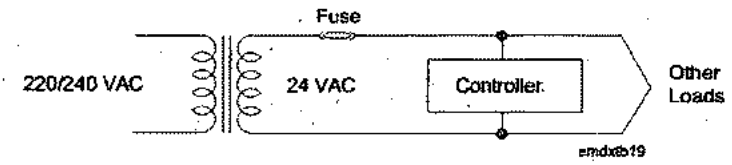


Figure 26: *Incorrect* Wiring of Controller to 24V Transformer

Battery Replacement

The controller has a rechargeable capacitive battery and a non-rechargeable lithium battery. The capacitive battery is charged by connecting the controller to 24 VAC for a minimum of one hour. It will maintain the contents of the Random Access Memory (RAM) for up to seven days. The lithium battery provides RAM backup for at least one year at room temperature without external power.

When the lithium battery has less than 20% of its full charge and the controller has 24 VAC power, the battery LED on the front panel flashes to indicate that the battery should be changed.

Configuration and calibration data is stored in EEPROM and is not lost upon 24 VAC power failure or battery failure. However, if 24 VAC power, capacitive battery charge, and lithium battery charge are lost, the controller will lose all realtime operating data stored in RAM, such as the realtime clock, counter values, and supervisory control modes. These values must be set in the controller again when battery or 24 VAC power has been restored.

Lithium Battery

To replace the lithium battery, proceed as follows:

Version 1

Switch off the 24 VAC power supply and open the controller as described under *Mounting Instructions*. The lithium battery is located on the upper board behind the display panel. Carefully cut the nylon tie and remove the old battery. Insert the new battery, observing the correct polarity. Secure it with the new nylon tie supplied with the battery. Reattach the controller cover to the base and tighten the retaining Screw A (see Figure 4).

Note: Each controller is sent from the factory with the lithium battery jumper in the On position.

> **CAUTION:** The CMOS circuits in the controller are sensitive to static electricity. Take suitable precautions.

Versions 2 and 3

Remove the controller from its base as described under Version 2 and 3 *Mounting Instructions*. Remove the two retaining screws from the back of the controller to open it. See the figure below.

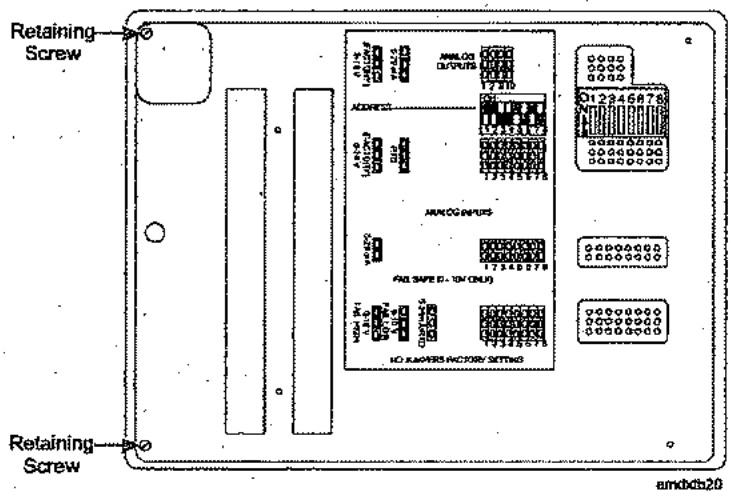


Figure 27: Retaining Screws on the Back of the Version 2 or 3 Controller

Place the controller on a flat surface and separate the two half shells of the controller, taking care not to damage the connecting cables. The lithium battery is located on the upper board behind the display panel, as shown in Figure 28. Carefully cut the nylon tie and remove the old battery. Insert the new battery, observing the correct polarity. Secure it with the new nylon tie supplied with the battery. Reassemble the controller, ensuring that the front panel is securely on the base and that the retaining screws are tight. Replace the controller on the base and tighten Retaining Screw C. See Figure 13 and Figure 15.

Note: Each controller is sent from the factory with the lithium battery jumper in the On position. The jumper should only be set to Off if the controller is to be kept in storage without power for an extended period of time. The jumper must be set to On before the controller is installed and powered up.

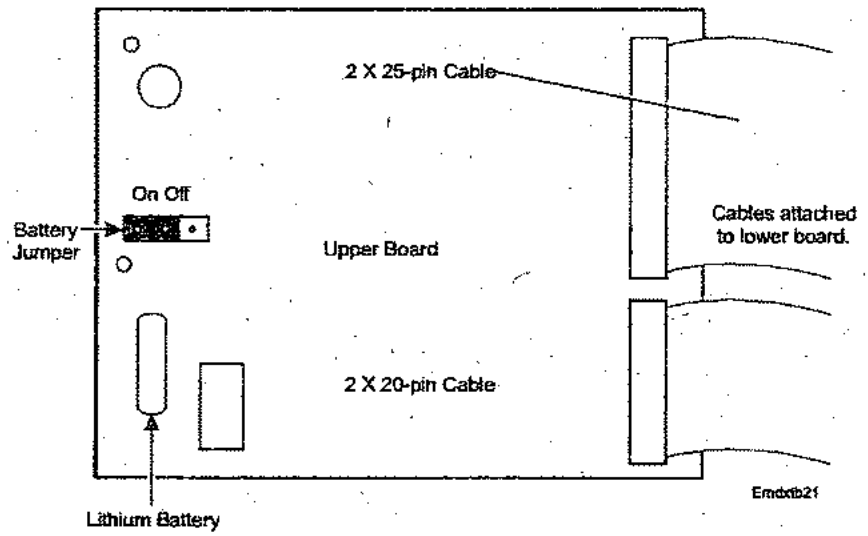


Figure 28: Replacing the Lithium Battery in the Version 2 or 3 Controller

CAUTION: The CMOS circuits in the controller are sensitive to static electricity. Take suitable precautions.

Startup

When all jumpers and address switches have been set, and all connections have been made to the controller and checked for correct voltage and current signal levels, 24 VAC power may be applied to the controller.

During startup, `init` will appear on the front panel. Then the version level of the firmware in the controller will be displayed, followed by the number, if any, of the configuration that has already been loaded into the controller. See *Startup Mode* under *Display Panel and Keypads*.

If no version number is displayed, the controller will have Version 1 firmware.

If the controller has already been loaded, it begins control operations automatically. Otherwise, the controller is now ready to receive a configuration via its N2 Bus (Bus 91) or RS-232-C communication port.

All these controller versions (Version 1 with Version 1.1 or later firmware) may be downloaded from the Metasys Operator Workstation (OWS).

Inputs/Outputs

Analog Inputs

The DX-9100 accepts eight analog inputs, each of which may be 0-10V, 0-20 mA, or passive RTD sensor by jumper configuration. For 0-20 mA inputs, a zero offset to 4 mA may be set by software configuration. The measurement unit for passive (RTD) inputs is configured for degrees Celsius or degrees Fahrenheit to enable the controller to convert the measured resistance according to the appropriate temperature scale.

In ***Version 1*** of the controller, measurement units of Celsius, Fahrenheit, or percent may be selected for active inputs to enable the appropriate LED to be lit on the front panel. (Versions 2 and 3 do not have these LEDs.)

These active inputs (voltage or current) are ranged using the programmable range parameters as follows:

- Lower end of range (LR) for 0V/0 mA/4 mA
- Higher end of range (HR) for 10V/20 mA

Voltage and current inputs from differential pressure transducers can be linearized by a square root function, which operates over the complete range of the input.

$$AI = \sqrt{\frac{\%PR}{100}} (HR - LR) + LR$$

Where: %PR = the analog value in percent of the physical range (0-10V, 0-20 mA, 4-20 mA)

A configurable filter constant in seconds is incorporated for the reduction of signal instability.

In addition, the DX-9100 will accept Ni1000 (Johnson Controls and DIN characteristics), Pt1000, and A99 passive RTD sensors. For these sensors, the measurement range is fixed. The programmable range must only be set to determine the range of control when the input is connected to a control module.

The DX-9100 provides the 15 VDC supply for active analog input sensors.

Note: The maximum current supplied from this power supply must not exceed 100 mA in the ***Version 1*** controller and must not exceed 200 mA in the ***Version 2*** or ***3*** controller for current (0-20 mA and 4-20 mA) transmitters. A maximum of 80 mA may be used for voltage transmitters or other devices that take the current from the 15 VDC supply but do not return the current via the analog input terminal.

Each of the analog inputs can be assigned to any of the 12 programmable function modules.

A high and low limit setting can also be assigned to each of the analog inputs. By utilizing the startup and shutoff module commands, timer function modules and the alarm disable function, it is possible to inhibit these high and low alarms on plant startup or shutdown while retaining any alarm that is present when these commands are initiated.

Digital Inputs

The DX-9100 accepts eight digital input signals. A digital input is active (true) when connected to the digital input common via an external potential-free contact. Each of the digital inputs can be assigned as inputs to any of the 12 programmable function modules or to the programmed logic control module.

Digital Counters

Each digital input has an associated digital counter. The number of positive transitions of the physical digital input required to increment the counter can be programmed in the controller. The maximum value of each counter can be configured as 9,999,999 or 32,767 (15 bits) for FMSs, such as Metasys, which read 15-bit counter data.

Analog Outputs

The analog output modules of the DX-9100 provide the interface between the hardware analog outputs and the outputs of the programmable function modules. Each of the analog outputs can be ranged to give a 0-100% output between a low range (LRO) and high range (HRO) input value.

Each analog output module is therefore configurable with three parameters and can carry out the following functions:

$$\text{For LRO} < I < \text{HRO, the Output} = \frac{I - \text{LRO}}{\text{HRO} - \text{LRO}} \times 100\%$$

For I less than LRO, the Output = 0%

For I greater than HRO, the Output = 100%

Where:

I = Input variable from one of the programmable function modules.

LRO = Low range variable corresponding to the module input value that requires the hardware output to be at 0% (0V, 0 mA, or 4 mA by configuration).

HRO = High range variable corresponding to the module input value that requires the hardware output to be at 100% (10V or 20 mA by configuration).

The actual output signal can also be limited by a high limit (HLO) and a low limit (LLO) value:

For Output less than LLO, Output = LLO

For Output greater than HLO, Output = HLO

Each analog output module may be put in Hold mode and its output value modified via an FMS.

Version 1 (DX-9100-8154) provides two analog outputs, which can be set to 0-10V or 0-20 mA by jumper configuration (see Figure 9), and which can have a 4 mA zero offset by software configuration.

Version 2 (DX-9100-8454* or *FA-DX9100-8454) and ***Version 3 (DX-912x-8454)*** each provide four analog outputs, which can be set to 0-10 V or 0-20 mA by jumper configuration (see Figure 22), and which can have a 4 mA zero offset by software configuration, and an additional four outputs that are 0-10V only.

Digital Outputs

The six logic output modules are used to configure the six digital outputs (24 VAC triacs) of the DX-9100. Alternatively, a digital output may be enabled for FMS control only.

The output modules provide the interface between the hardware digital outputs (triacs) and the outputs (logic or numeric variables) from the programmable function modules, programmable logic control module, or time scheduling modules. Any of these modules may be assigned to any of the logic output modules, and in turn each of the logic output modules controls its output triac.

A logic module may be put into Hold mode and its output value modified via an FMS.

Each logic output module can be configured to provide one of the following output types:

- On/off (driven from a logic variable)

  The triac is switched on or off by a change-of-state of the logic variable.

- On/off (driven from a numeric variable)

  The triac is switched on or off as a function of the output of a programmable function module (positive output = On, 0 or negative output = Off).

- Duration Adjusted Type (DAT) (driven from a numeric variable)

  The triac is driven open or closed with a time base duty cycle that is proportional to the numeric output of a programmable function module. The DAT output can be ranged to give 0-100% duty cycle between a low range (LRO) and high range (HRO) value of the controlling variable.

  A minimum on/off time in percent of the time base may be set to avoid very short on pulses at the low range value (output at 0%) and very short off pulses at the high range value (output at 100%).

- Position Adjust Type (PAT, incremental control), without feedback (driven from a numeric variable)

  A pair of triacs, (two adjacent output modules) can be used as a Position Adjust Type (PAT) output to operate a synchronous reversible electric actuator.

  PAT output gives modulating control by reference to the programmed actuator total runtime (fully open to fully closed), and drives the actuator for a part of that time base in proportion to the change in the controlling numeric variable. For example, for a 120 second actuator to achieve 40% open, the actuator will run for 48 seconds from a fully closed position.

  A deadband, in percent of total runtime, may be set to avoid driving the actuator for very small changes in the output signal, thus reducing unnecessary wear on the drive mechanism.

  The output can be programmed to give 0-100% between a low range (LRO) and high range (HRO) of the value of the controlling variable.

  The travel of the actuator may be limited by entering low and high limits for the output signal (LLO and HLO).

  A PAT output requires two output modules. The triac of the output module, which is programmed as a PAT type, will be switched on when the output must increase. The next output module (in numerical sequence) cannot be used for any other output function, and its triac will be switched on when the output must decrease. Modules 3/4, 4/5, 5/6, 6/7, and 7/8 can be used as PAT type output.

  When a PAT module is at 0% or 100%, the appropriate output triac will switch on for the full stroke time every two hours.

- PAT with feedback (driven from a numeric variable)

  This output is identical to the above with the exception that a 0-100% analog position feedback signal is input into the controller and the actuator is driven in the appropriate direction until the position feedback signal is equal to the controlling variable position signal plus or minus the deadband value. A logic variable, which can be used for information or control purposes, is set if the feedback signal does not change when the actuator is driven in either direction.

- Start/Stop (S/S) (driven from a logic variable).

  A pair of triacs (two adjacent output modules) can be used as a start/stop output to operate an external latching circuit which controls the starting and stopping of a pump, fan, etc. A start/stop output requires two output modules.

  The triac of the output module, which is programmed as an S/S type, will be switched on for 1 second when the connected logic variable goes to State 1 (true). The next output module (in numerical sequence) must not be programmed and its triac will be switched on for 1 second when the connected logic variable goes to State 0 (false). Modules 3/4, 4/5, 5/6, 6/7, and 7/8 can be used as S/S type output.

- Pulse (driven from a logic variable).

  (The triac is switched on for a period of 1 second for each state transition of the connected logic variable.)

Analog/Digital Constants and Logic Result Status

There are 8 analog constants (ACO) and 32 digital constants (DCO), which can be used to store values set by the service module, front panel, or FMS. These constants can be used in the configuration in the same way as analog inputs, numeric variables, digital inputs, and logic variables.

There are 64 Logic Result Status (LRS) variables, which can be read by the service module or FMS, and are used in the Programmable Logic Control (PLC) module as program logic variables, partial logic results, or final logic results of logic routines. The logic result status variables can be used in the configuration in the same way as other logic variables.

Extension Modules

The input/output capacity of the DX-9100 controller may be extended by connecting up to eight extension modules via the XT Bus.

An extension module set comprises an XT-9100 or an XTM-905 extension module and one or more XP/XPx expansion modules. The expansion modules provide input/output capability for the extension modules.

The following expansion modules are available for the XT-9100 extension module:

- XP-9102: six analog inputs and two analog outputs
- XP-9103: eight digital outputs (triac)
- XP-9104: four digital inputs and four digital outputs (triac)
- XP-9105: eight digital inputs
- XP-9106: four digital outputs (relay) (Europe only)
- XP-9107: four digital outputs (relay) (North America)

Refer to the *XT-9100 Technical Bulletin (LIT-6364040)* for full details of these modules.

An XTM-905 may be combined with its expansion modules to provide the following configurations:

Table 3: Expansion Module Types Available for the XTM-905 Extension Module (North America)

Model	Analog Inputs	Analog Outputs	Binary Inputs	Binary Outputs
XPA-821-5	6	2	–	–
XPB-821-5	–		8	–
XPE-401-5	–	–	4	3 single state
XPE-404-5	–	–	4	4 (common supply)
XPL-401-5	–	–	4	3 single state
XPT-401-5	–	–	4	4
XPT-861-5	–	–	–	8

An XT-9100 or XTM-905 can be combined with its expansion modules to provide the following configurations:

- eight analog inputs/outputs

  or

- eight digital inputs/outputs, with digital counters associated with the digital inputs

  or

- eight analog inputs/outputs and eight digital inputs/outputs

  or

- sixteen digital inputs/outputs, with digital counters associated with the digital inputs within the first eight input/output points

Note: When an extension module is configured with 16 inputs/outputs, it takes the place, in the DX-9100 database, of 2 extension modules with 8 inputs/outputs each. The DX-9100 can communicate with a maximum of 64 inputs and outputs.

Analog inputs to extension modules may be 0-10V, 0-20 mA, or passive RTD-NI1000 (Johnson Controls characteristic only), Pt1000, or A99 sensors.

Analog inputs to the XPA-421-5 module only may additionally be RTD-Ni1000 (L&G and DIN), Pt100 and Ni100 sensors, or a 5K ohm potentiometer.

Voltage and current inputs from differential pressure transducers can be linearized by a square root function. Each analog input can be assigned to any of the 12 programmable function modules, and high and low alarm settings can be entered to each analog input.

Digital inputs to extension modules are potential-free contacts. The input is active (true) when the contact is closed. Each digital input can be assigned to any of the 12 programmable function modules or to the programmable logic control module.

Digital counters are available in extension modules, which do not have analog inputs or outputs. Digital counters are associated with digital inputs only on the first eight BIs on the XT-9100 or XTM-905. The number of positive transitions of the physical digital input required to increment the counter can be programmed in the extension module.

Analog outputs in extension modules can be configured to provide 0-10V, 0-20 mA, or 4-20 mA, and can be connected to outputs of programmable function modules in the DX-9100 controller. The output is ranged by low range and high range variables to provide a 0-100% signal to the extension module.

Digital outputs in extension modules can only be configured as on/off or pulse type, and the physical output may be a triac or a relay contact. Pulse type outputs switch on for a configurable period (1 to 1275 ms) for each transition of the connected variable. The exceptions are the XPM-421-5, XPL-421-5, and XPE-421-5 modules with relay outputs, which operate according to the type of module and have no equivalence in the XT-9100 set of XP modules.

Extension modules do not have logic output modules to control the digital outputs.

The digital outputs may be driven by any logic variable or output of the programmable function modules or time schedule modules, or by Logic Result (LRS) variables set by the Programmable Logic Control (PLC) module.

Note: For further information about extension modules, refer to the *XT-9100 Technical Bulletin (LIT-6364040)*, the *XT-9100 Configuration Guide (LIT-6364050)*, and the *XTM-905 Extension Module, XPx-xxx Expansion Modules Technical Bulletin (LIT-6364210)*.

Network Inputs/Outputs for Version 3, LONWORKS Only

The DX-912x-8454 controller with the LONWORKS network interface can send and receive data over the network without an FMS. A peer-to-peer network may comprise up to 30 controllers. This is made possible by the LONWORKS network processor, which resides inside the controller and communicates with all other network processors on the same network. The network configures itself, reading each connected controller to determine if and when data should be transmitted. Both analog and digital data may be transmitted from one controller to another, and any one piece of data – one analog value or a block of 16 digital values - may be sent from one controller to up to 16 other controllers.

Data is received in a controller as network analog inputs and network digital inputs, and data is transmitted from network analog outputs and network digital outputs. The only parameters to define are the sources of the output values within the controller and the network destinations.

The Metasys NCM300 or NCM350 (NCM311 or NCM361 in Europe) may be connected to the network as an FMS but it acts only as a supervisory controller and does not take part in the exchange of data between controllers.

Analog Inputs

The Version 3 controller accepts 16 network analog inputs, each of which contains a numerical value received from a network analog output in another controller. These inputs can be used in the configuration in the same way as physical analog inputs, except that there are no parameters to define. The source of the analog data is defined in the transmitting controller. A typical application for a network analog input would be for receiving the value of the outdoor temperature from another controller.

Digital Inputs

The Version 3 controller accepts 8 network digital inputs, each of which contains 16 digital input logic values, received from a network digital output in another controller. Each of the 16 digital values in the digital input can be used in the configuration in the same way as physical digital inputs. The source of the digital data is defined in the transmitting controller. Digital data is always transmitted in blocks of 16 values from one controller to another and the block cannot be split apart by the network. Not all 16 values need to be used, and within the controller the values can be used independently. A typical application for a network digital input might be for receiving operating status data by secondary equipment from a primary unit so that the secondary unit can start when the load is high or the primary unit fails.

Analog Outputs

The Version 3 controller has up to 16 network analog outputs, each of which may be configured to transmit a numerical value to a network analog input in another controller. These outputs receive their values from other inputs, outputs, constants, programmable function modules, or extension module inputs of the same controller. Each network analog output may send its value to up to 16 other controllers. If 1 controller has an outdoor temperature input, for example, this input can be connected to a network output and sent to 16 other controllers, or connected to 2 network outputs and sent to 29 other controllers. (A maximum of 30 controllers is allowed on one LONWORKS network).

Digital Outputs

The Version 3 controller has up to 8 network digital outputs, each of which may be configured to transmit 16 digital values to a network digital input in another controller. Each of the 16 digital values in the digital output receives its value from another digital input, output, constant, logic result status, programmable function module, time scheduling module, or extension module input of the same controller. Each network digital output may send its 16 digital values as a block to up to 16 other controllers. If one controller has been configured to determine the occupancy status of an area, for example, a network output could be used to give this information to, say, three other controllers in the same area.

Operation

Introduction

The DX-9100 provides realtime functions, 12 programmable function modules, and 1 programmable logic control module.

The realtime **functions** are dedicated to the management of all the features related to the calendar and the time information. The following realtime modules are implemented:

- eight Time Schedule Modules, each with eight on/off events
- two optimal start/stop modules

The function of **each programmable function module** depends on the algorithm selected for that module. The following programmable algorithms are implemented in the DX-9100 operating system:

- PID Controller
- On/Off Controller
- Heating/Cooling PID Controller (Dual PID)
- Heating/Cooling On/Off Controller (Dual On/Off)
- Average Calculation
- Minimum/Maximum Selection
- Psychrometric Calculation (Celsius/Fahrenheit)
- Line Segment Function (16 segment)
- Input Selector
- Calculator (Linear or Polynomial Equation)
- Timer Functions (8 Channels)
- Totalization (Event, Integration, Runtime) (8 Channels)
- Comparator (8 Channels)
- Sequencer (Up to 8 Output Stages)
- 4 Line Segment Functions (4 Functions with 4 Segments each)
- 8 Calculators (8 Channel with Simple Math Function)
- Trend Log

The function of the **programmable logic control** module depends on a user-entered program of up to 512 program lines, each containing a field for an instruction code. The following instruction codes are implemented in the DX-9100 operating system:

- AND/AND NOT — Logic AND/AND NOT
- OR/OR NOT — Logic OR/OR NOT
- ANDB — Logic AND between logic blocks
- ORB — Logic OR between logic blocks
- OUT/OUT NOT — Result transfer/Inverted result transfer
- COS — Change-of-state detection
- SET/RST — SET state to 1/RESET state to 0

In the GX-9100 Graphic Configuration software, the program code is automatically generated from a graphic representation of the logic functions.

Realtime Functions

The realtime functions are based on a hardware realtime clock and on software tasks, which perform all the calendar and time functions, the daylight saving time changes, the day of the week definition, and the handling of holidays.

The realtime clock has a battery backup so it will retain the correct time during a power failure. The clock parameters (year, month, day, hour, minute) can be set from both the front panel and the FMS. The actual day of the week is automatically calculated from the calendar day during power up initialization and at every change of date.

A daylight saving function provides the automatic modification of the realtime clock, setting the time forward one hour when daylight saving time begins and setting the clock back one hour when it ends. The daylight saving period begins at time 00:00 on the begin date and terminates at 01:00 on the end date.

An Exception Day Table determines exceptions for the day of the week status. These exceptions are normally used to define holidays. The Exception Day Table comprises up to 30 entries, each of which defines a time period with a begin date and an end date. If the actual date is within an exception day time period, the day type is set to Holiday (or Day Type 8).

Time Schedule Modules

The eight time schedule modules each provide the control of a logic output as a function of a programmable start/stop schedule, the day of the week, exception days condition, and the realtime clock.

The time schedule module is executed each minute. If external forcing conditions are not present, the event schedule is examined to verify whether a start/stop command is programmed for the actual time and day of the week.

Three logic inputs can modify the normal behavior of the time schedule module according to the following priorities:

1. A forcing command sets the output to Off.
2. A forcing command sets the output to On.
3. An extension override command extends the occupancy period for a programmable time and is active only during occupancy time.

The extension override status of the module can also be controlled by a keyboard command or by a command from an FMS. When any one of the commands from the keyboard, FMS, or logic input are true, the extension override status of the module is true.

The time schedule module can contain up to eight events. Each entry contains the following information:

DAYS ENABLE: to select in which days of the week (1 = Mon, 2 = Tue, up to 8 = Holiday) the start/stop command is enabled; may be enabled for one or more days

START TIME: [Hour][Minute]

STOP TIME: [Hour][Minute]

The duration of a time programmed event can be extended to cover a period greater than one day by programming the stopping time of one event as 24:00 and the starting time of the next event as 00:00 on the next day.

A time schedule module may be put in Hold mode and its logic output modified via an FMS.

Optimal Start/Stop Modules

Two optimal start/stop modules each calculate the minimum time to bring a controlled zone temperature to a desired level at occupancy time under heating and/or cooling conditions. The modules also calculate the optimal stop time necessary to maintain the desired conditions to the end of the occupancy time.

The optimal start algorithm adapts as the heating and cooling thermal characteristics of the building are measured during the preheating or precooling cycles. The algorithm optionally compensates for outdoor temperatures above or below building design parameters.

The optimal stop algorithm uses the given heating and cooling characteristics and outdoor temperature at the time of plant shutdown. If the outdoor temperature is not connected, the optimal Stop mode is automatically disabled. The optimal start modules are defined by the following parameters:

- Zone Temperature
- Outdoor Temperature
- Zone Temperature On Setpoint (20)* [°C] or (68)* [°F]
- Zone Temperature Stop mode (Off) Bias (-3)* [°C] or (-6)* [°F]
- Time Schedule Module connections
- External Disable Signal to the Adapting Algorithm
- External Disable Signal to the Module
- Module type: Heating, Cooling, Heating and Cooling
- Minimum Heat/Cool Time (20)* [minutes]
- Maximum Startup Time (240)* [minutes]
- Maximum Optimal Stop Time (240)* [minutes]
- Start Mode Building Heating Factor (5)* [min/°C²]
  or (1)* [min/°F²]
- Start Mode Building Cooling Factor (5)* [min/°C²] or (1)* [min/°F²]
- Stop Mode Building Heating Factor (100)* [min/°C/°C]
  or (100)* [min/°F/°F]
- Stop Mode Building Cooling Factor (100)* [min/°C/°C] or (100)* [min/°F/°F]
- Adaptive Control (Filter Weight) (10)* [%]
- Outdoor Air Design Temperature Heating (-10)* [°C] or (14)* [°F]

- Outdoor Air Design Temperature
  Cooling (30)* [°C] or (86)* [°F]
- Control Range (+/-) (2)* [°C] or (4)* [°F]

* Default value in the Graphic Configuration software.

The parameters Zone Temperature On Setpoint and Zone Temperature Off Setpoint Bias may be set as fixed values or they may be connected to other numerical values in the configuration.

Optimal Start Adaptive Process

The adaptive process monitors how quickly the temperature reaches the halfway point between the setpoint and actual temperature:

- If it takes less than the calculated warmup time based on the building factor, then the building factor will be decreased so that the next calculation will result in a shorter warmup time, all other factors being equal.
- If it takes more than the calculated warmup time based on the building factor, then the building factor will be increased so that the next calculation will result in a longer warmup time, all other factors being equal.

The adaptive process calculation only takes place when the Optimal Start mode actually starts the plant.

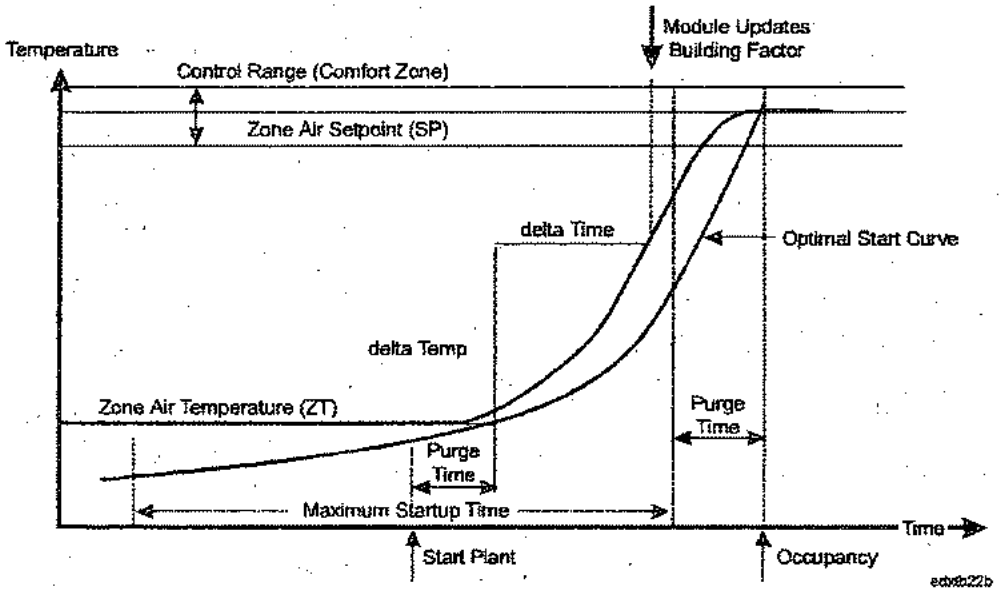


Figure 29: Optimal Start Module in Heating Mode

Warmup Time = Heating Factor x $(SP - ZT + TC)^2 + PT$

TC = (HTD - OT)/4 when HTD is greater than OT, else TC = 0

Cooldown Time = Cooling Factor x $(ZT - SP + TC)^2 + PT$

TC = (OT - CTD)/4 when OT is greater than CTD, else TC = 0

When the Zone Air Temperature has risen halfway towards the Zone Setpoint, the module updates the Building Factor value using the following calculation:

$$NBF = \frac{(100 - FW) \times OF + FW \times \text{delta Time}/(\text{delta Temp})^2}{100}$$

The Building Factor is not updated if the initial Zone Air Temperature is within the Control Range, or the Outdoor Temperature is outside of design values.

NBF = New Building Factor
FW = Filter Weight
OF = Old Factor
SP = Zone Air Setpoint Temp.
ZT = Zone Air Temperature
PT = Min. Heat/Cool Time (Purge Time)
HTD = Outdoor Design Temp. Heating
CTD = Outdoor Design Temp. Cooling
TC = Temperature Compensation
OT = Outdoor Temperature

Optimal Stop Operation

If the difference between the outdoor air and the zone temperature is small, the heating equipment can be stopped at an earlier time than if the difference is large.

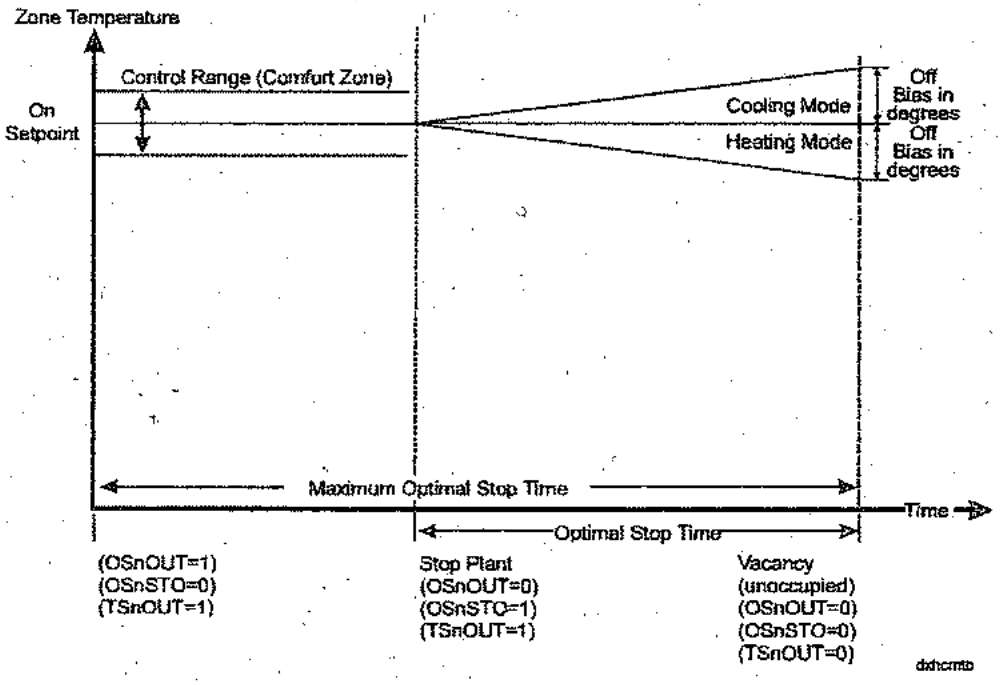


Figure 30: Optimal Stop Module in Heating/Cooling

$$\text{Optimal Stop Time} = \frac{\text{Zone Temp. Off Bias} * \text{Shutdown Building Htg/Clg Factor}}{\text{Zone Temp.} - \text{Outdoor Temp.}}$$

or = Maximum Optimal Stop Time (whichever is least)

If the Zone Temperature (ZT) is not within the Control Range (CRNG), or Outdoor Temperature (OT) is not connected, the Optimal Stop algorithm is not executed and the output **OSnOUT** is reset at the vacancy time (i.e., the Optimal Stop Time set at 0).

Programmable Function Modules: Control Algorithms

The DX-9100 has four control algorithms:

- PID Controller
- On/Off Controller
- Heating/Cooling PID Controller (Dual PID)
- Heating/Cooling On/Off Controller (Dual On/Off)

Each algorithm can be used in 1 of the 12 programmable function modules.

The four algorithms have a number of operating modes, which are a function of the operating parameters and digital inputs. These operating modes are as follows:

- **Comfort Mode**: This is used to obtain the desired space temperature typically during occupancy. The setpoints in this mode mark the beginning of demand for heating or cooling. The output is calculated by the control algorithm using the following value as the working setpoint (WSP):

  $$WSP = RV \times (LSP + RSP)$$

- **Standby Mode**: When operating in this mode, the controller setpoint is reduced or increased during heating or cooling, respectively, when it is compared with the Comfort mode setpoint. This mode is typically selected for brief periods when the controlled zone is unoccupied in order to save energy. The output is calculated by the control algorithm using the following value as the working setpoint:

  $$WSP = RV \times (LSP + RSP) + BSB$$

- **Off Mode**: This is similar to the Standby mode, but the setpoint is further reduced or increased when the controlled zone is unoccupied for long periods. This mode is typically selected for nights, weekends, vacations, etc. The output is calculated by the control algorithm using following value as the working setpoint:

$$WSP = RV \times (LSP + RSP) + BOF$$

- **External Forcing Mode**: The control module output assumes a configured value, overriding the output limits of the control module.

The above modes can be selected through digital inputs or through digital constants, depending on the configuration.

In *Version 1.1 or later* of the DX-9100, high and low limit values for WSP can be set in the configuration to limit the calculated value for WSP and any overridden value of WSP to within an acceptable working range.

Once a DX-9100 control module is set to receive information from an FMS it can, in addition to the above, assume one or more of the following operating modes:

- CMP Computer mode (working setpoint is no longer calculated by the algorithm, but is set by the FMS).
- REM Remote mode (working setpoint is determined only by the remote setpoint).
- HLD Hold mode (module output value is no longer calculated by the algorithm, and may be overridden by the FMS).
- STA Startup mode (set by the FMS when STAE Startup Mode Enabled is set).
- SOF Shutoff mode (set by the FMS when SOFE Shutoff Mode Enabled is set).

In Startup or Shutoff mode, the control module assumes a configured value overriding the output limits of the control module.

When the DX-9100 is not in Computer mode, the Working Setpoint (WSP) is dynamically calculated using the following formula:

$$WSP = RV \times (LSP + RSP) + BIAS$$

where the BIAS value is dependent on the operating mode.

In Remote mode, the local setpoint (LSP) is set to zero.

In Hold mode, the control module output (OCM) is not updated by the control algorithm.

Algorithm 1 - PID Control

Each of the 12 programmable function modules can be defined as a PID (Proportional, Integral, and Derivative) control module. The proportional control module generates an **output (OCM)** ranging between 0 and 100% by comparing the Process Variable (PV) with the Working Setpoint (WSP) and the Proportional Band (PB).

During configuration the **Proportional Band (PB)** is entered as a percentage of the programmed range of the PV. It determines the operating range of the control module. A positive value for a PB selects direct acting and a negative value for a PB selects reverse acting. For example, a PV input range of 0-40°C and a PB setting of 15% result in a direct acting controller with a proportional band of 6 Kelvin. When the PV does not have a programmed range (PV@ is not connected to an analog input) a range of 0-100 is assumed.

The PI, PD, or PID action of a control module is determined by setting the appropriate values of reset action (TI) and rate action (TD) in the control module settings.

The **reset action (TI)** represents the integral time and is definable between 0 and 60 repeats per minute. A value of 0 disables the integral action.

Integral action time **Tn = 1/TI** minutes

The **rate action (TD)** represents the derivative action decay time and is definable between 0 and 5 minutes. A value of 0 disables the derivative action.

The controller output can be generally described by a three zone function: two static zones defined by a low limit (LOL) and a high limit (HIL), and a dynamic zone where the output is the function of proportional band, reset action and rate action.

The output connects directly to an output module, or use as an input to one or more programmable function modules (for example, to obtain cascade control).

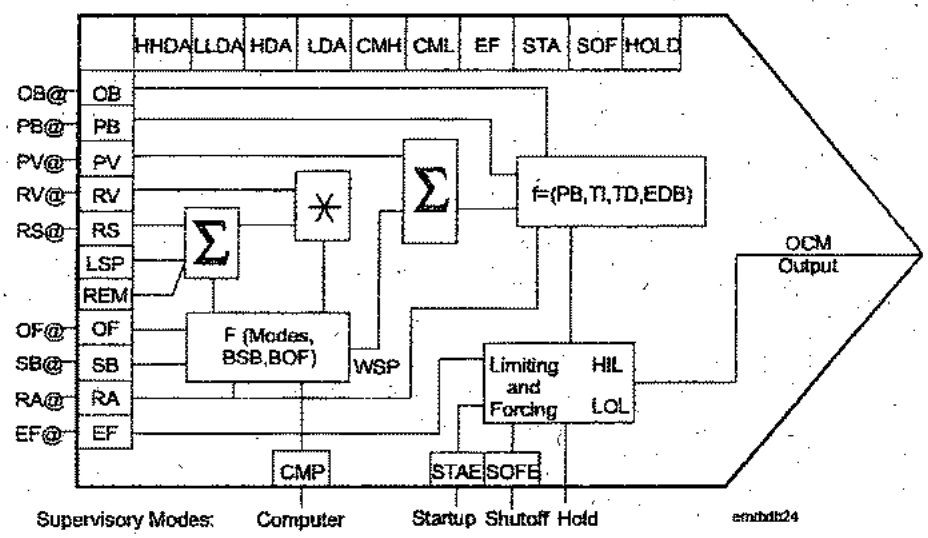


Figure 31: Control Module Block Diagram

Control Module Inputs and Outputs

The PID algorithm can be configured by using a number of analog and logic variables. As part of its operating function, it also provides a number of logical outputs to be used for interlocking or alarm purposes. Below is a list of these variables:

Numeric Input Variable Connections

- **PB@** defines the source of the proportional band. If the input is not connected, the internal value **PB** is used.
- **PV@** defines the source of the process variable. It is typically a pressure, temperature, or humidity input which, as it varies, causes the control module to change its output according to its PID transfer function.
- **RV@** defines the source of the reference variable. This input causes the control module to perform as a ratio controller. Its effect is a multiplication factor in the working setpoint calculation. If not connected, a default value of 1 is assumed.
- **RS@** defines the source of a remote setpoint. This input produces a bias on the local setpoint. If not connected, a default value of 0 is assumed.
- **OB@** defines the source of the output bias. If the input is not connected, the internal value OB is used.

Logic Input Variable Connections

- **OF@** defines the source of a digital input that will force the control module to the Off mode. If not connected, the Off mode is disabled.
- **SB@** defines the source of the digital input that will put the control module to the Standby mode. If not connected, the Standby mode is disabled.
- **RA@** defines the source of the digital input that will cause the control module action to be reversed. If not connected, the control action change function is disabled.
- **EF@** defines the source of the digital input that forces the control module to the External Forcing mode. If not connected, the function is disabled.

Logic Output States

- **CMH**: Output of control module has reached its high limit.
- **CML**: Output of control module has reached its low limit.
- **HHDA**: High High Deviation Alarm. (PV - WSP) is greater than the high high deviation alarm value.
- **HDA**: High Deviation Alarm. (PV - WSP) is greater than the high deviation alarm value.
- **LDA**: Low Deviation Alarm. (WSP - PV) is greater than the low deviation alarm value.
- **LLDA**: Low Low Deviation Alarm. (WSP - PV) is greater than the low low deviation alarm value.
- **EF**: When this state is on, the module is being externally forced.
- **STA**: When this state is on, the module is in Startup mode.
- **SOF**: When this state is on, the module is in Shutoff mode.
- **HLD**: When this state is on, the module is in Hold mode.
- **CMP**: When this state is on, the module is in Computer mode.
- **OF**: When this state is on, the module is in Off mode.
- **SB**: When this state is on, the module is in Standby mode.
- **RA**: When this state is on, the module is in Reverse Action mode.

Once the various inputs have been assigned to the control module, its operation will be determined using the following parameters:

- **LSP**: Local Setpoint. A value in the engineering unit of the PV (°C, °F, %, etc.) representing the basic setpoint of the control module. It is normally used to set the desired temperature, humidity or pressure of the controlled zone.
- **PB**: Proportional Band
- **TI**: Reset Action (PI, PID)
- **TD**: Rate Action (PD, PID)
- **BSB**: Standby Bias. Represents the shift of the WSP when the control module is operating in the Standby mode.
- **BOF**: Off Bias. Represents the shift of the WSP when the control module is operating in the Off mode. It normally represents the anti-condensation or night setpoint.
- **EDB**: Error Deadband. Expressed in % of proportional band. When the control variation (PV-WSP) is smaller than the Error Deadband, then the integral action of the controller is not active.
- **DHH**: Deviation High High Alarm Limit Value
- **DH**: Deviation High Alarm Limit Value
- **DL**: Deviation Low Alarm Limit Value
- **DLL**: Deviation Low Low Alarm Limit Value
- **HIL**: Upper limit of the controller output OCM
- **LOL**: Lower limit of the controller output OCM
- **OB**: Output Bias. Represents a constant value, which is added to the controller output OCM.

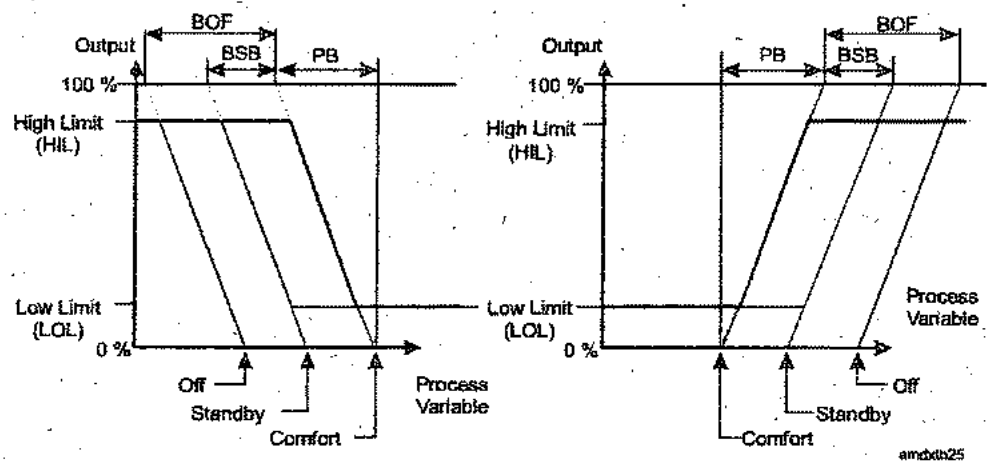


Figure 32: Reverse Acting Controller/Direct Acting Controller

Symmetrical Action

The control algorithm can be configured to operate as a controller with a symmetrical transfer function, where the cooling setpoint is calculated by adding a constant symmetry band to the heating setpoint and the control module output action is reversed. The settings and constants are the same as above with the addition of the symmetry band (SBC).

When the control module is operating in the Standby or Off mode, both heating and cooling setpoints are biased.

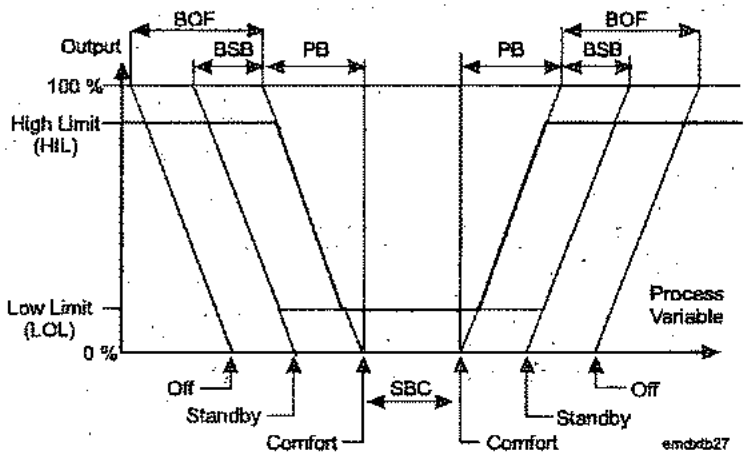


Figure 33: Controller with Symmetrical Operation (Proportional Controller Only)

Algorithm 2 - On/Off Control

Each of the 12 programmable function modules can be defined as an On/Off control module. The algorithm generates an output OCM (0 or 1) by comparing the Process Variable (PV) with the Working Setpoint (WSP) and the Action mode (ACT).

During configuration, enter the **Action** mode (ACT) as a positive or negative number. This determines the operating action of the control module. An ACT of "+1" selects direct acting and an ACT of "-1" selects reverse acting.

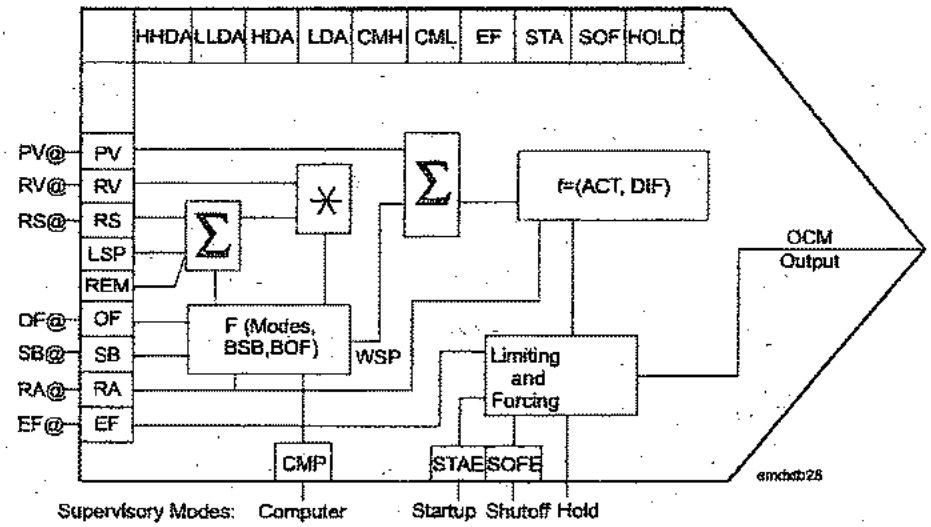


Figure 34: Control Module Block Diagram

Control Module Inputs and Outputs

The On/Off algorithm can be configured by using a number of analog and logic variables. As part of its operating function, it will also provide a number of logical outputs to be used for interlocking or alarm purposes. These variables are listed below.

Numeric Input Variable Connections

- **PV@** defines the source of the process variable. Typically a pressure, temperature, or humidity input which, as it varies, causes the control module to change its output according to its On/Off transfer function.
- **RV@** defines the source of the reference variable. This input causes the control module to perform as a ratio controller. Its effect is a multiplication factor in the working setpoint calculation. If not connected, a default value of 1 is assumed.
- **RS@** defines the source of a remote setpoint. This input produces a bias in the local setpoint. If not connected, a default value of 0 is assumed.

Logic Input Variable Connections

- **OF@** defines the source of a digital input that forces the control module to the Off mode. If not connected, the Off mode is disabled.
- **SB@** defines the source of the digital input that puts the control module to the Standby mode. If not connected, the Standby is disabled.
- **RA@** defines the source of the digital input that causes the control module action to be reversed. If not connected, the function is disabled.
- **EF@** defines the source of the digital input that forces the control module to the External Forcing mode. If not connected, the function is disabled.

Logic Output States

- **CMH**: Output of control module has reached its high limit.
- **CML**: Output of control module has reached its low limit.
- **HHDA**: High High Deviation Alarm. (PV - WSP) is greater than the high high deviation alarm value.
- **HDA**: High Deviation Alarm. (PV - WSP) is greater than the high deviation alarm value.
- **LDA**: Low Deviation Alarm. (WSP - PV) is greater than the low deviation alarm value.
- **LLDA**: Low Low Deviation Alarm. (WSP - PV) is greater than the low low deviation alarm value.
- **EF**: When this state is on, the module is being externally forced.
- **STA**: When this state is on, the module is in Startup mode.
- **SOF**: When this state is on, the module is in Shutoff mode.
- **HLD**: When this state is on, the module is in Hold mode.
- **CMP**: When this state is on, the module is in Computer mode.
- **OF**: When this state is on, the module is in Off mode.
- **SB**: When this state is on, the module is in Standby mode.
- **RA**: When this state is on, the module is in Reverse Action mode.

Once the various inputs have been assigned to the control module, its operation will be determined using the following parameters:

- **LSP**: Local Setpoint. A value in the engineering unit of the PV (°C, °F, %, etc.) representing the basic setpoint of the control module. It is normally used to set the desired temperature, humidity, or pressure of the controlled zone.
- **ACT**: Action mode
- **DIF**: Differential. Used to set the differential for on/off transitions.
- **BSB**: Standby Bias. Represents the shift of the WSP when the control module is operating in the Standby mode.
- **BOF**: Off Bias. Represents the shift of the WSP when the control module is operating in the Off mode. It normally represents the anti-condensation or night setpoint.
- **DHH**: Deviation High High Alarm Limit Value
- **DH**: Deviation High Alarm Limit Value
- **DL**: Deviation Low Alarm Limit Value
- **DLL**: Deviation Low Low Alarm Limit Value

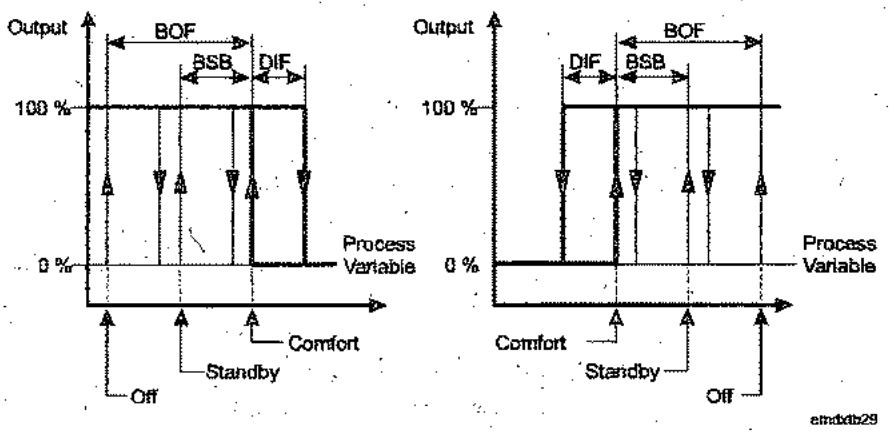


Figure 35: Reverse Acting Controller/Direct Acting Controller

Symmetrical Action

The control algorithm can be configured to operate as a controller with a symmetrical transfer function, where the cooling setpoint is calculated by adding a constant symmetry band to the heating setpoint and the control module output action is reversed. The settings and constants are the same as above with the addition of the symmetry band (**SBC**).

When the control module is operating in the Standby or Off modes, both heating and cooling setpoints are biased.

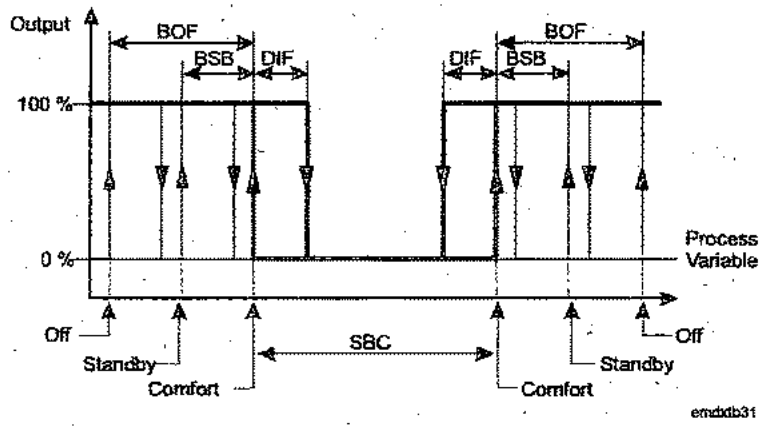


Figure 36: On/Off Controller with Symmetric Operation (ACT = -1)

Algorithm 3 - Heating/Cooling PID Control

Each of the 12 programmable function modules can be defined as a Heating/Cooling PID (Proportional, Integral, and Derivative) Control Module. The algorithm is implemented with two PID control loops sharing the same Process Variable (PV) and **Output (OCM)**. For ***Version 1.1 or later*** of the DX-9100 controller, the output of the heating control loop (**OCM1**) and the output of the cooling control loop (**OCM2**) are also available. The output ranges between 0 and 100%, comparing the process variable with a Working Setpoint (WSP) and the proportional band (PB1 and PB2) for each loop.

During configuration, the proportional bands **PB1** and **PB2** are entered as percentages of the programmed range of the PV and determine the operating ranges of the loops. A positive value of PB selects direct acting and a negative value of PB selects reverse acting. For the normal heating/cooling functions, PB1 is negative (-) and PB2 is positive (+). For example, a PV input range of 0-40°C and a PB setting of 15% results in a proportional band of 6 Kelvin. When the PV does not have a programmed range (PV@ is not connected to an analog input), a range of 0-100 is assumed.

The PI, PD, or PID action of a loop is determined by setting the appropriate values of reset action (TI1 and TI2) and rate action (TD1 and TD2) in the control module settings.

The **TI1** and **TI2** reset action represents the integral time and is definable between 0 and 60 repeats per minute. A value of 0 disables the integral action.

Integral action time $T_R = 1/TI$ minutes

The **TD1** and **TD2** rate action represents the derivative action decay time and is definable between 0 and 5 minutes. A value of 0 disables the derivative action.

The controller output can be generally described by a three zone function for each loop: two static zones defined by a low limit (LOL1 and LOL2) and a high limit (HIL1 and HIL2), and a dynamic zone where the output is the function of the respective proportional band, reset action, and rate action. The outputs can be connected directly to an output module, or used as an input to one or more other programmable function modules (for example, to obtain cascade control).

Control Module Inputs and Outputs

The Heating/Cooling PID algorithm can be configured by using a number of analog and logic variables. As part of its operating function, it also provides a number of logical outputs to be used for interlocking or alarm purposes. A list of these variables follows.

Numeric Input Variable Connections

- **PB@** defines the source of the proportional band. If the input is not connected, the internal value PB1 or PB2 is used.
- **PV@** defines the source of the process variable. Typically a pressure, temperature, or humidity input which, as it varies, causes the control module to change its output according to its PID transfer function.
- **RV1@/RV2@** defines the source of the reference variable or ratio for the respective loop. This input causes the control module to perform as a ratio controller. Its effect is a multiplication factor in the working setpoint calculation. If not connected, a default value of 1 is assumed.
- **RS1@/RS2@** defines the source of a remote setpoint for the respective loop. This input produces a bias on the local setpoint LSP1 or LSP2. If not connected, a default value of 0 is assumed.
- **OB1@/ OB2@** defines the source of the output bias of the respective loop. If the input is not connected, the internal value OB1/OB2 is used.

Logic Input Variable Connections

- **OF@** defines the source of a digital input that forces the control module to the Off mode. If not connected, the Off mode is disabled.
- **SB@** defines the source of the digital input that puts the control module to the Standby mode. If not connected, the Standby mode is disabled.
- **RA@** defines the source of the digital input that causes the control module action to be reversed. If not connected, the control action change function is disabled.
- **EF@** defines the source of the digital input that forces the control module to the External Forcing mode. If not connected, the function is disabled.

Logic Output States

- **CMH**: Output of control module has reached its high limit. (Loop 1 or 2)
- **CML**: Output of control module has reached its low limit. (Loop 1 or 2)
- **HHDA**: High High Deviation Alarm. (PV - WSP) is greater than the high high deviation alarm value. (Loop 1 or 2)
- **HDA**: High Deviation Alarm. (PV - WSP) is greater than the high deviation alarm value. (Loop 1 or 2)
- **LDA**: Low Deviation Alarm. (WSP - PV) is greater than the low deviation alarm value. (Loop 1 or 2)
- **LLDA**: Low Low Deviation Alarm. (WSP - PV) is greater than the low low deviation alarm value. (Loop 1 or 2)
- **EF**: When this state is on, the module is being externally forced.
- **STA**: When this state is on, the module is in Startup mode.
- **SOF**: When this state is on, the module is in Shutoff mode.
- **HLD**: When this state is on, the module is in Hold mode.
- **CMP**: When this state is on, the module is in Computer mode.
- **OF**: When this state is on, the module is in Off mode.
- **SB**: When this state is on, the module is in Standby mode.
- **RA**: When this state is on, the module is in Reverse Action mode.
- **HEAT**: When this state is on, the module is in Heating mode.

Once the various inputs are assigned to the control module, its operation is determined using the following parameters for the respective control loops:

- **LSP1/LSP2**: Local Setpoint. A value in the engineering unit of the PV (°C, °F, %, etc.) representing the basic setpoint of the respective loop. It is normally used to set the desired temperature, humidity, or pressure of the controlled zone.
- **PB1/PB2**: Proportional Band. This parameter ranges from 0 to -100% for a heating loop, and from 0 to +100% for a cooling loop.
- **TI1/TI2**: Reset Action (PI, PID)
- **TD1/TD2**: Rate Action (PD, PID)
- **BSB1/BSB2**: Standby Bias. Represents the shift of the WSP when the loop is operating in the Standby mode.
- **BOF1/BOF2**: Off Bias. Represents the shift of the WSP when the loop is operating in the Off mode.
- **EDB1/EDB2**: Error Deadband. Expressed in % of proportional band. When the control variation (PV-WSP) is smaller then the error deadband then the integral action of the controller is not active.
- **DHH1/DHH2**: Deviation High High Alarm Limit Value
- **DH1/DH2**: Deviation High Alarm Limit Value
- **DL1/DL2**: Deviation Low Alarm Limit Value
- **DLL1/DLL2**: Deviation Low Low Alarm Limit Value
- **HIL1/HIL2**: Upper limit of the OCM controller output.
- **LOL1/LOL2**: Lower limit of the controller output OCM.
- **OB1/OB2**: Output Bias. Represents a constant value, which is added to the controller output OCM.

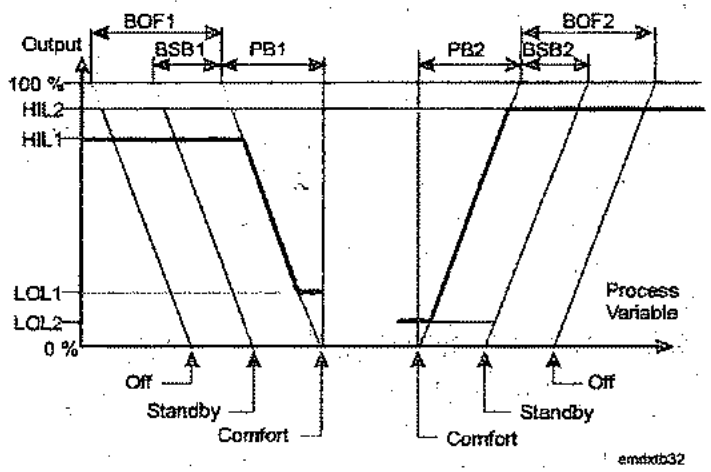


Figure 37: Heating/Cooling PID Module Operation

Loop Changeover (Versions 1.4, 2.4, 3.4, or Later)

A loop is active when the process variable is within the control range of the loop and loop changeover takes place midway between the two comfort, standby, or off setpoints, depending on the current mode. An option is available in later versions of the controller to set a configuration parameter, Enable Zero Output Changeover, which prevents loop changeover when the controller output is not at a zero value (or at its low limit value). This option avoids step changes in the controller output when the process variable changes rapidly between the heating and cooling setpoints.

Algorithm 4 - Heating/Cooling On/Off Control

Each of the 12 programmable function modules can be defined as a Heating/Cooling On/Off Control Module. The algorithm is implemented with two on/off control loops sharing the same Process Variable (PV) and output (**OCM**). For ***Version 1.1 or later*** of the DX-9100 controller, the output of the heating control loop (OCM1) and the output of the cooling control loop (OCM2) are also available. The algorithm generates an output of 0 or 1 by comparing the Process Variable (PV) with the Working Setpoint (WSP) and Action mode (ACT1/ACT2) for the respective loop.

During configuration, the Action mode (**ACT1/ACT2**) is entered as a positive or negative number. It determines the operating action of the respective loop. An ACT of +1 selects direct acting and an ACT of -1 selects reverse acting. For the normal heating/cooling functions, ACT1 is -1 and ACT2 is +1.

Control Module Inputs and Outputs

The Heating/Cooling On/Off algorithm can be configured by using a number of analog and logic variables. As part of its operating function, it also provides a number of logical outputs to be used for interlocking or alarm purposes. Below is a list of these variables:

Numeric Input Variable Connections

- **PV@** defines the source of the process variable. It is typically a pressure, temperature, or humidity input which, as it varies, causes the control module to change its output according to its On/Off function.
- **RV1@/RV2@** defines the source of the reference variable or ratio for the respective loop. This input causes the control module to perform as a ratio controller. Its effect is a multiplication factor in the working setpoint calculation. If not connected, a default value of 1 is assumed.
- **RS1@/RS2@** defines the source of a remote setpoint for the respective loop. This input produces a bias on the local setpoint LSP1/LSP2. If not connected, a default value of 0 is assumed.

Logic Input Variable Connections

- **OF@** defines the source of a digital input that forces the control module to the Off mode. If not connected, the Off mode is disabled.
- **SB@** defines the source of the digital input that puts the control module to the Standby mode. If not connected, the Standby mode is disabled.
- **RA@** defines the source of the digital input that causes the control module action to be reversed. If not connected, the control action change function is disabled.
- **EF@** defines the source of the digital input that forces the control module to the External Forcing mode. If not connected, the function is disabled.

Logic Output States

- **CMH**: Output of control module has reached its high limit. (Loop 1 or 2)
- **CML**: Output of control module has reached its low limit. (Loop 1 or 2)
- **HHDA**: High High Deviation Alarm. (PV - WSP) is greater than the high high deviation alarm value. (Loop 1 or 2)
- **HDA**: High Deviation Alarm. (PV - WSP) is greater than the high deviation alarm value. (Loop 1 or 2)

- **LDA**: Low Deviation Alarm. (WSP - PV) is greater than the low deviation alarm value. (Loop 1 or 2)
- **LLDA**: Low Low Deviation Alarm. (WSP - PV) is greater than the low low deviation alarm value. (Loop 1 or 2)
- **EF**: When this state is on, the module is being externally forced.
- **STA**: When this state is on, the module is in Startup mode.
- **SOF**: When this state is on, the module is in Shutoff mode.
- **HLD**: When this state is on, the module is in Hold mode.
- **CMP**: When this state is on, the module is in Computer mode.
- **OF**: When this state is on, the module is in Off mode.
- **SB**: When this state is on, the module is in Standby mode.
- **RA**: When this state is on, the module is in Reverse Action mode.
- **HEAT**: When this state is on, the module is in Heating mode.

Once the various inputs have been assigned to the control module, its operation will be determined using the following parameters for the respective loops:

- **LSP1/LSP2**: Local Setpoint. A value in the engineering unit of the PV (°C, °F, %, etc.) representing the basic setpoint of the control module. It is normally used to set the desired temperature, humidity, or pressure of the controlled zone.
- **ACT1/ACT2**: Action mode
- **DIF1/DIF2**: Differential. Used to set the differential for On/Off transitions.
- **BSB1/BSB2**: Standby Bias. Represents the shift of the WSP when the control module is operating in the Standby mode.
- **BOF1/BOF2**: Off Bias. Represents the shift of the WSP when the control module is operating in the Off mode. It normally represents the anti-condensation or night setpoint.
- **DHH1/DHH2**: Deviation High High Alarm Limit Value
- **DH1/DH2**: Deviation High Alarm Limit Value
- **DL1/DL2**: Deviation Low Alarm Limit Value
- **DLL1/DLL2**: Deviation Low Low Alarm Limit Value

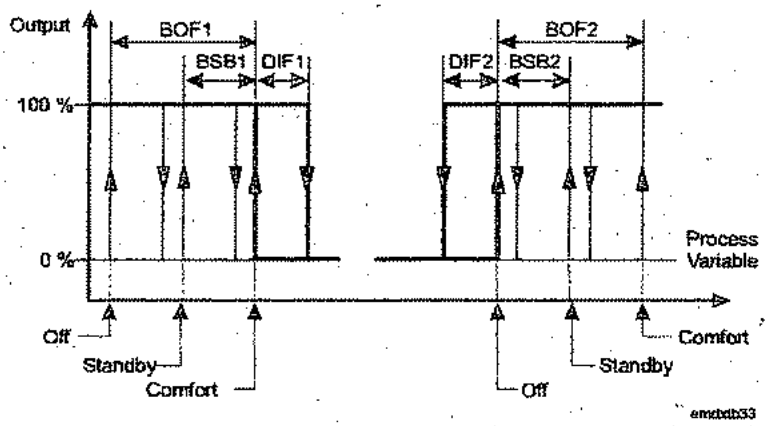


Figure 38: Heating/Cooling On/Off Module Operation

Numeric Calculation Algorithms

Each of the 12 programmable function modules can be defined as a numeric calculation module, capable of executing a mathematical algorithm. Each module can accept up to eight inputs from the controller's numerical and logic variables and each module provides an output, which can be connected to either a control or output module, the appropriate interconnections being carried out during configuration. Each of the 12 programmable function modules can be configured to perform one of the following algorithms:

Algorithm 11 - Average Calculation

This algorithm calculates the arithmetic average of up to eight connected inputs. Each input may be weighted with a constant K.

$$\frac{(I1 \times K1 + I2 \times K2 + \ldots, + I8 \times K8)}{K0}$$

n = Input Variable n= 1 to 8

n = Constant n = 0 to 8

The module output (NCM) can be limited by a Low Limit (LOL) and a High Limit (HIL).

When the module is in Hold mode, its numeric output is not updated by the algorithm and can be modified by an FMS.

Algorithm 12 - Minimum Select

This algorithm selects the minimum value of up to eight input variables. Each input may be weighted with a constant K.

Output = K0 + MIN.(I1*K1, I2*K2, ...I8*K8)

In = Input Variable n = 1 to 8

Kn = Constant n = 0 to 8

The module output (NCM) can be limited by a Low Limit (LOL) and a High Limit (HIL).

When the module is in Hold mode, its numeric output is not updated by the algorithm and can be modified by an FMS.

Algorithm 13 - Maximum Select

This algorithm selects the maximum value of up to eight input variables. Each input may be weighted with a constant K.

Output = K0 + MAX.(I1*K1, I2*K2, ...I8*K8)

In = Input variable n = 1 to 8

Kn = Constant n = 0 to 8

The module output (NCM) can be limited by a Low Limit (LOL) and a High Limit (HIL).

When the module is in Hold mode, its numeric output is not updated by the algorithm and can be modified by an FMS.

Algorithm 14 - Celsius Psychrometric Calculation

Three calculation functions are selectable in this algorithm, providing an output representing enthalpy, wet bulb temperature, or dew point temperature.

The output is a function of two inputs, one representing temperature and the other humidity. The units used are as follows:

- Enthalpy: kJ/kg
- Wet Bulb: °C
- Dew Point: °C
- Temperature: °C
- Humidity: %

The module output (NCM) can be limited by a Low Limit (LOL) and a High Limit (HIL).

When the module is in Hold mode its numeric output is not updated by the algorithm and can be modified by an FMS.

Algorithm 15 - Fahrenheit Psychrometric Calculation

Three calculation functions are selectable in this algorithm, providing an output representing either enthalpy, wet bulb temperature, or dew point temperature.

The output is a function of two inputs, one representing temperature, and the other humidity. The units used are as follows:

- Enthalpy: BTU/lb
- Wet Bulb: °F
- Dew Point: °F
- Temperature: °F
- Humidity: %

The module output (NCM) can be limited by a Low Limit (LOL) and a High Limit (HIL). When the module is in Hold mode, its numeric output is not updated by the algorithm and can be modified by an FMS.

Note: In ***Version 1.1 or later*** of the DX-9100, two enthalpy functions are provided in the psychrometric calculation modules. Each calculation has an output (NCM1, NCM2), can be limited by a low limit and a high limit, and can be put in Hold mode. Enthalpy switchover control (economizer control) can be achieved using the two enthalpy outputs and a comparator module. (See *Algorithm 21 - Comparator.*)

Algorithm 16 - Line Segment

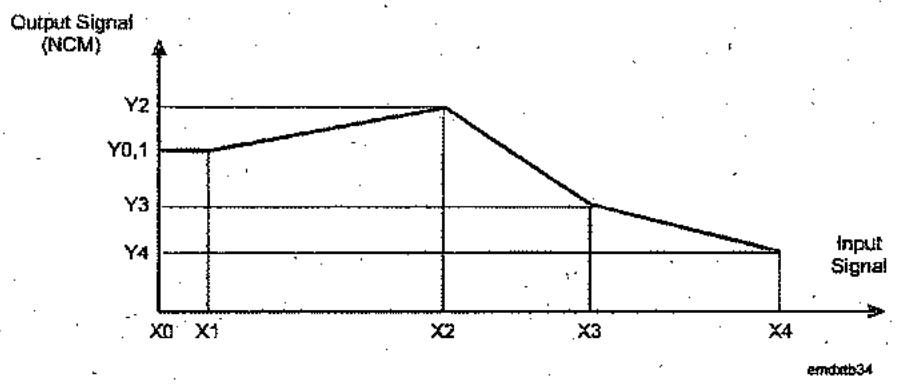


Figure 39: Example of a Line Segment Function

The output of this algorithm is a nonlinear function of the input defined on an x, y plane, using up to 17 break points (16 segments):

- Break Point 0: coordinates x0, y0
- Break Point 16: coordinates x16, y16

Notes: Values of the Output y for the complete range of the Input x must be defined. The module can be chained with the next programmable function module (in numerical sequence) to obtain up to 34 break point coordinates for 1 input.

When the module is in Hold mode, its numeric output (NCM) is not updated by the algorithm and can be modified by an FMS.

Algorithm 17 - Input Selector

This algorithm selects one of its four analog inputs (I1-I4) as its output. The selection is determined by the state of Digital Inputs I5 and I6.

Table 4: Algorithm 17 - Input Selector

Input	I5	I6	Output
I1	Off	Off	I1 x K1 + C1
I2	On	Off	I2 x K2 + C2
I3	Off	On	I3 x K3 + C3
I4	On	On	I4 x K4 + C4

In = Analog Input Variable n = 1 to 4

In = Logic Input Variable n = 5 and 6

Cn, Kn = Constants n = 1 to 4

The module output (NCM) can be limited by a Low Limit (LOL) and a High Limit (HIL). When the module is in Hold mode, its numeric output is not updated by the algorithm and can be modified by an FMS.

Algorithm 18 - Calculator

This algorithm provides two selectable functions, each of which is an algebraic expression of up to eight input variables.

Inputs, which are not connected, assume a default value of 1.

Equation 1 (Linear):

$$K0 + \frac{((K1 * I1 + K2 * I2 + K3) * I3 + K4) * I4}{((K5 * I5 + K6 * I6 + K7) * I7 + K8) * I8}$$

Equation 2 (Polynomial):

$$K0 + \frac{K1 * I1^3 + K2 * I2^2 + K3 * I3 * (K4 * I4 - K5 * I5) + K6 * \sqrt{I6} + K9}{K7 * I7 + K8 * I8}$$

In = Input Variable n = 1 to 8

Kn = Constant n = 0 to 9

The module output (NCM) can be limited by a Low Limit (LOL) and a High Limit (HIL). When the module is in Hold mode its numeric output is not updated by the algorithm and can be modified by an FMS.

Numeric Calculation Algorithms for Version 1.1 or Later

The following numeric calculation algorithms are available in the DX-9100-8154 controller with ***Version 1.1 firmware*** in the DX-9100-8454 or FA-DX9100-8454, ***Version 2 controller***, and in the DX-912x-8454, ***Version 3 controller.***

Algorithm 23 - Four Channel Line Segment

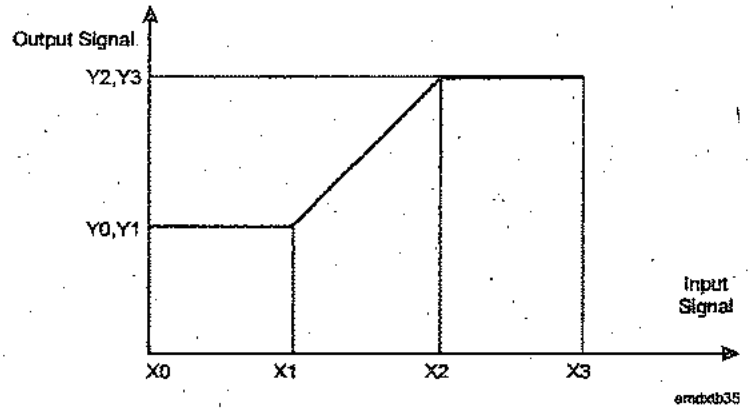


Figure 40: Example of a Line Segment Function

This algorithm comprises four line segment function channels, each defined by four break points (three segments).

- Break Point 0: coordinates x0, y0
- Break Point 3: coordinates x3, y3

Each channel has an input connection and an output (NCM1-NCM4), each of which may be put in Hold mode. When in Hold mode, the numeric output is not updated by the algorithm and can be modified by an FMS.

Algorithm 24 - Eight Channel Calculator

This algorithm provides eight calculator channels, each with two inputs, one output, and one of six mathematical functions:

- Addition (K1. I1) + (K2. I2)
- Subtraction (K1. I1) - (K2. I2)
- Multiplication (K1. I1) x (K2. I2)
- Division (K1. I1)/(K2. I2)
- Minimum MIN (K1. I1, K2. I2)
- Maximum MAX (K1. I1, K2. I2)

I_1 = Input Variable 1

I_2 = Input Variable 2

K_1, K_2 = Constants

The module has eight outputs (NCM1-NCM8), one for each channel, each of which may be put in the Hold mode. When in Hold mode, the numeric output is not updated by the algorithm and can be modified by an FMS. The channels are independent and each may use any one of the available mathematical functions.

Other Functions

Algorithm 19 - Timer Functions

Each of the 12 programmable function modules can be configured to operate as a timer, providing an eight channel time delay unit. Each of the channels will have two inputs and provide one output, which can be connected to a control, logic, or output module. Each channel can be put in Hold mode and its logic output modified.

A channel can be configured to perform one of the following functions:

Pulse

The output goes high for a time period (T) after an input transition from low to high. Further transitions during the timing cycle do not influence the cycle. A 1 on the reset input forces the output to "0," clearing the time cycle.

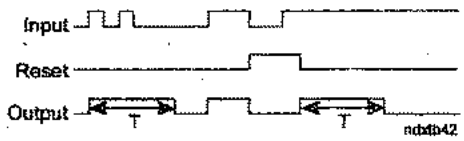


Figure 41: Pulse

Retriggerable Pulse

Similar to above, with the exception that the timing period begins from the last input transition. A 1 on the reset input forces the output to "0," clearing the time cycle.



Figure 42: Retriggerable Pulse

On Delay with Memory

The output goes high after a time period (T) from the input going high. If the input is high for a period less than (T), the output never goes high. A 1 on the reset input is the only way to force the output to "0," clearing the time cycle.

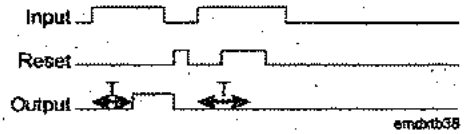


Figure 43: On Delay with Memory

On Delay

The output goes high after a time period (T) from the input going high. The output goes low when the input goes low. A 1 on the reset input forces the output to "0," clearing the time cycle.

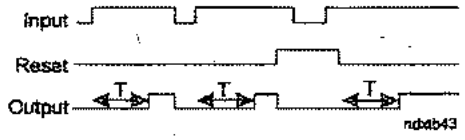


Figure 44: On Delay

Off Delay

The output goes high when the input goes high. The output goes low after a time period (T) from the input going low.

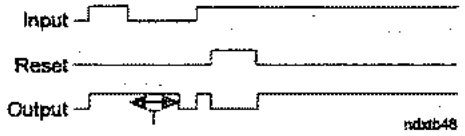


Figure 45: Off Delay

Algorithm 20 - Totalization

Each of the 12 programmable function modules can be defined as a totalization module, capable of executing a totalization algorithm. The algorithm has eight channels available. Each channel can be configured to perform one of the following functions:

- digital input event counter
- analog input integrator
- digital input time counter

Each channel has configurable inputs and provides one numeric output (TOT) as a result of the totalization function and a logic output (FSS) indicating that the numeric output has reached a programmed limit (FSL). Additionally, in ***Version 1.1 and later***, each channel has an accumulator output (ACT), which may be set to count the number of times the totalization has reached its programmed limit and to automatically reset the channel. The accumulator output has a maximum value of 9,999,999 or 32,767 (15 bits) by configuration.

Each channel can be put in Hold mode. When in Hold mode, the numeric output is not updated by the algorithm and can be modified by an FMS.

Event Counter

This function performs the count of all transitions from 0 to 1 of a logic item connected to the input of the channel. The number of transitions is scaled to generate a numeric output. The event counter can be set to zero by a logic item connected to a reset input. When the output reaches a programmable full scale value, the counter full scale logic status is set and the output value remains at full scale until reset, or alternatively, the accumulator output is incremented and the channel reset to continue counting.

Integrator

This function performs the integration of the value of a numeric item connected to the input of the channel. The time constant determines integration rate. The integrator can be set to zero by a logic item connected to a reset input. When the output reaches a programmable full scale value, the integrator full scale logic status is set and the output value remains at full scale until reset, or alternatively, the accumulator output is incremented and the channel reset to continue integrating.

Time Counter

This function increases the value of the numeric output when the connected digital input is at 1. The output increase rate is a function of a time constant. The time counter can be set to zero by a logic item connected to a reset input. When the output reaches a programmable full scale value, the time counter full scale logic status is set and the output value remains at full scale until reset, or alternatively, the accumulator output is incremented and the channel reset to continue counting.

Algorithm 21 - Comparator

Each of the 12 programmable function modules can be defined as a module with a comparator algorithm. The algorithm has eight channels available. Each channel performs the comparison of an analog input variable with a setpoint value and, by configuration, sets a logic status when the input value exceeds or alternatively falls below the setpoint value. The numerical value of the output is equal to the deviation. The setpoint value is either a configured constant or the value of a connected numerical variable.

Each channel can be individually put in Hold mode. When in Hold mode, the numeric output is not updated by the algorithm and can be modified by an FMS.

Algorithm 22 - Sequencer

Each of the 12 programmable function modules can be configured as a sequencer providing the control of 1-8 logic outputs as a function of the value of an analog variable or 2 logic variables and the state of 8 logic (disable) inputs. The sequencer can be interfaced to the programmable logic control module and to other programmable function modules to provide interlocking and alarm capability.

Two consecutive sequencer modules can be linked together to control up to 16 outputs.

When an analog variable is connected, its value determines the required output in percent of the total output. When logic variables are connected, the first variable increases the required output value and the second variable decreases the output value.

The load factor for each output stage must be specified, and as a function of the total requested output the appropriate number of stages is activated. Whenever a stage is switched on or off, a delay timer is activated to prevent further stages being switched in rapid succession.

The difference between the requested output and the total activated output is available as a numeric variable for connection to other modules to provide proportional corrective control if required.

A set is a physical item of equipment, which requires set switching delay times to be entered independently of the stage switching delay times. For example, a set could be a refrigeration compressor, which has two stages. The switching delay times for the first stage of the compressor must be longer than for the second stage because in the first stage a large motor is being switched and in the second stage only a control valve on the compressor is being switched.

A special delay parameter is provided for the first set in the sequence and a limit value for the number of switching cycles in one hour for the set can be programmed.

A set is selected only if the disable logic input of the first stage of the set is not active. If the first stage is disabled when a set is running, the sequencer will automatically select another set.

The sequencer can be put in Hold mode. When in Hold mode, its required output value is not calculated by the algorithm and may be modified by an FMS.

Each sequencer module can be configured to operate in one of several modes:

- **Step mode:** The output stages are controlled in sequence according to the "last on, first off" principle. For example, a three stage sequencer controls the output stages in the following sequence:

Stage								
1	0	1	1	1	1	1	1	0
2	0	0	1	1	1	1	0	0
3	0	0	0	1	1	0	0	0
	Increasing input >				Decreasing input >			

- **Sequential:** The output sets are controlled in sequence according to the "first on, first off" principle. Stages within a set are controlled according to the "last on, first off" principle. For example, a three set sequencer controls the sets in the following sequence:

Set								
1	0	1	1	1	1	0	0	0
2	0	0	1	1	1	1	0	0
3	0	0	0	1	1	1	1	0
	Increasing input >				Decreasing input >			

- **Equal Runtime**: The on time of the first output stage of each set is totaled. In case of an increase of load requiring the activation of a new set, the set with the lowest on time will be switched on. In case of a decrease of load requiring the switching off of a stage in a set at full load, the set with the highest on time will be switched off first. Stages within a set are always controlled to the "last on, first off" principle. For example, a three set sequencer controls the sets in the following sequence:

Set	Runtime					Runtime				
1	90	0	0	0	1	95	1	1	1	0
2	40	0	1	1	1	110	1	0	0	0
3	65	0	0	1	1	99	1	1	0	0
		Increasing input >					Decreasing input >			

- **Binary Code**: The output stages must form one set and are controlled in sequence according to a "binary code" principle. For example: a three stage sequencer controls the output stages in the following sequence:

Stage								
1	0	1	0	1	0	1	0	1
2	0	0	1	1	0	0	1	1
3	0	0	0	0	1	1	1	1

Increasing input >

Note: The Binary Code mode is designed for the control of electric heater batteries or other nonmechanical devices.

The binary code sequencer will always select the appropriate stage combination for the requested output, with a delay between the changing of a stage combination. The binary code sequencer will not step through successive combinations when a large change in the requested output occurs.

A Fast Step Down procedure causes the switching off of all the stages of all sets using a dedicated set of delays. The procedure is activated by a logic input, which cannot be interrupted until the switching-off sequence is completed. The Fast Step Down mode is automatically cleared when all the stages are off and the Fast Step Down input is off.

Programmable Logic Control

The DX-9100 operating system provides a software-implemented Programmable Logic Controller (PLC), which supports most of the functions available in dedicated PLCs. (Every second the PLC module executes a user-defined program, which references a memory area containing an image of the hardware digital inputs/outputs, logic variables from programmable function modules, logic result status variables, and digital constants required by the PLC program.) Variables in the memory area are frozen before the execution of the program in the PLC module, and the resulting changes in the logic variables are transferred out of the memory area to the appropriate hardware or function modules at the end of the module execution.

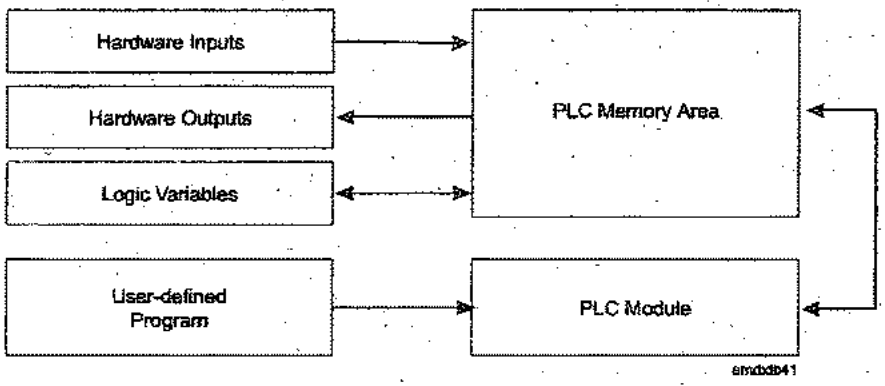


Figure 46: Programmable Logic Control

PLC User-Defined Program

A user-defined program is a sequence of instruction blocks and sub blocks, which contain logic instructions. Each instruction block has a result status, which is initialized by the first instruction of the block and transferred to the memory area by the final instruction of the block. When executing sub blocks, the PLC program creates a **partial result status**, which is logically combined with the **result status** at the end of the sub block.

In the GX-9100 Graphic Configuration software, the instructions are laid out in eight pages of ladder diagrams, each containing eight lines of up to eight instructions, graphically depicted as follows:

Instruction LOAD

This instruction begins an instruction block or logic sub block. A logic variable in the PLC memory area is referenced by the instruction and its status determines the **result status**. In the following diagram, the logic variable DI1 (Digital Input 1) is shown.

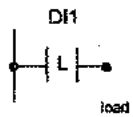


Figure 47: Load Instruction

Instruction LOAD NOT

This instruction begins an instruction block or logic sub block. A logic variable in the PLC memory area is referenced by the instruction and its inverse status determines the **result status**. In the following diagram, the logic variable AIH8 (high alarm status of Analog Input 8) is shown.

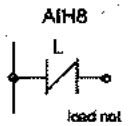


Figure 48: Load Not Instruction

Instruction AND

This instruction calculates a new **result status** using the Boolean AND operator. The status of a logic variable in the PLC memory area is referenced by the instruction. In the following diagram, the logic variable DI2 (Digital Input 2) is shown.

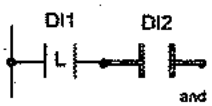


Figure 49: AND Instruction

Instruction AND NOT

This instruction calculates a new **result status** using the Boolean AND NOT operator. The status of a logic variable in the PLC memory area is referenced by the instruction. In the following diagram, the logic variable DI3 (Digital Input 3) is shown.

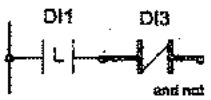


Figure 50: AND NOT Instruction

Instruction OR

This instruction calculates a new **result status** using the Boolean OR operator. The status of a logic variable in the PLC memory area is referenced by the instruction. In the following diagram, the logic variable DI4 (Digital Input 4) is shown.

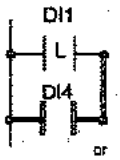


Figure 51: OR Instruction

Instruction OR NOT

This instruction calculates a new **result status** using the Boolean OR NOT operator. The status of a logic variable in the PLC memory area is referenced by the instruction. In the diagram, the logic variable DI5 (Digital Input 5) is shown.

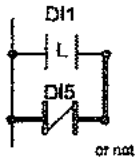


Figure 52: OR NOT Instruction

Instruction ANDB (AND Block)

This instruction calculates a new **result status** from the **partial result status** of the logic sub block and the **PLC result status**, which existed before the start (LOAD) of the sub block. The Boolean AND operator is used. No logic variable is referenced.

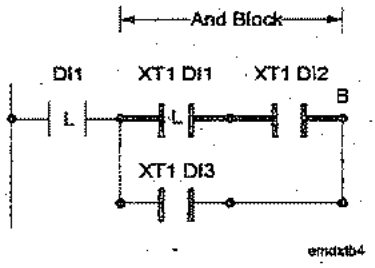


Figure 53: AND-Block Instruction

Instruction ORB (OR Block)

This instruction calculates a new **result status** from the **partial result status** of the logic sub block and the PLC **result status**, which existed before the start (LOAD) of the sub block. The Boolean OR operator is used. No logic variable is referenced.

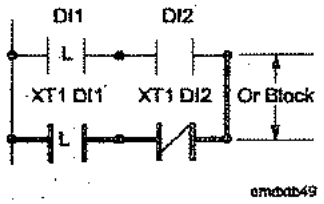


Figure 54: OR-Block Instruction

Note: OR Blocks may be nested within AND Blocks.

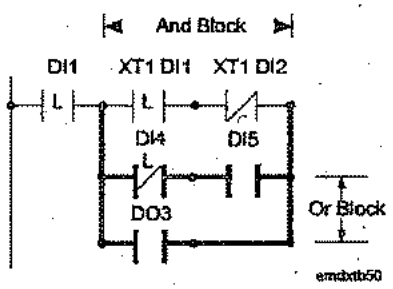


Figure 55: OR Block Nested Within AND Block

Instruction OUT

This instruction transfers the **result status** of the instruction block to the referenced logic variable in the PLC memory area. In this example, the result is transferred to the Logic Result Status Variable LRS1.

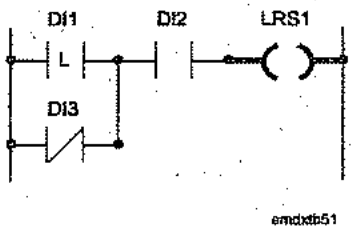


Figure 56: OUT Instruction

Instruction OUT NOT

This instruction transfers the inverse of the **result status** of the instruction block to the referenced logic variable in the PLC memory area. In this example, the result is transferred to the Logic Result Status Variable LRS2.

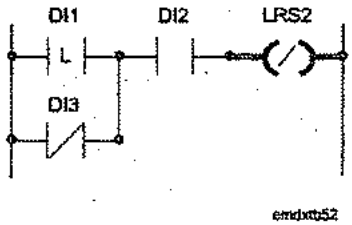


Figure 57: OUT NOT Instruction

Instruction COS

This instruction compares the PLC **result status** of the previous instruction in the logic block or sub block with the **result status,** which existed in the previous execution cycle of the PLC program. If the **result status** has changed from 0 to 1, the new **result status** is set to 1. Otherwise it is set to "0." The instruction thus detects a positive "change of status."



Figure 58: COS Instruction

Instruction SET

This instruction sets the status of the referenced logic variable in the PLC memory area to 1 if the PLC **result status** is true (1). Otherwise no action is taken. This instruction is conditional and operates only if the **result status** is true. In this example, the variable LRS3 will be set if the logic block result is true.

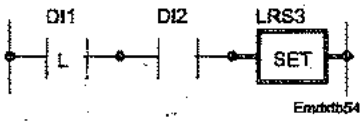


Figure 59: SET Instruction

Instruction RESET

This instruction resets the status of the referenced logic variable in the PLC memory area to 0 if the PLC **result status** is true (1). Otherwise no action is taken. This instruction is conditional and operates only if the **result status** is true. In this example, the variable LRS3 resets (set to 0) if the logic block result is true.

Note that normally each variable set by the PLC also needs to be reset by the PLC unless it is reset by some other module, by controller initialization, or by an FMS command.

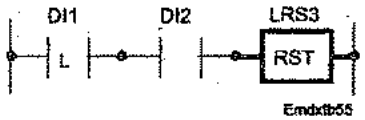


Figure 60: RESET Instruction

Instruction END

This instruction ends the execution of the user-defined program and sets the **result status** to the 0 state.

The next PLC execution cycle begins with the logic instruction in the specified address field. This allows the skipping of initialization routines in the lowest address locations.

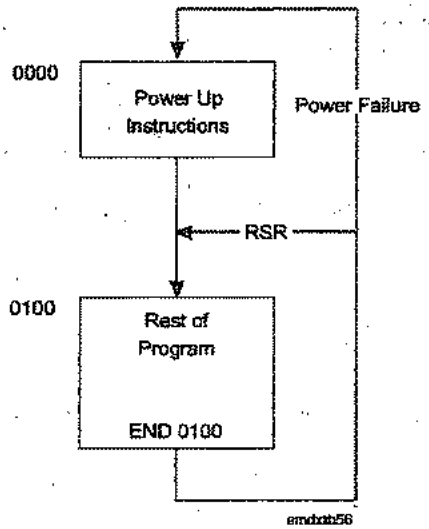


Figure 61: END Instruction

Instruction RSR

In the GX-9100 Graphic Configuration software, the "RSR" block marks the place where the PLC execution cycle begins when there has been no power failure.

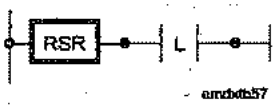


Figure 62: "RSR" Block

The PLC program is generated on the Graphic Configuration software. The program is laid out in the format of a ladder diagram and the GX Tool automatically generates the program code for the PLC module.

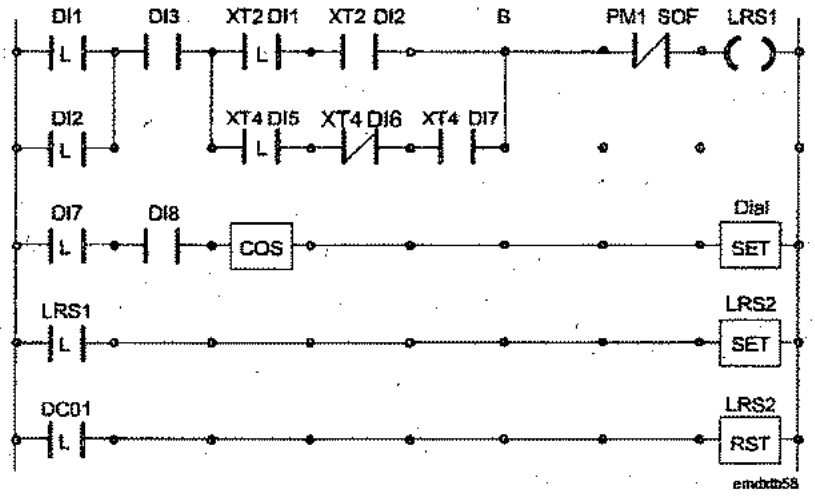


Figure 63: Example of a PLC Program

Dial-up Feature

The DX-9100, Versions 1 and 2 (with the Metasys N2 Bus Interface), can be used with a Metasys N2 Dialer Module (NU-NDM101-0) to establish a connection over a switch telephone line to an FMS installed at another location. The dial-up sequence is initiated when the N2 Dialer Module, which monitors the DX-9100 over the N2 Bus, finds that the logic variable DIAL has been set to 1. This variable is set within the PLC using COS and SET instructions and is reset by the FMS when the DX controller makes a successful connection. For further details, refer to the *LONWORKS N2E Bus Technical Bulletin (LIT-6364100)* and the *DX-9100 Configuration Guide (LIT-6364030)* found in this manual.

Note: This feature is only available with firmware Versions 1.2 and 2.1 or later, and is not available with the DX-912x LONWORKS version, Version 3.

Power Up Conditions

Various options are available to determine power up conditions in the controller.

After a power failure, the following Hold modes may be set to hold, reset to Auto mode, or the mode before the power failure occurred can be retained:

- Analog Output Module Hold
- Logic Output Module Hold
- Programmable Function Module Hold
- Time Schedule Module Hold
- Optimal Start Module Hold

After a power failure, the following supervisory modes may be reset, or the mode before the power failure occurred can be retained:

- Startup mode
- Shutoff mode
- Digital Output Triac Override Enable

Password Feature (Versions 1.4, 2.4, 3.4, or Later)

The password is used to protect a configuration when loaded into a controller. Once the password has been downloaded into the controller with the configuration, the controller will only allow a subsequent download or upload when the password is entered in the Download or Upload dialog box of the GX Software Configuration Tool. The password is encrypted by the GX Tool before download. If the password is lost and the user does not have access to the original configuration file which includes the password, then the controller must be returned to the supplier or the Johnson Controls factory to have the memory cleared. A password of 0 disables the protection feature.

Notes:
1. The password feature is enabled by an entry in the gx9100.ini file of the GX Tool. The GX Tool software is delivered without this entry. Contact your local Johnson Controls sales office if you wish to enable the password feature in your GX Tool.
2. This feature is only available with firmware Versions 1.4, 2.4, 3.4, or later. In older versions, the password feature was not implemented.

Trend Log Feature (Versions 1.4, 2.4, 3.4, or Later)

The Trend Log module provides 12 trend log channels, each recording data from either 1 analog item or from a set of 8 logic variables. The trend can be used to provide data for Point History in DX controllers, which are remote from the Metasys Network or for a local DX LCD Display. Trend data cannot be displayed on the integral DX controller display panel, or on the GX or SX tools.

Point History (for DX Versions 1.4 and 2.4, or Later)

When the DX controller is connected to a Metasys Network by an NDM dialer and telephone lines, the trend data may be read whenever a connection is made by the system. The data is stored in the Point History file of AI, AOS, BO, and BI objects when they are mapped to the items being recorded. When the Point History option is selected for a trend log channel, only those items which can be mapped to Metasys objects are allowed and the trend parameters are set by the GX Tool to recommend default values for the Point History feature. You must link the Historical Trend Read Request logic variable to the DIAL request logic variable in a PLC module to initiate a connection when a trend record buffer is full. Trend logs cannot be configured for Point History in a DX Version 3.x because they cannot be connected to an FMS by the NDM dialer and telephone lines.

Trend Log for DX LCD Display (for DX Versions 2.4 and 3.4, or Later)

Trend channels that are not used for Point History are freely configurable. For analog items, the sampling rate may be entered, and the stored values may be either the average, maximum, or minimum values during the sampling period, or the instantaneous value at the time of recording. Logic variables are recorded with a time and date stamp when there is a change of value. All channels may be displayed on the DX LCD Display.

Display Panel and Keypads

Front Panel Layout

Working parameters and values in the controller can be displayed, and in some cases modified, using the front panel. The panel layout consists of seven functional blocks that contain indicator LEDs and operating keys required to perform a variety of tasks.

DX-9100 Controller (Version 1)

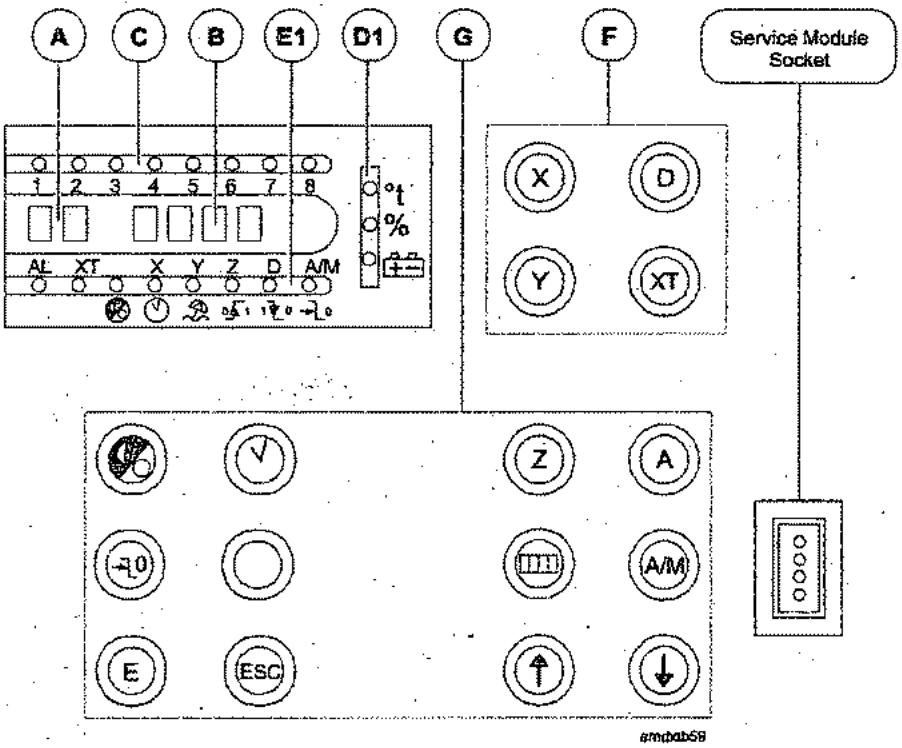


Figure 64: Front Panel Layout for Version 1 (DX-9100-8154)

DX-9100 Controller (Version 2)

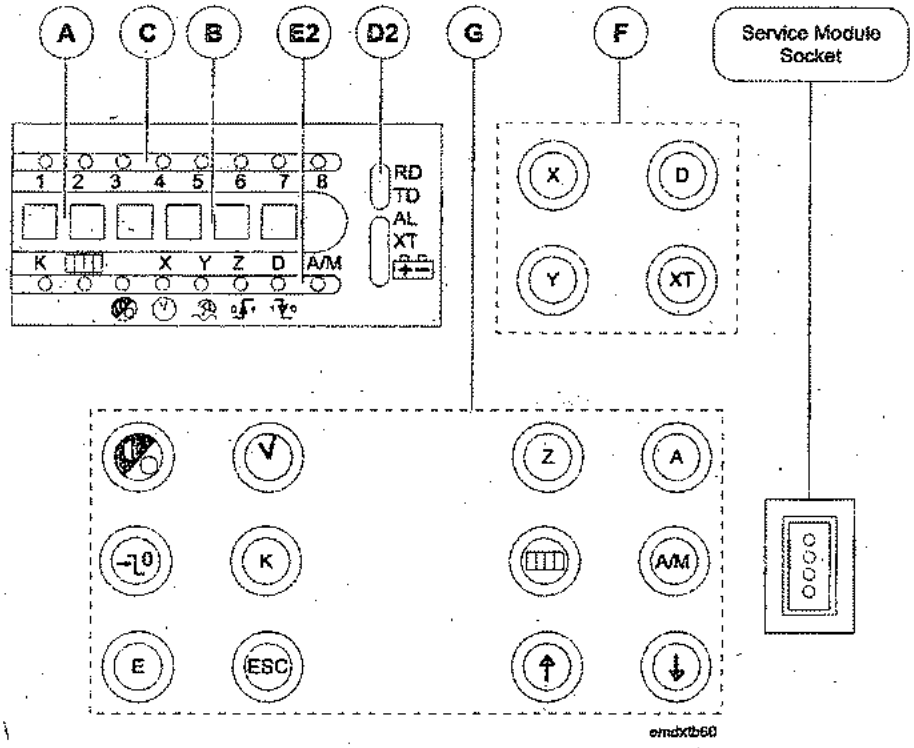


Figure 65: Front Panel Layout for Version 2 (DX-9100-8454 or FA-DX9100-8454)

DX-9100 Controller (Version 3)

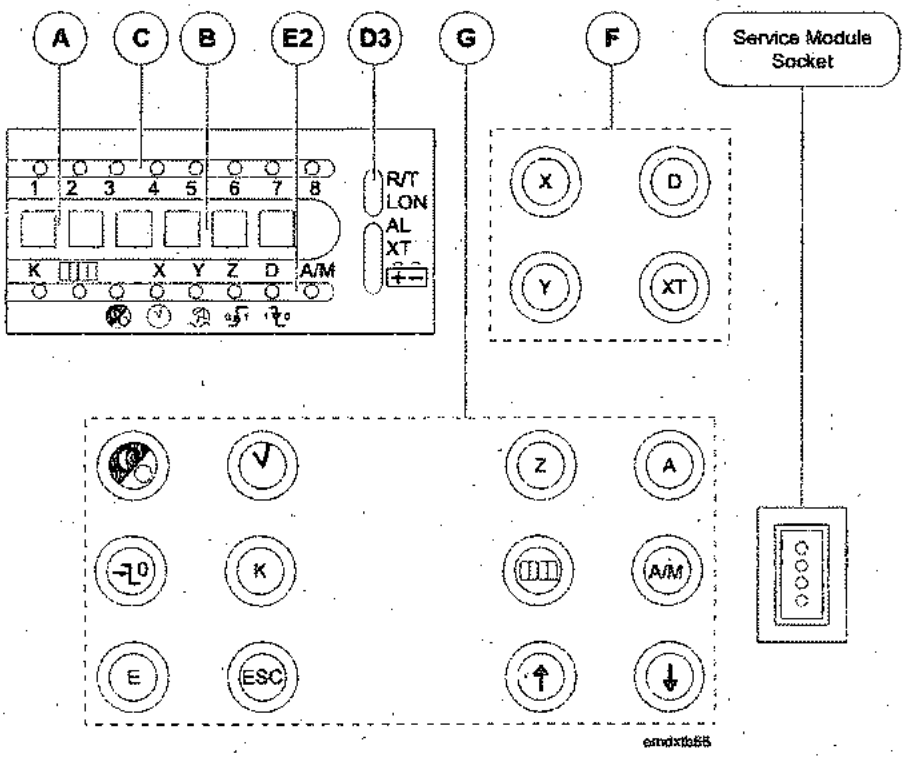


Figure 66: Front Panel Layout for Version 3 (DX-912x-8454)

Block Functions

Block functions for all versions of the controller are outlined below.

Block A

Two 7-segment green LEDs show the **index number** of a selected Item.

Block B

Four 7-segment red LEDs monitor, display, and update the **value** of a selected Item:

- Analog inputs, outputs, and constants are indicated numerically.
- Digital inputs, outputs, and constants are indicated by the words `On` or `Off`.

Counter values of digital inputs and other totaled values are indicated numerically, showing units and thousands alternately.

Block C

Eight red LEDs indicate the status of **digital inputs** to the DX (or XT/XTM if selected in Block A), the **day of the week** in time schedule modules when in Time Schedule mode, and the **current day of the week** when in Realtime Clock mode.

Block D1 (Version 1)

Three red LEDs indicate the **units of measurement** in °t (°C or °F, as configured) or %. The  LED flashes when the internal **lithium battery** is due for replacement.

Block D2 (Version 2)

The two upper red LEDs indicate when data is being received (RD) on the N2 Bus (Bus 91) and when data is being transmitted (TD) by the DX-9100 controllers on the N2 Bus (Bus 91).

The lower three red LEDs indicate abnormal conditions:

- **AL** indicates that an analog input is in an **alarm** state.
- **XT** indicates a communication problem with the I/O **extension modules** (communication failure, XT/XTM hardware failure, or incorrect XP configuration).
-  flashes when the internal **lithium battery** is due for replacement.

Block D3 (Version 3)

The R/T red LED indicates when data is being received from or transmitted to the LONWORKS network processor. The red "LON" LED indicates the LONWORKS network processor activity, and will blink rapidly to indicate normal operation. If this LED is off, there is no communication with the LONWORKS N2 Bus network.

The lower three red LEDs indicate abnormal conditions:

- **AL** indicates that an analog input is in an **alarm** state.
- **XT** indicates a communication problem with the I/O **extension modules**.
-  flashes when the internal **lithium battery** is due for replacement.

Block E1 (Version 1)

Eight red LEDs indicate the selected Item or logic state.

AL indicates that an analog input is in an **alarm** state.

XT indicates a communication problem with the I/O **extension modules**.

 indicates the **Time Scheduling** mode. When this LED is on, the remaining LEDs in this block indicate the following:

 realtime clock display

 exception day function selected

 display of a **period begin** or **start time**

 display of a **period end** or **stop time**

 a time schedule module is in **Extension** mode

When the  LED is **off**, the remaining LEDs in this block indicate the following:

X selection of an **analog input**

Y selection of an **output module**

Z selection of a **programmable function module**

D selection of a **digital input**

A/M a control or output module is in **manual override**

Block E2 (Versions 2 and 3)

Eight red LEDs indicate the selected Item or logic state.

K indicates the selection of **analog or digital constants** for display.

indicates the selection of **counter values** of digital inputs.

indicates the **Time Scheduling** mode. When this LED is on, the remaining LEDs in this block indicate the following:

realtime clock display

exception day function selected

display of a **period begin** or start time

display of a **period end** or **stop time**

A/M a time schedule module is in **manual override**

Note: In ***Versions 2 and 3***, the Extension mode of a time schedule module is indicated by a flashing display of the module status in Block B.

When the LED is **off**, the remaining LEDs in this block indicate the following:

X selection of an **analog input**

Y selection of an **output module**

Z selection of a **programmable function module**

D selection of a **digital input**

A/M a control or output module is in **manual override**

Block F

Block F contains four operating keys for function selection.

- < X > selects **Analog Input** Display mode.
- < D > selects **Digital Input** Display mode.
- < Y > selects **Output Module** Display mode.
- < XT > selects **Input/Output** Display mode for extension modules.

Block G

Block G contains 12 operating keys for function selection. **These keys are concealed by the hinged cover during normal operation.**

- < Z > selects control module **Working Setpoint Display** mode.
- < A > is used to **advance** further information about the analog inputs, output modules, control module working setpoints, and time scheduling functions.
- < ▯▯▯ > selects **Digital Input Counter** Display mode.
- < A/M > is used to select **automatic** or **manual** operation of the control, output, and time schedule modules.
- < ↑ > **increases** the value of the selected Item or selects On.
- < ↓ > **decreases** the value of the selected Item or selects Off.
- <  > selects the **Time Scheduling** mode.
- <  > selects the **Realtime Clock** mode.
- <  > **extension override** control sets the selected time schedule module to day **Extension** mode when the time schedule module is On. This is only possible when the time schedule module is On.
- < K > *(Versions 2 and 3)* selects Analog And Digital Constant Display mode.
- < E > selects the Edit mode for parameters and is used to confirm the entry of a new value.
- < Esc > is used to escape from Edit mode, ignoring the entry of a new value.

Note: To operate the < E >, < A/M >, < ↑ >, and < ↓ > keys, a special connector must be plugged into the service module socket.

Startup Mode

When the DX-9100 controller is first powered up or when power returns after an interruption, the following indications will be displayed in sequence during the startup period.

1. The red LED display will show `init` to indicate that the processor has started an initialization routine. All other LEDs will be turned on as an LED test function.
2. ***Version 1.1 or later:*** The red LED display will indicate the version number of the firmware.
3. ***Version 1.1 or later:*** If a configuration number has been entered into the DX-9100 database, the green LED display will show CF and the red LED display will show the configuration number.
4. ***All versions*:** Analog Input 1 will be displayed to indicate that the initialization routine is complete.
5. ***Version 1.1 or later:*** The eight analog inputs will be displayed successively, each value remaining for approximately three seconds. To stop the scrolling of analog values, press the < ↓ > key. To begin scrolling again, press the < ↑ > key.

Download Mode (Version 1.1 or Later)

When the DX-9100 is being downloaded by the GX Tool, the red LED display will show `halt` to indicate that all output operations have been suspended. At the end of the download, the GX Tool will command the DX-9100 to initialize as in *Startup Mode* above.

Time Schedule Mode

Press the <  > key once to select the Time Schedule mode.

- Time Schedule Module 1 will be shown via the green LED display.

Press the <  > key 2-8 times in succession to select and display Time Schedule Modules 2-8, respectively.

- The lighted red  LED indicates that the Time Schedule mode has been selected.
- The green LED display indicates the time schedule module number that has been selected.
- The red LED display shows the output status (On or Off) of the selected time schedule module.

Version 1

When the selected module is in extension override, the  LED is lit. When it flashes, another module is in extension override.

Versions 2 and 3

When the selected module is in extension override, the output status display will flash. The A/M LED indicates that the selected time schedule module is in Manual mode. When it flashes, another time schedule module is in Manual mode. When in Manual mode, the output of the module may be switched On or Off using the < ↑ > < ↓ > keys. Switching a module to Off will cancel the extension override, if it is active.

The < A > key is pressed to view information about the time schedule module. Press the < A > key once for a display of the **extension override time.**

- A lighted red LED indicates the selection of Time Scheduling mode.
- The green LED display indicates the number of the time schedule module that has been selected.
- The red LED display shows the actual extension time in minutes (0-255).

Press the < A > key in succession for a display of programmed events, starting with Event Number 1. First the start time and then the stop time of each event is shown.

When the **start time** of an event is selected, the red and LEDs are lit.

- The first digit of the green LED display indicates the time schedule module number (1-8).
- The second digit of the green LED display indicates the event number (1-8).
- The red LED display indicates the event starting time.
- Red LEDs 1-8 at the top of the front panel indicate for which days of the week the event is enabled. (1 = Monday, 2 = Tuesday, up to 8 = Holiday).

When the **stop time** of an event is selected, red and LEDs are lit.

- The green LED display indicates time schedule module number and event number.
- The red LED display indicates the event stop time.
- The eight red LEDs 1-8 at the top of the front panel indicate for which days of the week the event is enabled. (1 = Monday, 2 = Tuesday, up to 8 = Holiday).

When the first non-programmed event is selected, the red and LEDs are lit.

- The green LED display indicates time schedule module number and event number.
- The red LED display shows the message "- - . - -".

Press the < A > key to restore the selection of the time schedule module parameters from the time schedule output status.

Time Schedule Event Programming

A time schedule event is represented by the **extension time, start time, stop time,** and **days of the week** for which the event is enabled. It can be edited when the event is selected on the front panel.

Extension Time

The extension time is displayed and the red LED is lit. Press the < E > key to select the extension time Edit mode.

- The red LED on the front panel flashes.
- The green LED display indicates the time schedule module number.
- The red LED display shows the extension time in minutes (0-255).

Press the < ↑ > < ↓ > keys to modify the value of the extension time. Press the < E > key to save the value. Press the < Esc > key to restore the previous value and cancel the Editing mode.

Start Time

Start time is indicated via lighted red and LEDs. Press the < E > key to select the Edit mode of the event start time.

- On the front panel the red LED flashes and the LED is lit.
- The green LED display indicates the time schedule module number and event number.
- The red LED display indicates the start time in hour.minute format.

Press the < ↑ > < ↓ > keys to modify the start time value.

To clear the event, modify the start time to 00.00 and then press the < ↓ > key again.

- A cleared event is indicated with the message "- - . - -".

The resulting gap in the time schedule is automatically filled with the higher indexed events.

Press the < Esc > key to restore the previous value and cancel the event Editing mode.

Press the < E > key to save the modified start time and for stop time editing access.

Stop Time

- On the front panel, the red LED flashes and the LED is lit.
- The green LED display indicates time schedule module number and event number.
- The red LED display indicates the stop time in hour.minute format.

Press the < ↑ > < ↓ > keys to modify the stop time value.

Press the < Esc > key to restore the previous value and cancel the event Editing mode.

Days of the Week

Pressing the < E > key saves the modified stop time and gives access to the next step in which the days of the week for the command can be edited.

- On the front panel, the red LED flashes and LEDs 1-8 indicate for which days of the week the event is enabled.
- The green LED display shows the time schedule module number and event number.
- The red LED display indicates the day of the week selected (1-8).

Press the < ↑ > < ↓ > keys to enable or disable, respectively, the event for the selected day.

This action will immediately update the status of the corresponding red LED in the upper display, and the number representing the next day of the week will appear.

Press the < A > key to advance without changing the status.

Press the < Esc > key to restore the previous days of week selection and cancel the event Editing mode.

Press the < E > key to save the modified day enabling conditions.

Realtime Clock Calendar

The < > key selects the Realtime Clock mode and the successive selection and display of:

- Realtime and Date
- Exception Days Schedule (Holidays)
- Daylight Saving Dates

Realtime and Date Mode

Initially press the < > key once to select the Realtime **Clock** mode. On the front panel:

- The red and LEDs are lit, indicating that the Realtime and Date mode has been selected.
- The green LED display shows the character `t`.
- The red LED display shows the realtime in the hour.minute format.
- The upper row of red LEDs show the day of the week (1-7) and whether the current day is a holiday (8).

Press the < A > key in the Realtime mode to select the **date**. On the front panel:

- The red and LEDs are lit, indicating that the Realtime and Date mode has been selected.
- The green LED display shows the characters `dt`.
- The red LED display shows the actual date in the "month.day" format.

Press the < A > key in the Actual Date mode to select the **year**. On the front panel:

- The red and LEDs are lit, indicating that the Realtime and Date mode has been selected.
- The green LED display shows the characters `yr`.
- The red LED display shows the actual year.

The realtime and date can be modified when displayed on the front panel. Press the < E > key to select the Edit mode.

- The front panel shows the LED flashing and the LED lit.

Press the < ↑ > < ↓ > keys to modify the realtime or date.

Press the < Esc > key to restore the previous time.

Press the < E > key to save the modified time or date.

Press the < > key while in Realtime and Date mode to select the Exception Days Schedule mode.

Exception Days Schedule Mode

The Exception Days (Holidays) Schedule mode can be reached from the Realtime and Date mode by pressing the < > key. On the front panel:

- Lighted red , , and LEDs indicate that the Exception Days Schedule mode has been selected.
- The red or LEDs indicate whether a period begin or period end date is selected.
- The green LED display shows the exception day period index, from 01-32.
- The red LED display shows the value of the first exception period begin date in the "month.day" format.

An exception day period, normally describing a holiday period, is defined by a begin date and an end date.

Press the < A > key in succession to view all the programmed exception day periods.

- The LED indicates the begin date and LED indicates the end date.
- The first location not programmed will be indicated by the message "- - . - -".

The exception days period can be programmed when the period begin date is selected on the front panel. The procedure begins and is advanced with the < E > key and is aborted with the < Esc > key.

Initially press the < E > key once to select the Edit mode of the **period begin date**.

- The front panel shows the red LED flashing, and the , , and LEDs are lit.
- The green LED display shows the exception day period index.
- The red LED display shows the begin date in the "month.day" format.

Press the < ↑ > < ↓ > keys to modify the **begin date**.

The period can be cleared by modifying the begin date to "01.01" and pressing the < ↓ > key.

- A cleared period is indicated with the message "- - . - -".

The resulting gap in the Exception Days Schedule is automatically filled with the higher indexed periods.

The < Esc > key restores the previous value and cancels the exception day Edit mode.

Pressing the < E > key saves the modified begin date and gives access to the editing of the **end date**.

- The front panel shows the red LED flashing and the , , and LEDs are lit.
- The green LED display shows the exception day period index.

  The red LED display shows the end month and day in the "month.day" format.

Press the < ↑ > < ↓ > keys to modify the end date.

Press the < Esc > key to restore the previous value and cancel the exception day Edit mode.

Press the < E > key to save the modified end date. Press the < A > key for access to the next exception day period.

Press the < > key in the Exception Days mode to select the Daylight Saving mode.

Daylight Saving Dates Mode

A daylight saving period is defined by a begin date and an end date and can be reached from the Exception Days Schedule mode by pressing the < > key. On the front panel:

- The red , and LEDs are lit.
- The green LED display shows the message dL.
- The red LED display shows the daylight saving begin date in the "month.day" format.

Press the < E > key to select the Edit mode of the begin date. On the front panel:

- The red LED flashes and the and LEDs are lit.
- The green LED display shows the message dL.
- The red LED display shows the daylight saving begin date in the "month.day" format.

Press the < ↑ > < ↓ > keys to modify the begin date.

The daylight saving can be disabled by modifying the start date to "01.01" and pressing the < ↓ > key.

- This will be indicated with the message "- - . - -".

The < Esc > key restores the previous value and cancels the Daylight Saving mode.

Pressing the < E > key saves the modified begin date and gives access to the editing of the end date. On the front panel:

- The red LED flashes, and the and LEDs are lit.
- The green LED display shows the message dL.
- The red LED display shows the daylight saving end date in the "month.day" format.

Press the < ↑ > < ↓ > keys to modify the end date.

Press the < Esc > key to restore the previous value and cancel the daylight saving Editing mode.

Press the < E > key to save the modified end date.

Press the < > key in the Daylight Saving mode to select the Realtime and Date mode.

Analog Input Display Mode

Press the < X > key to select the Analog Input Display mode and Analog Input 1 will appear. Press the < X > key in succession to select and display Analog Inputs 2-8.

- A lighted red X LED indicates that the Analog Input Display mode has been selected.
- The green LED display indicates the analog input number that has been selected.
- The red LED display shows the measured value of the analog input.
- ***Version 1:*** The red LED in Block D indicates the unit of measurement.

Note: In ***Version 2***, the units of measurement LEDs have been replaced by N2 Bus transmission indicators RD and TD. In ***Version 3***, they have been replaced by R/T and LON.

If the analog input reading is outside the alarm limits, the red AL LED will be lit.

If the AL LED flashes, then another analog input of the DX-9100 controller has exceeded its alarm limits.

Press the < A > key to view the high and low alarm limits that correspond to each of the analog inputs.

- The green LED display shows the parameter selected as L for low limit and H for high limit.
- The red LED display shows the value of the limit selected.

Press the < E > key, followed by the < ↑ > < ↓ > keys to modify the high and low limits.

- During the Edit mode the X LED flashes.

Press the < E > key to confirm a change. Press the < Esc > key to restore the previous value.

When XT/XTM extension modules are connected, providing additional analog inputs, press the < XT > key while in the Analog Input Display mode to view the corresponding analog inputs.

- The first digit of the green LED display indicates the extension module (1-8).
- The second digit of the green LED display indicates analog input (1-8).

If the analog input reading is outside the alarm limits, the red **AL** LED will be lit. If the **AL** LED flashes, then another analog input of the selected XT/XTM extension module is outside its alarm limits. Press the < X > key in succession to select and display all analog inputs in each module.

Press the < A > key to view high and low alarm limits that correspond to each of the extended analog inputs.

Press the < E > key, followed by the < ↑ > < ↓ > keys to modify the high and low limits. Press the < E > key to confirm a change. Press the < Esc > key to restore the previous value.

Analog Input Scroll Mode

When in the Analog Input Display mode, the Analog Input Scroll mode may be selected by pressing the < ↑ > key. In this mode, the analog inputs will be displayed successively with each value remaining for approximately three seconds. The analog inputs are displayed as described under *Analog Input Display Mode*. To stop the scrolling of analog values, press the < ↓ > key. The Analog Input Scroll mode operates for the eight analog inputs of the DX-9100 or for the four, six, or eight analog inputs of any connected XT/XTM extension module. After a power failure, the Analog Input Scroll mode is automatically started for the eight analog inputs of the DX-9100 controller.

Digital Input Display Mode

Initially press the < D > key once to select the Digital Input Display mode and view Display Digital Input 1. Press the < D > key in succession to select and view display Digital Inputs 2-8.

- The red D LED is lit, which indicates that the Digital Input Display mode has been selected.
- The green LED display shows the digital input number selected.
- The red LED display shows the states of the digital inputs.

When XT/XTM extension modules are connected, providing additional digital inputs, press the < XT > key while in the Digital Input Display mode to view related digital inputs.

- The first digit of the green LED display indicates the extension module (1-8).
- The second digit of the green LED display indicates digital input (1-8).

Press the < D > key in succession to select and display all digital inputs in each extension module.

Note: When an XT/XTM extension module has 16 digital inputs, the input values are displayed under 2 consecutive XT numbers. The <D> key is used to display all 16 inputs in sequence.

Output Module Display Mode

Press the < Y > key once to select the Output Module Display mode and view Output Module 1. Press the < Y > key in succession to select and Display Output Modules 2-8.

- A lighted red Y LED indicates that the Output Module Display mode has been selected.
- The green LED display shows the output module number selected.
- The red LED display shows the measured value of the output module as follows:

Table 5: Output Module Values

Output Module Type	Indication Range
Analog (0-10V or 0/4-20 mA)	0-100%
Digital - On/Off (Logic source)	On or Off
Digital - On/Off (Numeric source)	0-100%
Digital - DAT	0-100%
Digital - PAT without Feedback	0-100%
Digital - PAT with Feedback	0-100%
Digital - Start/Stop	On or Off
Digital - Pulse	On or Off

Note: Only those outputs that have been defined in the DX-9100 controller configuration are displayed. On/off outputs must also have a connection to determine whether the source is logic or numeric. When the connection is numeric, the output is Off when the value is 0 or less, and On for any value greater than 0.

Version 1: The red LED in Block D will indicate % as the unit of measurement.

Notes: In ***Version 1***, Output Modules 1 and 2 are analog outputs, while Output Modules 3-8 are logic type outputs.

In ***Versions 2 and 3***, Output Modules 1, 2, 9-14 are analog outputs, while Output Modules 3-8 are logic type outputs.

When XT/XTM extension modules are connected and providing additional outputs, press the < XT > key while in the Output Display mode to view the outputs.

- The first digit of the green LED display indicates the extension module (1-8).
- The second digit of the green LED display indicates the output (1-8).

Press the <Y > key in succession to select and view all outputs in each extension module.

Note: When an XT/XTM extension module has 16 digital outputs, the output values are displayed under 2 consecutive XT numbers, but the <Y> key is used to display all 16 outputs in sequence.

To distinguish between Analog Outputs 11-14 and Outputs 1-4 on XT1, the first digit of the green LED will show a small 1 for Analog Outputs 11 14.

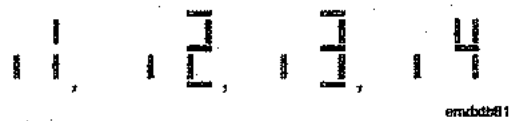


Figure 67: LEDs Showing Analog Outputs 11-14

Press the < A > key to view information about the output modules.

- If the output module is connected to the OCM output of a control algorithm, the red LED display will indicate Cnn where "nn" is the number of the control module (1-12).
- If the output is connected to another variable, the message "- -" appears in the red LED display.

Press the < A/M > key to switch the output module or XT output into Manual mode.

- A lighted red A/M LED indicates that the output module is in Manual Operating mode.
- A flashing red A/M LED indicates that another output module in the DX-9100 or XT output in the selected XT is in the Manual Operating mode.

Press the < ↑ > < ↓ > keys to increase or decrease the module output. For a logic output, the state will change from On to Off.

Press the < A/M > key again to switch the output module to Automatic mode.

Notes: Output modules may be overridden from an FMS by placing the module into Hold (Manual) mode. The override condition is indicated by a lighted red A/M LED when the module value is displayed, and the Hold mode may be reset by pressing the < A/M > key.

The triac outputs used by digital output modules may be directly overridden from an FMS, in which case there is no indication at the DX front panel and the override condition cannot be reset.

Digital Counter Display Mode

Press the < ⊞ > key to select the Digital Input Counter Display mode and view the counter value for Digital Input 1. Press the < ⊞ > key in succession to display counter values for Digital Inputs 2-8.

- ***Version 1:*** A lighted red D LED indicates that the Digital Input Display mode has been selected.
- ***Versions 2 and 3:*** A lighted red ⊞ LED indicates that the Digital Input Counter Display mode has been selected.
- The green LED display shows the digital input number that has been selected.
- The red LED display shows the counter value via two numbers, which are displayed alternately. The number preceded by a "." is the units value of the counter (0.000 - 0.999). The other number is the thousands value of the counter (0000 - 9999). The actual counter value is obtained by placing the two numbers together (0000000 - 9999999). Depending on the configuration, the counter value may reset at 32767.

When XT/XTM **extension modules** are connected, providing additional digital inputs, press the < XT > key while in the Digital Counter Display mode to view the corresponding digital counters.

- The first digit of the green LED display indicates the extension module (1-8).
- The second digit of the green LED display indicates the digital input (1-8).

Press the < ⊞ > key in succession to select and view all digital counter values in each extension module.

Press the < E > key followed by the < ↑ > < ↓ > keys to modify the counter value.

Press the < E > key to enter the modified value or press the < Esc > key to restore the previous value.

Programmable Function Module Display Mode

Operating values and parameters for control, totalization, and sequencer algorithms can be viewed and modified from the front panel.

- Press the < Z > key to select the Programmable Function Module Display mode and view values and parameters for the first module.

Press the < Z > key in succession to view the values and parameters for the other programmable function modules that have been configured as control, totalization, or sequencer modules.

Control Modules

A lighted red Z LED indicates that the Working Setpoint Display mode has been selected.

The green LED display shows the control module number selected. If the control module is a heating/cooling (dual) PID or On/Off module, the control module number and loop number are displayed alternately. The heating loop working setpoint is displayed first with a flashing "L1." Press the < A > key to view the cooling loop working setpoint with a flashing "L2."

The red LED display shows the working setpoint value for the selected control module.

- ***Version 1:*** The red LED in Block D shows the units of measurement.

Press the < E > key, followed by the < ↑ > < ↓ > keys, to modify the local setpoint of the selected control module. This, in turn, modifies the working setpoint displayed.

During the Edit mode the **Z** LED flashes. To confirm the modification, press the < E > key. To restore the previous value, press the < Esc > key.

Note: The working setpoint may only be adjusted within the minimum and maximum values entered into the control module database.

Press the < A > key to view auxiliary information on the working setpoint.

Press the < A > key to view the **process variable** value for the selected control module.

The red **Z** LED is lit and the red **X** LED flashes.

Press the < A > key a second time to view the **output** of the selected control module.

The red **Z** LED is lit and the red **Y** LED flashes.

Press the < A/M > key to switch the control module to **Manual** mode.

- A lighted red A/M LED indicates that the control module is in the Manual mode.
- A flashing red A/M LED indicates that another control module is in the Manual mode.

Press the < ↑ > < ↓ > keys to increase or decrease control module output.

Press the < A/M > key again to switch the control module back to Automatic mode.

PID Control Modules

Press the < A > key in succession to view further parameters as follows:

- **Proportional band** (flashing "P," "P1," or "P2" in the green LED display).
- **Reset action** in repeats/minute (flashing "i," "i1," or "i2" in the green LED display).
- **Rate (derivative) action decay time** in minutes (flashing "d," "d1," or "d2" in the green LED display).
- **Standby bias** (flashing "b," "b1," or "b2" in the green LED display).
- **Off bias** (flashing "o," "o1," or "o2" in the green LED display).

On/Off Control Modules

The following parameters can be modified on the On/Off Control Modules:

- Control action (flashing "A," "A1," or "A2" in the green LED display).
- Differential (flashing "d," "d1," or "d2" in the green LED display).
- Standby bias (flashing "b," "b1," or "b2" in the green LED display).
- Off bias (flashing "o," "o1," or "o2" in the green LED display).

Press the < E > key, followed by the < ↑ > < ↓ > keys, to increase or decrease the parameters displayed. Press the < E > key to save the modified value, or press the < Esc > key to restore the previous value.

Totalization Modules

A lighted red **Z** LED and a flashing red **Y** LED indicate that the **Totalization Module Output Value Display** mode has been selected.

- The green LED display shows, alternately, the programmable function module number selected and the totalization module channel number "t1."
- The red LED display shows the totaled value for the selected module and Channel 1.
- Press the < A > key to view the totaled output values of Channels 2-8.
- The green LED display shows, alternately, the programmable function module number selected and the totalization module channel number "t2," "t3," up to "t8."
- The red LED display shows the totaled value for the selected module and channel.

Whenever a totaled value is being displayed, the < A/M > key may be pressed to set the channel to **Manual** mode.

- A lighted red A/M LED indicates that the channel is in the Manual mode.
- A flashing red A/M LED indicates that another module or channel is in the Manual mode.

Press the < ↑ > < ↓ > keys to increase or decrease (reset to 0, for example) the totaled value.

Press the < A/M > key again to set the channel back to Automatic mode. The totaled value set in Manual mode will be maintained as the initial value for the continuing totaling operation.

Special Option for Totalization Channel Accumulator

If any channel has been configured with the **accumulator** option, the total accumulated value for this channel will be displayed after the display of the totaled value (t1-t8) when the < A > key is pressed.

The green LED display alternately show the programmable function module number selected and the totalization module channel number are displayed as "A1" to "A8" to indicate the accumulated value.

The red LED display shows the accumulated value for the selected module and channel. Two numbers flash alternately. The number preceded by a "." represents units and the other number represents thousands of units. An accumulated value of up to 9999999 is displayed with the two alternate displays of "9999" and ".999." Depending on the configuration, the accumulated value may reset at 32767.

Whenever an accumulated value is being displayed, press the < E > key to edit the value or to reset it to 0.

- A flashing **Z** LED indicates **Edit** mode.

Press the < ↑ > < ↓ > keys to modify the displayed value.

Press the < E > key to enter the modified value or the < Esc > key to retain the original value.

Note: The DX-9100 controller automatically increments the **accumulated** value each time the **totaled** value reaches a configured limit. In this case the totaled value may be regarded as a fine resolution (or a "vernier scale") for the accumulated value.

Sequencer Module

A lighted red **Z** LED and a flashing red **Y** LED indicate that the **Sequencer Module Requested Output Value** Display mode has been selected.

- The green LED display shows the programmable function module number selected.
- The red LED display shows the requested output value for the selected module.

Press the < A/M > key to set the module to Manual mode.

- A lighted red A/M LED indicates that the module is in the Manual mode.
- A flashing red A/M LED indicates that another module is in the Manual mode.

Press the < ↑ > < ↓ > keys to increase or decrease the output value.

Press the < A/M > key again to set the module back to Automatic mode.

Press the < A > key to view the **totaled run time** (in hours) of the sets in the selected sequencer module.

- The green LED display shows the sequencer stage number of the first stage in each set with an "r" prefix for single digit numbers.
- The red LED display shows the totaled runtime value via two numbers which are displayed alternately. The number preceded by a "." is the units value of the runtime (.000 - .999). The other number is the thousands value of the runtime (0000 - 9999). The full runtime value is obtained by placing the two numbers together (0000000 - 9999999).

Press the < E > key, followed by the < ↑ > < ↓ > keys, to modify the runtime value displayed (reset to 0, for example). Press the < E > key to save the modified value, or press the < Esc > key to restore the previous value.

Press the < A > key to successively view and modify the runtime values of all sets in the module.

Press the < E > key, followed by the < ↑ > < ↓ > keys, to increase or decrease the parameters displayed. Press the < E > key to save the modified value, or press the < Esc > key to restore the previous value.

Analog/Digital Constant Display Mode

Versions 2 and 3 only: Press the <K> key to select the Analog/Digital Constant Display mode.

- A lighted red K LED indicates that the Analog/Digital Function Display mode has been selected.

Press the <K> key in succession to view the eight analog constants followed by the digital constants.

Press the <E> key followed by the < ↑ > < ↓ > keys to modify the selected analog or digital constant.

During the Edit mode, the K LED flashes. Press the < E > key to save the modified value, or press the < Esc > key to restore the previous value.

Note: Changes made to analog and digital constants will remain until another change is made from the front panel or from an FMS. The originally downloaded values can only be restored by a new download.

Specifications and Technical Data

Table 6: Specifications

Supply Voltage	24 VAC, ±15%, 50-60 Hz ***Version 1:*** To maintain an active sensor supply ≥ 15 VDC, the supply voltage must always exceed (24 VAC - 10%).	
Power Consumption	10 VA (nominal) at 50/60 Hz	
Ambient Operating Conditions	0 to 40°C (32 to 104°F) 10 to 90% RH non-condensing	
Ambient Storage Conditions	-20 to 70°C (4 to 160°F) 5 to 95% RH	
Internal Batteries	Lithium. Shelf life (disconnected): 10 years Working life, with 24V power: 5 years; without 24V power: ≤ 1 year Rechargeable backup battery. Recharge time is one hour; capacity is seven days when fully charged.	
Processor	***All Versions:*** NEC 78C10	***Additional in Version 3:*** Neuron® 3150 (Three CPUs)
Memory:	***All Versions:*** 8 Kb RAM 56 Kb EPROM 8 Kb EEPROM	***Additional in Version 3:*** 32 Kb ROM 26 Kb RAM 512 Byte EEPROM
Terminations	Terminal block for 1 x 1.5 mm^2/14 AWG (maximum) cable	
Serial Interfaces	***Versions 1 and 2:*** One optically isolated RS 485 interface for N2 connection; 9600 baud ***Versions 2 and 3:*** One RS-232-C port; 9600 baud ***DX9120 Version 3.0 to 3.4:*** One TP78 transceiver LONWORKS Bus interface; 78K baud. (Maximum of thirty controllers on one N2 LONWORKS Bus.) ***DX9121 Version 3.4:*** One FTT10a transceiver LONWORKS Bus interface; 78K baud. (Maximum of thirty controllers on one N2 LONWORKS Bus.) ***All Versions:*** One optically isolated RS-485 interface for XT Bus connection; 9600 baud ***All Versions:*** One interface for service module; 600 baud	

Continued on next page . . .

Specifications (Cont.)	
Analog Inputs	Eight inputs, 13-bit resolution. Inputs selectable, via jumper, for 0-10 VDC (300K minimum impedance), 0/4-20 mA (100 ohm impedance) or RTD (Ni1000, Pt1000, A99) ***Version 1:*** Active sensor supply: 15 VDC, 100 mA for maximum of four current transmitters (20 mA). To maintain an active sensor supply ≥ 15 VDC, the supply voltage must always exceed (24 VAC - 10%). ***Versions 2 and 3:*** Active sensor supply: 15 VDC, 200 mA for maximum of eight current transmitters (0/4-20 mA). Maximum of 80 mA may be used for voltage transmitters.
Digital Inputs	Eight inputs via potential-free contacts Transition counter function: maximum 10 Hz (>50 ms closed, >50 ms open)
Analog Outputs	Eight Bit Resolution ***Version 1:*** Two outputs, selectable via jumper for 0-10 VDC (maximum 10 mA) or 0/4-20 mA (maximum 500 ohm) ***Versions 2 and 3:*** Four outputs, selectable via jumper for 0-10 VDC (maximum 10 mA) or 0/4-20 mA (maximum 500 ohm). Four additional outputs 0-10 VDC (maximum 10 mA)
Digital Outputs	Six triac outputs, 24 VAC, 0.5 ampere continuous (0.8 ampere peak)
Realtime Clock	Time in hours and minutes. Date in year, month, day. Automatic calendar for day of week (1-7). Daylight saving time change at defined dates.
Scheduling Modules	Eight time schedule modules, each with eight events; two optimal start/stop modules
Exception Days	Thirty exception day (holiday) periods defined by begin and end dates
Programmable Function Modules	Twelve modules, each configurable for: • PID Controller • On/Off Controller • Heating/Cooling PID Controller • Heating/Cooling On/Off Controller • Average Calculation • Minimum/Maximum Selection • Psychrometric Calculation (Celsius/Fahrenheit) • Line Segment Function (16-segment or 4 x 4-segment) • Input Selector • Calculator (Linear or Polynomial Equation) • Timer Functions (Eight Channels) • Totalization (Event, Integration, Runtime) (Eight Channels) • Comparator (Eight Channels) • Sequencer (Up to Eight Output Stages, Sixteen Stages by Chaining) • Simple Calculator (Eight Channels)
Continued on next page . . .	

Specifications (Cont.)	
Programmed Logic Control	PLC module executing Boolean functions: • AND/AND NOT • OR/OR NOT • ANDB (AND-Block) • ORB (OR-Block) • OUT/OUT NOT • COS (Change-of-State) • SET/RESET Maximum of 512 instructions (on GX Tool, eight pages with eight lines of up to eight instructions)
Network Inputs/Outputs	***Version 3 only:*** Sixteen analog inputs. Eight blocks of sixteen digital inputs. Sixteen analog outputs, each with sixteen network destinations. Eight blocks of sixteen digital outputs, each block with sixteen network destinations. (Maximum of thirty controllers on one LONWORKS N2 Bus.)
Program Execution Cycle	DX-9100: I/O, Programmable Function Modules, PLC - 1 second XT Bus: Digital I/O only or up to four XT-9100s - 1 second XT Bus: More than four XT-9100s with analog I/O - 2 seconds
Housing	Material: ABS + polycarbonate, self-extinguishing VO UL 94 Protection: IP30 (IEC529)
Dimensions (H x W x D)	***Version 1 Controller:*** 148 x 184 x 81mm (5.8 x 7.3 x 3.2 in.) ***Controller with Panel Mounting Base, Versions 2 and 3:*** 200 x 184 x 95 mm (7.9 x 7.3 x 3.8 in.). Allow minimum of 160 mm (6.3 in.) depth for hinged door clearance. ***Controller with Cabinet Door Mounting Frame, Versions 2 and 3:*** 164 x 200 x 114 mm (6.5 x 7.9 x 4.5 in.)
Shipping Weight (Maximum)	Controller: 0.8 kg (1 lb 12 oz) Panel Mounting Base: 0.8 kg (1 lb 12 oz) Cabinet Door Mounting Frame: 0.8 kg (1 lb 12 oz)
Agency Listings	UL Listed and CSA certified UL 864 with DX-9100-8990F/DX-9121-8454 Controller/ DX-9121-8997 Base FCC Part 15 - Subpart B (Class A Device). CE Directive 89/336/EEC: • EN50081/1, EN50082/1 Terminal cover required on DX panel mounting base (supplied with mounting base DX-9100-8997 and DX-9121-8997) when the DX controller is not installed inside a metal cabinet.

Products Available in North America

Table 7: Controller and Accessories (North America)

Code	Description
DX-9100-8454	Extended Digital Plant Controller, Version 2
FA-DX9100-8454	Extended Digital Plant Controller, Version 2 (Facilitator)
DX-9100-7454	Extended Digital Plant Controller, Version 2 Repair Module
FA-DX9100-7454	Extended Digital Plant Controller, Version 2 Repair Module (Facilitator)
DX-9120-8454	Extended Digital Plant Controller, Version 3 (LONWORKS TP78)
DX-9120-7454	Extended Digital Plant Controller, Version 3 (LONWORKS TP78) Repair Module
DX-9121-8454	Extended Digital Plant Controller, Version 3 (LONWORKS FTT10a)
DX-9121-7454	Extended Digital Plant Controller, Version 3 (LONWORKS FTT10a) Repair Module
DX-9100-8990	Panel Mounting Base for Controller, Versions 2 and 3 (LONWORKS DX-9120 TP78), without terminal covers
DX-9100-8990F	Panel Mounting Base for Controller, Versions 2 and 3 (LONWORKS TP78), UL 864 applications, without terminal covers
DX-9100-8991	Terminal Cover Kit for Panel Mounting Base
DX-9100-8996	Cabinet Door Mounting Frame for Controller, Versions 2 and 3 (LONWORKS TP78)
DX-9121-8997	Panel Mounting Base for Controller, Version 3 (LONWORKS FTT10a), UL 864 applications, with terminal covers
DX-9121-8996	Cabinet Door Mounting Frame for Controller, Version 3 (LONWORKS FTT10)
AS-LCPKEY-0	Security Key (US) for Front Panel Operation
SX-9120-8110	Service Module (North American)
SX-9120-8912	Service Module Firmware Upgrade Kit
DX-9100-8911	Controller, Version 1, Firmware Upgrade
DX-9100-8913	Controller, Version 2, Firmware Upgrade
FA-DX91-8913	Controller, Version 2, Firmware Upgrade (Facilitator)
DX-9120-8911	Controller, Version 3, Firmware Upgrade
MW-MTOOL	Configuration Tools Software
FA-WINPRO-0	Configuration Tools Software (Facilitator)
DEMO-DX120	Demo Case, DX-9100 (120 V) Version 2
DEMO-FDX120-2	Demo Case, DX-9100 (120 V) Version 2 (Facilitator)
DEMO-DX120-3	Demo Case, DX-9121* (120 V) Version 3 (FTT10)
NU-NET201-0	N2E LONWORKS Network Card for NCMs - TP78 Network
NU-EOL201-0	End-of-Line Termination Module - TP78 Bus (DX-9120)
NU-NET202-0	N2E LONWORKS Network Card for NCMs - FTT10 Network
NU-EOL202-0	End-of-Line Termination Module – FTT10 Bus (DX-9121)
DC-9100-6800	Replacement Lithium Battery

Table 8: XT/XP Ordering Codes (North America)

Code	Description
XT-9100-8304	Extension Module
XP-9102-8304	Expansion Module (6 AI, 2 AO)
XP-9103-8304	Expansion Module (8 DO – Triacs)
XP-9104-8304	Expansion Module (4 DI, 4 DO – Triacs)
XP-9105-8304	Expansion Module (8 DI)
XP-9107-8304	Expansion Module (4 DO – Relay) (North American) 24 V only

Table 9: XTM-905/XPx-xxx-x Ordering Codes (North America)

Code	Module Type	Description
XTM-905-5	Extension Module	Communications interface and 24 VAC supply
XPA-821-5	Expansion Module Analog	6 analog inputs 2 analog outputs without manual override
XPB-821-5	Expansion Module Binary	8 binary inputs
XPL-401-5	Expansion Module Binary	4 binary inputs 3 binary outputs (latching relays with manual override)
XPE-401-5	Expansion Module Binary	4 binary inputs 3 binary outputs (electrically maintained relays with manual override)
XPE-404-5	Expansion Module Binary	4 binary inputs 4 binary outputs (common supply) (On/Off or pulse relays with manual override)
XPT-401-5	Expansion Module Binary	4 binary inputs 4 binary outputs (24 VAC triacs with manual override)
XPT-861-5	Expansion Module Binary	8 binary outputs (24 VAC triacs without manual override)
XST-101-0	Blank Stickers for Module Front Panels: Pack of 50 sheets, DIN A4, 12 stickers per sheet, laser printable	

Products Available in Europe

Table 10: Controller and Accessories Ordering Codes (Europe)

Code	Description
DX-9100-8154	Extended Digital Plant Controller, Version 1
DX-9100-7154	Extended Digital Plant Controller, Version 1 Repair Module
DC-9100-8905	Security Key (European) for Front Panel Operation
DC-9100-6800	Replacement Lithium Battery
SX-9120-8101	Service Module
MW-MTOOLE-0	M-Tool Software, English Language, European Version
DEMO-DX230	Demo Case, DX-9100 (230 V) Version 2
DEMO-DX230-3	Demo Case, DX-9121* (230 V) Version 3 (LONWORKS FTT10)

Table 11: XT/XP Ordering Codes (Europe)

Code	Description
XP-9106-8304	Expansion Module (4 DO - Relay) (European)
TR-9100-8101	230/24 V Transformer 12 VA

Table 12: XPx-xxx-x Ordering Codes (Europe)

Code	Module Type	Description
XPA-421-5 XPA-431-5	Expansion Module Analog	4 analog inputs (including PT100, Ni100, and 0-5K ohm)
XPA-442-5 XPA-452-5	Expansion Module Analog	4 analog outputs with manual override
XPA-462-5 XPA-472-5	Expansion Module Analog	4 analog outputs without manual override
XPA-831-5	Expansion Module Analog	6 analog inputs 2 analog outputs without manual override
XPB-831-5	Expansion Module Binary	8 binary inputs
XPM-401-5 XPM-411-5	Expansion Module Binary	4 binary inputs 2 binary outputs (momentary relays with manual override)
XPL-411-5	Expansion Module Binary	4 binary inputs 3 binary outputs (latching relays with manual override)
XPL-421-5 XPL-431-5	Expansion Module Binary	4 binary inputs 3 binary outputs (latching relays without manual override)
XPE-411-5	Expansion Module Binary	4 binary inputs 3 binary outputs (electrically maintained relays with manual override)
XPE-421-5 XPE-431-5	Expansion Module Binary	4 binary inputs 3 binary outputs (electrically maintained relays without manual override)
XPE-414-5	Expansion Module Binary	4 binary inputs 4 binary outputs (common supply) (On/Off or pulse relays with manual override)
XPE-424-5 XPE-434-5	Expansion Module Binary	4 binary inputs 4 binary outputs (common supply) (On/Off or pulse relays without manual override)
XPE-444-5 XPE-454-5	Expansion Module Binary	4 binary outputs (common supply) (On/Off or pulse relays with manual override)
XPE-464-5 XPE-474-5	Expansion Module Binary	4 binary outputs (common supply) (On/Off or pulse relays without manual override)
XPT-411-5	Expansion Module Binary	4 binary inputs 4 binary outputs (24 VAC triacs with manual override)
XPT-421-5 XPT-431-5	Expansion Module Binary	4 binary inputs 4 binary outputs (24 VAC triacs without manual override)
XPT-871-5	Expansion Module Binary	8 binary outputs (24 VAC triacs without manual override)

Note: The model numbers with a 0, 2, 4, or 6 as the second digit are for modules with normal terminals; the model numbers with a 1, 3, 5, or 7 as the second digit are for modules with disconnect terminals.

Appendix A: LONWORKS N2E Bus Poll Estimation Worksheet

The hardware on a Metasys Network allows up to thirty DX-912x controllers to be connected to an N2E Bus. However, some configurations using more than five DX-912x controllers on one bus may result in a slower system performance for monitoring functions than in an equivalent N2 Bus system. Determine the probable performance of your system by calculating the number of messages processed by the NCM per second. This varies depending on the NCM software configuration and on how many controllers are installed on one N2E Bus. The ideal message rate is at or below 1.5 messages per second. If the system has a higher rate than this, consider reducing the number of controllers or reconfiguring the NCM data base to make for a more efficient system. Control processes can be moved from GPL to the DX controllers, for example, using peer-to-peer communication for processes covering more than one controller.

Use the *LONWORKS N2E Bus Poll Estimation Worksheet* to calculate the message rate generated by a particular NCM configuration.

LONWORKS N2E Bus Poll Estimation Worksheet

Number of DXs (poll priority should be set to 3 for N2E applications) *93 msg/h =_____

Number of AIs with warning limits defined *120 msg/h =_____

Number of ADs mapped to CS attributes *120 msg/h =_____

Number of BDs mapped to CS attributes *900 msg/h =_____

Number of AIs with point history *2 msg/h =_____

Number of AOs with local control and point history *2 msg/h =_____

Number of ACMs *60 msg/h =_____

Total number of displayed CS attributes, AIs and AOs with local control typically displayed on all OWS/OT/NTU (average):

Number of OWS/OT/NTU _____ *number of points_____ *180 msg/hr =_____

Number of AI alarm events per hour =_____

Number of attributes read by JC-BASIC/GPL processes or Metalink® per hour =_____

Average number of scheduled commands per hour =_____

Average number of MCO commands per hour =_____

Number of trend samples per hour =_____

Sum of all messages per hour =_____

÷ 3600

Sum of all messages per second =_____

(The message rate should **not** exceed 1.5 msg/sec.)

The message rate of 180 messages per hour for AI and AO objects with local control must be adjusted if the refresh time parameters SummaryUpdate and GraphicsUpdate are changed from a default of 20 in the METASYS.INI file. See the *LONWORKS N2E Bus Technical Bulletin (LIT-6364100)* for more information and instructions about this process.

Notes

Notes

JOHNSON CONTROLS

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Printed in U.S.A.

TECHNICAL DOCUMENTATION FOR ONICON INSERTION FLOW METERS

This file contains the following:

1. **ONICON Flow Meter Ordering Guide For Johnson Controls**
2. **Flow Meter Order Form**
3. **Insertion Turbine Flow Meter Installation and Adjustment Guide**

Please note that Excel® spreadsheet versions of our order forms are available on our web site: www.onicon.com

ONICON Incorporated is proud to be a partner in Johnson Controls' Preferred Supplier Program

Updated September 2001

ONICON FLOW METER ORDERING GUIDE

ONICON INCORPORATED

I. MODEL NUMBERING SYSTEM

Format: F(B)-XX YY

SERIES ← F(B)-XX YY → *OUTPUT SIGNAL*

F-11 **Single Turbine, Insertion Type**
For 1¼" – 72" pipes with fully developed flow profile (20 – 30 straight pipe diameters, based on upstream obstruction) Note: can be used in 1" copper with Onicon install kit.

F-12 **Dual Turbine, Insertion Type**
For 2½" –72" pipes with 15 straight pipe diameters or less. The most popular series for demanding HVAC applications.

FB-12 **Bi-Directional, Insertion Type**
For bi-directional applications in 2½" –72" pipes. Designed for primary/secondary decoupler (bypass) and thermal storage applications.

F-13 **Inline Turbine Meter**
For ¾" and 1" applications

Example: "F-1210" = Dual turbine, analog output
ONICON Model Number = Item number

00 **Frequency Output** (15 V pulse)
For connection to Onicon display or BTU meter only. Signal is too fast for most building control systems (0-300 hz).

10 **Analog Output** (non-isolated)
Provides both 4-20 mA and 0-10 V outputs. Most commonly used output type. (3-wire connection)

11 **Isolated Analog Output**
Provides both 4-20 mA and 0-10 V outputs. Signal ground is isolated from power supply and pipe ground. (4-wire connection)

20 **Divided Output** (dry contact)
Provides an isolated binary/digital output. Signal is divided to limit the maximum frequency. For rate/totalization.

30 **Scaled Output** (dry contact)
Provides an isolated binary/digital output scaled to provide one pulse per desired unit volume (i.e.: 1 pulse = 10 gal.). Ideal for totalization applications.

II. OPTIONAL FEATURES

Refer to flow meter catalog page for standard features. Optional features are listed below and must be ordered separately. NOTE: ½" FIP fitting for conduit connector and weather-tight enclosure are now standard features; high temp option is provided for HW meters at no additional charge.

OPTIONAL FEATURE:	ITEM NUMBER:	NOTES:
* 316 SS wetted metal parts for F-11, F-12 or FB-12 series. Use item number for appropriate series.	F-1199-STANLS F-1299-STANLS FB-1299-STANLS	For industrial/process applications, high temp HW, and submersible applications
10 ft. liquid-tight conduit and connectors	F-OPT1-CONDUIT	This option NOT required for conduit connection. Provides conduit & fittings.
25 ft. standard cable	F-OPT2-25FT	Provides cable length indicated in addition to 10 ft. standard cable length (add'l cable is provided separately)
50 ft. standard cable	F-OPT3-50FT	
100 ft. standard cable	F-OPT4-100FT	
10 ft. plenum cable with inline DIN connector	F-OPT5-PLENUM	For installations with exposed wire runs in an air plenum – no conduit. Inline DIN connector is approx. 12" from meter, with remaining cable on other side of the connector.
25 ft. plenum cable with inline DIN connector	F-OPT6-25FTPL	
50 ft. plenum cable with inline DIN connector	F-OPT7-50FTPL	
100 ft. plenum cable with inline DIN connector	F-OPT8-100FTPL	
* Submersible electronics enclosure	F-OPT9-SUBMER	For installations in areas subject to intermittent submersion. Also requires 316SS wetted parts.

*** Not available for F-13 Series inline meters.**

III. INSTALLATION HARDWARE

Purchase of installation kit with the flow meter (insertion type) is **strongly recommended** to prevent installation problems. Refer to catalog page for most common installation kits; complete list on next page.

IV. CALIBRATION DATA

Pipe size, material, flow range, etc. is required for all meters. Use order form and fax or e-mail directly to ONICON Incorporated. Reference project name and number on order form.

V. PERIPHERAL DEVICES AVAILABLE

Display Modules: See D-1200 and D-1500 Series Display Modules
BTU Meters: See System-1 and System-2 Series BTU Meters

ORDER FORM: Insertion Flow Meters

ONICON INCORPORATED

Please provide ship to & bill to information on your purchase order

Company Name: location (city,ST)	***Note:*** *Standard lead time for meters is two weeks, contact factory if shorter lead time is required.*
Contact Name:	**Requested Delivery Date:**
Purchase Order #:	**Ship Meters Via:** *Ground, 3-day, 2-day, Overnight*
Project Name: and location (city,ST)	**Ship install kits in advance?** *YES or NO*
Specified By: (Engineering firm, city, ST)	**Ship Kits Via:** *Ground, 3-day, 2-day, Overnight*

APPLICATION INFORMATION:

	Item #1	#2	#3	#4	#5
FLOW METER MODEL:					
METER TAG INFORMATION:					
APPLICATION TYPE: *(CHW, HW, make-up, boiler feed, etc.)*					
LIQUID TYPE: *(water, x% ethylene glycol, brine, etc.)*					
PIPE SIZE *(nominal)*:					
PIPE MATERIAL: *(i.e: black iron, copper tube, pvc, etc.)*					
PIPE SCHEDULE, TYPE, or I.D.: *(i.e.: sch 40, type L, etc.)*					
MAX. OPERATING TEMPERATURE: * *Required for hot water systems only*					
TYPICAL FLOW RATE: *Expected "typical" flow rate for the system*					
DESIGN MAXIMUM FLOW RATE: *Maximum flow per system design*					
ANALOG FULL SCALE FLOW RATE: *Analog Output (i.e.: 20 mA = X gpm)*					
ANALOG OUTPUT: *For Analog Models Only* *Choose from: 4-20 mA, 0-10 V, 0-5 V*					
MAXIMUM OUTPUT FREQUENCY: *For Frequency, Divided, or Scaled Output*					
SCALE FACTOR: *For Scaled Output Models* *(1 Pulse = X gal, L, etc.)*					

AVAILABLE OPTIONS: *These affect price, refer to price sheet for details.*

NOTES:
* 316 SS wetted parts required for HW systems operating over 250° F as well as for submersible meters.
Max. operating pressure for flow meters is 400 PSI.

Installation Hardware: *All kits allow insertion/removal without system shutdown. Choose kit # from price book, or select below:* A. Standard *(w/1" valve, for new const.)* B. Hot Tap *(w/1.25" valve, for "wet tap")* C. Stainless Steel *(select A or B also)* D. No Kit - *provide height of valve assy.*					
Wetted Metal Components Standard: Plated Brass Optional: 316 SS					
Signal Connections Standard: 10' cable & 1/2" conduit adapter Optional: Plenum cable w/ DIN connector					
Additional Signal Cable Standard: 10 ft. cable Optional: 25, 50 or 100 ft. additional cable					
Electronics Enclosure Standard: Weathertight enclosure Optional: Submersible enclosure *					
Optional Display Module (see catalog)					

ONICON Incorporated Tel (727) 447-6140 Fax (727) 442-5699 e-mail: sales@onicon.com

FLOW METER INSTALLATION HARDWARE KITS

All ONICON insertion type flow meters can be installed and removed without system shutdown when installed through a 1" or larger full port ball valve. The terms: "Standard" and "Hot Tap" refer to the installation kit types only.

Standard Installation Kit: For new construction or scheduled shutdown. The valve is installed after the 1" hole is drilled in the pipe. Once the valve kit is installed, the flow meter can be installed or removed without system shutdown.

Hot Tap Installation Kit: For applications which require the access hole in the pipe to be drilled through the valve, using a wet tap drilling machine, with the hydronic system pressurized and operating.

PIPE MATERIAL	STANDARD KITS		HOT TAP KITS	
	KIT #	DESCRIPTION	KIT #	DESCRIPTION
Welded Carbon Steel / Black Iron (CS)	F-STD-INSTL1	Std. kit for 1.25" & larger welded steel pipe; includes bronze valve, fittings, weld-on CS branch outlet	F-HTAP-INSTL2	Hot tap kit for 1.25" & larger welded steel pipe; includes bronze valve, fittings, weld-on CS branch outlet
	F-STD-INSTL5	SS std. kit for 1.25" & larger welded steel pipe; includes 316SS valve, fittings, weld-on CS branch outlet	F-HTAP-INSTL6	SS hot tap kit for 1.25" & larger welded steel pipe; includes 316SS valve, fittings, weld-on CS branch outlet
Threaded Carbon Steel (CS)	F-STD-INSTL7	Std. kit for 1.25- 2.5" threaded pipe; includes bronze valve, fittings, 6" CS pipe nipple w/ branch outlet	F-HTAP-INSTL19	Hot tap kit for threaded steel pipe (1.5" and up); includes bronze valve, fittings and clamp-on saddle
	F-STD-INSTL8	SS std. kit for 1.25-2.5" threaded pipe; includes 316SS valve, fittings, 6" CS pipe nipple w/ branch outlet	F-HTAP-INSTL20	Hot tap kit for threaded steel pipe (1.5" and up); includes 316SS valve, fittings and clamp-on saddle
Copper tube	F-STD-INSTL3	Std. kit for 1" to 2" copper; includes bronze valve, fittings, copper tee	F-HTAP-INSTL21	Hot tap kit for 2" copper; includes bronze valve, fittings, special clamp-on saddle
	F-STD-INSTL4	Std. kit for 2.5" to 3" copper; includes bronze valve, fittings, copper tee	F-HTAP-INSTL22	Hot tap kit for 2.5 - 6" copper; includes bronze valve, fittings, special clamp-on SS saddle
	F-STD-INSTL9	Std. kit for 4" copper; includes bronze valve, fittings, copper tee		
Ductile Iron (cast iron)	F-STD-INSTL10	Std. kit for 3" to 6" ductile iron; includes bronze valve, fittings and clamp-on saddle	F-HTAP-INSTL23	Hot tap kit for 3" to 6" ductile iron; includes bronze valve, fittings and clamp-on saddle
	F-STD-INSTL11	Std. kit for 8" to 16" ductile iron; includes bronze valve, fittings and clamp-on saddle (brass/bronze)	F-HTAP-INSTL24	Hot tap kit for 8" to 16" ductile iron; includes bronze valve, fittings and clamp-on saddle
	F-STD-INSTL12	SS std. kit for 3" to 16" ductile iron; includes SS valve, fittings and clamp-on saddle	F-HTAP-INSTL25	SS hot tap kit for 3" to 6" ductile iron; includes SS valve, fittings and clamp-on saddle (all parts SS)
			F-HTAP-INSTL26	SS hot tap kit for 8" to 16" ductile iron; includes SS valve, fittings and clamp-on saddle (all parts SS)
PVC	F-STD-INSTL13	Std. kit for 2" to 6" PVC pipe. Includes bronze valve, fittings and clamp-on saddle	F-HTAP-INSTL27	Hot tap kit for 2.5" to 6" PVC pipe. Includes bronze valve, fittings and clamp-on saddle
	F-STD-INSTL14	Std. kit for 8" to 12" PVC pipe. Includes bronze valve, fittings and clamp-on saddle	F-HTAP-INSTL28	Hot tap kit for 8" to 12" PVC pipe. Includes bronze valve, fittings, and clamp-on saddle
	F-STD-INSTL15	SS/ PVC std. kit for 2" to 4" PVC pipe Includes SS valve, fittings and sch 80 PVC clamp-on saddle	F-HTAP-INSTL29	SS hot tap kit for 2" to 6" PVC pipe. Includes SS valve, fittings and clamp-on saddle (all SS parts)
	F-STD-INSTL16	SS/ PVC std. kit for 6" PVC pipe Includes SS valve, fittings and sch 80 PVC clamp-on saddle	F-HTAP-INSTL30	SS hot tap kit for 8" to 12" PVC pipe. Includes SS valve, fittings and clamp-on saddle (all SS parts)
	F-STD-INSTL17	SS std. kit for 8" to 12" PVC pipe. Includes SS valve, fittings and clamp-on saddle (all SS parts)		
Stainless steel	F-STD-INSTL18	SS std. kit for SS pipe. Includes 316SS valve, fittings and weld-on SS branch outlet (all SS parts)	F-HTAP-INSTL31	SS Hot tap kit for SS pipe. Includes SS valve, fittings and weld-on SS branch outlet (all SS parts)



ONICON INCORPORATED

Insertion Turbine Flow Meter Installation & Adjustment Guide

Insertion Flow Meters
are available in
Single or Dual Turbine.
This manual applies to all
Insertion Flow Meters.

For use with serial numbers
115692 and later

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9-4-01

SAFETY INFORMATION

Throughout this manual some text appears in bold type. These statements contain information related to safety issues. Many installations of our meters will be in high pressure or high temperature systems and accidents with these systems can cause serious injury or death to those working on them or standing nearby. There is also the possibility of property damage.

Please pay extra attention to these areas of bold text.

The information in this manual has been carefully checked for accuracy. There is, however, the possibility of omission or error. In such an event, ONICON Incorporated does not assume liability for any damages resulting from the use of this manual.

SERVICE

If ONICON equipment requires servicing, we prefer to have it returned to the factory. In some cases you may want to service it yourself. Our technical staff will be happy to work with you in these cases; however, we request that you contact us before beginning to work on the equipment because we can provide helpful information which is not contained in this manual.

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SECTION 1.0: INTRODUCTION

We, at ONICON INCORPORATED, would like to thank you for purchasing our quality U.S. made Insertion Turbine Flow Meter. As our valued customer, our commitment to you is to provide fast reliable service and assistance, while continuing to offer you new products to meet your growing flow measurement needs.

1.1 PURPOSE OF THIS GUIDE

We have written this guide to provide the persons responsible for the installation, operation, and maintenance of your insertion flow meter with most of the specific equipment information they will need. This is NOT an electrical or plumbing trade manual.

PLEASE DO NOT PERMIT ANY PERSONS TO INSTALL, OPERATE, OR MAINTAIN THIS EQUIPMENT UNLESS THEY HAVE A COMPLETE KNOWLEDGE OF THEIR TRADE SKILLS AND ARE COMPETENT TO WORK ON HIGH VOLTAGE POWER WIRING OR HIGH PRESSURE HOT AND COLD WATER AND STEAM SYSTEMS, ACCORDING TO THEIR INDIVIDUAL TRADES. DEATH OR PERMANENT INJURY MAY RESULT FROM ACCIDENTS WITH THESE SYSTEMS.

This guide is the basic reference tool for everyone who purchases an ONICON Insertion Flow Meter regardless of which of the many options they may have selected. If you have not purchased all of the options, there will be references in this manual which are not applicable to your system.

1.2 A TYPICAL INSERTION TURBINE FLOW METER

ONICON'S F-1100 and F-1200 series Insertion Flow Meters are true turbine meters which measure the velocity of a flowing liquid by counting the frequency at which the blades of a rotating turbine pass a fixed electrode. Circuitry within the flow meter electronics enclosure then converts the rotational rate to digital and/or analog signals which are transmitted via a connecting cable to any of ONICON's display devices, BTU meters, or a data acquisition system. See the typical installation diagram on pages 10A-C.

A typical F-1100 or F-1200 series Insertion Flow Meter consists of the following components:

- **Electronics Enclosure**

  The turbine rotation sensing circuit boards, along with the standard frequency output signal processing circuit boards, and most optional circuits such as ONICON's analog output signal processing board are housed in this die cast aluminum case.

- **Sensing Head Assembly**

  This part of the meter is actually in the stream of liquid at the proper position to sense the average flow velocity. It consists of the turbines, bearings, shafts, electrodes, and the associated mechanical supporting structure.

- **Hot Tap Adapter**

  The hot tap adapter provides the mechanical connection to the pipe through a coupling, welded fitting, or preferably, through a valve. The hot tap adapter and valve make removal easy.

If your flow meter was furnished with any additional items, they will be listed on the packing slip.

1.3 STANDARD FEATURES AND SPECIFICATIONS

- **Series F-1100**
  - » Patented Non-magnetic Impedance Sensing System
  - » Low Mass Non-metallic Turbine Rotor
  - » Sapphire Radial and Axial Bearings
  - » Tungsten Carbide Turbine Shaft
  - » Hot Tap Adapter with Internal "O" Ring Seal
  - » Pre-wired 10' Signal Cable with Inline Connector
  - » Calibrated Frequency Output
  - » Die Cast Aluminum Case for Circuit Boards

- **Series F-1200**

  This model has all of the features of the series F-1100 plus:

  - » A Dual Turbine Sensing Head
  - » Frequency Output Averaging Circuitry

1.4 OPTIONAL HARDWARE

- **Hot Tap Installation Kit**

  This bronze full port valve, attached brass close nipple, and weld-on branch outlet fitting provide an easy way to remove the insertion meter from the pipe for routine service or inspection without interrupting the operation of the circulating liquid system. We STRONGLY recommend this option.

1.5 OPTIONAL FEATURES

- **316 Stainless Steel**

  Wetted metal supporting structure is constructed from 316 stainless steel.

- **Conduit Connections**

  Allows flexible conduit to be connected directly to the electronics enclosure. Includes 10' of ¾" flexible conduit with connectors. The inline connector is not supplied with this configuration.

- **Weathertight Electronics Enclosure**

  The standard electronics enclosure is designed for interior installations such as chiller plants. The weathertight enclosure should be used for exterior installations.

- **High Temperature Operation**

  The standard ONICON Insertion Flow Meters will operate at a liquid temperature of up to 200° F (220° F peak); however, with a change of construction materials, the operating temperature can be increased to 280° F (300° F peak). Be sure to read the caution notices about high temperature operation in the installation section.

- **Additional Cable with Inline Connector**

  Extra cable is frequently ordered, with the connector attached, to assist the installers by maintaining the factory wire colors.

- **Plenum Rated Cable with Inline Connector**

  This option is offered to accommodate local building codes requiring plenum rated cable.

1.6 FIVE AVAILABLE MODELS

- **F-1100/F-1200: Frequency Output**

  The standard frequency output signal is a calibrated non-isolated 0-15 V peak pulse frequency output and is included with ALL models of ONICON flow meters.

- **F-1110/F-1210: Analog Output**

  These models provide factory calibrated 4-20 mA and 0-10 V analog output signals in addition to the standard calibrated frequency output.

- **F-1111/F-1211: Isolated Analog Output**

  These models provide the same output signals as the F-1110/F-1210 models except that the analog signals are totally isolated from the common system ground.

- **F-1120/F-1220: Divided Output**

  These models include a binary divider which can be used to reduce the standard output frequency to interface with monitoring equipment having a relatively slow scan rate. The output is a solid state photo-isolated switch (dry contact).

- **F-1130/F-1230: Scaled Output**

  These models are similar to the F-1120/F-1220 except that they include a precision binary divider which allows the user to scale the output to one pulse per specific unit of volume, (i.e. one pulse per gallon, hundred gallons, liter, etc.). The output is a photo-isolated switch (dry contact).

1.7 WORKING ENVIRONMENT

We designed the F-1100 and F-1200 series Insertion Flow Meters for installation and use in typical industrial environments that are free of corrosive liquids and fumes, direct liquid exposure or heavy condensation, temperature extremes and vibrations.

The operating ambient air temperature range is -5° F to 160° F (-20° C to 70° C) with weathertight electronics enclosure.

The electrical power should be relatively clean, free of high frequency noise and large voltage transients, and protected from power surges and brown-outs.

1.8 WARRANTY AND SERIAL NUMBER

- **Warranty**

  ONICON's complete warranty is included in Appendix D of this manual as a part of the "Conditions of Sale."

- **Serial Number**

  The serial number of your Insertion Flow Meter is located on a label on the side of the circuit board case. This label also exhibits the model number. The serial number is a unique identifier that you should refer to, along with the model number, whenever you require assistance regarding your system.

SECTION 2.0: UNPACKING

Insertion Flow Meters are generally shipped in one package unless optional hardware or equipment is ordered. This package may contain up to two complete meters along with the optional valve assemblies. If any display equipment was ordered with the meters, the other equipment may be packed in a separate package. Please open all packages with caution to prevent damage to their contents. In the event that they are damaged when you receive them, notify the shipping company immediately and the ONICON Customer Service Department. All products are shipped insured.

2.1 CHECKING THAT YOU HAVE RECEIVED EVERYTHING

- **The Documentation**

  Enclosed with each Insertion Flow Meter is a comprehensive documentation package which includes the following items:

  » A PACKING SLIP SHOWING ALL ITEMS SHIPPED OR BACK ORDERED

  » INSERTION FLOW METER INSTALLATION AND ADJUSTMENT GUIDE

  » THE FLOW METER CALIBRATION AND INSERTION DATA SHEETS

  If any of these documents is missing, please notify the ONICON Customer Service Department.

- **The Flow Meter**

  The flow meter is a rugged instrument and should arrive without any damage; however, when you remove it from the shipping carton, inspect it for physical damage such as broken turbine blades or a damaged stem.

  » Test the turbine(s) to see that they rotate freely when you blow on them parallel to their shafts.

  » Make sure that the threads on the hot tap adapter have not been damaged.

  » Inspect the long stem for bends or other damage. The stem forms the seal against liquid leakage as it slides through an 'O' ring inside the hot tap adapter. Deep scratches may cause leakage.

» Confirm that any additional cable which you ordered has been included (10' is standard). Make certain that the serial/model number label, the wire connection/calibration data tag, and the **red safety tag** are attached to the meter. These tags should remain attached to the meters even after final installation.

» The serial and model numbers on the wire connection/calibration data tag should match the numbers on the tag mounted directly on the flow meter. Be sure that the unit was calibrated to the correct pipe size and flow rate for your installation by comparing the wire connection/calibration data tag with your specifications.

- **Optional Equipment**

  Any optional equipment, with the exception of the hot tap installation kit, may have been shipped in a second package. Open it and inspect for damage. The packing list reflects any other optional equipment ordered.

- **Discrepancies or Damage**

  If you find discrepancies or damage, please notify the ONICON Customer Service Department as soon as possible.

SECTION 3.0: INSTALLATION, REMOVAL & ADJUSTMENT

*****CAUTION*****

Insertion Flow Meters will often be installed in pipes which are under high pressure. To prevent personal injury from moving parts of the meter, installation, adjustment, and removal should only be done by persons experienced with high pressure systems and related knowledge in the heating, cooling, and fluid metering fields. Refer to the installation drawings before performing any work on these meters.

ONICON will be happy to assist with technical recommendations and to provide guidance by telephone and/or mail. On-site field engineering, installation, and service is also available at additional cost.

Before beginning, clean the external surfaces of all pipes at the installation sites so that they are free of debris, foreign matter, solids, sticky liquids such as certain leak inhibitors, and chemically aggressive substances. Flush the entire system so that it is free of flux, solder, pipe and tube cuttings and any other free moving particles. Damage resulting from failure to maintain a clean system is not covered under the warranty.

3.1 SITE SELECTION

Careful attention to the site selection for the system components will help the installers with the initial installation, reduce start-up problems, and make future maintenance easier. For example, do not install the flow meter where it will be difficult for your personnel to perform the necessary periodic maintenance. When selecting a site for mounting the system components, you should consider the criteria under Section 1.7, WORKING ENVIRONMENT, as well as the following:

- Install the flow meter in a straight length of pipe with no valves, tees, elbows, bends, or other such fittings, for a distance of at least 20 pipe diameters upstream and 10 pipe diameters downstream from the meter. This general rule applies only to single turbine insertion meters. Refer to pages 8A thru 8C for more information about installation location. If yours is a single turbine and there is no suitable location, contact ONICON's Sales Office to discuss upgrading to a dual turbine meter. This meter is more tolerant of conditions which cause swirl, turbulence, and flow profile distortions. Please make this decision before installing the single turbine meter so that we may be able to give you credit if you elect to upgrade to a dual turbine meter. Such returns may be subject to a restocking charge.

» Choose a section of pipe that is well supported and free of harmonic motion and high or low frequency vibration.

» The location must allow convenient access for easy removal for cleaning and preventive maintenance.

» Place the flow meter so that it can be used with ONICON's standard hot tap adapter and a valve and nipple assembly, thereby allowing for easy removal for inspection or maintenance without draining or stopping the hydronic system.

» A full 1" opening is required to clear the turbine assembly. Make sure that your valves and fittings are full port and at least 1" in actual internal diameter.

3.2 PLUMBING INSTALLATION

All plumbing installations should be done only in pipes which have readily accessible shut-off valves so that the flow may be turned off in case of an emergency.

Once you choose the installation site for your flow meter, clean the mounting surface so that it is free of insulation, corrosion, and other debris. Next, relieve all pressure within the fluid system and reduce the fluid level to the height where no liquid will escape when you drill the installation holes in the pipe.

To take advantage of ONICON Flow Meters' built-in Hot Tap feature, the flow meter must be installed through an isolation valve.

The drawings on pages 10A and 10B show installations using ONICON's *Standard Installation Hardware* kit in a drained, non-pressurized system. The access hole is drilled (1" minimum) prior to installation of the 1" NPT branch outlet, close nipple and full port ball valve. Once the isolation valve is installed, the piping system can be flushed and pressurized . The flow meter can now be inserted or removed by hand without having to drain the system again. Please refer to page 10 for important safety instructions.

ONICON's *Hot Tap Installation Hardware* kit offers an alternative installation when it is not practical to drain or relieve the pressure in the system. The drawings on pages 10C and 10D show the Hot Tap installation configuration. In this case, a 1¼" branch outlet, close nipple and 1¼" full port ball valve are installed first. Then, a hot tap drilling apparatus can be used to drill a 1" diameter hole through the valve, without shutting down or draining the pipe.

You can also attach the flow meter to the pipe with a saddle. The meter requires relatively little structural support and any saddle suitable for the system operating pressure should be adequate. Hot tap drilling attachments also work well with clamp-on saddles.

When installations are made in small pipe sizes, a tee may be available; however, the inside diameter of most tees is larger than that of the pipe and a tee also creates more turbulence than a small drilled hole. If you will be mounting the flow meter in a tee and our factory was not aware of that at the time of calibration, return the meter for recalibration in a tee.

Consider the following:

- The access hole into the pipe should be as small as possible to minimize turbulence (1" diameter minimum.)
- Always use a valve assembly as shown on pages 10A & 10B. Turbine meters require periodic maintenance and you should be able to remove the meter when necessary without shutting down your system.
- If you select a 1" valve, it must be a full port valve. A standard 1" valve will usually have an undersized inside diameter.
- Install the flow meter in an area which is easily accessible for future service.
- Try to limit the overall height from the pipe's outside diameter to the top of the valve to 5½ - 6". ONICON calculates the stem length of the flow meter based on pipe size and this nominal height. If your installation requires a higher fitting assembly and the dimension was not specified on the order form, please contact the factory before installation. This way ONICON can offer you credit for your meter if you decide to exchange it for one with a longer stem. Such a return may be subject to a restocking charge.

After fitting the necessary plumbing hardware, flush the entire system so that it is free of flux, solder, and slag. Prepare to install the flow meter by loosening the clamping nut and withdrawing the turbine assembly entirely into the hot tap adapter. Next, thread the adapter into the ball valve using a paste type thread sealant. Do not use teflon tape because torn strands of the tape may wind around the turbine, slowing down or even stopping the turbine rotor.

When you are ready to refill the system, make sure that all lines are filled with water before inserting the turbine into the stream. If the lines are not filled, air may interrupt the flowing stream and damage the turbine assembly. A greater danger is that if this is a hot water system, some water may flash into steam and exceed the high temperature limit for the turbine and its mechanical assembly. The assembly could fail to hold the pressure and allow steam and hot water to escape causing serious injury or death.

Check the installation for leaks by slightly opening the ball valve under the hot tap adapter. An "O" ring in the adapter seals the meter's stem against leakage. If there are any leaks around the clamping nut or stem, **DO NOT ATTEMPT TO STOP THE LEAKAGE BY OVERTIGHTENING THE CLAMPING NUT. Damage to this nut or the clamping ring under the nut may prevent the assembly from properly holding the meter in the pipe.** The clamping nut is not part of the sealing mechanism. Any leaks in this area indicate that the "O" ring is not sealing properly and you must contact the factory for assistance.

3.3 INSERTION OF THE METER

Begin by calculating the effort that will be required to hold the meter. Establish adequate footing for this task, taking extra caution when working from a ladder or platform. Use the following formula:

E=0.11xP Where: E=effort in pounds
P=system pressure in pounds per square inch

Example: In a 300 PSI system, 33 pounds of effort is required to push the meter into the pipe.

- **Meter with a factory supplied depth gage: (Refer to the following diagram.)**

1. Pierce insulation with gage until the tip touches the pipe.
2. Open valve completely, loosen the lock nut, and insert the meter until the bottom of the electronics case touches the eye of the depth gage.
3. Align the arrow on the meter with the flow direction and tighten the lock nut.

- **Meter without a gage: (Refer to pages 10A & 10B for insertion information)**

Position the electronics enclosure parallel to the pipe in the direction relative to the flow, as shown on the label and on pages 10A & 10B. This will position the turbine with its axis in line with the flow and in the same direction as it was calibrated at the factory.

Do not release the flow meter until you have tightened the position clamping nut enough to hold the flow meter in the desired location. This will require less torque than you might think, so be careful not to overtighten it and risk damaging the adapter, nut, or stem.

Place several turns of electrical tape around the stem just above the clamping nut so that if the meter is removed at a later time, it can be easily replaced in the same position.

NOTE: For installations with limited straight run of pipe (less than the recommended distances shown on pages 8A, 8B and 8C), adjustments in insertion depth may be desirable to compensate for velocity flow profile variations. Please contact the factory for information on velocity flow profiling for determining the average velocity location in undeveloped flow locations.

3.4 REMOVAL OF THE METER

Caution - Remember, the meter may be under high pressure, and while removal of the meter is basically the reverse of the insertion procedure detailed above, care must be taken to ensure that the meter is supported against the pipe pressure before the position clamping nut is loosened. Failure to do this will allow the pressure to suddenly and rapidly force the meter from the pipe and someone could be seriously injured if struck by the meter.

Prior to removal of the meter, make sure that you are standing on a secure platform and have both hands available to manipulate the flow meter.

First support the flow meter against the pipe pressure by holding the circuit board enclosure firmly by hand BEFORE loosening the position clamping nut. The effort which will be required is the same as that required for insertion of the meter and should be calculated according to the formula in the prior section covering insertion of the meter. This effort will be 0.11 times the pipe pressure. **If your footing is not secure, or if you are unsure of your ability to hold the meter for any reason, DO NOT loosen the clamping nut.**

Then **SLOWLY** loosen the position clamping nut and **carefully and slowly** allow the pressure to force the meter out of the pipe. This is not at all difficult, but you must not let go of the meter until it is fully withdrawn into the hot tap adapter as shown in the inset drawings on pages 10A & 10B. After the meter is completely withdrawn, you may close the isolation ball valve.

The main cause of damage to the meters comes from persons accidentally closing the valve on the turbine assembly. To avoid this, gently rotate the meter by twisting the circuit board enclosure back and forth (twist the stem, do not bend it) while you slowly close the valve. If the valve touches any part of the meter, you will feel it as you are twisting the meter. If the valve touches anything, it means the meter is not fully withdrawn. Usually a gentle twisting motion while withdrawing the meter will clear any obstructions and permit the meter to withdraw completely.

After the valve is completely closed, you can safely unscrew the hot tap adapter from the valve. There will be very little water in the hot tap adapter; however, a small bucket or pan should be held under the valve to catch any spilled water.

NOTE: Flow meters prior to S/N 102860 utilized a Delrin (plastic) compression ring in the position clamping nut which tended to deform and not release the flow meter completely when the position clamping nut was loosened. This resulted in the installer possibly having to assist the meter out of the pipe by pulling on the electronics enclosure. For flow meters S/N 102860 and higher, the position clamping nut was redesigned utilizing a slotted brass collet assembly which releases quickly and completely allowing the pressure of the line to

push the meter out of the pipe.

3.5 ADJUSTMENT OF THE METER

CAUTION - If adjustment of the meter position is required, the same procedure must be followed as if the meter was being removed. Please carefully read the section above on removal of the meter. Remember, the meter may be under high pressure and failure to follow the procedure may result in injury or death.

Once the meter has been moved to its new position, tighten the position clamping nut and place several turns of electrical tape around the stem just above the clamping nut so that at a later time, when the meter is removed for service, it can be easily replaced in the same position.

3.6 ELECTRICAL CONNECTIONS

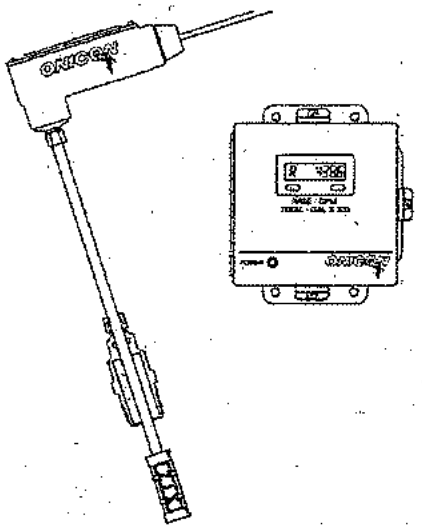
Most insertion flow meters are furnished with an inline cable connector which makes it easy to remove the meter for cleaning or service. If your meter was furnished with the conduit option, it will not have a connector. Refer to page 12A for installation details. Make your electrical connections to the 10' cable, which is supplied by ONICON and is pre-wired to the connector, or circuit board when the conduit option is furnished.

Please do not attempt to make any connections inside the electronics case, or to remove factory installed connection fittings. Damage resulting from these actions will not be covered under warranty.

Caution - the most common cause of electronic failure is incorrect connection. If you will be adding any additional cable, please record any substitution of wire colors. If additional cable is purchased from ONICON, the color code can be maintained. However, cable from other sources will most likely have a different set of colors. Please refer to Appendix A for wiring diagrams and factory color codes.

Only qualified service personnel should make connections between the Insertion Flow Meter and the user's external equipment. Any misapplication of power and/or ground can result in improper operation of the unit or damage to the Insertion Flow Meter, the flow meter circuitry, and to any externally connected equipment.

SECTION 4.0: START-UP COMMISSIONING FOR ONICON INSERTION TURBINE FLOW METERS



4.1 HELPFUL HINTS FOR START-UP AND COMMISSIONING

A step-by-step procedure and companion worksheet are located on the next two pages. Please read all installation instructions carefully before proceeding with installation, start-up and commissioning.

Please read these helpful hints before proceeding with the start-up and commissioning procedure on the next page.

1. ONICON Flow Meters are individually calibrated for a particular application. Be sure to verify the pipe size and location.
2. The electronic sensing system will not work in air. Blowing on the turbine(s) will not produce a signal. You can test the meter by holding the turbines under a faucet or carefully moving it back and forth in a bucket of water.
3. When measuring analog output signals, remember that currents (mA) must be measured in series, while voltages are measured in parallel. If the 4-20 mA signal is alreay connected to a control system, you must break the connection and measure the signal in series.
4. When measuring frequency outputs in hertz, take your multimeter out of "autorange mode" and manually set range for a voltage level above 15 VDC. This will prevent false readings when no turbine signal is present.
5. All wiring connections should be made at the end of the factory cable. Do not attempt to remove the factory installed cable or change the orientation of the electronics enclosure.
6. Never connect power to analog or frequency output signal wires. ONICON flow meters are not "loop powered" devices.

4.2 START-UP AND COMMISSIONING FOR ONICON INSERTION TURBINE FLOW METERS

Please read all installation carefully before proceeding. Wiring diagrams are located in the appendix. A worksheet for checking off the following steps and recording measured values is located on the following page.

1.	Confirm meter location and adequate straight pipe run to achieve desired results	Is the meter located in the correct location as required by the plans? Compare actual straight pipe upstream and downstream of the meter location to recommended distances identified in the installation manual. Note that the manual is very conservative, assuming worst-case pipe obstructions; contact ONICON's technical support department to discuss specifics of your application. If straight pipe run is very short, consult factory PRIOR to installing a single turbine meter to discuss possibility of upgrade to a dual turbine meter.
2.	Confirm Pipe Size	Confirm that the meter is tagged for the pipe size it is installed in. When in doubt measure the circumference of the pipe. Pipe O.D. = (circumference / 3.14) - (insulation thickness x 2)
3.	Confirm insertion depth and orientation	Each flow meter comes with an attached insertion gage and instruction tag. Ensure that meter is inserted to the correct depth and that the electronics enclosure is parallel with the pipe, with the arrow in the direction of flow.
4.	Confirm control system programming	Confirm that the control system input point is properly configured for the analog range (or binary scale factor) identified on the flow meter calibration tag & certificate.
5.	Confirm connection to correct ONICON display or BTU Meter (if ordered)	Confirm that the flow meter serial number matches the ONICON display or BTU meter serial number (when ordered together)
6.	Verify wiring before connecting power	Prior to connecting the power, verify that wiring is correct as shown in this manual and/or additional wiring diagram provided with ONICON display or BTU meter. If in doubt, call factory for assistance before proceeding further.
7.	Confirm correct supply voltage	Verify that 24 (+/- 4) V is available. Serial Numbers 115682 and later can accept 24 V DC or AC, but earlier meters required 24 VDC. Note: ONICON display module or BTU Meter provides 24 VDC to the flow meter. ONICON display modules and BTU meters are typically powered by 120 VAC, however, low voltage versions are also available.
8.	Connect power	Wait approximately 45 seconds after power-on before proceeding further.
	The following steps require flow in the pipe. Flow signal readings should be taken while holding the flow rate constant if possible, otherwise, take the various output readings as quickly as possible.	
9.	Measure and record frequency output(s):	The average frequency output signal is a 0-15 VDC pulsed output ranging up to 200 Hz and must be measured with a frequency counter or oscilloscope. Measure DC Frequency (Hz) from GREEN(+) to BLACK(-). Also measure DC volts on same wires. 5 to 7 VDC is normal for a spinning turbine, 0 or 14+ VDC indicates a stopped turbine. (1 to 4 VDC could indicate a problem) GPM = $\frac{\text{Frequency in Hz x 60}}{\text{Meter Factor in ppg}}$ (refer to calibration tag for meter factor) For Dual Turbine models, also measure and record the top and bottom turbine signals TOP: WHITE (+) to BLACK (-) BOTTOM: ORANGE (+) to BLACK (-)
10.	Measure and record analog or binary outputs	Refer to flow meter wiring diagram for wire colors for the various outputs available, based on your particular flow meter model. Use the following formulas to calculate flow rate from measured analog signals:
	Current Output:	GPM = $\frac{\text{(measured current in mA -4)}}{16}$ x Full Scale Analog Flow Rate
	Voltage Output:	GPM = $\frac{\text{measured DC volts}}{10}$ x Full Scale Analog Flow Rate
	Divided Output:	Same calculations step 9, except use divided meter factor (measure and record frequency)
	Scaled Output:	Each contact closure = unit volume identified as Scale Factor (measure and record time interval between contact closures)
11.	Compare various output signals to each other and to the flow rate displayed by the control system	The top and bottom turbine frequencies (dual) should be within about 20% of each other and their average should equal the average frequency output. Compare the flow rates calculated in STEPS 9 and 10 to each other and to the flow rate indicated by the control system. Refer to troubleshooting guide when readings are inconsistent.

End of standard start-up and commissioning. Please contact ONICON's technical service department at (727) 447-6140 with any questions.

4.3 START-UP AND COMMISSIONING WORKSHEET ONICON INSERTION TURBINE FLOW METERS

Please read all installation instructions carefully prior to proceeding with these steps. Wiring diagrams are located in the appendix. Use the following worksheet for checking off the commissioning steps and recording measured values:

STEP	TEST / MEASUREMENT	S/N:_____	S/N:_____	S/N:_____	S/N:_____
1.	Meter location	❑	❑	❑	❑
2.	Confirm pipe size	❑ _____	❑ _____	❑ _____	❑ _____
3.	Insertion depth and orientation	❑	❑	❑	❑
4.	Control system programming	❑	❑	❑	❑
5.	Match display or BTU meter serial # (if ordered)	❑ _____	❑ _____	❑ _____	❑ _____
6.	Signal connections verified	❑	❑	❑	❑
7.	Supply voltage verified	❑ _____	❑ _____	❑ _____	❑ _____
8.	Connect power	❑	❑	❑	❑
	The following steps require flow in the pipe. Flow signal readings should be taken while holding the flow rate constant if possilbe, otherwise, take the various output readings as quickly as possible.				
9.	Frequency output(s): Avg = green, Top = white Bottom = orange				
	Avg Freq. (HZ):	_____ Hz	_____ Hz	_____ Hz	_____ Hz
	Avg Freq. (VDC):	_____ VDC	_____ VDC	_____ VDC	_____ VDC
	Top Turbine (HZ)	_____ Hz	_____ Hz	_____ Hz	_____ Hz
	Top Turbine (VDC)	_____ VDC	_____ VDC	_____ VDC	_____ VDC
	Bottom Turbine (HZ):	_____ Hz	_____ Hz	_____ Hz	_____ Hz
	Bottom Turbine (VDC):	_____ VDC	_____ VDC	_____ VDC	_____ VDC
	Calculated Flow Rate:	_____ GPM	_____ GPM	_____ GPM	_____ GPM
10.	Analog or binary outputs				
	4 - 20 mA signal:	_____ mA	_____ mA	_____ mA	_____ mA
	0 - 10 V signal:	_____ VDC	_____ VDC	_____ VDC	_____ VDC
	Scaled output interval or divided output frequency	_____	_____	_____	_____
	Calculated Flow Rate:	_____ GPM	_____ GPM	_____ GPM	_____ GPM
11.	Flow rate displayed by control system	_____ GPM	_____ GPM	_____ GPM	_____ GPM

4.4 TROUBLESHOOTING GUIDE FOR ONICON INSERTION TURBINE FLOW METERS

NOTE: Also refer to the START-UP and COMMISSIONING GUIDE located on the preceding pages.

REPORTED PROBLEM:	POSSIBLE SOLUTIONS
No Signal	Verify that the meter is correctly inserted into the pipe. Verify that the electronics enclosure is parallel with the pipe. Verify 24 V supply voltage. Verify correct wiring to control system (see wiring diagram) Check turbine(s) for debris.
Reading is too high or too low	Verify pipe size. Contact factory if pipe size is different from calibration tag. Verify that meter is inserted correctly into the pipe. Verify that the electronics enclosure is parallel with the pipe. Verify correct wiring to control system (see wiring diagram). Confirm that output signals are consistent (frequency vs. analog, etc). Confirm that control system is programmed for correct flow range or scale factor. Check turbine(s) for debris.
Analog signal seems high or low and does not correspond to frequency output	Check for ground loop or offset voltage: Disconnect analog signal input to control system and measure analog outputs directly from the flow meter. Re-connect signal input to control system and measure the analog signals again. Any difference between these readings indicates a potential ground loop or offset voltage. Please contact ONICON for further assistance.
Control system displays flow rate, but no flow rate indication on local display module or BTU Meter	Verify that all wires from flow meter were connected to the display module or BTU Meter. The frequency output wire (green) must be connected for any ONICON Display or BTU Meter.

For technical assistance, contact ONICON Incorporated at (727) 447-6140.

SECTION 5.0: ANALOG ADJUSTMENT PROCEDURE

Our electronic circuits are designed and tested to ensure long life with minimal drift; therefore, you should not expect to make regular field adjustments or calibrations. However, it will be necessary for you to rescale the analog output under the following conditions:

- The turbine was replaced with a new one having a significantly different meter factor.
- You wish to change the flow rate represented by the analog output.
- An analog output card was added in the field.
- An analog output meter is being moved to a different size pipe.

ONICON will do all of these recalibrations at low cost and with a one or two day turn-around. However, we have included this section for those instances where you cannot return the meter or simply want to do the work yourself. We will be happy to work through the procedure with you on the phone, if you desire.

While these adjustments are not complicated, they are crucial for accurate performance of the flow meter. Therefore, any adjustments should be made only by qualified personnel having an understanding of flow equations and experience with control systems.

5.1 GENERAL DISCUSSION

ONICON Insertion Flow Meters contain circuitry which measures the velocity of a flowing stream of water, or water based liquid, by sensing the rotational rate of a freely rotating axial turbine which is immersed in the flowing stream. As each turbine blade passes a fixed electrode, an electronic pulse is produced by the circuitry. In the case of single turbine meters, the pulse rate is then calibrated in terms of the number of pulses per gallon in whatever size pipe the user has selected. This number is called the METER FACTOR. For example an Insertion Flow Meter might have a meter factor of 31.3 PPG (Pulses Per Gallon) in 3" pipe. This is the calibrated frequency output signal.

Dual turbine meters are basically the same except that the pulse rates from the upper and lower turbines are electronically averaged and the calibration is done using this average output signal.

This frequency output signal can be used directly by many data acquisition systems. Other systems require an analog representation of flow rate. For these systems the frequency output signal is processed by the optional analog output card and another calibration is then done on the 4-20 mA and 0-10 V analog output signal.

5.2 ANALOG ADJUSTMENT PROCEDURE

This procedure adjusts both 4-20 mA & 0-10 V output signals. It is limited to meters with serial numbers 115692 and higher. Lower serial numbers cannot be rescaled in the field.

5.21 Equipment Required

- Voltmeter
- Pulse Generator
- 24 V Power Supply

5.22 Procedure

1) Determine the input frequency required to simulate the desired maximum flow rate using the equation below.

Where:

F = Input Frequency (Hz)
R = Maximum Flow Rate (GPM)
MF = Meter Factor* (Pulses Per Gallon)

$$F = \frac{R \times MF}{60}$$

*The meter factor is written on a calibration tag attached to each meter and is also recorded on the calibration data sheet. Please contact the factory if you cannot locate the meter factor.

2) Remove the flow meter from the pipe and make sure the electrode and the surrounding area are dry.

3) Choose the input frequency range (Hz) from the table on the next page and set the appropriate range selection switch. Some meters may have jumpers instead of switches. Refer to Appendix B for the internal wiring diagram of your model.

4) Connect the pulse generator output lead to the test signal input lead on the analog card, and connect the pulse generator ground lead to the black ground wire in the flow meter cable. Set the output to a 15 V P-P square wave at the frequency determined in step #1.

5) Set the DC voltmeter to the 0-10 V scale and connect the (+) lead to the brown wire in the flow meter cable. Connect the (-) lead from the voltmeter to the black ground wire in the flow meter cable.

6) Connect the red and black wires in the flow meter cable to the (+) and (-) terminals of the 24 V power supply respectively. Apply power.

7) Adjust the span potentiometer on the analog card to produce a 10 V reading on the voltmeter.

NOTE:
The selection switch frequency ranges in the table are a starting point, and since they vary with electronic component tolerance, it may be necessary to change the switch position once rescaling is started. If the range of adjustment of the span potentiometer is not sufficient to produce the desired 10 VDC, change the switch position as follows:

VOLTAGE READING TOO HIGH: Choose the next lower switch position.

VOLTAGE READING TOO LOW: Choose the next higher switch position.

8) The flow meter is now rescaled. Disconnect all equipment, replace the cover and reinstall the flow meter.

Analog Range Switch Settings

INPUT FREQUENCY (Hz) AT MAXIMUM FLOW RATE		SWITCH POSITION SINGLE / DUAL TURBINE
Over 248	Hz	1
124-248	Hz	2
62-123	Hz	3
31-61	Hz	4
15-30	Hz	5
Under 15	Hz	6

NOTES:

APPENDIX A

External Wiring Diagrams

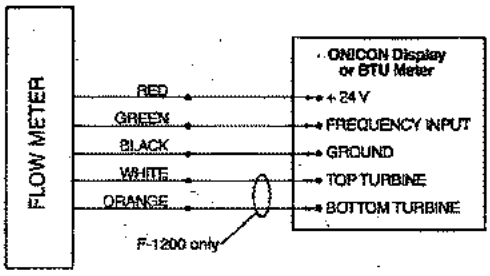
FLOW METER WIRING INFORMATION

User Connections for Models with Frequency Output
Models: F-1100, F-1200, FB-1200 & F-1300

F-1100 Single Turbine	F-1300 Inline	F-1200 Dual Turbine	FB-1200 Bi-Directional	Wiring Information		
				WIRE COLOR CODE		NOTES
√	√	√	√	RED*	(+) 24 ± 4 V AC/DC supply voltage	Connect to power supply positive
√	√	√	√	BLACK	(–) Common ground (Common with pipe ground)	Connect to power supply negative
√	√	√	√	GREEN	(+) Frequency output signal: 0-15 V peak pulse	Output frequency is typically below 200 Hz, but can be up to 300 Hz
			√	GRAY	Dry contact directional output - indicates flow direction	Contact closed when flow is in direction of arrow on meter
			√	VIOLET		
				DIAGNOSTIC SIGNALS		
		√	√	ORANGE	Bottom turbine frequency	These signals are for diagnostic purposes - connect to local display or BTU meter
		√	√	WHITE	Top turbine frequency	

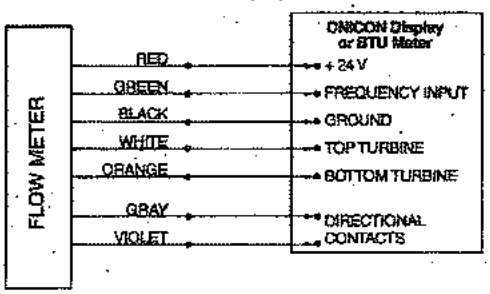
F-1100 / F-1200 / F-1300 Wiring Diagram

Flow Meter Connections to ONICON Display or BTU Meter



FB-1200 Wiring Diagram

Connections to ONICON Display or BTU Meter



NOTES:
* 1. Serial Numbers 115691 and earlier require 24 VDC. Serial Numbers 115692 and higher can accept 24 V AC/DC.
2. Black wire is common with the pipe (typically earth ground).
3. For ONICON display module or BTU meter, connect all wires provided. Refer to wiring diagram provided with display or BTU meter.

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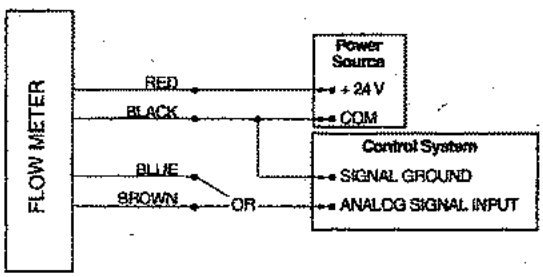
FLOW METER WIRING INFORMATION

User Connections for Models with Non-Isolated Analog Outputs
Models: F-1110, F-1210, FB-1210 & F-1310

F-1110 Single Turbine	F-1310 Inline	F-1210 Dual Turbine	FB-1210 Bi-Directional	Wiring Information		
				WIRE COLOR CODE		NOTES
√	√	√	√	RED*	(+) 24 ± 4 V AC/DC supply voltage	Connect to power supply positive
√	√	√	√	BLACK	(–) Common ground (Common with pipe ground)	Connect to power supply negative & analog input ground
√	√	√	√	GREEN	(+) Frequency output signal: 0-15 V peak pulse	Required when meter is connected to local display or BTU meter
√	√	√	√	BLUE	(+) Analog signal: 4-20 mA (non-isolated)	Both signals may be used independently (unless 0-5 V output is ordered)
√	√	√	√	BROWN	(+) Analog signal: 0-10 V (non-isolated) (Can also be ordered as 0-5 V)	
			√	GRAY	Dry contact directional output - indicates flow direction	Contact closed when flow is in direction of arrow on meter
			√	VIOLET		
				DIAGNOSTIC SIGNALS		
		√	√	ORANGE	Bottom turbine frequency	These signals are for diagnostic purposes - connect to local display or BTU meter
		√	√	WHITE	Top turbine frequency	

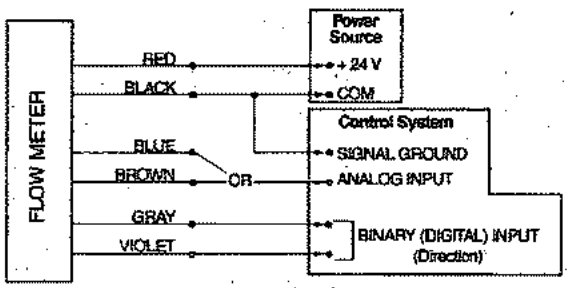
F-1110 / F-1210 / F-1310 Wiring Diagram

Connections to a Control System (No Display or BTU Meter)



FB-1210 Wiring Diagram

Connections to a Control System (No Display or BTU Meter)



NOTES:
* 1. Serial Numbers 115691 and earlier require 24 VDC. Serial Numbers 115692 and higher can accept 24 V AC/DC.
2. Black wire is common with the pipe (typically earth ground).
3. For ONICON display module or BTU meter, connect all wires provided. Refer to wiring diagram provided with display or BTU meter.
4. This is NOT a "loop-powered" instrument. DO NOT connect power to any of the signal output wires (blue, brown, green, orange or white)

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FLOW METER WIRING INFORMATION

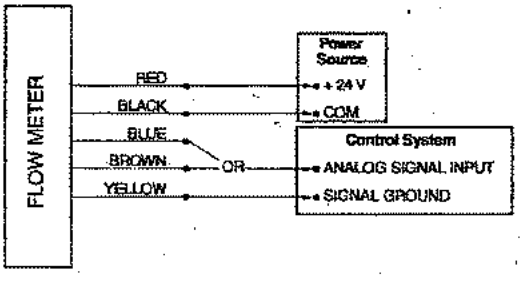
User Connections for Models with Isolated Analog Outputs

Models: F-1111, F-1211, FB-1211 & F-1311

F-1111 Single Turbine	F-1311 Inline	F-1211 Dual Turbine	FB-1211 Bi-Directional	Wiring Information		
				WIRE COLOR CODE		NOTES
√	√	√	√	RED*	(+) 24 ± 4 V AC/DC supply voltage	Connect to power supply positive
√	√	√	√	BLACK	(–) Common ground (Common with pipe ground)	Connect to power supply negative
√	√	√	√	GREEN	(+) Frequency output signal: 0-15 V peak pulse	Required when meter is connected to local display or BTU meter
√	√	√	√	BLUE	(+) Analog signal: 4-20 mA (isolated)	Both signals may be used independently (unless 0-5 V output is ordered)
√	√	√	√	BROWN	(+) Analog signal: 0-10 V (isolated) (Can also be ordered as 0-5 V)	
√	√	√	√	YELLOW	(–) Isolated ground	Use for analog signals only
			√	GRAY	Dry contact directional output - indicates flow direction	Contact closed when flow is in direction of arrow on meter
			√	VIOLET		
				DIAGNOSTIC SIGNALS		
		√	√	ORANGE	Bottom turbine frequency	These signals are for diagnostic purposes - connect to local display or BTU meter
		√	√	WHITE	Top turbine frequency	

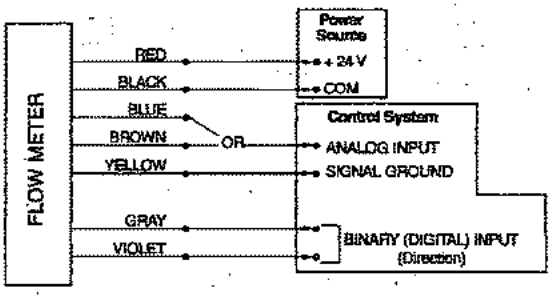
F-1111 / F-1211 / F-1311 Wiring Diagram

Connections to a Control System (No Display or BTU Meter)



FB-1211 Wiring Diagram

Connections to a Control System (No Display or BTU Meter)



NOTES:
* 1. Serial Numbers 115691 and earlier require 24 VDC. Serial Numbers 115692 and higher can accept 24 V AC/DC.
2. Black wire is common with the pipe (typically earth ground).
3. For ONICON display module or BTU meter, connect all wires provided. Refer to wiring diagram provided with display or BTU meter.
4. This is NOT a "loop-powered" instrument. DO NOT connect power to any of the signal output wires (blue, brown, green, orange or white)

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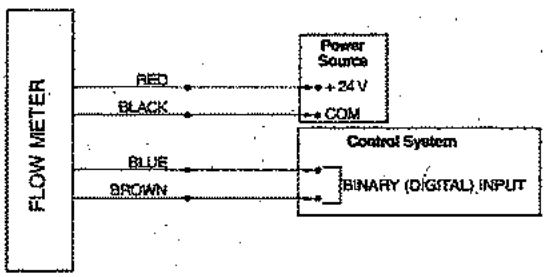
FLOW METER WIRING INFORMATION

User Connections for Models with Divided Output
Models: F-1120, F-1220, FB-1220 & F-1320

F-1120 Single Turbine	F-1320 Inline	F-1220 Dual Turbine	FB-1220 Bi-Directional	Wiring Information		
				WIRE COLOR CODE		NOTES
√	√	√	√	RED*	(+) 24 ± 4 V AC/DC supply voltage	Connect to power supply positive
√	√	√	√	BLACK	(–) Common ground (Common with pipe ground)	Connect to power supply negative
√	√	√	√	GREEN	(+) Frequency output signal: 0-15 V peak pulse	Required when meter is connected to local display or BTU meter
√	√	√	√	BLUE	Dry contact divided output - indicates flow rate	Output can be divided by any binary number up to 4096 to meet frequency limitations of control system
√	√	√	√	BROWN		
			√	GRAY	Dry contact directional output - indicates flow direction	Contact closed when flow is in direction of arrow on meter
			√	VIOLET		
				DIAGNOSTIC SIGNALS		
		√	√	ORANGE	Bottom turbine frequency	These signals are for diagnostic purposes - connect to local display or BTU meter
		√	√	WHITE	Top turbine frequency	

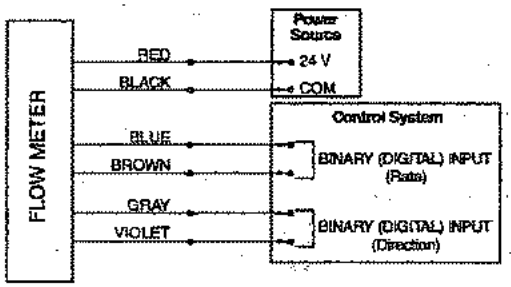
F-1120 / F-1220 / F-1320 Wiring Diagram

Connections to a Control System (No Display or BTU Meter)



FB-1220 Wiring Diagram

Connections to a Control System (No Display or BTU Meter)



NOTES:
* 1. Serial Numbers 115691 and earlier require 24 VDC. Serial Numbers 115692 and higher can accept 24 V AC/DC.
2. Black wire is common with the pipe (typically earth ground).
3. For ONICON display module or BTU meter, connect all wires provided. Refer to wiring diagram provided with display or BTU meter.

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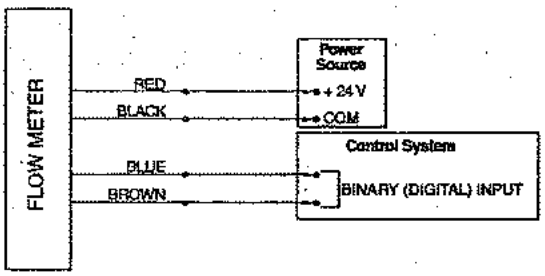
FLOW METER WIRING INFORMATION

User Connections for Models with Scaled Output
Models: F-1130, F-1230, FB-1230 & F-1330

F-1130 Single Turbine	F-1330 Inline	F-1230 Dual Turbine	FB-1230 Bi-Directional	Wiring Information		
				WIRE COLOR CODE		NOTES
√	√	√	√	RED*	(+) 24 ± 4 V AC/DC supply voltage	Connect to power supply positive
√	√	√	√	BLACK	(–) Common ground (Common with pipe ground)	Connect to power supply negative
√	√	√	√	GREEN	(+) Frequency output signal: 0-15 V peak pulse	Required when meter is connected to local display or BTU meter
√	√	√	√	BLUE	Dry contact scaled output	Scaled to provide one pulse per volumetric unit Examples: 1 pulse per 10 gal. 1 pulse per 100 gal.
√	√	√	√	BROWN		
			√	GRAY	Dry contact directional output - indicates flow direction	Contact closed when flow is in direction of arrow on meter
			√	VIOLET		
				DIAGNOSTIC SIGNALS		
		√	√	ORANGE	Bottom turbine frequency	These signals are for diagnostic purposes - connect to local display or BTU meter
		√	√	WHITE	Top turbine frequency	

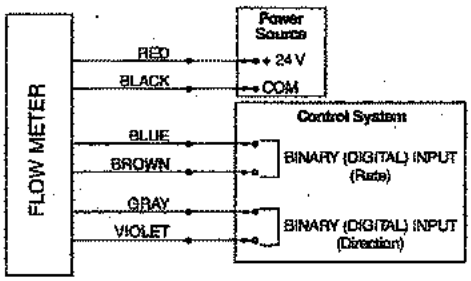
F-1130 / F-1230 / F-1330 Wiring Diagram

Connections to a Control System (No Display or BTU Meter)



FB-1230 Wiring Diagram

Connections to a Control System (No Display or BTU Meter)



NOTES:
* 1. Serial Numbers 115691 and earlier require 24 VDC. Serial Numbers 115692 and higher can accept 24 V AC/DC.
2. Black wire is common with the pipe (typically earth ground).
3. For ONICON display module or BTU meter, connect all wires provided. Refer to wiring diagram provided with display or BTU meter.
4. This is NOT a "loop-powered" instrument. DO NOT connect power to any of the signal output wires (blue, brown, green, orange or white)

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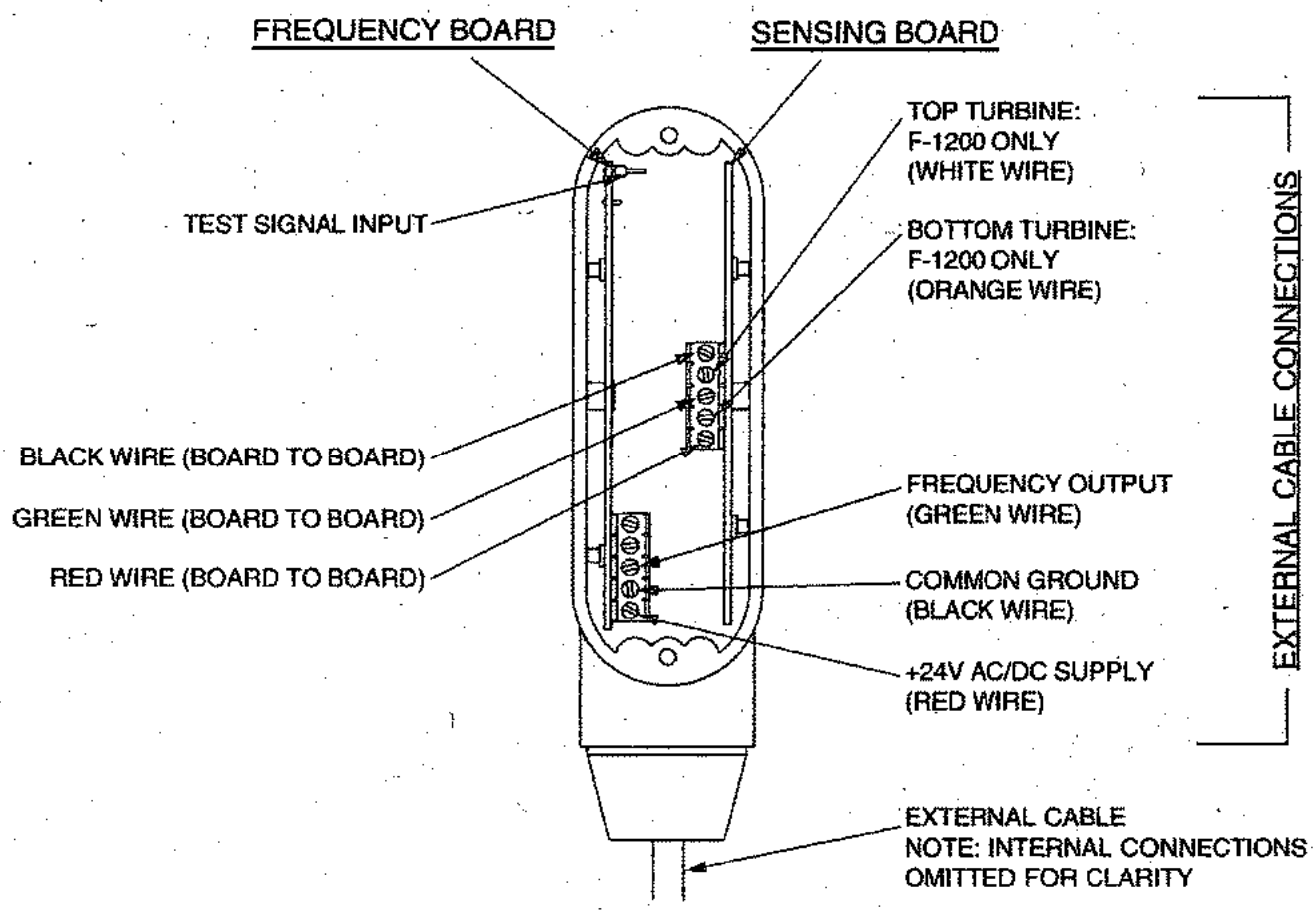
APPENDIX B

Internal Wiring Diagrams

WIRING DIAGRAM
INTERNAL CONNECTIONS FOR
FREQUENCY OUTPUT
FLOW METERS
MODELS F-1100 / F-1200 / F-1300

For use with serial numbers
115692 and later

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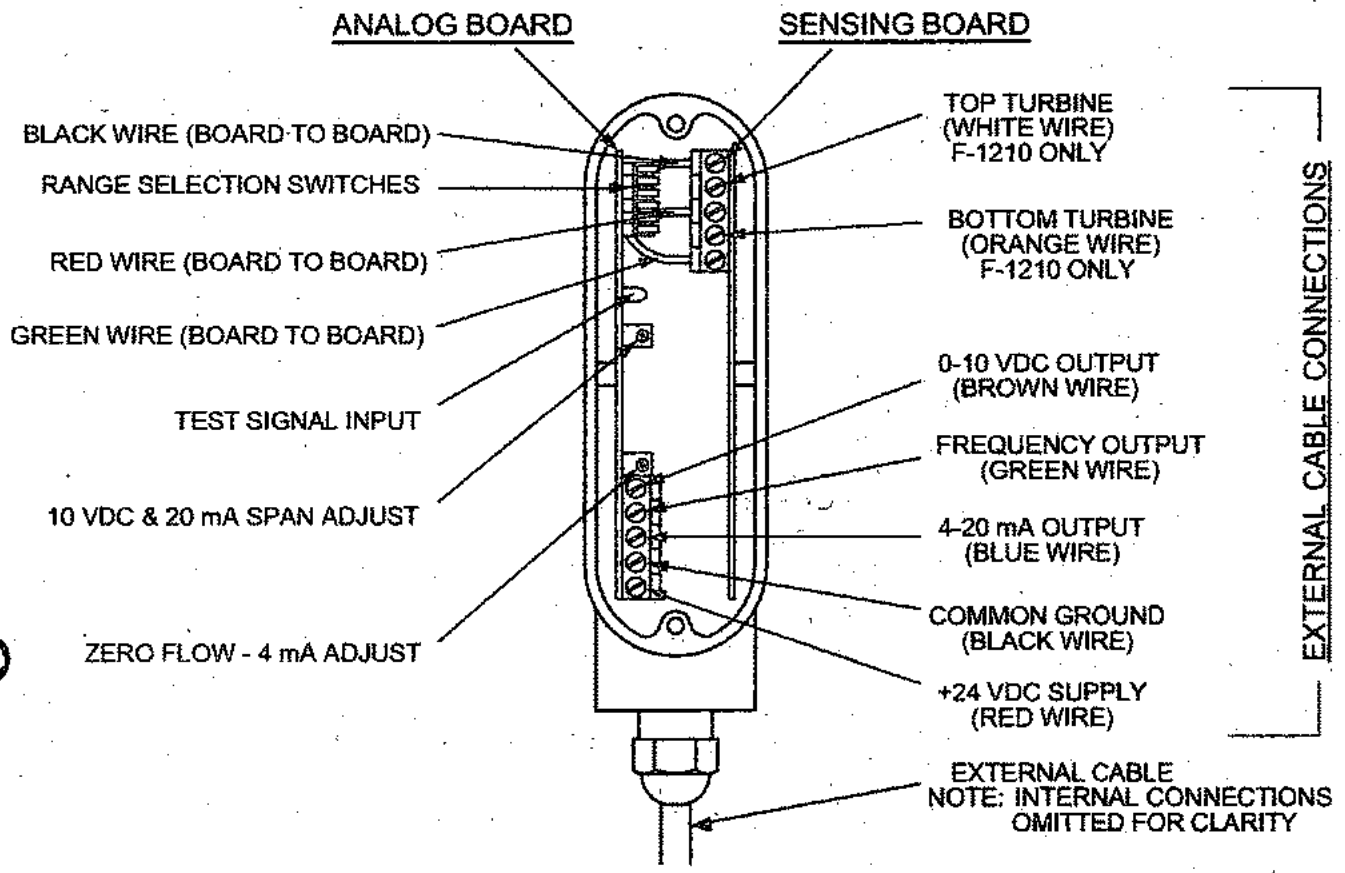


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WIRING DIAGRAM
INTERNAL CONNECTIONS FOR NON-ISOLATED ANALOG OUTPUT FLOW METERS
MODELS F-1110 / F-1210 / F-1310

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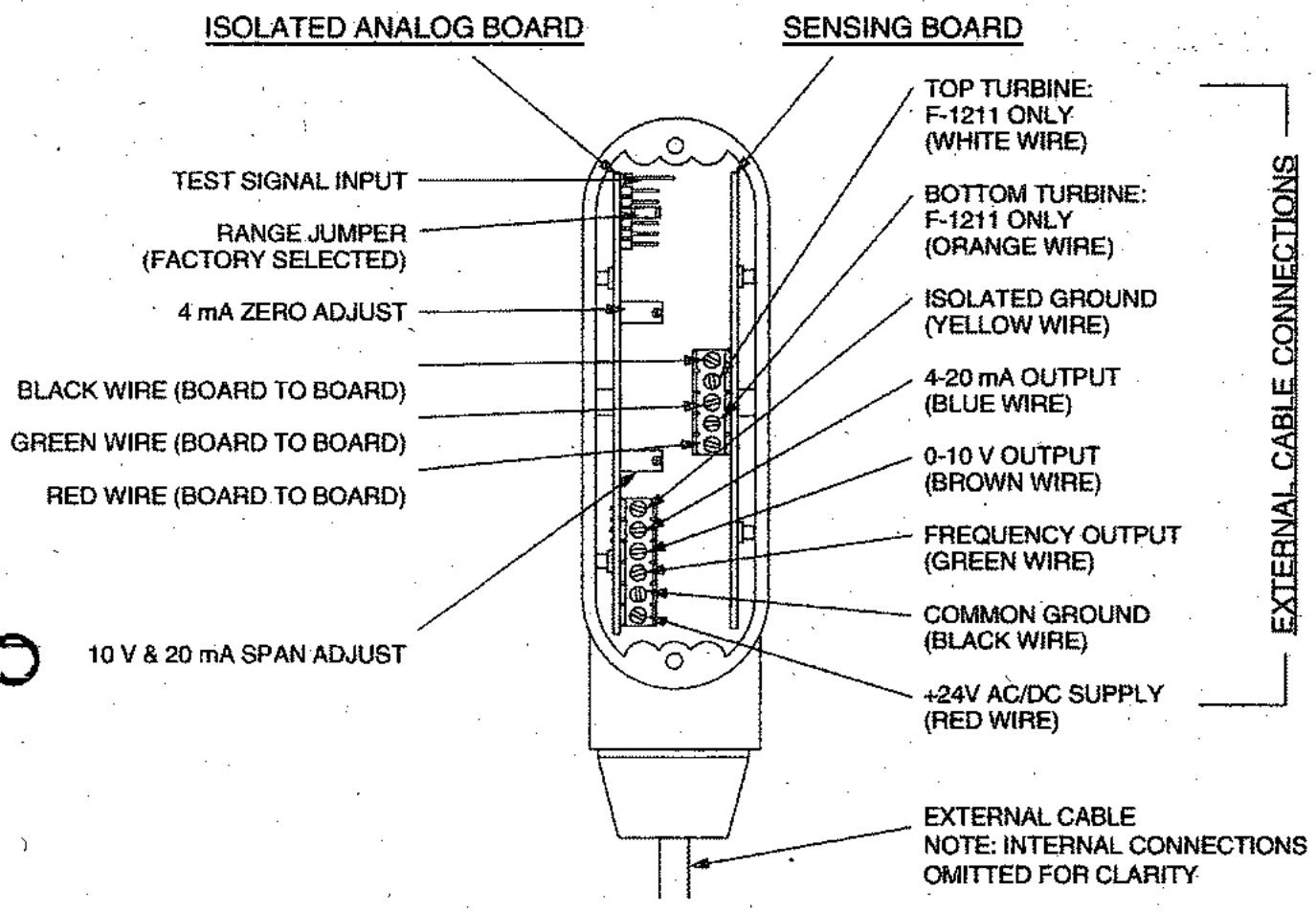
NOTES:

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WIRING DIAGRAM
INTERNAL CONNECTIONS FOR ISOLATED ANALOG OUTPUT FLOW METERS
MODELS F-1111 / F-1211 / F-1311

For use with serial numbers
115692 and later

ONICON INCORPORATED



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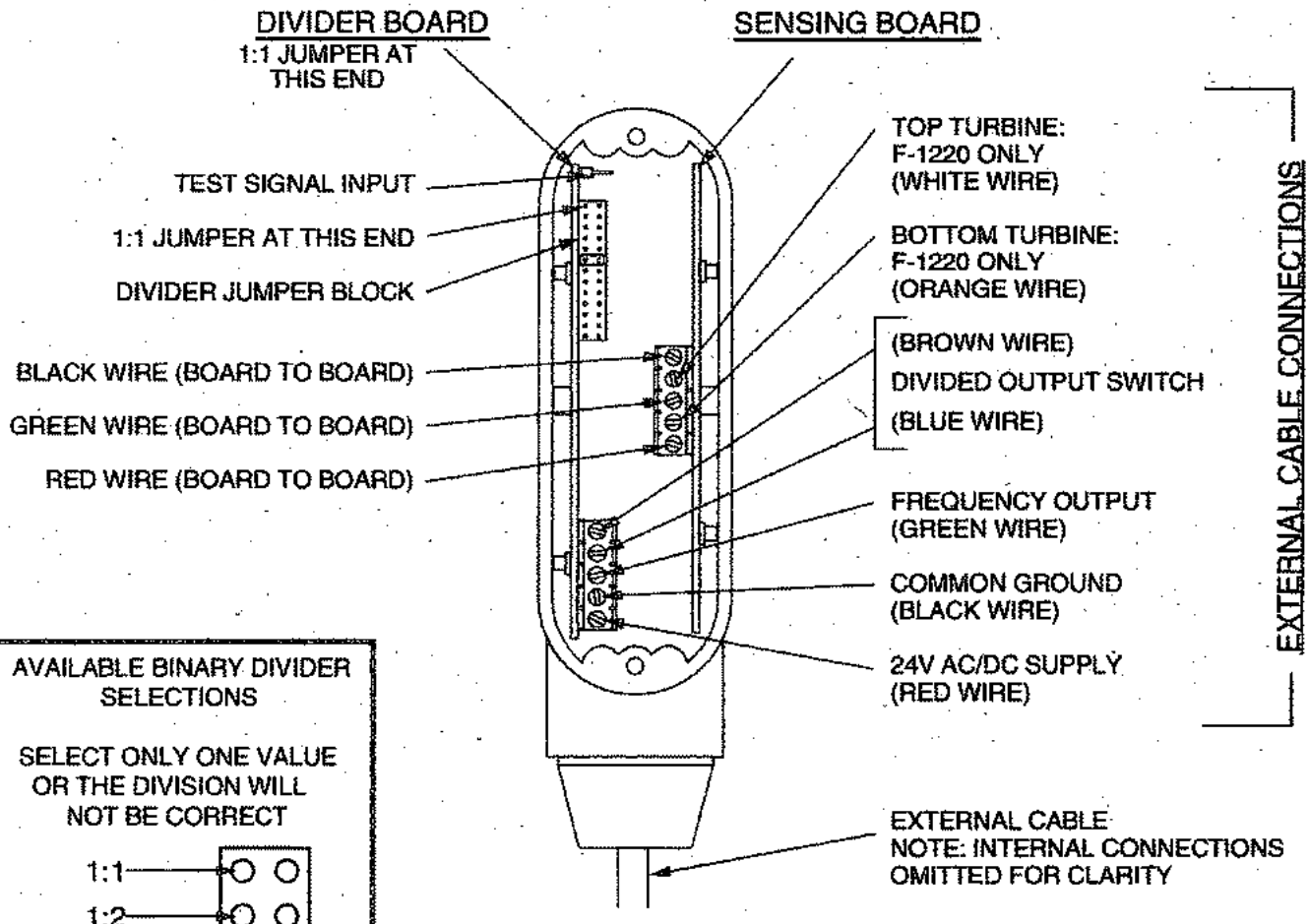
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WIRING DIAGRAM
INTERNAL CONNECTIONS FOR DIVIDED OUTPUT FLOW METERS
MODELS F-1120 / F-1220 / F-1320

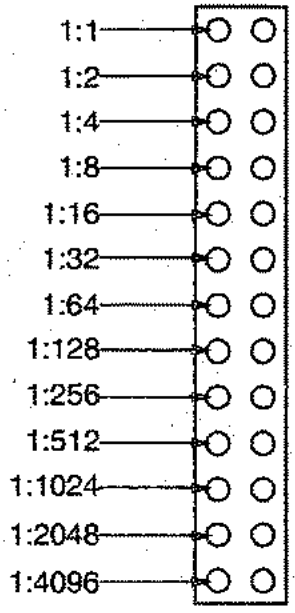
ONICON INCORPORATED

For use with serial numbers
115692 and later



AVAILABLE BINARY DIVIDER SELECTIONS

SELECT ONLY ONE VALUE OR THE DIVISION WILL NOT BE CORRECT



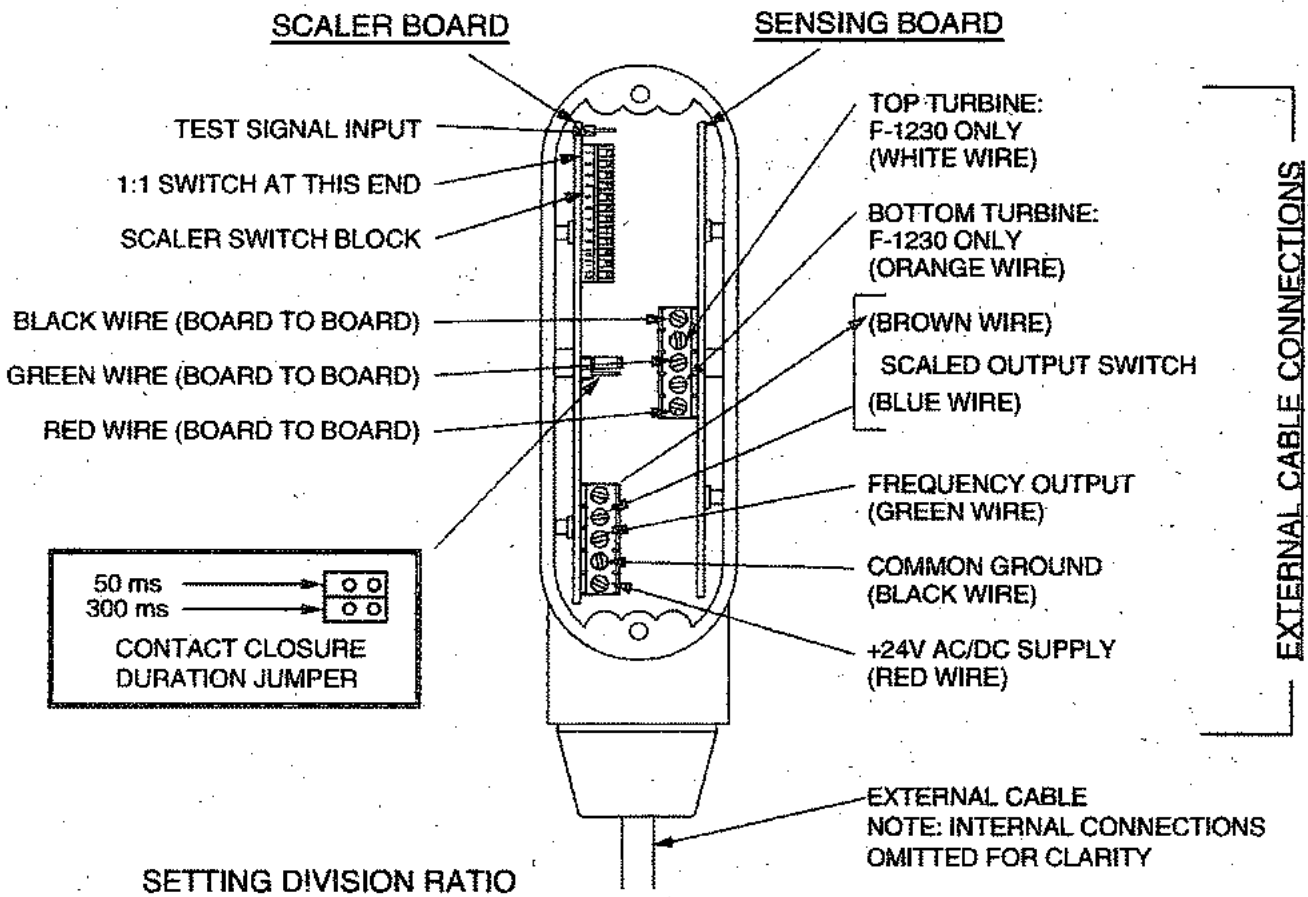
NOTES:

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WIRING DIAGRAM
INTERNAL CONNECTIONS FOR SCALED OUTPUT FLOW METERS
MODELS F-1130 / F-1230 / F-1330

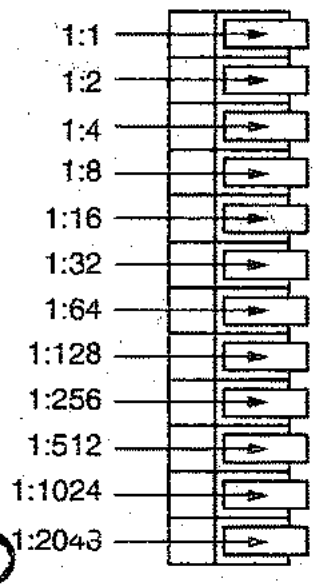
For use with serial numbers
115692 and later

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SETTING DIVISION RATIO

Available binary scaler selections



To set division ratio, turn ON each switch that is required to produce an arithmetic sum equal to the desired ratio. For example:

SW	VAL
1	1
2	2
3	4
4	8
5	16
6	32
7	64
8	128
9	256
10	512
11	1024
12	2048

DESIRED RATIO = 629
Subtract the largest possible switch value.

629 - 512=117
117 - 64=53
53 - 32=21
21 - 16=5
5 - 4=1
1 - 1=0

512+64+32+16+4+1=629

SET SWITCHS
10, 7, 6, 5, 3, & 1
TO "ON"

NOTES:

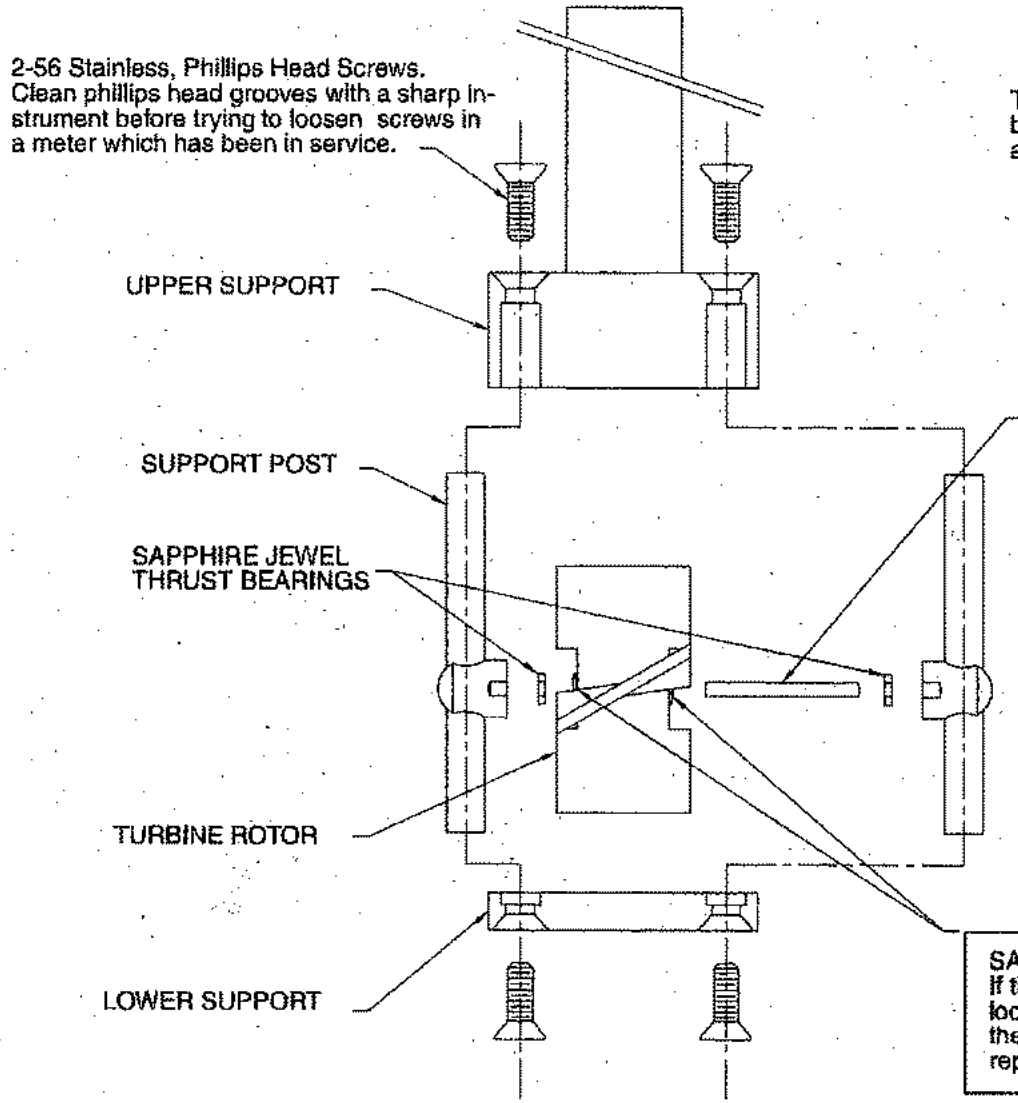
2161 Logan St, Clearwater, Florida 33765 Tel (727) 447-6140 Fax (727) 442-5699

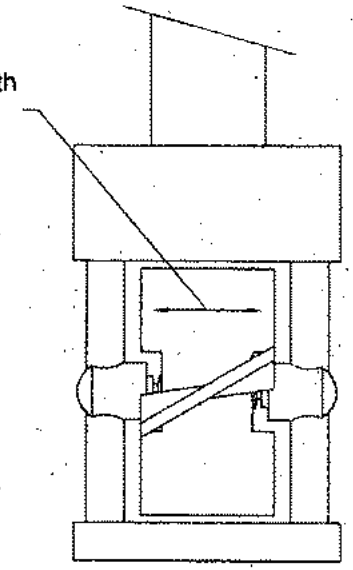
APPENDIX C

Turbine Assembly Detail Drawings

TURBINE ASSEMBLY DETAILS
for
ALL MODELS IN F-1100 SERIES

ONICON INCORPORATED





Replace turbines in the same end-for-end relationship to the direction of flow. (Mark one end of the turbine and the same end of the upper support with a permanent felt tip marker)

After re-assembly, test the turbine for free rotation by gently blowing on the turbine PARALLEL TO ITS SHAFT. The turbine must spin freely and must have a minimum of .015" of free end play.

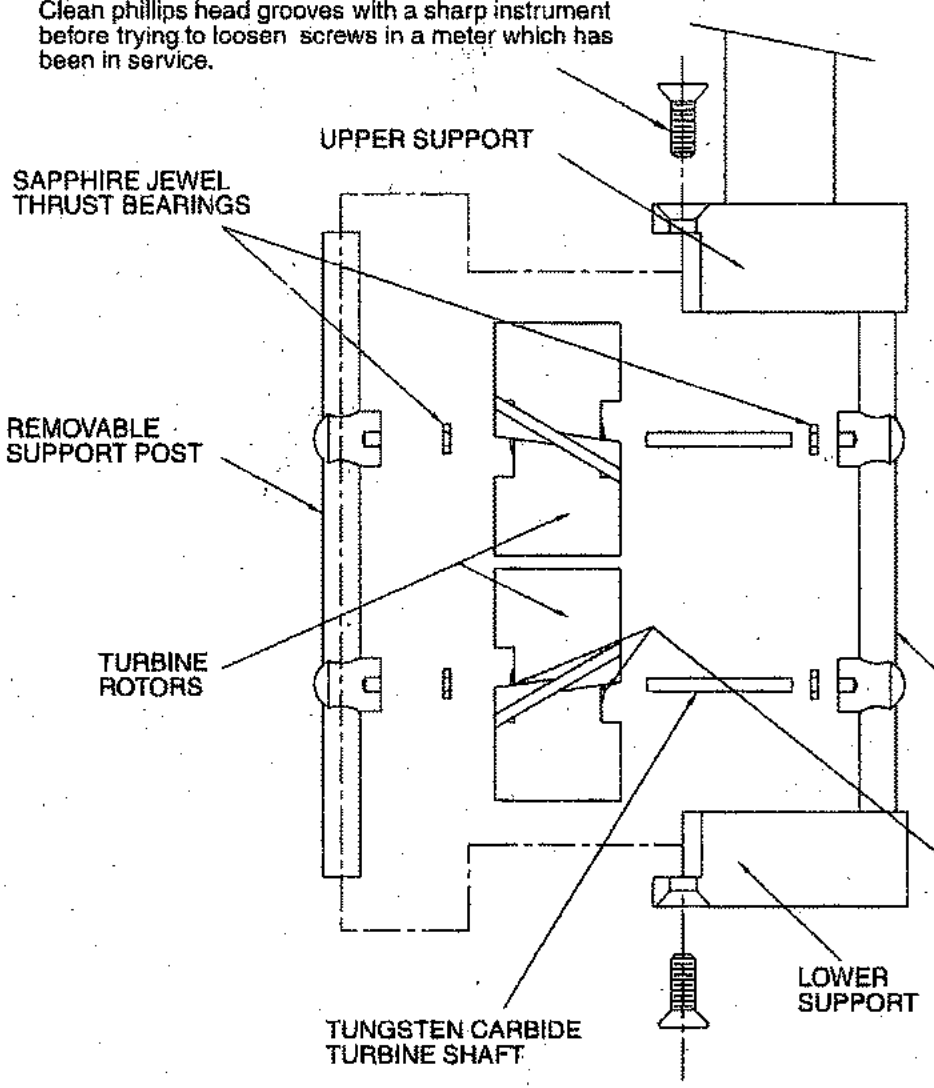
SAPPHIRE JEWEL RADIAL BEARINGS
If these bearings are removed from the turbine or loosened at all, the flow meter must be returned to the factory for recalibration or the turbine must be replaced.

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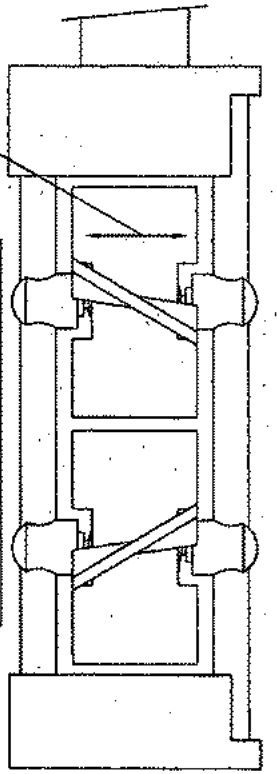
TURBINE ASSEMBLY DETAILS
for
ALL MODELS IN F-1200 SERIES

ONICON INCORPORATED

2-56 STAINLESS, PHILLIPS HEAD SCREWS.
Clean phillips head grooves with a sharp instrument before trying to loosen screws in a meter which has been in service.



Turbines must be free to slide back and forth on the shaft with at least .015" of movement.



Replace turbines in the same upper or lower location and in the same end-for-end relationship to the direction of flow. (Mark one end of each turbine and the same end of the upper support with a permanent felt tip marker)

After re-assembly, test the turbines for free rotation by gently blowing on the turbines PARALLEL TO THEIR SHAFTS. The turbines must spin freely and must have a minimum of .015" of free end play.

NON-REMOVABLE SUPPORT POST

SAPPHIRE JEWEL RADIAL BEARINGS
If these bearings are removed from the turbines or loosened at all, the flow meter must be returned to the factory for recalibration or the turbines must be

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RH Series — General Purpose Midget Relays

Key features of the RH series include:

- **Compact midget size saves space**
- **High switching capacity (10A)**
- **Choice of blade or PCB style terminals**
- **Relay options include indicator light, check button, and top mounting bracket**
- **DIN rail, surface, panel, and PCB type sockets available for a wide range of mounting applications**



UL Recognized
Files No. E67770
E59804
E64245

CSA Certified
File No.LR35144

TUV File No. BL9511113332319

CE

D

Specifications

Contact Material	Silver cadmium oxide
Contact Resistance	50mΩ maximum (initial value)
Minimum Applicable Load	24V DC/30mA, 5V DC/100mA (reference value)
Operating Time	SPDT (RH1), DPDT (RH2): 20ms maximum 3PDT (RH3), 4PDT (RH4): 25ms maximum
Release Time	SPDT (RH1), DPDT (RH2): 20ms maximum 3PDT (RH3), 4PDT (RH4): 25ms maximum
Power Consumption	**SPDT** (RH1): DC: 0.8W AC: 1.1VA (50Hz), 1VA (60Hz) **DPDT** (RH2): DC: 0.9W AC: 1.4VA (50Hz), 1.2VA (60Hz) **3PDT** (RH3): DC: 1.5W AC: 2VA (50Hz), 1.7VA (60Hz) **4PDT** (RH4): DC: 1.5W AC: 2.5VA (50Hz), 2VA (60Hz)
Insulation Resistance	100MΩ min (measured with a 500V DC megger)
Dielectric Strength	**SPDT** (RH1) Between live and dead parts: 2,000V AC, 1 minute; Between contact circuit and operating coil: 2,000V AC, 1 minute; Between contacts of the same pole: 1,000V AC, 1 minute
	DPDT (RH2), **3PDT** (RH3), **4PDT** (RH4) Between live and dead parts: 2,000V AC, 1 minute; Between contact circuit and operating coil: 2,000V AC, 1 minute; Between contact circuits: 2,000V AC, 1 minute; Between contacts of the same pole: 1,000V AC, 1 minute
Frequency Response	1,800 operations/hour
Temperature Rise	Coil: 85°C maximum Contact: 65°C maximum
Vibration Resistance	0 to 6G (55Hz maximum)
Shock Resistance	SPDT/DPDT: 200N (approximately 20G) 3PDT/4PDT: 100N (approximately 10G)
Life Expectancy	Electrical: over 500,000 operations at 120V AC, 10A; (over 200,000 operations at 120V AC, 10A for SPDT [RH1], 3PDT [RH3], 4PDT [RH4]) Mechanical: 50,000,000 operations
Operating Temperature	–30 to +70°C
Weight	SPDT: 24g, DPDT: 37g (approximately) 3PDT: 50g, 4PDT: 74g (approximately)

See page D-39 for dimensions.

Operational Characteristics

Maximum Continuous Applied Voltage (AC/DC) at 20°C	110% of the rated voltage
Minimum Operating Voltage (AC/DC) at 20°C	80% of the rated voltage
Drop-Out Voltage (AC)	30% or more of the rated voltage
Drop-Out Voltage (DC)	10% or more of the rated voltage

Ordering Information

Order standard voltages for fastest delivery. Allow extra delivery time for non-standard voltages.

Basic Part No.	Coil Voltage:
RH2B-U	**AC110-120V**

Part Numbers

Part Numbers: RH Series with Options

Termination	Contact Configuration	Basic Part No.	Indicator Light	Check Button	Indicator Light and Check Button	Top Bracket
B (blade)	SPDT	RH1B-U	RH1B-L*	—	—	RH1B-UT
	DPDT	RH2B-U	RH2B-UL	RH2B-UC	RH2B-ULC	RH2B-UT
	3PDT	RH3B-U	RH3B-UL	RH3B-UC	RH3B-ULC	RH3B-UT
	4PDT	RH4B-U	RH4B-UL	RH4B-UC	RH4B-ULC	RH4B-UT
V2 (PCB 0.078" [2mm] wide)	SPDT	RH1V2-U	RH1V2-L*	—	—	—
	DPDT	RH2V2-U	RH2V2-UL	RH2V2-UC	RH2V2-ULC	—
	3PDT	RH3V2-U	RH3V2-UL	RH3V2-UC	RH3V2-ULC	—
	4PDT	RH4V2-U	RH4V2-UL	RH4V2-UC	RH4V2-ULC	—

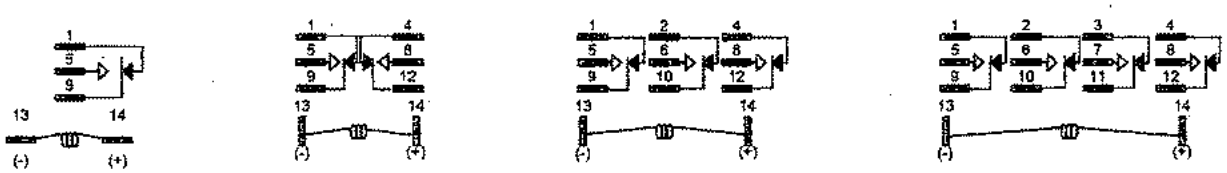
1. * *RH1B(V2)-L is not UL recognized.*
2. *For Coil and Contact Ratings, see the next page.*

Part Numbers: Sockets

Relay	Standard DIN Rail Mount	Finger-Safe DIN Rail Mount	Surface Mount	Panel Mount	PCB Mount	Spring (optional)
RH1B	SH1B-05	SH1B-05C	—	SH1B-51	SH1B-62	SY2S-02F1 SFA-103 SFA-202 SY4S-51F1 SFA-301 SFA-302
RH2B	SH2B-05	SH2B-05C	SH2B-02	SH2B-51	SH2B-62	SY4S-02F1 SFA-101 SFA-202 SY4S-51F1
RH3B	SH3B-05	SH3B-05C	—	SH3B-51	SH3B-62	SH3B-05F1 SFA-101, -202 SY4S-51F1
RH4B	SH4B-05	SH4B-05C		SH4B-51	SH4B-62	SH4B-02F1 SFA-101, -202 SY4S-51F1

3. *See Section F for details on sockets. All DIN rail mount sockets shown above can be mounted using DIN rail BNDN1000.*

Internal Circuit



Ratings

Coil Ratings

Rated Voltage		Rated Current ±15% at 20°C								Coil Resistance ±15% at 20°C			
		60Hz				50Hz							
		SPDT		DPDT		3PDT		4PDT		SPDT	DPDT	3PDT	4PDT
AC	6V	150mA	200mA	280mA	330mA	170mA	238mA	330mA	387mA	18.8Ω	9.4Ω	6.0Ω	5.4Ω
	12V	75mA	100mA	140mA	165mA	86mA	118mA	165mA	196mA	76.8Ω	39.3Ω	25.3Ω	21.2Ω
	24V	37mA	50mA	70mA	83mA	42mA	59.7mA	81mA	98mA	300Ω	153Ω	103Ω	84.5Ω
	120V*	7.5mA	11mA	14.2mA	16.5mA	8.6mA	12.9mA	16.4mA	19.5mA	7,680Ω	4,170Ω	27,70Ω	22,20Ω
	240V†	3.2mA	5.5mA	7.1mA	8.3mA	3.7mA	6.5mA	8.2mA	9.8mA	3,1200Ω	15,210Ω	12,100Ω	91,20Ω
		SPDT		DPDT		3PDT		4PDT		SPDT	DPDT	3PDT	4PDT
DC	6V	128mA		150mA		240mA		250mA		47Ω	40Ω	25Ω	24Ω
	12V	64mA		75mA		120mA		125mA		188Ω	160Ω	100Ω	96Ω
	24V	32mA		36.9mA		60mA		62mA		750Ω	650Ω	400Ω	388Ω
	48V	18mA		18.5mA		30mA		31mA		2,660Ω	2,600Ω	1,600Ω	15,50Ω
	110V‡	8mA		9.1mA		12.8mA		15mA		13,800Ω	12,100Ω	8,600Ω	7,340Ω

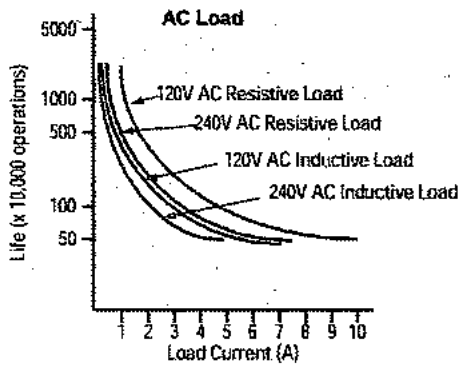
** For RH2 relays = 110/120V AC.*
† For RH2 relays = 220/240V AC.
‡ For RH2 relays = 100/110V DC.

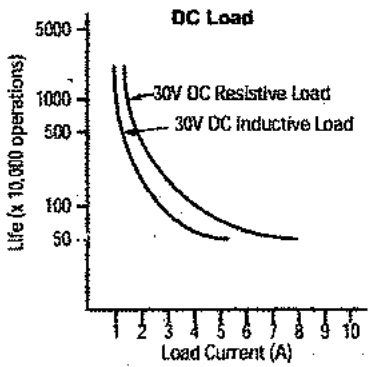
Contact Ratings

		Resistive				Inductive				Motor Load	
Voltage	Rating	SPDT	DPDT	3PDT	4PDT	SPDT	DPDT	3PDT	4PDT	SPDT	DPDT
28V DC	UL	10A	10A	10A	10A	7.5A	—	—	7.5A	—	—
30V DC	UL	10A	10A	10A	—	7A	7A	—	—	—	—
	CSA				10A		7.5A			—	—
	Nominal							7.5A	7.5A	—	—
110V DC	Nominal	0.5A	0.5A	0.5A	0.5A	0.3A	0.3A	0.3A	0.3A	—	—
120V AC	UL	10A	10A	10A	10A	7.5A	—	—	7.5A	1/6	1/6
	CSA						7.5A			—	—
	Nominal					7A		7.5A			
240V AC	UL	10A	10A	—	7.5A	7A	7A	*	5A	1/3	1/3
	CSA							7A		—	—
	Nominal	7A	7.5A	7.5A	4.5A	5A	5A	5A			

*1. * 6.5A/pole, 20A total.*
2. Inductive load cos α = 0.3, L/R = 7ms.

Electrical Life Curves

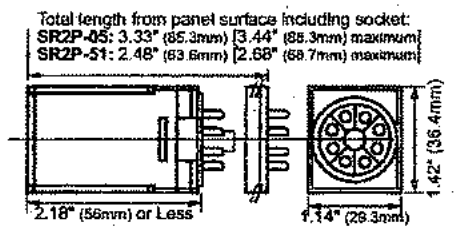




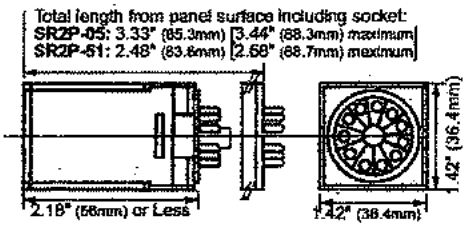
General Purpose and Latching Relay Dimensions

RR Series

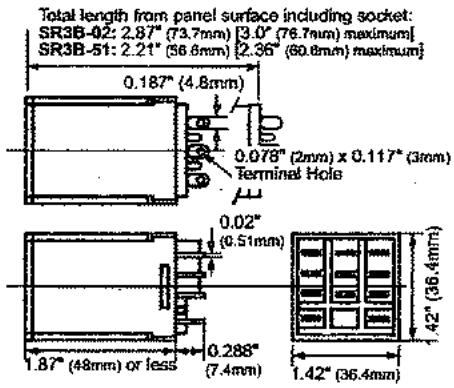
8-Pin
RR2P



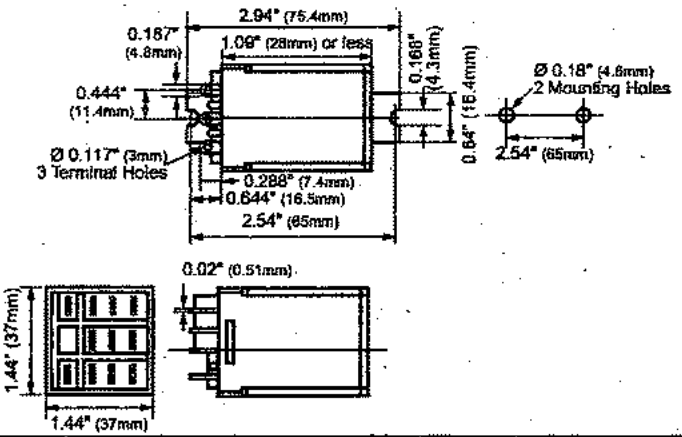
11-Pin
RR3PA



Blade
RR1BA, RR2BA, RR3B



Side Flange
RR1BA-US, RR2BA-US, RR3B-US

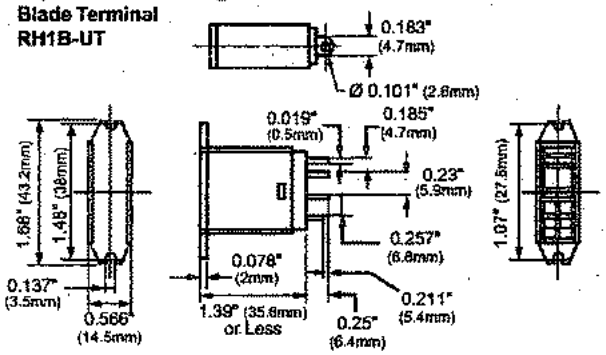


Note: Dimensions in [ ] include hold-down spring.

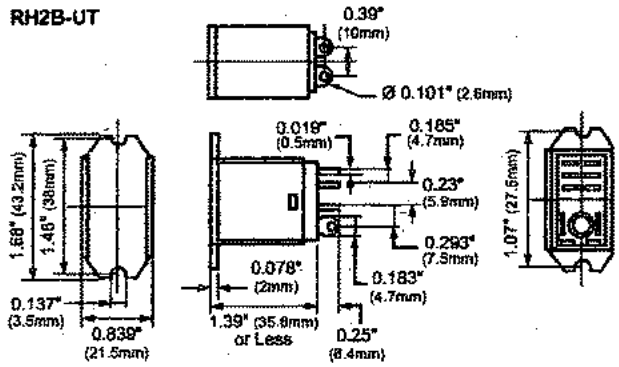
D

RH Series

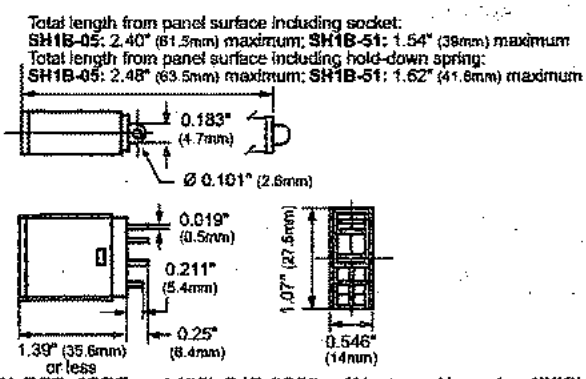
Top Bracket Mounting
Blade Terminal
RH1B-UT



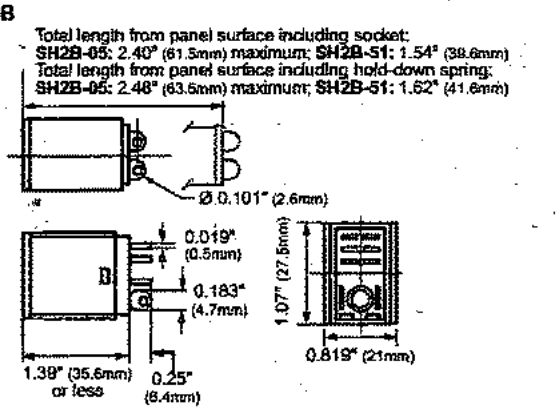
RH2B-UT



Plug-in
Blade Terminal
RH1B



RH2B



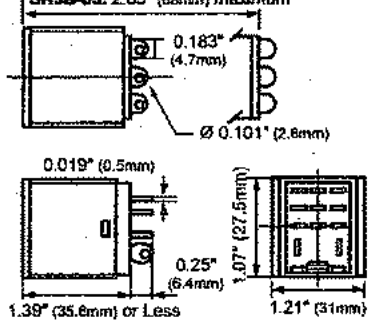
Dimensions, continued

RH Series, continued

Plug-in
Blade Terminal

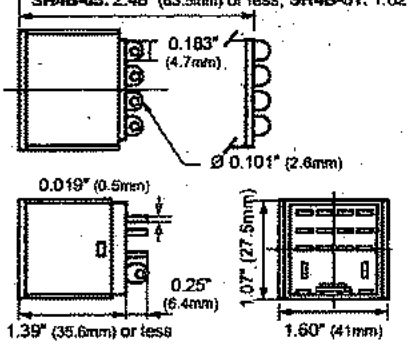
RH3B

Total length from panel surface including socket:
SH3B-05: 2.57" (66mm) maximum
Total length from panel surface including hold-down spring:
SH3B-05: 2.65" (68mm) maximum



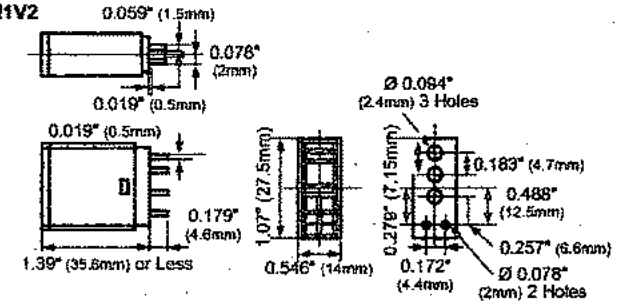
RH4B

Total length from panel surface including socket:
SH4B-05: 2.40" (61.5mm) or less; **SH4B-51:** 1.54" (39.6mm)
Total length from panel surface including hold-down spring:
SH4B-05: 2.48" (63.5mm) or less; **SH4B-51:** 1.62" (41.6mm)

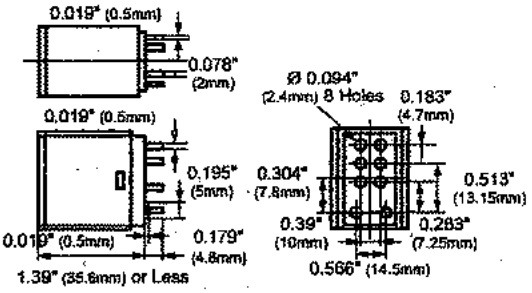


PCB Terminal

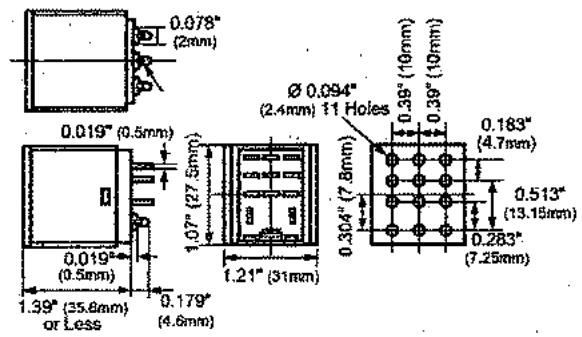
RH1V2



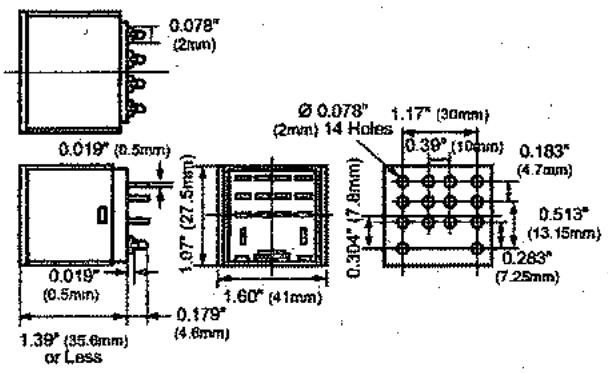
RH2V2



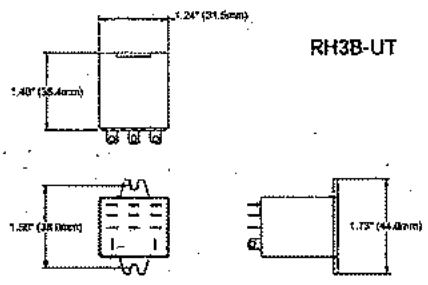
RH3V2



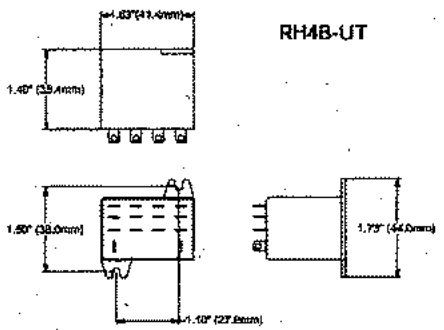
RH4V2



RH3B-UT

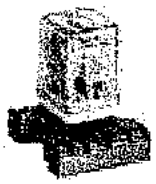


RH4B-UT



Selection Guides, continued

General Purpose Relays

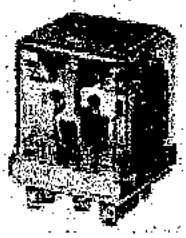
	RR Series	RH Series	RM Series	RY Series
Appearance				
Page	D-8	D-11	D-14	D-17
Features	• Highly reliable • Large capacity • 8-pin, 11-pin, or 11-blade plug-in base • 1 to 3 pole switching • AC or DC coils	• Compact midget size • Highly reliable • Large capacity • AC or DC coils • 1 to 4 pole switching	• Compact miniature size • Highly reliable • AC or DC coils	• Compact ice-cube size • 2- or 4-pole switching • Bifurcated contacts for dry circuit switching
Options	Indicator light Check button Side flange	Indicator light Check button Top mount	Indicator light Check button Top mount	Indicator light Check button Top mount
Contact Configuration	1, 2, 3 Form C	1, 2, 3, 4 Form C	2 Form C	2, 4 Form C
Contact Rating (resistive)	10A, 30V DC 10A, 120V, 240V AC 1/3HP, 240V AC 1/4HP, 120V AC	10A, 30V DC 10A, 120V, 240V AC 1/3HP, 240V AC 1/6HP, 120V AC	5A, 30V DC 5A, 120V AC, 240V AC	DPDT: 3A, 30V DC; 3A, 120V AC, 240V AC 4PDT: 5A, 30V DC; 5A, 120V AC, 240V AC
Contact Material	Silver	Silver-cadmium oxide	Silver	Silver, gold-plated
Minimum Electrical Life	500,000 operations (10A, 120V AC)	500,000 operations (10A, 120V AC)	500,000 operations (5A, 240V AC)	200,000 operations (DPDT: 3A, 120V AC) (4PDT: 5A, 120V AC)
Minimum Mechanical Life	10,000,000 operations	50,000,000 operations	50,000,000 operations	50,000,000 operations
Dielectric Strength (between contact and coil)	2,000V AC, 1 minute	2,000V AC, 1 minute	2,000V AC, 1 minute	2,000V AC, 1 minute (4-pole version)
Coil Voltage	6, 12, 24, 48, 110V DC	6, 12, 24, 48, 110V DC	6, 12, 24, 48, 110V DC	6, 12, 24, 48, 110V DC
	6, 12, 24, 120, 240V AC	6, 12, 24, 120, 240V AC	6, 12, 24, 120, 240V AC	6, 12, 24, 120, 240V AC
Power Consumption (approximately)	2.5VA/1.5W	SPDT: 1VA/0.8W 2PDT: 1.2VA/0.9W 3PDT: 1.7VA/1.5W 4PDT: 2VA/1.5W	1.4VA/0.9W	DPDT: 1.0VA/0.8W 4PDT: 1.2VA/0.9W
Termination	Pin/Blade	Blade/PCB	Blade/PCB	Blade/PCB
Sockets	SR2P SR3P SR3B	SH1B SH2B SH3B SH4B	SY4S	SY2S SY4S
Approvals	UL Recognized Files No. E67770 E59804 E64245 CSA Certified File No.LR35144 TÜV PRODUCT SERVICE * File No. BL951113332319 CE *	UL Recognized Files No. E59804 E64245 CSA Certified File No.LR35144 TÜV PRODUCT SERVICE * File No. BL951113332319 CE *		

D

* *CE marking and TUV ratings do not apply to RR blade style relays.*

Selection Guides, continued

General Purpose Latching Relays

	RR2KP Series	RH2L Series	RY2KS Series	RY2L Series
Appearance				
Page	D-20	D-22	D-24	D-26
Features	• Magnetic dual coil • Self-maintaining without power • Separate set and reset coils • AC or DC coils	• Midget size latch relay • 10A capacity • Dual coil • Power saving pulse input • Indicator shows set-reset condition • AC or DC coils	• Magnetic dual coil • Self-maintaining without power • Separate set and reset coil • AC or DC coils	• Miniature size latch relay • 3A capacity • Dual coil • Power saving pulse input • Mechanical indicator to show set/reset condition • AC or DC coils
Options	Check button	—	Check button	—
Contact Configuration	2 Form C	2 Form C	2 Form C	2 Form C
Contact Rating (resistive)	10A, 30V DC 10A, 120V AC	10A, 30V DC 7.5A, 240V AC 10A, 120V AC	3A, 30V DC 3A, 120V AC	3A, 30V DC 3A, 120V AC 3A, 240V AC
Contact Material	Silver	Silver-cadmium oxide	Silver, gold-plated	Silver, gold-flashed
Minimum Electrical Life	500,000 operations	200,000 operations	200,000 operations	200,000 operations
Minimum Mechanical Life	5,000,000 operations	10,000,000 operations	5,000,000 operations	10,000,000 operations
Dielectric Strength (between contact and coil)	1,500V AC, 1 minute	2,000V AC, 1 minute	1,500V AC, 1 minute	1,500V AC, 1 minute
Coil Voltage	6, 12, 24, 110V DC 6, 12, 24, 120, 240V AC	6, 12, 24V DC 6, 12, 24, 120V AC	6, 12, 24, 110V DC 6, 12, 24, 120, 240V AC	6, 12, 24V DC 6, 12, 24, 120V AC
Power Consumption	AC: 2.2VA DC: 1.5W	1.2VA/2W (set) 0.5VA/0.9W (reset)	AC: 1.5VA DC: 1.2W	0.7VA/1.2W (set) 0.35VA/0.6W (reset)
Termination	Pin	Blade/PCB	Blade	Blade/PCB
Sockets	SR3P	SH3B	SY4S	SY4S
Approvals	UL Recognized Files No. E67770 E55996		CSA Certified File No.LR35144	

Sockets (for reference only)

Panel Mount



SH1B-51



SH3B-51



SY2S-61

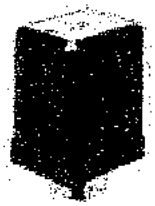


SY4S-51

For more socket information, see Section F.

Selection Guides, continued

Solid State Relays

		RSS Series	RA Series	RB Series
Appearance				
Page		D-35	D-39	D-42
Isolation Method		Phototransistor coupler	Phototransistor coupler	Phototransistor coupler
Zero-Voltage Switching		Yes	Yes	Yes
Input Rating	Voltage Range	DC: 4 – 32V AC: 90 – 280V	3 – 28V DC	3 – 28V DC
	Impedance	1500Ω (DC) 40K, +10% (AC)	1.2kΩ (approximately)	1.5kΩ (approximately)
Output Rating	Maximum Load Current	10, 25, 50, 75, and 90A	1.2A	1.5A, 2A
	Voltage Range	48 – 660V AC	70 – 250V AC	5 – 60V DC
	Drop-Out Voltage	1.5V, maximum	0.8V DC, minimum	0.8V DC, minimum
Mounting Style		Panel mount	Blade/Plug-in, Pin/Plug-in, PC mount	
Sockets		—	SR2P-... SH1B-...	SR2P-... SH1B-... SH2B-...
Approvals		CE UL Recognized Files No. E59604 CSA Certified File No.LR38595-94M	—	

D

Sockets (for reference only)

DIN Rail Mount



SR2P-05



SR3P-05C (finger-safe)



SH2B-05

DIN Rail



BNDN-1000

PC Mount



SH1B-62



SY2S-05



SY4S-05



SH-05C (finger-safe)



SH4B-62

Hold-Down Springs/Clips



SR2B-02F1



SH4B-02F1



SFA-202



SFA-301



For more details on sockets, see Section F.

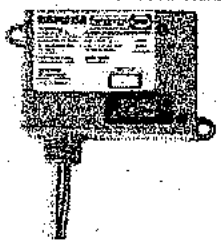
Functional Devices, Inc.
310 South Union Street
Russiaville, IN 46979
www.functionaldevices.com

Office: (765) 883-5538
Sales: (800) 888-5538
Fax: (765) 883-7505
Email: sales@functionaldevices.com

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RIB2401SB

Enclosed Relay 20 Amp SPST-N/O + Override with 24 Vac/dc/120 Vac Coil



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MADE IN USA

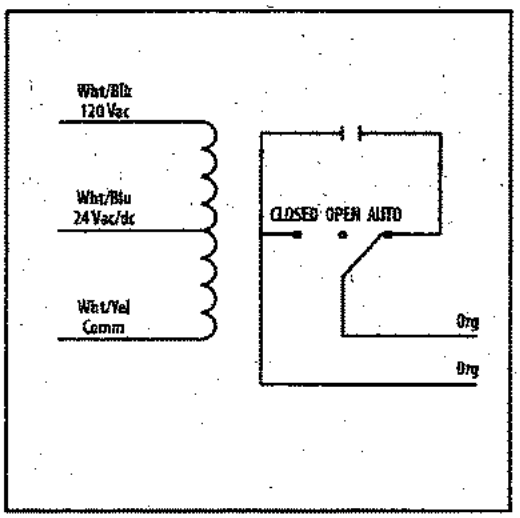
 # Relays & Contact Type: One (1) SPST Continuous Duty Coil
Expected Relay Life: 10 million cycles minimum mechanical
Operating Temperature: -30 to 140° F
Operate Time: 18mS
Relay Status: LED On = Activated
Dimensions: 2.30" x 3.20" x 1.80" with .50" NPT Hipple
Wires: 16", 600V Rated
Approvals: UL Listed, UL916, UL864, C-UL
California State Fire Marshal, CE
Housing Rating: Plenum, NEMA 1
Gold Flash: No
Override Switch: Yes

Contact Ratings:
20 Amp Resistive @ 277 Vac
20 Amp Ballast N/O @ 120/277 Vac
10 Amp Ballast N/C @ 120/277 Vac
10 Amp Tungsten N/O @ 120 Vac
770 VA Pilot Duty @ 120 Vac
1,110 VA Pilot Duty @ 277 Vac
2 HP @ 277 Vac
1 HP @ 120 Vac

Coil Current:
45 mA @ 18 Vac
75 mA @ 24 Vac
42 mA @ 120 Vac
30 mA @ 22 Vdc
32 mA @ 24 Vdc
42 mA @ 38 Vdc

Coil Voltage Input:
24 Vac/dc ; 120 Vac ; 50-60 Hz
Drop Out = 2.1 Vac / 3.8 Vdc
Pull In = 18 Vac / 22 Vdc

Notes:
» Order Normally Closed by adding "-NC" to end of model number

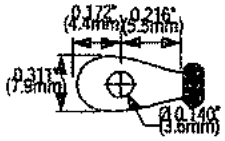


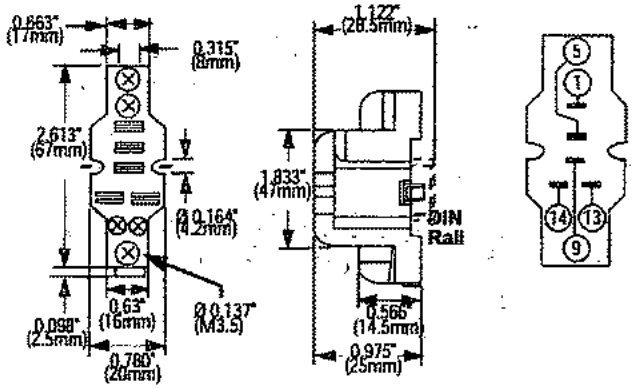
NOTES

SH Series: DIN Rail Snap-Mount Sockets

SH1B Sockets







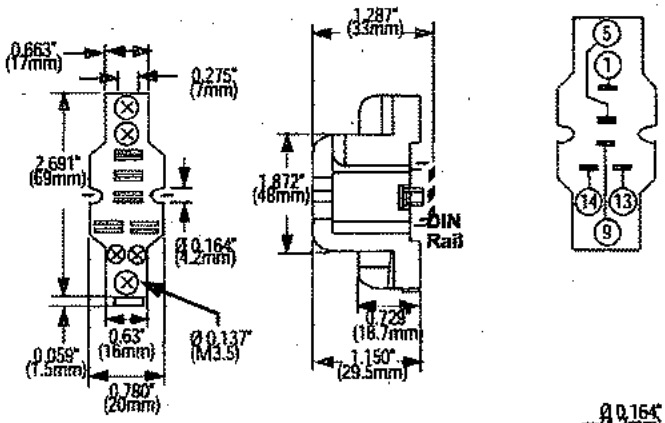
SH1B-05

Style	5-blade, snap-mount/surface mount
Terminal	(Coil) M3 screws/(contact) M3.5 screws with captive wire clamp
Wire Size	Maximum up to 2–#12AWG
Electrical Rating	250V, 10A
Compatible Relay	RH1B, RAHB, RBHB
Hold-Down Spring	SY2S-02F1
Hold-Down Clip	SFA-101, SFA-202



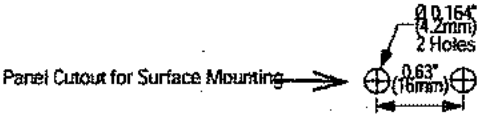
F





SH1B-05C Fingersafe

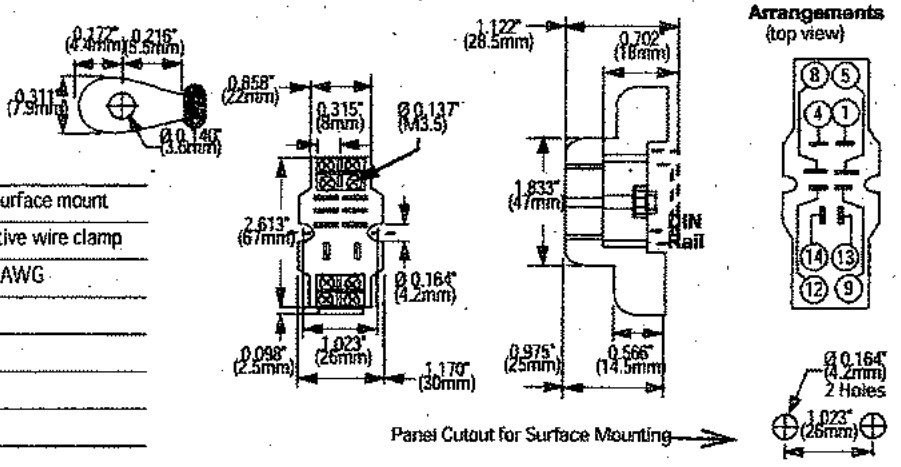
Style	5-blade, snap-mount/surface mount.
Terminal	(Coil) M3 screws/(contact) M3.5 screws with captive wire clamp, fingersafe
Wire Size	Maximum up to 2–#12AWG
Electrical Rating	250V, 10A
Compatible Relay	RH1B, RAHB, RBHB
Hold-Down Spring	SY2S-02F1
Hold-Down Clip	SFA-101, SFA-202



1. For socket mounting accessories, see page F-22.
2. For hold-down clip/spring selections, see page F-4.

SH2B Sockets

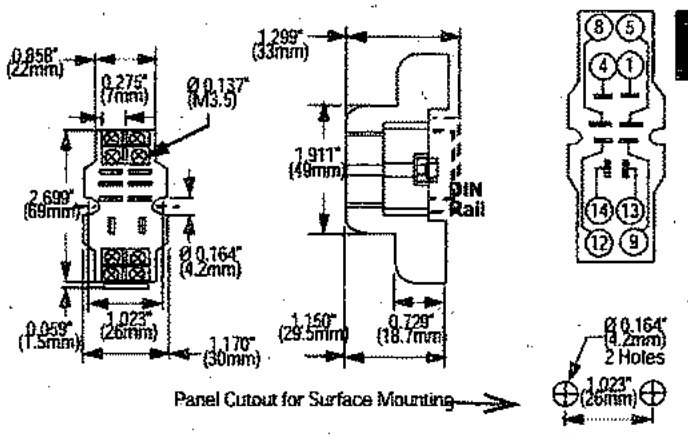




SH2B-05

Style	8-blade, snap-mount/surface mount
Terminal	M3.5 screws with captive wire clamp
Wire Size	Maximum up to 2–#12AWG
Electrical Rating	300V, 10A
Compatible Relay	RH2B, RAMB, RBMB
Hold-Down Spring	SY4S-02F1
Hold-Down Clip	SFA-101, SFA-202





SH2B-05C Fingersafe

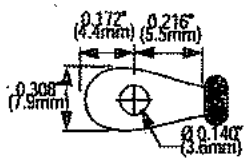
Style	8-blade, snap-mount/surface mount
Terminal	M3.5 screws with captive wire clamp, fingersafe
Wire Size	Maximum up to 2–#12AWG
Electrical Rating	300V, 10A
Compatible Relay	RH2B, RAMB, RBMB
Hold-Down Spring	SY4S-02F1
Hold-Down Clip	SFA-101, SFA-202

F

1. For socket mounting accessories, see page F-22.
2. For hold-down clip/spring selections, see page F-4.

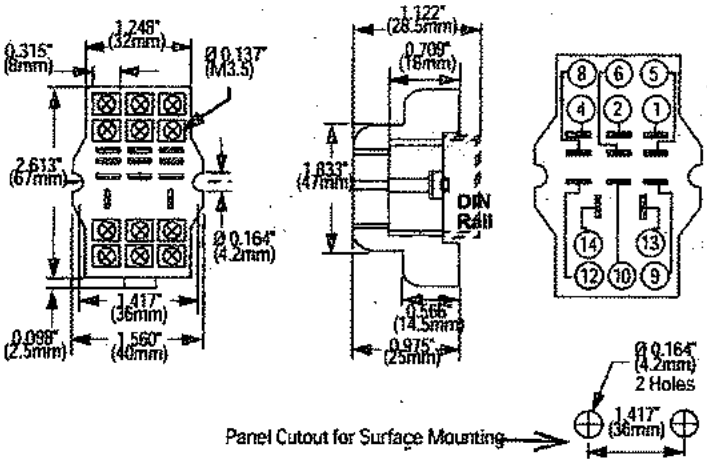
SH3B Sockets





SH3B-05

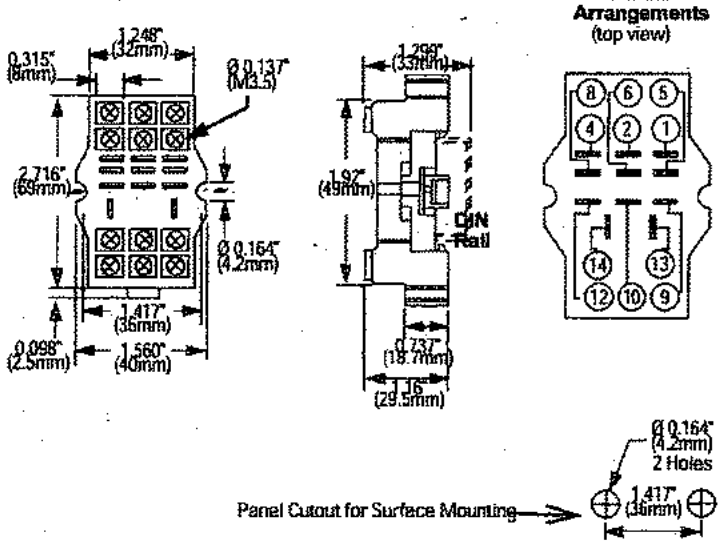
Style	11-blade, snap-mount/surface mount
Terminal	M3.5 screws with captive wire clamp
Wire Size	Maximum up to 2–#12AWG
Electrical Rating	300V, 10A
Compatible Relay	RH3B, *RH2LB (*latching relay)
Hold-Down Spring	SH3B-05F1
Hold-Down Clip	SFA-101, SFA-202





SH3B-05C Fingersafe

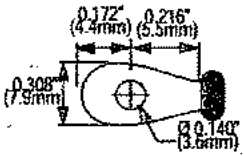
Style	11-blade, snap-mount/surface mount
Terminal	M3.5 screws with captive wire clamp, fingersafe
Wire Size	Maximum up to 2–#12AWG
Electrical Rating	300V, 10A
Compatible Relay	RH3B, *RH2LB (*latching relay)
Hold-Down Spring	SH3B-05F1
Hold-Down Clip	SFA-101, SFA-202

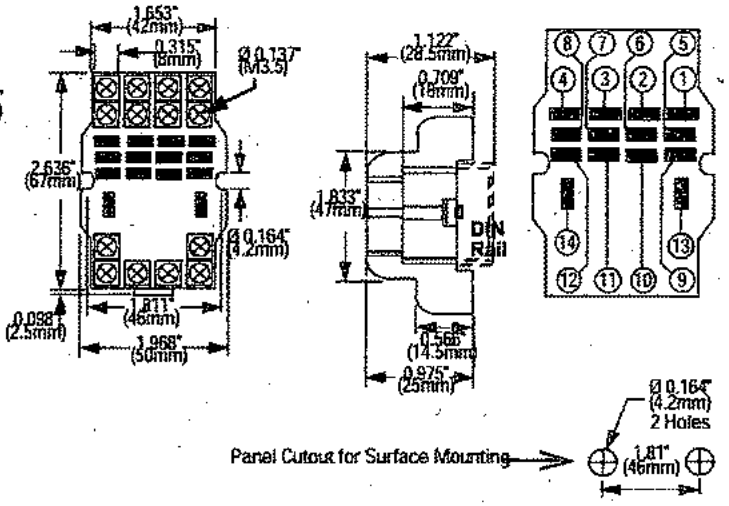


1. For socket mounting accessories, see page F-22.
2. For hold-down clip/spring selections, see page F-4.

SH4B Sockets



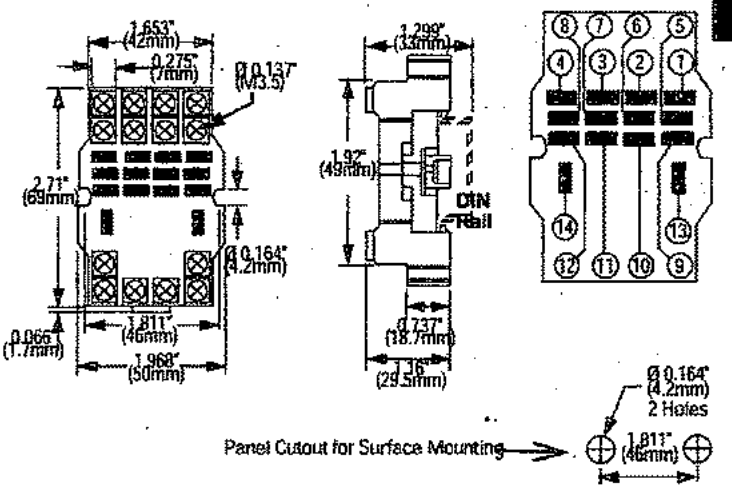




SH4B-05

Style	14-blade, snap-mount/surface mount
Terminal	M3.5 screws with captive wire clamp
Wire Size	Maximum up to 2–#12AWG
Electrical Rating	300V, 10A
Compatible Relay	RH4B
Hold-Down Spring	SH4B-02F1
Hold-Down Clip	SFA-101, SFA-202





SH4B-05C Fingersafe

Style	14-blade, snap-mount/surface mount
Terminal	M3.5 screws with captive wire clamp, fingersafe
Wire Size	Maximum up to 2–#12AWG
Electrical Rating	300V, 10A
Compatible Relay	RH4B
Hold-Down Spring	SH4B-02F1
Hold-Down Clip	SFA-101, SFA-202

1. For socket mounting accessories, see page F-22.
2. For hold-down clip/spring selections, see page F-4.

Accessories

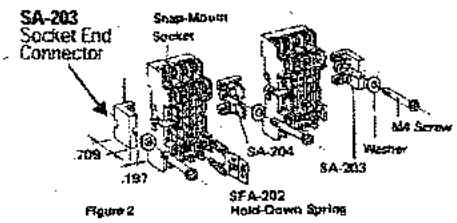
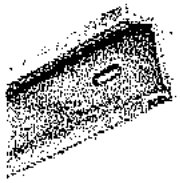
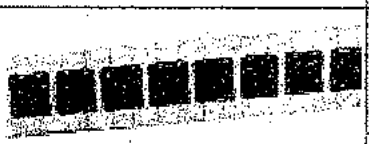
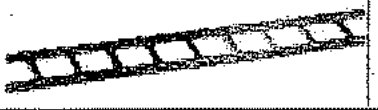


Figure 2



Description	Appearance	Use with	Part No.	Remarks
Aluminum DIN Rail (1 meter length)		All DIN rail sockets	BNDN1000	IDEC offers a low-profile DIN rail (BNDN-1000). The BNDN-1000 is designed to accommodate snap-mount sockets and surface mount sockets. Made of durable extruded aluminum, the BNDN-1000 measures 0.413" in height and 1.37" (35mm) in width (DIN standard). Standard length is 39" (1,000mm).
DIN Rail End Stop		BNDN1000 DIN rail	BNL6	9.1 mm wide.
Surface Mount End Connector		SY2S, SY4S, SR3B, SH1B, SH2B, SH3B, SH4B	SA-203	For use on ends of socket groupings when surface mounting.
			SA-204	For use between adjoining sockets when surface mounting.
Surface Mount Connector		SY2S, SY4S, SR3B, SH1B, SH2B, SH3B, SH4B	SA-405	For use between adjoining sockets when surface mounting.
DIN Rail Spacer		All DIN rail sockets	SA-405	
Steel Mounting Plates (for panel mount sockets)		SY4S-51, SH2B-51	SA-402	11.42" length with 10 holes.
		SY4S-51, SH2B-51	SA-403	23.33" length with 21 holes.
Relay Holders		RH2B, RM2S, RY4S, RY42S, RY2LS, RAMB, RBMB	RH-01	For diagram, see next page.
		RY2S, RAHB,RBHB, RH1B	RH-03	
Replacement Hold-Down Spring Anchor (horseshoe clip)		All DIN rail sockets	Y778-011	For use with hold-down springs (bale wire types) or DIN rail mount sockets. 2 pieces included with each socket.

Instructions

Mounting Snap-Mount Sockets

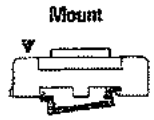


Figure 1



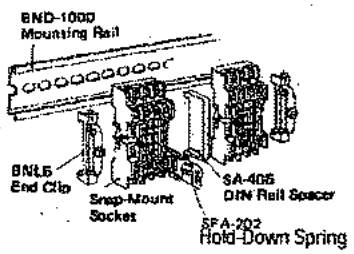
Figure 2

Snap-mount sockets are designed to mount on the BNDN-1000 mounting rail. The built-in mounting clip eliminates mounting hardware and reduces mounting time by 80%.

To mount see Figure 1. Place the end of the socket (end opposite of mounting clip against the outer edge of the rail). Press the socket down firmly until the clip snaps onto the mounting rail. To remove see Figure 2. Pull out the mounting clip with a screwdriver, and lift the socket.

For spacing between adjoining sockets, use the SA-406 DIN rail spacer. Spacers are 0.195" wide. Spacing can be adjusted according to the number of spacers added. Spacers snap on and off easily like snap-mount sockets.

To prevent side-to-side movement, use a BNL-5 end clip at **each** end of every socket row.



Mounting Relay Holders

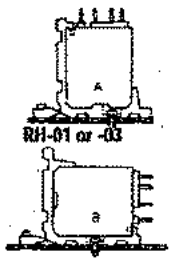


Figure 1

Mount directly onto panel boards in two alternate positions: A and B (see Figure 1).

To mount the relay into the holder, hook the bottom edge of the relay case (coil terminal side) onto the relay holder (see Figure 2).

Push down until the relay snaps into place.

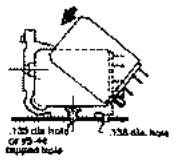


Figure 2

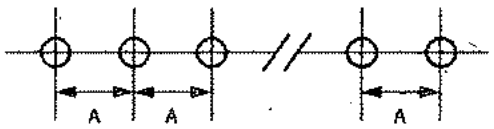
Dimensions

Surface Mount Sockets (SH2B-02)

IDEC surface mount sockets (SH2B-02) are also designed to mount individually or collectively on a flat surface without the use of a DIN rail. Use the mounting screw between adjoining sockets and at the outer ends of the row of sockets.

Dimension Table

Socket Part No.	Dimension A
SH2B-02	1.14"



1. Drawing is not to scale.

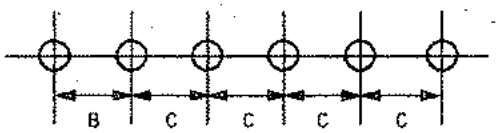
Snap-Mount Sockets

Snap-mount sockets are designed to mount individually or collectively without using a rail. Use a SA-405 connector or SA-204 connector between adjoining sockets (see Figures 1 and 2). Use the SA-203 end connector at the outer ends of each socket row when using the SA-204 connector (see Figure 2).

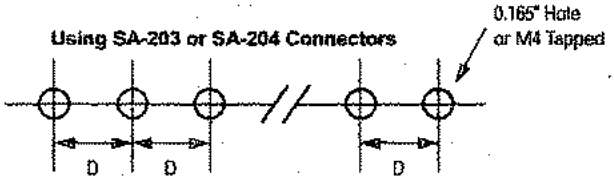
Dimension Table

Socket Part No.	Dim. B	Dim. C	Dim. D
SY2S-05, SY2S-05C	0.669"	0.826"	0.866"
SY4S-05, SY4S-05C	1.024"	1.181"	1.220"
SR3B-05	1.496"	1.693"	1.732"
SH1B-05, SH1B-05C	0.630"	0.787"	0.827"
SH2B-05, SH2B-05C	1.024"	1.181"	1.220"
SH3B-05, SH3B-05C	1.417"	1.575"	1.614"
SH4B-05, SH4B-05C	1.811"	1.969"	2.008"

Using an SA-406 Connector



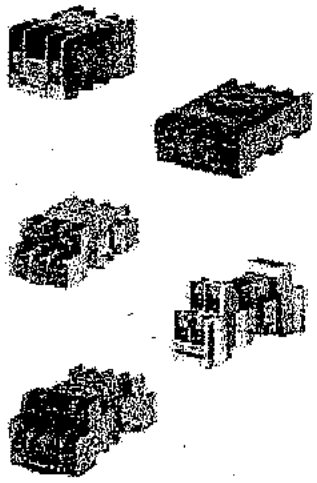
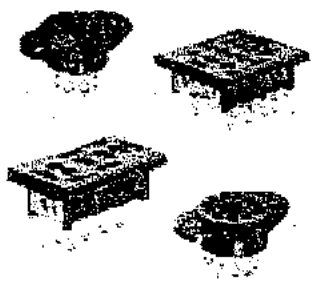
Using SA-203 or SA-204 Connectors



2. Drawings are not to scale.

Relay Socket Selection Guide

Relay Sockets

Mounting	Series	Page	Part No.	No. of Poles	Receptacle	Terminal	Compatible IDEC Relay and Timer
DIN Rail Snap-Mount 	SR	F-5	SR2P-05 SR2P-05C SR2P-06	2	8-Pin	M3.5 Screw	RR2P, RAPP, RBPP, GT5P, RTE-P1, GT3 (8-pin)
			SR3P-05 SR3P-05C SR3P-06	3	11-Pin		RR3PA, RR2KP, RTE-P2 GT3 (11-pin)
			SR3B-05	3	11-Blade		RR1BA, RR2BA, RR3B, RTE-B
	SH	F-8	SH1B-05 SH1B-05C	1	5-Blade	M3.5 Screw Coil Terminal: M3	RH1B, RAHB, RBHB
			SH2B-05 SH2B-05C	2	8-Blade	M3.5 Screw	RH2B, RAMB, RBMB
			SH3B-05 SH3B-05C	3	11-Blade		RH3B, RH2LB
			SH4B-05 SH4B-05C	4	14-Blade		RH4B
	SY	F-12	SY2S-05 SY2S-05C	2	8-Blade	M3 Screw	RY2S, RY22S
			SY4S-05 SY4S-05C	4	14-Blade		RY4S, RY42S, RY2KS, RY2LS, RM2S, GT5Y
Panel Mount 	SR	F-14	SR2P-51	2	8-Pin	Solder	RR2P, RAPP, RBPP, GT5P, RTE-P1, GT3 (8-pin)
			SR3P-51	3	11-Pin		RR3PA, RR2KP, RTE-P2, GT3 (11-pin)
			SR3B-51	3	11-Blade		RR1BA, RR2BA, RR3B
	SH	F-15	SH1B-51	1	5-Blade		RH1B, RAHB, RBHB
			SH2B-51	2	8-Blade		RH2B, RAMB, RBMB
			SH3B-51	3	11-Blade		RH3B, RH2LB
			SH4B-51	4	14-Blade		RH4B
	SY	F-17	SY2S-51	2	8-Blade		RY2S, RY22S
			SY4S-51	4	14-Blade		RY4S, RY42S, RY2KS, RY2LS, RM2S, GT5Y
Surface Mount 	SH	F-18	SH2B-02	2	8-Blade	M3.5 Screw	RH2B, RAMB, RBMB
PCB Mount 	SH	F3-19	SH1B-62	1	5-Blade	PC Board	RH1B, RAHB, RBHB
			SH2B-62	2	8-Blade		RH2B, RAMB, RBMB
			SH3B-62	3	11-Blade		RH3B, RH2LB
			SH4B-62	4	14-Blade		RH4B
	SY	F3-20	SY2S-61	2	8-Blade		RY2S, RY22S
			SY4S-61	4	14-Blade		RY4S, RY42S, RY2KS, RY2LS, RM2S, GT5Y
			SY4S-62	4	14-Blade		RY4S, RY42S, RY2KS, RY2LS, RM2S, GT5Y

For relay mounting accessories, see page F-22.

Specifications	
Rated Insulation Voltage	300V; except SH1B and SY4S-62: 250V
Rated Current	SR/SH: 10A, SY: 7A (SH1B coil terminal 7A)
Insulation Resistance	100MΩ minimum
Dielectric Strength	2,000V AC, 1 minute
Material Grade	UL94V-0

UL Recognized File No. E62437

CSA Certified File No.LR35144

TÜV PRODUCT SERVICE File No. BL9608133332307 *

CE *

1. * *Applicable to DIN rail sockets only.*

Relay Socket Part Numbering Guide

Relay socket part numbers are composed of 5 part number codes. When ordering a relay socket, select one code from each category.
Example: SR2P-05C

SR	2	P	—	05	C
① Socket Series	② No. of Poles	③ Termination		④ Mounting Style	⑤ Fingersafe Option

F

Part Numbers: Relay Sockets

	Description	Part Number Code	Remarks
① Socket Series	SR	SR	For use with RR series relays
	SH	SH	For use with RH series relays
	SY	SY	For use with RY series relays
② No. of Poles	1-pole	1	SH series
	2-pole	2	SR, SH, and SY series
	3-pole	3	SR, and SH series
	4-pole	4	SH series
③ Termination	Tubular pin	P	SR series
	Blade	B	SH series
	Solder/blade	S	SY series
④ Mounting Styles	DIN rail snap-mount	05	To decide between configuration 05 and 06, see pictures and schematics beginning on page F-5
		06	Model 05 is available as 05C with a fingersafe option; see ⑤ below
	Panel mount	51	
	PC board mount	61	
		62	
⑤ Fingersafe Option	With finger-protection terminals	C	Available only on SR, SH, and SY series snap-mount sockets
	Without finger-protection terminals	Leave blank	

2. *For hold-down springs and clips for DIN rail snap-mount, panel mount, and PC board mount, see page F-4.*
3. *For socket accessories, see page F-22.*

Hold-Down Springs and Clips Selection Guide

DIN Rail Snap-Mount Sockets

Socket Part No.	Applicable Relays, Timer	Hold-Down Spring	Hold-Down Clip
SR2P-05 SR2P-05C	RRZP, RAPP, RBPP	SR2B-02F1	SFA-203
	RTE-P1, GT3, GT5P	—	SFA-203
SR2P-06	RRZP, RAPP, RBPP	SR2B-02F1	SFA-202
	GT3 (8-pin), RTE-P1, GT5P	—	SFA-202
SR3P-05 SR3P-05C	RR3PA	SR3B-02F1	SFA-203
	RR2KP	SR3P-06F3	SFA-203
	RTE-P2, GT3 (11-pin)	—	SFA-203
SR3P-06	RR3PA	SR3B-02F1	SFA-202
	RR2KP	SR3P-06F3	SFA-202
	RTE-P2, GT3 (11-pin)	—	SFA-202
SR3B-05	RR1BA, RR2BA, RR3B, RTE-B	SR3B-02F1	SFA-202
SH1B-05 SH1B-05C	RH1B, RAHB, RBHB	SY2S-02F1	SFA-101 SFA-202
SH2B-05 SH2B-05C	RH2B, RAMB, RBMB	SY4S-02F1	SFA-101 SFA-202
SH3B-05 SH3B-05C	RH3B, RH2LB	SH3B-05F1	SFA-101 SFA-202
SH4B-05 SH4B-05C	RH4B	SH4B-02F1	SFA-101 SFA-202
SY2S-05 SY2S-05C	RY2S, RY22S	SY2S-02F1	SFA-101 SFA-202
SY4S-05 SY4S-05C	RY4S, RY42S, RY2LS, RM2S	SY4S-51F1	SFA-101 SFA-202
	RY2KS, GT5Y	(SY4S-51F3)	SFA-202

Panel and PC Board Mount Sockets

Socket Part No.	Applicable Relays, Timer	Hold-Down Spring	Hold-Down Clip
SR2P-51	RR2P, RAPP, RBPP	SR3P-01F1	—
	GT3 (8-pin), RTE-P1	—	SFA-402
SR3P-51	RR3PA	SR3P-01F1	—
	RR2KP	SR3P-51F3	
	GT3 (11-pin), RTE-P2	—	SFA-402
SR3B-51	RR1BA, RR2BA, RR3B, RTE-B	SR3B-02F1	—
SH1B-51 SH1B-62	RH1B, RAHB, RBHB	SY4S-51F1	SFA-301 SFA-302
SH2B-51	RH2B, RAMB, RBMB	SY4S-51F1 (SY4S-02F1)	SFA-301 SFA-302
SH2B-62	RH2B, RAMB, RBMB	SY4S-51F1 (SY4S-02F1)	—
SH3B-51 SH3B-62	RH3B, RH2LB	SY4S-51F1 (SY4S-02F1)	SFA-301 SFA-302
SH4B-51 SH4B-62	RH4B	SY4S-51F1 SY4S-02F1)	SFA-301 SFA-302
SY2S-51 SY2S-61	RY2S, RY22S	SY4S-51F1	SFA-301 SFA-302
SY4S-51 SY4S-61	RY4S, RY42S, RY2LS	SY4S-51F1 (SY4S-02F1)	SFA-301 SFA-302
	RY2KS	SY4S-51F1 (SY4S-02F3)	SFA-302
	GT5Y	—	SFA-302
SY4S-62 *	RY4S, RY42S, RY2LS, RM2S	SY4S-51F1 (SY4S-02F1)	—
	RY2KS	SY4S-51F1 (SY4S-02F3)	—

** Does not accept hold down clips*

1. *When mounting relays with a check button onto panel mount or PC board mount sockets, use the hold-down spring shown in parenthesis. Hold-down springs for relays with check buttons are not available for SR2P-51.*
2. *For close mounting of panel mount or PC mount sockets, use hold-down clips rather than hold-down springs.*


SFA-101


SFA-202


SFA-302


SFA-402


SR3P-01F1


SY4S-51F1

Kaiser Interstate South Boilers

7084-0015 - AS-BUILT

Page	Description
NR-1-1	NETWORK RISER DIAGRAM
HW-1-1	HWS FLOW LAYOUT
HW-1-2	HWS WIRING SCHEDULE
HW-1-3	HWS WIRING DETAILS
HW-1-4	HWS PANEL WIRE PULL

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- [ ] Energy Conservation Control
- [ ] Training Programs
- [ ] Performance Contracting
- [ ] Planned Service Agreements

Air Conditioning
Heating
Diagnostic Services
Coil Cleaning
Refrigeration
Automatic Temperature Controls
Facility Management Systems
Fire Management
Security Management
Building Operations and Management
Water Treatment
Electrical Equipment
Emergency Generator / Lighting Equipment
Industrial Controls / Rebidding / Pollution Equipment

PROJECT TITLE
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CONTRACTOR
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Portland, OR 97208
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ENGINEER/ARCHITECT
Phone:

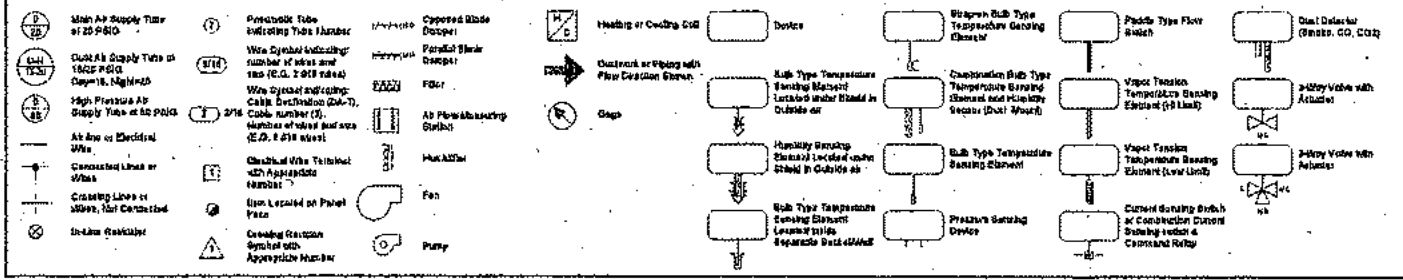
	1	AS-BUILT		2/1/07	Tom W.

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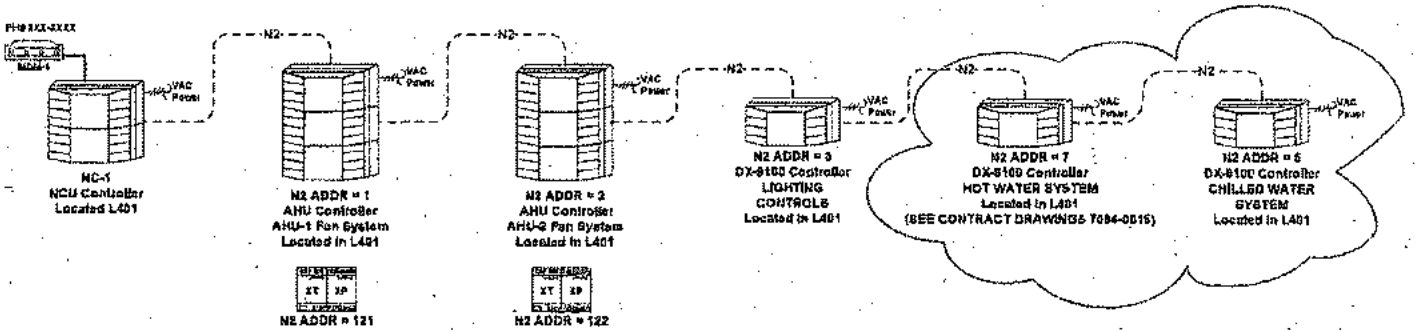
DRAWN BY	DESIGNED BY	APPROVED BY	DATE	JOB NUMBER
Mark Lemke	Wheeler Hurst	Wayne Hoyal	2/1/07	7084-0015

LEGEND



Bill of Materials

Designation	#	Part Number	Description
Panel Devices			
NC-1	1	[illegible]	[illegible]
	2	[illegible]	[illegible]
	1	[illegible]	[illegible]
	1	[illegible]	[illegible]
MDM-1	1	[illegible]	[illegible]



RECORD DRAWING

18/3 Blue, N2 BUS

Drawing Title
N2 Riser Diagram
NC-1

No.	Description	By	Date
3	New NC for Boiler		
2	Per Revised Contract 7084-0015		01/16/2007
1	AS-BUILT		07/11/03

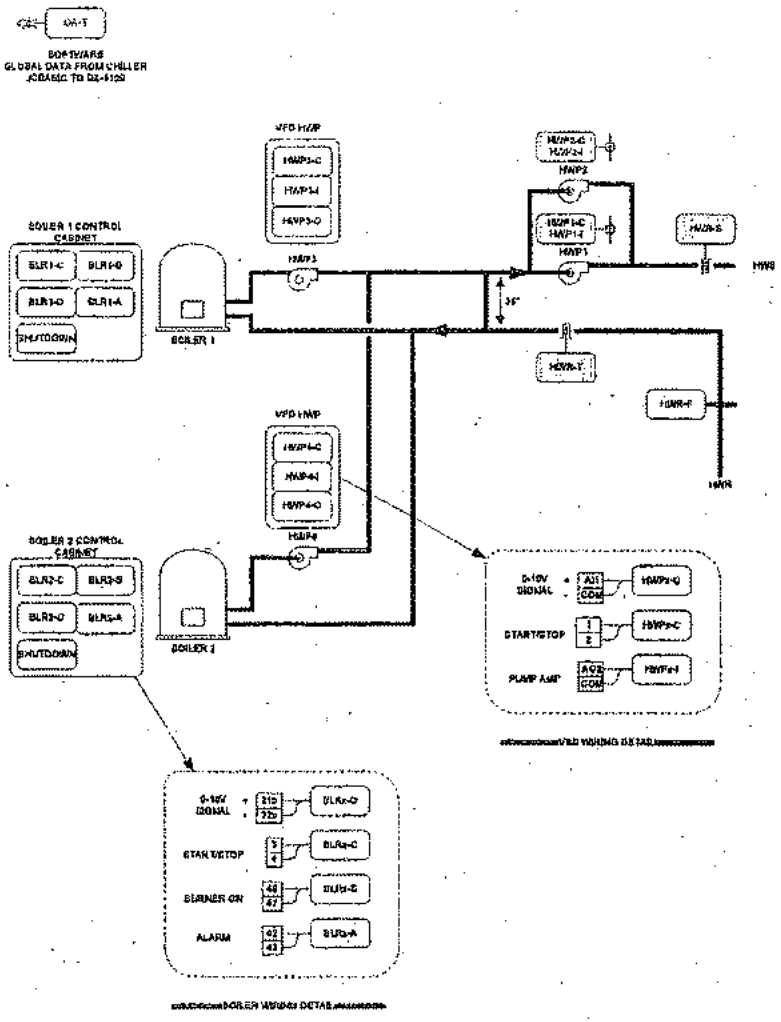
Project Title
Kaiser EFK & MOB
Edgar F. Kaiser Campus
Portland OR 97232

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7084-0022

1



FIELD HOT WATER PUMP CONTROL: THE OPERATOR SELECTED LEAD HOT WATER PUMP WILL AUTOMATICALLY START WHEN THE OUTSIDE AIR TEMPERATURE FALLS BELOW THE SYSTEM ENABLE SETPOINT. WHEN THE OUTSIDE AIR TEMPERATURE RISES ABOVE THIS SETPOINT, THE HOT WATER PUMPS WILL TURN OFF. WHEN ENABLED, THE LEAD PUMP WILL START AND RUN CONTINUOUSLY. IF FOR ANY REASON ITS STATUS DOES NOT MATCH ITS COMMANDED VALUE AN ALARM WILL BE GENERATED. THE LAG PUMP WILL START IF THE LEAD PUMP IS IN ALARM. WHENEVER THE SYSTEM IS COMMANDED OFF, THE LEAD HOT WATER PUMP WILL RUN FOR A PERIOD OF TIME TO DISPATE THE HEAT IN THE SYSTEM.

BOILER HOT WATER PUMP CONTROL: WITH THE SELECTION OF THE LEAD BOILER THE ASSOCIATED HOT WATER PUMP VFD (3 OR 4) WILL BE STARTED. THE LEAD PUMP WILL RAMP UP TO THE CALCULATED SPEED SETPOINT. THE SPEED OF THE PUMP VFD IS DETERMINDED BY THE RETURN HOT WATER FLOW.

HOT WATER RETURN FLOW	VFD % SPEED
20 GPM	20.0 %
270 GPM	62.0 %

BOILER CONTROL: THE OPERATOR WILL SELECT WHICH HOT WATER BOILER WILL OPERATE AS LEAD.THE BOILER CONTROL SEQUENCE WILL BEGIN WHEN EITHER ONE OF THE HOT WATER PUMPS 1 OR 2 HAS A STATUS OF ON. IF BOILER 1 IS SELECTED THAN HOT WATER PUMP 3 IS STARTED. IF BOILER 2 IS SELECTED THAN HOT WATER PUMP 4 IS STARTED.WHEN THERE IS PROOF THAT EITHER HOT WATER PUMP IS RUNING VIA CURRENT DRAW FROM THE PUMP VFD PANEL, THE BOILER IS ENABLE.THE LEAD BOILER WILL MODULATE TO MAINTAIN THE HOT WATER SUPPLY TEMPERATURE AT A SETPOINT THAT IS RESET INVERSLY TO THE OUTSIDE AIR TEMPERATURE.

OUTSIDE AIR	HOT WATER SETPOINT IS
23.0 DEGF	185.0 DEGF
60.0 DEGF	140.0 DEGF

THE LAG BOILER WILL BE ENABLED IF SYSTEM LOAD REQUIRES THE SECOND BOILER OR THE FAILURE OF THE LEAD BOILER OR PUMP. DEMAND IS DETERMIND WHEN THE OUTSIDE AIR TEMPERATURE IS LESS THEN 23 DEGF AND HWS TEMPERAURE DROPS BELOW 185.0 DEGF FOR 5 MINUTES.

THE BOILERS SAFETIES CIRCUIT WILL BE MONITORED AND THE SYSTEM WILL REPORT A GENERAL ALARM CONDITION IF A SAFETY IS TRIPPED. A MANUAL RESET OF THE BOILER LOCAL SAFETIES MIGHT BE REQUIRED BEFORE THE BOILER CAN BE RESTARTED.

ALL SETPOINTS DESCRIBED ABOVE ARE ADJUSTABLE

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Drawing Title: HWS Flow Layout

Project Title: Kaiser Interstate South Boilers

	1	AS-BUILT			2/1/07	lrw

Mark Lewis | Project Head | Project Lead | Date | Job # 7084-0015

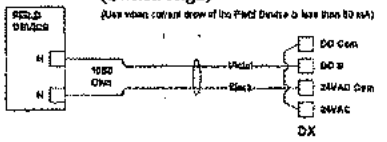
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Drawing No. HW-1-1

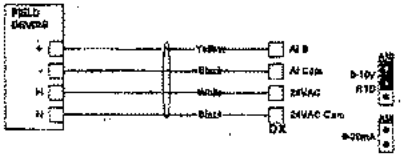
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		HWS			DX 9100						EH-7	Mech Room												All Trunk
DO-3		HWS	HWP1-C	Hot Water Pump 1 Cmd	DX9100	DX 9100	I/O		7:DO-3	DO3 COM	EH-7	Mech Room	HWP1-C	2/22	COIL (24V, Com)	Valve Command Relay	COM. NO	At Starter	2/14	See wiring detail	Starter (HS) (Sw Hi)		D502	Existing
DO-4		HWS	HWP2-C	Hot Water Pump 2 Cmd	DX9100	DX 9100	I/O		7:DO-4	DO4 COM	EH-7	Mech Room	HWP2-C	2/22	COIL (24V, Com)	Valve Command Relay	COM. NO	At Starter	2/14	See wiring detail	Starter (HS) (Sw Hi)		D502	Existing
DO-5		HWS	HWB1-C	Hot Water Boiler 1 Cmd	DX9100	DX 9100	I/O		7:DO-5	DO5 COM	EH-7	Mech Room	HWB1-C	2/22	COIL (WH/Yel,WH/Blue)	TSB Relay	COIL NO (Yel, Org)	At Boiler	2/11	See wiring detail	Control Panel (MD) (Sw Hi)	BOILER	D502	New
DO-6		HWS	HWP3-C	Hot Water Pump 3 Cmd	DX9100	DX 9100	I/O		7:DO-6	DO6 COM	EH-7	Mech Room	HWP3-C	2/22	COIL (13,14)	SEC Relay	COIL NO (9,8)	In Panel	2/22	See wiring detail	Control Panel (MD) (Sw Hi)	DX PNL	D502	New
DO-7		HWS	HWB2-C	Hot Water Boiler 2 Cmd	DX9100	DX 9100	I/O		7:DO-7	DO7 COM	EH-7	Mech Room	HWB2-C	2/22	COIL (WH/Yel,WH/Blue)	TSB Relay	COIL NO (Yel, Org)	At Boiler	2/14	See wiring detail	Control Panel (MD) (Sw Hi)	BOILER	D502	New
DO-8		HWS	HWP4-C	Hot Water Pump 4 Cmd	DX9100	DX 9100	I/O		7:DO-8	DO8 COM	EH-7	Mech Room	HWP4-C	2/22	COIL (13,14)	SEC Relay	COIL NO (9,8)	In Panel	2/22	See wiring detail	Control Panel (MD) (Sw Hi)	DX PNL	D502	New
DI-1		HWS	E-STOP	Boiler Shutdown	DX9100	DX 9100	I/O		7:DI-1	DI1 DICom	EH-7	Mech Room	E-STOP	4/18				Open/Panel	2/22	See wiring detail	Dry Contact	DOORS	D331	Existing
DI-2		HWS	HWB1-S	Hot Water Boiler 1 Sts	DX9100	DX 9100	I/O		7:DI-2	DI2 DICom	EH-7	Mech Room	HWB1-S	2/22				At Boiler	2/22	See wiring detail	Dry Contact	BOILER	D331	New
DI-3		HWS	HWB1-A	Hot Water Boiler 1 Alm	DX9100	DX 9100	I/O		7:DI-3	DI3 DICom	EH-7	Mech Room	HWB1-A	2/22				At Boiler	2/22	See wiring detail	Dry Contact	BOILER	D331	New
DI-4		HWS	HWB2-S	Hot Water Boiler 2 Sts	DX9100	DX 9100	I/O		7:DI-4	DI4 DICom	EH-7	Mech Room	HWB2-S	2/22				At Boiler	2/22	See wiring detail	Dry Contact	BOILER	D331	New
DI-5		HWS	HWB2-A	Hot Water Boiler 2 Alm	DX9100	DX 9100	I/O		7:DI-5	DI5 DICom	EH-7	Mech Room	HWB2-A	2/22				At Boiler	2/22	See wiring detail	Dry Contact	BOILER	D331	New
DI-6		HWS			DX9100	DX 9100	I/O		7:DI-6		EH-7	Mech Room												
DI-7		HWS			DX9100	DX 9100	I/O		7:DI-7		EH-7	Mech Room												
DI-8		HWS			DX9100	DX 9100	I/O		7:DI-8		EH-7	Mech Room												
AI-1		HWS	HWS-T	Hot Water Supply Temp	DX9100	DX 9100	I/O		7:AI-1	AI1 AICom	EH-7	Mech Room	HWS-T	2/18				Field	2/22	2-Wire	TE	HWS	D131	Existing
AI-2		HWS	HWR-T	Hot Water Return Temp	DX9100	DX 9100	I/O		7:AI-2	AI2 AICom	EH-7	Mech Room	HWR-T	2/18				Field	2/22	2-Wire	TE	HWR	D131	Existing
AI-3		HWS	HWR-F	Hot Water Return Flow	DX9100	DX 9100	I/O		7:AI-3	AI3 AICom, +15V	EH-7	Mech Room	HWR-F	4/22				Field	2/22	See wiring detail	Voltage Input (Internal Pwr)	HWR	D102	New
AI-4		HWS	HWP1-I	Hot Water Pump 1 Amp	DX9100	DX 9100	I/O		7:AI-4	AI4 AICom	EH-7	Mech Room	HWP1-I	2/22		Veris H-931	Motor Lead	At Starter	Motor Lead	See wiring detail	Motor Status		D106	Existing
AI-5		HWS	HWP2-I	Hot Water Pump 2 Amp	DX9100	DX 9100	I/O		7:AI-5	AI5 AICom	EH-7	Mech Room	HWP2-I	2/22		Veris H-931	Motor Lead	At Starter	Motor Lead	See wiring detail	Motor Status		D106	Existing
AI-6		HWS	HWP3-I	Hot Water Pump 3 Amp	DX9100	DX 9100	I/O		7:AI-6	AI6, +15V	EH-7	Mech Room	HWP3-I					At VFD	2/22	See wiring detail	Current Input (2 Wire)	VFD	D106	New
AI-7		HWS	HWP4-I	Hot Water Pump 4 Amp	DX9100	DX 9100	I/O		7:AI-7	AI7, +15V	EH-7	Mech Room	HWP4-I					At VFD	2/22	See wiring detail	Current Input (2 Wire)	VFD	D106	New
AI-8		HWS			DX9100	DX 9100	I/O		7:AI-8		EH-7	Mech Room												
AO-1		HWS	HWB1-O	#1 Setpoint Output	DX9100	DX 9100	I/O		7:AO-1	AO1 AOCom	EH-7	Mech Room	HWB1-O					At Boiler	2/22	See wiring detail	Output (Voltage)	BOILER	D291	New
AO-2		HWS	HWB2-O	#2 Setpoint Output	DX9100	DX 9100	I/O		7:AO-2	AO2 AOCom	EH-7	Mech Room	HWB2-O					#2 Boiler	2/22	See wiring detail	Output (Voltage)	BOILER	D291	New
AO-9		HWS	HWP3-O	#3 VFD Output	DX9100	DX 9100	I/O		7:AO-9	AO9 AOCom	EH-7	Mech Room	HWP3-O					At VFD	2/22	See wiring detail	Output (Voltage)	VFD	D291	New
AO-10		HWS	HWP4-O	#4 VFD Output	DX9100	DX 9100	I/O		7:AO-10	AO10 AOCom	EH-7	Mech Room	HWP4-O					At VFD	2/22	See wiring detail	Output (Voltage)	VFD	D291	New
AO-11		HWS			DX9100	DX 9100	I/O		7:AO-11		EH-7	Mech Room												
AO-12		HWS			DX9100	DX 9100	I/O		7:AO-12		EH-7	Mech Room												
AO-13		HWS			DX9100	DX 9100	I/O		7:AO-13		EH-7	Mech Room												
AO-14		HWS			DX9100	DX 9100	I/O		7:AO-14		EH-7	Mech Room												

DETAIL D502 — 24 VAC BINARY OUTPUT to LOW CURRENT DRAW DEVICE (Switch High)

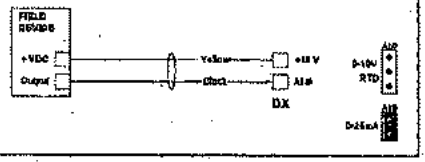
(Use when current draw of the Field Device is less than 50 mA)



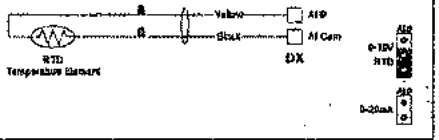
DETAIL D102 — VOLTAGE INPUT - INTERNAL SOURCE



DETAIL D106 — CURRENT INPUT - INTERNAL SOURCE (2 Wire)



DETAIL D131 — TEMPERATURE SENSOR INPUT



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Drawing Title: HWS Point Schedule

Project Title: Kaiser Interstate South Boiler

				1	AS-BUILT	3/1/07	TWW
Mark Lentz	Terence Hewitt	Duane Hewitt					

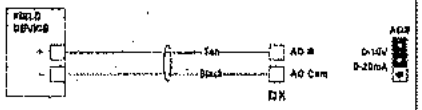
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7084-0015

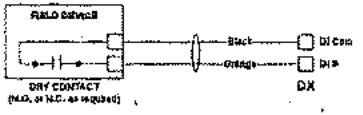
HWI-1-2

DETAIL D201 ANALOG OUTPUT (VOLTAGE)



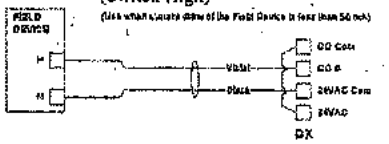
NOTE:
AO-1, 2, 3, 10 require a Jumper to be set as shown.
AO-11...14 are 0-10V Only. No Jumper is required.

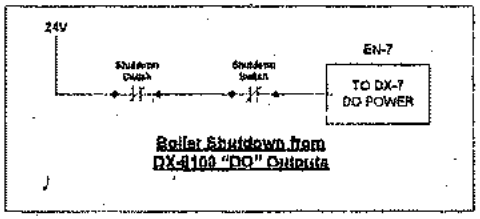
DETAIL D301 BINARY INPUT (DRY CONTACT)



DETAIL D602 24 VAC BINARY OUTPUT to LOW CURRENT DRAW DEVICE (Switch High)

(Use when current draw of the Field Device is less than 50 mA)





Boiler Shutdown from DX-9100 "DO" Outputs

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Drawing Title: HWS Wiring Details

Project Title: Kaiser Interstate South Boilers

1	AS-BUILT		3/15/07	Tim W.

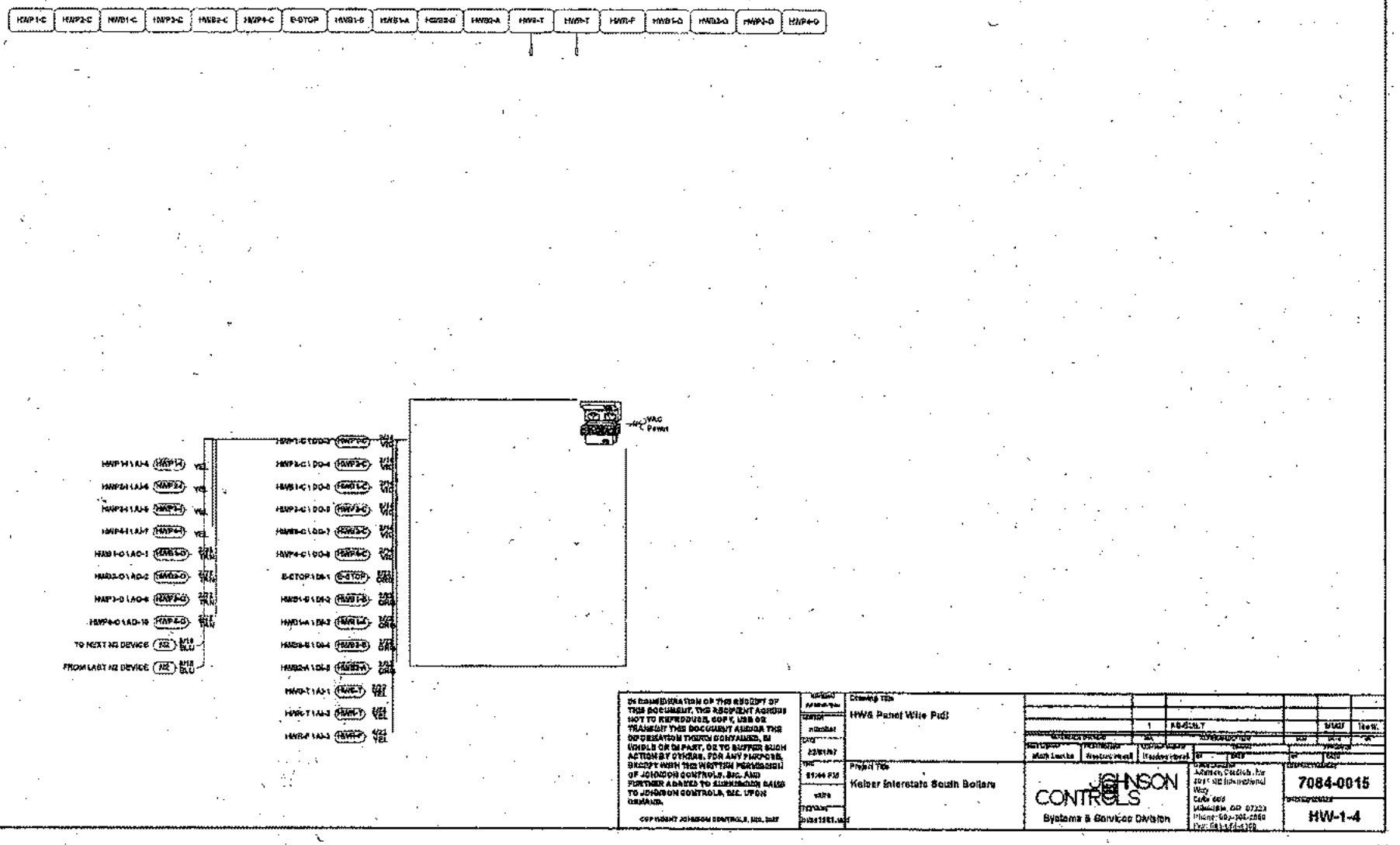
Mark Lemke | Richard Hewitt | Bradley Hewitt

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HW-1-3



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Drawing Title: HW6 Panel Wire Pull

Project Title: Keiser Interstate South Boilers

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HW-1-4

ABB Drives and Motors

OPERATION
and
MAINTENANCE
MANUAL

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How To Maintain a VFD

By: Dave Polka

Training Notes

Do you know how to maintain Variable Frequency Drives (VFDs)? Doing so is easier than you might think. By integrating some simple, logical steps into your preventative maintenance program, you can ensure your drives provide many years of trouble-free service. Before looking at those steps, let's quickly review what a VFD is and how it works.

A Quick Overview

A VFD controls the speed, torque and direction of an AC Induction motor. It takes fixed voltage and frequency AC input and converts it to a variable voltage and frequency AC output. See Training Note *"What is a VFD?"* available at www.abb-drives.com for a more detailed description of VFD concepts and operating principles. In very small VFDs, a single power pack unit may contain the converter and inverter.

Fairly involved control circuitry coordinates the switching of power devices, typically through a control board that dictates the firing of power components in the proper sequence. A microprocessor or Digital Signal Processor (DSP) meets all the internal logic and decision requirements.

From this description, you can see a VFD is basically a computer and power supply. And the same safety and equipment precautions you'd apply to a computer and to a power supply apply here. VFD maintenance requirements fall into three basic categories:

- keep it clean;
- keep it dry; and
- keep the connections tight.

Let's look at each of these.

Keep it Clean

Most VFDs fall into the NEMA 1 category (side vents for cooling airflow) or NEMA 12 category (sealed, dust-tight enclosure). Drives that fall in the NEMA 1 category are susceptible to dust contamination. Dust on VFD hardware can cause a lack of airflow, resulting in diminished performance from heat sinks and circulating fans (Photo 1).



Photo 1, Fan Injecting Dust into Drive Enclosure

Dust on an electronic device can cause malfunction or even failure. Dust absorbs moisture, which also contributes to failure. Periodically spraying air through the heat sink fan is a good PM measure. Discharging compressed air into a VFD is a viable option in some environments, but typical plant air contains oil and water. To use compressed air for cooling, you must use air that is oil-free and dry or you are likely to do more harm than good. That requires a specialized, dedicated, and expensive air supply. And you still run the risk of generating electrostatic charges (ESD).

A non-static generating spray or a reverse-operated ESD vacuum will reduce static build-up. Common plastics are prime generators of static electricity. The material in ESD vacuum cases and fans is a special, non-static generating plastic. These vacuums, and cans of non-static generating compressed air, are available through companies that specialize in static control equipment.

Keep it Dry

In Photo 2 you can see what happened to a control board periodically subjected to a moist environment. Initially, this VFD was wall-mounted in a clean, dry area of a mechanical room and moisture was not a problem. However, as is often the case, a well-meaning modification led to problems.

ABB

In this example, an area of the building required a dehumidifier close to the mechanical room. Since wall space was available above the VFD, this is where the dehumidifier went. Unfortunately, the VFD was a NEMA 1 enclosure style (side vents and no seal around the cover). The obvious result was water dripping from the dehumidifier into the drive. In six months, the VFD accumulated enough water to produce circuit board corrosion.

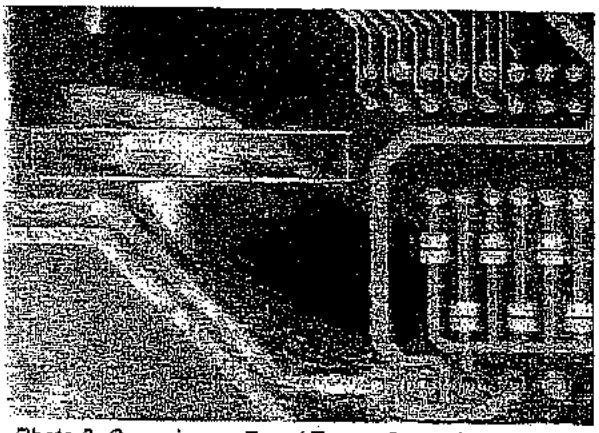


Photo 2, Corrosion on Board Traces Caused by Moisture

What about condensation? Some VFD manufacturers included a type of "condensation protection" on earlier product versions. When the mercury dipped below 32 degrees Fahrenheit, the software logic would not allow the drive to start. VFDs seldom offer this protection today. If you operate the VFD all day, every day, the normal radiant heat from the heatsink should prevent condensation. Unless the unit is in continuous operation, use a NEMA 12 enclosure and thermostatically controlled space heater if you locate it where condensation is likely.

Keep Connections Tight

While this sounds basic, checking connections is a step many people miss or do incorrectly - and the requirement applies even in clean rooms. Heat cycles and mechanical vibration can lead to sub-standard connections, as can standard PM practices. Re-torquing screws is not a good idea, and further tightening an already tight connection can ruin the connection (see Sidebar).

Bad connections eventually lead to arcing. Arcing at the VFD input could result in nuisance over voltage faults, clearing of input fuses, or damage to protective components. Arcing at the VFD output could result in over-current faults, or even damage to the power components. Photos 3 and 4 show what can happen.

Loose control wiring connections can cause erratic operation. For example, a loose START/STOP signal wire can cause uncontrollable VFD stops. A loose speed reference wire can cause the drive speed to fluctuate, resulting in scrap, machine damage, or personnel injury.

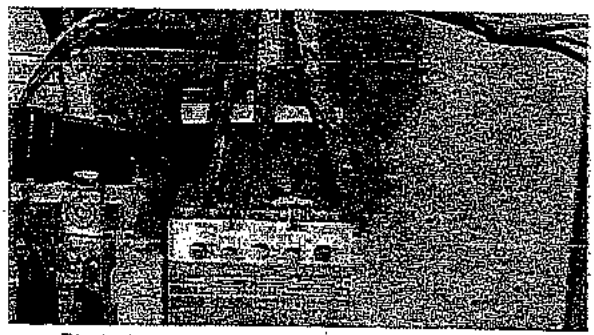


Photo 3, Arcing Caused by Loose Input Contacts

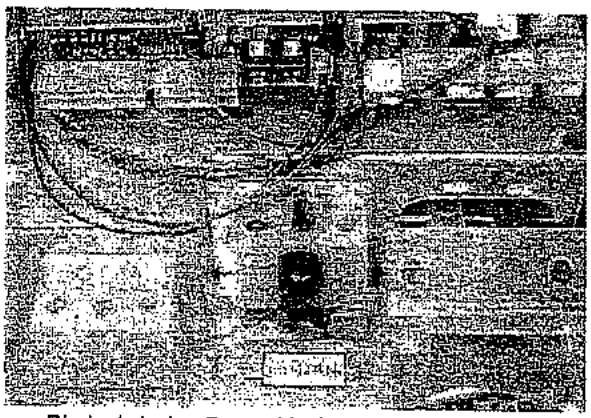


Photo 4, Arcing Caused by Loose Output Contacts

Re-torquing - A Screwy Practice

Although "re-torquing" as a way of checking tightness is common in many PM procedures, it violates basic mechanical principles and does more harm than good. A screw has maximum clamping power at a torque value specific to its size, shape, and composition. Exceeding that torque value permanently reduces the clamping power of that screw by reducing its elasticity and deforming it. Loosening and then re-torquing still reduces elasticity, which still means a loss of clamping power. Doing this to a lock washer results in a permanent 50% loss. What should you do? Use an infrared thermometer to note hot connections. Check their torque. If they have merely worked loose, you can try retightening them. Note which screws were loose, and be sure to give them an IR check at the next PM cycle. If they are loose again, replace them. Finally, don't forget the "tug test." This checks crimps, as well as screw connections. Don't do this with the drive online with the process, though, or you may cause some very expensive process disturbances.

Additional Steps

1. As part of a mechanical inspection procedure, don't overlook internal VFD components. Check circulating fans for signs of bearing failure or foreign objects - usually indicated by unusual noise or shafts that appear wobbly.

2. Inspect DC bus capacitors for bulging and leakage. Either could be a sign of component stress or electrical misuse. Photos 5 and 6 show fan and capacitor stress problems.

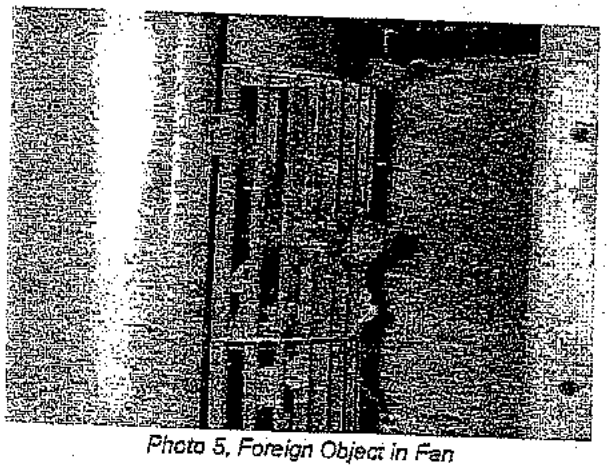


Photo 5, Foreign Object in Fan

3. Take voltage measurements while the VFD is in operation. Fluctuations in DC bus voltage measurements can indicate degradation of DC bus capacitors. One function of the capacitor bank is to act as a filter section (smoothing out any AC ripple voltage on the Bus). Abnormal AC voltage on the DC bus indicates the capacitors are headed for trouble.

Most VFD manufacturers have a special terminal block for this type of measurement and also for connection of the dynamic braking resistors. Measurements more than 4VAC may indicate a capacitor filtering problem or a possible problem with the diode bridge converter section (ahead of the bus). If you have such voltage levels, consult the VFD manufacturer before taking further action.

With the VFD in START and at zero speed, you should read output voltage of 40VAC phase-to-phase or less. If you read more than this, you may have transistor leakage. At zero speed, the power components should not be operating. If your readings are 60VAC or more, you can expect power component failure.

4. What about spare VFDs? Store them in a clean, dry environment, with no condensation allowed. Place this unit in your PM system so you know to power it up every 6 months to keep the DC bus capacitors at their peak performance capability. Otherwise, their charging ability will significantly diminish. A capacitor is much like a battery-it needs to go into service soon after purchase or suffer a loss of usable life.

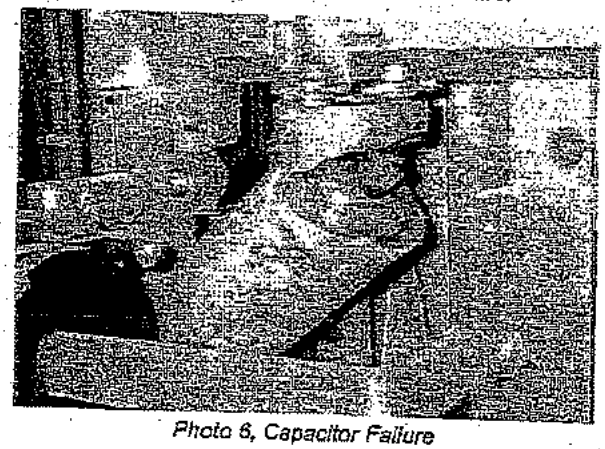


Photo 6, Capacitor Failure

5. Regularly monitor heat sink temperatures. Most VFD manufacturers make this task easy by including a direct temperature readout on the Keypad or display. Verify where this readout is, and make checking it part of a weekly or monthly review of VFD operation.

You wouldn't place your laptop computer outside, on the roof of a building or in direct sunlight, where temperatures could reach 115 degrees Fahrenheit or as low as -10 degrees Fahrenheit. A VFD, which is basically a computer with a power supply, needs the same consideration. Some VFD manufacturers advertise 200,000 hours-almost 23 years-of Mean Time Between Failures (MTBF). Such impressive performance is easy to obtain, if you follow these simple procedures.

Name		Value	Unit	Min	Max
99	START-UP DATA				
9901	LANGUAGE	RESERVED		0	14
9902	APPLIC MACRO	HVAC DEFAULT		-4	14
9904	MOTOR CTRL MODE	SCALAR:FREQ		1	3
9905	MOTOR NOM VOLT	460	V	230	690
9906	MOTOR NOM CURR	0	A	0	0
9907	MOTOR NOM FREQ	60	Hz	10	500
9908	MOTOR NOM SPEED	1580	rpm	50	18000
9909	MOTOR NOM POWER	0	hp	0	0
9910	ID RUN	OFF		0	1
1	OPERATING DATA				
102	SPEED	0	rpm	0	30000
103	OUTPUT FREQ	0	Hz	0	500
104	CURRENT	0	A	0	0
105	TORQUE	0	%	-200	200
106	POWER	0	kW	0	0
107	DC BUS VOLTAGE	0	V	0	1150
109	OUTPUT VOLTAGE	0	V	0	920
110	DRIVE TEMP	0	°C	0	150
111	EXTERNAL REF 1	0	Hz	0	500
112	EXTERNAL REF 2	0	%	0	600
113	CTRL LOCATION	LOCAL		0	2
114	RUN TIME (R)	0	h	0	10000
115	KWH COUNTER (R)	0	kWh	0	9999
116	APPL BLK OUTPUT	0	%	0	600
118	DI 1-3 STATUS	0 0 0		0	7
119	DI 4-6 STATUS	0 0 0		0	7
120	AI 1	0	%	0	100
121	AI 2	0	%	0	100
122	RO 1-3 STATUS	0 0 0		0	7
123	RO 4-6 STATUS	0 0 0		0	7
124	AO 1	0	mA	0	20
125	AO 2	0	mA	0	20
126	PID 1 OUTPUT	0	%	0	100
127	PID 2 OUTPUT	0	%	0	100
128	PID 1 SETPNT	0	%	0	0
129	PID 2 SETPNT	0	1	0	0
130	PID 1 FBK	0	%	0	0
131	PID 2 FBK	0	1	0	0
132	PID 1 DEVIATION	0	%	-100	0
133	PID 2 DEVIATION	0	1	-100	0
134	COMM RO WORD	0		0	65535
135	COMM VALUE 1	0		-32768	32767
136	COMM VALUE 2	0		-32768	32767
137	PROCESS VAR 1	0	Hz	0	500
138	PROCESS VAR 2	0	A	0	0
139	PROCESS VAR 3	0	%	0	100
140	RUN TIME	0	kh	0	500
141	MWH COUNTER	0	MWh	0	9999
142	REVOLUTION CNTR	0	Mrev	0	65535
143	DRIVE ON TIME HI	0	d	0	65535
144	DRIVE ON TIME LO	0		0	43200
145	MOTOR TEMP	0		0	0

3	FB ACTUAL SIGNALS				
301	FB CMD WORD 1	0		0	65535
302	FB CMD WORD 2	0		0	65535
303	FB STS WORD 1	0		0	65535
304	FB STS WORD 2	0		0	65535
305	FAULT WORD 1	0		0	65535
306	FAULT WORD 2	0		0	65535
307	FAULT WORD 3	0		0	65535
308	ALARM WORD 1	0		0	65535
309	ALARM WORD 2	0		0	65535
				0	65535
4	FAULT HISTORY				
401	LAST FAULT	NO RECORD			
402	FAULT TIME 1	0	d	0	65535
403	FAULT TIME 2	0		0	65535
404	SPEED AT FLT	0	rpm	0	65535
405	FREQ AT FLT	0	Hz	-32768	32767
406	VOLTAGE AT FLT	0	V	-3276.8	3276.7
407	CURRENT AT FLT	0	A	0	6553.5
408	TORQUE AT FLT	0	%	0	6553.5
409	STATUS AT FLT	0		-3276.8	3276.7
410	DI 1-3 AT FLT	0 0 0		0	65535
411	DI 4-6 AT FLT	0 0 0		0	65535
412	PREVIOUS FAULT 1	NO RECORD		0	65535
413	PREVIOUS FAULT 2	NO RECORD		0	65535
				0	65535
10	START/STOP/DIR				
1001	EXT1 COMMANDS	DI1		0	14
1002	EXT2 COMMANDS	DI1		0	14
1003	DIRECTION	FORWARD		1	3
11	REFERENCE SELECT				
1101	KEYPAD REF SEL	REF1(Hz/rpm)		1	2
1102	EXT1/EXT2 SEL	EXT1		-6	12
1103	REF1 SELECT	AI1		0	17
1104	REF1 MIN	0	Hz	0	500
1105	REF1 MAX	60	Hz	0	500
1106	REF2 SELECT	PID1OUT		0	20
1107	REF2 MIN	0	%	0	100
1108	REF2 MAX	100	%	0	100
12	CONSTANT SPEEDS				
1201	CONST SPEED SEL	DI3		-14	18
1202	CONST SPEED 1	6	Hz	0	500
1203	CONST SPEED 2	12	Hz	0	500
1204	CONST SPEED 3	18	Hz	0	500
1205	CONST SPEED 4	24	Hz	0	500
1206	CONST SPEED 5	30	Hz	0	500
1207	CONST SPEED 6	48	Hz	0	500
1208	CONST SPEED 7	60	Hz	0	500
1209	TIMED MODE SEL	CS1 / CS2		1	2
13	ANALOG INPUTS				
1301	MINIMUM AI1	20	%	0	100
1302	MAXIMUM AI1	100	%	0	100
1303	FILTER AI1	0.1	s	0	10

1304 MINIMUM AI2	20	%	0	100
1305 MAXIMUM AI2	100	%	0	100
1306 FILTER AI2	0.1	s	0	10
14 RELAY OUTPUTS				
1401 RELAY OUTPUT 1	READY		0	45
1402 RELAY OUTPUT 2	RUN		0	45
1403 RELAY OUTPUT 3	FAULT(-1)		0	45
1404 RO 1 ON DELAY	0	s	0	3600
1405 RO 1 OFF DELAY	0	s	0	3600
1406 RO 2 ON DELAY	0	s	0	3600
1407 RO 2 OFF DELAY	0	s	0	3600
1408 RO 3 ON DELAY	0	s	0	3600
1409 RO 3 OFF DELAY	0	s	0	3600
1410 RELAY OUTPUT 4	NOT SEL		0	45
1411 RELAY OUTPUT 5	NOT SEL		0	45
1412 RELAY OUTPUT 6	NOT SEL		0	45
1413 RO 4 ON DELAY	0	s	0	3600
1414 RO 4 OFF DELAY	0	s	0	3600
1415 RO 5 ON DELAY	0	s	0	3600
1416 RO 5 OFF DELAY	0	s	0	3600
1417 RO 6 ON DELAY	0	s	0	3600
1418 RO 6 OFF DELAY	0	s	0	3600
15 ANALOG OUTPUTS				
1501 AO1 CONTENT SEL	OUTPUT FREQ		99	199
1502 AO1 CONTENT MIN	0	Hz	0	500
1503 AO1 CONTENT MAX	0	Hz	0	500
1504 MINIMUM AO1	4	mA	0	20
1505 MAXIMUM AO1	20	mA	0	20
1506 FILTER AO1	0.1	s	0	10
1507 AO2 CONTENT SEL	CURRENT		99	199
1508 AO2 CONTENT MIN	0	A	0	0
1509 AO2 CONTENT MAX	0	A	0	0
1510 MINIMUM AO2	4	mA	0	20
1511 MAXIMUM AO2	20	mA	0	20
1512 FILTER AO2	0.1	s	0	10
16 SYSTEM CONTROLS				
1601 RUN ENABLE	NOT SEL		-6	7
1602 PARAMETER LOCK	OPEN		0	2
1603 PASS CODE	0		0	65535
1604 FAULT RESET SEL	KEYPAD		-6	8
1605 USER PAR SET CHG	NOT SEL		-6	6
1606 LOCAL LOCK	NOT SEL		-6	8
1607 PARAM SAVE	DONE		0	1
1608 START ENABLE 1	DI4		-6	7
1609 START ENABLE 2	NOT SEL		-6	7
17 OVERRIDE				
1701 OVERRIDE SEL	NOT SEL		-6	6
1702 OVERRIDE FREQ	0	Hz	-500	500
1703 OVERRIDE SPEED	0	rpm	-30000	30000
1704 OVERR PASS CODE	0		0	65535
1705 OVERRIDE	OFF		0	1
20 LIMITS				

2001 MINIMUM SPEED	0	rpm	-30000	30000
2002 MAXIMUM SPEED	1800	rpm	0	30000
2003 MAX CURRENT	0	A	0	0
2006 UNDERVOLT CTRL	ENABLE(TIME)		0	1
2007 MINIMUM FREQ	0	Hz	-500	500
2008 MAXIMUM FREQ	60	Hz	0	500
2013 MIN TORQUE SEL	MIN TORQUE 1		-6	7
2014 MAX TORQUE SEL	MAX TORQUE 1		-6	7
2015 MIN TORQUE 1	-300	%	-600	0
2016 MIN TORQUE 2	-300	%	-600	0
2017 MAX TORQUE 1	300	%	0	600
2018 MAX TORQUE 2	300	%	0	600
21 START/STOP				
2101 START FUNCTION	AUTO		1	5
2102 STOP FUNCTION	COAST		1	2
2103 DC MAGN TIME	0.3	s	0	10
2104 DC HOLD	NOT SEL		0	3
2106 DC CURR REF	30	%	0	100
2107 DC BRAKE TIME	0	s	0	250
2108 START INHIBIT	OFF		0	1
2109 EM STOP SEL	NOT SEL		-6	6
2110 TORQ BOOST CURR	100	%	0	300
22 ACCEL/DECEL				
2201 ACC/DEC 1/2 SEL	NOT SEL		-6	7
2202 ACCELER TIME 1	30	s	0	1800
2203 DECELER TIME 1	30	s	0	1800
2204 RAMP SHAPE 1	0	s	0	1000
2205 ACCELER TIME 2	60	s	0	1800
2206 DECELER TIME 2	60	s	0	1800
2207 RAMP SHAPE 2	0	s	0	1000
2208 EM DEC TIME	1	s	0	1800
2209 RAMP INPUT 0	NOT SEL		-6	7
23 SPEED CONTROL				
2301 PROP GAIN	3		0	200
2302 INTEGRATION TIME	2.5	s	0	600
2303 DERIVATION TIME	0	ms	0	10000
2304 ACC COMPENSATION	0	s	0	600
2305 AUTOTUNE RUN	OFF		0	1
24 TORQUE CONTROL				
2401 TORQ RAMP UP	0	s	0	120
2402 TORQ RAMP DOWN	0	s	0	120
25 CRITICAL SPEEDS				
2501 CRIT SPEED SEL	OFF		0	1
2502 CRIT SPEED 1 LO	0	Hz	0	500
2503 CRIT SPEED 1 HI	0	Hz	0	500
2504 CRIT SPEED 2 LO	0	Hz	0	500
2505 CRIT SPEED 2 HI	0	Hz	0	500
2506 CRIT SPEED 3 LO	0	Hz	0	500
2507 CRIT SPEED 3 HI	0	Hz	0	500
26 MOTOR CONTROL				
2601 FLUX OPT ENABLE	ON		0	1

2602 FLUX BRAKING	OFF		0	1
2603 IR COMP VOLT	0	V	0	100
2604 IR COMP FREQ	50	%	0	100
2605 U/F RATIO	SQUARED		1	2
2606 SWITCHING FREQ	4	kHz	0	0
2607 SWITCH FREQ CTRL	ON		0	2
2608 SLIP COMP RATIO	0	%	0	200
29 MAINTENANCE TRIG				
2901 COOLING FAN TRIG	0	kh	0	6553.5
2902 COOLING FAN ACT	0	kh	0	6553.5
2903 REVOLUTION TRIG	0	Mrev	0	65535
2904 REVOLUTION ACT	0	Mrev	0	65535
2905 RUN TIME TRIG	0	kh	0	6553.5
2906 RUN TIME ACT	0	kh	0	6553.5
2907 USER MWh TRIG	0	MWh	0	6553.5
2908 USER MWh ACT	0	MWh	0	6553.5
30 FAULT FUNCTIONS				
3001 AI<MIN FUNCTION	NOT SEL		0	3
3002 PANEL COMM ERR	FAULT		1	3
3003 EXTERNAL FAULT 1	NOT SEL		-6	6
3004 EXTERNAL FAULT 2	NOT SEL		-6	6
3005 MOT THERM PROT	FAULT		0	2
3006 MOT THERM TIME	1050	s	256	9999
3007 MOT LOAD CURVE	100	%	50	150
3008 ZERO SPEED LOAD	70	%	25	150
3009 BREAK POINT FREQ	35	Hz	1	250
3010 STALL FUNCTION	NOT SEL		0	2
3011 STALL FREQUENCY	20	Hz	0.5	50
3012 STALL TIME	20	s	10	400
3013 UNDERLOAD FUNC	0		0	2
3014 UNDERLOAD TIME	20	s	10	400
3015 UNDERLOAD CURVE	1		1	5
3017 EARTH FAULT	ENABLE		0	1
3018 COMM FAULT FUNC	NOT SEL		0	3
3019 COMM FAULT TIME	10	s	0	60
3021 AI1 FAULT LIMIT	0	%	0	100
3022 AI2 FAULT LIMIT	0	%	0	100
31 AUTOMATIC RESET				
3101 NR OF TRIALS	5		0	5
3102 TRIAL TIME	30	s	1	600
3103 DELAY TIME	6	s	0	120
3104 AR OVERCURRENT	DISABLE		0	1
3105 AR OVERVOLTAGE	ENABLE		0	1
3106 AR UNDERVOLTAGE	ENABLE		0	1
3107 AR AI<MIN	ENABLE		0	1
3108 AR EXTERNAL FLT	ENABLE		0	1
32 SUPERVISION				
3201 SUPERV 1 PARAM	OUTPUT FREQ		101	199
3202 SUPERV 1 LIM LO	0	Hz	0	500
3203 SUPERV 1 LIM HI	0	Hz	0	500
3204 SUPERV 2 PARAM	CURRENT		101	199
3205 SUPERV 2 LIM LO	0	A	0	0
3206 SUPERV 2 LIM HI	0	A	0	0

3207 SUPERV 3 PARAM	TORQUE		101	199
3208 SUPERV 3 LIM LO	0	%	-200	200
3209 SUPERV 3 LIM HI	0	%	-200	200
33 INFORMATION				
3301 FW VERSION	150A		5386	5386
3302 LP VERSION	0		0	65535
3303 TEST DATE	0		0	655.35
3304 DRIVE RATING	0		0	65535
34 PANEL DISPLAY				
3401 SIGNAL1 PARAM	OUTPUT FREQ		100	199
3402 SIGNAL1 MIN	0	Hz	0	500
3403 SIGNAL1 MAX	0	Hz	0	500
3404 OUTPUT1 DSP FORM	+0.0		0	8
3405 OUTPUT1 UNIT	%		0	127
3406 OUTPUT1 MIN	0	Hz	0	500
3407 OUTPUT1 MAX	0	Hz	0	500
3408 SIGNAL2 PARAM	CURRENT		100	199
3409 SIGNAL2 MIN	0	A	0	0
3410 SIGNAL2 MAX	0	A	0	0
3411 OUTPUT2 DSP FORM	+0.0		0	8
3412 OUTPUT2 UNIT	A		0	127
3413 OUTPUT2 MIN	0	A	0	0
3414 OUTPUT2 MAX	0	A	0	0
3415 SIGNAL3 PARAM	AI 1		100	199
3416 SIGNAL3 MIN	0	%	0	100
3417 SIGNAL3 MAX	0	%	0	100
3418 OUTPUT3 DSP FORM	+0.0		0	8
3419 OUTPUT3 UNIT	mA		0	127
3420 OUTPUT3 MIN	0	%	0	100
3421 OUTPUT3 MAX	0	%	0	100
35 MOTOR TEMP MEAS				
3501 SENSOR TYPE	NONE		0	6
3502 INPUT SELECTION	AI1		1	8
3503 ALARM LIMIT	0		0	0
3504 FAULT LIMIT	0		0	0
36 TIMED FUNCTIONS				
3601 TIMERS ENABLE	NOT SEL		-6	7
3602 START TIME 1	0		0	43199
3603 STOP TIME 1	0		0	43199
3604 START DAY 1	MONDAY		1	7
3605 STOP DAY 1	MONDAY		1	7
3606 START TIME 2	0		0	43199
3607 STOP TIME 2	0		0	43199
3608 START DAY 2	MONDAY		1	7
3609 STOP DAY 2	MONDAY		1	7
3610 START TIME 3	0		0	43199
3611 STOP TIME 3	0		0	43199
3612 START DAY 3	MONDAY		1	7
3613 STOP DAY 3	MONDAY		1	7
3614 START TIME 4	0		0	43199
3615 STOP TIME 4	0		0	43199
3616 START DAY 4	MONDAY		1	7
3617 STOP DAY 4	MONDAY		1	7

3622 BOOST SEL	NOT SEL		-6	6
3623 BOOST TIME	0		0	43199
3626 TIMER 1 SRC	NOT SEL		0	31
3627 TIMER 2 SRC	NOT SEL		0	31
3628 TIMER 3 SRC	NOT SEL		0	31
3629 TIMER 4 SRC	NOT SEL		0	31
40 PROCESS PID SET 1				
4001 GAIN	2.5		0.1	100
4002 INTEGRATION TIME	3	s	0	600
4003 DERIVATION TIME	0	s	0	10
4004 PID DERIV FILTER	1	s	0	10
4005 ERROR VALUE INV	NO		0	1
4006 UNITS	%		0	255
4007 UNIT SCALE	1		0	4
4008 0% VALUE	0	%	-1000	1000
4009 100% VALUE	0	%	-1000	1000
4010 SET POINT SEL	KEYPAD		0	20
4011 INTERNAL SETPNT	0	%	-1000	1000
4012 SETPOINT MIN	0	%	-500	500
4013 SETPOINT MAX	100	%	-500	500
4014 FBK SEL	ACT1		1	9
4015 FBK MULTIPLIER	0		-32.77	32.77
4016 ACT1 INPUT	AI2		1	5
4017 ACT2 INPUT	AI2		1	5
4018 ACT1 MINIMUM	0	%	-1000	1000
4019 ACT1 MAXIMUM	100	%	-1000	1000
4020 ACT2 MINIMUM	0	%	-1000	1000
4021 ACT2 MAXIMUM	100	%	-1000	1000
4022 SLEEP SELECTION	NOT SEL		-6	7
4023 PID SLEEP LEVEL	0	Hz	0	500
4024 PID SLEEP DELAY	60	s	0	3600
4025 WAKE-UP DEV	0	%	0	1000
4026 WAKE-UP DELAY	0.5	s	0	60
4027 PID 1 PARAM SET	SET 1		-6	11
41 PROCESS PID SET 2				
4101 GAIN	2.5		0.1	100
4102 INTEGRATION TIME	3	s	0	600
4103 DERIVATION TIME	0	s	0	10
4104 PID DERIV FILTER	1	s	0	10
4105 ERROR VALUE INV	NO		0	1
4106 UNITS	%		0	255
4107 UNIT SCALE	1		0	4
4108 0% VALUE	0	%	-1000	1000
4109 100% VALUE	0	%	-1000	1000
4110 SET POINT SEL	KEYPAD		0	20
4111 INTERNAL SETPNT	0	%	-1000	1000
4112 SETPOINT MIN	0	%	-500	500
4113 SETPOINT MAX	100	%	-500	500
4114 FBK SEL	ACT1		1	9
4115 FBK MULTIPLIER	0		-32.77	32.77
4116 ACT1 INPUT	AI2		1	5
4117 ACT2 INPUT	AI2		1	5
4118 ACT1 MINIMUM	0	%	-1000	1000
4119 ACT1 MAXIMUM	100	%	-1000	1000
4120 ACT2 MINIMUM	0	%	-1000	1000

4121 ACT2 MAXIMUM	100	%	-1000	1000
4122 SLEEP SELECTION	NOT SEL		-6	7
4123 PID SLEEP LEVEL	0	Hz	0	500
4124 PID SLEEP DELAY	60	s	0	3600
4125 WAKE-UP DEV	0	%	0	1000
4126 WAKE-UP DELAY	0.5	s	0	60
42 EXT / TRIM PID				
4201 GAIN	1		0.1	100
4202 INTEGRATION TIME	60	s	0	600
4203 DERIVATION TIME	0	s	0	10
4204 PID DERIV FILTER	1	s	0	10
4205 ERROR VALUE INV	NO		0	1
4206 UNITS	%		0	255
4207 UNIT SCALE	1		0	4
4208 0% VALUE	0		-1000	1000
4209 100% VALUE	0		-1000	1000
4210 SET POINT SEL	AI1		0	20
4211 INTERNAL SETPNT	0		-1000	1000
4212 SETPOINT MIN	0	%	-500	500
4213 SETPOINT MAX	100	%	-500	500
4214 FBK SEL	ACT1		1	9
4215 FBK MULTIPLIER	0		-32.77	32.77
4216 ACT1 INPUT	AI2		1	5
4217 ACT2 INPUT	AI2		1	5
4218 ACT1 MINIMUM	0	%	-1000	1000
4219 ACT1 MAXIMUM	100	%	-1000	1000
4220 ACT2 MINIMUM	0	%	-1000	1000
4221 ACT2 MAXIMUM	100	%	-1000	1000
4228 ACTIVATE	NOT SEL		-6	12
4229 OFFSET	0	%	0	100
4230 TRIM MODE	NOT SEL		0	2
4231 TRIM SCALE	0	%	-100	100
4232 CORRECTION SRC	PID2REF		1	2
51 EXT COMM MODULE				
5101 FBA TYPE	NOT DEFINED		0	65535
5102 FBA PAR 2	0		0	65535
5103 FBA PAR 3	0		0	65535
5104 FBA PAR 4	0		0	65535
5105 FBA PAR 5	0		0	65535
5106 FBA PAR 6	0		0	65535
5107 FBA PAR 7	0		0	65535
5108 FBA PAR 8	0		0	65535
5109 FBA PAR 9	0		0	65535
5110 FBA PAR 10	0		0	65535
5111 FBA PAR 11	0		0	65535
5112 FBA PAR 12	0		0	65535
5113 FBA PAR 13	0		0	65535
5114 FBA PAR 14	0		0	65535
5115 FBA PAR 15	0		0	65535
5116 FBA PAR 16	0		0	65535
5117 FBA PAR 17	0		0	65535
5118 FBA PAR 18	0		0	65535
5119 FBA PAR 19	0		0	65535
5120 FBA PAR 20	0		0	65535
5121 FBA PAR 21	0		0	65535

5122 FBA PAR 22	0		0	65535
5123 FBA PAR 23	0		0	65535
5124 FBA PAR 24	0		0	65535
5125 FBA PAR 25	0		0	65535
5126 FBA PAR 26	0		0	65535
5127 FBA PAR REFRESH	DONE		0	1
5128 FILE CPI FW REV	0		0	65535
5129 FILE CONFIG ID	0		0	65535
5130 FILE CONFIG REV	0		0	65535
5131 FBA STATUS	IDLE		0	6
5132 FBA CPI FW REV	0		0	65535
5133 FBA APPL FW REV	0		0	65535
52 PANEL COMM				
5201 STATION ID	1		1	247
5202 BAUD RATE	96		0	0
5203 PARITY	8N1		0	3
5204 OK MESSAGES	0		0	65535
5205 PARITY ERRORS	0		0	65535
5206 FRAME ERRORS	0		0	65535
5207 BUFFER OVERRUNS	0		0	65535
5208 CRC ERRORS	0		0	65535
53 EFB PROTOCOL				
5301 EFB PROTOCOL ID	0		0	65535
5302 EFB STATION ID	1		0	65535
5303 EFB BAUD RATE	96		0	0
5304 EFB PARITY	8N1		0	4
5305 EFB CTRL PROFILE	ABB DRIVES		0	1
5306 EFB OK MESSAGES	0		0	65535
5307 EFB CRC ERRORS	0		0	65535
5308 EFB UART ERRORS	0		0	65535
5309 EFB STATUS	IDLE		0	7
5310 EFB PAR 10	0		0	65535
5311 EFB PAR 11	0		0	65535
5312 EFB PAR 12	0		0	65535
5313 EFB PAR 13	0		0	65535
5314 EFB PAR 14	0		0	65535
5315 EFB PAR 15	0		0	65535
5316 EFB PAR 16	0		0	65535
5317 EFB PAR 17	0		0	65535
5318 EFB PAR 18	0		0	65535
5319 EFB PAR 19	0		0	65535
5320 EFB PAR 20	0		0	65535
81 PFC CONTROL				
8103 REFERENCE STEP 1	0	%	0	100
8104 REFERENCE STEP 2	0	%	0	100
8105 REFERENCE STEP 3	0	%	0	100
8109 START FREQ 1	60	Hz	0	500
8110 START FREQ 2	60	Hz	0	500
8111 START FREQ 3	60	Hz	0	500
8112 LOW FREQ 1	30	Hz	0	500
8113 LOW FREQ 2	30	Hz	0	500
8114 LOW FREQ 3	30	Hz	0	500
8115 AUX MOT START D	5	s	0	3600
8116 AUX MOT STOP D.	3	s	0	3600

8117 NR OF AUX MOT	1		0	3
8118 AUTOCHNG INTERV	0	h	0	336
8119 AUTOCHNG LEVEL	50	%	0	100
8120 INTERLOCKS	DI4		0	6
8121 REG BYPASS CTRL	NO		0	1
8122 PFC START DELAY	0.5	s	0	10
8123 PFC ENABLE	NOT SEL		0	1
8124 ACC IN AUX STOP	0	s	0	1800
8125 DEC IN AUX START	0	s	0	1800
8126 TIMED AUTOCHNG	NOT SEL		0	4
8127 MOTORS	2		1	6
98 OPTIONS				
9802 COMM PROT SEL	NOT SEL		0	5

Diagnostics

Warning! Do not attempt any measurement, parts replacement or other service procedure not described in this manual. Such action will void the warranty, may endanger correct operation, and increase downtime and expense.

Warning! All electrical installation and maintenance work described in this chapter should only be undertaken by qualified service personnel. The Safety instructions on the first pages of this manual must be followed.

Diagnostic Displays

The drive detects error situations and reports them using:

- The green and red LED on the body of the drive
- The status LED on the control panel (if the HVAC control panel is attached to the drive)
- The control panel display (if the HVAC control panel is attached to the drive)
- The Fault Word and Alarm Word parameter bits (parameters 0305 to 0309). See "Group 03: Actual Signals" on page 56.

The form of the display depends on the severity of the error. You can specify the severity for many errors by directing the drive to:

- Ignore the error situation.
- Report the situation as an alarm.
- Report the situation as a fault.

Red – Faults

The drive signals that it has detected a severe error, or fault, by:

- Enabling the red LED on the drive (LED is either steady on or blinking).
- Setting an appropriate bit in a Fault Word parameter (0305 to 0307).
- Overriding the control panel display with the display of a fault code.
- Stopping the motor (if it was on).

The fault code on the control panel display is temporary. Pressing any of the following buttons removes the fault message: MENU, ENTER, UP button or DOWN button. The message reappears after a few seconds if the control panel is not touched and the fault is still active.

Flashing Green – Alarms

For less severe errors, called alarms, the diagnostic display is advisory. For these situations, the drive is simply reporting that it had detected something "unusual." In these situations, the drive:

- Flashes the green LED on the drive (does not apply to alarms that arise from control panel operation errors).
- Sets an appropriate bit in an Alarm Word parameter (0308 or 0309). See "Group 03: Actual Signals" on page 56 for the bit definitions.
- Overrides the control panel display with the display of an alarm code and/or name.

Alarm messages disappear from the control panel display after a few seconds. The message returns periodically as long as the alarm condition exists.

Correcting Faults

The recommended corrective action for faults is:

- Use the "Fault Listing" table below to find and address the root cause of the problem.
- Reset the drive. See "Fault Resetting" on page 217.

Fault Listing

Fault Code	Fault Name in Panel	Description and Recommended Corrective Action
1	OVERCURRENT	Output current is excessive. Check for and correct: • Excessive motor load. • Insufficient acceleration time (parameters 2202 ACCELER TIME 1 and 2205 ACCELER TIME 2). • Faulty motor, motor cables or connections.
2	DC OVERVOLT	Intermediate circuit DC voltage is excessive. Check for and correct: • Static or transient overvoltages in the input power supply. • Insufficient deceleration time (parameters 2203 DECELER TIME 1 and 2206 DECELER TIME 2). • Undersized brake chopper (if present).
3	DEV OVERTEMP	Drive heatsink is overheated. Temperature is at or above 115 °C (239 °F). Check for and correct: • Fan failure. • Obstructions in the air flow. • Dirt or dust coating on the heat sink. • Excessive ambient temperature. • Excessive motor load.
4	SHORT CIRC	Fault current. Check for and correct: • A short-circuit in the motor cable(s) or motor. • Supply disturbances.

Fault Code	Fault Name in Panel	Description and Recommended Corrective Action
5	OVERLOAD	Inverter overload condition. The drive output current exceeds the ratings given in "Ratings" on page 225.
6	DC UNDERVOLT	Intermediate circuit DC voltage is not sufficient. Check for and correct: • Missing phase in the input power supply. • Blown fuse. • Undervoltage on mains.
7	AI1 LOSS	Analog input 1 loss. Analog input value is less than AI1FLT LIMIT (3021). Check for and correct: • Source and connection for analog input. • Parameter settings for AI1FLT LIMIT (3021) and 3001 AI<MIN FUNCTION.
8	AI2 LOSS	Analog input 2 loss. Analog input value is less than AI2FLT LIMIT (3022). Check for and correct: • Source and connection for analog input. • Parameter settings for AI2FLT LIMIT (3022) and 3001 AI<MIN FUNCTION.
9	MOT TEMP	Motor is too hot, based on either the drive's estimate or on temperature feedback. • Check for overloaded motor. • Adjust the parameters used for the estimate (3005...3009). • Check the temperature sensors and Group 35 parameters.
10	PANEL LOSS	Panel communication is lost and either: • Drive is in local control mode (the control panel displays HAND), or • Drive is in remote control mode (REM) and is parameterized to accept start/stop, direction or reference from the control panel. To correct check: • Communication lines and connections • Parameter 3002 PANEL COMM ERROR. • Parameters in Group 10: Command Inputs and Group 11: Reference Select (if drive operation is REM).
11	ID RUN FAIL	The motor ID run was not completed successfully. Check for and correct: • Motor connections.
12	MOTOR STALL	Motor or process stall. Motor is operating in the stall region. Check for and correct: • Excessive load. • Insufficient motor power. • Parameters 3010...3012.
13	RESERVED	Not used.
14	EXTNAL FLT 1	Digital input defined to report first external fault is active. See parameter 3003 EXTERNAL FAULT 1.
15	EXTERNAL FLT 2	Digital input defined to report second external fault is active. See parameter 3004 EXTERNAL FAULT 2.
16	EARTH FAULT	The load on the input power system is out of balance. • Check for/correct faults in the motor or motor cable. • Verify that motor cable does not exceed max. specified length.
17	UNDERLOAD	Motor load is lower than expected. Check for and correct: • Disconnected load. • Parameters 3013 UNDERLOAD FUNCTION...3015 UNDERLOAD CURVE.

Fault Code	Fault Name In Panel	Description and Recommended Corrective Action
18	THERM FAIL	Internal fault. The thermistor measuring the internal temperature of the drive is open or shorted. Contact your local ABB sales representative.
19	OPEX LINK	Internal fault. A communication-related problem has been detected on the fiber optic link between the OITF and OINT boards. Contact your local ABB sales representative.
20	OPEX PWR	Internal fault. Low voltage condition detected on OINT power supply. Contact your local ABB sales representative.
21	CURR MEAS	Internal fault. Current measurement is out of range. Contact your local ABB sales representative.
22	SUPPLY PHASE	Ripple voltage in the DC link is too high. Check for and correct: • Missing mains phase. • Blown fuse.
23	ENCODER ERR	Not used (Available only with encoder and parameter group 50).
24	OVERSPEED	Motor speed is greater than 120% of the larger (in magnitude) of 2001 MINIMUM SPEED or 2002 MAXIMUM SPEED. Check for and correct: • Parameter settings for 2001 and 2002. • Adequacy of motor braking torque. • Applicability of torque control. • Brake chopper and resistor.
25	RESERVED	Not used as of the publication of this manual.
26	DRIVE ID	Internal fault. Configuration Block Drive ID is not valid. Contact your local ABB sales representative.
27	CONFIG FILE	Internal configuration file has an error. Contact your local ABB sales representative.
28	SERIAL 1 ERR	Fieldbus communication has timed out. Check for and correct: • Fault setup (3018 COMM FAULT FUNC and 3019 COMM FAULT TIME). • Communication settings (Group 51 or 53 as appropriate). • Poor connections and/or noise on line.
29	EFB CONFIG FILE	Error in reading the configuration file for the fieldbus adapter.
30	FORCE TRIP	Fault trip forced by the fieldbus. See the fieldbus User's Manual.
31	EFB 1	Fault code reserved for the EFB protocol application. These codes are not used as of the publication of this manual.
32	EFB 2	
33	EFB 3	
34	MOTOR PHASE	Fault in the motor circuit. One of the motor phases is lost. Check for and correct: • Motor fault. • Motor cable fault. • Thermal relay fault (if used). • Internal fault.
35	OUTPUT WIRING	Error in power wiring suspected. Check for and correct: • Input power wired to drive output. • Ground faults.
36	INCOMP SWTYPE	The wrong software has been loaded onto the drive. Either standard (ACS) software has been loaded onto an ACH drive, or HVAC (ACH) software has been loaded on an ACS drive.

Fault Code	Fault Name in Panel	Description and Recommended Corrective Action
101	SERF CORRUPT	Error internal to the drive. Contact your local ABB sales representative and report the error number.
102	SERF ITFILE	
103	SERF MACRO	
104	SERF EFBPROT	
105	SERF BPFILE	
201	DSP T1 OVERLOAD	Error in the system. Contact your local ABB sales representative and report the error number.
202	DSP T2 OVERLOAD	
203	DSP T3 OVERLOAD	
204	DSP STACK ERROR	
205	DSP REV ERROR	
206	OMIO ID ERROR	
207	EFB LOAD ERR	
1000	PAR HZRPM LIMITS	Parameter values are inconsistent. Check for any of the following: • 2001 MINIMUM SPEED > 2002 MAXIMUM SPEED. • 2007 MINIMUM FREQ > 2008 MAXIMUM FREQ. • 2001 MINIMUM SPEED or 9908 MOTOR NOM SPEED is outside of the range: -128...128. • 2002 MAXIMUM SPEED or 9908 MOTOR NOM SPEED is outside of the range: -128...128. • 2007 MINIMUM FREQ or 9907 MOTOR NOM FREQ is outside of the range: -128...128. • 2008 MAXIMUM FREQ or 9907 MOTOR NOM FREQ is outside of the range: -128...128.
1001	PAR PFAREFNG	Parameter values are inconsistent. Check for the following: • 2007 MINIMUM FREQ is negative, when 8123 PFA ENABLE is active.
1002	PAR PFAIOCNF	Parameter values are inconsistent. The number of programmed PFA relays does not match with interlock configuration, when 8123 PFA ENABLE is active. Check consistency of: • RELAY OUTPUT parameters 1401...1403, and 1410...1412. • 8117 NR OF AUX MOTORS, 8118 AUTOCHANGE INTERV, and 8120 INTERLOCKS.
1003	PAR AI SCALE	Parameter values are inconsistent. Check for any of the following: • 1301 AI 1 MIN > 1302 AI 1 MAX. • 1304 AI 2 MIN > 1305 AI 2 MAX.
1004	PAR AO SCALE	Parameter values are inconsistent. Check for any of the following: • 1504 AO 1 MIN > 1505 AO 1 MAX. • 1510 AO 2 MIN > 1511 AO 2 MAX.
1005	PAR PCU 2	Parameter values for power control are inconsistent: improper motor nominal kVA or motor nominal power. Check for the following: • $1.1 \leq (9906 \text{ MOTOR NOM CURR} * 9905 \text{ MOTOR NOM VOLT} * 1.73 / P_N) \leq 2.6$ • Where: $P_N = 1000 * 9909$ MOTOR NOM POWER (if units are kW) or $P_N = 746 * 9909$ MOTOR NOM POWER (if units are HP, e.g. in US)

Fault Code	Fault Name in Panel	Description and Recommended Corrective Action
1006	PAR EXT RO	Parameter values are inconsistent. Check for the following: • Extension relay module not connected and • 1410...1412 RELAY OUTPUTS 4...6 have non-zero values.
1007	PAR FBUS	Parameter values are inconsistent. Check for and correct: • A parameter is set for fieldbus control (e.g. 1001 EXT1 COMMANDS = 10 (COMM)), but 9802 COMM PROT SEL = 0.
1008	PAR PFAMODE	Parameter values are inconsistent – 9904 MOTOR CTRL MODE must be = 3 (SCALAR: SPEED), when 8123 PFA ENABLE is activated.
1009	PAR PCU 1	Parameter values for power control are inconsistent: Improper motor nominal frequency or speed. Check for both of the following: • $1 \leq (60 * 9907$ MOTOR NOM FREQ / 9908 MOTOR NOM SPEED ≤ 16 • $0.8 \leq 9908$ MOTOR NOM SPEED / (120 * 9907 MOTOR NOM FREQ / Motor Poles) ≤ 0.992
1010	PAR PFA OVERRIDE	Both the override mode and PFA are activated at the same time. These modes are mutually incompatible, because PFA interlocks cannot be observed in the override mode.
1011	PAR OVERRIDE PARS	Overeride is enabled, but parameters are incompatible. Verify that1701 is not zero, and (depending on 9904 value) 1702 or 1703 is not zero.

Fault Resetting

The ACH550 can be configured to automatically reset certain faults. Refer to parameter Group 31: Automatic Reset.

Warning! If an external source for start command is selected and it is active, the ACH550 may start immediately after fault reset.

Flashing Red LED

To reset the drive for faults indicated by a flashing red LED:

- Turn off the power for 5 minutes.

Red LED

To reset the drive for faults indicated by a red LED (on, not flashing), correct the problem and do one of the following:

- From the control panel, press RESET
- Turn off the power for 5 minutes.

Depending on the value of 1604, FAULT RESET SELECT, the following could also be used to reset the drive:

- Digital input
- Serial communication

When the fault has been corrected, the motor can be started.

History

For reference, the last three fault codes are stored into parameters 0401, 0412, 0413. For the most recent fault (identified by parameter 0401), the drive stores additional data (in parameters 0402...0411) to aid in troubleshooting a problem. For example, parameter 0404 stores the motor speed at the time of the fault.

To clear the fault history (all of the Group 04, Fault History parameters):

1. Using the control panel in Parameters mode, select parameter 0401.
2. Press EDIT.
3. Press UP and Down simultaneously.
4. Press SAVE.

Correcting Alarms

The recommended corrective action for alarms is:

- Determine if the Alarm requires any corrective action (action is not always required).
- Use "Alarm Listing" below to find and address the root cause of the problem.

Alarm Listing

The following table lists the alarms by code number and describes each.

Alarm Code	Display	Description
2001	Reserved	
2002		
2003		
2004	DIR LOCK	The change in direction being attempted is not allowed. Either: • Do not attempt to change the direction of motor rotation, or • Change parameter 1003 DIRECTION to allow direction change (if reverse operation is safe).
2005	I/O COMM	Fieldbus communication has timed out. Check for and correct: • Fault setup (3018 COMM FAULT FUNC and 3019 COMM FAULT TIME). • Communication settings (Group 51 or 53 as appropriate). • Poor connections and/or noise on line.
2006	AI1 LOSS	Analog input 1 is lost, or value is less than the minimum setting. Check: • Input source and connections • Parameter that sets the minimum (3021) • Parameter that sets the Alarm/Fault operation (3001)
2007	AI2 LOSS	Analog input 2 is lost, or value is less than the minimum setting. Check: • Input source and connections • Parameter that sets the minimum (3022) • Parameter that sets the Alarm/Fault operation (3001)

Alarm Code	Display	Description
2008	PANEL LOSS	Panel communication is lost and either: • Drive is in local control mode (the control panel displays LOC), or • Drive is in remote control mode (REM) and is parameterized to accept start/stop, direction or reference from the control panel. To correct check: • Communication lines and connections • Parameter 3002 PANEL LOSS. • Parameters in groups 10 COMMAND INPUTS and 11 REFERENCE SELECT (if drive operation is REM).
2009	Reserved	
2010	MOT OVERTEMP	Motor is hot, based on either the drive's estimate or on temperature feedback. This alarm warns that a Motor Underload fault trip may be near. Check: • Check for overloaded motor. • Adjust the parameters used for the estimate (3005...3009). • Check the temperature sensors and Group 35 parameters.
2011	UNDERLOAD	Motor load is lower than expected. This alarm warns that a Motor Underload fault trip may be near. Check: • Motor and drive ratings match (motor is NOT undersized for the drive) • Settings on parameters 3013 to 3015
2012	MOTOR STALL	Motor is operating in the stall region. This alarm warns that a Motor Stall fault trip may be near.
2013 (note 1)	AUTORESET	This alarm warns that the drive is about to perform an automatic fault reset, which may start the motor. • To control automatic reset, use parameter group 31 AUTOMATIC RESET.
2014 (note 1)	AUTOCHANGE	This alarm warns that the PFA autochange function is active. • To control PFA, use parameter group 81 PFA CONTROL
2015	PFA INTERLOCK	This alarm warns that the PFA interlocks are active, which means that the drive cannot start the following: • Any motor (when Autochange is used), • The speed regulated motor (when Autochange is not used).
2016	Reserved	
2017	OFF BUTTON	Note 1.
2018 (note 1)	PID SLEEP	This alarm warns that the PID sleep function is active, which means that the motor could accelerate when the PID sleep function ends. • To control PID sleep, use parameters 4022...4026 or 4122...4126.
2019	ID RUN	Performing ID run.
2020	OVERRIDE	Override mode activated.
2021	START ENABLE 1 MISSING	This alarm warns that the Start Enable 1 signal is missing. • To control Start Enable 1 function, use parameter 1608. To correct, check: • Digital input configuration. • Communication settings.

Alarm Code	Display	Description
2022	START ENABLE 2 MISSING	This alarm warns that the Start Enable 2 signal is missing. • To control Start Enable 2 function, use parameter 1609. To correct, check: • Digital Input configuration. • Communication settings.
2023	EMERGENCY STOP	Emergency stop activated.

Note 1. Even when the relay output is configured to indicate alarm conditions (e.g. parameter 1401 RELAY OUTPUT 1 = 5 (ALARM) or 16 (FLT/ALARM)), this alarm is not indicated by a relay output.

Maintenance

Warning! Read "Safety" on page 3 before performing any maintenance on the equipment. Ignoring the safety instructions can cause injury or death.

Maintenance Intervals

If installed in an appropriate environment, the drive requires very little maintenance. This table lists the routine maintenance intervals recommended by ABB.

Maintenance	Interval	Instruction
Heatsink temperature check and cleaning	Depends on the dustiness of the environment (every 6...12 months)	See "Heatsink" on page 221.
Main cooling fan replacement	Every five years	See "Main Fan Replacement" on page 222.
Internal enclosure cooling fan replacement (IP 54/UL Type 12 units)	Every three years.	See "Internal Enclosure Fan Replacement" on 223.
Capacitor change (Frame sizes R5 and R6)	Every ten years	See "Capacitors" on page 223.
HVAC control panel battery change	Every ten years	See "Battery" on page 62.

Heatsink

The heatsink fins accumulate dust from the cooling air. Since a dusty heatsink is less efficient at cooling the drive, overtemperature faults become more likely. In a "normal" environment (not dusty, not clean) check the heatsink annually, in a dusty environment check more often.

Clean the heatsink as follows (when necessary):

1. Remove power from drive.
2. Remove the cooling fan (see section "Main Fan Replacement" on page 222).
3. Blow clean compressed air (not humid) from bottom to top and simultaneously use a vacuum cleaner at the air outlet to trap the dust.

Note: If there is a risk of the dust entering adjoining equipment, perform the cleaning in another room.

4. Replace the cooling fan.
5. Restore power.

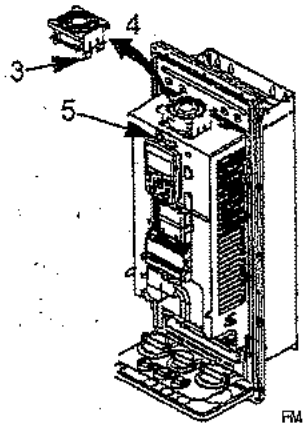
Internal Enclosure Fan Replacement

IP 54 / UL Type 12 enclosures have an additional internal fan to circulate air inside the enclosure.

Frame Sizes R1 to R4

To replace the internal enclosure fan in frame sizes R1 to R4:

1. Remove power from drive.
2. Remove the front cover.
3. The housing that holds the fan in place has barbed retaining clips at each corner. Press all four clips toward the center to release the barbs.
4. When the clips/barbs are free, pull the housing up to remove from the drive.
5. Disconnect the fan cable.
6. Install the fan in reverse order, noting that:
   - The fan air flow is up (refer to arrow on fan).
   - The fan wire harness is toward the front.
   - The notched housing barb is located in the right-rear corner.
   - The fan cable connects just forward of the fan at the top of the drive.



Frame Sizes R5 and R6

To replace the internal enclosure fan in frame sizes R5 or R6:

- Remove power from drive.
- Remove the front cover.
- Lift the fan out and disconnect the cable.
- Install the fan in reverse order.
- Restore power.

Capacitors

The drive intermediate circuit employs several electrolytic capacitors. Their life span is from 35,000...90,000 hours depending on drive loading and ambient temperature. Capacitor life can be prolonged by lowering the ambient temperature.

It is not possible to predict a capacitor failure. Capacitor failure is usually followed by a input power fuse failure or a fault trip. Contact ABB if capacitor failure is suspected. Replacements for frame size R5 and R6 are available from ABB. Do not use other than ABB specified spare parts.

Main Fan Replacement

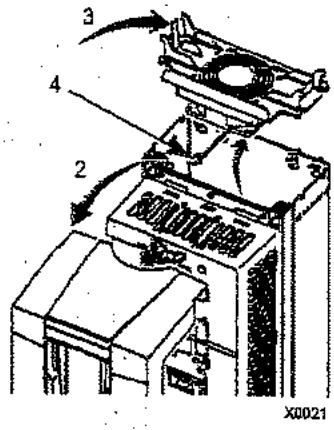
The drive's main cooling fan has a life span of about 60,000 operating hours at maximum rated operating temperature and drive load. The expected life span doubles for each 10 °C (18 °F) drop in the fan temperature (fan temperature is a function of ambient temperatures and drive loads).

Fan failure can be predicted by the increasing noise from fan bearings and the gradual rise in the heatsink temperature in spite of heatsink cleaning. If the drive is operated in a critical part of a process, fan replacement is recommended once these symptoms start appearing. Replacement fans are available from ABB. Do not use other than ABB specified spare parts.

Frame Sizes R1...R4

To replace the fan:

1. Remove power from drive.
2. Remove drive cover.
3. For Frame Size:
   - R1, R2: Press together the retaining clips on the fan cover sides, and lift.
   - R3, R4: Press in on the lever located on the left side of the fan mount, and rotate the fan up and out.
4. Disconnect the fan cable.
5. Install the fan in reverse order.
6. Restore power.

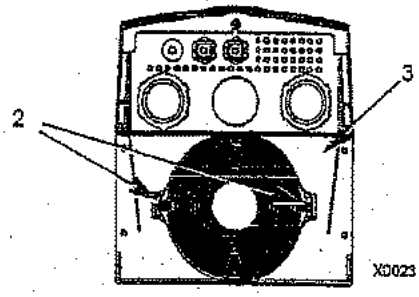


Frame Sizes R5 and R6

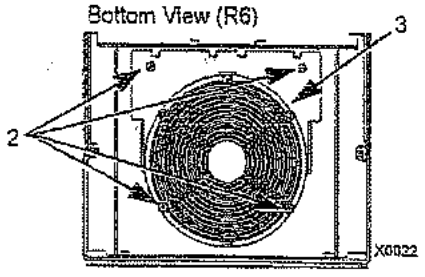
To replace the fan:

1. Remove power from drive.
2. Remove the screws attaching the fan.
3. Disconnect the fan cable.
4. Install the fan in reverse order.
5. Restore power.

Bottom View (R5)



Bottom View (R6)



Control Panel

Cleaning

Use a soft damp cloth to clean the control panel. Avoid harsh cleaners which could scratch the display window.

Battery

A battery is only used in Assistant control panels that have the clock function available and enabled. The battery keeps the clock operating in memory during power interruptions.

The expected life for the battery is greater than ten years. To remove the battery, use a coin to rotate the battery holder on the back of the control panel. Replace the battery with type CR2032.

Ratings, 208...240 Volt Drives

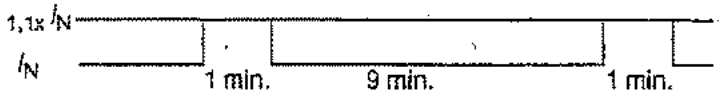
Abbreviated column headers are described in "Symbols" on page 226.

Type Code	Valid up to 40°C (104 °F)			Frame Size
ACH550-UH-see below	I_{2N} A	P_N kW	P_N HP	
Three-phase supply voltage, 208...240 V				
-04A6-2	4.6	1.1	1.0	R1
-06A6-2	6.6	1.5	1.5	R1
-07A5-2	7.5	2.2	2.0	R1
-012A-2	11.8	3.0	3.0	R1
-017A-2	16.7	4.0	5.0	R1
-024A-2	24.2	5.5	7.5	R2
-031A-2	30.8	7.5	10.0	R2
-046A-2	46.2	11.0	15.0	R3
-059A-2	59.4	15.0	20.0	R3
-075A-2	74.8	18.5	25.0	R4
-088A-2	88.0	22.0	30.0	R4
-114A-2	114	30.0	40.0	R4
-143A-2	143	37.0	50.0	R6
-178A-2	178	45.0	60.0	R6
-221A-2	221	55.0	75.0	R6
-248A-2	248	75.0	100	R6

Symbols

Typical ratings:
Normal use (10% overload capability)

I_{2N} continuous rms current. 10% overload is allowed for one minute in ten minutes.



P_N typical motor power in normal use. The kilowatt power ratings apply to most IEC, 4-pole motors. The Horsepower ratings apply to most 4-pole NEMA motors.

Sizing

The current ratings are the same regardless of the supply voltage within one voltage range. To achieve the rated motor power given in the table, the rated current of the drive must be higher than or equal to the rated motor current.

Note 1: The ratings apply in ambient temperature of 40 °C (104 °F).

Ratings, 208...240 Volt Drives

Abbreviated column headers are described in "Symbols" on page 226.

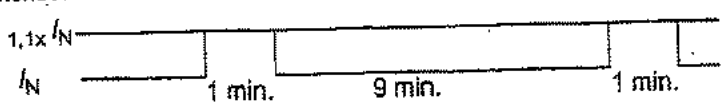
Type Code	Valid up to 40°C (104 °F)			Frame Size
ACH550-UH-see below	I_{2N} A	P_N kW	P_N HP	
Three-phase supply voltage, 208...240 V				
-04A6-2	4.6	1.1	1.0	R1
-06A6-2	6.6	1.5	1.5	R1
-07A5-2	7.5	2.2	2.0	R1
-012A-2	11.8	3.0	3.0	R1
-017A-2	16.7	4.0	5.0	R1
-024A-2	24.2	5.5	7.5	R2
-031A-2	30.8	7.5	10.0	R2
-046A-2	46.2	11.0	15.0	R3
-059A-2	59.4	15.0	20.0	R3
-075A-2	74.8	18.5	25.0	R4
-088A-2	88.0	22.0	30.0	R4
-114A-2	114	30.0	40.0	R4
-143A-2	143	37.0	50.0	R6
-178A-2	178	45.0	60.0	R6
-221A-2	221	55.0	75.0	R6
-248A-2	248	75.0	100	R6

Symbols

Typical ratings:

Normal use (10% overload capability)

I_{2N} continuous rms current. 10% overload is allowed for one minute in ten minutes.



P_N typical motor power in normal use. The kilowatt power ratings apply to most IEC, 4-pole motors. The Horsepower ratings apply to most 4-pole NEMA motors.

Sizing

The current ratings are the same regardless of the supply voltage within one voltage range. To achieve the rated motor power given in the table, the rated current of the drive must be higher than or equal to the rated motor current.

Note 1: The ratings apply in ambient temperature of 40 °C (104 °F).

Derating

The load capacity (current and power) decreases if the installation site altitude exceeds 1000 meters (3300 ft), or if the ambient temperature exceeds 40 °C (104 °F) or if 8 kHz switching frequency (parameter 2606) is used.

Temperature Derating

In the temperature range +40 °C...50 °C (+104 °F...122 °F) the rated output current is decreased 1% for every 1 °C (1.8 °F) above +40 °C (+104 °F). The output current is calculated by multiplying the current given in the rating table by the derating factor.

Example If the ambient temperature is 50 °C (+122 °F) the derating factor is 100% - 1%/°C x 10 °C = 90% or 0.90.
The output current is then 0.90 x I_{2N}.

Altitude Derating

In altitudes from 1000...4000 m (3300...13,200 ft) above sea level, the derating is 1% for every 100 m (330 ft). If the installation site is higher than 2000 m (6600 ft) above sea level, please contact your local ABB distributor or office for further information.

Single Phase Supply Derating

For 208...240 Volt series drives, a single phase supply can be used. In that case, the derating is 50%.

Switching Frequency Derating

If the 8 kHz switching frequency (parameter 2606) is used, either:

- Derate P_N and I_{2N} to 80% or
- Set parameter 2607 SW FREQ CTRL = 1 (ON) which allows the drive to reduce the switching frequency if/when the drive's internal temperature exceeds 90 °C. See the parameter description for 2607 for details.

Input Power Connections

Warning! Do not operate the drive outside the nominal input line voltage range. Over-voltage can result in permanent damage to the drive.

Input Power Specifications

Input Power Connection Specifications	
Voltage (U_1)	208/220/230/240 VAC 3-phase (or 1-phase) +10% -15% for 230 VAC units. 400/415/440/460/480 VAC 3-phase +10% -15% for 400 VAC units.
Prospective short-circuit current (IEC 629)	Maximum allowed prospective short-circuit current in the supply is 100 kA in a second providing that the drive's input power is protected with appropriate fuses. US: 100,000 AIC.
Frequency	48...63 Hz
Imbalance	Max. ± 3% of nominal phase to phase input voltage
Fundamental power factor (cos φ)	0.98 (at nominal load)
Cable Temperature Rating	90 °C (194 °F) rating minimum.

Branch Circuit Protection

The ACH550 does not include a disconnect device. A means to disconnect input power must be installed between the AC power source and the ACH550. This branch circuit protection must:

- Be sized to conform to applicable safety regulations, including, but not limited to, both National and local electrical codes.
- Be locked in the open position during installation and maintenance work.

The disconnect device must not be used to control the motor. Instead use the control panel, or commands to the I/O terminals for motor control. Cycling the disconnect device cycles power to the drive's DC capacitors. These capacitors have a maximum limit of 5 cycles in ten minutes.

Fuses

The following tables provide fuse recommendations for short circuit protection on the drive's input power. These recommendations are not requirements if branch circuit protection is otherwise provided per NEC. UL508A manufacturers are not required to use the recommended fuses for the purpose of UL listing a panel that includes the ACH550.

380...460 Volt Drives

ACH550-UH- see below	Input Current (A)	Input Fuses		
		IEC269 gG (A)	UL Class T (A)	Bussmann Type
-03A3-4	3.3	10	[illegible]	JJS-10
-04A1-4	4.1			
-06A9-4	6.9			
-08A8-4	8.8		15	JJS-15
-012A-4	11.9	16		
-015A-4	16.4		20	JJS-20
-023A-4	23	25	30	JJS-30
-031A-4	31	35	40	JJS-40
-038A-4	38	50	50	JJS-50
-044A-4	44		60	JJS-60
-059A-4	59	63	80	JJS-80
-072A-4	72	80	90	JJS-90
-077A-4	77		100	JJS-100
-096A-4	96	125	125	JJS-125
-124A-4	124	160	175	JJS-175
-157A-4	157	200	200	JJS-200
-180A-4	180	250	250	JJS-250

208...240 Volt Drives

ACH550-UH- see below	Input Current A	Input Fuses		
		IEC269 gG (A)	UL Class T (A)	Bussmann Type
-04A6-2	4.6	10	[illegible]	JJS-10
-06A6-2	6.6			
-07A5-2	7.5			
-012A-2	11.8	16	15	JJS-15
-017A-2	16.7	25	25	JJS-25
-024A-2	24.2		30	JJS-30
-031A-2	30.8	40	40	JJS-40
-046A-2	46.2	63	60	JJS-60
-059A-2	59.4		80	JJS-80
-075A-2	74.8	80	100	JJS-100
-088A-2	88.0	100	110	JJS-110
-114A-2	114	125	150	JJS-150
-143A-2	143	200	200	JJS-200
-178A-2	178	250	250	JJS-250
-221A-2	221	315	300	JJS-300
-248A-2	248		350	JJS-350

IEC				NEC	
Based on: • EN 60204-1 and IEC 60364-5-2/2001 • PVC insulation • 30 °C (86 °F) ambient temperature • 70 °C (158 °F) surface temperature • Cables with concentric copper shield • Not more than nine cables laid on cable ladder side by side.				Based on: • NEC Table 310-16 for copper wires • 90 °C (194 °F) wire insulation • 40 °C (104 °F) ambient temperature • Not more than three current-carrying conductors in raceway or cable, or earth (directly buried) • Copper cables with concentric copper shield	
Max Load Current (A)	**Cu Cable (mm^2)**		**Max Load Current (A)**	**Al Cable (mm^2)**	**Max Load Current (A)**	**Cu Wire Size (AWG/kcmil)**
249	3x150				237	4/0
284	3x185				264	250 MCM or 2 x 1
					291	300 MCM or 2 x 1/0
					319	350 MCM or 2 x 2/0

Ground Connections

For personnel safety, proper operation and to reduce electromagnetic emission/pick-up, the drive and the motor must be grounded at the installation site.

- Conductors must be adequately sized as required by safety regulations.
- Power cable shields must be connected to the drive PE terminal in order to meet safety regulations.
- Power cable shields are suitable for use as equipment grounding conductors only when the shield conductors are adequately sized as required by safety regulations.
- In multiple drive installations, do not connect drive terminals in series.

Drive's Power Connection Terminals

The following table provides specifications for the drive's power connection terminals.

Frame Size	U1, V1, W1 and U2, V2, W2 Terminals				Earthing PE Terminal			
	Maximum Wire Size		Torque		Maximum Wire Size		Torque	
	mm^2	AWG	Nm	lb-ft	mm^2	AWG	Nm	lb-ft
R1	6	8	1.4	1.0	4	10	1.4	1.0
R2	10	6	1.4	1.0	10	8	1.4	1.0
R3	25	3	1.8	1.3	16	6	1.8	1.3
R4	50	1/0	2.0	1.5	35	2	2.0	1.5
R5	70	2/0	15	11.1	70	2/0	15	11.1
R6	185	350 MCM	40	29.5	95	4/0	8	5.9

Emergency Stop Devices

The overall design of the installation must include emergency stop devices and any other safety equipment that may be needed. Pressing STOP on the drive's control panel does NOT:

- Generate an emergency stop of the motor.
- Separate the drive from dangerous potential.

Input Power Cables/ Wiring

Input wiring can be either:

- A four conductor cable (three phases and ground/protective earth) routed through conduit.
- Four insulated conductors routed through conduit.

Size wiring according to local safety regulations, appropriate input voltage and the drive's load current. In any case, the conductor must be less than the maximum limit defined by the terminal size (see "Drive's Power Connection Terminals" on page 231).

The table below lists copper and aluminum cable types for different load currents. These recommendations apply only for the conditions listed at the top of the table.

IEC				NEC	
Based on: • EN 60204-1 and IEC 60364-5-2/2001 • PVC insulation • 30 °C (86 °F) ambient temperature • 70 °C (158 °F) surface temperature • Cables with concentric copper shield • Not more than nine cables laid on cable ladder side by side.				Based on: • NEC Table 310.16 for copper wires • 90 °C (194 °F) wire insulation • 40 °C (104 °F) ambient temperature • Not more than three current carrying conductors in raceway or cable or earth (directly buried) • Copper cables with concentric copper shield	
Max Load Current (A)	Cu Cable (mm^2)	Max Load Current (A)	Al Cable (mm^2)	Max Load Current (A)	Cu Wire Size (AWG/kcmil)
14	3x1.5	61	3x25	22.8	14
20	3x2.5	75	3x35	27.3	12
27	3x4	91	3x50	36.4	10
34	3x6	117	3x70	50.1	8
47	3x10	143	3x95	68.3	6
62	3x16	166	3x120	86.5	4
79	3x25	191	3x150	100	3
98	3x35	218	3x185	118	2
119	3x50	257	3x240	137	1
153	3x70	274	3x (3x50)	155	1/0
186	3x95	285	2x (3x95)	178	2/0
215	3x120			205	3/0

ABB DC motors carry a 12-month, "parts only" warranty from date of start up, not to exceed 18 months from date of shipment, excluding items that are considered normal wear and tear on a DC Machine (i.e. brushes, bearings, etc.). For additional warranty requirements, please contact ABB LV Drives Sales.

If the scope of supply includes motors not manufactured by ABB, including brand labeled motors, such motors are covered by the Manufacturer's standard warranty. The Manufacturer is responsible for warranty administration.

***Additional warranties, not covered in this procedure, must be approved by the VP of LV Drives Sales using the guidelines of the Sales Quotation Procedure (Must Wins).**

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Engineered Drives

Extended warranty for drives only in an engineered drives system must be purchased at the time of order and in compliance with the approved request for quote. This extended warranty can be obtained by using the Sales Quotation Procedure (RFQ).

If additional warranty is purchased, the following adder apply:

- For "on-site parts, labor, and travel" warranty, 5% of the total net price of the equipment ordered is to be added for each additional year purchased, up to the maximum total warranty of 5 years from date of shipment from ABB New Berlin.

Extended warranty for non-ABB equipment (e.g. motors, transformers, etc.) in an engineered drive system is available to the extent it is offered by the Manufacturer.

DRIVES PURCHASED IN THE US AND CANADA AND INSTALLED IN COUNTRIES OTHER THAN THE US AND CANADA

Drives purchased by US OEM's for export to countries other than the US and Canada carry the same standard "parts only" or "parts and on-site labor" warranty as drives purchased and installed in the US and Canada as set forth above. Certified start-up and extended warranty coverage is not available.

Warranty remedies are normally executed through the ABB global service network either by repair at a local ABB facility or by providing on-site service. Replacement/repair parts are delivered to the point of repair at no cost to Purchaser, with the exception of cost of import duties. Replacement product (drives) is delivered to Purchaser in the US. Purchaser is responsible for delivery arrangements to third country.

Distance costs (travel time, travel costs) in third country by service personnel, local third country shipping costs in connection with return of product to ABB facility for repairs and import duties into third country are not included in the warranty coverage.

Purchaser is responsible for submitting export registration forms to ABB for exported drives. Registration forms can be found on www.abb-drives.com or can be requested from ABB Technical Support (1-800-HELP 365).

WARRANTY CLAIMS

When a warranty claim is made to ABB Technical Support a Fault/No-Fault purchase order must be issued to ABB. If the failed equipment is not returned within 30 days from the date of shipment of the replacement unit from ABB, or if the failure is found to be of non-warranty nature, the customer will be billed for the costs incurred on the No-fault purchase order.

MOTORS INCLUDED IN SCOPE OF SUPPLY

ABB NEMA or IEC Inverter Duty Low Voltage AC motors are warranted for 24 months from date of start up, not to exceed 30 months from date of shipment. For additional warranty requirements, please contact ABB LV Drives Sales.

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registered with ABB Technical Support in New Berlin, the warranty period is extended to 24 months from date of start up, not to exceed 30 months from date of shipment from the ABB New Berlin facility. The extended warranty includes repair, or replacement at ABB's option, when the defective unit is returned to ABB freight prepaid. Alternatively, the purchaser will receive on-site parts and labor, including travel time and travel costs as authorized by ABB Technical Support Department 1-800-HELP-365 during the warranty period. In order for the extended warranty to be valid, the certified start up must be performed within 24 months from date of shipment and properly registered with ABB Technical Support.

Returns to ABB of product or parts are to be made be by prepaid freight. Collect return shipments are not accepted. Replacement product or parts from ABB are shipped prepaid from ABB.

Engineered Drives and Multi-Drives (including XXT ratings) are not eligible for certified start-up and related extended warranty.

On-site drive warranty repairs are performed by local ABB certified Designated Service Stations or by ABB service engineers.

PURCHASE OF EXTENDED SALES WARRANTY

Extended warranty can be purchased for certain drives. The extended warranty can add up to 4 years of warranty to the standard warranty as described below, with a total maximum warranty time limit of 5 years after shipment from ABB in New Berlin, WI.

Eligible drives include standard ACS/H 400, ACS/H 550, ACS 600, ACS 800 and Engineered Drives prior to purchase. Drives already in operation are eligible if a registered certified start-up has been performed, subject to a 12-month limitation from date of shipment (see below).

When extended warranty is requested, start up services must be performed by an ABB certified start up technician and registered with ABB Technical Support in New Berlin.

Standard Products

Extended Warranties must be purchased at time of order, or within 12 months from date of shipment from the ABB New Berlin facility. The extended warranty can be obtained in two ways using the Sales Quotation Procedure and Must Wins:

1. If a warranty extension is requested, a Must Win stating the requested warranty period must be submitted to ABB Drives Sales and approved prior to order placement.
2. If a warranty extension is purchased, the following price adders shall apply:
   - For "parts and on-site labor" warranty, 3% of the total net price of the equipment ordered is to be added for each additional year purchased, up to the maximum total warranty time of 5 years from date of shipment.
   - For "on-site parts, labor, and travel" warranty, 5% of the total net price of the equipment ordered is to be added for each additional year purchased, up to the maximum total warranty time of 5 years from date of shipment.

WARRANTY POLICY

This policy defines the warranties covered by the Low Voltage Drives Sales group and the means by which a customer can obtain additional warranty for a specified product beyond the standard warranty period listed in the ABB General Terms & Conditions. (ABB typically warrants equipment, excluding software, against defects in material and workmanship for a period of twelve (12) months from date of start-up, not to exceed eighteen (18) months from date of shipment from ABB - for specifics consult the latest revision of the document). Extended warranty requirements must be requested through the Sales Quotation Procedure/Must Win Process.

This policy applies to all LV Drive Products purchased from the LV Drives Sales Divisions (i.e. Standard ACS 100, ACS 140, ACS 160, ACS/H 400, ACS/H 550, ACS 600, ACS 800 and DC Drives plus Motors and Accessories included in the scope of supply). Certified start-up and extended warranty coverage is available only for the products listed herein when purchased and installed in the US and Canada, unless otherwise defined and approved through the Sales Quotation Procedure and RFQ Process/Must Win process.

The following lists the general products and the warranties available for each product.

DRIVES PURCHASED AND INSTALLED IN THE US AND CANADA

ACS 100/140/160 general machinery drive products carry a standard "parts only" warranty for a period of 24 months from date of start up, not to exceed 30 months from date of shipment from ABB New Berlin. These drives are not serviceable in the field and are replaced. Associated labor and transportation costs are not covered. Certified start up is not available.

Standard ACS 400 products carry a standard "parts and on-site labor " warranty, excluding travel time and travel cost, for a period of 24 months from date of start up, not to exceed 30 months from date of shipment from ABB New Berlin. Frame sizes R1 and R2 are not field serviceable and are replaced with new or refurbished product at ABB's option. When start up service is performed by an ABB certified start up technician and registered with ABB Technical Support in New Berlin, the purchaser will receive on-site parts, labor and travel costs as authorized by ABB Technical Support 1-800-HELP-365 during the standard warranty period. Certified start-up must be performed within 24 months from the date of shipment from ABB New Berlin and properly registered within the normal warranty period in order for the on-site parts, labor and travel costs to be covered.

Standard ACH 400, ACS/H 550, ACS 600, ACS 800 and DCS 400/500B products carry a standard "parts and on-site labor" warranty, excluding travel time and travel cost, for a period of 12 months from date of start up, not to exceed 24 months from date of shipment from ABB New Berlin. When start up service is performed by an ABB certified start up technician and

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Electromechanical Environments

Product standard EN 61800-3 (Adjustable speed electrical power drive systems - Part 3: EMC product standard including specific test methods) defines **First Environment** as environment that includes domestic premises. It also includes establishments directly connected without intermediate transformers to a low voltage power supply network which supplies buildings used for domestic purposes.

Second Environment includes establishments other than those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.

Liability Limits

The manufacturer is not responsible for:

- Any costs resulting from a failure if the installation, commissioning, repair, alteration, or ambient conditions of the drive do not fulfil the requirements specified in the documentation delivered with the unit and other relevant documentation.
- Units subjected to misuse, negligence or accident.
- Units comprised of materials provided or designs stipulated by the purchaser.

In no event shall the manufacturer, its suppliers or subcontractors be liable for special, indirect, incidental or consequential damages, losses or penalties.

If you have any questions concerning your ABB drive, please contact the local distributor or ABB office. The technical data, information and specifications are valid at the time of printing. The manufacturer reserves the right to modifications without prior notice.

Compliance is valid with the following provisions:

- The motor and control cables are chosen as specified in this manual.
- The installation rules of this manual are followed.

UL Markings

The ACH550 is UL listed to 100 KAIC without use of input fuses or circuit breaker. For end-users's convenience, section "Branch Circuit Protection" provides fuse recommendations. Branch circuit protection must to be provided, either per NEC, or per the recommendations in "Branch Circuit Protection".

Note! UL508A manufactures are not required to use the fuse recommendations for the purpose of UL Listing a panel with an ACH550 AFD.

The ACH550 has an electronic motor protection feature that complies with the requirements of UL 508C. When this feature is selected and properly adjusted, additional overload protection is not required unless more than one motor is connected to the drive or unless additional protection is required by applicable safety regulations. See parameters 3005 (MOT THERM PROT) and 3006 (MOT THERM TIME).

EMC (Europe, Australia, and New Zealand)

This section describes conformance with EMC requirements (in Europe, Australia, and New Zealand). For installations in the Unites States and other locations without special EMC requirements, skip to "Control Cables" on page 237.

CE Marking

A CE mark is attached to the ACH550 AC drive to verify that the drive follows the provisions of the European Low Voltage and EMC Directives (Directive 73/23/EEC, as amended by 93/68/EEC and Directive 89/336/EEC, as amended by 93/68/EEC).

The EMC Directive defines the requirements for immunity and emissions of electrical equipment used in European Economic Area. The EMC product standard EN 61800-3 covers the requirements stated for drives, such as the ACH550. The drive complies with the First environment (restricted distribution) and Second Environment limits of EN/IEC 61800-3.

C-Tick Marking

A C-Tick mark is attached to the ACH550 drive to verify compliance with the relevant standard, IEC 61800-3 (1996) – Adjustable speed electrical power drive systems – Part 3: EMC product standard including specific test methods, mandated by the Trans-Tasman Electromagnetic Compatibility Scheme. The drive complies with the First environment (restricted distribution) and Second Environment limits of EN/IEC 61800-3 with the following provisions:

- The motor and control cables are chosen as specified in this manual.
- The installation instructions in this manual are followed.

Ambient Environment Requirements		
	Installation Site	**Storage and Transportation in the protective package**
Free fall	Not allowed	• 76 cm (30 in), frame size R1 • 61 cm (24 in), frame size R2 • 46 cm (18 in), frame size R3 • 31 cm (12 in), frame size R4 • 25 cm (10 in), frame size R5 • 15 cm (6 in), frame size R6

Materials

Materials Specifications	
Drive enclosure	• PC/ABS 2.5 mm, color NCS 1502-Y (RAL 90021 / PMS 420 C and 425 C) • Hot-dip zinc coated steel sheet 1.5...2 mm, thickness of coating 100 micrometers • Cast aluminium AlSi • Extruded aluminium AlSi
Package	Corrugated board (drives and option modules), expanded polystyrene. Plastic covering of the package: PE-LD, bands PP or steel.
Disposal	The drive contains raw materials that should be recycled to preserve energy and natural resources. The package materials are environmentally compatible and recyclable. All metal parts can be recycled. The plastic parts can either be recycled or burned under controlled circumstances, according to local regulations. Most recyclable parts are marked with recycling marks. If recycling is not feasible, all parts excluding electrolytic capacitors and printed circuit boards can be landfilled. The DC capacitors contain electrolyte and the printed circuit boards contain lead, both of which will be classified as hazardous waste within the EU. They must be removed and handled according to local regulations. For further information on environmental aspects and more detailed recycling instructions, please contact your local ABB distributor.

Applicable Standards

The drive complies with the following standards. The compliance with the European Low Voltage Directive is verified according to standards EN 50178 and EN 60204-1.

Applicable Standards	
EN 50178 (1997)	Electronic equipment for use in power installations
EN 60204-1 (1997)	Safety of machinery. Electrical equipment of machines. Part 1: General requirements. *Provisions for compliance:* The final assembler of the machine is responsible for installing: • An emergency-stop device • A supply disconnecting device
EN 60529: 1991 (IEC 529), IEC 60664-1 (1992)	Degrees of protection provided by enclosures (IP code)
EN 61800-3 (1996) + Amendment A11 (2000)	EMC product standard including specific test methods
UL 508C	UL Standard for Safety, Power Conversion Equipment, second edition

Degrees of Protection

Available enclosures:

- IP 21 / UL type 1 enclosure. The site must be free of airborne dust, corrosive gases or liquids, and conductive contaminants such as condensation, carbon dust, and metallic particles.
- IP 54 / UL type 12 enclosure. This enclosure provides protection from airborne dust and light sprays or splashing water from all directions.

Compared to the IP 21 / UL type 1 enclosure, the IP 54 / UL type 12 enclosure has:

- The same internal plastic shell as the IP 21 enclosure
- A different outer plastic cover
- An additional internal fan to improve cooling.
- Larger dimensions
- The same rating (does not require a derating).

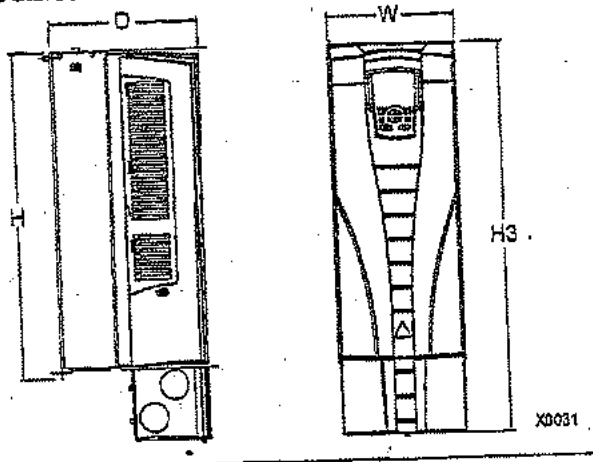
Ambient Conditions

The following table lists the ACH550 environmental requirements.

Ambient Environment Requirements		
	Installation Site	**Storage and Transportation in the protective package**
Altitude	• 0...1000 m (0...3,300 ft) • 1000...2000 m (3,300...6,600 ft) if P_N and I_2 derated 1% every 100 m above 1000 m (300 ft above 3,300 ft)	
Ambient temperature	• -15...40 °C (5...104 °F) • Max. 50 °C (122 °F) if P_N and I_2 derated to 90%	-40...70 °C (-40...158 °F)
Relative humidity	< 95% (non-condensing)	
Contamination levels (IEC 721-3-3)	• No conductive dust allowed. • The ACH550 should be installed in clean air according to enclosure classification. • Cooling air must be clean, free from corrosive materials and free from electrically conductive dust. • Chemical gases: Class 3C2 • Solid particles: Class 3S2	Storage • No conductive dust allowed. • chemical gases: Class 1C2 • solid particles: Class 1S2 Transportation • No conductive dust allowed. • Chemical gases: Class 2C2 • Solid particles: Class 2S2
Sinusoidal vibration	• Mechanical conditions: Class 3M4 (IEC60721-3-3) • 2...9 Hz 3.0 mm (0.12 in) • 9...200 Hz 10 m/s^2 (33 ft/s^2)	In accordance with ISTA 1A and 1B specifications.
Shock (IEC 68-2-29)	Not allowed	max. 100 m/s^2 (330 ft/s^2), 11ms (36 fts)

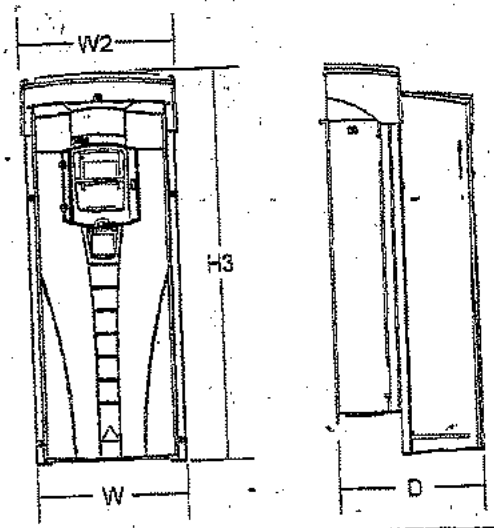
Outside Dimensions

Outside dimensions depend on frame size and enclosure type, as defined below.



IP 21 / UL type 1 – Outside Dimensions by Frame Size

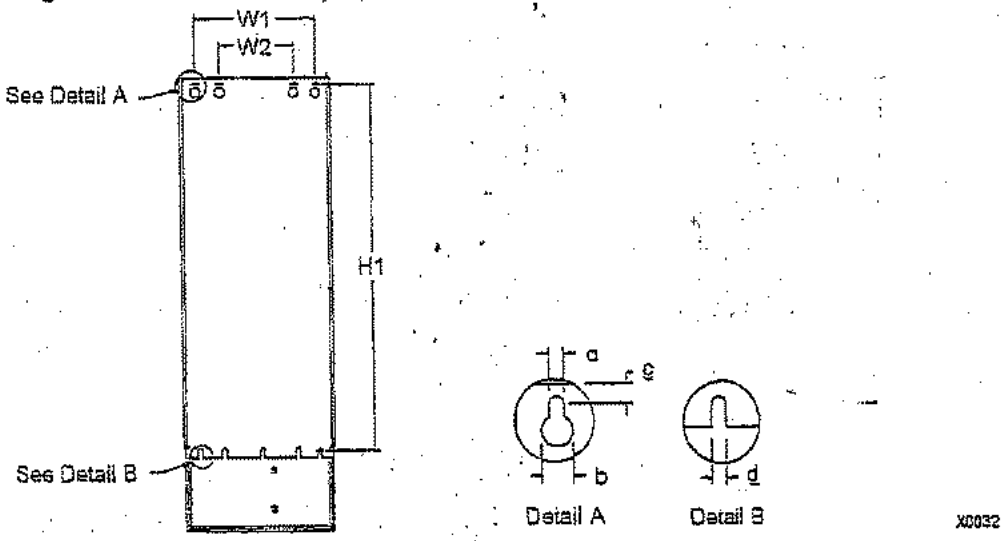
Ref.	R1		R2		R3		R4		R5		R6	
	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
W	125	4.9	125	4.9	203	8.0	203	8.0	265	10.4	300	11.8
H	330	13.0	430	16.9	490	19.2	596	23.4	602	23.7	700	27.6
H3	369	14.5	469	18.5	583	23.0	689	27.1	736	29.0	880	34.6
D	212	8.3	222	8.7	231	9.1	262	10.3	286	11.3	400	15.8



IP 54 / UL type 12 – Outside Dimensions by Frame Size

Ref.	R1		R2		R3		R4		R5		R6	
	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
W	213	8.4	213	8.4	257	10.1	257	10.1	369	14.5	410	16.1
W2	222	8.7	222	8.7	267	10.5	267	10.5	369	14.5	410	16.1
H3	461	18.2	561	22.1	629	24.8	760	29.9	776	30.6	924	36.4
D	234	9.2	246	9.7	254	10.0	285	11.2	309	12.2	423	16.6

Mounting Dimensions



IP 21 / UL type 1 and IP 54 / UL type 12 – Dimensions for each Frame Size												
Ref.	R1		R2		R3		R4		R5		R6	
	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
W1*	98.0	3.9	98.0	3.9	160	6.3	160	6.3	238	9.4	263	10.4
W2*	–	–	–	–	98.0	3.9	98.0	3.9	–	–	–	–
H1*	318	12.5	418	16.4	473	18.6	578	22.8	588	23.2	675	26.6
a	5.5	0.2	5.5	0.2	6.5	0.25	6.5	0.25	6.5	0.25	9.0	0.35
b	10.0	0.4	10.0	0.4	13.0	0.5	13.0	0.5	14.0	0.55	14.0	0.55
c	5.5	0.2	5.5	0.2	8.0	0.3	8.0	0.3	8.5	0.3	8.5	0.1
d	5.5	0.2	5.5	0.2	6.5	0.25	6.5	0.25	6.5	0.25	9.0	0.35
Mounting Hardware												
	M5	10	M5	10	M5	10	M5	10	M6	1/4	M8	5/16

* Center to center dimension.

Weight

The following table lists typical maximum weights for each frame size. Variations within each frame size (due to components associated with voltage/current ratings, and options) are minor.

Enclosure	Weight											
	R1		R2		R3		R4		R5		R6	
	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb
IP 21 / UL type 1	6.5	14	9.0	19.8	16	35.0	24	53.0	34	75	69	152
IP 54 / UL type 12	8.4	18.6	11.5	25.4	18.1	40.0	26.6	58.7	42	93	86	190

Drive		Heat Loss		Air Flow	
ACH550-UH-	Frame Size	W	BTU/Hr	m^3/h	ft^3/min
-077A-4	R5	1295	4420	168	99
-096A-4	R5	1440	4915	168	99
-124A-4	R6	1940	6621	405	238
-157A-4	R6	2310	7884	405	238
-180A-4	R6	2810	9590	405	238

Air Flow, 208...240 Volt Drives

The following table lists heat loss and air flow data for 208...240 Volt drives.

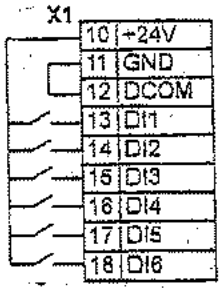
Drive		Heat Loss		Air Flow	
ACH550-UH-	Frame Size	W	BTU/Hr	m^3/h	ft^3/min
-04A6-2	R1	55	189	44	26
-06A6-2	R1	73	249	44	26
-07A5-2	R1	81	276	44	26
-012A-2	R1	116	404	44	26
-017A-2	R1	161	551	44	26
-024A-2	R2	227	776	88	52
-031A-2	R2	285	973	88	52
-046A-2	R3	420	1434	134	79
-059A-2	R3	536	1829	134	79
-075A-2	R4	671	2290	280	165
-088A-2	R4	786	2685	280	165
-114A-2	R4	1014	3463	280	165
-143A-2	R6	1268	4331	405	238
-178A-2	R6	1575	5379	405	238
-221A-2	R6	1952	6666	405	238
-248A-2	R6	2189	7474	405	238

Dimensions and Weights

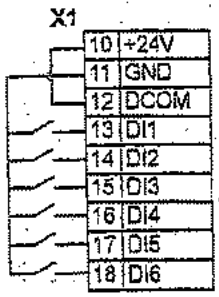
The dimensions and mass for the ACH550 depend on the frame size and enclosure type. If unsure of frame size, first, find the "Type" code on the drive labels. Then look up that type code in the **"Technical Data"** on page 225, to determine the frame size. A complete set of dimensional drawings for ACH550 drives is located in the ACH550 Technical Reference manual.

You can wire the digital input terminals in either a PNP or NPN configuration.

PNP connection (source)



NPN connection (sink)



Serial Communications

Terminals 28...32 provide RS485 serial communication connections used to control or monitor the drive from a fieldbus controller. See "Serial Communication – EFB" on page 143 for details.

Efficiency

Approximately 98% at nominal power level.

Cooling

Cooling Specifications	
Method	Internal fan, flow direction from bottom to top.
Requirement	**Free space around the unit:** • 200 mm (8 in) above and below the unit • 25 mm (1 in) along each side of the unit.

Air Flow, 380...480 Volt Drives

The following table lists heat loss and air flow data for 380...480 Volt drives.

Drive		Heat Loss		Air Flow	
ACH550-UH-	Frame Size	W	BTU/Hr	m^3/h	ft^3/min
-03A3-4	R1	40	137	44	26
-04A1-4	R1	52	177	44	26
-06A9-4	R1	97	331	44	26
-08A8-4	R1	127	433	44	26
-012A-4	R1	172	587	44	26
-015A-4	R2	232	792	88	52
-023A-4	R2	337	1150	88	52
-031A-4	R3	457	1560	134	79
-038A-4	R3	562	1918	134	79
-044A-4	R4	667	2276	280	165
-059A-4	R4	907	3096	280	165
-072A-4	R4	1120	3820	280	165

	X1		Drive Control Terminal Description
Analog I/O	1	SCR	Terminal for signal cable screen. (Connected internally to chassis ground.)
	2	AI1	Analog input channel 1, programmable. Default[2] = external reference. Resolution 0.1%, accuracy ±1%.
			J1:AI1 OFF: 0(2)...10 V (R_i = 312 kΩ) ON NO
			J1:AI1 ON: 0(4)...20 mA (R_i = 100 Ω) ON NO
	3	AGND	Analog input circuit common. (Connected internally to chassis gnd. through 1 MΩ)
	4	+10 V	10 V/10 mA reference voltage output for analog input potentiometer, accuracy ±2%.
	5	AI2	Analog input channel 2, programmable. Default[2] = PID feedback. Resolution 0.1%, accuracy ±1%.
			J1:AI2 OFF: 0(2)...10 V (R_i = 312 kΩ) ON NO
			J1:AI2 ON: 0(4)...20 mA (R_i = 100 Ω) ON NO
	6	AGND	Analog input circuit common. (Connected internally to chassis gnd. through 1 MΩ)
	7	AO1	Analog output, programmable. Default[2] = frequency. 0...20 mA (load < 500 Ω)
	8	AO2	Analog output, programmable. Default[2] = current. 0...20 mA (load < 500 Ω)
	9	AGND	Analog output circuit common (Connected internally to chassis gnd. through 1 MΩ)
Digital Inputs[1]	10	+24V	Auxiliary voltage output 24 VDC / 250 mA (reference to GND). Short circuit protected.
	11	GND	Auxiliary voltage output common. (Connected internally as floating.)
	12	DCOM	Digital input common. To activate a digital input, there must be ≥+10 V (or ≤-10 V) between that input and DCOM. The 24 V may be provided by the ACH550 (X1-10) or by an external 12...24 V source of either polarity.
	13	DI1	Digital input 1, programmable. Default[2] = start/stop.
	14	DI2	Digital input 2, programmable. Default[2] = not configured.
	15	DI3	Digital input 3, programmable. Default[2] = constant (preset) speed.
	16	DI4	Digital input 4, programmable. Default[2] = safety interlock.
	17	DI5	Digital input 5, programmable. Default[2] = not configured.
	18	DI6	Digital input 6, programmable. Default[2] = not configured.
Relay Outputs	19	RO1C	 Relay output 1, programmable. Default[2] = Ready Maximum: 250 VAC / 30 VDC, 2 A Minimum: 500 mW (12 V, 10 mA)
	20	RO1A	
	21	RO1B	
	22	RO2C	 Relay output 2, programmable. Default[2] = Running Maximum: 250 VAC / 30 VDC, 2 A Minimum: 500 mW (12 V, 10 mA)
	23	RO2A	
	24	RO2B	
	25	RO3C	 Relay output 3, programmable. Default[2] = Fault (-1) Maximum: 250 VAC / 30 VDC, 2 A Minimum: 500 mW (12 V, 10 mA)
	26	RO3A	
	27	RO3B	

1 Digital input impedance 1.5 kΩ. Maximum voltage for digital inputs is 30 V.

2 Default values depend on the macro used. Values specified are for the HVAC default macro. See "Application Macros" on page 35.

Analog Cables

Recommendations for analog signal runs:

- Use double shielded, twisted pair cable.
- Use one individually shielded pair for each signal.
- Do not use a common return for different analog signals.

Digital Cables

Recommendations for digital signal runs:

- A double shielded cable is the best alternative, but single-shielded, twisted, multi-pair cable is also usable.

Control Panel Cable

If the control panel is connected to the drive with a cable, use only Category 5 Patch ethernet cable.

Drive's Control Connection Terminals

The following table provides specifications for the drive's control terminals

Frame Size	Control			
	Maximum Wire Size		Torque	
	mm^2	AWG	Nm	lb-ft
All	1.5	[illegible]	0.4	[illegible]

Control Terminal Descriptions

The following full-page diagram provides a general description of the control terminals on the drive. For specific application details, see the "Application Macros" on page 35.

Note! Terminals 3, 6, and 9 are at the same potential.

Note! For safety reasons the fault relay signals a "fault" when the ACH550 is powered down.

Control Connections

Control Connection Specifications

Control Connection Specifications	
Analog Inputs and Outputs	See table heading "Drive Control Terminal Description" on page 239.
Digital Inputs	Digital input impedance 1.5 kΩ. Maximum voltage for digital inputs is 30 V.
Relays (Digital Outputs)	• Max. contact voltage: 30 V DC, 250 V AC • Max. contact current / power: 6 A, 30 V DC; 1500 VA, 250 V AC • Max. continuous current: 2 A rms (cos φ = 1), 1 A rms (cos φ = 0.4) • Minimum load: 500 mW (12 V, 10 mA) • Contact material: Silver-nickel (AgN) • Isolation between relay digital outputs, test voltage: 2.5 kV rms, 1 minute

Control Cables

General Recommendations

Use multi-core cables with a braided copper wire screen, temperature rated at 60 °C (140 °F) or above:



Double Shielded
Example: JAMAK by Draka NK Cables



Single Shielded
Example: NOMAK by Draka NK Cables

At the drive end, twist the screen together into a bundle not longer than five times its width and connected to terminal X1-1 (for digital and analog I/O cables) or to either X1-28 or X1-32 (for RS485 cables).

Route control cables to minimize radiation to the cable:

- Route as far away as possible from the input power and motor cables (at least 20 cm (8 in)).
- Where control cables must cross power cables make sure they are at an angle as near 90° as possible.
- Stay at least 20 cm (8 in) from the sides of the drive.

Use care in mixing signal types on the same cable:

- Do not mix analog and digital input signals on the same cable.
- Run relay-controlled signals as twisted pairs (especially if voltage > 48 V). Relay-controlled signals using less than 48 V can be run in the same cables as digital input signals.

Note! Never mix 24 VDC and 115/230 VAC signals in the same cable.

- Longer than 30 m (100 ft) must be limited as specified in the table below. Follow the instructions in the filter package for all cable screen connections.

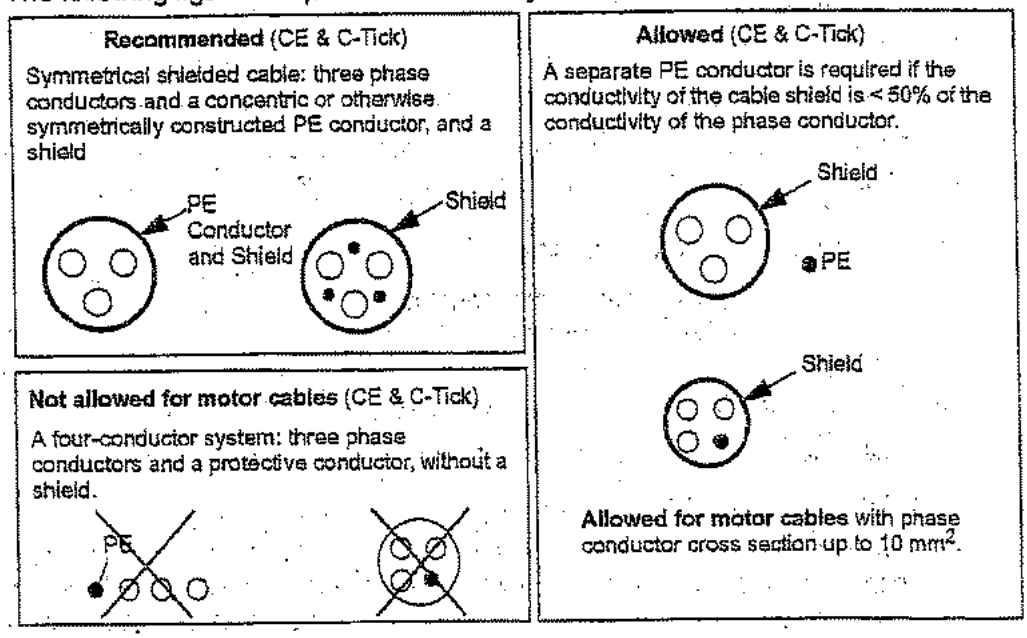
Cable Requirements for CE Compliance			
Drive Type	RFI/EMC Filter	Switching Frequency (Parameter 2606)	
		1 or 4 kHz (1 or 4)	8 kHz (8)
		Maximum motor cable length	
ACH550-UH-03A3-4	ACS400-iF11-3	100 m (330 ft)	Not CE compliant for more than 30 m
ACH550-UH-04A1-4			
ACH550-UH-06A9-4			
ACH550-UH-08A8-4			
ACH550-UH-012A-4			
ACH550-UH-015A-4	ACS400-iF21-3	100 m (330 ft)	100 m (330 ft)
ACH550-UH-023A-4			
ACH550-UH-031A-4	ACS400-iF31-3	100 m (330 ft)	100 m (330 ft)
ACH550-UH-038A-4			
ACH550-UH-044A-4	ACS400-iF41-3	100 m (330 ft)	100 m (330 ft)
ACH550-UH-059A-4			
ACH550-UH-072A-4			
ACH550-UH-077A-4 ... ACH550-UH-180A-4	Not defined at time of publication.		



Warning! Do not use filters in a floating, or high impedance earthed network.

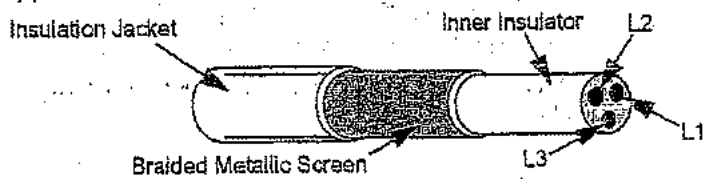
Recommendation for Conductor Layout

The following figure compares conductor layout features in motor cables.



Effective Motor Cable Screens

The general rule for cable screen effectiveness is: the better and tighter the cable's screen, the lower the radiated emission level. The following figure shows an example of an effective construction (for example Ölflex-Servo-FD 780 CP, Lappkabel or MCCMK, NK Cables).



Clamp the cable shield into the gland plate at the drive end. Twist the cable screen wires together into a bundle not longer than five times its width and connect it to the terminal marked ⏚ (at the bottom right-hand corner of the drive).

At the motor end the motor cable screen must be earthed 360 degrees with an EMC cable gland or the screen wires must be twisted together into a bundle not longer than five times its width and connected to the PE terminal of the motor.

EN61800-3 Compliant Motor Cables

To comply with EN61800-3, First and Second Environment (Restricted Distribution) requirements, motor cables:

- Less than or equal to 30 m (100 ft) do not require an RFI/EMC filter.
- Must have an effective screen as described in "Effective Motor Cable Screens" on page 235.
- Must be earthed, at the motor end, with an EMC cable gland.The earthing must contact the cable screen all the way around the cable.

- Power Shield Cable – For power shield cable details, see "Motor Cable Requirements for CE & C-Tick Compliance" below.

Grounding

See "Ground Connections" in "Input Power Connections" above.

For CE compliant installations and installations where EMC emissions must be minimized, see "Effective Motor Cable Screens" below.

Drive's Motor Connection Terminals

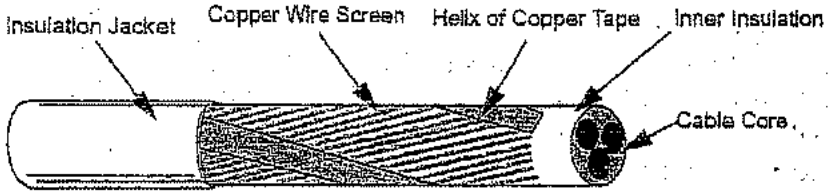
The drive's motor and input power terminals have the same specifications. See "Drive's Power Connection Terminals" above.

Motor Cable Requirements for CE & C-Tick Compliance

The requirements in this section apply for CE or C-Tick compliance.

Minimum Requirement (CE & C-Tick)

The motor cable must be a symmetrical three conductor cable with a concentric PE conductor or a four conductor cable with a concentric shield, however, a symmetrical constructed PE conductor is always recommended. The following figure shows the minimum requirement for the motor cable screen (for example, MCMK, NK Cables).



* Input filters designed for ACH550 cannot be used in an isolated, or high impedance earthed industrial distribution network.

Grounding and Routing

Background

Motor cables require extra care in grounding and routing. The reasons have to do with the following factors:

- Parasitic capacitance – Capacitors are, essentially, conductors that don't touch, but are in close proximity to each other. So, for example, there is a weak capacitive connection between cables and any conductors they are near. Such unintentional, but inevitable conductive paths are called parasitic capacitors. Currents flowing through these paths often create problems. For example, current leaks to control cables can create noise interference, leaks to the motor can damage bearings, and leaks to the drive or other electronic cabinets can damage components.
- Proximity – As the conductors get closer together, capacitance increases.
- Proximal area – As the area in close proximity increases, the capacitance increases, e.g. close parallel paths increase parasitic capacitance between conductors.
- AC frequency – For a given capacitance, increased AC frequency increases current conductance. Hence, capacitive paths that are negligible at 50/60 Hz can be very significant conductors at 8,000 Hz. Motor cable signals are pulses at up to 8,000 Hz and the common mode frequency can reach 48,000 Hz (8k Hz x 3 phases x 2 pulse edges).
- Alternate paths – Where multiple paths exist, the most conductive path draws the most current. So, the ground wiring must be a significantly better path, in order to reduce the current in the alternate paths, the paths through parasitic capacitors.

The high frequencies associated with motor cables also increase the potential for electromagnetic noise radiation. See "Motor Cable Requirements for CE & C-Tick Compliance" below.

Motor Cable Shielding

Motor cables require shielding using conduit, armored cable or power shield cable.

- Conduit – When using conduit:
  - Bridge joints with a ground conductor bonded to the conduit on each side of the joint.
  - Bond conduit run to the drive enclosure.
  - Use a separate conduit run for motor cables (also separate input power and control cables).
  - Use a separate conduit run for each drive.
- Armored Cable – When using armored cable:
  - Use six-conductor (3 phases and 3 grounds), type MC continuous corrugated aluminum armor cable with symmetrical grounds.
  - Armored motor cable can share a cable tray with input power cables, but not with control cables.

Motor Connections

Warning! Never connect line power to the drive output terminals: U2, V2 or W2. Line voltage applied to the output can result in permanent damage to the unit. If frequent bypassing is required, use mechanically interlocked switches or contactors.

Warning! Do not connect any motor with a nominal voltage less than one half of the drive's nominal input voltage.

Warning! Disconnect the drive before conducting any voltage tolerance (HI-Pot) test or insulation resistance (Megger) test on the motor or motor cables. Do not conduct these tests on the drive.

Motor Connection Specifications

Motor Connection Specifications			
Voltage (U_2)	0...U_1, 3-phase symmetrical, U_{max} at the field weakening point		
Frequency	0...500 Hz		
Frequency Resolution	0.01 Hz		
Current	See "Ratings" on page 225.		
Field Weakening Point	10...500 Hz		
Switching Frequency	Selectable: 1, 4, or 8 kHz		
Cable Temperature Rating	90 °C (194 °F) rating minimum.		
Maximum Motor Cable Length	Frame Size	Max. Motor Cable Length*	
		f_{sw} = 1 or 4 kHz	f_{sw} = 8 kHz
	R1	100 m	50 m
	R2...R4	200 m	100 m
	R5...R6	300 m	150 m

*** Warning! Using a motor cable longer than specified in the chart above may cause permanent damage to the drive.**

Ground Fault Protection

ACH550 internal fault logic detects ground faults in the drive, motor, or motor cable. This fault logic:

- Is NOT a personal safety or fire protection feature.
- Can be set to trigger only a warning using parameter 3017 EARTH FAULT.
- Could be tripped by leakage currents (input power to ground) associated with the use of an optional RFI/EMC filter.

OPERATORS GUIDE

Firetube Boilers

with

Induced Flue Gas Recirculation (LE Option)

Addendum to
Model CB Operation, Maintenance, and Parts Manual (750-91, 750-93, 750-94, and 750-95)

Manual Part Number 750-156
R1, 11/95

Cleaver-Brooks®
DIVISION OF AQUA-CHEM, INC.

Safety Precautions

Throughout this manual, procedures or operations that require special attention will be emphasized by the symbols WARNING, CAUTION, or NOTE:

It is essential to read and understand the following safety precautions before attempting to operate the equipment Failure to heed these precautions may result in damage to equipment, serious personal injury or death.

⚠ WARNING

This symbol indicates a potentially hazardous situation which, if not avoided, could result in serious personal injury or death.

⚠ CAUTION

This symbol indicates a potentially hazardous situation which, if not avoided, could result in damage to the equipment.

NOTICE

This symbol indicates information that is vital to the operation or maintenance of the equipment.

A complete understanding of this manual is required before attempting to startup, operate, or maintain the equipment.

The equipment should be operated only by personnel who have a working knowledge and understanding of the equipment.

Printed in U.S.A.
November 1996

To: Owners, Operators and Maintenance Personnel

NOTE: No attempt should be made to operate the unit until the principles of operation and all components are thoroughly understood.

This addendum to the CB Firetube Operation and Maintenance (O&M) manual provides guidance to operate and maintain the Induced Flue Gas Recirculation (IFGR) system for Cleaver-Brooks Low Emission (LE) boilers. Study the manual carefully. The IFGR system will provide lower emissions and continued operation if the instructions are followed.

This manual is to be used in conjunction with the appropriate boiler O&M manual. It is also recommended that a boiler room log book be maintained, recording daily, weekly, monthly, and yearly maintenance activities, and any unusual occurrences, to aid in establishing trends, maintenance requirements, and problem diagnosis.

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Please direct purchase orders for replacement manuals to your local Cleaver-Brooks authorized representative

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NOTES

CHAPTER 1

GENERAL DESCRIPTION

A. GENERAL

This manual provides instructional materials to operate and maintain the Induced Flue Gas Recirculation (IFGR) system used on boilers that incorporate the Cleaver-Brooks Low Emission (LE) Option. The manual is supplemental to the corresponding Model CB Firetube Boiler manual (750-91, 750-93, 750-94, or 750-95).

The LE Option, available on Cleaver-Brooks Firetube Boilers, reduces Nitrogen Oxide (NOx) emissions, a major precursor to ozone pollution (smog). Carbon Monoxide (CO) emissions also tend to be lower, due to increased turbulence caused by the addition of the flue gases into the combustion air stream, thereby improving combustion.

The LE Option, with its various levels of IFGR systems, can affect the selection of the combustion air fan, motor, burner, and other components. Several different system configurations are available, depending on the requirements for NOx emissions and the fuels used. All systems use similar primary components, but may have different linkage controls, IFGR damper, fan, and motor sizes.

Always order genuine Cleaver-Brooks parts from your local Cleaver-Brooks authorized representative.

The LE Option is used on Cleaver-Brooks Model CB Firetube boilers firing either natural gas and/or light oil, and is compatible with both hot water and steam systems.

B. DESCRIPTION

The IFGR system mixes a portion of the relatively cool flue gas from the exit of the fourth-pass tubes with the incoming combustion air to reduce the furnace flame temperature, thereby reducing NOx emissions. In this approach, the combustion air fan handles both the combustion air and the recirculated flue gases. Accordingly, this method is called Induced Flue Gas Recirculation (IFGR), because the flue gas is "induced" into the fan inlet.

The flue gases are induced from the boiler fourth pass exit into the combustion air fan through the flue gas transfer port. The IFGR damper, in the transfer port, controls the flow of flue gas. (Refer to Figure 1.)

C. MAJOR COMPONENTS

1. Flue Gas Transfer Port, IFGR Damper, and Flange Collar (Figure 1). The flue gas transfer port is a tube that allows the flue gases to travel from the exit of the fourth-pass tubes to the entrance of the combustion air fan.

   The IFGR damper controls the volume of flue gas induced into the combustion air stream. The damper is located in the flue gas transfer port and is positioned by the control linkage.

   The flange collar is used to "fine tune" the mixture ratio of combustion air and flue gas. The collar can be set to adjust the flue gas recirculation rate. Once it is set in the correct position, it will not need to be reset of altered.

2. IFGR Damper Linkage (Figure 1). The IFGR damper is positioned by the control linkage. The linkage could consist of a single arm, or it could consist of several arms driven from the jackshaft to provide modulating control (see Figure 2). Multiple-fuel burners may require separate settings for gas and oil if they have high turndown rates or low NOx requirements.

3. Over-Travel Mechanism (Figures 1 and 2). The over-travel mechanism has two functions. It allows the linkage to pass through the front door, and it allows jackshaft rotation to exceed (over travel) IFGR linkage movement. A set of springs allows the linkage to stay in a fixed position while the jackshaft rotates. Stop screws set the minimum and maximum open position of the IFGR damper (Figure 5).

4. Fuel Change-Over Linkage (Figure 2). When a boiler is equipped to fire either gas or oil (dual-fuel boilers), and the required NOx levels are below 60 ppm on natural gas, a dual-linkage arrangement is used to provide the different recirculation rates required for each fuel. Two jackshaft drive arms are provided, one for oil and one for gas. The linkage is manually connected to the appropriate arm, based on the fuel being used.

   On dual-fuel boilers with two jackshaft drive arms, as defined above, a proximity switch is used to prove that the

correct linkage connection is made. (Refer to the wiring diagram provided with the boiler.)

5. Fan/Motor Cassette (Figure 1). The fan and motor assemblies are designed as a cassette so that they can be removed from the front of the boiler, without opening the front door. The front door davit can be used to remove the assembly (Figure 3).
6. Burner Drawer (Figure 1). Note that the gas spudding pattern for the IFGR system may be different than that of a non-IFGR, High-Turndown CB Boiler of the same horsepower (HP) model designation.
7. Combustion Air Inlet (Figure 1). The combustion air inlets are located at the top of the front door. Air enters from the rear of the air inlet shrouds, which reduces the sound level and captures heat from the boiler and stack outlet.

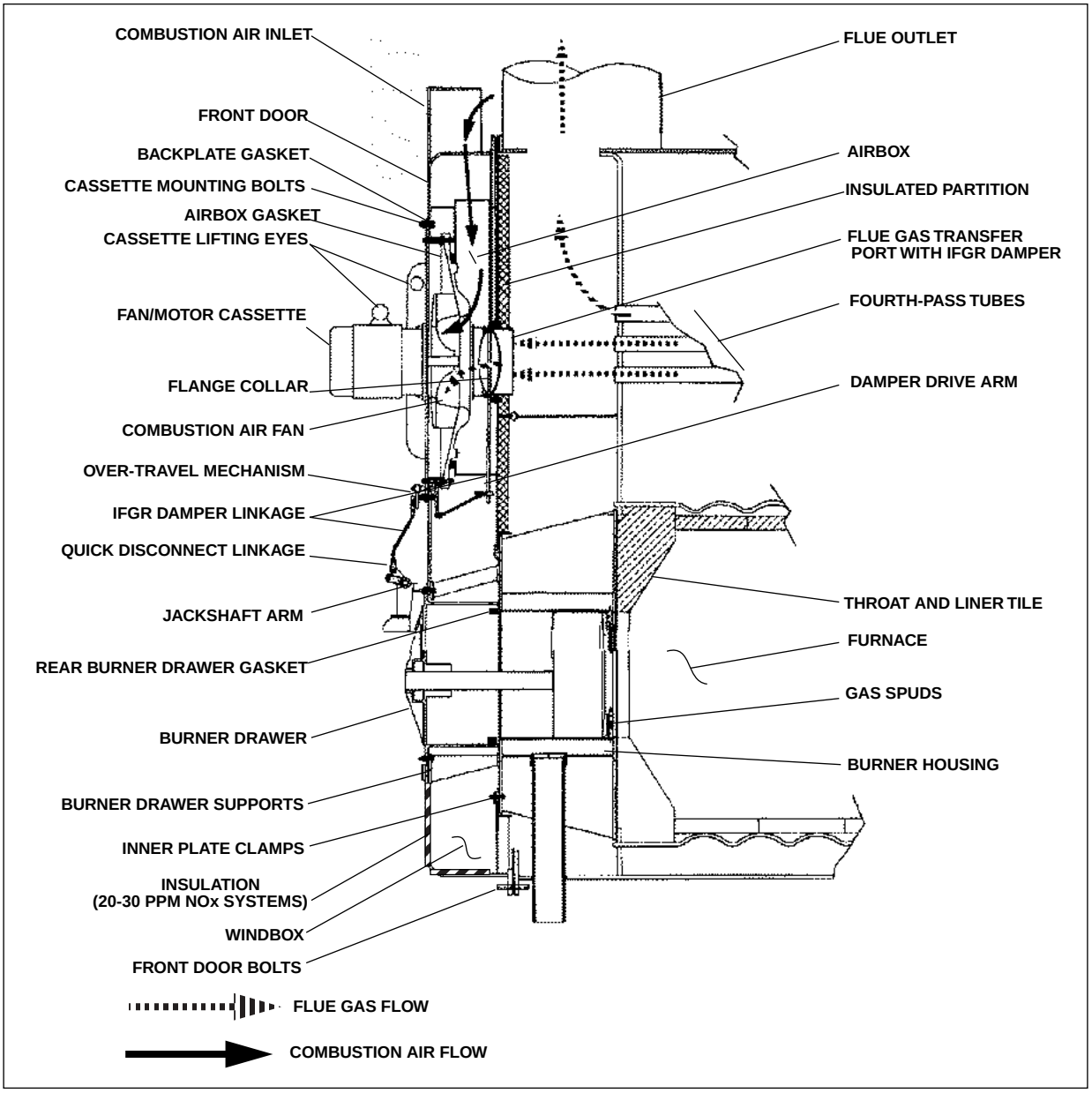


Figure 1. Induced Flue Gas Recirculation System, General Arrangement

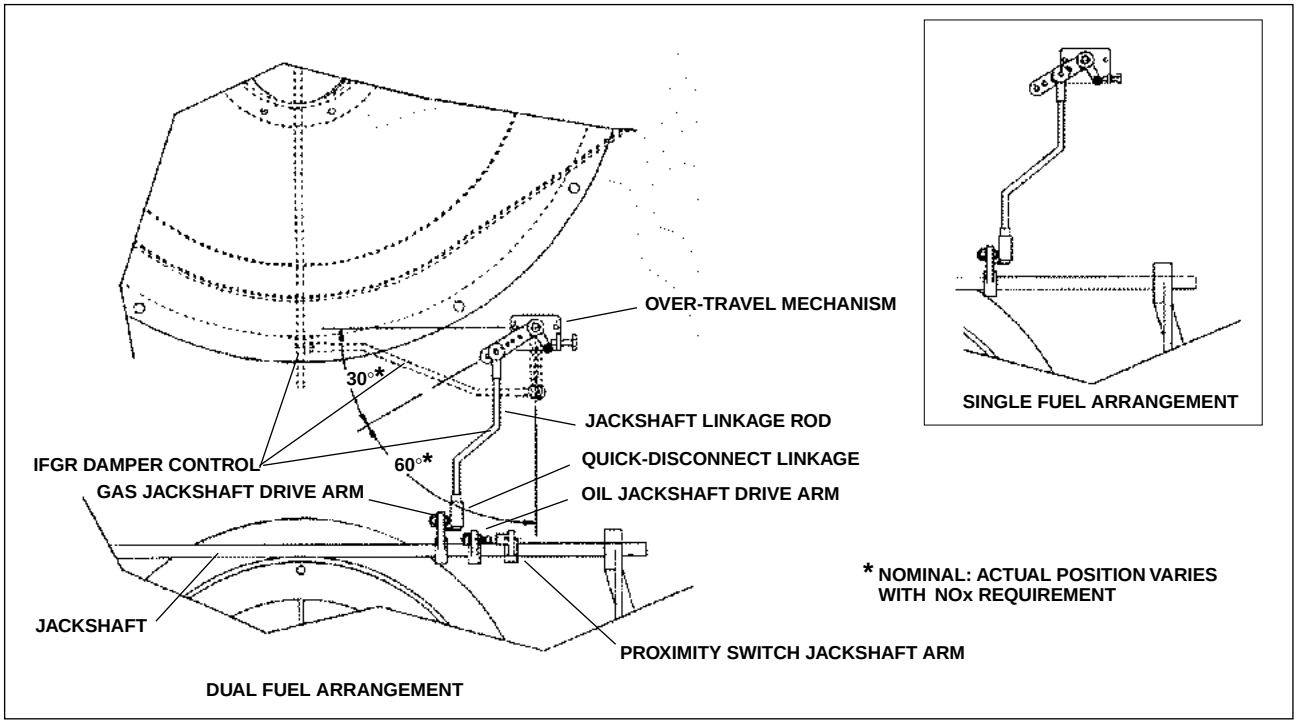


Figure 2. IFGR Damper Linkage

NOTES

CHAPTER 2

SETUP AND OPERATION

NOTE: Initial IFGR linkage settings and adjustments must be established by a Cleaver-Brooks authorized representative. Set up of the LE Option requires simultaneous consideration of air-to-fuel ratios and NOx levels. This can only be accomplished with proper combustion emissions monitoring equipment with NOx, O_2, CO, and smoke spot measuring capability.

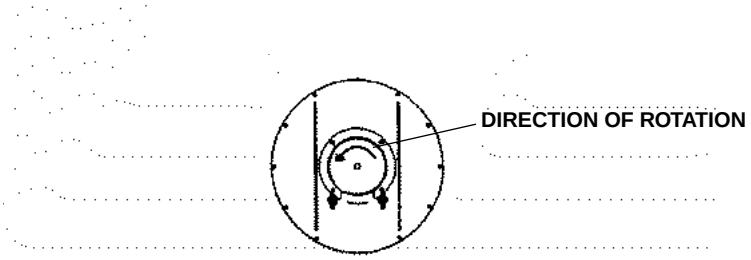
A. GENERAL

It is recommended that the final "installed" settings be noted on Figure 4, 5, and 6 for future reference. The settings should be marked on the linkage as well.

Normally, once the system has been set and adjusted, it should not be required to change these settings unless conditions (including boiler settings) change. In that case, it will be necessary to contact your local Cleaver-Brooks authorized representative for assistance.

After the IFGR system is initially set up, it will start up with the boiler as an integrated boiler system. After shut down periods in which maintenance and /or adjustments have been performed on the fuel cams, fuel and air linkages, or IFGR control linkages, the recommended approach to start-up is as follows:

1. Set all boiler components to their initial settings as discussed in the boiler Operation & Maintenance (O&M) manual.



2. Check fan impeller and motor rotation. Correct rotation is counter-clockwise when viewed from the front of the boiler.
3. Verify that all the IFGR components are set to the settings shown in Figures 4, 5, and 6 (as noted by the Cleaver-Brooks authorized representative during original set up). Be sure that all linkages are secure.
4. Start and warm the boiler as described in the BOILER O&M manual.
5. Adjust the boiler components as described in the boiler O&M manual to achieve proper boiler operation.

Refer to Figure 3 for instructions on cassette removal and installation

B. FAN/MOTOR CASSETTE REMOVAL AND INSPECTION

Before the boiler is commissioned at the job site, the IFGR system should be visually inspected. This requires that the fan/motor cassette be removed to expose the internal IFGR linkage and damper. Remove the fan/motor cassette as follows:

⚠WARNING

Disconnect and lock out electrical power to the boiler before removing the fan/motor cassette. Failure to follow these instructions can cause injury or death.

1. **Disconnect and lock out electric power to the boiler.**
2. Be sure that the front door is securely bolted to the boiler

⚠WARNING

Do not remove the davit arm assembly without first ensuring that the front door is securely bolted to the boiler. Failure to follow these instructions can result in serious personal injury or death.

3. Release the davit arm by removing the retaining bolt at the top center of the boiler.

⚠WARNING

When suspending the fan/motor cassette from the davit arm, all equipment used must be of adequate strength to safely support the complete cassette. Failure to follow these instructions can cause injury or death.

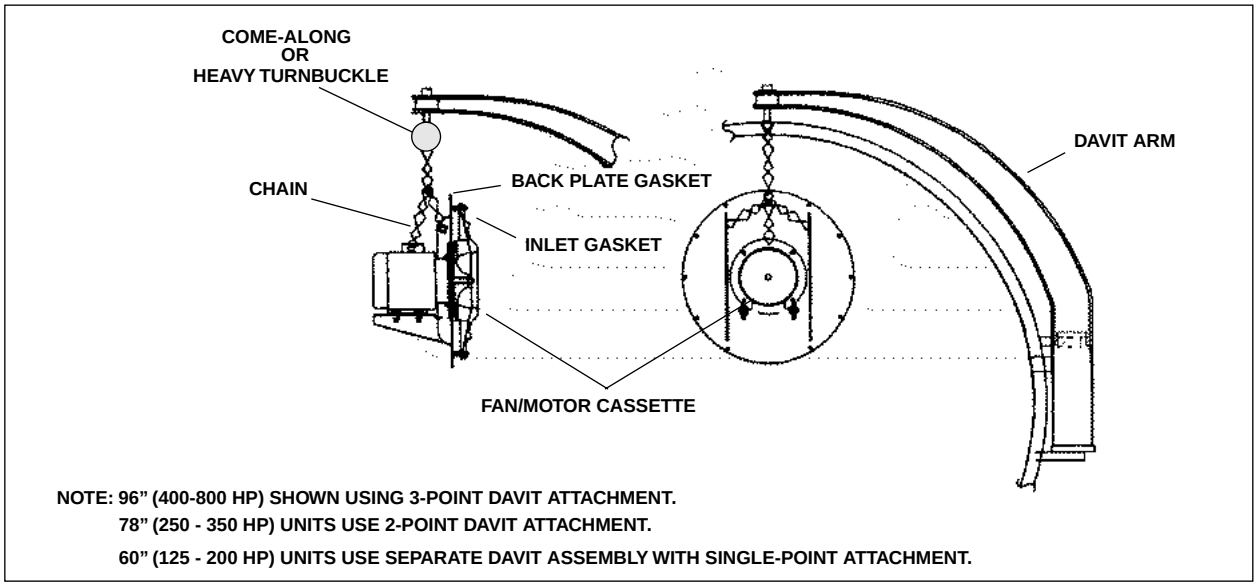


Figure 3. Fan/Motor Cassette

⚠ CAUTION

Chains or other devices used to attach a lifting device to the fan/motor cassette must be arranged so the cassette does not rotate or tilt when removed from the front head. Failure to do so can result in damage to attachment stud threads and cause difficulty in removal or installation of the cassette.

4. Connect the davit arm to the fan/motor cassette using the suspension system noted above.
5. Arrange the attaching chains so the lifting point is over the motor shaft centerline and the center of balance for the fan/motor cassette. This point is approximately 4-inches from the motor backplate for 600-800 hp units, and 3-inches for 250-500 hp units.
6. Remove the fan/motor cassette fastening nuts (Figure 1).

⚠ CAUTION

Be sure that the fan motor wiring and conduit are not stretched during the fan/motor cassette removal. Failure to follow these instructions can result in damage to the equipment.

7. Swing the fan/motor cassette to the side and secure it to the boiler using high strength cord. Do not over-extend the motor wires.

C. INSPECTION AND ADJUSTMENT

1. With the IFGR damper exposed, inspect the internal linkages for secure connections, and check for free movement of linkage arms and the IFGR damper assembly. This can be accomplished by separating the external linkage from the jackshaft drive arm(s) and cycling the exterior linkage through its range of movement.
2. The clearance between the impeller and backplate should be checked, and adjusted, if required. Impeller clearances must be as shown in Table 1.
3. Impeller clearance is checked by inserting a long feeler gauge of the proper thickness between the impeller and the impeller housing. Impeller clearances should be checked at the highest fin on the impeller (that fin which is closest to the impeller housing), and must be checked at each point where the housing is attached to the motor backplate.
4. If impeller clearance is not correct at all points, make adjustments as follows:

   A. Loosen the retaining nuts on both sides of the impeller housing.

STANDARD 60 PPM	30 PPM 25 PPM	20 PPM
.040 ±.010	0.050 +.010/–.005	.060 +.005/–.000

Table 1. Impeller Clearances

B. Adjust retainers for correct impeller clearance at two housing attachment points 180° apart.

C. Adjust retainers for correct clearance at the housing attachment points 90° from those initially adjusted.

D. Adjust for correct impeller clearance at the remaining attachment points.

5. Check and replace any gaskets that have been damaged. Gaskets that have been in use for one year or more should be replaced. In particular, inspect the airbox gasket (Figure 1) for damage. If it needs to be replace, refer to Section G for installation instructions.

D. AIRBOX GASKET INSTALLATION

If the fan/motor cassette is opened for any reason after the unit has been in operation for one year, the airbox gasket should be replaced.

⚠WARNING

When replacing the airbox gasket, use only Cleaver-Brooks components. Failure to use components designed for this application can result in improper combustion. Failure to follow these instructions can result in serious personal injury or death.

1. Attach the airbox gasket to the inlet box with high-temperature silicone adhesive/sealant, using two beads of silicone about 1/4" in from each side of the gasket (gasket surface is 2" wide).
2. Secure the gasket in position with clamps, using strips of wood on top of the gasket for a bearing surface.
3. After the silicone has dried (approximately 24 hours), remove the clamps and strips of wood.

E. FAN/MOTOR CASSETTE INSTALLATION

The fan/motor cassette can be closed as follows:

1. Check that all adjustment screws are tight, and check the linkage and IFGR damper for free movement before closing the unit.
2. Position the cassette into the front door.
3. Slide the cassette into position until it begins to contact the inlet gasket (see Figure 1), then measure the clearance between the cassette flange and the front door mounting face. There must be clearance of at least 1/4" to provide adequate gasket compression when the cassette is mounted tightly to the door.
4. Secure the cassette with the fastening nuts.

⚠WARNING

Do not remove the davit arm assembly from the motor/fan cassette without first verifying that the cassette is securely bolted to the boiler. Failure to follow these instructions can cause injury or death.

5. After the cassette has been secured to the front head, reconnect the davit to the front door by screwing in the retaining bolt at the top centerline.

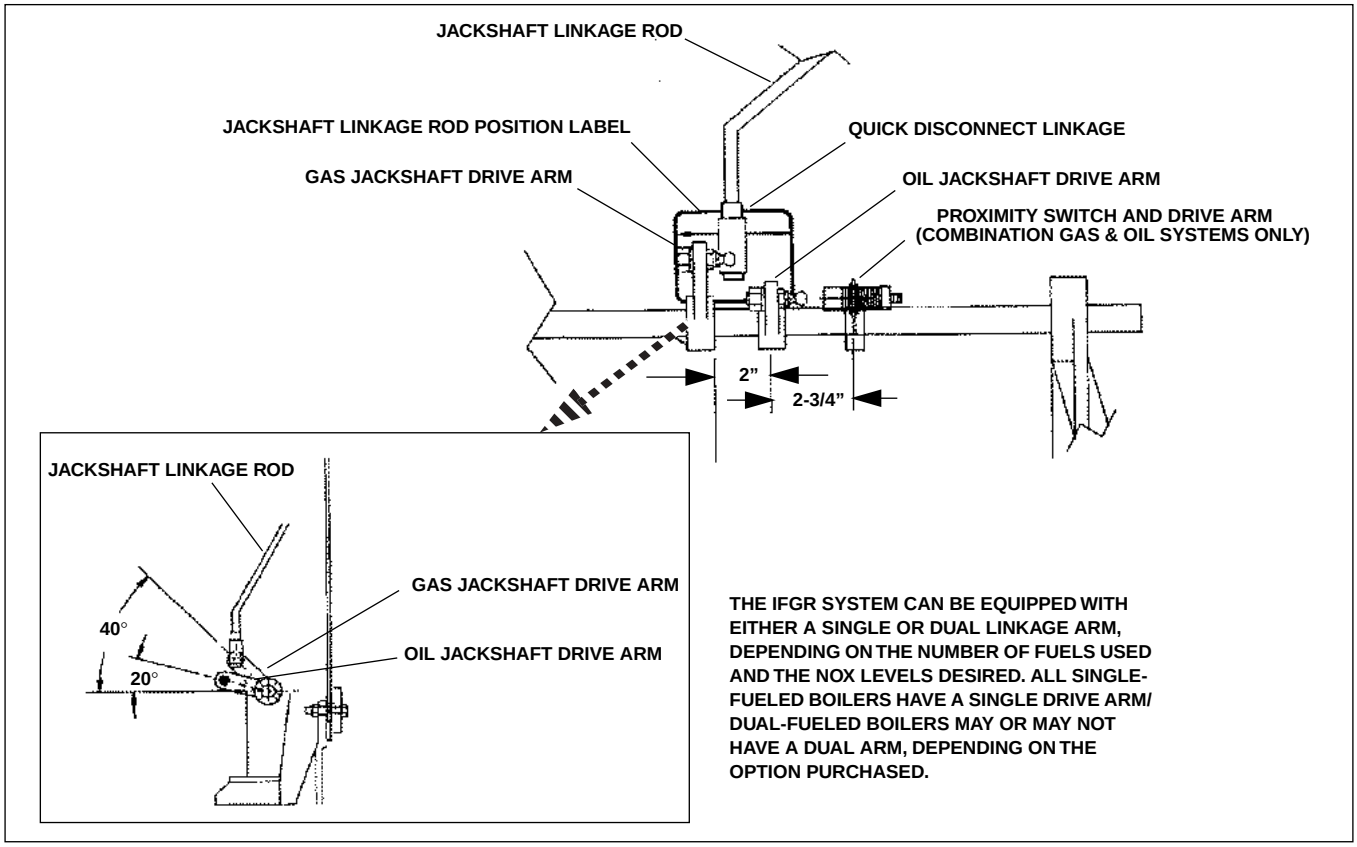
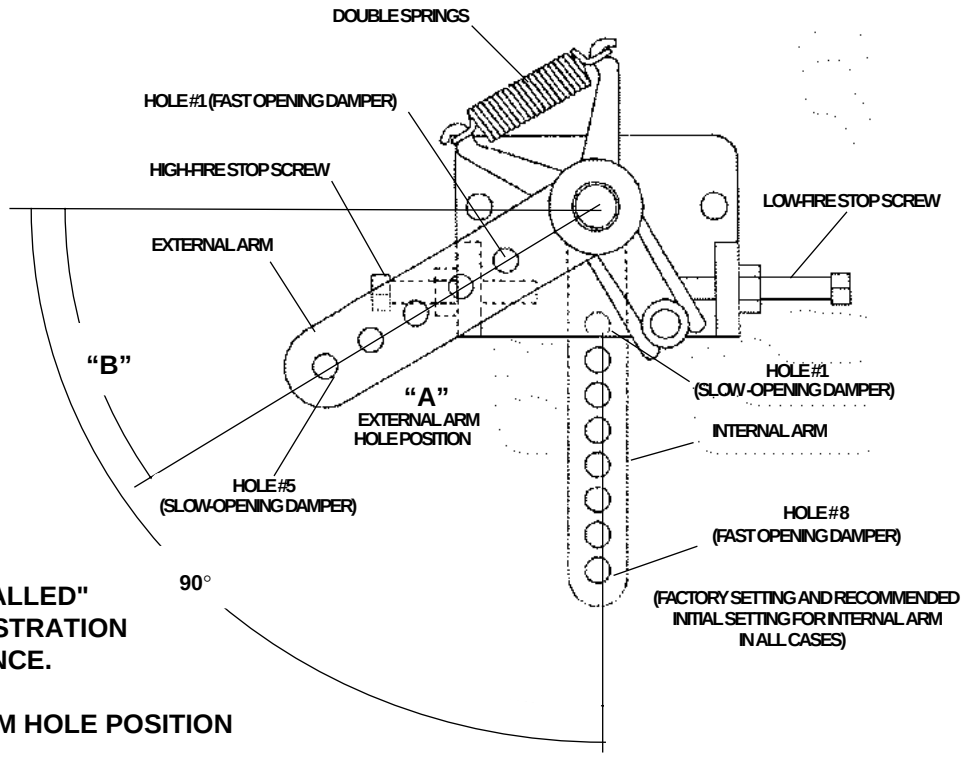


Figure 4. Jackshaft Linkage Settings



NOTE: RECORD "INSTALLED" VALUES ON THIS ILLUSTRATION FOR FUTURE REFERENCE.

A.__ EXTERNAL ARM HOLE POSITION
B.__ DEGREES

Figure 5. Overtravel Linkage Settings

NOTE: RECORD "INSTALLED" VALUES ON THIS ILLUSTRATION FOR FUTURE REFERENCE.

A.__ FLANGE COLLAR SETTING
B.__ DAMPER POSITION AT LOW-FIRE
C.__ DAMPER LINKAGE ARE ANGLE (DEGREES)
D.__ HOLE POSITION NUMBER

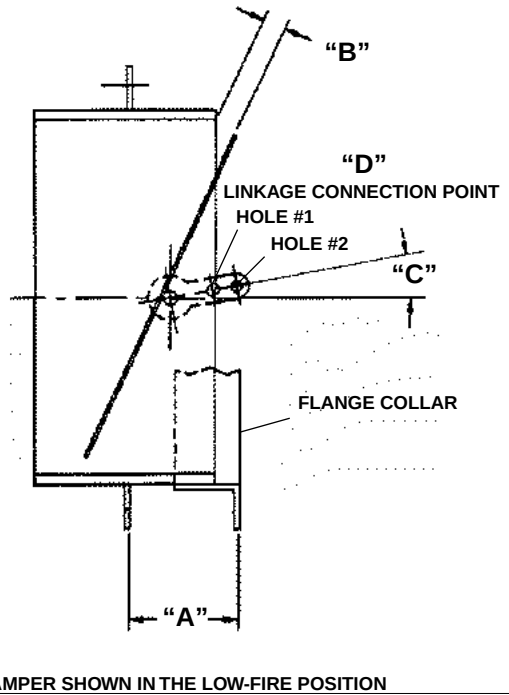


Figure 7. Flange Collar and Damper Settings (Top View)

CHAPTER 3

PREVENTIVE MAINTENANCE FOR IFGR SYSTEMS

A. General

B. Lubrication

A. GENERAL

Note that these instructions are in addition to inspection and maintenance information provided in your boiler Operation and Maintenance manual.

Daily	• Check visually for free movement of IFGR linkage.
Quarterly	• Manually check for free movement of IFGR linkage. • Inspect and clean IFGR damper (oil-fueled system). • Inspect and clean fan and burner (oil-fueled system). • Grease fan motor.
Semi-Annual	• Inspect and clean IFGR damper (gas-fueled system). • Inspect and clean fan and burner (gas-fueled system). • Open motor/fan cassette to check for free movement of IFGR linkage and damper assembly.
Annual	• Inspect fan impeller. • Check emissions. • Change inlet gasket.

NOx levels should be checked periodically to ensure compliance with all local and federal regulations, as well as to ensure that the boiler is operating at maximum efficiency. Linkages should be inspected and free movement (no binding) of the IFGR damper confirmed.

Increasing or decreasing NOx levels could indicate incorrect damper positioning, loose linkages, an improper air-to-fuel ratio, or stack draft changes. If adjustment is required, or if problems persist, contact your local Cleaver-Brooks authorized representative for further assistance.

As ash and products of combustion pass through the IFGR damper, there will be some accumulation on the damper, windbox, and other parts of the IFGR system and burner.

To ensure proper operation of the IFGR system and burner, inspection and cleaning should be performed at regular intervals, depending on the load, type of fuel, and combustion temperatures.

B. LUBRICATION

Motors should be lightly lubricated at startup, using the grease specified below or equivalent. Lubricate the motor as follows:

⚠WARNING

Disconnect and lock out electrical power to the boiler before lubricating the fan motor. Failure to follow these instructions can cause injury or death.

1. Disconnect and lock out electrical power to the boiler.
2. Wipe clean all grease fittings (fill and drain fittings).
3. Remove the fill and drain plugs from the motor end cap.
4. Free the drain hole of any hard grease. (Use a piece of wire, if necessary.)
5. Add grease using a low-pressure grease gun.

   NOTE: The amount and type of grease is very important. Only enough grease should be added to replace the grease used by the bearing. Either too much or too little grease can be harmful. The grease cavity should be filled 1/3 to 1/2 full, using Chevron SRI 2 grease or equivalent. Shell Dolium R is a suitable substitute lubricant.

6. With the fill and drain plugs still removed, apply electric power to the boiler, start the motor, and let it run for approximately 30 minutes.

1. Turn boiler off.

⚠ WARNING

Disconnect and lock out electrical power to the boiler before lubricating the fan motor. Failure to follow these instructions can cause injury or death.

2. Disconnect and lock out electrical power to the boiler.
3. Wipe excess grease from the motor, and install the fill and drain plugs. Motor is ready for operation.
4. Reconnect electrical power.

CHAPTER 4

CUSTOMER SERVICE

When ordering parts for repair or spares, give description and state the quantity of parts desired, together with the complete nameplate data including rating, model, serial number of the motor, and all data.

Use only genuine Cleaver-Brooks parts, ordered from your local Cleaver-Brooks authorized representative.

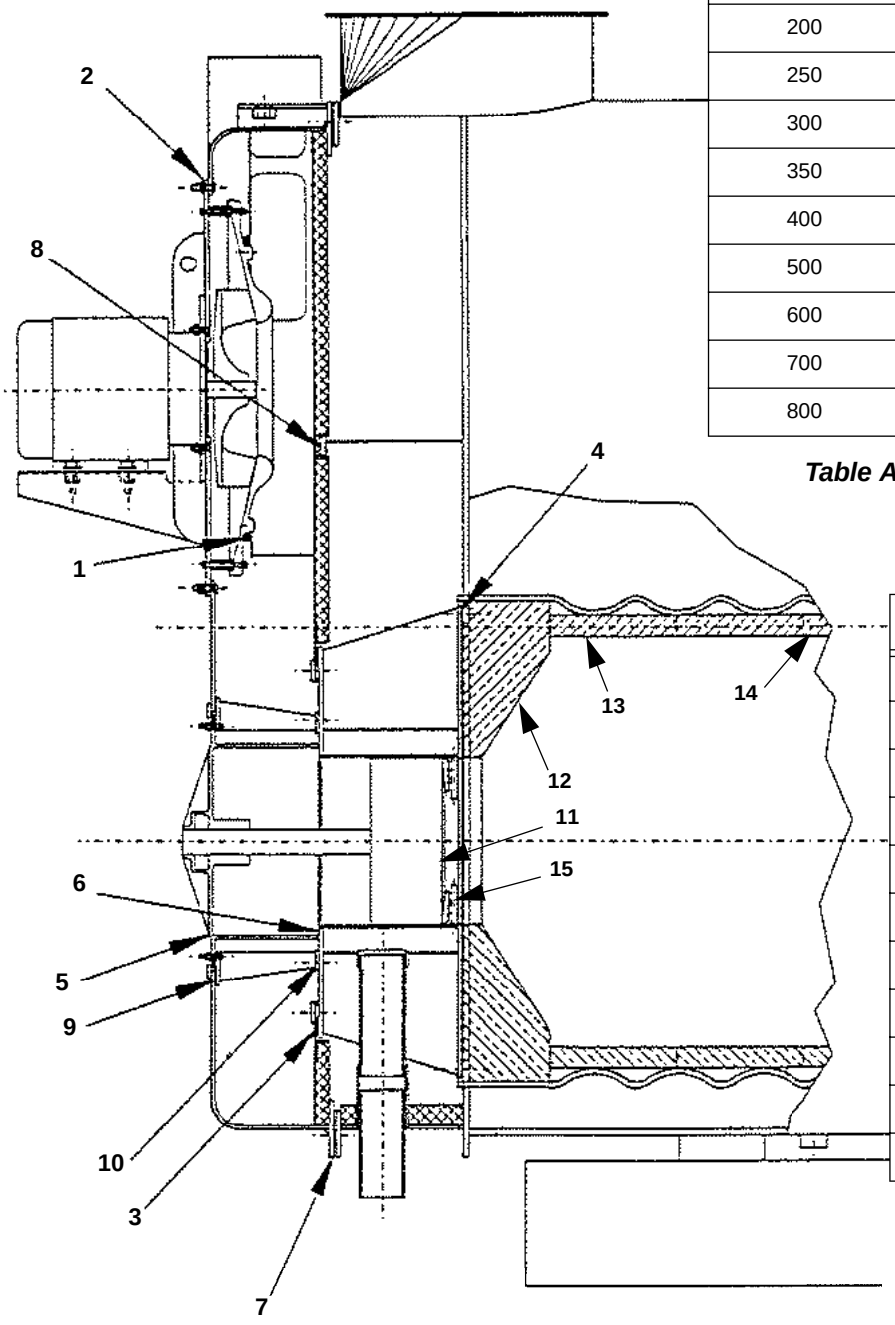
Refer to Figure 8 for locations of parts listed below.

	REQ'D	125-200 HP	250-350 HP	400-800 HP
1. AIR INLET BOX GASKET	1	32-2538	32-2537	32-2537
2. FAN/MOTOR CASSETTE GASKET	1	32-2535	32-2532	32-2524
3. INNER DOOR - BURNER HOUSING GASKET	1	32-106	32-898	32-993
4. BURNER HOUSING - DRY OVEN GASKET	-	32-107 (3 REQ'D)	872-249 (72" LG)	872-249 (96" LG)
5. BURNER DRAWER (FRONT) GASKET	-	32-605 (1 REQ'D)	32-927 (2 REQ'D)	32-2531 (1 REQ'D)
6. BURNER DRAWER (REAR) GASKET	1	N/A	853-1017 (48.5" LG)	853-1017 (61" LG)
7. FRONT and REAR DOORS GASKET	1	32-105	32-899	32-901
8. BAFFLE SEAL	1	904-12 (60" LG) 872-362 (1x2x60" LG)	904-12 (83" LG) 872-362 (1x2x83" LG)	853-982 (94" LG) 904-12 (94" LG) 872-362 (1x2x94" LG)
9. BURNER SUPPORT (FRONT) GASKET	1	32-603	853-3 (71.5" LG)	N/A
10. BURNER SUPPORT (REAR) GASKET	1	32-109	32-928	N/A
11. NOZZLE TIP & SWIRLER	1	251-10	251-188	251-187
12. THROAT TILE	34	*	*	94-429
13. FURNACE LINER (FRONT)	54	*	*	94-428
14. FURNACE LINER (REAR)	17	*	*	94-430
15. SPUD KIT		SEE TABLE A		
OVERTRAVEL LINKAGE ASSEMBLY	1	427-251	427-251	427-251
BALL JOINT	AR	883-17	883-17	883-17
BALL JOINT BUSHING	AR	10-288	10-288	10-288
DIFFUSER	1	SEE TABLE B		
QUICK DISCONNECT BALL JOINT	1	883-69		

* For 125 through 350 hp units, refer to the appropriate Boiler Operation & Maintenance manual.

BOILER HP	60 PPM	30 PPM
125	275-82	275-63
150	275-82	275-264
200	275-82	257-264
250	275-253	275-254
300	275-253	275-254
350	275-254	275-254
400	275-256	275-256
500	275-255	275-255
600	275-255	275-255
700	275-255	275-255
800	275-255	275-255

Table A. Diffuser Part Numbers



BOILER HP	30 PPM*
125	90-1664
150	--
200	--
250	90-1657
300	90-1656
350	90-1556
400	90-1627
500	90-1623
600	90-1624
700	90-1626
800	90-1626

* Applies only to 30ppm NOx units.

Table B. Spud kits

Figure 8. Part Location

Gray Bear Construction

ONE YEAR WARRANTY AND GUARANTEE

Project: Boiler
Installation

Owner: Camtech Manufacturing
7809 Industrial Boulevard
Atlanta, GA 30301

Work Completed: 08/03/17
Expiration of Warranty: 08/03/18

We, the undersigned, hereby warrant and/or guarantee the work at the above mentioned project has been performed in accordance with the contract documents and that the work, as installed, will fulfill all of the warranty/guarantee requirements included in these contract documents. We hereby agree to replace at our sole cost and expense, any or all materials adjudged not in accordance with the contract documents or improperly installed, as well as guarantee the Owner and Contractor against liability, losses or damage to any or all parts of the work arising from said installation during the period of one (1) year from the date of the Notice of Completion. If the period of guarantee is stipulated in excess of one (1) year by the contract documents, subcontractor shall be bound as specified. All guarantees will insure to the benefit of the Contractor, Owner, successors or assigns. Exempt from the guarantee/warranty is ordinary wear and tear and unusual abuse.

In the event of failure to comply with the above mentioned conditions within a reasonable time as determined by the Owner, after being notified in writing, we, the undersigned, so hereby authorize the Owner to have said defect, repairs, and/or replacements made good and we will refund to the Owner, on demand, all costs and charges therefore, including all collection costs and reasonable attorney's fees.

The above warranty does not supersede the Latent and Patent Defect Laws.

Gray Bear Construction Co

By: John F. Witty
Title: President
Date: 2/1/17

State License No: 158733
Expiration Date: 08/03/18

Local Representative to be contacted for maintenance, repair and/or replacement service:

Firm Name: Gray Bear Construction Co, Contact: John F Witty

Address: 4548 N. Albina Avenue
Atlanta, GA 30301

Telephone: 404-282-2116

HVAC UNIT – GUH-21 ICA-7

HIGH PERFORMANCE ROOFTOP UNIT

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PART 1 GENERAL

1.01 SUMMARY

The Offeror shall provide a detailed description of the rooftop unit (RTU) model offered for sale in response to this Solicitation.

To be considered, models offered must have between 120,000 and 240,000 Btu/h of capacity and meet all of the minimum specification requirements listed below. The models offered must also be supplied as compatible with direct digital control and remote diagnostic systems. Requirements listed in the Specifications (below) include standalone controls, capability to interface with major manufacturer control systems, and availability of specific equipment sensing parameters at a "signal access interface." Offers that do not meet the following minimum technical specifications will be deemed unresponsive and will be automatically rejected. Offers that exceed these specifications, on the other hand, will receive favorable consideration, and offerors are requested to indicate how their products exceed them. In addition to meeting the minimum specifications, the successful Offeror(s) shall be responsible for having complied with all applicable federal and state standards, regulations and laws governing these types of air conditioners. This includes compliance with all applicable safety and environmental standards.

A. Section Includes:
   1. Furnishing of packaged air conditioning equipment by RTU manufacturer
      a. Cooling-only units 10 to 20 tons
      b. Cooling and heating units 10 to 20 tons
B. Providing delivery coordination of RTU equipment to job site by RTU manufacturer.
   1. Providing installation support by RTU manufacturer.
   2. Providing submittals, operating instruction, service manuals and warranty process by RTU manufacturer
C. Related Sections:
   1. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.02 SYSTEM DESCRIPTION, PERFORMANCE REQUIRMENTS:

A. Design Requirements: Provide products and systems that have been manufactured to the following criteria:
   1. Refrigeration system construction of units shall be in accordance with ASHRAE 15.
   2. Units shall be designed, manufactured, and tested and listed in accordance with UL 1995 requirements, and shall bear the UL or ETL label.
   3. Gas-fired furnace section construction shall be in accordance with UL/ETL safety standards. Furnace section shall bear the UL/ETL label.
   4. Refrigerant must have a global warming potential (gwp) no more than 2100 per ASHRAE Fundamentals 2009.
B. Electrical Characteristics:
   1. 60 Hz
   2. 3-phase
C. Cooling Performance:
   1. Unit(s) shall have a minimum IEER of 18.0.
   2. Unit(s) shall be in accordance with and independently tested to ANSI/AHRI Standard 340/360.
   3. The IEER shall be reported along with the EER and supply air conditions for each of the ANSI/AHRI Standard 340/360 2007 test conditions shown in Appendix A.

4. DOE will conduct tests following the ANSI/AHRI Standard 340/360 with a 30% outdoor air ratio and test conditions shown in Appendix A.
5. As part of the DOE testing the supply fan will experience 0.7 in H_2O external static pressure at design conditions.
6. Testing will occur at the manufacturer's or a third-party facility approved by the DOE under observation by a DOE third party representative. Required performance metrics based on the testing will be calculated by a DOE third party representative.

D. Heating performance:
1. Gas Heating:
   a. Efficiency:
      1) Units ≤ 225 kBtuh shall have a minimum AFUE of 80
      2) Units > 225 kBtuh shall have a minimum thermal efficiency of 80%
      3) Furnish gas heat units with electronic ignition
      4) Gas heat capacity options shall provide the following minimum temperature increase:
         a) 10 Tons and Over: Low Heat: 25°F rise; High Heat: 50°F rise
      5) Gas Input Requirements:
         a) Natural Gas Supply Pressure: 7 in. w.c. (1.7 kPa).
         b) LPG/Propane Supply Pressure: 11 in. w.c. (2.7 kPa).
2. Electric Heating:
   a. Electric heat capacity options (minimum):
      1) 10 Tons and over: Low Heat: 25°F rise High Heat: 50°F rise
   b. Electrical Requirements:
      1) Provide for single connection of power to unit.

E. Fan performance:
1. The supply air fan shall be tested and rated in accordance with ANSI/AMCA 210.
2. Fan shall produce the ARI rated air-flow at 0.7 inches water column external static pressure (+/- 10%) without using the required motor service factor.
3. Fan efficiency shall be a minimum of 60%.
4. Fan shall be variable volume or multi-stage operation capability with, at minimum, a speed for heating mode, ventilation mode, and each stage of cooling.
5. Fan motor shall be direct drive and meet NEMA premium efficiency for over 1 hp or an ECM for 1 hp and under.

F. Economizer and Outdoor Air Damper:
1. Unit(s) shall have differential economizing capability using either dry-bulb or enthalpy with a minimum condition lock out
2. The economizing function will be capable of actuating from a set minimal outdoor air intake to 100% of ARI rated flow
3. Outdoor air damper shall be able to fully close switching to 100% recirculation mode and maintain a leakage rate based on section 2.01 E 1 g.

G. General:
1. Unit(s) shall be a single package air-cooled DX mechanical cooling system with capacity between 120,000 to 240,000 Btu/h.
2. Unit(s) shall be capable of discharging downward.
3. The single package unit shall be a product of a firm regularly engaged in the manufacture of heating/cooling equipment.
4. The manufacturer shall have parts and service available throughout the U.S and Canada.
5. Unit(s) shall be shipped completely factory assembled, pre-charged, piped and wired internally ready for field connections.
6. Unit(s) shall be 100% run tested by the manufacturer with a copy of the run test report on file at the manufacturing facility.

PART 2 PRODUCTS

2.01 PACKAGED ROOFTOP UNITS

A. General:
   1. Rooftop unit shall be specifically designed for outdoor application with a fully weatherproof cabinet, fully flashed on 4 sides, and shipped as one piece. (Roof curb can be shipped or supplied separately.)

B. Manufacturer shall perform all of the following at the factory:
   1. Assemble units
   2. Wire and pipe units
   3. Install unit controller
   4. Run test units before shipping

C. Information plates:
   1. Outside Nameplate
      a. Material shall be durable and weather resistant.
      b. Located on outside of unit
      c. Information on the nameplate shall contain:
         1) Name of manufacturer
         2) Model and serial number
   2. Unit shall have tags/decals showing lifting/rigging points, caution areas and refrigerant type.
   3. Information in control compartment:
      a. Unit(s) shall have Installation and Maintenance manuals supplied with each unit in the control access section.
      b. Unit(s) shall be provided with a durable and weather resistant Wiring Diagram mounted to the control compartment door.

D. Plastic or rubber bushings or tooled openings to prevent wire abrasion wherever wiring runs through sheet metal

E. RTU's to include the following equipment:
   1. Cabinet: Formed and reinforced insulated panels, hinged to allow access to internal parts and components, with joints between sections sealed.
      a. Enclosure shall include anti-corrosion coating and shall be capable of withstanding ASTM B117 750 hour Salt Spray Test
      b. Base rails:
         1) Full perimeter
         2) To have rigging holes for lifting
         3) Shall have forklift slots
      c. Access Doors and Panels:
         1) Provide hinged access doors and removable panels to allow for removal, replacement or repair of all internal components. All doors and removable panels shall be gasketed.
         2) Include air/water seals for panels/doors separating conditioned from unconditioned air.
         3) Factory supplied latching handles
         4) Provide access to:
            a) Economizer section
            b) Filter section
            c) Blower section
            d) Compressors/control/heat section(s)
            e) Condenser section
      d. Condenser section access panel:

1) One square foot minimum panel size

e. Openings:
   1) Unit base access for electrical
   2) Horizontal access knockouts for electrical and double gas lines
   3) ½″ Raised edges around duct and power entry openings in the base pan
   4) Base pan:
      a) Provide openings with nonmetallic grommets for the following:
         (1) Unit power wiring.
         (2) 120V convenience receptacle wiring.
         (3) Low voltage network or external device wiring.
         (4) Low voltage fire alarm wiring.

f. Insulation:
   1) Cabinet shall be thermally and acoustically insulated.
   2) Unit base fully insulated to serve as air seal to the roof curb.
   3) All panels adjacent to conditioned air including the base shall be fully insulated with a minimum of R=1.0 (higher R value is preferred) fiberglass insulation to prevent condensation and minimize sound transmission.
   4) Door liners, top panels, divider panels and mullions shall be fully insulated to meet an R-value of 1.0 (higher R value is preferred).
   5) Casing Insulation and Adhesive: Comply with NFPA 90A.

g. Outdoor- and Return-Air Mixing Dampers:
   1) Damper leakage rate no greater than the rate described in ASHRAE/IESNA 90.1 Table 6.4.3.4.4.
   2) Damper Motor: Direct-coupled, modulating with adjustable minimum position, plug-in connections.
   3) Gear driven preferred, use of rod and linkages is acceptable
   4) Outdoor Air Hood furnished with cleanable aluminum mesh outdoor air filters.
   5) Relief-Air Damper: Motorized (Direct coupled, gear driven preferred, use of rod and linkages is acceptable) or backdraft gravity (nonmotorized), as required by ASHRAE/IESNA 90.1, with bird screen and hood.

h. Airstream Surfaces: Surfaces in contact with the air stream shall be protected against erosion and meet NFPA 90 flame retardance requirements (preferably interior panel, but foil faced cleanable insulation encapsulated with panel design or tape edges securing fit is acceptable).

2.02 COOLING SYSTEM:

A. Operating range of 0°F - 115°F degrees F (-18 - 46°C) outdoor ambient conditions.

B. Refrigerant Circuits:
   1. Each circuit shall have gauge port and connections on high and low pressure side in accessible locations.
   2. Refrigerant charging valves and connections shall be provided for each circuit.

C. Refrigerant:
   1. Refrigerant shall not be an HCFC compound.
   2. Factory charged with refrigerant and oil

D. Compressors:
   1. Intent is to not restrict technology employed, therefore type of compressor is not specified
   2. Safeties will be provided for the following:
      a. Internal overcurrent and high-temperature protection
      b. Internal pressure relief and high pressure (manual reset)
      c. Internal pressure relief and high pressure

d. Low pressure (automatic reset)
e. Low charge
f. Overload protection
g. Short cycle protection:
1) To allow circuit pressure equalization prior to compressor start
2) To allow minimum run time

3. Equip with vibration isolation
4. Crankcase heaters
5. Compressor(s) shall be easily accessible and removable without disassembling cabinet. Refrigerant piping is to be protected to not leak or be damaged during shipment or unit operation.

E. Coil Construction:
1. The evaporator coil and condenser coil shall be leak tested to 200 psig and pressure tested to a minimum 450 psig.

F. Evaporator Coil:
1. Intent is to not restrict technology employed, therefore type and construction of coil is not specified

G. Condenser Coils:
1. Intent is to not restrict technology employed, therefore type and construction of coil is not specified

H. Condenser fan(s):
1. Intent is to not restrict technology employed, therefore type of fan is not specified
2. Fan(s) shall be statically balanced
3. Fan(s) and motor(s) shall be suitable for outdoor installation
4. Fan(s) shall have safety guard(s)

I. Outdoor Coil Fan Motors:
1. Thermal overload protection
2. Totally enclosed
3. Permanently lubricated bearings

J. Condensate Drain Pan:
1. Unit shall have a non-corroding condensate drain pan under evaporator coil pitched for proper drainage at any orientation on a ⅛″/ft roof slope.

2.03 HEATING SYSTEM:

A. Gas Furnace
1. Description: Factory assembled, piped, and wired; complying with ANSI Z83.8 and NFPA 54.
a. Certified by and bearing label of ULC or CETLus
2. Burners: Stainless steel
a. Fuel: Natural gas
b. Ignition: Electronically controlled hot-surface or direct spark igniter with flame sensor.
c. High-Altitude Model: For Project elevations more than 2000 feet (610 m) above sea level advise derated capacity
d. Heat-Exchanger: Aluminized steel or stainless steel.
3. Power Vent: Integral, motorized centrifugal fan interlocked with gas valve.
4. Gas Controls:
a. Gas Control Valve: Two-Stage or Modulating, indicate on submittal documents.
b. Gas Train: Single-body, regulated, , 24-V ac gas valve assembly with manual shutoff. (Pressure regulator to be factory or field installed.)
c. Gas valve delay
d. High temperature limit switches

e. Electronic switch to lockout gas valve until combustion air flow is proven.

B. Electric-Resistance Heating:
   1. All electric heat specified above 15-kW nominal heat shall have 2 stages.
   2. Electric heaters shall meet requirements of NEC, shall be listed by UL for zero clearance to combustible surfaces, and shall be wired for 208/3/60 or 460/3/60 as indicated on Drawings.
   3. Overtemperature Protection: Disk-type, automatically reset, thermal-cutout, safety device; serviceable through terminal box.
   4. Overcurrent Protection: Manual-reset thermal cutouts.
   5. Control Panel: Unit mounted with disconnecting means and overcurrent protection. Include the following controls:
      a. Magnetic contactors, one (1) contactor per heating stage, must provide individual contactors for staging electric heat as required by the equipment schedule. All heaters rated above 15-kW shall have two stages.
      b. Built-in fuses to be included for each heater circuit larger than 40 amps.
      c. All contactors shall be wired to heating overcurrent device to allow for single-point power connection to the rooftop unit.
      d. .
   6. Internal wiring insulated for operating temperatures.

2.04 INDOOR AIR QUALITY:

A. Air Filtration: Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
   1. 2-inch Minimum MERV 7, Factory-Installed for use during construction.
   2. 2-inch pleated Replacement Set: Minimum MERV 8.

B. Filter compartment shall have a hinged, gasketed, access panel on one side of cabinet to allow for easy filter removal.

C. Supply Air Blower:
   1. Intent is to not restrict technology employed, therefore type of fan is not specified.
   2. Fan(s), motor(s), and drive(s) shall be entirely self-contained.
   3. Each supply-air fan and motor shall be installed on an adjustable fan base.
   4. Fan(s) may be direct or belt drive.
   5. Motor:
      a. Overload protected
      b. Bearings shall be air-handling quality, heavy-duty grease or permanently lubricated ball type. Bearings shall be selected for a Basic Rating Life, (L10) of 100,000 hours at maximum operating speed and horsepower for each construction level
      c. Ground and polished shafts
      d. Motor mount base shall permit ease of changeover and belt tension adjustment (if applicable).
      e. Blowers, drives and motors shall be balanced.
      f. Shall be “NEMA premium” for motors 1 hp or greater.
      g. Supply fan motors shall comply with NEMA MG 1

2.05 CONTROLS AND DIAGNOSTICS:

A. Safety Control Operation:
   1. Smoke Detectors Connection:
      a. Provide Smoke Detector terminals for connection to unit controller or a terminal strip in the electrical compartment for field wiring of the smoke detector(s) to the unit.

2. Smoke Purge: RTU shall have the capability for an EMS, other network application, or external device to start supply fan, deactivate cooling and heating systems, open outside and relief dampers, close return dampers, and activate power exhaust fan(s).

B. RTU shall have a stand-alone Direct Digital Control (DDC) based unit control system.
   1. DDC unit control system shall include all required, input/output boards, main microprocessor, software and operator interface for stand-alone operation and for communication with an external third-party device, network or EMS.
   2. The temperature sensors shall have an accuracy of ±1 deg F, relative humidity sensors shall have an accuracy of ±5%, dew-point sensors shall have an accuracy of ±1 deg F, pressure transducers shall have an accuracy of ±1% FS and power measurements shall be ±5%.
   3. DDC unit control system shall perform all unit control functions including unit safeties and either zone sensor control mode or thermostat control mode
   4. All boards shall be individually replaceable for ease of service. All microprocessors, boards, and sensors shall be factory mounted and tested.
   5. The DDC controller shall be stand-alone, not dependent on communications with any on-site or remote master control panel when operating in either a zone sensor control or a thermostat control mode.
   6. DDC controller shall accept virtual thermostat inputs from an external BACnet third party device or network (e.g., an Energy Management System[1] (EMS)) when operating in zone space temperature control mode. DDC controller shall be capable of switching from external EMS (or other) control mode to zone sensor or thermostat or non-EMS-based zone sensor or thermostat control mode.
   7. DDC controller shall support full communication with external compatible third-party devices, networks, or EMS using standard BACnet open protocol, that is, the DDC controller shall have communication capability with an external BACnet compliant third-party device (e.g. an EMS) to read all sensor data and all signal and status information (damper signal, status of both supply and outdoor fans, status of compressor and any protection limits). If additional sensors are installed to support the diagnostic functions, those sensor values also shall be readable from the external BACnet compliant third-party device or network (e.g. an EMS). In addition, the controller shall allow for reading the fault codes and messages.

C. The microprocessor memory shall be protected from voltage fluctuations and power failures. All factory and user set control points, control algorithms and schedules shall be maintained in nonvolatile memory. No settings shall be lost, even during extended power shutdowns.
   1. Compressor protections and delays shall be no greater than the following:
      a. Minimum On time of 120 seconds
      b. Minimum Off time of 300 seconds
   2. Minimum outside air damper position setpoint used during occupied periods if network communications are lost.

D. The user interface shall consist of a keypad/display device with characters of a size and font that is clearly visible for service personnel on a rooftop. Password protection from changes to writable properties by unauthorized personnel shall be one easily remembered default that is the same for all RTU's. Read only properties shall be available without

1. Some EMS systems are also referred to as Energy Management and Control Systems or Building Automation Systems.

password requirements. The service technician shall be able to scroll though to read the sensor values and fault codes and messages. In addition to the diagnostic fault codes and messages, it shall provide possible cause(s) for each fault condition.

E. BACnet Communications:
   1. A BACnet communications port shall be provided for direct communication to an external third-party network compliant with the BACnet protocol.
   2. All BACnet features shall be implemented per the latest version of the ANSI/ASHRAE 135 industry recognized BACnet standard.
   3. Dip switches or digital display shall be available for setting MAC addresses on individual RTUs in the field.
   4. Dip switches or keypad display shall be capable of setting a unique BACnet Device Instance on each RTU in the field.
   5. BACnet communications hardware and software shall be configured and available when the RTU arrives from the factory with no additional software, hardware, or peripheral (e.g., laptop computer) device connections required to initiate communication between RTU and external third-party network or device (e.g., an EMS).
   6. All required BACnet objects and properties shall be open protocol, non-proprietary type.
   7. BACnet implementation shall include (but not be limited to) the following features to assure satisfactory communication speed:
      a. BAUD rate shall be BACnet MS/TP 76800 BPS or faster.
      b. ReadPropertyMultiple service for accessing more than one data point per request message in addition to the ReadProperty service.
      c. WritePropertyMultiple service for changing more than one data point per request message in addition to the WriteProperty service.
      d. BACnet MS/TP implementations shall provide the ability to adjust the Max_Masters property of the Device Object through BACnet network communications interface.
      e. BACnet MS/TP implementations shall not respond with BACnet Reply_Postponed frames to all Confirmed Service Requests.

F. The DDC unit control system shall have the ability to communicate with an external third-party network or device through a direct wired BACnet communication connection. Multiple units shall communicate on the BACnet communication network. The RTU DDC unit shall enable such external third-party devices to both read and write to properties of the following BACnet objects on the individual rooftop DDC unit controllers:
   1. BACnet Binary Inputs Objects:
      a. Supply Fan (G) Start/stop the supply fan.
      b. Cool 1 (Y1) Start/stop first stage cooling.
      c. Cool 2 (Y2): Start/stop second stage cooling. Cool stages shall directly follow these control inputs.
      d. Cool 3 (Y3): Start/stop third stage cooling on units with three stages. Cool stages shall directly follow these control inputs. Third stage may be defined by combinations of Y1 and Y2.
      e. Heat 1 (W1) Start/stop first stage heating.
      f. Heat 2 (W2): Start/stop second stage heating.
      g. Smoke Alarm: Controller shall allow external BACnet systems (such as EMS) to monitor this BACnet binary input object for alarm purposes.
      h. Diagnostic Alarm: Controller shall allow external BACnet systems (such as EMS) to monitor this BACnet binary input object for alarm purposes.
      i. Compressor On/Off Status: Controller shall allow external BACnet systems (such as EMS) to monitor the binary input.

j. Indoor Fan Status: Controller shall allow external BACnet systems (such as EMS) to monitor this binary input.
k. Outdoor Fan Status: Controller shall allow external BACnet systems (such as EMS) to monitor this binary input.

2. BACnet Analog Input Objects:
   a. Zone Temperature Analog Input. EMS shall monitor and use this value to provide thermostat type staging of RTU heating and cooling.
   b. Discharge Air Temperature Analog Input EMS shall monitor.
   c. Return Air Temperature Analog Input for monitoring thru EMS.
   d. Zone Relative Humidity Analog Input On units with a field mounted zone humidity sensor, EMS shall monitor and provide dehumidification control.
   e. Carbon Dioxide (CO_2) Analog Input On units with a field-mounted zone CO_2 sensor, EMS shall monitor and vary the OA damper for demand controlled ventilation.
   f. Energy Recovery Ventilator (ERV) Temperature Analog Input On units with ERV, EMS shall monitor.
   g. If any additional sensors are installed to support diagnostics, all those sensor values shall be available as BACnet objects for EMS to monitor.
3. Commandable BACnet Analog Output Objects:
   a. Outside Air Damper Actuator: The EMS shall write to this output at priority level 9 to achieve direct control of the outside air damper position (overriding the DDC unit controller's ability to control the damper). If damper control resides on an auxiliary control board other than the main processor, the physical analog output of the auxiliary board shall also be directly under EMS control through the same BACnet object.
4. Commandable BACnet Binary Outputs:
   a. Power Exhaust 1 Units with economizer shall have this output which the EMS shall write to at priority level 9 when exhaust is required.
   b. Energy Recovery Ventilator Units with ERV shall have output which the EMS shall write to at priority level 9 when ERV is required..
5. All fault codes shall be presented to the EMS as BACnet multi-state value object. The state text property shall be implemented and contain English language descriptions of the associated fault codes.
6. Alarm/Alert Information
   a. Current alarms and alerts (if these are different from diagnostic information above) shall be presented to the EMS as BACnet multi-state value object. The optional state text property shall be implemented and contain English language descriptions of the associated alarms and alerts.
7. Remote Alarm Reset
   a. A commandable BACnet value object shall be available which allows reset of RTU lockouts to be performed over the EMS network. If conditions which caused the lockout still exist, RTU shall again lock out operations. Local alarm reset at the unit shall also be available. After clearing an alarm by setting the present value to "true", the priority array entry used to clear the alarm shall be reset to "auto" by the DDC unit controller so clearing alarms can be done again at any priority (this guarantees local clearing abilities at the unit after remote clearing). Relinquish default property of this object shall equal "false".
8. The present value property of all BACnet Binary Inputs shall be writable when the object's "out of service" property has been set to true by the EMS.
9. DDC unit controller shall support the BACnet Time Synchronization service. EMS will automatically set the unit controllers time properties for scheduling purposes.

10. Watchdog Timer (Heartbeat): DDC controller shall accept a watchdog timer signal from EMS network building controller into a BACnet analog value object. EMS will write the value of 300 every 90 seconds at priority level 9. This present value shall be reduced by 1 (at priority level 9) each second by the DDC controller until it reaches zero. If DDC controller's watchdog timer counts down to zero, the DDC controller shall know that EMS network communication has been lost.
11. On all commandable BACnet objects, the DDC unit controller shall write to the present value property at any priority level higher than 9, preferably 16. Normal EMS control shall override the DDC unit controller at the command priority level 9. Manual EMS control shall write at command priority level 8.
12. If EMS network communications fail (indicated through the watchdog timer), the DDC unit controller shall assume command in the zone temperature control mode, overriding control of all commandable objects at priority level 8 and 9 from the non-communicating EMS. When communications is restored and the watchdog timer is restored, the controller shall automatically switch back to thermostat control mode. Priority levels less than 8 (manual life safety, automatic life safety, etc) shall not be overridden after communications loss.

G. RTU controls shall have an available power source to supply loop power through the following optional field installed sensors and back to the associated analog inputs:
1. One Relative Humidity sensor at:
   a. 18-30 VDC
   b. 1 VA maximum power
2. One CO_2 sensor at:
   a. 18-30 VDC
   b. 3 VA maximum power

H. RTU manufacturer shall provide discharge air temperature (DAT), outdoor air temperature, return air temperature (RAT) and humidity sensors wired to DDC unit controller inputs and presented to the external third-party device or network (e.g., an EMS) as BACnet Analog inputs. DAT sensor shall be mounted downstream of the coil, fan and heat source and measure a well mixed air stream. RAT sensor shall be mounted in direct line of sight from the return air duct to the lowest visible spot on the cooling coil. RAT sensor shall not be subjected to air from the OA damper or OA pulled backwards through a closed relief air damper.

I. In the event of a zone temperature sensor failure (open-circuit, short-circuit, or otherwise defined to have failed by RTU manufacturer), the DDC unit controller shall switch to return air temperature as the control input in zone temperature control mode. The zone temperature sensor failure code shall be set, so an external third-party device or network (e.g., an EMS) can read the code and issue an alarm. This condition, along with the provision to operate the RTU in zone temperature control mode when network communication fails, shall enable units shipped from the factory to condition the space upon startup (before the zone sensor and external third-party devices or network (e.g., EMS) are installed).

J. DDC unit controller must support enthalpy economizer controls.

K. DDC unit controller in zone temperature control mode shall provide the following economizer control based on outside air temperature when EMS network communications are lost:
1. Low OA temp lockout = 35 deg F
2. High OA temp lockout = 65 deg F
3. DDC controller shall support integrated economizer operation, i.e., the unit shall be able to economize while also providing mechanical cooling, if economizer can't fully satisfy the zone cooling load.

4. If economizer is available, and the zone is in the cooling mode, and no compressors are running, the OA damper shall modulate to supply discharge air temperature control (setpoint = 55 deg F).
5. If economizer is available and any compressor is running, the OA damper shall be fully (100%) open.
6. If economizer is not available, the OA damper shall be at Minimum Position during occupied times and fully closed during unoccupied times

L. DDC unit controller shall provide a service test mode. This operating mode shall allow a service contractor to force RTU into cool, heat, economizer, fan, dehumidification for local troubleshooting control and for independent testing and verification of the unit in the field during start-up commissioning. A BACnet Binary Value object shall indicate to the EMS when the unit is in service test mode.

M. Communication from unit controller to an external device or network shall use BACnet MS/TP (Master-Slave/Token-Passing) or BACnet/IP**.**

N. All operational capabilities described in previous sections A-M shall be automatically executed at equipment start-up to ensure proper operation and assist in commissioning.

2.06 ELECTRICAL:

A. Single point connection:
1. Provide for single connection of power to unit with non-fused disconnect accessible from outside unit and control-circuit transformer with built-in overcurrent protection.
2. Electrical power at unit shall be either 208, 460 or 575 volt, three phase, 60 hertz as indicated on Drawings. Provide a 208, 460 or 575 volt to 24 volt transformer (as dictated by unit operating voltage) for integral control of adequate capacity for control wiring and EMS..
3. Electrical components shall have ETL or UL label where applicable and shall be identified with printed labels.

B. Circuit Breakers:
1. Factory wired and mounted
2. Current sensitive
3. Temperature activated
4. Manual reset
5. Only one voltage shall be controlled through the contacts of any particular relay
6. GFCI receptacles:
7. Provide a 120 volt, 2-receptacle GFI outlet at the electrical penetration.
8. The outlet shall be factory-provided with a separate disconnect switch and powered from the line side of the main unit disconnect switch.
9. Provide label near GFI outlet stating “WARNING: Circuit feeding GFI receptacle is energized when unit disconnect is in OFF position”

C. All relays, timers, contactors to be located in one compartment

D. Electric heat contactors located in electric heat compartment, if selected

E. Wiring:
1. Wiring shall be color-coded or numbered and consistent throughout the unit.
2. If a wire numbering system is utilized, the numbers shall be located between one and two inches from both ends of each wire.
3. Wiring shall comply with NEC requirements and with local applicable codes.
4. Terminal blocks shall be provided for power wiring and external control wiring.
5. Use wire ties to keep wires grouped together
6. Orient components such that adequate clearance will remain after common replacement parts are installed.
7. Wiring, including control wiring, shall have insulation rated at 600 volts.

8. Sheet metal knockouts used for wiring shall have nonmetallic grommets installed to protect wire insulation from abrasion.
9. If a terminal board is located in another compartment for field terminations, the control systems communication conductors to the transition board shall be in a shielded cable.

F. Provide a laminated wiring diagram attached to the inside of the compartment door that contains the following:
1. The ladder schematic shall read left to right, top to bottom. The diagram shall accurately reflect the wire numbers or colors used throughout the unit, and shall have a picture of the physical layout of the electrical system of the unit including the unit components and the wiring between them.
2. Display a fully explained, legible, legend at the bottom.
3. Provide a diagram of the actual component locations (Acceptable location of layout is in the Installation Manual)
4. The name of each component inside the compartment shall be labeled on the panel adjacent to it with a sturdy plastic label.
5. Components shall have labels matching wiring diagram.

G. Motor control for supply fan motors, each compressor, and each condenser fan motor shall have an ETL or UL label. Provide motors with overload protection in each phase. Separately protect each phase against overcurrent.

H. Motors:
1. Electrical motors and starter shall comply with AIEE, NEMA, and this specification.
2. Design motors for supply voltages indicated, sized to develop required brake horsepower and operate satisfactorily with a voltage variation of ± 10%. Dynamically balance motors and hold to commercial tolerances.
3. Except for fractional motors, fan motors shall be high efficiency type.
4. Select motors for satisfactory operation without failure when ambient temperature reaches (104°F) for a period of 2-hours or more.
5. Provide squirrel-cage type motors, drip-proof enclosure, constant speed, across-the-line normal torque designed for quiet operation. Motor shall operate at proper full load and speed continuously without excessive heating in any part. Size at minimum 115 percent service factor.
6. Wind motors 1hp and larger for 3-phase, 60 hertz current unless shown otherwise on Drawings.

APPENDIX A: SUMMARY OF PERFORMANCE METRIC TEST PROCEDURES

Table 1. Summary of performance metric test procedures

Test Conditions[1]	OUTDOOR SECTION: Air Entering (Condenser Coil)		Return Air		OA Ratio	INDOOR SECTION : Air Entering (Evaporator Coil)	
	Dry-Bulb	Wet-Bulb	Dry-Bulb	Wet-Bulb		Dry-Bulb	Wet-Bulb
IEER 100%[2,3]	95°F	75°F	80°F	67°F	0%	80°F	67°F
IEER 75%[2,4]	81.5°F	66.3°F					
IEER 50%[2,4]	68.0°F	57.5°F					
IEER 25%[2,4]	65°F	52.8°F					
Low Temp Cooling Condition[2,4]	67°F	57°F	NA	NA	100%	67°F	57°F
Max Operating Condition[2,4]	115°F	75°F	80°F	67°F	0%	80°F	67°F
Condensate Disposal[2,4]	80°F	75°F	NA	NA	100%	80°F	75°F
Hot-Dry Annual Average Condition[3,4,5]	90°F	64°F	78°F	64°F	30%	82°F	64°F
Hot-Humid Annual Average Condition[3,4,5]	80°F	77°F	80°F	67°F	30%	80°F	70°F

Notes

1. All tests shall operate the unit against 0.7 H_2O of external static
2. Based on ANSI/AHRI Standard 340/360 2007
3. Indoor-coil airflow rate not to exceed 37.5 SCFM per 1000 Btu/h of rated capacity
4. Airflow rate should be adjusted to maintain or try to maintain the “IEER 100%” test condition measured leaving air dry-bulb temperature
5. Operate all refrigeration circuits at maximum capacity

APPENDIX B: REFERENCES

A. American National Standards Institute (ANSI):
   1. ASHRAE 33 - 2000 Methods of Testing Forced Circulation Air Cooling and Air Heating Coils
   2. ANSI/ASHRAE 15 - 2007 Safety Standard for Refrigeration Systems.
   3. ANSI/ASHRAE/IESNA 90.1 - 2007 Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings.
   4. ANSI/ASHRAE 135 – 2008 BACnet
   5. ANSI/CSA Z83.8-2009 - Gas Unit Heaters, Gas Packaged Heaters, Gas Utility Heaters and Gas-Fired Duct Furnaces.
   6. ANSI/NEMA MG1 - 2009 Motors and Generators
   7. ANSI/AMCA 210 - 2007 Laboratory Methods of Testing Fans for Aerodynamic Performance Rating

B. Air-Conditioning, Heating and Refrigeration Institute (AHRI):
   1. ANSI/AHRI 270 - 2009 Sound Rating of Outdoor Unitary Equipment.
   2. ANSI/AHRI 210/240 - 2008 Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment
   3. ANSI/AHRI 340/360 - 2007 Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.
   4. ANSI/AHRI 370 - 2010 Sound Rating of Large Outdoor Refrigerating and Air Conditioning Equipment.

C. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE):
   1. ASHRAE 52.1 - 1992 Gravimetric and Dust Spot Procedures for Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
   2. ASHRAE 52.2 - 2007 Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size (ANSI approved).
   3. ASHRAE 62.1 - 2007 Ventilation for Acceptable Indoor Air Quality.

D. American Society for Testing and Materials (ASTM):
   1. ASTM D5894 (2005) Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal.
   2. ASTM B117 - (2009) Standard Practice for Operating Salt Spray (Fog) Apparatus.
   3. ASTM D3359 - (2009) Standard Test Methods for Measuring Adhesion by Tape Test
   4. ASTM D2794 (2004) Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
   5. ASTM D2485 (2007) Standard Test Methods for Evaluating Coatings for High Temperature Service
   6. ASTM D2247 (2002) Standard Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity
   7. ASTM D4060 - 2010 Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
   8. ASTM D522 - 2008 Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings
   9. ASTM D3363 (2005) Standard Test Method for Film Hardness by Pencil Test

E. International Code Council (ICC)
   1. International Building Code (IBC) – (2009)
   2. International Mechanical Code (IMC) – (2009)

F. U.S. Energy Policy Act of 2005 (EPACT)
G. U.S. Energy Independence and Security Act of 2007 (EISA)
H. U.S. National Appliance Energy Conservation Act of 2006 (NAECA):
I. National Fire Protection Association (NFPA):
    1. NFPA 54 (2009) National Fuel Gas Code
    2. NFPA 70 (2009) National Electrical Code
    3. NFPA 90A (2009) Installation of Air Conditioning and Ventilation Systems.
    4. NFPA 90B (2009) Installation of Warm Air Heating and Air-Conditioning Systems.
J. Underwriters Laboratories, Inc. (UL):
    1. UL 1995 Standard for Safety for Heating and Cooling Equipment.

APPENDIX C: DEFINITIONS

A. DDC: Direct-digital controls.
B. BMS (or EMS): Building Management System (or Energy Management System).
C. ECM: Electronically commutated motor.
D. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.
E. Outdoor-Air Refrigerant-Coil Fan: The fan for circulating outdoor air over the corresponding refrigerant-coil. "Outdoor air" is defined as above.
F. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-conditioning units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.
G. Supply-Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.
H. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations or reject heat (provide heating) in a heat pump configuration during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

APPENDIX D: SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of Contract and Submittal Procedures

B. Product Data: Submit technical data for each RTU including specifications, capacity ratings, dimensions, required clearances, weights, materials, accessories furnished and installation instructions.
   1. Completed data spreadsheets for each unit as described above in Part 1.04, Section C. 3.
   2. Gas heating efficiency (AFUE) or combustion efficiency as applicable
   3. Maintenance methods, procedures and recommended intervals
   4. Equipment, piping and connections, together with valves, strainers, control assemblies, thermostatic controls, auxiliaries and hardware which are mounted, wired and piped ready for final connection to the building system.
   5. Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, mounting curb details, sizes and location of mounting bolt holes; include mass distribution drawings showing point loads.
   6. Details of vibration isolation.

C. Shop Drawings: Submit shop drawings that Indicate:
   1. Equipment
   2. Piping and connections
   3. Recommended accessories
   4. External construction
   5. Recommended method of installation
   6. Mounting curb details, including provisions required for seismic and wind performance
   7. Sizes and location of mounting bolt holes
   8. Include mass distribution drawings showing point loads.
   9. Wiring diagrams for power supply and control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed. Wiring diagrams shall indicate MOCP (maximum overcurrent protection), MCA (minimum circuit ampacity) and FLA (full load amps). Wiring diagrams shall indicate necessary internal protection for equipment fed from RTU single point electrical connection.
   10. Fan performance tables or curves
   11. Type of refrigerant used
   12. Dimensions:
      a. Plan view
      b. Front view
      c. Side view
      d. Field/factory-installed options
      e. Service clearances
      f. Curb detail with dimensions

D. Certifications:
   1. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
   2. Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

3. Manufacturer’s installation instructions

E. Closeout Submittals: Submit electronic versions of the following:
   1. Brief description of unit
   2. Cut-sheets
   3. Warranty documents
      a. Furnish written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, components with inadequate and defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required, provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period.
   4. Operation and Maintenance Data:
      a. Include methods for cleaning and maintaining installed products
      b. Include final sequence of operation
      c. Methods/cleaning materials detrimental to finishes and performance
      d. Include names and addresses of spare part suppliers

F. Manufacturer Wind Loading Qualification Certification: Submit certification that specified equipment will withstand wind forces identified for each wind zone in the International Building Code to include remaining in place when curbs are in use.

G. Manufacturer Seismic Qualification Certification: Submit certification that RTUs, accessories, and components will withstand seismic forces identified for each seismic zone in the International Building Code to include remaining in place when curbs are in use.

APPENDIX E: QUALITY ASSURANCE

A. AHRI Compliance:
   1. Comply with ANSI/AHRI 210/240 or 340/360 as appropriate for testing and rating energy efficiencies for RTUs.
   2. Comply with ANSI/AHRI 270 or 370 for testing and rating sound performance for RTUs.

B. ASHRAE Compliance:
   1. Comply with ASHRAE 15 for refrigeration system safety.
   2. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. Heating efficiency shall be certified by CSA/ANSI Z83.8.

E. Unit(s) shall be safety certified, listed and labeled by Underwriters Laboratories (UL), UL of Canada (UL/C), Environmental Testing Laboratories (ETL) a division of Intertek Testing Laboratories, or Canadian Standards Association (CSA) in accordance with UL 1995/CAN/CSA No. 236-M90 and ANSI Z21.47 standards for Central Cooling Air Conditioners.

F. Unit(s) nameplate shall carry the label of the certification agency.

G. NFPA Compliance:
   1. Comply with NFPA 90A.
   2. Comply with NFPA 54.

H. All wiring shall be in compliance with NEC and CEC

I. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use. All electrical components shall have UL/C-UL, ETL and CGA listing.

J. Unit(s) shall be manufactured according to ISO 9002 manufacturing quality control.

Limited Warranty for Air Conditioner & Heat Pump Condensing Units

FOR WARRANTY SERVICE OR REPAIR:

Contact the installer or a Payne dealer. You may find their name on the product or in your Owner's Packet.

For help, contact: Payne Heating & Cooling, Consumer Relations, P.O. Box 4808, Syracuse, New York 13221, Phone 1-888-417-2963

PRODUCT REGISTRATION: Register your product online at *www.payne.com*.

Model No. GUH-21 1CA-7

Unit Serial No. HVGUH21-ICA72000

Date of Installation 04/28/2017

Installed by Air Systems, Inc.

Name of Owner Camtech Manufacturing

Address of Installation 7809 Industrial Bl., Atlanta, GA

Payne Heating & Cooling (hereinafter "Company") warrants this product against failure due to defect in materials or workmanship under normal use and maintenance as follows. Warranty periods begin on the date of original installation. If a part fails due to defect during the applicable warranty period Company will provide a new or remanufactured part, at Company's option, to replace the failed defective part at no charge for the part. Alternatively, and at its option, the Company will allow a credit in the amount of the then factory selling price for a new equivalent part toward the retail purchase price of a new Company product. Except as otherwise stated herein, those are Company's exclusive obligations under this warranty for a product failure. This limited warranty is subject to all provisions, conditions, limitations and exclusions listed below and on the reverse (if any) of this document.

OWNER-OCCUPIED, RESIDENTIAL APPLICATIONS
This warranty is to the original purchasing owner only and is not transferable. Except as otherwise stated, **if the product is installed in an owner-occupied residence and is properly registered within 90 days after original installation (see Warranty Conditions below for registration instructions), then the warranty period will be ten (10) years from the date of installation. Otherwise the warranty period is five (5) years from the date of installation**.

OTHER RESIDENTIAL APPLICATIONS (Apartments, Rental Properties, etc.)
The warranty period is five (5) years all parts and is not transferable.

OTHER APPLICATIONS
This warranty is non-transferable. The warranty period is five (5) years on the compressor, and one (1) year on all other parts.

LEGAL REMEDIES: The owner **must** notify the Company in writing, by certified or registered letter to Payne Heating & Cooling, Warranty Claims, P.O. Box 4808, Syracuse, New York 13221, of any defect or complaint with the product, stating the defect or complaint and a specific request for repair, replacement, or other correction of the product under warranty, mailed at least thirty (30) days before pursuing any legal rights or remedies.

Always Ask for FACTORY AUTHORIZED PARTS

APPENDIX G: CAPACITIES AND CHARACTERISTICS

A. Provide submittal data indicating compliance to Equipment Schedule, and provide any additional information as required in the following list.
B. Supply-Air Fan:
    1. Airflow CFM:
    2. External Static Pressure INCHES WG:
    3. Fan Speed RPM:
    4. Motor Horsepower:
    5. Motor Speed RPM:
C. Supply-Air Refrigerant Coil:
    1. Total Cooling Capacity Btu/h:
    2. Sensible Cooling Capacity Btu/h:
    3. Part Load Capacity Btu/h:
    4. Entering-Air Dry-Bulb Temperature deg F:
    5. Entering-Air Wet-Bulb Temperature deg F:
    6. Coil configuratation (face-split, row-split, interlaced, etc)
    7. Fin per inch count:
    8. Coating:
D. Outdoor-Air Refrigerant Coil:
    1. Ambient-Air Temperature deg F:
    2. Coating:
    3. Fan Motor HP:
    4. Number of Fans:
E. Hot-Gas Reheat Coil:
    1. Heating Capacity Btu/h:
    2. Entering-Air Temperature deg F:
    3. Air-Temperature Rise deg F:
    4. Coating:
F. Electric-Resistance Heating Coil:
    1. Capacity kW:
    2. Number of Steps (min 2 if >15 kW):
G. Compressors:
    1. Quantity (if not same size, properties required for each)
    2. Suction Temperature deg F:
    3. Power Input kW:
    4. Energy-Efficiency Ratio (EER):
    5. Seasonal Energy-Efficiency Ratio (SEER):
    6. Coefficient of Performance (COP):
H. Gas Furnace:
    1. Airflow CFM:
    2. Minimum AFUE %:
    3. Minimum Thermal Efficiency %:
    4. Minimum Combustion Efficiency %:
    5. Input Btu/h:
    6. Output Btu/h:
    7. Entering-Air Temperature deg F:
    8. Air-Temperature Rise deg F:
I. Electrical Characteristics for Single-Point Connection:
    1. Voltage:

2. Phase:
3. Hertz:
4. Full-Load Amperes:
5. Minimum Circuit Ampacity:
6. Maximum Overcurrent Protection (indicate Fuse or Circuit Breaker):

J. Sound Power: Measured per AHRI 270.

K. Economizer:
1. Single sensor or differential control:
2. Controller model:
3. Two-stage thermostat, with first-stage of cooling wired for economizer:
4. Final changeover temperature or setting:
5. Minimum outdoor airflow:

APPENDIX H: EXECUTION
(INCLUDED FOR HVAC INSTALLATION AND STARTUP)

Examination

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.
B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.
C. Examine roof for suitable conditions where RTUs will be installed.
D. Proceed with installation only after unsatisfactory conditions have been corrected.

Installation

A. Roof Curb: Install on roof structure, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts" and AHRI Guideline B. Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in other Sections. Secure RTUs to upper curb rail according to manufacturer's guidelines and using manufacturer supplied anchoring devices to make air and rain tight connection.
B. Install wind and seismic restraints according to manufacturer's written instructions.
C. Install prominent external tags/decals showing unit number.

Connections

A. Install condensate drain per IMC, with trap and indirect connection to nearest roof drain or area drain, or other location as indicated on the drawings.
B. Install piping adjacent to RTUs to allow service and maintenance.
    1. Gas Piping: Comply with applicable requirements in Division 23 Section "Facility Natural-Gas Piping." Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service. Do not block access to any of the unit panels with the gas piping. Install all factory grommets so that all unit piping penetrations are watertight.
C. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
    1. Install ducts to termination at top of roof curb with a 1-inch minimum duct flange secured to the top of the curb. All duct connections for drop-box diffusers shall be made using bolted transverse connectors. A threaded rod shall be installed from each supporting clip located on each corner of 4-way diffusers and double-nut secured to the bracing supports installed according to the details shown on the Drawings.
    2. The curb shall be installed directly to the joist and the roof decking will be installed by others to be attached to the curb flange.

Field Quality Control

A. Provide customer selectable option for Manufacturer's Field Service: A factory-authorized service representative shall be included in all equipment pricing to the Owner and shall be present when requested to inspect, test, and adjust components, assemblies, and equipment installations, including connections, and to assist in testing startup. Factory-authorized service reps shall be competent technicians prepared to use refrigerant gauges to report unit performance. Report all results in writing.

B. Tests and Inspections by installing contractor prior to engaging factory-authorized service rep. (Part 3.05):
   1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
   2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

D. Install 2-inch pleated Replacement Filter Set: Minimum 90 percent arrestance provided to contractor for installation immediately prior to Building Commissioning.

Startup & Commissioning Service

A. Engage a factory-authorized service representative to perform startup service. The factory technician shall be fully engaged and prepared to record refrigerant pressures and shall coordinate all activity and take direction from the Owner’s commissioning agents.

B. Complete installation and startup checks according to manufacturer's written instructions and do the following:
   1. Inspect for visible damage to unit casing.
   2. Inspect for visible damage to furnace combustion chamber.
   3. Inspect for visible damage to compressor, coils, and fans.
   4. Inspect internal insulation.
   5. Verify that labels are clearly visible.
   6. Verify that clearances have been provided for servicing.
   7. Verify that controls are connected and operable.
   8. Verify that filters are installed.
   9. Clean condenser coil and inspect for construction debris.
   10. Clean furnace flue and inspect for construction debris.
   11. Connect and purge gas line.
   12. Remove packing from vibration isolators.
   13. Inspect operation of barometric relief dampers.
   14. Verify lubrication on fan and motor bearings.
   15. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
   16. Adjust fan belts to proper alignment and tension.
   17. Start unit according to manufacturer's written instructions.
       a. Start refrigeration system.
       b. Check for proper rotation direction of the compressors
       c. Do not operate below recommended low-ambient temperature.
       d. Complete startup sheets and attach copy with Contractor's startup report.
   18. Enable the DDC unit controller’s automated self-check sequence to provide the following diagnostic checks as a start-up commissioning function:
       a. Low Evaporator Air Flow
       b. High Refrigerant Charge
       c. Low Refrigerant Charge
       d. Sensor Failure/Fault (including drifting out of calibration)

e. Equipment Short Cycling
f. Dirty Filter
g. Efficiency does not meet unit rating
h. Capacity does not meet unit rating
i. Economizer Faults
    1) Damper not modulating (stuck damper)
    2) Not economizing when it should
    3) Excess outdoor air
    4) Low ventilation

19. Inspect and record performance of interlocks and protective devices; verify sequences.
20. Operate unit for an initial period as recommended or required by manufacturer.
    a. Gas Heat: Perform the following operations for both minimum and maximum firing. Adjust burner for peak efficiency. Perform tests with the outside air damper closed.
        1) Measure gas pressure on manifold.
        2) Inspect operation of power vents.
        3) Measure combustion-air temperature at inlet to combustion chamber.
        4) Measure flue-gas temperature at furnace discharge.
        5) Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
        6) Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off.
        7) Calculate useful heat to supply air.
    b. Electric Heat: Perform the following operations for all stages of heating.
        1) Measure supply-air temperature and volume for each, and for combined, stages of electric heating.
21. Calibrate thermostats and temperature sensors
22. Adjust and inspect high-temperature limits.
23. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
24. Start refrigeration system and measure and record the following when outdoor ambient is a minimum of 15 deg. F (8 deg. C) above return-air temperature (If outdoor air temperature is too cold, a return trip shall be coordinated to perform these tests at a later date, but proceed with startup without measurements):
    a. Coil leaving-air, dry- and wet-bulb temperatures.
    b. Coil entering-air, dry- and wet-bulb temperatures.
    c. Outdoor-air, dry-bulb temperature.
    d. Outdoor-air-coil, discharge-air, dry-bulb temperature.
25. Inspect controls for correct setpoints, scheduling, sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
26. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
    a. Supply-air volume.
    b. Return-air volume.
    c. Relief-air volume.
    d. Outdoor-air intake volume.
27. Simulate maximum cooling demand and inspect the following:
    a. Compressor refrigerant suction and hot-gas pressures.
    b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.

Air Conditioner

Clothes Dryer

Advantium Microwave

Dishwasher & Disposer

Cooktop

Wall Oven

Kitchen & Dining Room Receptacles

Clothes Washer

Furnace (FAU in Attic)

Garage Door Openers

Master Bath Receptacles

Bathroom Receptacles (Hall & Garage)

Living Room Receptacles

Dishwasher & Disposer

Cooktop

Refrigerator

Kitchen & Island Receptacles

Garage Receptacles

Bathroom Receptacles (Hall & Garage)

Living Room Receptacles

Smoke Detectors

Master Bedroom Receptacles

Middle Bedroom Receptacles

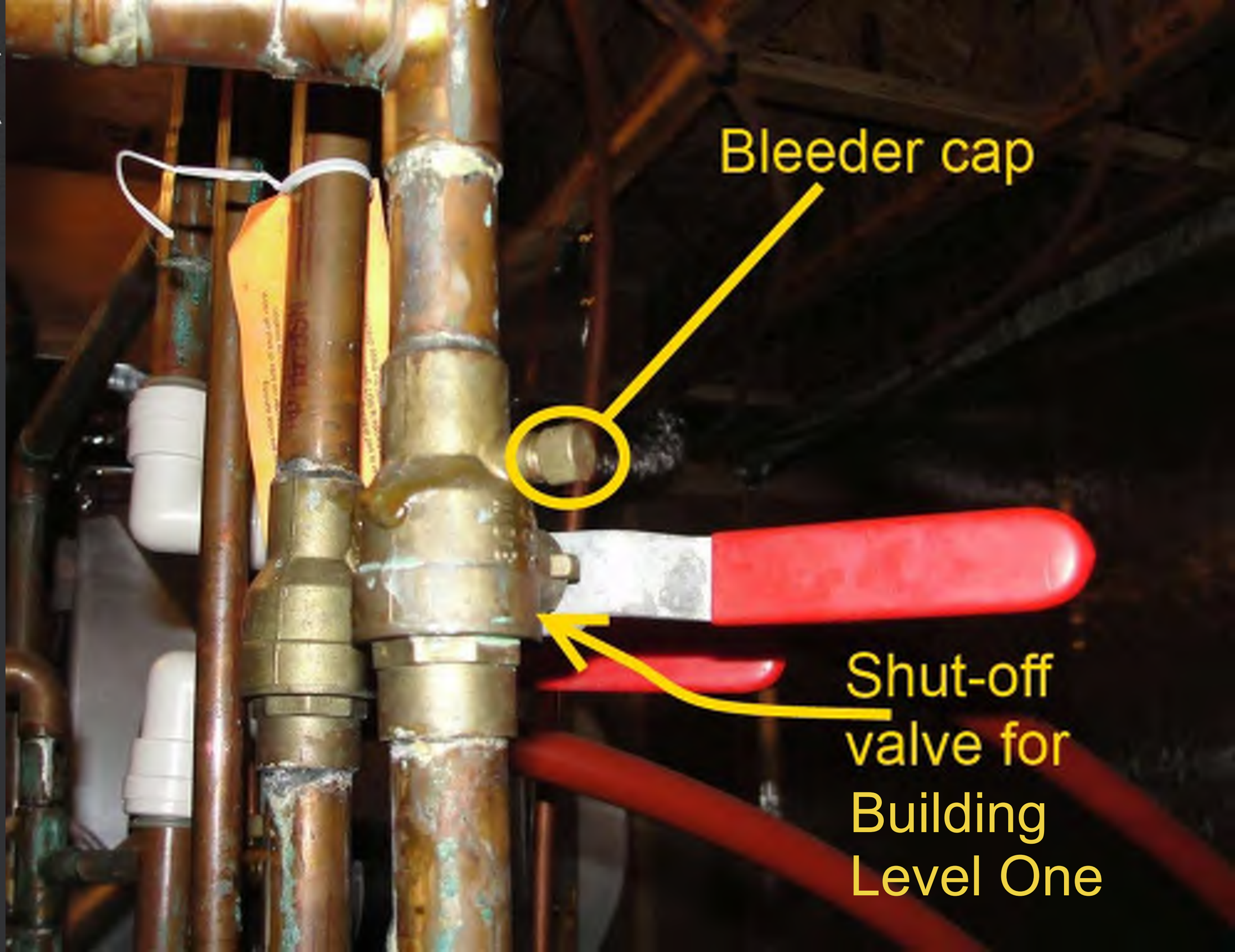
Front Bedroom Receptacles

Bedroom, Bathroom & Kitchen Lights

Garage, Laundry Hall & Porch Lights




Facility
Main Water
Shut-Off


Bleeder cap
Shut-off valve for Building Level One

CAMTECH
MANUFACTURING

EMERGENCY MANAGEMENT PLAN:

CONCEPTS, AUTHORITIES & POLICIES

EMERGENCY MANAGEMENT PLAN

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I. Purpose and Scope

This Emergency Management Plan provides a framework for Camtech Manufacturing's efforts to mitigate, prepare for, respond to, and recover from major emergencies or disasters.

This Plan sets forth overall concepts, authorities and policies. A separate and more detailed companion document (Emergency Response Guide) provides "hands on" information for use by staff when training for and responding to actual emergencies.

Note: Throughout this document there is terminology with specific application in emergencies. The glossary in Appendix A includes commonly used terms.

II. Concepts

This chapter establishes a context for assessing and responding to emergencies.

a) Levels of Activity

Although incidents occur frequently, they rarely have the scope or complexity which requires extraordinary organizational measures. Activation of this Plan, therefore, will be based on the following criteria. If there is disagreement regarding the application of these criteria, the City Manager shall make the determination. (Note: these levels of activation can be triggered not only by incidents within the City, but also by incidents in neighboring jurisdictions when Wilsonville's assistance is requested.)

Level 1: Minor incidents or relatively routine emergencies, which can be addressed by normal organization and procedures of City Departments, do not require implementation of this Plan. Examples of such cases would be an isolated water line break or a temporary power outage.

Level 2: Incidents of special, unusual and/or severe characteristics requiring response by more than one City Department, or which are beyond the scope of available resources, may require partial or full implementation of this Plan. Examples of such cases would be a train derailment, a school evacuation, or prolonged closure of the I-5 bridge.

Level 3: Incidents requiring coordinated response of multiple agencies to save lives and protect the property of a large portion of the community will automatically trigger activation of the City's Emergency Operations Center (EOC) and implementation of this Plan. Examples of such cases would be a flood or severe earthquake.

b) Field versus EOC Activities

Typically the initial response to an emergency is handled by field personnel at the scene of the incident. The gathering area for such field coordination is called the Field Command Post. If/when the incident response expands to the point where the Emergency Operations Center (EOC) is activated, then Incident Command responsibilities are transferred to the EOC. At that point, personnel at the Field Command Post continue to conduct tactical field response activities while maintaining communication with the EOC. It is the role of the EOC staff to manage the overall effort including the setting of incident priorities,

resource allocation, contingency planning, coordination among agencies, and public information.

c) Priorities During Emergencies

During an emergency, the foremost priority is safety of the responders. This is not only in consideration for the person's own welfare, but also to assure that maximum effective effort can be directed toward addressing the emergency. An injured responder is no longer available to deal with the emergency at hand. Furthermore, two or more coworkers are then diverted away from emergency response tasks in order to care for the injured responder. Within this context, the following hierarchy of priorities shall be used by the Incident Commander when establishing objectives and allocating resources.

1. Life Safety
    i. Emergency response personnel
    ii. At-risk populations
    iii. The public at large

2. Incident Stabilization
   (contain the intensity and/or geographical extent of the emergency)

3. Protection of Property and the Environment
   (minimize the overall impact of the emergency)
    i. Essential infrastructure
    ii. Environment with health/safety implications
    iii. Environment in general
    iv. Property in general

d) Continuity of City Operations

The impact of an emergency will vary from one part of the City to another. It is possible, for example, that some properties may suffer severe and long-term disruption while other portions of the City are relatively unaffected or may quickly recover.

Sections a), b) and c) in this chapter of the Plan focus primarily on the emergency itself. Section d) provides guidance regarding continuity of service for those portions of the City which are less impacted by the emergency.

During an emergency, City Departments retain their identity and functions. The Incident Commander, however, has the authority to

reassign City personnel to assist in emergency response. Due to the unusual demands placed on available resources, it may become necessary to temporarily scale back or suspend certain City services. In such cases, service delivery will be based on the following ratings. If there is disagreement regarding the application of these ratings, the City Manager shall make the determination.

Tier 1: Services that must be performed to maintain public health and safety, as well as public trust. Examples of such services include water supply (for drinking and for fire suppression); adequate sanitation; auxiliary power; essential medical care; critical transportation corridors; basic communications capabilities; and maintaining civil authority. Service level in Tier 1 also involves activities required for response and recovery efforts (e.g., inspection of damaged properties, debris removal, environmental remediation).

Tier 2: Services that should be performed to avoid major inconvenience or financial loss to the City, its residents and/or the business community.

Tier 3: Routine services that can be delayed for a short time (one month or less) without serious consequences.

III. Authorities and Responsibilities

This Plan is issued by the Atlanta City Council pursuant to the provisions of Georgia Revised Statutes (GRS) Chapter 401 and City of Atlanta Resolutions No. 1959 and No. 1960. Copies of these documents are contained in Appendices to this Plan.

a) Declaration of Emergency

Under emergency conditions, it may be necessary to depart from standard practices when securing needed resources, conducting response activities, maintaining civil authority, and minimizing injury to persons/property/environment. Resolution No. 1959 identifies the procedures and authorities associated with the declaration of an emergency.

It is the responsibility of the City Council to determine and declare a state of emergency exists. If circumstances make it impractical for the City Council to take timely action, the Mayor may declare a state of emergency. If the Mayor is unavailable for any reason, then the authority to declare an emergency shall pass to the Council President; if such person is unavailable for any reason, then to the City Manager (or person duly designated as Acting City Manager). Ratification by the City Council shall be obtained at the first available opportunity to confirm or amend the provisions of a declared state of emergency.

An emergency declaration shall state in writing:

- the nature of the emergency;
- the geographic boundaries of the area which is subject to emergency controls; and
- any special regulations or emergency powers imposed as a result of the declared emergency.

A declaration of emergency shall be terminated by the City Council when emergency conditions cease to exist.

Whenever an emergency is declared, the City may implement the following measures as reasonably required to protect public health, safety, and welfare:

1. ***Redirect funds*** for emergency use;
2. ***Suspend standard procurement procedures***;
   (Note: Price gouging is prohibited. No person or business may sell or attempt to sell any goods or services for a price in excess of the

"normal market price," which shall mean that person's or business's average of the regular price of the goods or services for the 30 days preceding the state of emergency.)

3. ***Implement mutual aid agreements***;
4. ***Turn off water, gas or electricity***;
5. ***Restrict, regulate or prohibit vehicular or pedestrian traffic***;
6. ***Enter or pass through private property*** for the purpose of responding to the emergency and/or for the conduct of damage assessment;
7. ***Evacuate persons*** from the area designated as an emergency area;
8. ***Establish a curfew*** during specified hours in specified locations;
9. ***Prohibit or limit the number of persons who may gather or congregate*** upon any public street, public place, or any outdoor place within the area designated as an emergency area;
10. ***Prohibit possession of weapons or explosives*** of any kind on public streets, public places or any outdoor place;
11. ***Prohibit or restrict the sale of gasoline*** or other flammable liquids;
12. ***Curtail or suspend commercial activity***;
13. ***Prohibit the sale of alcoholic beverages***;
14. Order such ***other measures as are found to be necessary*** for the protection of life, property, infrastructure, the environment, or for the recovery from the emergency.

b) Chain of Succession

The Chain of Succession for Declaring an Emergency is as follows:

1. Mayor
2. City Council President
3. City Manager
4. Acting City Manager designated by the City Council
5. Deputy City Manager
6. Community Development Director
7. Building Official
8. City Engineer
9. Such other City Manager who by time and existent circumstances is the only person available or is designated at such time by the then available city managers.

c) City Council Role and Responsibilities

During emergencies, the role of the Mayor and Councilors is primarily that of liaison with the public and with the elected officials of other affected or assisting jurisdictions. Responsibilities include:

- formal declaration/ratification of a state of emergency;
- status reports to residents, local businesses, and the media (with information provided through the Incident Commander);
- assistance in securing/coordinating volunteers (as requested by the Incident Commander);
- maintaining communications with elected officials of other jurisdictions that are directly or indirectly impacted by the emergency; and
- formally terminating the declared state of emergency when emergency conditions cease to exist.

d) Staff Roles, Responsibilities and Reporting Relationships

During normal operating conditions and/or Level 1 emergencies, staff duties and accountability are as defined in each employee's job description.

During Level 2 and Level 3 emergencies, the duties and accountability of staff involved in response or recovery activities will be as defined within the Incident Command System (ICS) structure. As such, individual employees may be assigned roles, responsibilities, and reporting relationships which differ from the day-to-day work defined in their City job descriptions.

All employees are encouraged to foster emergency preparedness at home. During emergencies it is the responsibility of each City employee to first ensure their own safety and the safety of their family. It is then the responsibility of each City employee to make him/herself available for duty as needed in the emergency response effort. In the event of a Level 2 or Level 3 emergency whereby telephone or pager service is interrupted, all pre-designated personnel on the Incident Management Team are to report to the Emergency Operations Center.

For large-scale and/or prolonged emergencies, it will be necessary to rotate staff through multiple shifts. The type and level of response will be situational, as will the availability of City staff. To expedite communication and development of incident-specific staffing plans, the City's Human Resources Director is responsible for maintaining accurate employee contact information, and for having such information available in a secure location within the Emergency Operations Center. It is also

the responsibility of each City Department Director to maintain this contact information for employees of their respective Departments.

The City shall have an Emergency Management Coordinator as designated by the City Manager. The Emergency Management Coordinator is responsible for:

- preparing and updating the City's Emergency Management Plan and Emergency Response Guide;
- assuring the City's Emergency Operations Center remains in a continual state of readiness;
- conducting preparedness exercises and implementing relevant training for City staff; and
- coordinating the City's emergency management program with the emergency preparedness efforts of other jurisdictions and emergency response organizations.

e) Interagency Support and Coordination

Other organizations play a key role addressing emergencies that may occur within the City of Wilsonville. As a general rule, the City will look to the following agencies as having primary responsibility for the various functions as noted.

Clackamas County Sheriff. To provide law enforcement services on behalf of the City of Wilsonville, and to coordinate with other law enforcement agencies as appropriate. In addition to these primary response roles, the Clackamas County Sheriff's Office will assign a representative to the Operations Section of Wilsonville's EOC whenever activated.

Tualatin Valley Fire & Rescue (TVF&R). To address fires, explosions, hazardous materials, rescues, and pre-hospital medical care. In addition to these primary response roles, TVF&R will assign a representative to the Operations Section of Wilsonville's EOC whenever activated.

Clackamas County Office of Emergency Management. To provide county-wide allocation of limited resources; to secure state and federal emergency response resources as needed; and to coordinate county-wide public information. (Note: Should the emergency involve the portion of Wilsonville located within Washington County, then the Washington County Emergency Operations Center may also be involved in these functions.)

American Red Cross. To direct emergency shelter operations, including provisions for housing, food, clothing, necessities for persons with special needs, and welfare inquiry services.

Atlanta Amateur Radio Emergency Services (ARES). This volunteer organization is trained and equipped with HAM radio technology to supplement the City's communications systems, and to provide backup communication capabilities.

Mutual Aid Organizations. To provide equipment, supplies and/or personnel for assignment by the Incident Commander in support of emergency response/recovery efforts.

Others. Depending on the emergency at hand, other organizations may also have primary responsibility for aspects of the response and/or recovery effort. Such organizations may involve private and not-for-profit sectors, as well as County and State social service agencies. Specific needs/assignments will be determined through the Incident Command function on a case-by-case basis.

IV. Policies

The following policies enable the City to make effective use of available resources in its efforts to minimize the effects of emergencies.

a) ***Essential Services.*** Essential City services will be maintained as long as conditions permit.

b) ***Principle of Self-Help.*** The City will use all available local and mutual aid resources prior to requesting County or State support of emergency operations.

c) ***National Incident Management System (NIMS).*** The City will use the National Incident Management System (NIMS) as the basis for coordination among emergency response providers.

d) ***Incident Command System (ICS).*** The City will use the Incident Command System (ICS) as the basis for establishing its organizational structure in response to the demands of any given emergency.

e) ***Access to Emergency Services.*** Emergency services shall not be denied on the grounds of race, color, national origin, sex, age, handicap, marital status, or religious or political affiliation. To the extent possible, the needs of special populations shall be taken into account when conducting emergency response operations. Such special populations may include, but are not limited to: physically or mentally disabled; non-English speakers; the aged or infirm; and the incarcerated.

f) ***Cancellation of Leave.*** As deemed necessary by the City Manager, the declaration of an emergency nullifies leaves and vacations.

g) ***Emergency Response Guide.*** The City will prepare and regularly update an Emergency Response Guide based on the concepts, authorities, and policies presented in this Emergency Response Plan. The Emergency Response Guide will designate Incident Command System functions and corresponding staffing assignments. The Guide will also contain "hands on" reference materials for use by staff in emergencies.

h) ***Emergency Operations Center (EOC).*** The City will maintain a properly equipped site from which the City's Incident Management Team can direct emergency response activities.

i) ***Preparedness and Training.*** The City will exercise its emergency response system (or pertinent portions thereof) at least once per year. Based on these exercises, appropriate training will be identified and implemented.

j) ***Mitigation and Recovery.*** While the focus of this Plan is largely on the *response* phase of an emergency, the City will seek to prevent or minimize disaster impact throughout the preparation and recovery phases as well.

APPENDIX A:

Glossary of Terms

The definitions below convey the intent and meaning of terms as used in Wilsonville's Emergency Management Plan.

Disaster
Any hurricane, tornado, storm, flood, high water, wind-driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, drought, fire, explosion, or other catastrophe in any part of the United States which, in the determination of the President, causes damage of sufficient severity and magnitude to warrant Major Disaster assistance under PL 93-288, above and beyond emergency services by the federal government, to supplement the efforts and available resources of states, local governments, and disaster relief organizations in alleviating the damage, loss, hardship or suffering caused thereby. (PL 93-288).

Emergency
Any event whereby extraordinary measures must be taken to save lives; protect public health, safety and welfare; minimize destruction of property or the environment; or avert or lessen the threat of a major disaster.

Emergency Management Coordinator
The individual who has primary responsibility for developing and updating the City's emergency management program documents, conducting preparedness and training activities, and coordinating preparedness activities with other emergency response organizations. The Emergency Management Coordinator is so designated by the City Manager.

Emergency Management Plan
A document which discusses the concepts, authorities, and policies governing the way the City categorizes and addresses emergencies. The Emergency Management Plan will be reviewed annually to assure the overall direction provided by the Plan remains appropriate to meet the City's ongoing needs.

Emergency Operations Center (EOC)
The site from which the City's Incident Management Team coordinates the City's response, allocates City resources, and coordinates with other organizations during an emergency.

Emergency Response Guide
A document providing detailed information regarding the functions, organizational structure, lines and methods of communication, and "fingertip" reference materials for use by staff involved in addressing emergencies. The Emergency Response Guide is based on the overall direction provided by the Emergency Management Plan. Due to changes in the workforce, employee contact information, resource listings, and other pertinent information, updates to the Emergency Response Guide occur at least annually. Such revisions are conducted administratively and do not require City Council action.

Field Command Post
The field location from which tactical operations are conducted. Staff at the field Command Post are communicate with people in the Emergency Operations Center (EOC) if activated. Field Command Post personnel direct field response activities using whatever resources are authorized. EOC staff, when activated, manage the overall effort including the setting of incident priorities, resource allocation, contingency planning, coordination among agencies, and public information.

Incident Command System (ICS)
A standardized, all-hazard incident management concept used to provide effective incident management through the identification of specific functional roles, responsibilities, and chain of command. Used throughout the United States, this organizational structure has the flexibility to rapidly expand and contract in response to incident needs.

Incident Commander (IC)
The individual responsible for the overall management of the incident. Note: the person designated as the IC may change during the course of the incident. If/when this happens, the duties and authorities of the IC pass to the designated individual.

Incident Management Team
The group of City individuals, so designated in the Emergency Response Guide, who staff the Emergency Operations Center and direct the City's response during an emergency.

National Incident Management System (NIMS)
A comprehensive, national approach to incident management that is applicable to all jurisdictional levels and across functional disciplines. This system, established by Homeland Security Presidential Directive 5, provides a consistent nationwide template to enable all government, private-sector, and non-governmental organizations to work together during domestic incidents.

APPENDIX B: Excerpts from Oregon Revised Statues (ORS) Chapter 401

The following excerpts provide the statutory authority upon which Camtech Manufacturing's Emergency Management Plan is based.

401.015 Statement of policy and purpose. " . . . It is declared to be the policy and intent of the Legislative Assembly that preparations for emergencies and governmental responsibility for responding to emergencies be placed at the local government level. The state shall prepare for emergencies, but shall not assume authority or responsibility for responding to such an event unless the appropriate response is beyond the capability of the city and county in which it occurs, the city or county fails to act, or the emergency involves two or more counties."

401.305 Emergency management agency of city or county; emergency program manager; coordination of emergency management functions. "Each county of this state shall, and each city may, establish an emergency management agency which shall be directly responsible to the executive officer or governing body of the county or city. The executive officer or governing body of each county and any city which participates shall appoint an emergency program manager who shall have responsibility for the organization, administration and operation of such agency, subject to the direction and control of the county or city. . . Each emergency management agency shall perform emergency program management functions within the territorial limits of the county or city and may perform such functions outside the territorial limits as required under any mutual aid or cooperative assistance agreement or as authorized by the county or city."

401.309 Declaration of state of emergency by local government. "Each county, city or other municipal corporation in this state may, by ordinance or resolution, establish procedures to prepare for and carry out any activity to prevent, minimize, respond to or recover from an emergency. The ordinance or resolution shall describe the conditions required for the declaration of a state of emergency within the jurisdiction and the agency or individual authorized to declare that a state of emergency exists."

401.315 City or county authorized to incur obligations for emergency services. "In carrying out the provisions of GRS 401.015 to 401.105, 401.260 to 401.325 and 401.355 to 401.580, counties or cities may enter into contracts and incur obligations necessary to mitigate, prepare for, respond to or recover from emergencies or major disaster."

401.325 Emergency management agency appropriation; tax levy. "(1) Each county and city may make appropriations, in the manner provided by law for making appropriations for the expenses of the county or city, for the payment of expenses of its emergency management agency and may levy taxes upon the taxable property within the county or city.

(2) An appropriation made under subsection (1) of this section shall be budgeted so that it is possible to identify it as a distinguishable expense category."

401.480 Cooperative assistance agreements. The state, counties and cities may, in collaboration with public and private agencies, enter into cooperative assistance agreements for reciprocal emergency aid and resources. [1983 c.586 §15]

401.490 Mutual use of supplies and services. In carrying out the provisions of ORS 401.015 to 401.105, 401.260 to 401.325 and 401.355 to 401.580, the Governor and the executive officers or governing bodies of the counties and cities may request and utilize the services, equipment, supplies and facilities of existing departments, offices and agencies of the state and of local governments. The officers and personnel of all local government departments, offices and agencies may cooperate with, and extend such services and facilities to the Governor, to the Office of Emergency Management and to emergency management agencies and emergency service agencies upon request. [1983 c.586 §16]

401.505 Acceptance of aid for emergency services. Whenever any organization, agency, person, firm, corporation or officer thereof offers to the state or to any county or city, services, equipment, supplies, material or funds by way of gift, grant or loan for purposes of emergency program management or emergency services, the state, acting through the Governor, or the county or city, acting through its executive officer or governing body, may accept the offer. Upon acceptance, the Governor or executive officer or governing body of a county or city, as the case may be, may authorize any officer thereof to receive the services, equipment, supplies, materials or funds on behalf of the state, county or city, subject to the terms of the offer and any rules of the agency making the offer. [1983 c.586 §19]

APPENDIX C:

Resolution No. 1959
Declaration of Emergency

RESOLUTION NO. 1959

A RESOLUTION REPLACING RESOLUTION NO. 1589 AND PROVIDING FOR AUTHORITY TO DECLARE A STATE OF EMERGENCY AND IMPOSE EMERGENCY MEASURES.

WHEREAS, Georgia Revised Statutes (GRS) 401.309 provides for cities to establish by ordinance or resolution "the conditions required for the declaration of a state of emergency within the jurisdiction and the agency or individual authorized to declare that a state of emergency exists"; and

WHEREAS, Georgia Revised Statutes (GRS) 401.305 et seq. grant general and specific powers to cities to respond to emergencies; and

WHEREAS, in August of 1999 the City Council adopted Resolution No. 1589 known as the "Atlanta State of Emergency Resolution"; and

WHEREAS, since 1999 the City has participated in several emergency preparedness exercises and as a result has continued to refine and revised its emergency management program; and

WHEREAS, additions and clarifications to the "Atlanta State of Emergency Resolution" would enable better coordination and implementation of emergency operations;

NOW, THEREFORE, THE CITY OF ATLANTA RESOLVES AS FOLLOWS:

1. **Short Title.** This resolution replaces Resolution No. 1589 and shall be known as the "Atlanta State of Emergency Resolution" and may be so cited and pled.
2. **Purpose.** The purpose of this resolution is to provide a procedure to minimize injury to persons, property, and the environment and to preserve the established civil authority in the event that a state of emergency exists within the City of Atlanta. It is intended to grant as broad a power as permitted by statutory and constitutional authority.
3. **Definition of Emergency.** A state of emergency exists whenever any part of the City of Atlanta is suffering or in imminent danger of suffering from a

tornado, storm, flood, high water, wind-driven water, earthquake, volcanic eruption, landslide, mudslide, snow or ice storm, drought, fire, explosion, health hazard, infestation, toxic substance, civil disorder, disruption of community services, or any other catastrophe whereby extraordinary measures must be taken to save lives; protect public health, safety and welfare; minimize destruction of property or the environment; or avert or lessen the threat of a major disaster.

4. **Authority.** Under Georgia Revised Statutes (GRS) Chapter 401, local jurisdictions have the authority and responsibility for responding to emergencies.

5. **Declaration of Emergency.**

   A. When in the judgment of the City Council a state of emergency exists, the City Council shall so declare in writing and publicize the existence of same. If circumstances make it impractical or prohibitive for the City Council to take timely action, the Mayor may declare a state of emergency provided that the approval of a majority of the City Council is sought and obtained at the first available opportunity after order has been restored and the emergency has subsided.

   B. If the Mayor is unavailable for any reason, then the authority to declare an emergency shall pass to the Council President; if such person is unavailable for any reason, then to the City Manager (or person duly designated as Acting City Manager); if such person is unavailable, then to the order of succession as provided in the City's Emergency Management Plan. Ratification by a majority of the City Council shall be sought and obtained at the first available opportunity to confirm or amend the provisions of a declared state of emergency.

   C. An emergency declaration shall state in writing:

      i. the nature of the emergency;

      ii. the geographic boundaries of the area which is subject to emergency controls; and

iii. any special regulations or emergency powers imposed as a result of the declared emergency.

6. **Regulation and Control.** Whenever the circumstances arise upon which a state of emergency has been declared to exist within the City of Atlanta, the powers, actions, and authorities set forth in the City's Emergency Management Plan shall be in effect. The City Council is empowered to order and enforce the measures listed herein. However, if circumstances prohibit the timely action of the City Council, the Mayor, or his/her successor as set forth in Section 5, may order emergency measures, provided that approval from a majority of the City council is sought and obtained at the first available opportunity. Such emergency measures shall include, but not be limited to:

   A. Redirect funds for emergency use.
   B. Suspend standard procurement procedures to obtain necessary goods, services and/or equipment. However, price gouging shall be prohibited. No person or business may sell or attempt to sell any goods or services for a price in excess of the "normal market price," which shall mean that person's or business's average of the regular price of the goods or services for the 30 days preceding the state of emergency.
   C. Implement mutual aid agreements.
   D. Turn off water, gas or electricity.
   E. Restrict, regulate or prohibit vehicular or pedestrian traffic for such distance or degree as may be deemed necessary under the circumstances.
   F. Enter or pass through private property for the purpose of responding to the emergency and/or for the conduct of damage assessment.
   G. Evacuate persons from the area designated as an emergency area.
   H. Establish a curfew during specified hours in specified locations.
   I. Prohibit or limit the number of persons who may gather or congregate upon any public street, public place, or any outdoor place within the area designated as an emergency area.
   J. Prohibit possession of weapons or explosives of any kind on public streets, public places or any outdoor place.

K. Prohibit or restrict the sale of gasoline or other flammable liquids.

L. Curtail or suspend commercial activity.

M. Prohibit the sale of alcoholic beverages.

N. Order such other measures as are found to be necessary for the protection of life, property, infrastructure, the environment, or for the recovery from the emergency.

7. **Acquisition of Resources.** Under this section, the City Council is authorized to extend government authority to non-governmental resources (i.e. personnel, equipment) which may support regular government forces during an emergency and may enter into agreements with other public and private agencies for use of resources. When real or personal property is taken under power granted by this section, the owner of the property shall be entitled to reasonable compensation.

   Under the provisions of GRS Chapter 401, state resources are available when the appropriate response to an emergency is beyond the capability of the county in which it occurs.

8. **Penalty.**

   A. Any person, firm, corporation, association or entity that violates any emergency measure taken by the City Council under authority of this Ordinance shall be subject, upon conviction, to a fine of not more than $500.00 per offense.

   B. Each day of violation shall be deemed a separate offense for purposes of imposition of penalty.

   C. Where the Georgia Revised Statutes provide for a penalty for the act, commission or omission, the penalty prescribed herein shall be no greater than prescribed by said Georgia Revised Statutes.

9. **Responsibility for Emergency Management.** For the purpose of this resolution, in accordance with GRS Chapter 401, the emergency management agency of the City of Atlanta shall be the Incident Management Team as set forth in the City's Emergency Response Guide.

10. Separability. If any section, subsection, sentence, clause, phrase or portion of this resolution is, for any reason, held invalid or unconstitutional by a Court of competent jurisdiction, such portion shall be deemed a separate, distinct and independent provision, and such holding shall not affect the validity of the remaining portions of this resolution.

ADOPTED by the City Council of the City of Atlanta at a regular meeting thereof this 25th day of April, 2017, and filed with the Atlanta City Recorder this same date.

Charlotte Lehan

CHARLOTTE LEHAN, Mayor

ATTEST:

Sandra C. King

Sandra C. King, CMC, City Recorder

SUMMARY OF VOTES:
Mayor Lehan
Council President Kirk
Councilor Knapp
Councilor Holt
Councilor Scott-Tabb

APPENDIX D:

Resolution No. 1960 Adopts National Incident Management System (NIMS) and Incident Command System (ICS)

RESOLUTION NO. 1960

A RESOLUTION ADOPTING THE USE OF THE NATIONAL INCIDENT MANAGEMENT SYSTEM (NIMS) AND THE INCIDENT COMMAND SYSTEM (ICS) FOR COORDINATED RESPONSE TO EMERGENCIES.

WHEREAS, response to and recovery from major emergencies and disasters requires integrated management and coordination; and

WHEREAS, the President directed the Secretary of the Department of Homeland Security to develop and administer a National Incident Management System (NIMS) to standardize and enhance incident management procedures nationwide; and

WHEREAS, the National Incident Management System provides a structure and process to effectively coordinate responders from multiple disciplines and levels of government and to integrate them with resources from the private sector and non-governmental organizations; and

WHEREAS, the Incident Command System (ICS) is a standardized, all-hazard incident management concept and is a key component in the National Incident Management System; and

WHEREAS, use of the National Incident Management System and Incident Command System will improve the City of Atlanta's ability to manage major emergencies and disasters; and

WHEREAS, failure to adopt and use the National Incident Management System may preclude the City of Atlanta from receiving federal preparedness grants or reimbursement for costs expended during major emergency and disaster response and recovery operations;

NOW, THEREFORE, THE CITY OF ATLANTA RESOLVES AS FOLLOWS:

1. The City of Atlanta hereby adopts the National Incident Management System as the foundation for incident command, coordination and support activities.
2. The City of Atlanta hereby adopts the Incident Command System as the basis for establishing its organizational structure to address emergencies.

3. It shall further be the policy of the City of Atlanta to provide appropriate training on the National Incident Management System and the Incident Command System to personnel responsible for managing and/or supporting major emergency and disaster operations.

ADOPTED by the City Council of the City of Atlanta at a regular meeting thereof this 25th day of April, 2017, and filed with the Atlanta City Recorder this same date.

Charlotte Lehan

CHARLOTTE LEHAN, Mayor

ATTEST:

Sandra C. King

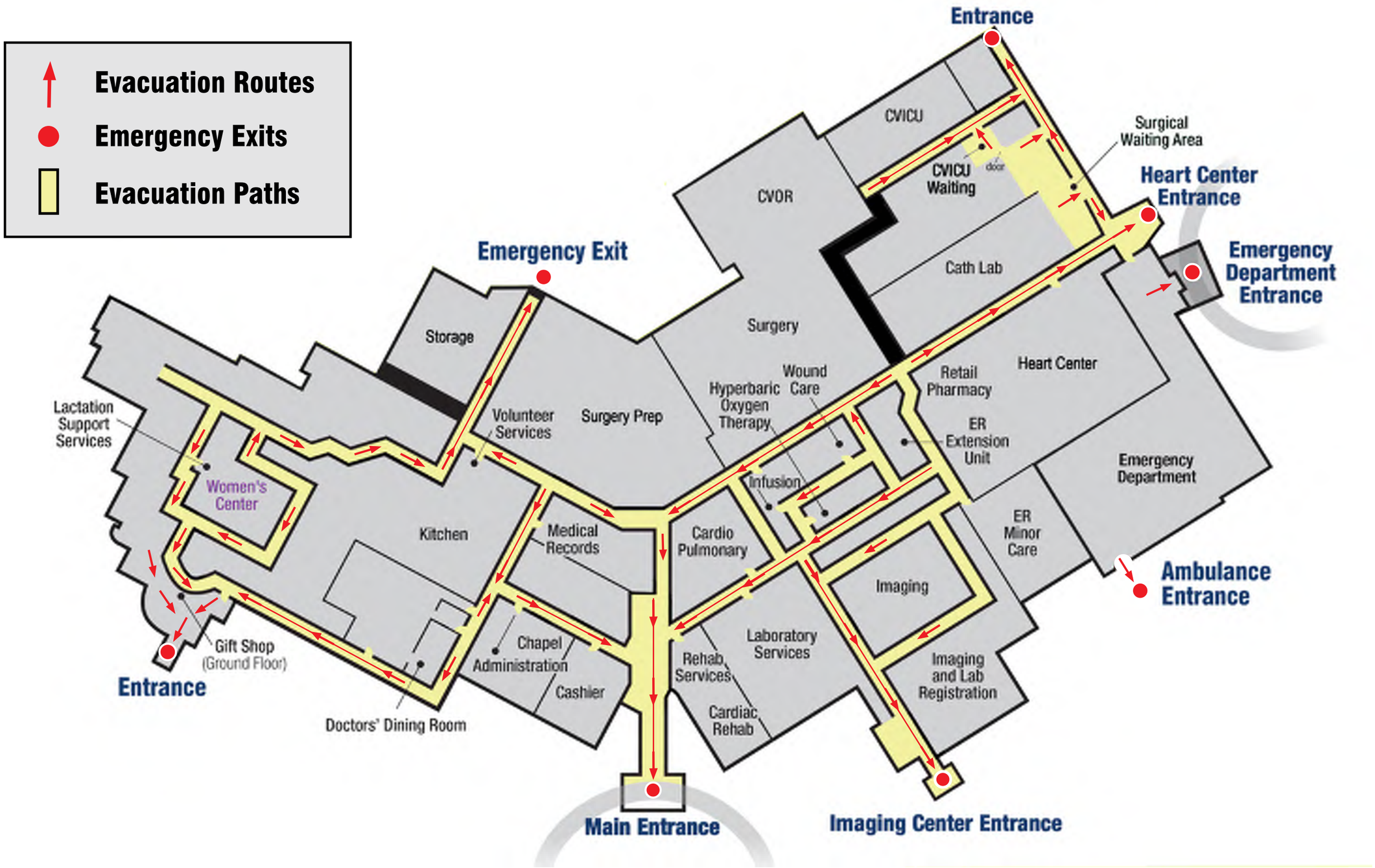
Sandra C. King, CMC, City Recorder

SUMMARY OF VOTES:
Mayor Lehan
Council President Kirk
Councilor Knapp
Councilor Holt
Councilor Scott-Tabb

CAMTECH
MANUFACTURING

BUILDING 7

7809 Industrial Boulevard, Atlanta, GA 30301



CAMTECH
MANUFACTURING

SAFE REFUGE AREA MAP

7809 Industrial Boulevard, Atlanta, GA 30301



EMERGENCY CONTACTS

CITY OFFICES

City Hall	404-682-1011
Community Center	404-682-3727
Library	404-682-2744
Public Works	404-682-4092
Parks & Recreation	404-783-7529
Fleet	404-682-1160
Transit ~ SMART	404-682-7790
Water Treatment Plant	404-582-9655
Wastewater Treatment Plant	404-682-1077

COUNTY

Fulton County

Canby Ferry	404-650-3030
Transportation - Holly Covington	404-557-6391
Electrician - Dorian Libal	404-650-3711 (M) 404-621-4208
Sign Shop- Sean	404-650-3357
Roads	404-846-7623
Signals	404-846-7626

STATE

ODOT

Salem Maint Coord	404-551-7166
Jeff Sorenson - Office	404-986-2887
Fax	404-986-5835
Baldock Rest Area	404-229-5303
South Exit	404-731-3322
North Exit	
Signals - TMOC	404-283-5859
Landscape Maint	404-229-5304
Milwaukie Maint Coord	
Ted Miller	404-653-3124
CDF&W	404-657-2000
Georgia Water Resources	404-378-8455

POLICE

Fulton County

Dispatch	404-655-8211
C-Com	404-655-8411
Back Line Dispatch	404-655-8911
Sheriff's Office	404-655-8218
Atlanta Police	404-682-1012
County Police	404-846-7661
State Police	800-731-3030

FIRE

TVF&R

Dispatch	404-629-0111
Elligsen Station	404-682-0306
Kinsman Station	404-682-0369

RAILROAD

Southern Pacific

Signals - Howard Sanders	(M) 404-816-8011 404-681-7941

DEQ

CA DEQ Emergency Response	800-452-0311
Pollution Report	404-229-5393
Chemtech	404-424-9300
Chlorine Leak	911

CAMTECH

MANUFACTURING

1/2" WHITE QUICK RESPONSE RECESSED PENDENT SPRINKLER 165°F - "K" FACTOR 5.6 - VIKING MICROFAST MODEL "M" (SIN VK302) WITH MICROMATIC MODEL "E-1" RECESSED WHITE ESCUTCHEON.

R 1/2" WHITE RESIDENTIAL RECESSED PENDENT SPRINKLER 155°F - "K" FACTOR 5.5 - VIKING RESIDENTIAL MODEL "M-5" (SIN VK432).

R 1/2" WHITE RESIDENTIAL HORIZONTAL SIDEWALL SPRINKLER 155°F - "K" FACTOR 5.5 - VIKING MICROFAST MODEL "M-5" (SIN VK442).

DS 1/2" WHITE QUICK RESPONSE RECESSED HORIZONTAL DRY SIDEWALL SPRINKLER 155°F - "K" FACTOR 8.0 - VIKING (SIN VK279).

1/2" WHITE QUICK RESPONSE CONCEALED SIDEWALL SPRINKLER 165°F - "K" FACTOR 5.6 - VIKING WITH COLOR OF COVER PLATE TO BE DETERMINED BY ARCHITECT 135°F (SIN VK481). PROVIDE ADDITIONAL 15% SUPPLY OF COVER PLATES.

1/2" WHITE QUICK RESPONSE CONCEALED PENDENT SPRINKLER 165°F - "K" FACTOR 5.6 - VIKING HORIZON MIRAGE "B-2" WITH COLOR OF COVER PLATE TO BE DETERMINED BY ARCHITECT 135°F (SIN VK462). PROVIDE ADDITIONAL 15% SUPPLY OF COVER PLATES.

1/2" BLACK STANDARD RESPONSE UPRIGHT SPRINKLER 155°F - "K" FACTOR 5.6 - VIKING MICROFAST MODEL "M" (SIN VK300) POLYESTER COATED.

1/2" WHITE ADJUSTABLE QUICK RESPONSE CONCEALED DRY PENDENT SPRINKLER 155°F - "K" FACTOR 5.6 - STANDARD COVERAGE RELIABLE MODEL "F3QR" WITH WHITE COVER PLATE 135°F (SIN R5714). PROVIDE ADDITIONS 15% SUPPLY OF COVER PLATES.

BRANCH PIPING
MAIN PIPING
PRESSURE GAUGE
O.S. & Y. GATE VALVE WITH TAMPER SWITCH
FLOW SWITCH
STANDPIPE
F.C. FLUSHING CONNECTION
PIPE CAPPED
PIPE BELOW
PIPE ABOVE
PIPE BELOW
DRAWING REFERENCE NOTE
POINT OF CONNECTION

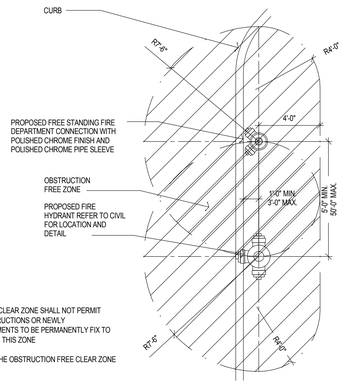
J | SCALE: N.T.S.

F | FIRE PROTECTION SYMBOL LEGEND | SCALE: N.T.S.

1. FIRE PROTECTION SYSTEM TO COMPLY WITH NFPA # 13, 14, 20, 24, 25, 2001 AND ALL APPLICABLE STATE AND LOCAL CODES.
2. FINAL INSPECTION AND APPROVAL BY LOCAL FIRE DEPARTMENT, BLDG. DEPT., AND ARCHITECT/ENGINEER.
3. A VISIT TO THE SITE TO CHECK AND VERIFY ALL EXISTING CONDITIONS PRIOR TO BIDDING TO INSURE THE COORDINATION OF THE FIRE SERVICES WITH EXISTING CONDITIONS.
4. CUTTING OF STRUCTURAL AND/OR ARCHITECTURAL MEMBERS TO BE DONE ONLY WITH THE WRITTEN APPROVAL OF THE ARCHITECT AND STRUCTURAL ENGINEER.
5. PIPE ROUTING SHOWN SHALL BE USED AND ANY ADDITIONAL OFFSETS OR FITTINGS REQUIRED FOR PROPER INSTALLATION, COORDINATION WITH OTHER TRADES, AND/OR TO MAINTAIN PROPER CLEARANCES SHALL BE PROVIDED. VERIFY STRUCTURAL, MECHANICAL, ELECTRICAL INSTALLATIONS AND AVOID ALL OBSTRUCTIONS OR INTERFERENCES.
6. REFER TO ARCHITECTURAL REFLECTED CEILING PLANS AND ELECTRICAL LIGHTING DRAWINGS FOR CEILING DESCRIPTIONS AND HEIGHTS.
7. FLOW TEST DATA IS 71 PSI STATIC PRESSURE WITH RESIDUAL PRESSURE OF 59 PSI @ 1870 GPM PERFORMED BY MILWAUKEE WATER WORKS ON 05/25/2006CONTRACTOR SHALL PER PERFORM UP TO DATE FLOW TEST AS PART OF HYDRAULIC CALCULATIONS
8. FIRE STOP ALL PENETRATIONS OF SMOKE/FIRE WALLS, CEILINGS, FLOORS, ROOFS, ETC., FLASH AND COUNTERFLASH ROOF PENETRATIONS.
7. PROVIDE ACCESS PANELS TO ALL VALVES ABOVE NON-ACCESSIBLE CEILINGS AND CHASES.
8. SPRINKLER HEADS ARE TO BE COORDINATED WITH ALL DIFFUSERS, SPEAKERS, LIGHTING FIXTURES, CEILING SYSTEMS AND STRUCTURAL SYSTEM.
9. INDICATE CENTER-TO-CENTER DIMENSIONS AND/OR PIPE CUT LENGTHS AND NOMINAL PIPE DIAMETERS ON ALL PIPING.
10. INDICATE PIPE TYPE, SCHEDULE OF WALL THICKNESS AND METHOD OF JOINING ON SHOP DRAWING.
11. PROVIDE STOCK OF EXTRA SPRINKLERS IN ACCORDANCE WITH N.F.P.A.-13.
12. PROVIDE DETAIL AND INDICATE TYPE OF HANGER TO BE INSTALLED FOR SPRINKLER PIPING. METHODS OF HANGING PIPES, HEADERS AND BRANCHES SHALL BE IN ACCORDANCE WITH N.F.P.A. 13. HANGERS SHALL NOT INTERFERE WITH ANY OTHER TRADE. POWDER DRIVEN STUDS SHALL NOT BE USED.
13. ALL GROOVED & SCREWED FITTING SHALL BE APPROVED PRIOR TO ANY INSTALLATION BY ENGINEER WHO RESERVES THE RIGHT TO DISAPPROVE ANY FITTING.
14. ALL SPRINKLER PIPING & FITTINGS SHALL BE INSTALLED RUST-FREE.
15. AUTOMATIC SPRINKLER TEMPERATURE RATINGS OF GLASS BULB ELEMENTS TO BE IN ACCORDANCE WITH N.F.P.A. 13. ALL SPRINKLERS SHALL HAVE CORROSIVE-RESISTANT COATING.
16. ALL VALVES FOR FIRE SERVICE SHALL BE LISTED BY THE UNDERWRITER'S LABORATORIES, INC. AND THE FACTORY MUTUAL LABORATORIES. VALVES SHALL BE FACTORY MARKED "UL" AND "FM", 175 WORKING PRESSURE, AND 300 WORKING PRESSURE WHERE APPLICABLE.
17. ALL VALVES ON THE FIRE PROTECTION SYSTEM TO BE ELECTRICALLY SUPERVISED. TYPE AND EXACT LOCATION OF FLOW AND SUPERVISORY SWITCHES SHALL BE ACCOMPLISHED/COORDINATED BETWEEN THE DIFFERENT RESPONSIBLE TRADES. ADDITIONAL WIRING OR ADDITIONAL SWITCHES REQUIRED SHALL BE PROVIDED.
18. BE ADVISED THAT PIPING SHOWN IS ARRANGED TO ALLOW FOR FIRE ALARM ZONING. FIRE PROTECTION PIPING ARRANGEMENT SHALL REFLECT AND ALLOW SAME ZONING AS SHOWN.
19. CAUTION: FINAL SPRINKLER SHOP DRAWINGS SHALL BE SUBMITTED TO ENGINEER THROUGH ARCHITECT. NO INSTALLATION SHALL BE PERMITTED UNTIL SPRINKLER SHOP DRAWINGS HAVE BEEN APPROVED.
20. SPRINKLERS SHALL COVER THE ENTIRE AREA OF ALL STRUCTURAL MEMBERS. SPRAY SHALL NOT BE BLOCKED BY WALLS, PARTITIONS OR STRUCTURAL COMPONENTS.
21. IMMEDIATELY NOTIFY THE ARCHITECT/ENGINEER OF ANY DISCREPANCIES FOUND BETWEEN THESE PLANS, OTHER ENGINEERING PLANS, THE ARCHITECTURAL PLANS AND/OR FIELD CONDITIONS PRIOR TO FINAL BID PRICE OR FINAL PERMITTING.
22. IN CASE OF DISPUTE OR DOUBT AS TO INTENT OF DRAWINGS OR SPECIFICATIONS, OBTAIN ARCHITECT/ENGINEER'S WRITTEN DECISION BEFORE PROCEEDING WITH BID INVOLVED.
23. BEFORE SUBMITTING PROPOSAL OR BID, EXAMINE ALL DRAWINGS AND SPECIFICATIONS RELATING TO THIS PROJECT, THE AMOUNT OF SPACE AVAILABLE FOR PIPING, EQUIPMENT AND CONNECTING SERVICES, THE SITE OF THE WORK, THE REQUIREMENTS TO CORRELATE THE FIRE PROTECTION WORK WITH THAT OF OTHER TRADES AND THE TIME SCHEDULE NECESSARY TO PERFORM THAT WORK.
24. AFTER EXAMINATION OF ALL PLANS AND SPECIFICATIONS, INCLUDE ALL THE COSTS NECESSARY FOR ALTERATION, MODIFICATIONS AND/OR ADDITIONS TO THE FIRE PROTECTION SYSTEM(S) NECESSARY TO MAKE A COMPLETE, APPROVED AND FINISHED INSTALLATION IN ALL ASPECTS. IT IS THE INTENT THAT ALL COSTS REQUIRED BE INCLUDED IN THE BID OF THIS TRADE.
25. PIPE SHALL BE REAMED AND CLEANED BEFORE ASSEMBLY, AND AFTER ASSEMBLY. THE ENTIRE PIPING SYSTEM SHALL BE FLUSHED CLEAN.
26. ADJUST NEW/EXISTING SPRINKLER PIPING AND SPRINKLER HEAD PLACEMENT TO ACCOMMODATE NEW/EXISTING CEILING HEIGHTS AND STRUCTURAL CONFIGURATIONS.
27. PROVIDE SYSTEM(S) WITH FLUSHING CONNECTION(S).
28. PROVIDE SPRINKLERS ABOVE AND BELOW EXPOSED DUCTWORK, AN OBSTRUCTION, OR COMBINATIONS OF OBSTRUCTIONS 4 FEET OR WIDER.
29. INDICATE THE ROOM FUNCTIONS FOR EACH AREA ON THE SHOP DRAWINGS.
30. INDICATE THE LOCATION AND SIZE OF BLIND SPACES AND CLOSETS ON THE SHOP DRAWINGS.
31. INDICATE THE TOTAL SQUARE FOOT AREA PROTECTED BY SYSTEM(S) ON EACH FLOOR(S) ON THE SHOP DRAWINGS.
32. INDICATE THE NUMBER OF SPRINKLERS ON EACH RISER PER FLOOR ON THE SHOP DRAWINGS.
33. PROVIDE HEAD GUARDS ON SPRINKLER HEADS IN ELECTRIC, TELEPHONE AND MECHANICAL ROOMS.
34. ALL PENDENT SPRINKLERS SHALL BE CENTER-OF-TILE, UNLESS MAXIMUM DISTANCES FROM WALLS OR BETWEEN HEADS IS EXCEEDED. ALL SPRINKLER HEADS MOUNTED IN CEILING SHALL BE LOCATED A MINIMUM OF 4" AWAY FROM ANY WALLS, CEILING GRID MEMBERS, CEILING HEIGHT CHANGES OR ANY OTHER VERTICAL INTERSECTING STRUCTURAL SURFACE.
35. INSPECTOR'S TEST VALVE SHALL NOT EXCEED 7 FEET ABOVE THE FINISHED FLOOR. STYLE OF TEST SHALL BE VICTAULIC TESTMASTER II #720.
36. PROVIDE SMOOTH BORE CORROSION RESISTANT OUTLET FOR INSPECTOR'S TEST GIVING FLOW EQUIVALENT TO 1 SPRINKLER.
37. FIRE PROTECTION CONTRACTOR SHALL ASSIST IN PREPARATION OF COORDINATION DRAWINGS FOR ALL LEVELS WHICH INDICATE ALL THE ENGINEERING DISCIPLINES & FIRE PROTECTION PIPING. THESE DRAWINGS SHALL BE PREPARED & APPROVED BY THE ENGINEER PRIOR TO ANY INSTALLATION. REFER TO SPECIFICATION SECTION 15002 - COORDINATION DRAWINGS.
38. FIRE SPRINKLER PIPING SHALL NOT TRAVEL WITHIN 6 FEET OVER THE TOPS OF ELECTRICAL PANEL BOARDS PER N.F.P.A 70 NEC ARTICLE 110-26-F-1-A, 1999 EDITION.
39. PROVIDE ADDITIONAL SPRINKLER HEADS, FITTINGS, APPURTENANCES, AND ALL OTHER WORK NECESSARY TO ACCOMMODATE A MINIMUM OF AN ADDITIONAL 15% OF THE TOTAL CONTRACT PRICE AS INDICATED ON THE CONTRACT DOCUMENTS. THE 15% OF THE TOTAL CONTRACT PRICE SHALL BE USED TO PROVIDE ANY ADDITIONAL FIRE PROTECTION SPRINKLER COVERAGE WHICH MAY BE NEEDED TO ACCOMMODATE ANY INTERIOR DESIGN LAYOUTS, OR CHANGES TO SUCH LAYOUTS WHICH ARE OR MAY BE INCLUDED IN THE WORK. THESE SPRINKLERS AND ASSOCIATED WORK SHALL BE PROVIDED WHERE REQUIRED TO RESOLVE ANY CONFLICTS OR OTHER LAYOUT CHANGES NEEDED TO ACCOMMODATE ALL MISCELLANEOUS ITEMS (I.E., CEILING OFFSETS, SOFFITS, COVES, CODE CORRECTIONS/INTERPRETATIONS, STRUCTURAL SYSTEM CONFLICTS, OR RELATED INTERIOR DESIGN CONFIGURATIONS). AT PROJECT COMPLETION, A CREDIT WILL BE DUE TO THE OWNER FOR ALL UNUSED PORTION OF THE 15% OF THE TOTAL CONTRACT PRICE AND THIS CREDIT WILL BE INCORPORATED INTO THE FINAL PAY APPLICATION AT A RATE ESTABLISHED IN THE BID PROPOSAL AS TWO SEPARATE LINE ITEMS. ONE LINE ITEM WILL IDENTIFY THE TOTAL COST OF THE REQUIRED 15% TOTAL CONTRACT PRICE, AND THE SECOND LINE ITEM WILL IDENTIFY AN INDIVIDUAL COST PER SPRINKLER HEAD AND ALL ASSOCIATED PIPING, FITTINGS AND HANGERS.
40. ALL SPRINKLERS SHALL MEET WITH NFPA #13 TEMPERATURE RATINGS FOR FIRE SPRINKLERS (i.e. SPRINKLERS LOCATED IN A HIGH TEMPERATURE ZONE SHALL HAVE HIGH-TEMPERATURE CLASSIFICATION SPRINKLERS AND SPRINKLERS LOCATED IN AN INTERMEDIATE ZONE SHALL HAVE INTERMEDIATE TEMPERATURE CLASSIFICATION SPRINKLERS).

ALL PUBLIC AREA DIFFUSERS, LIGHT FIXTURE TRIMS, CAMERA TRIMS, AND SPEAKER TRIMS/GRILLES SHALL BE FIELD PAINTED BY THE GC PER THE DEVICE COLOR SCHEDULE TO BE ISSUED BY THE ARCHITECT. ALL PUBLIC AREA SPRINKLER HEADS, ELECTRICAL, LOW VOLTAGE DEVICES AND COVERPLATES SHALL BE PRICED ASSUMING A CUSTOM COLOR, WHICH WILL BE PROVIDED AT A LATER DATE BY THE ARCHITECT. FOR THE THEMED SUITES, CONTRACTOR TO ALLOW FOR CUSTOM COLORS FOR ALL WALL AND CEILING DEVICES IN PRICING. FINAL COLORS WILL BE PROVIDED IN FUTURE ADDENDUM

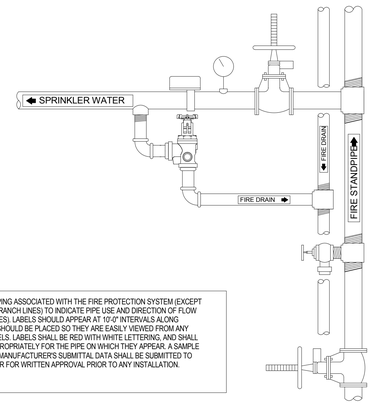
B | FIRE PROTECTION GENERAL NOTES | SCALE: N.T.S.



NOTES:

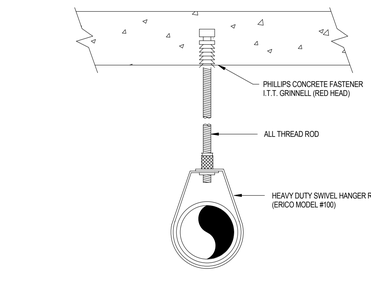
1. OBSTRUCTION FREE CLEAR ZONE SHALL NOT PERMIT ANY EXISTING OBSTRUCTIONS OR NEWLY CONSTRUCTION ELEMENTS TO BE PERMANENTLY FIX TO THE GROUND WITH IN THIS ZONE
2. NO PLANTING OF IN THE OBSTRUCTION FREE CLEAR ZONE

L | PLANTING ADJACENT TO FIRE HYDRANTS & CONNECTIONS | SCALE: N.T.S.



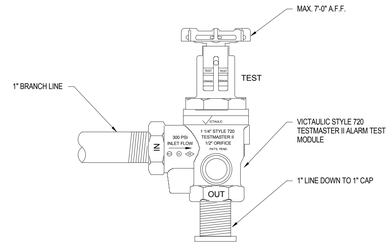
LABEL ALL PIPING ASSOCIATED WITH THE FIRE PROTECTION SYSTEM (EXCEPT SPRINKLER BRANCH LINES) TO INDICATE PIPE USE AND DIRECTION OF FLOW (SEE EXAMPLES). LABELS SHOULD APPEAR AT 15'-0" INTERVALS ALONG PIPING, AND SHOULD BE PLACED SO THEY ARE EASILY VIEWED FROM ANY ACCESS PANELS. LABELS SHALL BE RED WITH WHITE LETTERING, AND SHALL BE SIZED APPROPRIATELY FOR THE PIPE ON WHICH THEY APPEAR. A SAMPLE ALONG WITH MANUFACTURER'S SUBMITTAL DATA SHALL BE SUBMITTED TO THE ENGINEER FOR WRITTEN APPROVAL PRIOR TO ANY INSTALLATION.

H | FIRE PROTECTION SYSTEM LABELING | SCALE: N.T.S.

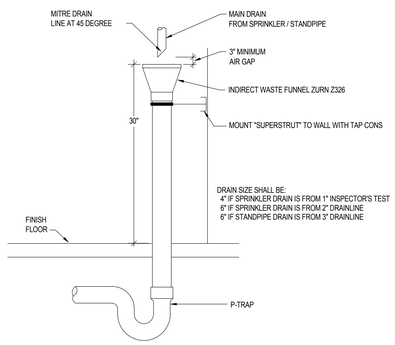


(U.L./F.M. APPROVED)

E | CONCRETE INSERT PIPE HANGER DETAIL | SCALE: N.T.S.

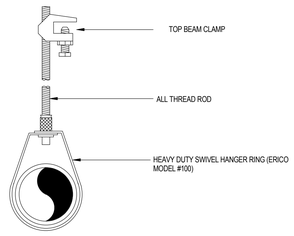


K | NEW INSPECTORS TEST CONNECTION - DRY SYSTEM | SCALE: N.T.S.



FOR REFERENCE ONLY

G | INDIRECT WASTE CONNECTION FOR FIRE PROTECTION DRAIN | SCALE: N.T.S.



A | TOP BEAM CLAMP PIPE HANGEAR DETAIL (U.L./F.M. APPROVED) | SCALE: N.T.S.

ABOVE FINISHED FLOOR	AFF	GALLONS PER MINUTE	GPM
BACK FLOW VALVE	BFV	GROOVED	GRV'D
BELOW FINISHED FLOOR	BFF	NOT IN CONTRACT	NIC
CONTINUATION	CONT.	NOT TO SCALE	NTS
DOWN	DN	OPEN STEM & YOKE	OS&Y
DRAWING	DWG.	POST INDICATOR VALVE	P.I.V.
ELECTRIC	ELEC	POUNDS / SQUARE INCH	PSI
EXISTING	EX.	STANDPIPE	STP
FIRE DEPARTMENT CONNECTION	FDC	UNDERGROUND	UNDG.
FIRE EXTINGUISHER	FE	UNLESS NOTED OTHERWISE	UNO
FIRE VALVE CABINET	FVC	VICTAULIC REDUCING COUPLING	VRC
FLOW SWITCH	FS	EXISTING TO REMAIN	ETR
TAMPER SWITCH	TS		

D | FIRE PROTECTION ABBREVIATIONS | SCALE: N.T.S.

Sheet List 1

Sheet Number	Sheet Name
FP001	FIRE PROTECTION LEGEND
FP002	FIRE PROTECTION DETAILS
FP003	FIRE PROTECTION - ENLARGED ROOMS
FP101	FIRE PROTECTION PLAN - LEVEL 1
FP102	FIRE PROTECTION PLAN - LEVEL 2
FP103	FIRE PROTECTION PLAN - LEVEL 3
FP104	FIRE PROTECTION PLAN - LEVEL 4
FP105	FIRE PROTECTION PLAN - LEVEL 5-15

A | SHEET INDEX | SCALE: N.T.S.

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Milwaukee, Wisconsin
USA

www.exp.com

BUILDINGS • EARTH & ENVIRONMENT • ENERGY
INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY

Revisions

No.	Date	Description
1	6/14/2013	Bulletin #14

Document Phase: CD
Date: 03/29/2016
PIC / AIC: PVK
Drawn By: CMZ
Checked By: MAN
Comm. No.: 11-0033

Project Title

PHASE 1

Package

Bulletin #8
Construction Package #3
Interiors

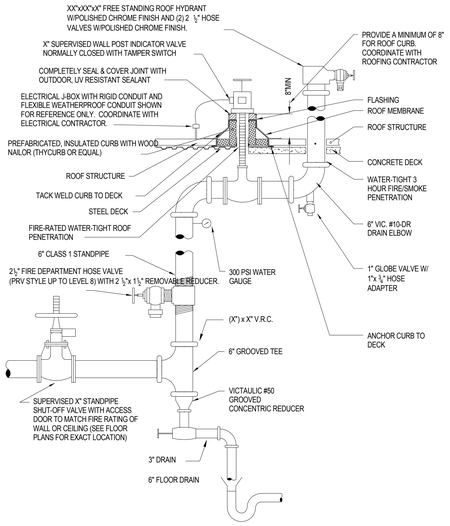
Sheet Title

FIRE PROTECTION LEGEND

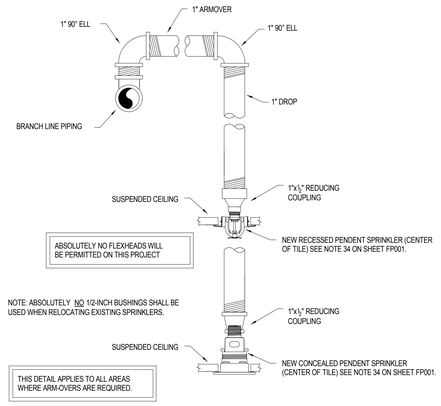
Sheet Number

FP001

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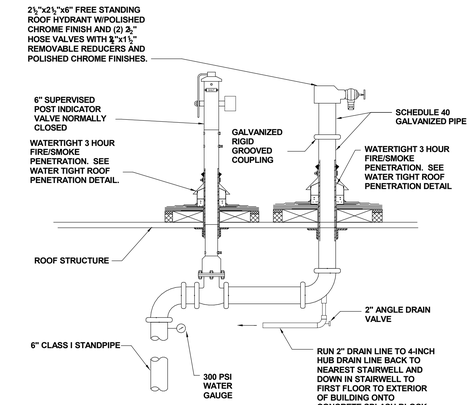


L | STANDPIPE RISER DETAIL | SCALE: N.T.S.

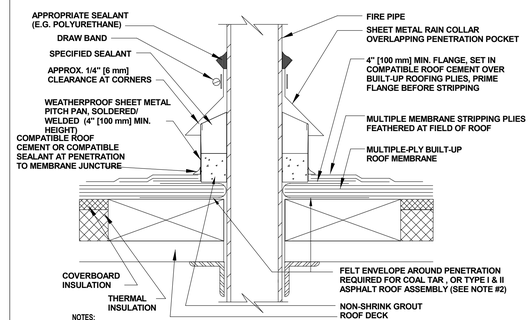


H | NEW TYPICAL SWING JOINT | SCALE: N.T.S.

H | STANDPIPE W/ROOF HYDRANT & DRAIN DETAIL - STAIR A | SCALE: N.T.S.



F | FREE STANDING ROOF HYDRANT & POST INDICATOR | SCALE: N.T.S.



NOTES:
1. PRIOR TO INSTALLATION, SEAL PENETRATION WITH ELASTIC FILL.
2. INSTALL ENVELOPE (BITUMEN-STOP) FOR A CONTINUOUS EDGE SEAL AT THE PERIMETER AND AT PENETRATIONS BY EXTENDING PERFORMANCE PLY, PIKA PLY SS-2, OR TWO PLIES OF NON-PERFORATED ORGANIC ASPHALT SATURATED FELT BEYOND THE EDGE OF THE MEMBRANE FIELD PLIES. AFTER ALL OVERLAPPING FIELD PLIES ARE IN PLACE, THE EXTENDED PLY IS TURNED BACK INTO THE MEMBRANE AND ADHERED. THE ENVELOPE IS INTENDED TO PREVENT BITUMEN SEEPAGE FROM THE EDGE OF THE MEMBRANE.
3. DO NOT USE MODIFIED COAL TAR ON SLOPES THAT EXCEED 1/2" PER FOOT
4. DO NOT USE TYPE I TAR WITH POLYESTER OR TARRED GLASS FELTS ON SLOPES THAT EXCEED 1/4" PER

F | WATER TIGHT ROOF PENETRATION POCKET | SCALE: N.T.S.



1. GYPSUM WALL ASSEMBLY (UL/ULC CLASSIFIED U300 OR U400 SERIES) (1-HR OR 2-HR FIRE-RATING) (2-HR SHOWN).

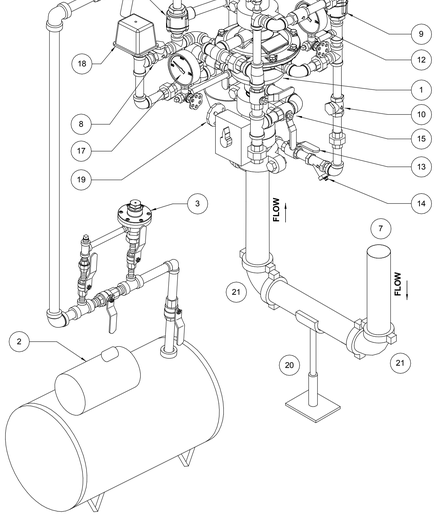
2. PENETRATING ITEM TO BE ONE OF THE FOLLOWING:
A. MAXIMUM 30" NOMINAL DIAMETER STEEL PIPE (SCHEDULE 10 OR HEAVIER).
B. MAXIMUM 30" NOMINAL DIAMETER CAST IRON PIPE.
C. MAXIMUM 6" NOMINAL DIAMETER COPPER PIPE.
D. MAXIMUM 6" NOMINAL DIAMETER STEEL CONDUIT.
E. MAXIMUM 4" NOMINAL DIAMETER EMT.

3. HILTI FS-ONE INTUMESCENT FIRESTOP SEALANT:
A. MINIMUM 5/8" DEPTH, FOR A 1-HR FIRE-RATING.
B. MINIMUM 1-1/4" DEPTH, FOR A 2-HR FIRE-RATING.

4. MINIMUM 1/2" BEAD HILTI FS-ONE INTUMESCENT FIRESTOP SEALANT AT POINT OF CONTACT.

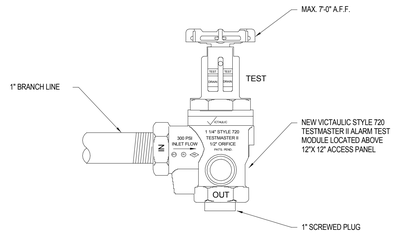
NOTES : 1. MAXIMUM DIAMETER OF OPENING:
A. 32-1/4" FOR STEEL STUD WALLS.
B. 14-1/2" FOR WOOD STUD WALLS.
2. ANNULAR SPACE = MINIMUM 0", MAXIMUM 2-1/4".

E | METAL PIPE THROUGH 1-HR. OR 2-HR GYPSUM WALL ASSEMBLY | SCALE: N.T.S.

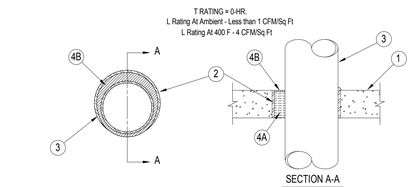


REFERENCE NOTES:
1. DRY PIPE VALVE
2. TANK MOUNTED AIR COMPRESSOR _VAC, _HP, _HZ, SINGLE PHASE
3. AIR MAINTENANCE DEVICE WITH BYPASS TRIM
4. OPTIONAL ACCELERATOR CONNECTION
5. AIR PRESSURE SUPERVISORY SWITCH _V
6. PNEUMATIC OPERATING RELEASE VALVE
7. _" FROM SUPPLY MAIN
8. DRAIN CHECK VALVE
9. A-1 DIFFERENTIAL VALVE
10. SWING CHECK VALVE
11. 300 PSI AIR PRESSURE GAUGE & VALVE
12. 300 PSI PRIME PRESSURE GAUGE & VALVE
13. PRIME VALVE
14. STRAINER
15. FLOW TEST VALVE
16. CHECK VALVE (SOFT SEAT)
17. 300 PSI SUPPLY PRESSURE GAUGE & VALVE
18. WATERFLOW PRESSURE SWITCH _V (CONNECT TO FIRE ALARM SYSTEM)
19. BUTTERFLY VALVE
20. ADJUSTABLE PIPE STAND
21. GROOVED 90° ELL WITH RIGID GROOVED COUPLINGS

A | DRY PIPE RISER DIAGRAM - EMERGENCY ELEC ROOM | SCALE: N.T.S.



K | NEW INSPECTORS TEST CONNECTION - WET SYSTEM | SCALE: N.T.S.



1. FLOOR OR WALL ASSEMBLY - MIN 4-1/2 IN. THICK REINFORCED LIGHTWEIGHT OR NORMAL WEIGHT (100-150 PCF) CONCRETE. WALL MAY ALSO BE CONSTRUCTED OF ANY UL CLASSIFIED CONCRETE BLOCKS. MAX DIA OF OPENING IS 32 IN. SEE CONCRETE BLOCKS (CAZT) CATEGORY IN THE FIRE RESISTANCE DIRECTORY FOR NAMES OF MANUFACTURERS.

2. METALLIC SLEEVE - (OPTIONAL) NOM 32 IN. DIA (OR SMALLER) SCHEDULE 40 (OR HEAVIER) STEEL SLEEVE CAST OR GROUTED INTO FLOOR OR WALL ASSEMBLY, FLUSH WITH FLOOR OR WALL SURFACES.

3. THROUGH PENETRANT - ONE METALLIC PIPE OR CONDUIT TO BE INSTALLED EITHER CONCENTRICALLY OR ECCENTRICALLY WITHIN THE FIRESTOP SYSTEM. THE ANNULAR SPACE BETWEEN PIPE OR CONDUIT AND PERIPHERY OF OPENING SHALL BE MIN 0 IN. (POINT CONTACT) TO MAX 1-7/8 IN. PIPE OR CONDUIT TO BE RIGIDLY SUPPORTED ON BOTH SIDES OF FLOOR OR WALL ASSEMBLY. THE FOLLOWING TYPES AND SIZES OF METALLIC PIPES OR CONDUITS MAY BE USED:
A. STEEL PIPE - NOM 30 IN. DIA (OR SMALLER) SCHEDULE 10 (OR HEAVIER) STEEL PIPE.
B. COPPER PIPE - NOM 6 IN. DIA (OR SMALLER) REGULAR (OR HEAVIER) COPPER PIPE.
C. COPPER TUBING - NOM 6 IN. DIA (OR SMALLER) TYPE L (OR HEAVIER) COPPER TUBING.
D. CONDUIT - NOM 6 IN. DIA (OR SMALLER) STEEL CONDUIT. E. CONDUIT - NOM 4 IN. DIA (OR SMALLER) STEEL ELECTRICAL METALLIC TUBING (EMT).

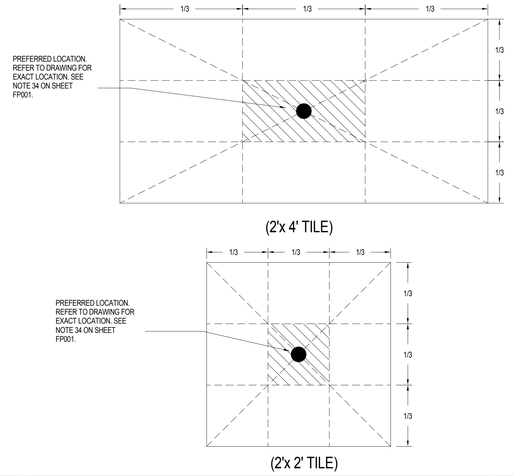
4. FIRESTOP SYSTEM - THE FIRESTOP SYSTEM SHALL CONSIST OF THE FOLLOWING:
A. PACKING MATERIAL - MIN 4 IN. THICKNESS OF MIN 4 PCF MINERAL WOOL BATT. INSULATION FIRMLY PACKED INTO OPENING AS A PERMANENT FORM. PACKING MATERIAL TO BE RECESSED FROM TOP SURFACE OF FLOOR OR FROM BOTH SURFACES OF WALL AS REQUIRED TO ACCOMMODATE THE REQUIRED THICKNESS OF FILL MATERIAL.

B. FILL, VOID OR CAVITY MATERIAL - SEALANT - MIN 1/4 IN. THICKNESS OF FILL MATERIAL APPLIED WITHIN THE ANNULUS, FLUSH WITH TOP SURFACE OF FLOOR OR WITH BOTH SURFACES OF WALL, AT THE POINT CONTACT LOCATION BETWEEN PIPE AND CONCRETE. A MIN 1/4 IN. DIA BEAD OF FILL MATERIAL SHALL BE APPLIED AT THE CONCRETE/PIPE INTERFACE ON THE TOP SURFACE OF FLOOR AND ON BOTH SURFACES OF WALL.

HILTI, INC. - FS-ONE SEALANT

BEARING THE UL CLASSIFICATION MARKING

G | PIPE THRU A SLEEVE IN CONCRETE FLOOR/WALL OR BLOCK WALL | SCALE: N.T.S.



D | TYPICAL CENTER OF TILE | SCALE: N.T.S.

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PIC / AIC:	PVK
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Project Title

PHASE 1

Package

Bulletin #14
Construction Package #3
Interiors

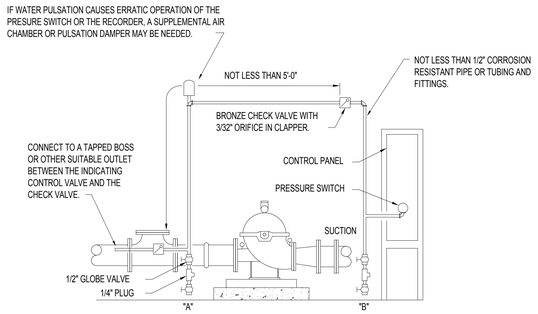
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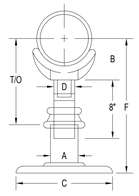
FIRE PROTECTION DETAILS

Sheet Number

FP002

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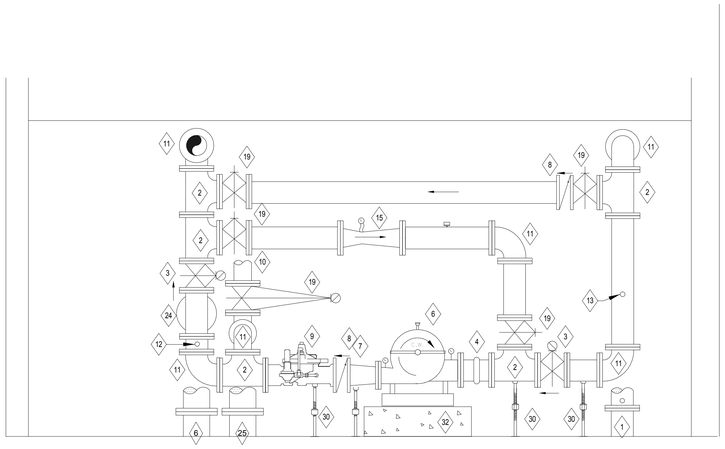




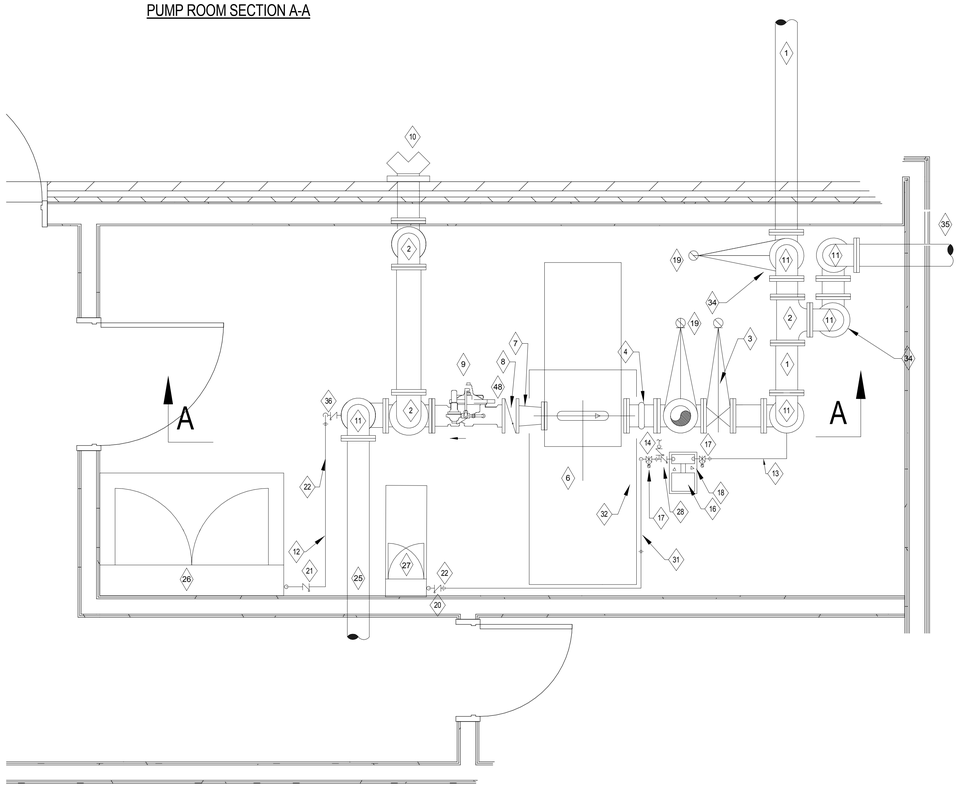
PIPE SIZE	DIMENSIONS IN INCHES										
	A	C	D MIN.	T/O	A	B	C	D	F MIN.	T/O DIM. T/O	T/O DIM. ADJ. ±
2 1/2	NOT AVAILABLE					3 1/2			11 1/2	8 1/4	
3	FOR PIPE SIZES				2 1/2	3 3/4		1 1/2	11 3/4	8 1/2	2 3/4
3 1/2	SMALLER THAN 4"					4			12	8 3/4	
4	3	9	7 1/4	4 1/4	3	4 1/4	9	2 1/2	12 1/4	8 3/4	2 1/2
5			7 7/8	4 7/8		4 7/8			12 7/8	9 3/8	
6			8 1/2	5 1/2		5 1/2			13 1/2	10	
8			9 7/8	6 7/8		6 7/8			14 7/8	11 3/8	
10			11 1/2	8 1/2		8 1/2			16 1/2	13	
12			13	10		10			18	14 1/2	

FIRE PUMP LEGEND EXTRA HEAVY RATED

1. 8" FIRE PUMP SUCTION MAIN
2. 8" FLGD. TEE (CLASS 250xH)
3. 8" FLGD O.S.&Y WITH TAMPER SWITCH (CLASS 250)NORMALLY OPEN
4. 8" FLGD FLEXIBLE SPOOL PIECE
5. 300 P.S.I. WATER GAUGE (xH)
6. 6"x 6" ELECTRIC FIRE PUMP PATTERSON DMD (xH) 160 P.S.I. @ 1000 G.P.M. 125 H.P. , 1800 R.P.M. , 460V 3-PHASE (250 xH)
7. 4"x 8" FLGD. CONCENTRIC INCREASER
8. 8" SPRING LOADED WAFER CHECK VALVE (CLASS 250)
9. 8" FLGD FIRE PUMP SUCTION CONTROL VALVE CLA-VAL # 50B-5KG (ONLY)(CLASS 300)
10. 8" OUT TO WALL MOUNTED FIRE PUMP TEST HEADER. SEE SHEET FP101 FOR LOCATION
11. 8" FLGD. ELL (CLASS 250xH)
12. 1/2" FIRE PUMP TEST SENSING LINE (xH)
13. JOCKEY PUMP SUCTION LINE (xH)
14. JOCKEY PUMP DISCHARGE LINE (xH)
15. 8" FLGD FLOW METER xH(GERAND ONLY) (CLASS 250)
16. JOCKEY PUMP 255 P.S.I. @ 12 G.P.M. GRUNDFROS ONLY #CRN1-21 460V AC 5 H.P. 3 PHASE (xH)
17. JOCKEY PUMP SUCTION AND DISCHARGE GATE VALVE W/T SWITCH (CLASS 250)
18. CONCRETE PAD FOR JOCKEY PUMP
19. 8" O.S.&Y. GATE VALVE NORMALLY CLOSED WITH TAMPER SWITCH , CHAIN & LOCK CLOSED(CLASS 250)
20. 1/2" JOCKEY PUMP TEST SENSING LINE CHECK VALVE (CLASS 250)
21. 1/2" FIRE PUMP TEST SENSING LINE CHECK VALVE (CLASS 250)
22. 1/2" GROUND JOINT UNION
23. 8" FLOW SWITCH (xH)
25. 8" OUT TO STANDPIPE/SPRINKLER SYSTEM
26. ELECTRICAL FIRE PUMP CONTROLLER REDUCED VOLTAGE SOLID STATE SOFT START WITH AUTOMATIC TRANSFER SWITCH
27. JOCKEY PUMP CONTROLLER
28. JOCKEY PUMP DISCHARGE CHECK VALVE (CLASS 250)
29. AIR VENT
30. ADJUSTABLE PIPE STAND
31. 1/2" JOCKEY PUMP TEST SENSING LINE (xH)
32. CONCRETE PAD FOR FIRE PUMP
33. 6" FLGD. ELL (CLASS 250xH)
34. 8" BACK FLOW PREVENTOR IN VERTICAL
35. 8" O/W PIPING FROM PLUMBING CONTRACTOR, SEE PLUMBING DRAWINGS FOR CONTINUATION



PUMP ROOM SECTION A-A



Enlarged Fire Pump
1/2" = 1'-0"

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Revisions

No.	Date	Description

Document Phase:	CD
Date:	03/29/2016
PIC / AIC:	PVK
Drawn By:	CMZ
Checked By:	MAN
Comm. No.:	11-0033

Project Title

PHASE 1

Package

Bulletin #14
Construction Package #3
Interiors

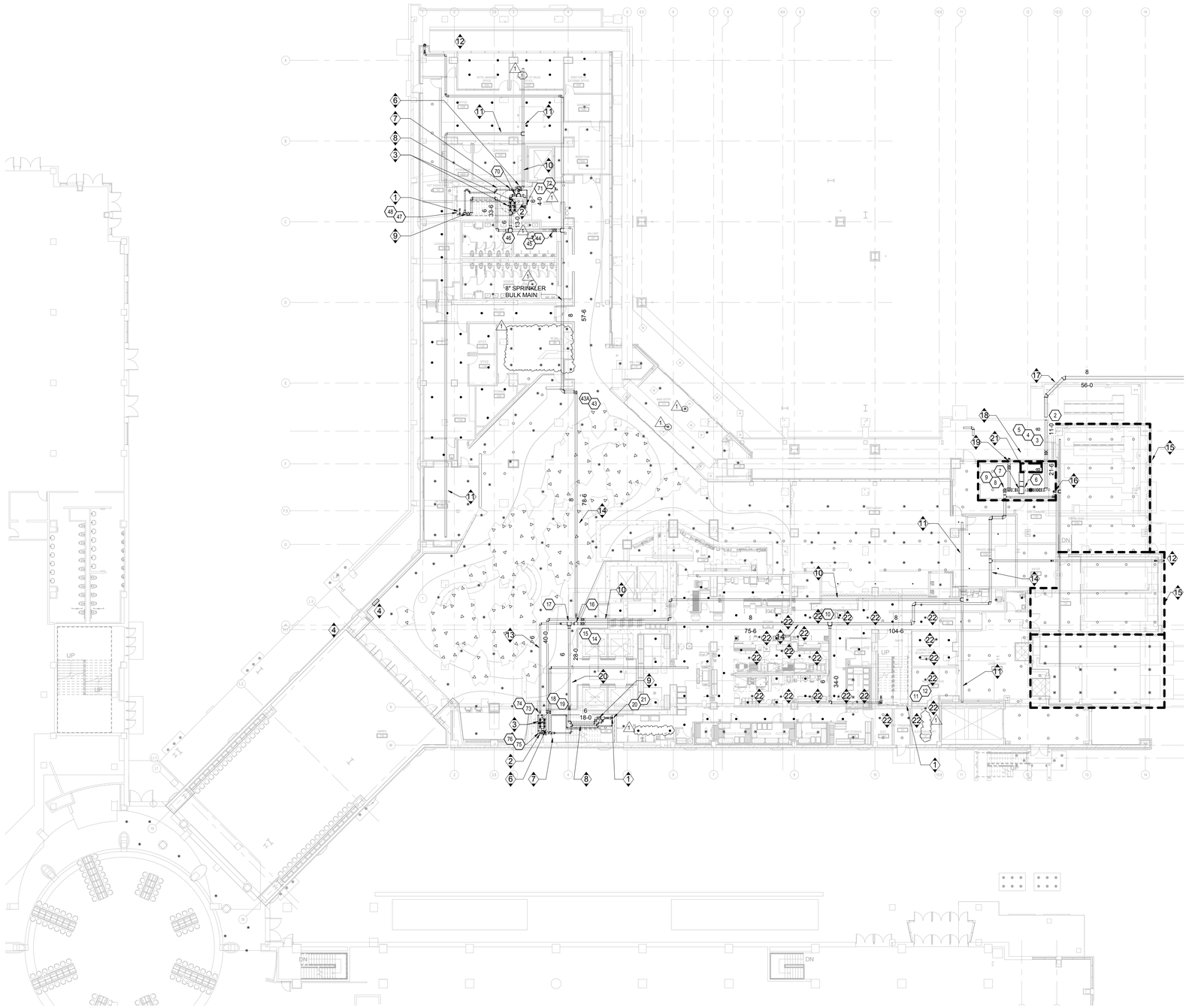
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FIRE PROTECTION - ENLARGED ROOMS

Sheet Number

FP003

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1 Level 1 - Fire Protection(Overall)
1/16" = 1'-0"

N

GENERAL NOTES:

1. SPRINKLER LOCATIONS ARE OF HIGH AESTHETIC IMPORTANCE. ANY DEVIATION FROM SPRINKLER LOCATION FROM THAT SHOWN IN PUBLIC SPACE SHALL BE APPROVED BY ENGINEER

REFERENCE NOTES:

1. 6" STANDPIPE UP WITH 2-1/2" PRESSURE REGULATING HOSE VALVE (PRESSURE REGULATING HOSE VALVE TYPE ONLY USED FOR LEVELS 1 TO 8) AND 3" DRAIN RISER (DRAIN RISER IS ON LEVELS 1 TO 8)
2. 6" SPRINKLER RISER UP AND 2" MAIN DRAIN RISER
3. 6" REDUNDANT PRESSURE REDUCING VALVES SET TO 165 PSI WITH BUTTERFLY ISOLATION VALVES
4. FIRE RATED FIRE VALVE CABINET WITH 2-1/2" HOSE VALVE SERVING HORIZONTAL EXIT
5. IDF ROOM SHALL BE PROTECTED BY NOVEC 1230 CLEAN AGENT FIRE SUPPRESSION SYSTEM
6. 6" SPRINKLER CONTROL VALVE ASSEMBLY
7. 3" BUTTERFLY VALVE AND 3" CHECK VALVE
8. 3" PRV TEST LINE
9. 6" BUTTERFLY VALVE
10. 6" SPRINKLER CROSS MAIN
11. 4" SPRINKLER CROSS MAIN
12. 2-1/2" x 2-1/2" x 6" WALL MOUNTED FIRE DEPARTMENT CONNECTION
13. 6" SPRINKLER BULK MAIN
14. 10" SPRINKLER BULK MAIN
15. GENERATOR ROOM SHALL BE PROTECTED BY 2% HIGH EXPANSION FOAM SYSTEM
16. 4" DRY SPRINKLER RISER ASSEMBLY SERVING TRASH ROOM AND LOADING DOCK
17. 10" UNDERGROUND FIRE PUMP SUPPLY LINE
18. SEE SHEET FP400 FOR ENLARGED FIRE PUMP ROOM
19. 2-1/2" x 2-1/2" x 2-1/2" x 8" WALL MOUNTED FIRE PUMP TEST HEADER
20. 6" SPRINKLER BULK MAIN
21. HIGH EXPANSION FOAM GENERATOR WITH 50 GALLON VERTICAL BLADDER TANK SERVING EMERG. ELEC 133A
22. SPRINKLER TO BE INSTALLED WITHIN GREASE DUCT

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Revisions

No.	Date	Description
1	7/02/2013	Bulletin #16

Document Phase:	CD
Date:	03/29/2016
PIC / AIC:	PVK
Drawn By:	MGU
Checked By:	CMZ
Comm. No.:	11-0033

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PHASE 1

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Sheet Title

FIRE PROTECTION
PLAN - LEVEL 1

Sheet Number

FP101

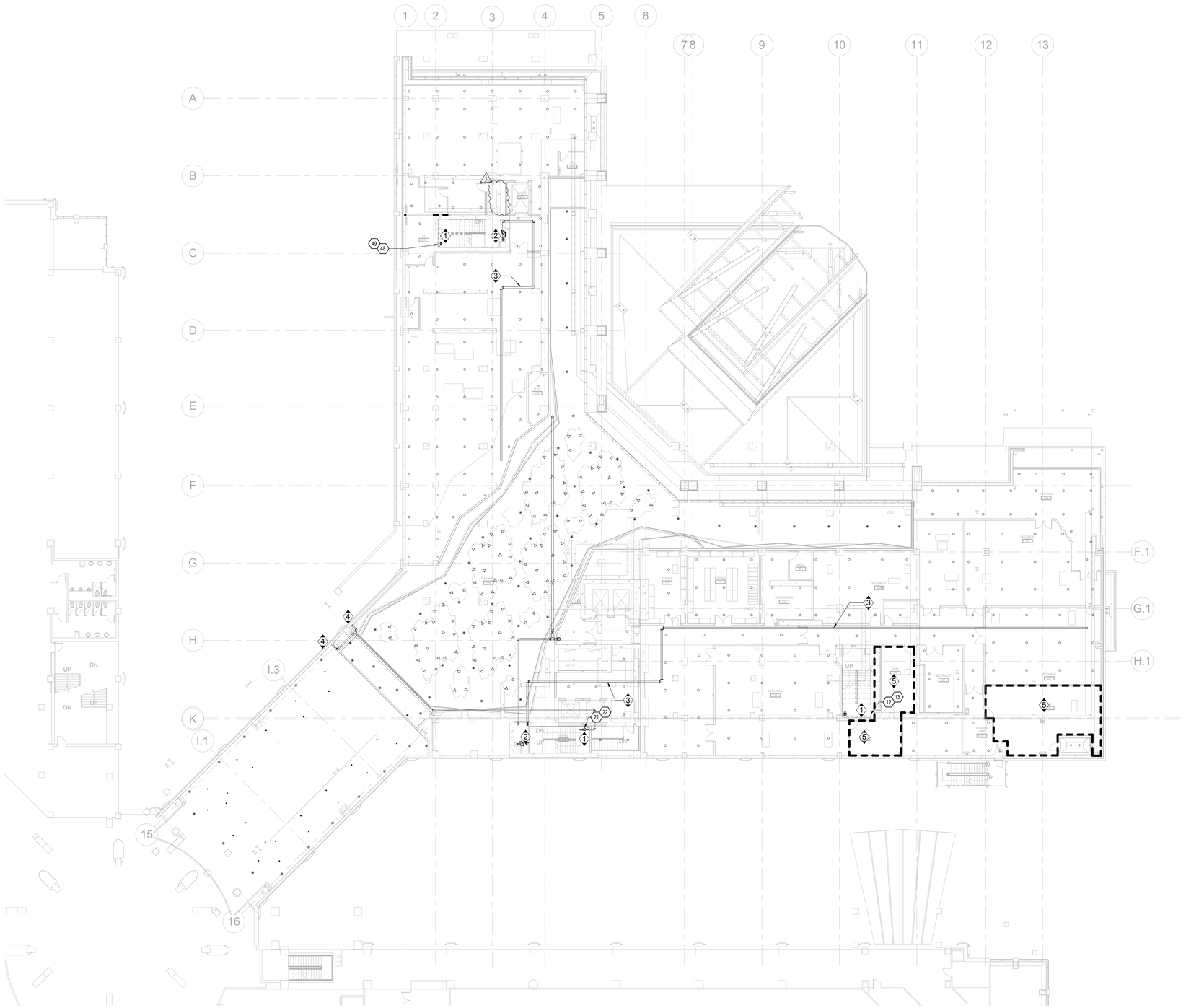
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GENERAL NOTES:

1. SPRINKLER LOCATIONS ARE OF HIGH AESTHETIC IMPORTANCE. ANY DEVIATION FROM SPRINKLER LOCATION FROM THAT SHOWN IN PUBLIC SPACE SHALL BE APPROVED BY ENGINEER

REFERENCE NOTES:

1. 6" STANDPIPE UP WITH 2-1/2" PRESSURE REGULATING HOSE VALVE (PRESSURE REGULATING HOSE VALVE TYPE ONLY USED FOR LEVELS 1 TO 8) AND 3" DRAIN RISER (DRAIN RISER IS ON LEVELS 1 TO 8)
2. 6" SPRINKLER RISER UP AND 2" MAIN DRAIN RISER
3. 6" SPRINKLER CROSS MAIN
4. FIRE RATED FIRE VALVE CABINET WITH 2-1/2" HOSE VALVE SERVING HORIZONTAL EXIT
5. IDF ROOM SHALL BE PROTECTED BY NOVEC 1230 CLEAN AGENT FIRE SUPPRESSION SYSTEM



1 Level 2 - Mezzanine - Fire Protection(Overall)
1/16" = 1'-0"

N

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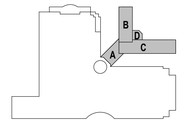
Revisions

No.	Date	Description
1	7/02/2013	Bulletin #16

Document Phase:	CD
Date:	03/29/2016
PIC / AIC:	PVK
Drawn By:	MGU
Checked By:	CMZ
Comm. No.:	11-0033

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PHASE 1



KEYPLAN

Package

Bulletin #14
Construction Package #3
Interiors

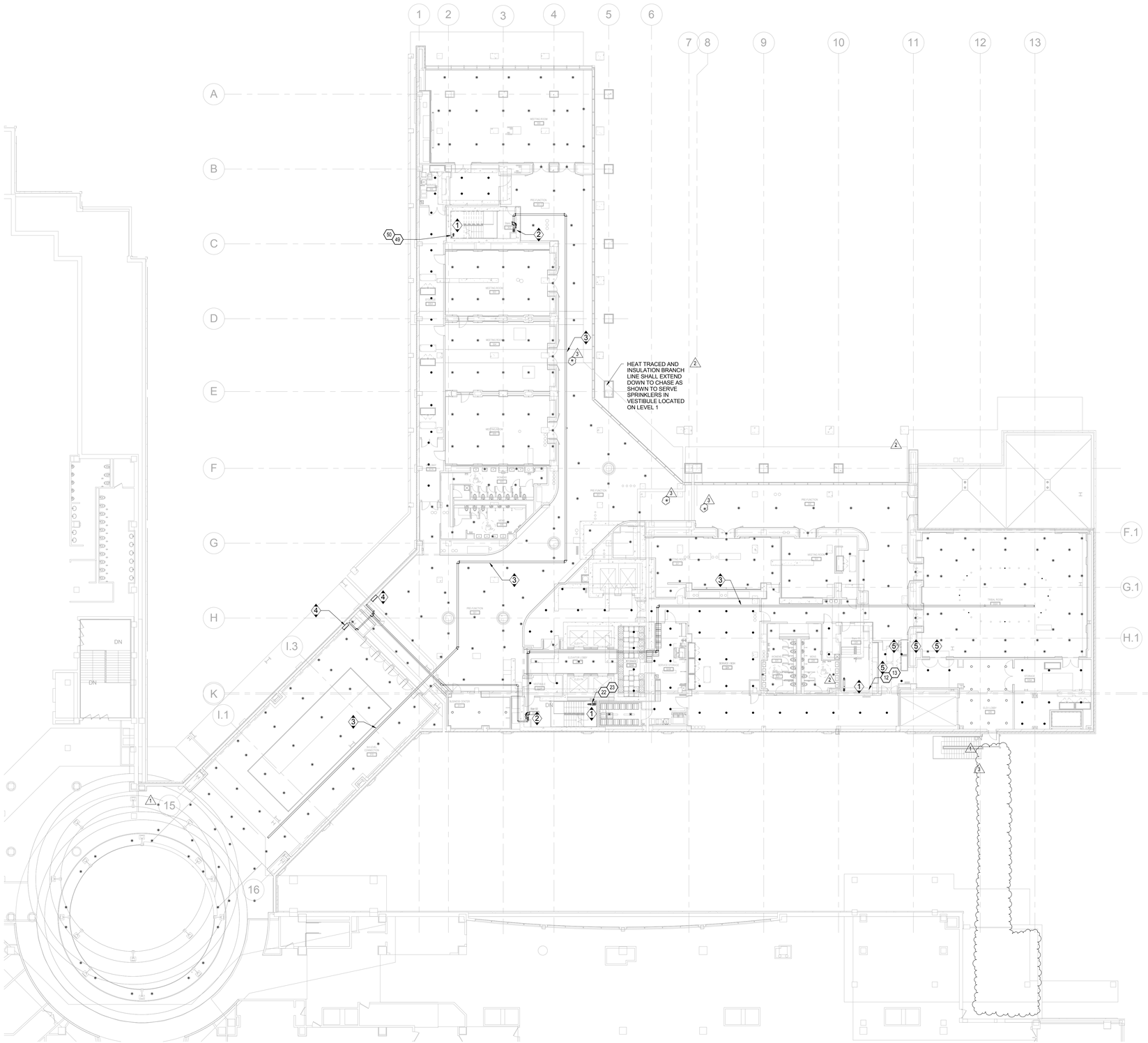
Sheet Title

FIRE PROTECTION
PLAN - LEVEL 2

Sheet Number

FP102

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1 Level 3 Meeting - Fire Protection(Overall)
1/16" = 1'-0"

GENERAL NOTES:

1. SPRINKLER LOCATIONS ARE OF HIGH AESTHETIC IMPORTANCE. ANY DEVIATION FROM SPRINKLER LOCATION FROM THAT SHOWN IN PUBLIC SPACE SHALL BE APPROVED BY ENGINEER

REFERENCE NOTES:

1. 6" STANDPIPE UP WITH 2-1/2" PRESSURE REGULATING HOSE VALVE (PRESSURE REGULATING HOSE VALVE TYPE ONLY USED FOR LEVELS 1 TO 8) AND 3" DRAIN RISER (DRAIN RISER IS ON LEVELS 1 TO 8)
2. 6" SPRINKLER RISER UP AND 2" MAIN DRAIN RISER
3. 6" SPRINKLER CROSS MAIN
4. FIRE RATED FIRE VALVE CABINET WITH 2-1/2" HOSE VALVE SERVING HORIZONTAL EXIT
5. SPRINKLER TO BE INSTALLED WITHIN GREASE DUCT

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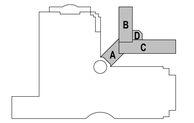
Revisions

No.	Date	Description
1	3/18/2013	Bulletin #10
2	6/14/2013	Bulletin #14
3	7/02/2013	Bulletin #16

Document Phase:	CD
Date:	03/29/2016
PIC / AIC:	PVK
Drawn By:	MGU
Checked By:	CMZ
Comm. No.:	11-0033

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PHASE 1



KEYPLAN

Package

Bulletin #8
Construction Package #3
Interiors

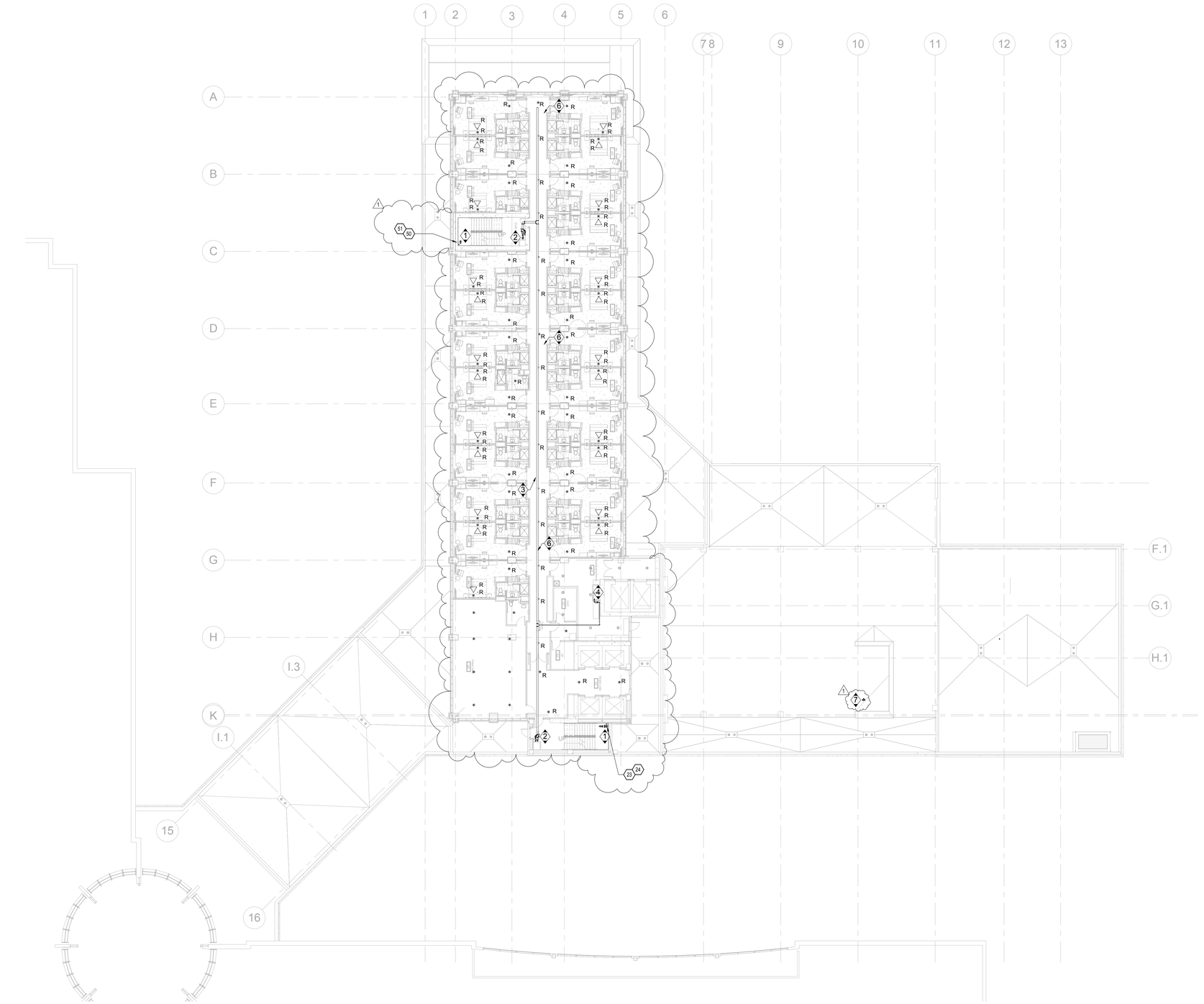
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FIRE PROTECTION
PLAN - LEVEL 3

Sheet Number

FP103

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1 Level 4 SPA - Fire Protection(Overall)
1/16" = 1'-0"

N

GENERAL NOTES:

1. SPRINKLER LOCATIONS ARE OF HIGH AESTHETIC IMPORTANCE. ANY DEVIATION FROM SPRINKLER LOCATION FROM THAT SHOWN IN PUBLIC SPACE SHALL BE APPROVED BY ENGINEER

REFERENCE NOTES:

1. 6" STANDPIPE UP WITH 2-1/2" PRESSURE REGULATING HOSE VALVE (PRESSURE REGULATING HOSE VALVE TYPE ONLY USED FOR LEVELS 1 TO 8) AND 3" DRAIN RISER (DRAIN RISER IS ON LEVELS 1 TO 8)
2. 6" SPRINKLER RISER AND 2" MAIN DRAIN RISER
3. 2" SPRINKLER CROSS MAIN
4. TRASH CHUTE SPRINKLER RISER WITH TAMPERED CONTROL VALVE
5. NEW 3" DRY SPRINKLER RISER
6. NEW 3" DRY SPRINKLER MAIN
7. NEW 2 1/2" X 2 1/2" X 2 1/2" X 6" FREE STANDING ROOF MOUNTED FIRE DEPARTMENT CONNECTION WITH 6" ROOF PIV NORMALLY CLOSED.

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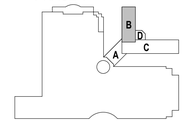
Revisions

No.	Date	Description
1	6/14/2013	Bulletin #14

Document Phase:	CD
Date:	03/29/2016
PIC / AIC:	PVK
Drawn By:	CMZ
Checked By:	MAN
Comm. No.:	11-0033

Project Title

PHASE 1



KEYPLAN

Package

Bulletin #8
Construction Package #3
Interiors

Sheet Title

FIRE PROTECTION
PLAN - LEVEL 4

Sheet Number

FP104

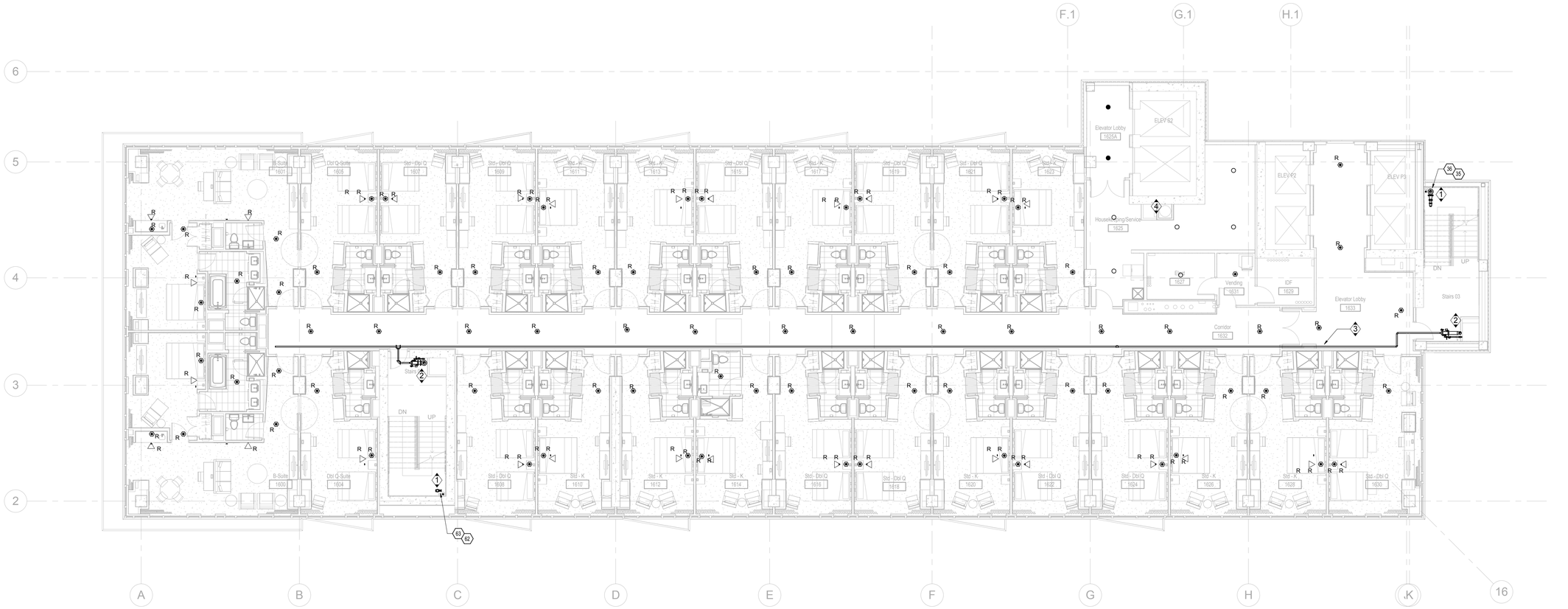
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GENERAL NOTES:

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REFERENCE NOTES:

1. 6" STANDPIPE WITH 2-1/2" HOSE VALVE
2. 6" SPRINKLER RISER AND 2" MAIN DRAIN RISER
3. 1 1/2" SPRINKLER CROSS MAIN
4. TRASH CHUTE SPRINKLER RISER



1 Fire Protection Plan - Level 16
1/8" = 1'-0"

N

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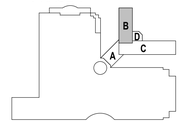
Revisions

No.	Date	Description

Document Phase:	CD
Date:	03/29/2016
PIC / AIC:	PVK
Drawn By:	MGU
Checked By:	CMZ
Comm. No.:	11-0033

Project Title

PHASE 1



KEYPLAN

Package

Bulletin #14
Construction Package #3
Interiors

Sheet Title

FIRE PROTECTION
PLAN - LEVELS 5-15

Sheet Number

FP105

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VALLEY MEDICAL

EMERGENCY MANAGEMENT PLAN:

CONCEPTS, AUTHORITIES & POLICIES

EMERGENCY MANAGEMENT PLAN

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I. Purpose and Scope

This Emergency Management Plan provides a framework for the City of Portland's efforts to mitigate, prepare for, respond to, and recover from major emergencies or disasters.

This Plan sets forth overall concepts, authorities and policies. A separate and more detailed companion document (Emergency Response Guide) provides "hands on" information for use by City staff when training for and responding to actual emergencies.

Note: Throughout this document there is terminology with specific application in emergencies. The glossary in Appendix A includes commonly used terms.

II. Concepts

This chapter establishes a context for assessing and responding to emergencies.

a) Levels of Activity

Although incidents occur frequently, they rarely have the scope or complexity which requires extraordinary organizational measures. Activation of this Plan, therefore, will be based on the following criteria. If there is disagreement regarding the application of these criteria, the City Manager shall make the determination. (Note: these levels of activation can be triggered not only by incidents within the City, but also by incidents in neighboring jurisdictions when Wilsonville's assistance is requested.)

Level 1: Minor incidents or relatively routine emergencies, which can be addressed by normal organization and procedures of City Departments, do not require implementation of this Plan. Examples of such cases would be an isolated water line break or a temporary power outage.

Level 2: Incidents of special, unusual and/or severe characteristics requiring response by more than one City Department, or which are beyond the scope of available resources, may require partial or full implementation of this Plan. Examples of such cases would be a train derailment, a school evacuation, or prolonged closure of the I-5 bridge.

Level 3: Incidents requiring coordinated response of multiple agencies to save lives and protect the property of a large portion of the community will automatically trigger activation of the City's Emergency Operations Center (EOC) and implementation of this Plan. Examples of such cases would be a flood or severe earthquake.

b) Field versus EOC Activities

Typically the initial response to an emergency is handled by field personnel at the scene of the incident. The gathering area for such field coordination is called the Field Command Post. If/when the incident response expands to the point where the Emergency Operations Center (EOC) is activated, then Incident Command responsibilities are transferred to the EOC. At that point, personnel at the Field Command Post continue to conduct tactical field response activities while maintaining communication with the EOC. It is the role of the EOC staff to manage the overall effort including the setting of incident priorities,

resource allocation, contingency planning, coordination among agencies, and public information.

c) Priorities During Emergencies

During an emergency, the foremost priority is safety of the responders. This is not only in consideration for the person's own welfare, but also to assure that maximum effective effort can be directed toward addressing the emergency. An injured responder is no longer available to deal with the emergency at hand. Furthermore, two or more coworkers are then diverted away from emergency response tasks in order to care for the injured responder. Within this context, the following hierarchy of priorities shall be used by the Incident Commander when establishing objectives and allocating resources.

1. Life Safety
    i. Emergency response personnel
    ii. At-risk populations
    iii. The public at large

2. Incident Stabilization
   (contain the intensity and/or geographical extent of the emergency)

3. Protection of Property and the Environment
   (minimize the overall impact of the emergency)
    i. Essential infrastructure
    ii. Environment with health/safety implications
    iii. Environment in general
    iv. Property in general

d) Continuity of City Operations

The impact of an emergency will vary from one part of the City to another. It is possible, for example, that some properties may suffer severe and long-term disruption while other portions of the City are relatively unaffected or may quickly recover.

Sections a), b) and c) in this chapter of the Plan focus primarily on the emergency itself. Section d) provides guidance regarding continuity of service for those portions of the City which are less impacted by the emergency.

During an emergency, City Departments retain their identity and functions. The Incident Commander, however, has the authority to

reassign City personnel to assist in emergency response. Due to the unusual demands placed on available resources, it may become necessary to temporarily scale back or suspend certain City services. In such cases, service delivery will be based on the following ratings. If there is disagreement regarding the application of these ratings, the City Manager shall make the determination.

Tier 1: Services that must be performed to maintain public health and safety, as well as public trust. Examples of such services include water supply (for drinking and for fire suppression); adequate sanitation; auxiliary power; essential medical care; critical transportation corridors; basic communications capabilities; and maintaining civil authority. Service level in Tier 1 also involves activities required for response and recovery efforts (e.g., inspection of damaged properties, debris removal, environmental remediation).

Tier 2: Services that should be performed to avoid major inconvenience or financial loss to the City, its residents and/or the business community.

Tier 3: Routine services that can be delayed for a short time (one month or less) without serious consequences.

III. Authorities and Responsibilities

This Plan is issued by the Portland City Council pursuant to the provisions of Oregon Revised Statutes (ORS) Chapter 401 and City of Portland Resolutions No. 1959 and No. 1960. Copies of these documents are contained in Appendices to this Plan.

a) Declaration of Emergency

Under emergency conditions, it may be necessary to depart from standard practices when securing needed resources, conducting response activities, maintaining civil authority, and minimizing injury to persons/property/environment. Resolution No. 1959 identifies the procedures and authorities associated with the declaration of an emergency.

It is the responsibility of the City Council to determine and declare a state of emergency exists. If circumstances make it impractical for the City Council to take timely action, the Mayor may declare a state of emergency. If the Mayor is unavailable for any reason, then the authority to declare an emergency shall pass to the Council President; if such person is unavailable for any reason, then to the City Manager (or person duly designated as Acting City Manager). Ratification by the City Council shall be obtained at the first available opportunity to confirm or amend the provisions of a declared state of emergency.

An emergency declaration shall state in writing:

- the nature of the emergency;
- the geographic boundaries of the area which is subject to emergency controls; and
- any special regulations or emergency powers imposed as a result of the declared emergency.

A declaration of emergency shall be terminated by the City Council when emergency conditions cease to exist.

Whenever an emergency is declared, the City may implement the following measures as reasonably required to protect public health, safety, and welfare:

1. ***Redirect funds*** for emergency use;
2. ***Suspend standard procurement procedures***;
   (Note: Price gouging is prohibited. No person or business may sell or attempt to sell any goods or services for a price in excess of the

"normal market price," which shall mean that person's or business's average of the regular price of the goods or services for the 30 days preceding the state of emergency.)

3. ***Implement mutual aid agreements***;
4. ***Turn off water, gas or electricity***;
5. ***Restrict, regulate or prohibit vehicular or pedestrian traffic***;
6. ***Enter or pass through private property*** for the purpose of responding to the emergency and/or for the conduct of damage assessment;
7. ***Evacuate persons*** from the area designated as an emergency area;
8. ***Establish a curfew*** during specified hours in specified locations;
9. ***Prohibit or limit the number of persons who may gather or congregate*** upon any public street, public place, or any outdoor place within the area designated as an emergency area;
10. ***Prohibit possession of weapons or explosives*** of any kind on public streets, public places or any outdoor place;
11. ***Prohibit or restrict the sale of gasoline*** or other flammable liquids;
12. ***Curtail or suspend commercial activity***;
13. ***Prohibit the sale of alcoholic beverages***;
14. Order such ***other measures as are found to be necessary*** for the protection of life, property, infrastructure, the environment, or for the recovery from the emergency.

b) Chain of Succession

The Chain of Succession for Declaring an Emergency is as follows:

1. Mayor
2. City Council President
3. City Manager
4. Acting City Manager designated by the City Council
5. Deputy City Manager
6. Community Development Director
7. Building Official
8. City Engineer
9. Such other City Manager who by time and existent circumstances is the only person available or is designated at such time by the then available city managers.

c) City Council Role and Responsibilities

During emergencies, the role of the Mayor and Councilors is primarily that of liaison with the public and with the elected officials of other affected or assisting jurisdictions. Responsibilities include:

- formal declaration/ratification of a state of emergency;
- status reports to residents, local businesses, and the media (with information provided through the Incident Commander);
- assistance in securing/coordinating volunteers (as requested by the Incident Commander);
- maintaining communications with elected officials of other jurisdictions that are directly or indirectly impacted by the emergency; and
- formally terminating the declared state of emergency when emergency conditions cease to exist.

d) Staff Roles, Responsibilities and Reporting Relationships

During normal operating conditions and/or Level 1 emergencies, staff duties and accountability are as defined in each employee's job description.

During Level 2 and Level 3 emergencies, the duties and accountability of staff involved in response or recovery activities will be as defined within the Incident Command System (ICS) structure. As such, individual employees may be assigned roles, responsibilities, and reporting relationships which differ from the day-to-day work defined in their City job descriptions.

All employees are encouraged to foster emergency preparedness at home. During emergencies it is the responsibility of each City employee to first ensure their own safety and the safety of their family. It is then the responsibility of each City employee to make him/herself available for duty as needed in the emergency response effort. In the event of a Level 2 or Level 3 emergency whereby telephone or pager service is interrupted, all pre-designated personnel on the Incident Management Team are to report to the Emergency Operations Center.

For large-scale and/or prolonged emergencies, it will be necessary to rotate staff through multiple shifts. The type and level of response will be situational, as will the availability of City staff. To expedite communication and development of incident-specific staffing plans, the City's Human Resources Director is responsible for maintaining accurate employee contact information, and for having such information available in a secure location within the Emergency Operations Center. It is also

the responsibility of each City Department Director to maintain this contact information for employees of their respective Departments.

The City shall have an Emergency Management Coordinator as designated by the City Manager. The Emergency Management Coordinator is responsible for:

- preparing and updating the City's Emergency Management Plan and Emergency Response Guide;
- assuring the City's Emergency Operations Center remains in a continual state of readiness;
- conducting preparedness exercises and implementing relevant training for City staff; and
- coordinating the City's emergency management program with the emergency preparedness efforts of other jurisdictions and emergency response organizations.

e) Interagency Support and Coordination

Other organizations play a key role addressing emergencies that may occur within the City of Wilsonville. As a general rule, the City will look to the following agencies as having primary responsibility for the various functions as noted.

Clackamas County Sheriff. To provide law enforcement services on behalf of the City of Wilsonville, and to coordinate with other law enforcement agencies as appropriate. In addition to these primary response roles, the Clackamas County Sheriff's Office will assign a representative to the Operations Section of Wilsonville's EOC whenever activated.

Tualatin Valley Fire & Rescue (TVF&R). To address fires, explosions, hazardous materials, rescues, and pre-hospital medical care. In addition to these primary response roles, TVF&R will assign a representative to the Operations Section of Wilsonville's EOC whenever activated.

Clackamas County Office of Emergency Management. To provide county-wide allocation of limited resources; to secure state and federal emergency response resources as needed; and to coordinate county-wide public information. (Note: Should the emergency involve the portion of Wilsonville located within Washington County, then the Washington County Emergency Operations Center may also be involved in these functions.)

American Red Cross. To direct emergency shelter operations, including provisions for housing, food, clothing, necessities for persons with special needs, and welfare inquiry services.

Portland Amateur Radio Emergency Services (ARES). This volunteer organization is trained and equipped with HAM radio technology to supplement the City's communications systems, and to provide backup communication capabilities.

Mutual Aid Organizations. To provide equipment, supplies and/or personnel for assignment by the Incident Commander in support of emergency response/recovery efforts.

Others. Depending on the emergency at hand, other organizations may also have primary responsibility for aspects of the response and/or recovery effort. Such organizations may involve private and not-for-profit sectors, as well as County and State social service agencies. Specific needs/assignments will be determined through the Incident Command function on a case-by-case basis.

IV. Policies

The following policies enable the City to make effective use of available resources in its efforts to minimize the effects of emergencies.

a) ***Essential Services.*** Essential City services will be maintained as long as conditions permit.

b) ***Principle of Self-Help.*** The City will use all available local and mutual aid resources prior to requesting County or State support of emergency operations.

c) ***National Incident Management System (NIMS).*** The City will use the National Incident Management System (NIMS) as the basis for coordination among emergency response providers.

d) ***Incident Command System (ICS).*** The City will use the Incident Command System (ICS) as the basis for establishing its organizational structure in response to the demands of any given emergency.

e) ***Access to Emergency Services.*** Emergency services shall not be denied on the grounds of race, color, national origin, sex, age, handicap, marital status, or religious or political affiliation. To the extent possible, the needs of special populations shall be taken into account when conducting emergency response operations. Such special populations may include, but are not limited to: physically or mentally disabled; non-English speakers; the aged or infirm; and the incarcerated.

f) ***Cancellation of Leave.*** As deemed necessary by the City Manager, the declaration of an emergency nullifies leaves and vacations.

g) ***Emergency Response Guide.*** The City will prepare and regularly update an Emergency Response Guide based on the concepts, authorities, and policies presented in this Emergency Response Plan. The Emergency Response Guide will designate Incident Command System functions and corresponding staffing assignments. The Guide will also contain "hands on" reference materials for use by staff in emergencies.

h) ***Emergency Operations Center (EOC).*** The City will maintain a properly equipped site from which the City's Incident Management Team can direct emergency response activities.

i) ***Preparedness and Training.*** The City will exercise its emergency response system (or pertinent portions thereof) at least once per year. Based on these exercises, appropriate training will be identified and implemented.

j) ***Mitigation and Recovery.*** While the focus of this Plan is largely on the *response* phase of an emergency, the City will seek to prevent or minimize disaster impact throughout the preparation and recovery phases as well.

APPENDIX A:

Glossary of Terms

The definitions below convey the intent and meaning of terms as used in Wilsonville's Emergency Management Plan.

Disaster
Any hurricane, tornado, storm, flood, high water, wind-driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, drought, fire, explosion, or other catastrophe in any part of the United States which, in the determination of the President, causes damage of sufficient severity and magnitude to warrant Major Disaster assistance under PL 93-288, above and beyond emergency services by the federal government, to supplement the efforts and available resources of states, local governments, and disaster relief organizations in alleviating the damage, loss, hardship or suffering caused thereby. (PL 93-288).

Emergency
Any event whereby extraordinary measures must be taken to save lives; protect public health, safety and welfare; minimize destruction of property or the environment; or avert or lessen the threat of a major disaster.

Emergency Management Coordinator
The individual who has primary responsibility for developing and updating the City's emergency management program documents, conducting preparedness and training activities, and coordinating preparedness activities with other emergency response organizations. The Emergency Management Coordinator is so designated by the City Manager.

Emergency Management Plan
A document which discusses the concepts, authorities, and policies governing the way the City categorizes and addresses emergencies. The Emergency Management Plan will be reviewed annually to assure the overall direction provided by the Plan remains appropriate to meet the City's ongoing needs.

Emergency Operations Center (EOC)
The site from which the City's Incident Management Team coordinates the City's response, allocates City resources, and coordinates with other organizations during an emergency.

Emergency Response Guide
A document providing detailed information regarding the functions, organizational structure, lines and methods of communication, and "fingertip" reference materials for use by staff involved in addressing emergencies. The Emergency Response Guide is based on the overall direction provided by the Emergency Management Plan. Due to changes in the workforce, employee contact information, resource listings, and other pertinent information, updates to the Emergency Response Guide occur at least annually. Such revisions are conducted administratively and do not require City Council action.

Field Command Post
The field location from which tactical operations are conducted. Staff at the field Command Post are communicate with people in the Emergency Operations Center (EOC) if activated. Field Command Post personnel direct field response activities using whatever resources are authorized. EOC staff, when activated, manage the overall effort including the setting of incident priorities, resource allocation, contingency planning, coordination among agencies, and public information.

Incident Command System (ICS)
A standardized, all-hazard incident management concept used to provide effective incident management through the identification of specific functional roles, responsibilities, and chain of command. Used throughout the United States, this organizational structure has the flexibility to rapidly expand and contract in response to incident needs.

Incident Commander (IC)
The individual responsible for the overall management of the incident. Note: the person designated as the IC may change during the course of the incident. If/when this happens, the duties and authorities of the IC pass to the designated individual.

Incident Management Team
The group of City individuals, so designated in the Emergency Response Guide, who staff the Emergency Operations Center and direct the City's response during an emergency.

National Incident Management System (NIMS)
A comprehensive, national approach to incident management that is applicable to all jurisdictional levels and across functional disciplines. This system, established by Homeland Security Presidential Directive 5, provides a consistent nationwide template to enable all government, private-sector, and non-governmental organizations to work together during domestic incidents.

APPENDIX B: Excerpts from Oregon Revised Statues (ORS) Chapter 401

The following excerpts provide the statutory authority upon which the City of Portland's Emergency Management Plan is based.

401.015 Statement of policy and purpose. " . . . It is declared to be the policy and intent of the Legislative Assembly that preparations for emergencies and governmental responsibility for responding to emergencies be placed at the local government level. The state shall prepare for emergencies, but shall not assume authority or responsibility for responding to such an event unless the appropriate response is beyond the capability of the city and county in which it occurs, the city or county fails to act, or the emergency involves two or more counties."

401.305 Emergency management agency of city or county; emergency program manager; coordination of emergency management functions. "Each county of this state shall, and each city may, establish an emergency management agency which shall be directly responsible to the executive officer or governing body of the county or city. The executive officer or governing body of each county and any city which participates shall appoint an emergency program manager who shall have responsibility for the organization, administration and operation of such agency, subject to the direction and control of the county or city. . . Each emergency management agency shall perform emergency program management functions within the territorial limits of the county or city and may perform such functions outside the territorial limits as required under any mutual aid or cooperative assistance agreement or as authorized by the county or city."

401.309 Declaration of state of emergency by local government. "Each county, city or other municipal corporation in this state may, by ordinance or resolution, establish procedures to prepare for and carry out any activity to prevent, minimize, respond to or recover from an emergency. The ordinance or resolution shall describe the conditions required for the declaration of a state of emergency within the jurisdiction and the agency or individual authorized to declare that a state of emergency exists."

401.315 City or county authorized to incur obligations for emergency services. "In carrying out the provisions of ORS 401.015 to 401.105, 401.260 to 401.325 and 401.355 to 401.580, counties or cities may enter into contracts and incur obligations necessary to mitigate, prepare for, respond to or recover from emergencies or major disaster."

401.325 Emergency management agency appropriation; tax levy. "(1) Each county and city may make appropriations, in the manner provided by law for making appropriations for the expenses of the county or city, for the payment of expenses of its emergency management agency and may levy taxes upon the taxable property within the county or city.

(2) An appropriation made under subsection (1) of this section shall be budgeted so that it is possible to identify it as a distinguishable expense category."

401.480 Cooperative assistance agreements. The state, counties and cities may, in collaboration with public and private agencies, enter into cooperative assistance agreements for reciprocal emergency aid and resources. [1983 c.586 §15]

401.490 Mutual use of supplies and services. In carrying out the provisions of ORS 401.015 to 401.105, 401.260 to 401.325 and 401.355 to 401.580, the Governor and the executive officers or governing bodies of the counties and cities may request and utilize the services, equipment, supplies and facilities of existing departments, offices and agencies of the state and of local governments. The officers and personnel of all local government departments, offices and agencies may cooperate with, and extend such services and facilities to the Governor, to the Office of Emergency Management and to emergency management agencies and emergency service agencies upon request. [1983 c.586 §16]

401.505 Acceptance of aid for emergency services. Whenever any organization, agency, person, firm, corporation or officer thereof offers to the state or to any county or city, services, equipment, supplies, material or funds by way of gift, grant or loan for purposes of emergency program management or emergency services, the state, acting through the Governor, or the county or city, acting through its executive officer or governing body, may accept the offer. Upon acceptance, the Governor or executive officer or governing body of a county or city, as the case may be, may authorize any officer thereof to receive the services, equipment, supplies, materials or funds on behalf of the state, county or city, subject to the terms of the offer and any rules of the agency making the offer. [1983 c.586 §19]

APPENDIX C:

Resolution No. 1959
Declaration of Emergency

RESOLUTION NO. 1959

A RESOLUTION REPLACING RESOLUTION NO. 1589 AND PROVIDING FOR AUTHORITY TO DECLARE A STATE OF EMERGENCY AND IMPOSE EMERGENCY MEASURES.

WHEREAS, Oregon Revised Statutes (ORS) 401.309 provides for cities to establish by ordinance or resolution "the conditions required for the declaration of a state of emergency within the jurisdiction and the agency or individual authorized to declare that a state of emergency exists"; and

WHEREAS, Oregon Revised Statutes (ORS) 401.305 et seq. grant general and specific powers to cities to respond to emergencies; and

WHEREAS, in August of 1999 the City Council adopted Resolution No. 1589 known as the "Portland State of Emergency Resolution"; and

WHEREAS, since 1999 the City has participated in several emergency preparedness exercises and as a result has continued to refine and revised its emergency management program; and

WHEREAS, additions and clarifications to the "Portland State of Emergency Resolution" would enable better coordination and implementation of emergency operations;

NOW, THEREFORE, THE CITY OF PORTLAND RESOLVES AS FOLLOWS:

1. **Short Title.** This resolution replaces Resolution No. 1589 and shall be known as the "Portland State of Emergency Resolution" and may be so cited and pled.
2. **Purpose.** The purpose of this resolution is to provide a procedure to minimize injury to persons, property, and the environment and to preserve the established civil authority in the event that a state of emergency exists within the City of Portland. It is intended to grant as broad a power as permitted by statutory and constitutional authority.
3. **Definition of Emergency.** A state of emergency exists whenever any part of the City of Portland is suffering or in imminent danger of suffering from a

tornado, storm, flood, high water, wind-driven water, earthquake, volcanic eruption, landslide, mudslide, snow or ice storm, drought, fire, explosion, health hazard, infestation, toxic substance, civil disorder, disruption of community services, or any other catastrophe whereby extraordinary measures must be taken to save lives; protect public health, safety and welfare; minimize destruction of property or the environment; or avert or lessen the threat of a major disaster.

4. **Authority.** Under Oregon Revised Statutes (ORS) Chapter 401, local jurisdictions have the authority and responsibility for responding to emergencies.

5. **Declaration of Emergency.**

   A. When in the judgment of the City Council a state of emergency exists, the City Council shall so declare in writing and publicize the existence of same. If circumstances make it impractical or prohibitive for the City Council to take timely action, the Mayor may declare a state of emergency provided that the approval of a majority of the City Council is sought and obtained at the first available opportunity after order has been restored and the emergency has subsided.

   B. If the Mayor is unavailable for any reason, then the authority to declare an emergency shall pass to the Council President; if such person is unavailable for any reason, then to the City Manager (or person duly designated as Acting City Manager); if such person is unavailable, then to the order of succession as provided in the City's Emergency Management Plan. Ratification by a majority of the City Council shall be sought and obtained at the first available opportunity to confirm or amend the provisions of a declared state of emergency.

   C. An emergency declaration shall state in writing:

      i. the nature of the emergency;

      ii. the geographic boundaries of the area which is subject to emergency controls; and

iii. any special regulations or emergency powers imposed as a result of the declared emergency.

6. **Regulation and Control.** Whenever the circumstances arise upon which a state of emergency has been declared to exist within the City of Portland, the powers, actions, and authorities set forth in the City's Emergency Management Plan shall be in effect. The City Council is empowered to order and enforce the measures listed herein. However, if circumstances prohibit the timely action of the City Council, the Mayor, or his/her successor as set forth in Section 5, may order emergency measures, provided that approval from a majority of the City council is sought and obtained at the first available opportunity. Such emergency measures shall include, but not be limited to:

   A. Redirect funds for emergency use.
   B. Suspend standard procurement procedures to obtain necessary goods, services and/or equipment. However, price gouging shall be prohibited. No person or business may sell or attempt to sell any goods or services for a price in excess of the "normal market price," which shall mean that person's or business's average of the regular price of the goods or services for the 30 days preceding the state of emergency.
   C. Implement mutual aid agreements.
   D. Turn off water, gas or electricity.
   E. Restrict, regulate or prohibit vehicular or pedestrian traffic for such distance or degree as may be deemed necessary under the circumstances.
   F. Enter or pass through private property for the purpose of responding to the emergency and/or for the conduct of damage assessment.
   G. Evacuate persons from the area designated as an emergency area.
   H. Establish a curfew during specified hours in specified locations.
   I. Prohibit or limit the number of persons who may gather or congregate upon any public street, public place, or any outdoor place within the area designated as an emergency area.
   J. Prohibit possession of weapons or explosives of any kind on public streets, public places or any outdoor place.

K. Prohibit or restrict the sale of gasoline or other flammable liquids.

L. Curtail or suspend commercial activity.

M. Prohibit the sale of alcoholic beverages.

N. Order such other measures as are found to be necessary for the protection of life, property, infrastructure, the environment, or for the recovery from the emergency.

7. **Acquisition of Resources.** Under this section, the City Council is authorized to extend government authority to non-governmental resources (i.e. personnel, equipment) which may support regular government forces during an emergency and may enter into agreements with other public and private agencies for use of resources. When real or personal property is taken under power granted by this section, the owner of the property shall be entitled to reasonable compensation.

   Under the provisions of ORS Chapter 401, state resources are available when the appropriate response to an emergency is beyond the capability of the county in which it occurs.

8. **Penalty.**

   A. Any person, firm, corporation, association or entity that violates any emergency measure taken by the City Council under authority of this Ordinance shall be subject, upon conviction, to a fine of not more than $500.00 per offense.

   B. Each day of violation shall be deemed a separate offense for purposes of imposition of penalty.

   C. Where the Oregon Revised Statutes provide for a penalty for the act, commission or omission, the penalty prescribed herein shall be no greater than prescribed by said Oregon Revised Statutes.

9. **Responsibility for Emergency Management.** For the purpose of this resolution, in accordance with ORS Chapter 401, the emergency management agency of the City of Portland shall be the Incident Management Team as set forth in the City's Emergency Response Guide.

10. Separability. If any section, subsection, sentence, clause, phrase or portion of this resolution is, for any reason, held invalid or unconstitutional by a Court of competent jurisdiction, such portion shall be deemed a separate, distinct and independent provision, and such holding shall not affect the validity of the remaining portions of this resolution.

ADOPTED by the City Council of the City of Portland at a regular meeting thereof this 25th day of April, 2017, and filed with the Portland City Recorder this same date.

Charlotte Lehan

CHARLOTTE LEHAN, Mayor

ATTEST:

Sandra C. King

Sandra C. King, CMC, City Recorder

SUMMARY OF VOTES:
Mayor Lehan
Council President Kirk
Councilor Knapp
Councilor Holt
Councilor Scott-Tabb

APPENDIX D:

Resolution No. 1960 Adopts National Incident Management System (NIMS) and Incident Command System (ICS)

RESOLUTION NO. 1960

A RESOLUTION ADOPTING THE USE OF THE NATIONAL INCIDENT MANAGEMENT SYSTEM (NIMS) AND THE INCIDENT COMMAND SYSTEM (ICS) FOR COORDINATED RESPONSE TO EMERGENCIES.

WHEREAS, response to and recovery from major emergencies and disasters requires integrated management and coordination; and

WHEREAS, the President directed the Secretary of the Department of Homeland Security to develop and administer a National Incident Management System (NIMS) to standardize and enhance incident management procedures nationwide; and

WHEREAS, the National Incident Management System provides a structure and process to effectively coordinate responders from multiple disciplines and levels of government and to integrate them with resources from the private sector and non-governmental organizations; and

WHEREAS, the Incident Command System (ICS) is a standardized, all-hazard incident management concept and is a key component in the National Incident Management System; and

WHEREAS, use of the National Incident Management System and Incident Command System will improve the City of Portland's ability to manage major emergencies and disasters; and

WHEREAS, failure to adopt and use the National Incident Management System may preclude the City of Portland from receiving federal preparedness grants or reimbursement for costs expended during major emergency and disaster response and recovery operations;

NOW, THEREFORE, THE CITY OF PORTLAND RESOLVES AS FOLLOWS:

1. The City of Portland hereby adopts the National Incident Management System as the foundation for incident command, coordination and support activities.
2. The City of Portland hereby adopts the Incident Command System as the basis for establishing its organizational structure to address emergencies.

3. It shall further be the policy of the City of Portland to provide appropriate training on the National Incident Management System and the Incident Command System to personnel responsible for managing and/or supporting major emergency and disaster operations.

ADOPTED by the City Council of the City of Portland at a regular meeting thereof this 25th day of April, 2017, and filed with the Portland City Recorder this same date.

Charlotte Lehan

CHARLOTTE LEHAN, Mayor

ATTEST:

Sandra C. King

Sandra C. King, CMC, City Recorder

SUMMARY OF VOTES:
Mayor Lehan
Council President Kirk
Councilor Knapp
Councilor Holt
Councilor Scott-Tabb

VALLEY MEDICAL

SAFE REFUGE AREA MAP

2800 Medical Center Drive, Portland, OR 97035





EMERGENCY CONTACTS

CITY OFFICES	
City Hall	503-682-1011
Community Center	503-682-3727
Library	503-682-2744
Public Works	503-682-4092
Parks & Recreation	503-783-7529
Fleet	503-682-1160
Transit ~ SMART	503-682-7790
Water Treatment Plant	503-582-9655
Wastewater Treatment Plant	503-682-1077

COUNTY	
Clackamas County	
Canby Ferry	503-650-3030
Transportation -	
Holly Covington	503-557-6391
Electrician -	
Dorian Libal	503-650-3711
	(M) 503-621-4208
Sign Shop-	
Sean	503-650-3357
Washington County	
Roads	503-846-7623
Signals	503-846-7626

STATE	
ODOT	
Salem Maint Coord	503-551-7166
Jeff Sorenson - Office	503-986-2887
Fax	503-986-5835
Baldock Rest Area	503-229-5303
South Exit	503-731-3322
North Exit	
Signals - TMOC	503-283-5859
Landscape Maint	503-229-5304
Milwaukie Maint Coord	
Ted Miller	503-653-3124
ODF&W	503-657-2000
Oregon Water Resources	503-378-8455

POLICE	
Clackamas County	
Dispatch	503-655-8211
C-Com	503-655-8411
Back Line Dispatch	503-655-8911
Sheriff's Office - OC	503-655-8218
Wilsonville Police	503-682-1012
Washington County	503-846-7661
Oregon State Police	503-731-3030

FIRE	
TVF&R	
Dispatch	503-629-0111
Elligsen Station	503-682-0306
Kinsman Station	503-682-0369

RAILROAD	
Portland & Western	
Signals -	
Howard Sanders	(M) 503-816-8011
	503-681-7941

DEQ	
OR DEQ Emergency Response	800-452-0311
Pollution Report	503-229-5393
Chemtech	800-424-9300
Chlorine Leak	911

CONTRACTORS LIST

CONTRACTORS

Construction/Excavation

BNE Const	
Brian Erickson	503-519-9889
CR Woods	503-925-0600
DaNeal Const	
Dave Erickson	(M) 503-793-0804
Clopton Exc (Snow Removal)	
Brian Clopton	503-209-1163
Joe Watts	503-209-6569
Coral Const	503-682-2252
A&A Drilling	503-659-8583
Tigard Sand & Gravel	503-692-1800

Flaggers

K&D Flagging	800-473-1649

Equipment & Supplies

Flint Trading - Gregg	206-963-5468
AWWA	503-246-5845
GC Systems	1-800-525-9425
Portland Engineering -	
Mike Hogan	(M) 503-789-5412
Pump Tech Systems	503-925-0667
	(M) 503-537-8080
Schneider Equipment	503-633-2666
Spencer Environmental	503-788-4612
Public Works Supply	336-308-3781
Traffic Safety Supply	503-235-8531
United Rentals	503-620-1235
Penske	503-682-2621
Xylem (Godwin Pumps)	503-981-0341
	503-710-6252
Peterson CAT Generators	503-280-1567
	503-710-6252

Water / Waste Water

United Pipe & Supply	503-588-8813
HD Fowler	503-656-3900
Consolidated Supply	503-620-7050
Ferguson	503-240-6747
HD Supply	503-620-9123
Oregon Meter Repair	503-842-7971
	503-970-7881
Watt Welding	503-639-2836
Godwin Pumps (Xylem)	503-981-0341
	(M) 503-572-3912
Kurka Contracting	503-428-0758
Water Truck Service	
Bravo Environmental	
Spencer Environmental	503-788-4612
River City Environmental (Dan)	503-467-2584
SafeSorb	
Mike Keller	503-781-6686

Labs

Alexin Analytical Lab	503-639-9311
Columbia Analytical	360-577-7222

Building Maint

TVWS Janitorial	503-649-8571
	503-720-5864
Thyssen Krupp Elevator	503-901-1518
Dogi Pot	1-800-364-7681
Sierra Springs	503-233-9991
Metro Gate Repair	503-285-7568

Disaster Cleanup

ServPro of Tualatin (24 hr)	503-684-5829
Kennedy Restoration	503-234-0509
Bio Management NW (24 hr)	1-877-524-6411

Lock & Security

Wilsonville Lock & Security	503-682-2323
Alarm Repair Only	503-682-1792

Pest Control

Columbia Pest Control	503-254-1606

First Aid / Fire Extinguisher Services

Tower Pointe First Aid Supply	503-655-0364
National Fire Ext Service	503-232-6646
Mobile	503-351-0971

Lumber / Roofing / Glass

Parr Lumber	503-638-7575
Anderson Roofing	503-294-0202
Jim Fisher Roofing	503-625-2586
ACE Glass	503-682-1618

HVAC

Roth HVAC	503-266-1249
Trane Oregon	503-620-8031

Electrical

Boones Ferry Electric	503-682-4936
ECO Electric - Chris	503-969-7053
Platt Electric	503-682-1399

Plumbing

Modern Plumbing	503-691-6166
Canby Plumbing	503-266-2091
Roto Rooter	503-692-5954
American Drain Cleaning	503-265-9593
United Services - Porta Potty	1-800-864-5387
ID# PNW-04775	

Tree/Mowing Service

City Wide Tree Service	503-653-6873
Gary Nebergall	503-969-7817
Fray Repp	503-653-0619

Street Sweeping

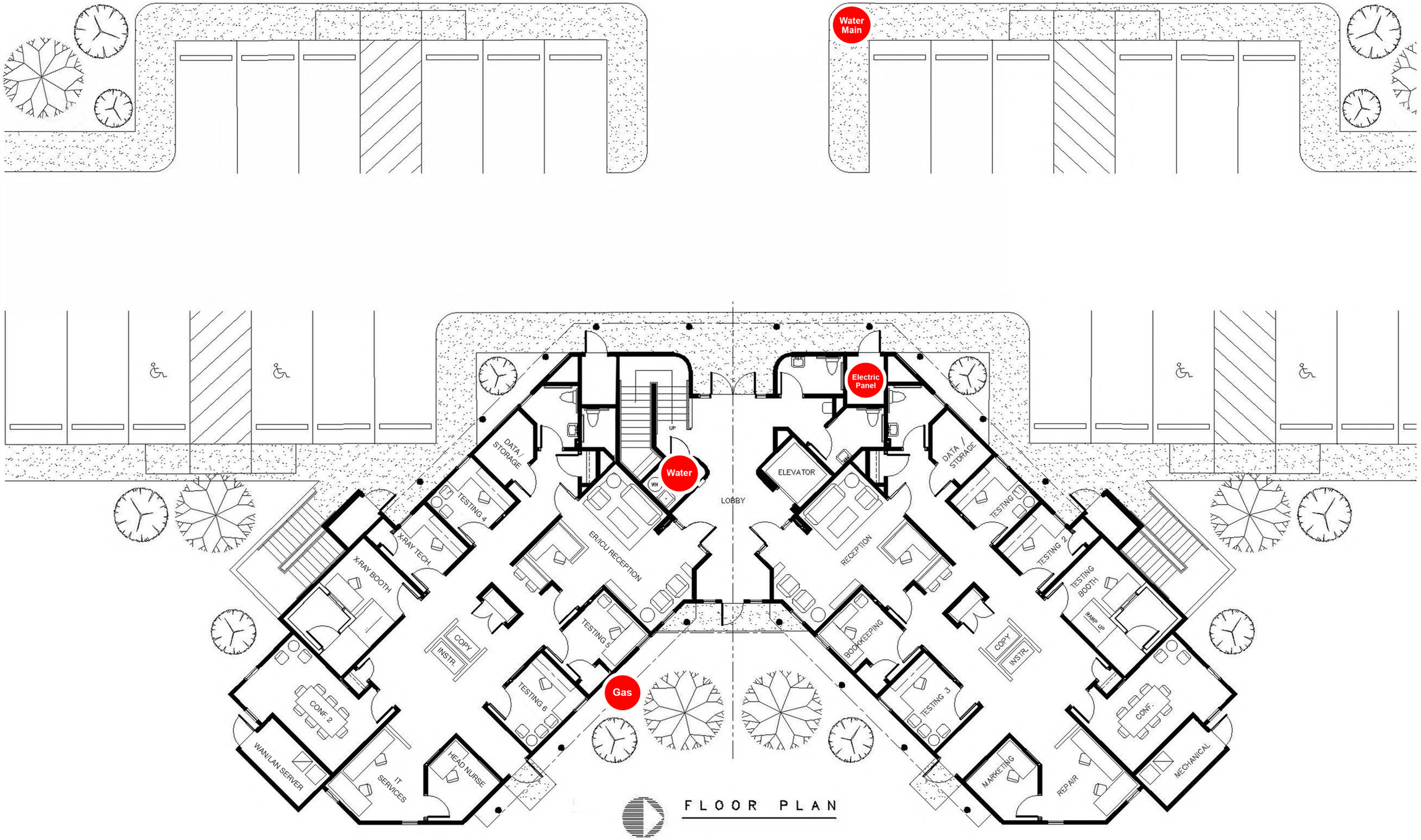
Water Truck Service (Sweeper)	503-682-2723

PPE Uniform/Laundry

Aramark	
Randy (M)	503-901-5517

VALLEY MEDICAL

MEDICAL CENTER DRIVE



FLOOR PLAN

BOUCHER
MOUCHKA
LARSON
Architects

209 S.W. Oak
Portland, Oregon
503/223-4886

EFK MOB AND PARKING AREAS

Drawing:
FLOOR PLAN
LEVEL L1

Job. No. 8019-0

Sheet:
A2.8

VALLEY MEDICAL

1/2" WHITE QUICK RESPONSE RECESSED PENDENT SPRINKLER 165°F - "K" FACTOR 5.6 - VIKING MICROFAST MODEL "M" (SIN VK302) WITH MICROMATIC MODEL "E-1" RECESSED WHITE ESCUTCHEON.

R 1/2" WHITE RESIDENTIAL RECESSED PENDENT SPRINKLER 155°F - "K" FACTOR 5.5 - VIKING RESIDENTIAL MODEL "M-5" (SIN VK432).

R 1/2" WHITE RESIDENTIAL HORIZONTAL SIDEWALL SPRINKLER 155°F - "K" FACTOR 5.5 - VIKING MICROFAST MODEL "M-5" (SIN VK442).

DS 1/2" WHITE QUICK RESPONSE RECESSED HORIZONTAL DRY SIDEWALL SPRINKLER 155°F - "K" FACTOR 8.0 - VIKING (SIN VK279).

1/2" WHITE QUICK RESPONSE CONCEALED SIDEWALL SPRINKLER 165°F - "K" FACTOR 5.6 - VIKING WITH COLOR OF COVER PLATE TO BE DETERMINED BY ARCHITECT 135°F (SIN VK481). PROVIDE ADDITIONAL 15% SUPPLY OF COVER PLATES.

1/2" WHITE QUICK RESPONSE CONCEALED PENDENT SPRINKLER 165°F - "K" FACTOR 5.6 - VIKING HORIZON MIRAGE "B-2" WITH COLOR OF COVER PLATE TO BE DETERMINED BY ARCHITECT 135°F (SIN VK462). PROVIDE ADDITIONAL 15% SUPPLY OF COVER PLATES.

1/2" BLACK STANDARD RESPONSE UPRIGHT SPRINKLER 155°F - "K" FACTOR 5.6 - VIKING MICROFAST MODEL "M" (SIN VK300) POLYESTER COATED.

1/2" WHITE ADJUSTABLE QUICK RESPONSE CONCEALED DRY PENDENT SPRINKLER 155°F - "K" FACTOR 5.6 - STANDARD COVERAGE RELIABLE MODEL "F3QR" WITH WHITE COVER PLATE 135°F (SIN R5714). PROVIDE ADDITIONS 15% SUPPLY OF COVER PLATES.

	BRANCH PIPING	F.C.	FLUSHING CONNECTION
	MAIN PIPING		PIPE CAPPED
	PRESSURE GAUGE		PIPE BELOW
	O.S. & Y. GATE VALVE WITH TAMPER SWITCH		PIPE ABOVE
	FLOW SWITCH		PIPE BELOW
	STANDPIPE	X	DRAWING REFERENCE NOTE
			POINT OF CONNECTION

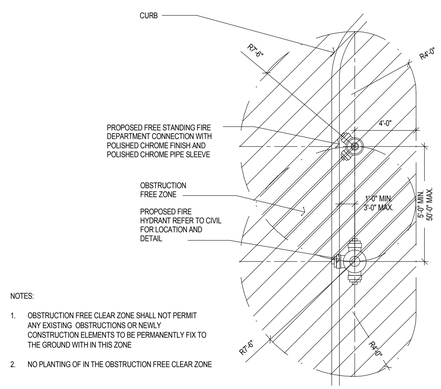
J | SCALE: N.T.S.

F | FIRE PROTECTION SYMBOL LEGEND | SCALE: N.T.S.

1. FIRE PROTECTION SYSTEM TO COMPLY WITH NFPA # 13, 14, 20, 24, 25, 2001 AND ALL APPLICABLE STATE AND LOCAL CODES.
2. FINAL INSPECTION AND APPROVAL BY LOCAL FIRE DEPARTMENT, BLDG. DEPT., AND ARCHITECT/ENGINEER.
3. A VISIT TO THE SITE TO CHECK AND VERIFY ALL EXISTING CONDITIONS PRIOR TO BIDDING TO INSURE THE COORDINATION OF THE FIRE SERVICES WITH EXISTING CONDITIONS.
4. CUTTING OF STRUCTURAL AND/OR ARCHITECTURAL MEMBERS TO BE DONE ONLY WITH THE WRITTEN APPROVAL OF THE ARCHITECT AND STRUCTURAL ENGINEER.
5. PIPE ROUTING SHOWN SHALL BE USED AND ANY ADDITIONAL OFFSETS OR FITTINGS REQUIRED FOR PROPER INSTALLATION, COORDINATION WITH OTHER TRADES, AND/OR TO MAINTAIN PROPER CLEARANCES SHALL BE PROVIDED. VERIFY STRUCTURAL, MECHANICAL, ELECTRICAL INSTALLATIONS AND AVOID ALL OBSTRUCTIONS OR INTERFERENCES.
6. REFER TO ARCHITECTURAL REFLECTED CEILING PLANS AND ELECTRICAL LIGHTING DRAWINGS FOR CEILING DESCRIPTIONS AND HEIGHTS.
7. FLOW TEST DATA IS 71 PSI STATIC PRESSURE WITH RESIDUAL PRESSURE OF 59 PSI @ 1870 GPM PERFORMED BY MILWAUKEE WATER WORKS ON 05/25/2005. CONTRACTOR SHALL PER PERFORM UP TO DATE FLOW TEST AS PART OF HYDRAULIC CALCULATIONS
8. FIRE STOP ALL PENETRATIONS OF SMOKE/FIRE WALLS, CEILINGS, FLOORS, ROOFS, ETC., FLASH AND COUNTERFLASH ROOF PENETRATIONS.
9. PROVIDE ACCESS PANELS TO ALL VALVES ABOVE NON-ACCESSIBLE CEILINGS AND CHASES.
10. SPRINKLER HEADS ARE TO BE COORDINATED WITH ALL DIFFUSERS, SPEAKERS, LIGHTING FIXTURES, CEILING SYSTEMS AND STRUCTURAL SYSTEM.
11. INDICATE CENTER-TO-CENTER DIMENSIONS AND/OR PIPE CUT LENGTHS AND NOMINAL PIPE DIAMETERS ON ALL PIPING.
12. INDICATE PIPE TYPE, SCHEDULE OF WALL THICKNESS AND METHOD OF JOINING ON SHOP DRAWING.
13. PROVIDE STOCK OF EXTRA SPRINKLERS IN ACCORDANCE WITH N.F.P.A.-13.
14. PROVIDE DETAIL AND INDICATE TYPE OF HANGER TO BE INSTALLED FOR SPRINKLER PIPING. METHODS OF HANGING PIPES, HEADERS AND BRANCHES SHALL BE IN ACCORDANCE WITH N.F.P.A. 13. HANGERS SHALL NOT INTERFERE WITH ANY OTHER TRADE. POWDER DRIVEN STUDS SHALL NOT BE USED.
15. ALL GROOVED & SCREWED FITTING SHALL BE APPROVED PRIOR TO ANY INSTALLATION BY ENGINEER WHO RESERVES THE RIGHT TO DISAPPROVE ANY FITTING.
16. ALL SPRINKLER PIPING & FITTINGS SHALL BE INSTALLED RUST-FREE.
17. AUTOMATIC SPRINKLER TEMPERATURE RATINGS OF GLASS BULB ELEMENTS TO BE IN ACCORDANCE WITH N.F.P.A. 13. ALL SPRINKLERS SHALL HAVE CORROSIVE-RESISTANT COATING.
18. ALL VALVES FOR FIRE SERVICE SHALL BE LISTED BY THE UNDERWRITER'S LABORATORIES, INC. AND THE FACTORY MUTUAL LABORATORIES. VALVES SHALL BE FACTORY MARKED "UL" AND "FM", 175 WORKING PRESSURE, AND 300 WORKING PRESSURE WHERE APPLICABLE.
19. ALL VALVES ON THE FIRE PROTECTION SYSTEM TO BE ELECTRICALLY SUPERVISED. TYPE AND EXACT LOCATION OF FLOW AND SUPERVISORY SWITCHES SHALL BE ACCOMPLISHED/COORDINATED BETWEEN THE DIFFERENT RESPONSIBLE TRADES. ADDITIONAL WIRING OR ADDITIONAL SWITCHES REQUIRED SHALL BE PROVIDED.
20. BE ADVISED THAT PIPING SHOWN IS ARRANGED TO ALLOW FOR FIRE ALARM ZONING. FIRE PROTECTION PIPING ARRANGEMENT SHALL REFLECT AND ALLOW SAME ZONING AS SHOWN.
21. CAUTION: FINAL SPRINKLER SHOP DRAWINGS SHALL BE SUBMITTED TO ENGINEER THROUGH ARCHITECT. NO INSTALLATION SHALL BE PERMITTED UNTIL SPRINKLER SHOP DRAWINGS HAVE BEEN APPROVED.
22. SPRINKLERS SHALL COVER THE ENTIRE AREA OF ALL STRUCTURAL MEMBERS. SPRAY SHALL NOT BE BLOCKED BY WALLS, PARTITIONS OR STRUCTURAL COMPONENTS.
23. IMMEDIATELY NOTIFY THE ARCHITECT/ENGINEER OF ANY DISCREPANCIES FOUND BETWEEN THESE PLANS, OTHER ENGINEERING PLANS, THE ARCHITECTURAL PLANS AND/OR FIELD CONDITIONS PRIOR TO FINAL BID PRICE OR FINAL PERMITTING.
24. IN CASE OF DISPUTE OR DOUBT AS TO INTENT OF DRAWINGS OR SPECIFICATIONS, OBTAIN ARCHITECT/ENGINEER'S WRITTEN DECISION BEFORE PROCEEDING WITH BID INVOLVED.
25. BEFORE SUBMITTING PROPOSAL OR BID, EXAMINE ALL DRAWINGS AND SPECIFICATIONS RELATING TO THIS PROJECT, THE AMOUNT OF SPACE AVAILABLE FOR PIPING, EQUIPMENT AND CONNECTING SERVICES, THE SITE OF THE WORK, THE REQUIREMENTS TO CORRELATE THE FIRE PROTECTION WORK WITH THAT OF OTHER TRADES AND THE TIME SCHEDULE NECESSARY TO PERFORM THAT WORK.
26. AFTER EXAMINATION OF ALL PLANS AND SPECIFICATIONS, INCLUDE ALL THE COSTS NECESSARY FOR ALTERATION, MODIFICATIONS AND/OR ADDITIONS TO THE FIRE PROTECTION SYSTEM(S) NECESSARY TO MAKE A COMPLETE, APPROVED AND FINISHED INSTALLATION IN ALL ASPECTS. IT IS THE INTENT THAT ALL COSTS REQUIRED BE INCLUDED IN THE BID OF THIS TRADE.
27. PIPE SHALL BE REAMED AND CLEANED BEFORE ASSEMBLY, AND AFTER ASSEMBLY. THE ENTIRE PIPING SYSTEM SHALL BE FLUSHED CLEAN.
28. ADJUST NEW/EXISTING SPRINKLER PIPING AND SPRINKLER HEAD PLACEMENT TO ACCOMMODATE NEW/EXISTING CEILING HEIGHTS AND STRUCTURAL CONFIGURATIONS.
29. PROVIDE SYSTEM(S) WITH FLUSHING CONNECTION(S).
30. PROVIDE SPRINKLERS ABOVE AND BELOW EXPOSED DUCTWORK, AN OBSTRUCTION, OR COMBINATIONS OF OBSTRUCTIONS 4 FEET OR WIDER.
31. INDICATE THE ROOM FUNCTIONS FOR EACH AREA ON THE SHOP DRAWINGS.
32. INDICATE THE LOCATION AND SIZE OF BLIND SPACES AND CLOSETS ON THE SHOP DRAWINGS.
33. INDICATE THE TOTAL SQUARE FOOT AREA PROTECTED BY SYSTEM(S) ON EACH FLOOR(S) ON THE SHOP DRAWINGS.
34. INDICATE THE NUMBER OF SPRINKLERS ON EACH RISER PER FLOOR ON THE SHOP DRAWINGS.
35. PROVIDE HEAD GUARDS ON SPRINKLER HEADS IN ELECTRIC, TELEPHONE AND MECHANICAL ROOMS.
36. ALL PENDENT SPRINKLERS SHALL BE CENTER-OF-TILE, UNLESS MAXIMUM DISTANCES FROM WALLS OR BETWEEN HEADS IS EXCEEDED. ALL SPRINKLER HEADS MOUNTED IN CEILING SHALL BE LOCATED A MINIMUM OF 4" AWAY FROM ANY WALLS, CEILING GRID MEMBERS, CEILING HEIGHT CHANGES OR ANY OTHER VERTICAL INTERSECTING STRUCTURAL SURFACE.
37. INSPECTOR'S TEST VALVE SHALL NOT EXCEED 7 FEET ABOVE THE FINISHED FLOOR. STYLE OF TEST SHALL BE VICTAULIC TESTMASTER II #720.
38. PROVIDE SMOOTH BORE CORROSION RESISTANT OUTLET FOR INSPECTOR'S TEST GIVING FLOW EQUIVALENT TO 1 SPRINKLER.
39. FIRE PROTECTION CONTRACTOR SHALL ASSIST IN PREPARATION OF COORDINATION DRAWINGS FOR ALL LEVELS WHICH INDICATE ALL THE ENGINEERING DISCIPLINES & FIRE PROTECTION PIPING. THESE DRAWINGS SHALL BE PREPARED & APPROVED BY THE ENGINEER PRIOR TO ANY INSTALLATION. REFER TO SPECIFICATION SECTION 15002 - COORDINATION DRAWINGS.
40. FIRE SPRINKLER PIPING SHALL NOT TRAVEL WITHIN 6 FEET OVER THE TOPS OF ELECTRICAL PANEL BOARDS PER N.F.P.A 70 NEC ARTICLE 110-26-F-1-A, 1999 EDITION.
41. PROVIDE ADDITIONAL SPRINKLER HEADS, FITTINGS, APPURTENANCES, AND ALL OTHER WORK NECESSARY TO ACCOMMODATE A MINIMUM OF AN ADDITIONAL 15% OF THE TOTAL CONTRACT PRICE AS INDICATED ON THE CONTRACT DOCUMENTS. THE 15% OF THE TOTAL CONTRACT PRICE SHALL BE USED TO PROVIDE ANY ADDITIONAL FIRE PROTECTION SPRINKLER COVERAGE WHICH MAY BE NEEDED TO ACCOMMODATE ANY INTERIOR DESIGN LAYOUTS, OR CHANGES TO SUCH LAYOUTS WHICH ARE OR MAY BE INCLUDED IN THE WORK. THESE SPRINKLERS AND ASSOCIATED WORK SHALL BE PROVIDED WHERE REQUIRED TO RESOLVE ANY CONFLICTS OR OTHER LAYOUT CHANGES NEEDED TO ACCOMMODATE ALL MISCELLANEOUS ITEMS (I.E., CEILING OFFSETS, SOFFITS, COVES, CODE CORRECTIONS/INTERPRETATIONS, STRUCTURAL SYSTEM CONFLICTS, OR RELATED INTERIOR DESIGN CONFIGURATIONS). AT PROJECT COMPLETION, A CREDIT WILL BE DUE TO THE OWNER FOR ALL UNUSED PORTION OF THE 15% OF THE TOTAL CONTRACT PRICE AND THIS CREDIT WILL BE INCORPORATED INTO THE FINAL PAY APPLICATION AT A RATE ESTABLISHED IN THE BID PROPOSAL AS TWO SEPARATE LINE ITEMS. ONE LINE ITEM WILL IDENTIFY THE TOTAL COST OF THE REQUIRED 15% TOTAL CONTRACT PRICE, AND THE SECOND LINE ITEM WILL IDENTIFY AN INDIVIDUAL COST PER SPRINKLER HEAD AND ALL ASSOCIATED PIPING, FITTINGS AND HANGERS.
42. ALL SPRINKLERS SHALL MEET WITH NFPA #13 TEMPERATURE RATINGS FOR FIRE SPRINKLERS (i.e. SPRINKLERS LOCATED IN A HIGH TEMPERATURE ZONE SHALL HAVE HIGH-TEMPERATURE CLASSIFICATION SPRINKLERS AND SPRINKLERS LOCATED IN AN INTERMEDIATE ZONE SHALL HAVE INTERMEDIATE TEMPERATURE CLASSIFICATION SPRINKLERS).

ALL PUBLIC AREA DIFFUSERS, LIGHT FIXTURE TRIMS, CAMERA TRIMS, AND SPEAKER TRIMS/GRILLES SHALL BE FIELD PAINTED BY THE GC PER THE DEVICE COLOR SCHEDULE TO BE ISSUED BY THE ARCHITECT. ALL PUBLIC AREA SPRINKLER HEADS, ELECTRICAL, LOW VOLTAGE DEVICES AND COVERPLATES SHALL BE PRICED ASSUMING A CUSTOM COLOR, WHICH WILL BE PROVIDED AT A LATER DATE BY THE ARCHITECT, FOR THE THEMED SUITES, CONTRACTOR TO ALLOW FOR CUSTOM COLORS FOR ALL WALL AND CEILING DEVICES IN PRICING. FINAL COLORS WILL BE PROVIDED IN FUTURE ADDENDUM

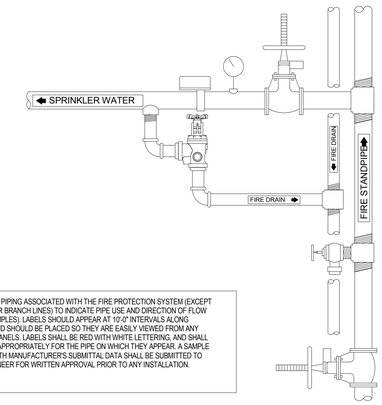
B | FIRE PROTECTION GENERAL NOTES | SCALE: N.T.S.



NOTES:

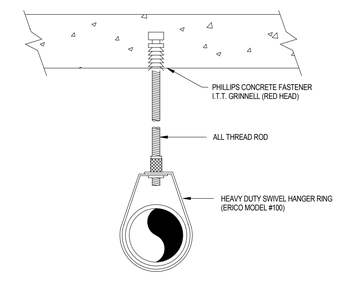
1. OBSTRUCTION FREE CLEAR ZONE SHALL NOT PERMIT ANY EXISTING OBSTRUCTIONS OR NEWLY CONSTRUCTION ELEMENTS TO BE PERMANENTLY FIX TO THE GROUND WITH IN THIS ZONE
2. NO PLANTING OF IN THE OBSTRUCTION FREE CLEAR ZONE

L | PLANTING ADJACENT TO FIRE HYDRANTS & CONNECTIONS | SCALE: N.T.S.



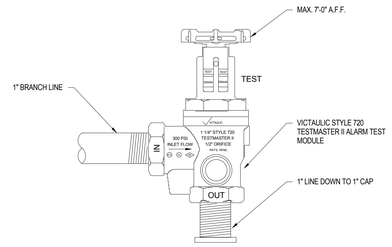
LABEL ALL PIPING ASSOCIATED WITH THE FIRE PROTECTION SYSTEM (EXCEPT SPRINKLER BRANCH LINES) TO INDICATE PIPE USE AND DIRECTION OF FLOW (SEE EXAMPLES). LABELS SHOULD APPEAR AT 15'-0" INTERVALS ALONG PIPING, AND SHOULD BE PLACED SO THEY ARE EASILY VIEWED FROM ANY ACCESS PANELS. LABELS SHALL BE RED WITH WHITE LETTERING, AND SHALL BE SIZED APPROPRIATELY FOR THE PIPE ON WHICH THEY APPEAR. A SAMPLE ALONG WITH MANUFACTURER'S SUBMITTAL DATA SHALL BE SUBMITTED TO THE ENGINEER FOR WRITTEN APPROVAL PRIOR TO ANY INSTALLATION.

H | FIRE PROTECTION SYSTEM LABELING | SCALE: N.T.S.

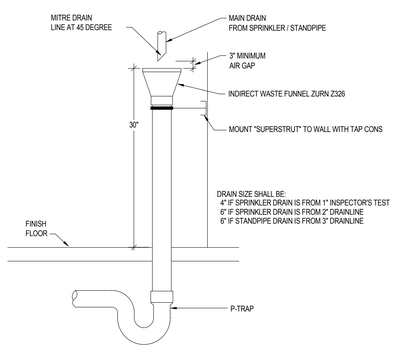


(U.L./F.M. APPROVED)

E | CONCRETE INSERT PIPE HANGER DETAIL | SCALE: N.T.S.

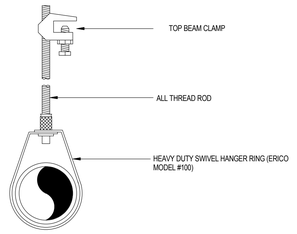


K | NEW INSPECTORS TEST CONNECTION - DRY SYSTEM | SCALE: N.T.S.



FOR REFERENCE ONLY

G | INDIRECT WASTE CONNECTION FOR FIRE PROTECTION DRAIN | SCALE: N.T.S.



A | TOP BEAM CLAMP PIPE HANGEAR DETAIL (U.L./F.M. APPROVED) | SCALE: N.T.S.

ABOVE FINISHED FLOOR	AFF	GALLONS PER MINUTE	GPM
BACK FLOW VALVE	BFV	GROOVED	GRV'D
BELOW FINISHED FLOOR	BFF	NOT IN CONTRACT	NIC
CONTINUATION	CONT.	NOT TO SCALE	NTS
DOWN	DN	OPEN STEM & YOKE	OS&Y
DRAWING	DWG.	POST INDICATOR VALVE	P.I.V.
ELECTRIC	ELEC	POUNDS / SQUARE INCH	PSI
EXISTING	EX.	STANDPIPE	STP
FIRE DEPARTMENT CONNECTION	FDC	UNDERGROUND	UNDG.
FIRE EXTINGUISHER	FE	UNLESS NOTED OTHERWISE	UNO
FIRE VALVE CABINET	FVC	VICTAULIC REDUCING COUPLING	VRC
FLOW SWITCH	FS	EXISTING TO REMAIN	ETR
TAMPER SWITCH	TS		

D | FIRE PROTECTION ABBREVIATIONS | SCALE: N.T.S.

Sheet List 1

Sheet Number	Sheet Name
FP001	FIRE PROTECTION LEGEND
FP002	FIRE PROTECTION DETAILS
FP003	FIRE PROTECTION - ENLARGED ROOMS
FP101	FIRE PROTECTION PLAN - LEVEL 1
FP102	FIRE PROTECTION PLAN - LEVEL 2
FP103	FIRE PROTECTION PLAN - LEVEL 3
FP104	FIRE PROTECTION PLAN - LEVEL 4
FP105	FIRE PROTECTION PLAN - LEVEL 5-15

A | SHEET INDEX | SCALE: N.T.S.

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Revisions

No.	Date	Description
1	6/14/2013	Bulletin #14

Document Phase: CD
Date: 03/29/2016
PIC / AIC: PVK
Drawn By: CMZ
Checked By: MAN
Comm. No.: 11-0033

Project Title

PHASE 1

Package

Bulletin #8
Construction Package #3
Interiors

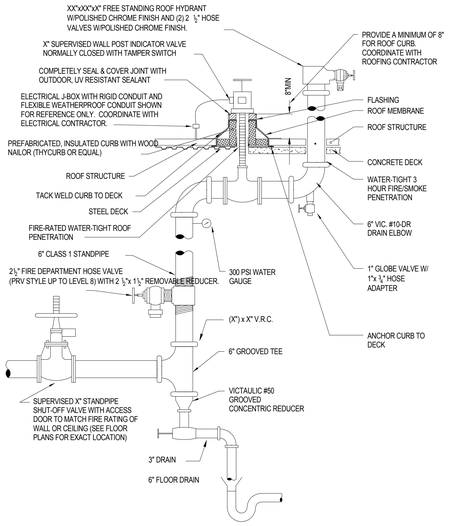
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FIRE PROTECTION LEGEND

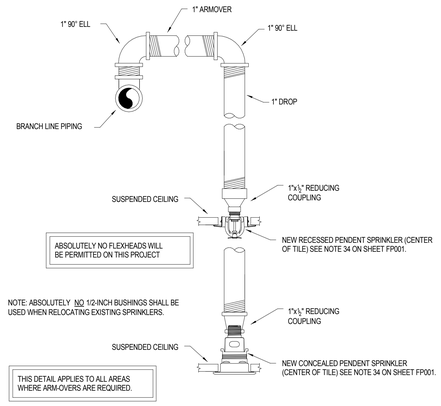
Sheet Number

FP001

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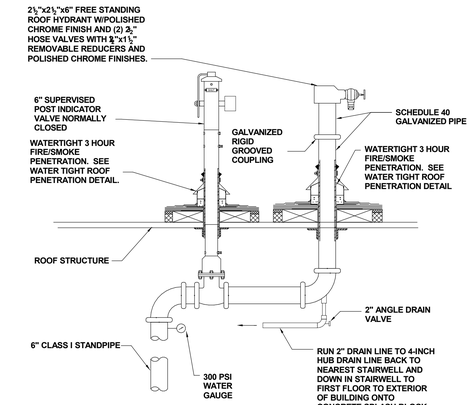


L | STANDPIPE RISER DETAIL | SCALE: N.T.S.

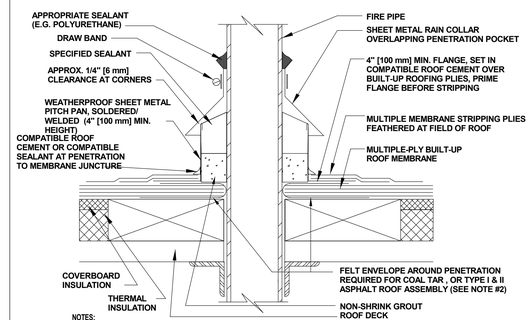


H | NEW TYPICAL SWING JOINT | SCALE: N.T.S.

H | STANDPIPE W/ROOF HYDRANT & DRAIN DETAIL - STAIR A | SCALE: N.T.S.



F | FREE STANDING ROOF HYDRANT & POST INDICATOR | SCALE: N.T.S.



NOTES:
1. PRIOR TO INSTALLATION, SEAL PENETRATION WITH ELASTIC FILL.
2. INSTALL ENVELOPE (BITUMEN-STOP) FOR A CONTINUOUS EDGE SEAL AT THE PERIMETER AND AT PENETRATIONS BY EXTENDING PERFORMANCE PLY, PIKA PLY SS-2, OR TWO PLIES OF NON-PERFORATED ORGANIC ASPHALT SATURATED FELT BEYOND THE EDGE OF THE MEMBRANE FIELD PLIES. AFTER ALL OVERLAPPING FIELD PLIES ARE IN PLACE, THE EXTENDED PLY IS TURNED BACK INTO THE MEMBRANE AND ADHERED. THE ENVELOPE IS INTENDED TO PREVENT BITUMEN SEEPAGE FROM THE EDGE OF THE MEMBRANE.
3. DO NOT USE MODIFIED COAL TAR ON SLOPES THAT EXCEED 1/2" PER FOOT
4. DO NOT USE TYPE I TAR WITH POLYESTER OR TARRED GLASS FELTS ON SLOPES THAT EXCEED 1/4" PER

F | WATER TIGHT ROOF PENETRATION POCKET | SCALE: N.T.S.



1. GYPSUM WALL ASSEMBLY (UL/ULC CLASSIFIED U300 OR U400 SERIES) (1-HR OR 2-HR FIRE-RATING) (2-HR SHOWN).

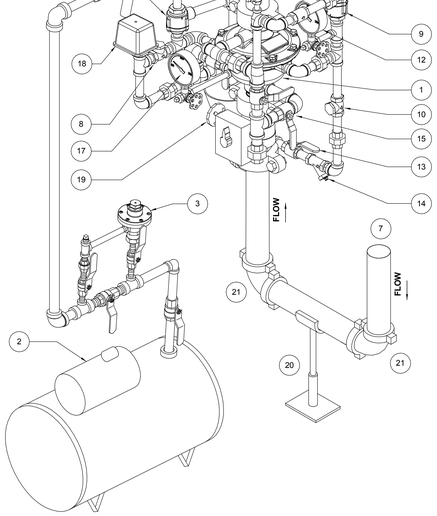
2. PENETRATING ITEM TO BE ONE OF THE FOLLOWING:
A. MAXIMUM 30" NOMINAL DIAMETER STEEL PIPE (SCHEDULE 10 OR HEAVIER).
B. MAXIMUM 30" NOMINAL DIAMETER CAST IRON PIPE.
C. MAXIMUM 6" NOMINAL DIAMETER COPPER PIPE.
D. MAXIMUM 6" NOMINAL DIAMETER STEEL CONDUIT.
E. MAXIMUM 4" NOMINAL DIAMETER EMT.

3. HILTI FS-ONE INTUMESCENT FIRESTOP SEALANT:
A. MINIMUM 5/8" DEPTH, FOR A 1-HR FIRE-RATING.
B. MINIMUM 1-1/4" DEPTH, FOR A 2-HR FIRE-RATING.

4. MINIMUM 1/2" BEAD HILTI FS-ONE INTUMESCENT FIRESTOP SEALANT AT POINT OF CONTACT.

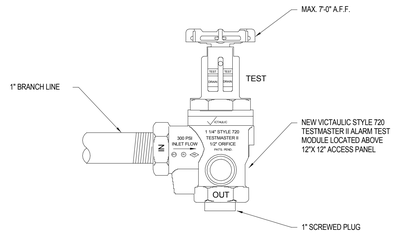
NOTES : 1. MAXIMUM DIAMETER OF OPENING:
A. 32-1/4" FOR STEEL STUD WALLS.
B. 14-1/2" FOR WOOD STUD WALLS.
2. ANNULAR SPACE = MINIMUM 0", MAXIMUM 2-1/4".

E | METAL PIPE THROUGH 1-HR. OR 2-HR GYPSUM WALL ASSEMBLY | SCALE: N.T.S.

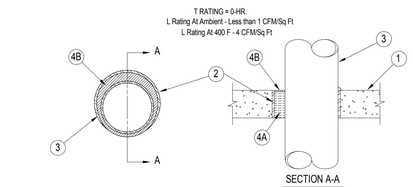


REFERENCE NOTES:
1. DRY PIPE VALVE
2. TANK MOUNTED AIR COMPRESSOR _VAC, _HP, _HZ, SINGLE PHASE
3. AIR MAINTENANCE DEVICE WITH BYPASS TRIM
4. OPTIONAL ACCELERATOR CONNECTION
5. AIR PRESSURE SUPERVISORY SWITCH _V
6. PNEUMATIC OPERATING RELEASE VALVE
7. _" FROM SUPPLY MAIN
8. DRAIN CHECK VALVE
9. A-1 DIFFERENTIAL VALVE
10. SWING CHECK VALVE
11. 300 PSI AIR PRESSURE GAUGE & VALVE
12. 300 PSI PRIME PRESSURE GAUGE & VALVE
13. PRIME VALVE
14. STRAINER
15. FLOW TEST VALVE
16. CHECK VALVE (SOFT SEAT)
17. 300 PSI SUPPLY PRESSURE GAUGE & VALVE
18. WATERFLOW PRESSURE SWITCH _V (CONNECT TO FIRE ALARM SYSTEM)
19. BUTTERFLY VALVE
20. ADJUSTABLE PIPE STAND
21. GROOVED 90° ELL WITH RIGID GROOVED COUPLINGS

A | DRY PIPE RISER DIAGRAM - EMERGENCY ELEC ROOM | SCALE: N.T.S.



K | NEW INSPECTORS TEST CONNECTION - WET SYSTEM | SCALE: N.T.S.



1. FLOOR OR WALL ASSEMBLY - MIN 4-1/2 IN. THICK REINFORCED LIGHTWEIGHT OR NORMAL WEIGHT (100-150 PCF) CONCRETE. WALL MAY ALSO BE CONSTRUCTED OF ANY UL CLASSIFIED CONCRETE BLOCKS. MAX DIA OF OPENING IS 32 IN. SEE CONCRETE BLOCKS (CAZT) CATEGORY IN THE FIRE RESISTANCE DIRECTORY FOR NAMES OF MANUFACTURERS.

2. METALLIC SLEEVE - (OPTIONAL) NOM 32 IN. DIA (OR SMALLER) SCHEDULE 40 (OR HEAVIER) STEEL SLEEVE CAST OR GROUTED INTO FLOOR OR WALL ASSEMBLY, FLUSH WITH FLOOR OR WALL SURFACES.

3. THROUGH PENETRANT - ONE METALLIC PIPE OR CONDUIT TO BE INSTALLED EITHER CONCENTRICALLY OR ECCENTRICALLY WITHIN THE FIRESTOP SYSTEM. THE ANNULAR SPACE BETWEEN PIPE OR CONDUIT AND PERIPHERY OF OPENING SHALL BE MIN 0 IN. (POINT CONTACT) TO MAX 1-7/8 IN. PIPE OR CONDUIT TO BE RIGIDLY SUPPORTED ON BOTH SIDES OF FLOOR OR WALL ASSEMBLY. THE FOLLOWING TYPES AND SIZES OF METALLIC PIPES OR CONDUITS MAY BE USED:
A. STEEL PIPE - NOM 30 IN. DIA (OR SMALLER) SCHEDULE 10 (OR HEAVIER) STEEL PIPE.
B. COPPER PIPE - NOM 6 IN. DIA (OR SMALLER) REGULAR (OR HEAVIER) COPPER PIPE.
C. COPPER TUBING - NOM 6 IN. DIA (OR SMALLER) TYPE L (OR HEAVIER) COPPER TUBING.
D. CONDUIT - NOM 6 IN. DIA (OR SMALLER) STEEL CONDUIT. E. CONDUIT - NOM 4 IN. DIA (OR SMALLER) STEEL ELECTRICAL METALLIC TUBING (EMT).

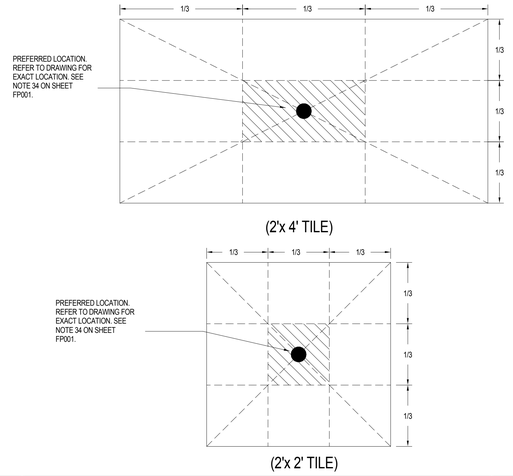
4. FIRESTOP SYSTEM - THE FIRESTOP SYSTEM SHALL CONSIST OF THE FOLLOWING:
A. PACKING MATERIAL - MIN 4 IN. THICKNESS OF MIN 4 PCF MINERAL WOOL BATT. INSULATION FIRMLY PACKED INTO OPENING AS A PERMANENT FORM. PACKING MATERIAL TO BE RECESSED FROM TOP SURFACE OF FLOOR OR FROM BOTH SURFACES OF WALL AS REQUIRED TO ACCOMMODATE THE REQUIRED THICKNESS OF FILL MATERIAL.

B. FILL, VOID OR CAVITY MATERIAL - SEALANT - MIN 1/4 IN. THICKNESS OF FILL MATERIAL APPLIED WITHIN THE ANNULUS, FLUSH WITH TOP SURFACE OF FLOOR OR WITH BOTH SURFACES OF WALL, AT THE POINT CONTACT LOCATION BETWEEN PIPE AND CONCRETE. A MIN 1/4 IN. DIA BEAD OF FILL MATERIAL SHALL BE APPLIED AT THE CONCRETE/PIPE INTERFACE ON THE TOP SURFACE OF FLOOR AND ON BOTH SURFACES OF WALL.

HILTI, INC. - FS-ONE SEALANT

BEARING THE UL CLASSIFICATION MARKING

G | PIPE THRU A SLEEVE IN CONCRETE FLOOR/WALL OR BLOCK WALL | SCALE: N.T.S.



D | TYPICAL CENTER OF TILE | SCALE: N.T.S.

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Revisions

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Document Phase:	CD
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PIC / AIC:	PVK
Drawn By:	CMZ
Checked By:	MAN
Comm. No.:	11-0033

Project Title

PHASE 1

Package

Bulletin #14
Construction Package #3
Interiors

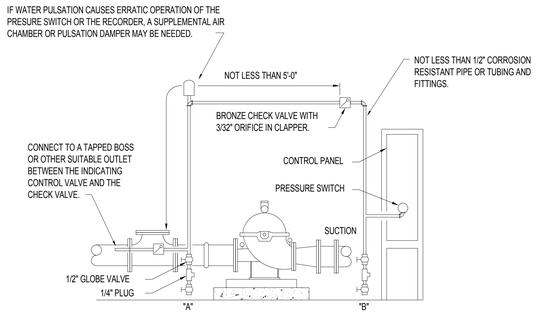
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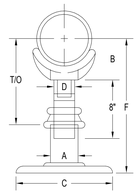
FIRE PROTECTION DETAILS

Sheet Number

FP002

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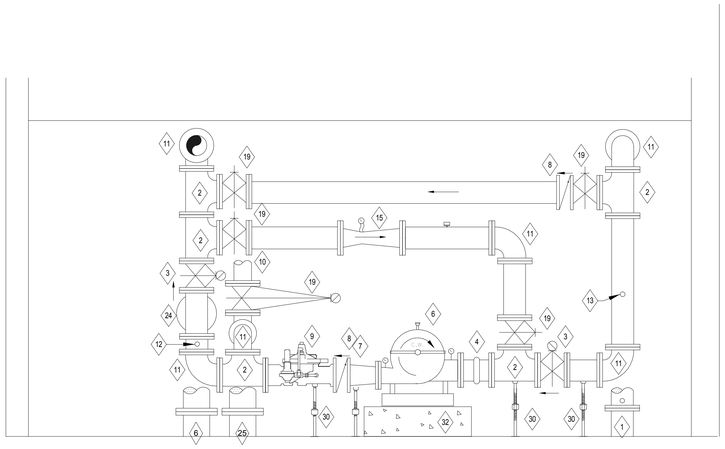




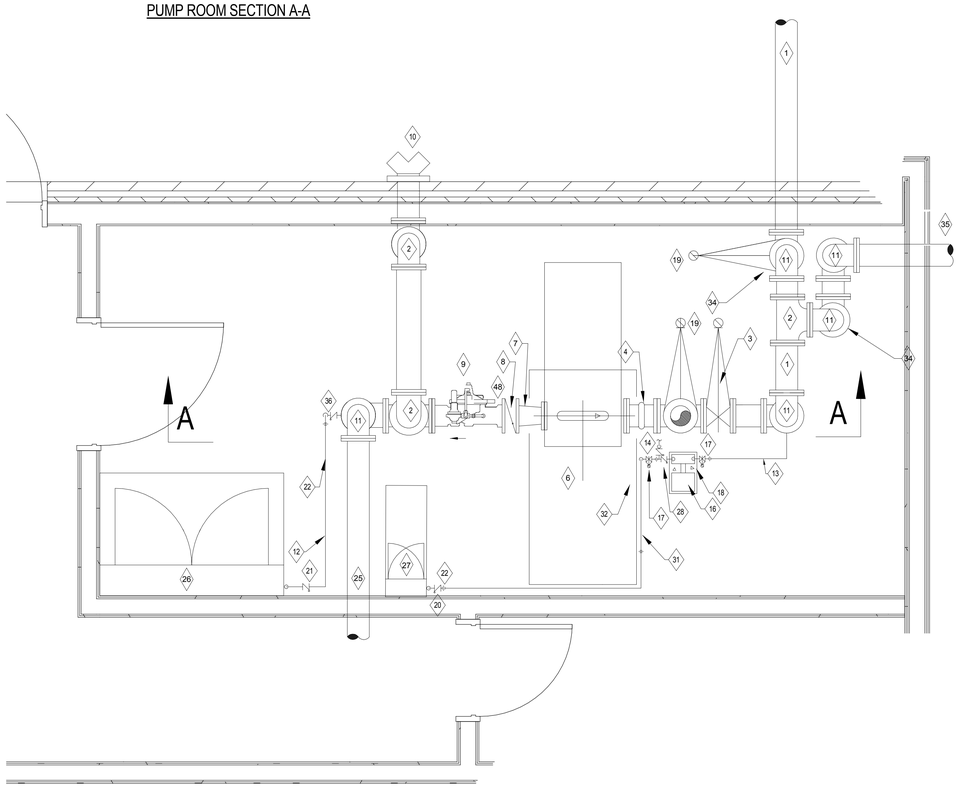
PIPE SIZE	DIMENSIONS IN INCHES										
	A	C	D MIN.	T/O	A	B	C	D	F MIN.	T/O DIM. T/O	T/O DIM. ADJ. ±
2 1/2	NOT AVAILABLE					3 1/2			11 1/2	8 1/4	
3	FOR PIPE SIZES				2 1/2	3 3/4		1 1/2	11 3/4	8 1/2	2 3/4
3 1/2	SMALLER THAN 4"					4			12	8 3/4	
4	3	9	7 1/4	4 1/4	3	4 1/4	9	2 1/2	12 1/4	8 3/4	2 1/2
5			7 7/8	4 7/8		4 7/8			12 7/8	9 3/8	
6			8 1/2	5 1/2		5 1/2			13 1/2	10	
8			9 7/8	6 7/8		6 7/8			14 7/8	11 3/8	
10			11 1/2	8 1/2		8 1/2			16 1/2	13	
12			13	10		10			18	14 1/2	

FIRE PUMP LEGEND EXTRA HEAVY RATED

1. 8" FIRE PUMP SUCTION MAIN
2. 8" FLGD. TEE (CLASS 250xH)
3. 8" FLGD O.S.&Y WITH TAMPER SWITCH (CLASS 250)NORMALLY OPEN
4. 8" FLGD FLEXIBLE SPOOL PIECE
5. 300 P.S.I. WATER GAUGE (xH)
6. 6"x 6" ELECTRIC FIRE PUMP PATTERSON DMD (xH) 160 P.S.I. @ 1000 G.P.M. 125 H.P. , 1800 R.P.M. , 460V 3-PHASE (250 xH)
7. 4"x 8" FLGD. CONCENTRIC INCREASER
8. 8" SPRING LOADED WAFER CHECK VALVE (CLASS 250)
9. 8" FLGD FIRE PUMP SUCTION CONTROL VALVE CLA-VAL # 50B-5KG (ONLY)(CLASS 300)
10. 8" OUT TO WALL MOUNTED FIRE PUMP TEST HEADER. SEE SHEET FP101 FOR LOCATION
11. 8" FLGD. ELL (CLASS 250xH)
12. 1/2" FIRE PUMP TEST SENSING LINE (xH)
13. JOCKEY PUMP SUCTION LINE (xH)
14. JOCKEY PUMP DISCHARGE LINE (xH)
15. 8" FLGD FLOW METER xH(GERAND ONLY) (CLASS 250)
16. JOCKEY PUMP 255 P.S.I. @ 12 G.P.M. GRUNDFROS ONLY #CRN1-21 460V AC 5 H.P. 3 PHASE (xH)
17. JOCKEY PUMP SUCTION AND DISCHARGE GATE VALVE W/T SWITCH (CLASS 250)
18. CONCRETE PAD FOR JOCKEY PUMP
19. 8" O.S.&Y. GATE VALVE NORMALLY CLOSED WITH TAMPER SWITCH , CHAIN & LOCK CLOSED(CLASS 250)
20. 1/2" JOCKEY PUMP TEST SENSING LINE CHECK VALVE (CLASS 250)
21. 1/2" FIRE PUMP TEST SENSING LINE CHECK VALVE (CLASS 250)
22. 1/2" GROUND JOINT UNION
23. 8" FLOW SWITCH (xH)
25. 8" OUT TO STANDPIPE/SPRINKLER SYSTEM
26. ELECTRICAL FIRE PUMP CONTROLLER REDUCED VOLTAGE SOLID STATE SOFT START WITH AUTOMATIC TRANSFER SWITCH
27. JOCKEY PUMP CONTROLLER
28. JOCKEY PUMP DISCHARGE CHECK VALVE (CLASS 250)
29. AIR VENT
30. ADJUSTABLE PIPE STAND
31. 1/2" JOCKEY PUMP TEST SENSING LINE (xH)
32. CONCRETE PAD FOR FIRE PUMP
33. 6" FLGD. ELL (CLASS 250xH)
34. 8" BACK FLOW PREVENTOR IN VERTICAL
35. 8" O/W PIPING FROM PLUMBING CONTRACTOR, SEE PLUMBING DRAWINGS FOR CONTINUATION



PUMP ROOM SECTION A-A



Enlarged Fire Pump
1/2" = 1'-0"

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PHASE 1

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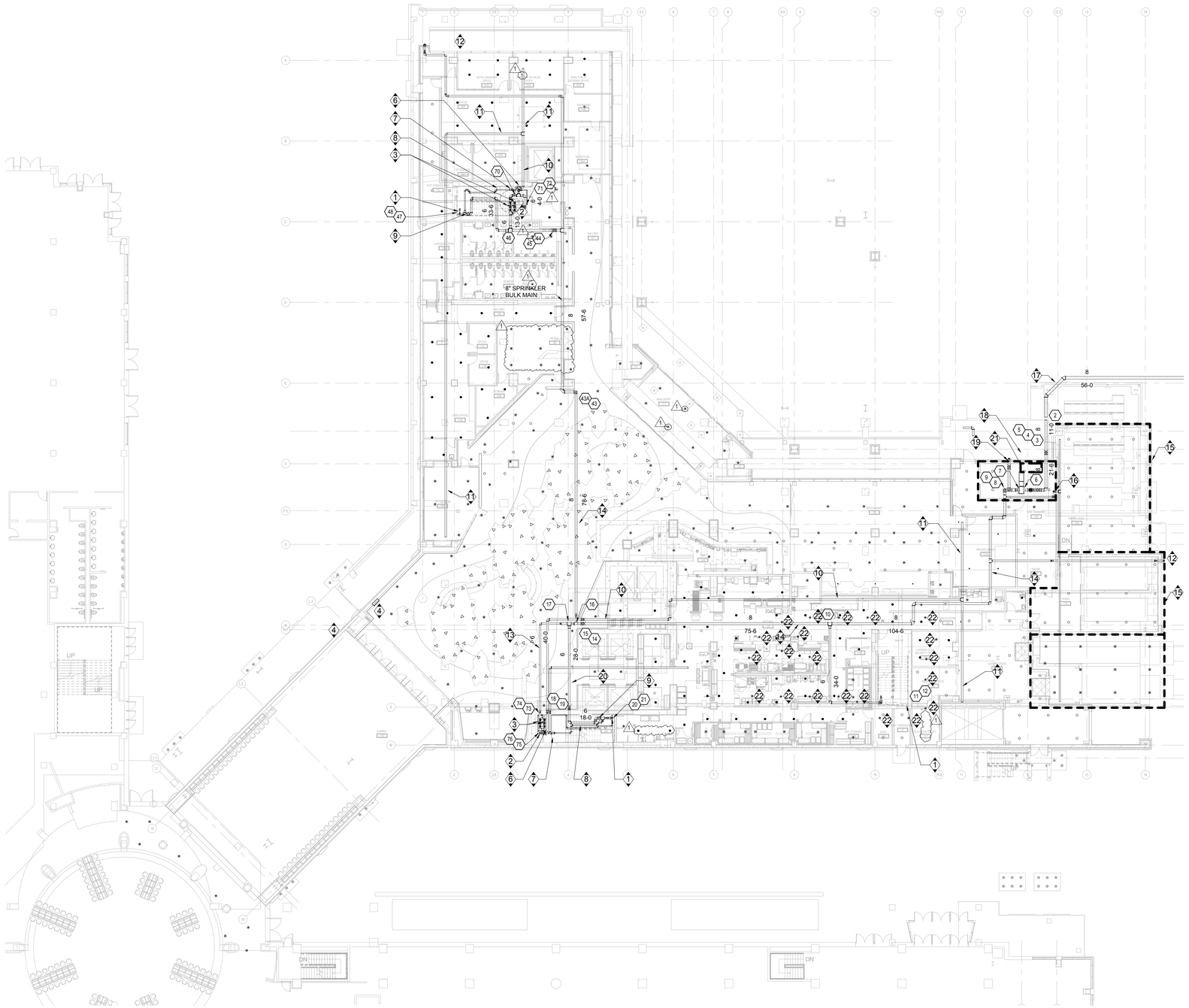
Sheet Title

FIRE PROTECTION - ENLARGED ROOMS

Sheet Number

FP003

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1 Level 1 - Fire Protection(Overall)
1/16" = 1'-0"

N

GENERAL NOTES:

1. SPRINKLER LOCATIONS ARE OF HIGH AESTHETIC IMPORTANCE. ANY DEVIATION FROM SPRINKLER LOCATION FROM THAT SHOWN IN PUBLIC SPACE SHALL BE APPROVED BY ENGINEER

REFERENCE NOTES:

1. 6" STANDPIPE UP WITH 2-1/2" PRESSURE REGULATING HOSE VALVE (PRESSURE REGULATING HOSE VALVE TYPE ONLY USED FOR LEVELS 1 TO 8) AND 3" DRAIN RISER (DRAIN RISER IS ON LEVELS 1 TO 8)
2. 6" SPRINKLER RISER UP AND 2" MAIN DRAIN RISER
3. 6" REDUNDANT PRESSURE REDUCING VALVES SET TO 165 PSI WITH BUTTERFLY ISOLATION VALVES
4. FIRE RATED FIRE VALVE CABINET WITH 2-1/2" HOSE VALVE SERVING HORIZONTAL EXIT
5. IDF ROOM SHALL BE PROTECTED BY NOVEC 1230 CLEAN AGENT FIRE SUPPRESSION SYSTEM
6. 6" SPRINKLER CONTROL VALVE ASSEMBLY
7. 3" BUTTERFLY VALVE AND 3" CHECK VALVE
8. 3" PRV TEST LINE
9. 6" BUTTERFLY VALVE
10. 6" SPRINKLER CROSS MAIN
11. 4" SPRINKLER CROSS MAIN
12. 2-1/2" x 2-1/2" x 6" WALL MOUNTED FIRE DEPARTMENT CONNECTION
13. 6" SPRINKLER BULK MAIN
14. 10" SPRINKLER BULK MAIN
15. GENERATOR ROOM SHALL BE PROTECTED BY 2% HIGH EXPANSION FOAM SYSTEM
16. 4" DRY SPRINKLER RISER ASSEMBLY SERVING TRASH ROOM AND LOADING DOCK
17. 10" UNDERGROUND FIRE PUMP SUPPLY LINE
18. SEE SHEET FP400 FOR ENLARGED FIRE PUMP ROOM
19. 2-1/2" x 2-1/2" x 2-1/2" x 8" WALL MOUNTED FIRE PUMP TEST HEADER
20. 6" SPRINKLER BULK MAIN
21. HIGH EXPANSION FOAM GENERATOR WITH 50 GALLON VERTICAL BLADDER TANK SERVING EMERG. ELEC 133A
22. SPRINKLER TO BE INSTALLED WITHIN GREASE DUCT

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1	7/02/2013	Bulletin #16

Document Phase:	CD
Date:	03/29/2016
PIC / AIC:	PVK
Drawn By:	MGU
Checked By:	CMZ
Comm. No.:	11-0033

Project Title

PHASE 1

KEYPLAN

Package

Bulletin #14
Construction Package #3
Interiors

Sheet Title

FIRE PROTECTION
PLAN - LEVEL 1

Sheet Number

FP101

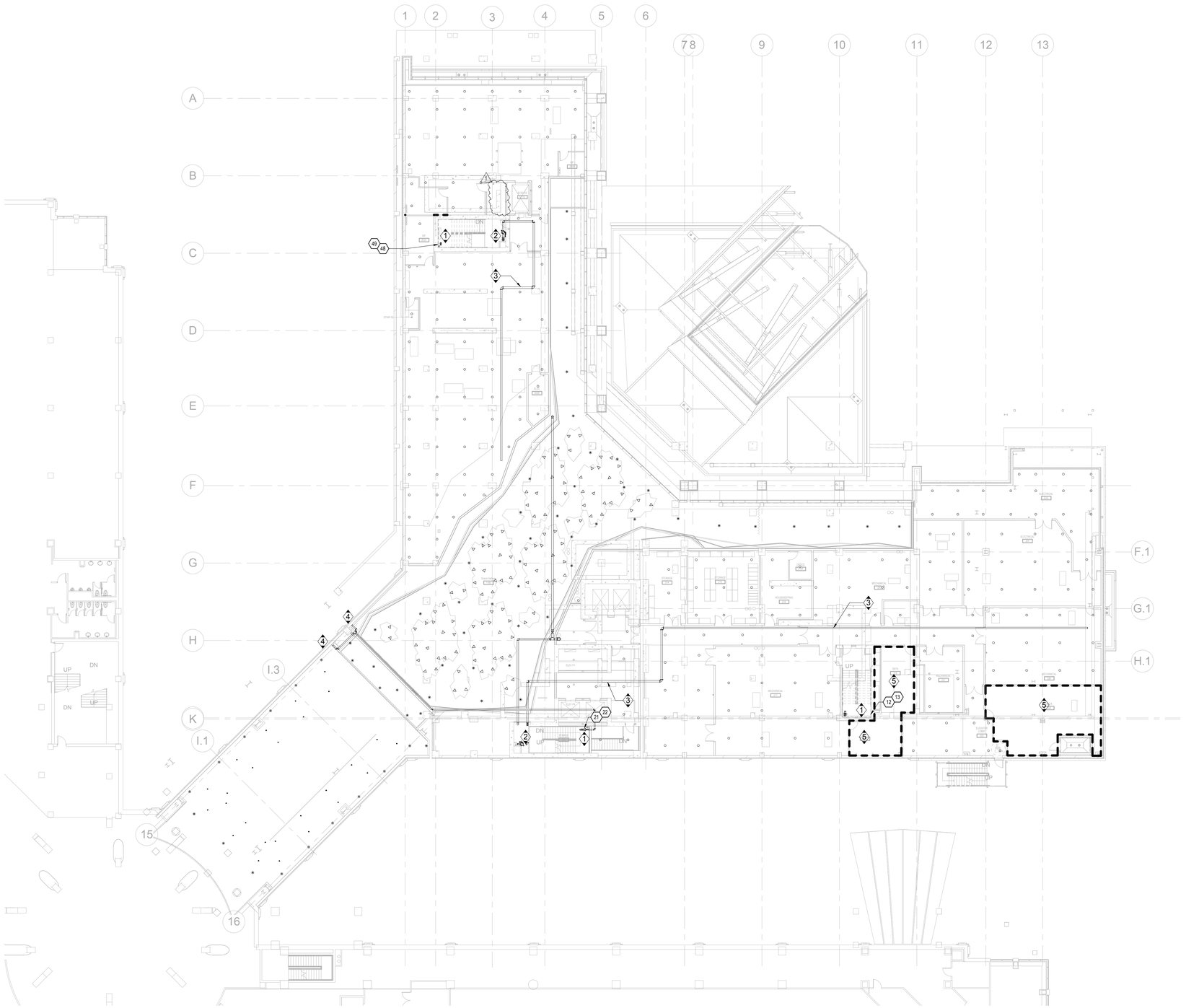
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GENERAL NOTES:

1. SPRINKLER LOCATIONS ARE OF HIGH AESTHETIC IMPORTANCE. ANY DEVIATION FROM SPRINKLER LOCATION FROM THAT SHOWN IN PUBLIC SPACE SHALL BE APPROVED BY ENGINEER

REFERENCE NOTES:

1. 6" STANDPIPE UP WITH 2-1/2" PRESSURE REGULATING HOSE VALVE (PRESSURE REGULATING HOSE VALVE TYPE ONLY USED FOR LEVELS 1 TO 8) AND 3" DRAIN RISER (DRAIN RISER IS ON LEVELS 1 TO 8)
2. 6" SPRINKLER RISER UP AND 2" MAIN DRAIN RISER
3. 6" SPRINKLER CROSS MAIN
4. FIRE RATED FIRE VALVE CABINET WITH 2-1/2" HOSE VALVE SERVING HORIZONTAL EXIT
5. IDF ROOM SHALL BE PROTECTED BY NOVEC 1230 CLEAN AGENT FIRE SUPPRESSION SYSTEM



1 Level 2 - Mezzanine - Fire Protection(Overall)
1/16" = 1'-0"

N

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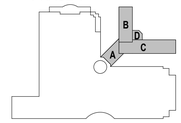
Revisions

No.	Date	Description
1	7/02/2013	Bulletin #16

Document Phase:	CD
Date:	03/29/2016
PIC / AIC:	PVK
Drawn By:	MGU
Checked By:	CMZ
Comm. No.:	11-0033

Project Title

PHASE 1



KEYPLAN

Package

Bulletin #14
Construction Package #3
Interiors

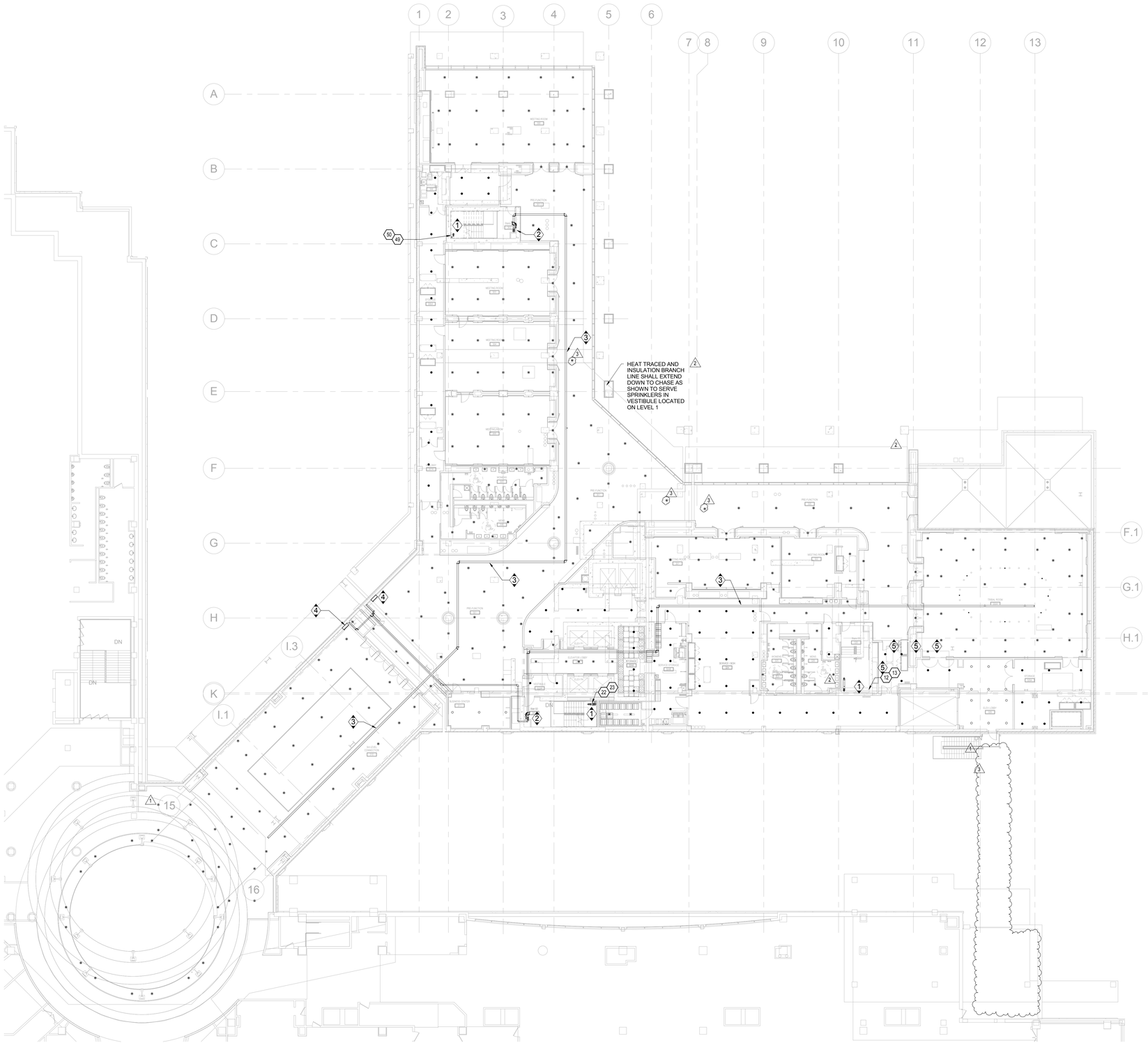
Sheet Title

FIRE PROTECTION
PLAN - LEVEL 2

Sheet Number

FP102

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1 Level 3 Meeting - Fire Protection(Overall)
1/16" = 1'-0"

GENERAL NOTES:

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REFERENCE NOTES:

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2. 6" SPRINKLER RISER UP AND 2" MAIN DRAIN RISER
3. 6" SPRINKLER CROSS MAIN
4. FIRE RATED FIRE VALVE CABINET WITH 2-1/2" HOSE VALVE SERVING HORIZONTAL EXIT
5. SPRINKLER TO BE INSTALLED WITHIN GREASE DUCT

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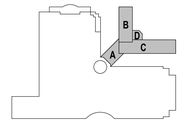
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No.	Date	Description
1	3/18/2013	Bulletin #10
2	6/14/2013	Bulletin #14
3	7/02/2013	Bulletin #16

Document Phase:	CD
Date:	03/29/2016
PIC / AIC:	PVK
Drawn By:	MGU
Checked By:	CMZ
Comm. No.:	11-0033

Project Title

PHASE 1



KEYPLAN

Package

Bulletin #8
Construction Package #3
Interiors

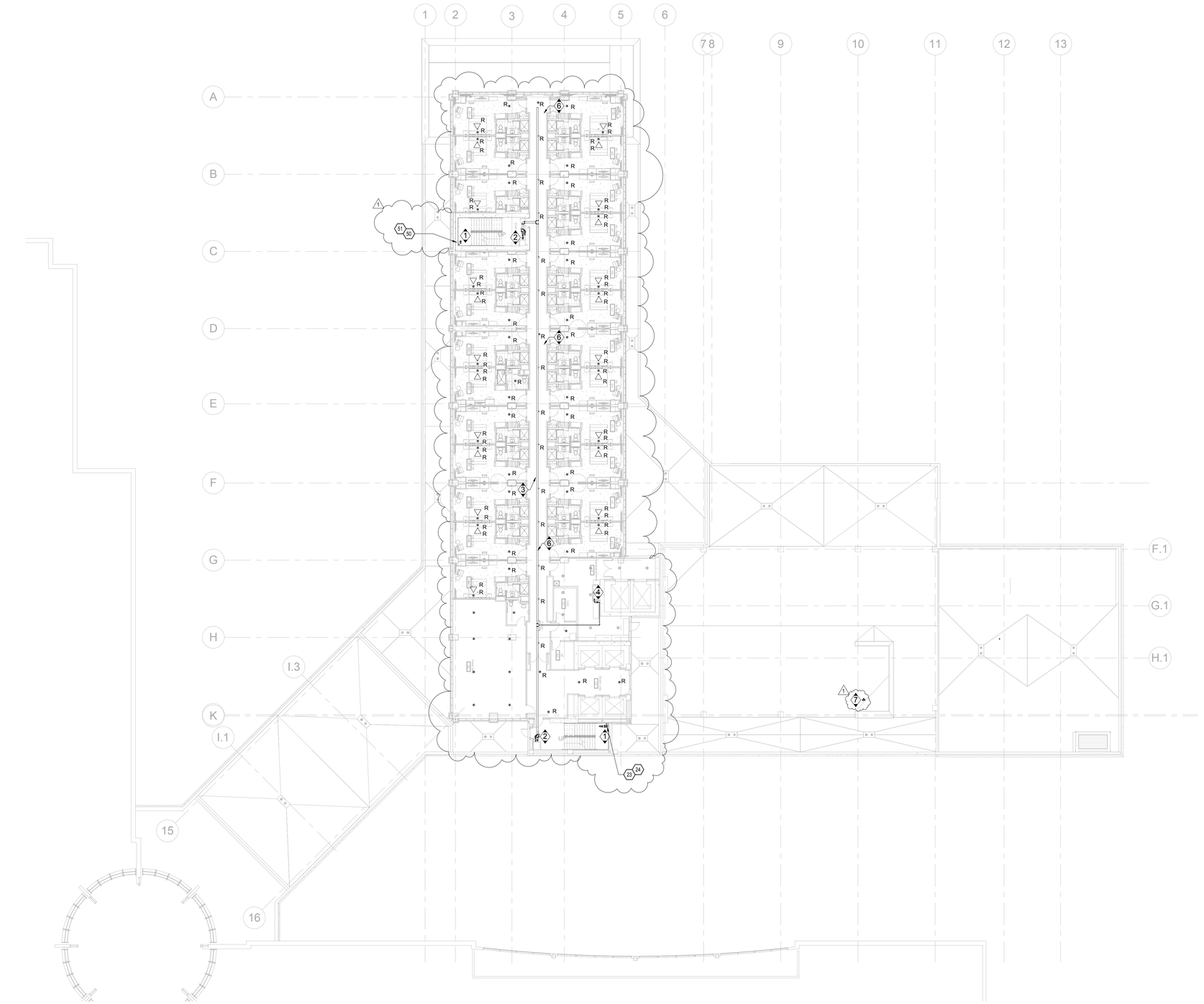
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FIRE PROTECTION
PLAN - LEVEL 3

Sheet Number

FP103

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1 Level 4 SPA - Fire Protection(Overall)
1/16" = 1'-0"

N

GENERAL NOTES:

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2. 6" SPRINKLER RISER AND 2" MAIN DRAIN RISER
3. 2" SPRINKLER CROSS MAIN
4. TRASH CHUTE SPRINKLER RISER WITH TAMPERED CONTROL VALVE
5. NEW 3" DRY SPRINKLER RISER
6. NEW 3" DRY SPRINKLER MAIN
7. NEW 2 1/2" X 2 1/2" X 2 1/2" X 6" FREE STANDING ROOF MOUNTED FIRE DEPARTMENT CONNECTION WITH 6" ROOF PIV NORMALLY CLOSED.

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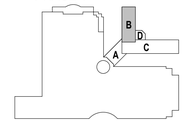
Revisions

No.	Date	Description
1	6/14/2013	Bulletin #14

Document Phase:	CD
Date:	03/29/2016
PIC / AIC:	PVK
Drawn By:	CMZ
Checked By:	MAN
Comm. No.:	11-0033

Project Title

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KEYPLAN

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Bulletin #8
Construction Package #3
Interiors

Sheet Title

FIRE PROTECTION
PLAN - LEVEL 4

Sheet Number

FP104

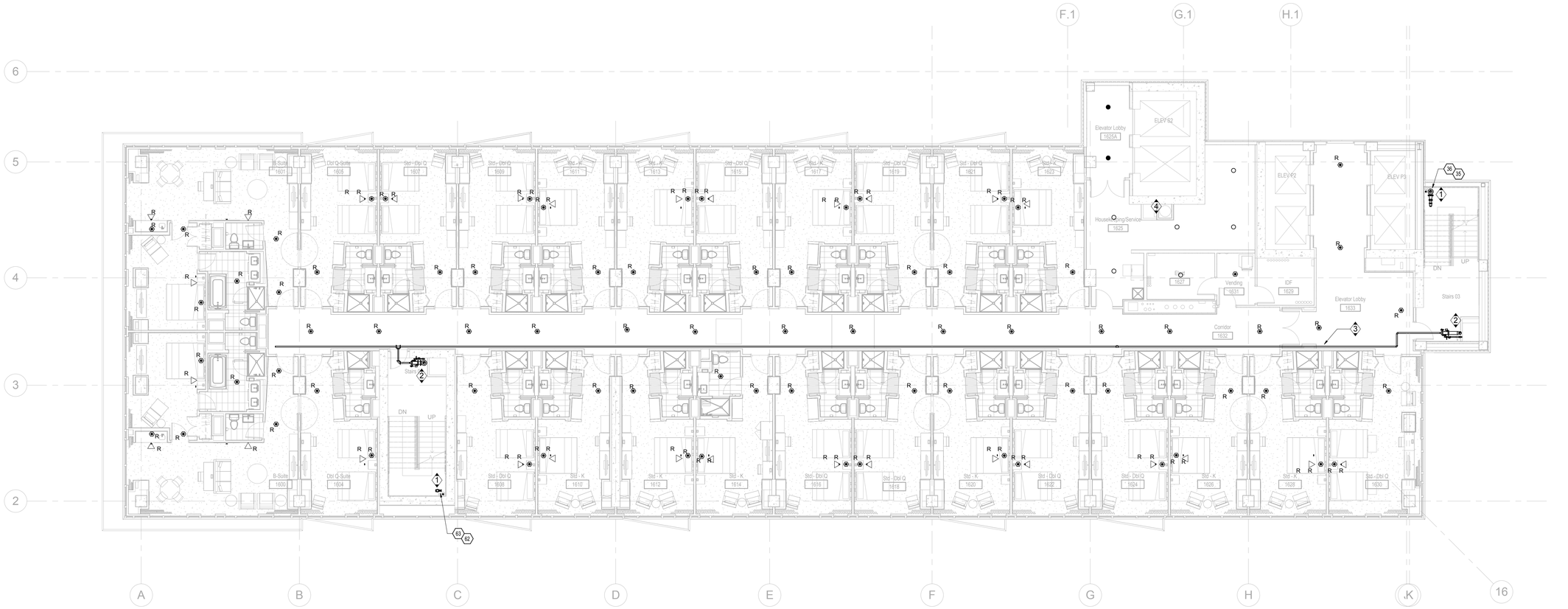
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REFERENCE NOTES:

1. 6" STANDPIPE WITH 2-1/2" HOSE VALVE
2. 6" SPRINKLER RISER AND 2" MAIN DRAIN RISER
3. 1 1/2" SPRINKLER CROSS MAIN
4. TRASH CHUTE SPRINKLER RISER



1 Fire Protection Plan - Level 16
1/8" = 1'-0"

N

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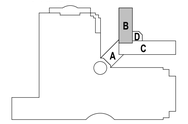
Revisions

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Project Title

PHASE 1



KEYPLAN

Package

Bulletin #14
Construction Package #3
Interiors

Sheet Title

FIRE PROTECTION
PLAN - LEVELS 5-15

Sheet Number

FP105

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ACTIVE SHOOTER
HOW TO RESPOND



National Retail Federation®
The Voice of Retail Worldwide

RILA
RETAIL INDUSTRY LEADERS ASSOCIATION
Retail's Future…Educate, Innovate, Advocate

October 2008

Emergency Numbers

Emergency Services: 9 -1 -1

Local Emergency Information Line: _____

Local Police Department: _____

Local Fire Department: _____

Local Hospital: _____

Local FBI Field Office: _____

Facility Security: _____

Facility Address: _____

_____

_____

_____

Floor: _____ Suite/Room: _____

Office #: _____ Ext. _____

PROFILE OF AN ACTIVE SHOOTER

An Active Shooter is an individual actively engaged in killing or attempting to kill people in a confined and populated area; in most cases, active shooters use firearms(s) and there is no pattern or method to their selection of victims.

Active shooter situations are unpredictable and evolve quickly. Typically, the immediate deployment of law enforcement is required to stop the shooting and mitigate harm to victims.

Because active shooter situations are often over within 10 to 15 minutes, before law enforcement arrives on the scene, individuals must be prepared both mentally and physically to deal with an active shooter situation.

Good practices for coping with an active shooter situation

- Be aware of your environment and any possible dangers
- Take note of the two nearest exits in any facility you visit
- If you are in an office, stay there and secure the door
- If you are in a hallway, get into a room and secure the door
- As a last resort, attempt to take the active shooter down. When the shooter is at close range and you cannot flee, your chance of survival is much greater if you try to incapacitate him/her.

CALL 911
WHEN IT IS SAFE TO DO SO!

HOW TO RESPOND WHEN AN ACTIVE SHOOTER IS IN YOUR VICINITY

Quickly determine the most reasonable way to protect your own life. Remember that customers and clients are likely to follow the lead of employees and managers during an active shooter situation.

1. Evacuate

If there is an accessible escape path, attempt to evacuate the premises. Be sure to:

- Have an escape route and plan in mind
- Evacuate regardless of whether others agree to follow
- Leave your belongings behind
- Help others escape, if possible
- Prevent individuals from entering an area where the active shooter may be
- Keep your hands visible
- Follow the instructions of any police officers
- Do not attempt to move wounded people
- Call 911 when you are safe

2. Hide out

If evacuation is not possible, find a place to hide where the active shooter is less likely to find you.

Your hiding place should:

- Be out of the active shooter's view
- Provide protection if shots are fired in your direction (i.e., an office with a closed and locked door)
- Not trap you or restrict your options for movement

To prevent an active shooter from entering your hiding place:

- Lock the door
- Blockade the door with heavy furniture

If the active shooter is nearby:

- Lock the door
- Silence your cell phone and/or pager
- Turn off any source of noise (i.e., radios, televisions)
- Hide behind large items (i.e., cabinets, desks)
- Remain quiet

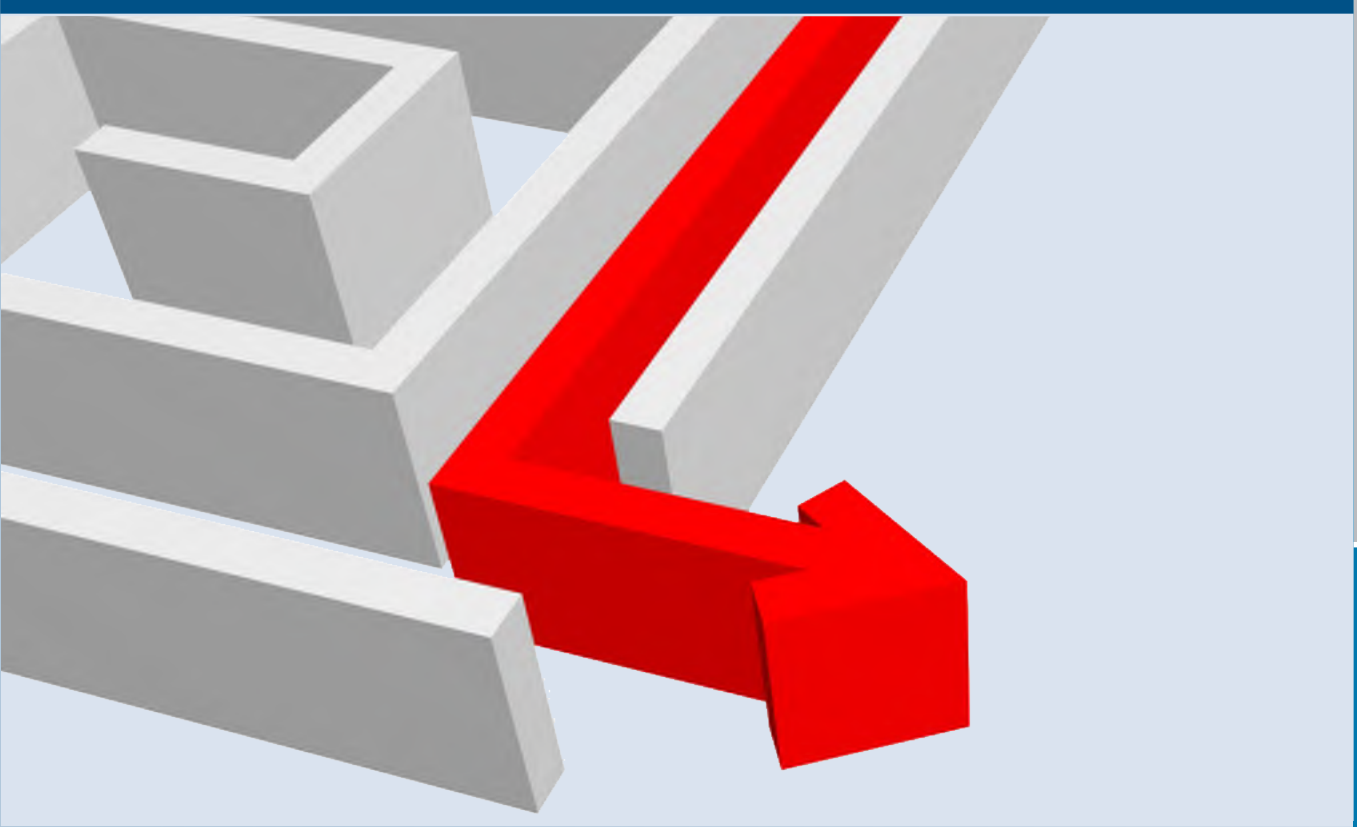
If evacuation and hiding out are not possible:

- Remain calm
- Dial 911, if possible, to alert police to the active shooter's location
- If you cannot speak, leave the line open and allow the dispatcher to listen

3. Take action against the active shooter

As a last resort, and only when your life is in imminent danger, attempt to disrupt and/or incapacitate the active shooter by:

- Acting as aggressively as possible against him/her
- Throwing items and improvising weapons
- Yelling
- Committing to your actions



HOW TO RESPOND WHEN LAW ENFORCEMENT ARRIVES

Law enforcement's purpose is to stop the active shooter as soon as possible. Officers will proceed directly to the area in which the last shots were heard.

- Officers usually arrive in teams of four (4)
- Officers may wear regular patrol uniforms or external bulletproof vests, Kevlar helmets, and other tactical equipment
- Officers may be armed with rifles, shotguns, handguns
- Officers may use pepper spray or tear gas to control the situation
- Officers may shout commands, and may push individuals to the ground for their safety

How to react when law enforcement arrives:

- Remain calm, and follow officers' instructions
- Put down any items in your hands (i.e., bags, jackets)
- Immediately raise hands and spread fingers
- Keep hands visible at all times
- Avoid making quick movements toward officers such as holding on to them for safety
- Avoid pointing, screaming and/or yelling
- Do not stop to ask officers for help or direction when evacuating, just proceed in the direction from which officers are entering the premises

Information to provide to law enforcement or 911 operator:

- Location of the active shooter
- Number of shooters, if more than one
- Physical description of shooter/s
- Number and type of weapons held by the shooter/s
- Number of potential victims at the location

The first officers to arrive to the scene will not stop to help injured persons. Expect rescue teams comprised of additional officers and emergency medical personnel to follow the initial officers. These rescue teams will treat and remove any injured persons. They may also call upon able-bodied individuals to assist in removing the wounded from the premises.

Once you have reached a safe location or an assembly point, you will likely be held in that area by law enforcement until the situation is under control, and all witnesses have been identified and questioned. Do not leave until law enforcement authorities have instructed you to do so.

TRAINING YOUR STAFF FOR AN ACTIVE SHOOTER SITUATION

To best prepare your staff for an active shooter situation, create an Emergency Action Plan (EAP), and conduct training exercises. Together, the EAP and training exercises will prepare your staff to effectively respond and help minimize loss of life.

Components of an Emergency Action Plan (EAP)

Create the EAP with input from several stakeholders including your human resources department, your training department (if one exists), facility owners / operators, your property manager, and local law enforcement and/or emergency responders. An effective EAP includes:

- A preferred method for reporting fires and other emergencies
- An evacuation policy and procedure
- Emergency escape procedures and route assignments (i.e., floor plans, safe areas)
- Contact information for, and responsibilities of individuals to be contacted under the EAP
- Information concerning local area hospitals (i.e., name, telephone number, and distance from your location)
- An emergency notification system to alert various parties of an emergency including:
  - Individuals at remote locations within premises
  - Local law enforcement
  - Local area hospitals

Components of Training Exercises

The most effective way to train your staff to respond to an active shooter situation is to conduct mock active shooter training exercises. Local law enforcement is an excellent resource in designing training exercises.

- Recognizing the sound of gunshots
- Reacting quickly when gunshots are heard and/or when a shooting is witnessed:
  - Evacuating the area
  - Hiding out
  - Acting against the shooter as a last resort
- Calling 911
- Reacting when law enforcement arrives
- Adopting the survival mind set during times of crisis

Additional Ways to Prepare For and Prevent an Active Shooter Situation

- Preparedness
  - Ensure that your facility has at least two evacuation routes
  - Post evacuation routes in conspicuous locations throughout your facility
  - Include local law enforcement and first responders during training exercises
  - Encourage law enforcement, emergency responders, SWAT teams, K-9 teams, and bomb squads to train for an active shooter scenario at your location

- Prevention
  - Foster a respectful workplace
  - Be aware of indications of workplace violence and take remedial actions accordingly

For more information on creating an EAP contact the U.S. Department of Labor, Occupational Health and Safety Administration, www.osha.gov.



PREPARING FOR AND MANAGING AN ACTIVE SHOOTER SITUATION

Your human resources department and facility managers should engage in planning for emergency situations, including an active shooter scenario. Planning for emergency situations will help to mitigate the likelihood of an incident by establishing the mechanisms described below.

Human Resources' Responsibilities

- Conduct effective employee screening and background checks
- Create a system for reporting signs of potentially violent behavior
- Make counseling services available to employees
- Develop an EAP which includes policies and procedures for dealing with an active shooter situation, as well as after action planning

Facility Manager Responsibilities

- Institute access controls (i.e., keys, security system pass codes)
- Distribute critical items to appropriate managers / employees, including:
  - Floor plans
  - Keys
  - Facility personnel lists and telephone numbers
- Coordinate with the facility's security department to ensure the physical security of the location
- Assemble crisis kits containing:
  - radios
  - floor plans
  - staff roster, and staff emergency contact numbers
  - first aid kits
  - flashlights
- Place removable floor plans near entrances and exits for emergency responders
- Activate the emergency notification system when an emergency situation occurs

Reactions of Managers During an Active Shooter Situation

Employees and customers are likely to follow the lead of managers during an emergency situation. During an emergency, managers should be familiar with their EAP, and be prepared to:

- Take immediate action
- Remain calm
- Lock and barricade doors
- Evacuate staff and customers via a preplanned evacuation route to a safe area

Assisting Individuals with Special Needs and/or Disabilities

- Ensure that EAPs, evacuation instructions and any other relevant information address to individuals with special needs and/or disabilities
- Your building should be handicap-accessible, in compliance with ADA requirements.



RECOGNIZING POTENTIAL WORKPLACE VIOLENCE

An active shooter in your workplace may be a current or former employee, or an acquaintance of a current or former employee. Intuitive managers and coworkers may notice characteristics of potentially violent behavior in an employee. Alert your Human Resources Department if you believe an employee or coworker exhibits potentially violent behavior.

Indicators of Potential Violence by an Employee

Employees typically do not just "snap," but display indicators of potentially violent behavior over time. If these behaviors are recognized, they can often be managed and treated. Potentially violent behaviors by an employee may include one or more of the following (this list of behaviors is not comprehensive, nor is it intended as a mechanism for diagnosing violent tendencies):

- Increased use of alcohol and/or illegal drugs
- Unexplained increase in absenteeism; vague physical complaints
- Noticeable decrease in attention to appearance and hygiene
- Depression / withdrawal
- Resistance and overreaction to changes in policy and procedures
- Repeated violations of company policies
- Increased severe mood swings
- Noticeably unstable, emotional responses
- Explosive outbursts of anger or rage without provocation
- Suicidal; comments about "putting things in order"
- Behavior which is suspect of paranoia, ("everybody is against me")
- Increasingly talks of problems at home
- Escalation of domestic problems into the workplace; talk of severe financial problems
- Talk of previous incidents of violence
- Empathy with individuals committing violence
- Increase in unsolicited comments about firearms, other dangerous weapons and violent crimes

MANAGING THE CONSEQUENCES OF AN ACTIVE SHOOTER SITUATION

After the active shooter has been incapacitated and is no longer a threat, human resources and/or management should engage in post-event assessments and activities, including:

- An accounting of all individuals at a designated assembly point to determine who, if anyone, is missing and potentially injured
- Determining a method for notifying families of individuals affected by the active shooter, including notification of any casualties
- Assessing the psychological state of individuals at the scene, and referring them to health care specialists accordingly
- Identifying and filling any critical personnel or operational gaps left in the organization as a result of the active shooter

LESSONS LEARNED

To facilitate effective planning for future emergencies, it is important to analyze the recent active shooter situation and create an after action report. The analysis and reporting contained in this report is useful for:

- Serving as documentation for response activities
- Identifying successes and failures that occurred during the event
- Providing an analysis of the effectiveness of the existing EAP
- Describing and defining a plan for making improvements to the EAP

References

Safety Guidelines for Armed Subjects, Active Shooter Situations, Indiana University Police Department, April 2007.

Safety Tips & Guidelines Regarding Potential "Active Shooter" Incidents Occurring on Campus, University of California Police.

Shots Fired, When Lightning Strikes (DVD), Center for Personal Protection and Safety, 2007.

Workplace Violence Desk Reference, Security Management Group International, www.SMGICorp.com

How to Plan for Workplace Emergencies and Evacuations, U.S. Department of Labor, Occupational Health and Safety Administration, OSHA 3088, 2001.

U.S. Department of Homeland Security

Washington, DC 20528

cfsteam@hq.dhs.gov

www.dhs.gov



BOMB THREAT PROCEDURES

This quick reference checklist is designed to help employees and decision makers of commercial facilities, schools, etc. respond to a bomb threat in an orderly and controlled manner with the first responders and other stakeholders.

Most bomb threats are received by phone. Bomb threats are serious until proven otherwise. Act quickly, but remain calm and obtain information with the checklist on the reverse of this card.

If a bomb threat is received by phone:

1. Remain calm. Keep the caller on the line for as long as possible. DO NOT HANG UP, even if the caller does.
2. Listen carefully. Be polite and show interest.
3. Try to keep the caller talking to learn more information.
4. If possible, write a note to a colleague to call the authorities or, as soon as the caller hangs up, immediately notify them yourself.
5. If your phone has a display, copy the number and/or letters on the window display.
6. Complete the Bomb Threat Checklist immediately. Write down as much detail as you can remember. Try to get exact words.
7. Immediately upon termination of call, DO NOT HANG UP, but from a different phone, contact authorities immediately with information and await instructions.

If a bomb threat is received by handwritten note:

- Call _____
- Handle note as minimally as possible.

If a bomb threat is received by e-mail:

- Call _____
- Do not delete the message.

Signs of a suspicious package:

- No return address
- Excessive postage
- Stains
- Strange odor
- Strange sounds
- Unexpected delivery
- Poorly handwritten
- Misspelled words
- Incorrect titles
- Foreign postage
- Restrictive notes

**** Refer to your local bomb threat emergency response plan for evacuation criteria***

DO NOT:

- Use two-way radios or cellular phone. Radio signals have the potential to detonate a bomb.
- Touch or move a suspicious package.

WHO TO CONTACT (Select One)

- **911**
- **Follow your local guidelines**

For more information about this form contact the DHS Office for Bombing Prevention at OBP@dhs.gov

Homeland Security

2014

BOMB THREAT CHECKLIST

DATE: **TIME:**

TIME CALLER HUNG UP: **PHONE NUMBER WHERE CALL RECEIVED:**

Ask Caller:

- Where is the bomb located? (building, floor, room, etc.)
- When will it go off?
- What does it look like?
- What kind of bomb is it?
- What will make it explode?
- Did you place the bomb? Yes No
- Why?
- What is your name?

Exact Words of Threat:

Information About Caller:

- Where is the caller located? (background/level of noise)
- Estimated age:
- Is voice familiar? If so, who does it sound like?
- Other points:

Caller's Voice

- ☐ **Female**
- ☐ **Male**
- ☐ Accent
- ☐ Angry
- ☐ Calm
- ☐ Clearing throat
- ☐ Coughing
- ☐ Cracking voice
- ☐ Crying
- ☐ Deep
- ☐ Deep breathing
- ☐ Disguised
- ☐ Distinct
- ☐ Excited
- ☐ Laughter
- ☐ Lisp
- ☐ Loud
- ☐ Nasal
- ☐ Normal
- ☐ Ragged
- ☐ Rapid
- ☐ Raspy
- ☐ Slow
- ☐ Slurred
- ☐ Soft
- ☐ Stutter

Background Sounds

- ☐ Animal noises
- ☐ House noises
- ☐ Kitchen noises
- ☐ Street noises
- ☐ Booth
- ☐ PA system
- ☐ Conversation
- ☐ Music
- ☐ Motor
- ☐ Clear
- ☐ Static
- ☐ Office machinery
- ☐ Factory machinery
- ☐ Local
- ☐ Long Distance

Other Information:

Threat Language

- ☐ Incoherent
- ☐ Message read
- ☐ Taped message
- ☐ Irrational
- ☐ Profane
- ☐ Well-spoken

Be Red Cross Ready

Earthquake Safety Checklist

An earthquake is a sudden, rapid shaking of the earth caused by the breaking and shifting of rock beneath the earth's surface. Earthquakes strike suddenly, without warning, and they can occur at any time of the year, day or night. Forty-five states and territories in the United States are at moderate to very high risk of earthquakes, and they are located in every region of the country.

Are you at increased risk from earthquakes?

- Contact your local emergency management office, local American Red Cross chapter, state geological survey or department of natural resources.
- Mobile homes and homes not attached to their foundations are at particular risk during an earthquake.
- Buildings with foundations resting on landfill and other unstable soils are at increased risk of damage.

Did you know?

Doorways are no stronger than any other part of the structure. During an earthquake, get under a sturdy piece of furniture and hold on. This will provide some protection from falling objects that can injure you during an earthquake.

How can I prepare?



- ❒ Become aware of fire evacuation and earthquake plans for all of the buildings you occupy regularly.
- ❒ Pick safe places in each room of your home, workplace and/or school. A safe place could be under a piece of furniture or against an interior wall away from windows, bookcases or tall furniture that could fall on you.
- ❒ Practice drop, cover and hold on in each safe place. If you do not have sturdy furniture to hold on to, sit on the floor next to an interior wall and cover your head and neck with your arms.
- ❒ Keep a flashlight and sturdy shoes by each person's bed.
- ❒ Make sure your home is securely anchored to its foundation.
- ❒ Bolt and brace water heaters and gas appliances to wall studs.
- ❒ Bolt bookcases, china cabinets and other tall furniture to wall studs.
- ❒ Hang heavy items, such as pictures and mirrors, away from beds, couches and anywhere people sleep or sit.
- ❒ Brace overhead light fixtures.
- ❒ Install strong latches or bolts on cabinets. Large or heavy items should be closest to the floor.
- ❒ Learn how to shut off the gas valves in your home and keep a wrench handy for that purpose.
- ❒ Learn about your area's seismic building standards and land use codes before you begin new construction.
- ❒ Keep and maintain an emergency supplies kit in an easy-to-access location.

What should I do during an earthquake?



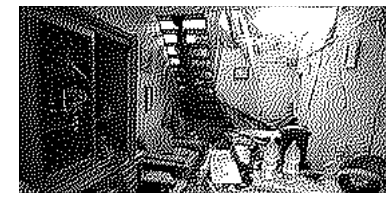
If you are inside when the shaking starts ...

- ❒ Drop, cover and hold on. Move as little as possible.
- ❒ If you are in bed, stay there, curl up and hold on. Protect your head with a pillow.
- ❒ Stay away from windows to avoid being injured by shattered glass.
- ❒ Stay indoors until the shaking stops and you are sure it is safe to exit. If you must leave the building after the shaking stops, use stairs rather than an elevator in case there are aftershocks, power outages or other damage.
- ❒ Be aware that fire alarms and sprinkler systems frequently go off in buildings during an earthquake, even if there is no fire.

If you are outside when the shaking starts ...

- ❒ Find a clear spot and drop to the ground. Stay there until the shaking stops (away from buildings, power lines, trees, streetlights).
- ❒ If you are in a vehicle, pull over to a clear location and stop. Avoid bridges, overpasses and power lines if possible. Stay inside with your seatbelt fastened until the shaking stops. Then, drive carefully, avoiding bridges and ramps that may have been damaged.
- ❒ If a power line falls on your vehicle, do not get out. Wait for assistance.
- ❒ If you are in a mountainous area or near unstable slopes or cliffs, be alert for falling rocks and other debris. Landslides are often triggered by earthquakes.

What do I do after an earthquake?



- ❒ After an earthquake, the disaster may continue. Expect and prepare for potential aftershocks, landslides or even a tsunami. Tsunamis are often generated by earthquakes.
- ❒ Each time you feel an aftershock, drop, cover and hold on. Aftershocks frequently occur minutes, days, weeks and even months following an earthquake.
- ❒ Check yourself for injuries and get first aid, if necessary, before helping injured or trapped persons.
- ❒ Put on long pants, a long-sleeved shirt, sturdy shoes and work gloves to protect against injury from broken objects.
- ❒ Look quickly for damage in and around your home and get everyone out if your home is unsafe.
- ❒ Listen to a portable, battery-operated or hand-crank radio for updated emergency information and instructions.
- ❒ Check the telephones in your home or workplace to see if you can get a dial tone. Make brief calls to report life-threatening emergencies.
- ❒ Look for and extinguish small fires. Fire is the most common hazard after an earthquake.
- ❒ Clean up spilled medications, bleach, gasoline or other flammable liquids immediately.
- ❒ Open closet and cabinet doors carefully as contents may have shifted.
- ❒ Help people who require special assistance, such as infants, children and the elderly or disabled.
- ❒ Watch out for fallen power lines or broken gas lines and stay out of damaged areas.
- ❒ Keep animals under your direct control.
- ❒ Stay out of damaged buildings.
- ❒ If you were away from home, return only when authorities say it is safe to do so. Use extreme caution and examine walls, floors, doors, staircases and windows to check for damage.
- ❒ Be careful when driving after an earthquake and anticipate traffic light outages.

Let Your Family Know You're Safe

If your community experiences an earthquake, or any disaster, register on the American Red Cross Safe and Well Web site available through **RedCross.org** to let your family and friends know about your welfare. If you don't have Internet access, call **1-866-GET-INFO** to register yourself and your family.

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For more information on disaster and emergency preparedness, visit **RedCross.org**.

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EVACUATION PROTOCOL

Members of the campus community who would require assistance to evacuate their building during an emergency or rolling blackout:

Please self-identify with the **Office of Occupational Health & Safety** **immediately** (x. 2055, **lharold@uwindsor.ca** or x. 4521, **mcginly@uwindsor.ca**) to respond to the following question:

Do you require assistance to evacuate the building in an emergency:

Yes _____ Name: _____ Ext. _____

If you answer in the affirmative, you, along with your area manager/supervisor will be contacted by the Office of Occupational Health & Safety to implement an emergency evacuation plan.

Managers/Supervisors
Please be aware that in an evacuation it may be necessary for you to provide or to arrange the safe evacuation of persons with disabilities from your work area.
If an evacuation is required and you are unexpectedly approached by an individual requiring assistance which you are unable to provide to them, please follow this protocol:

- report the situation immediately to the Campus Community Police (x. 4444)

If during an emergency evacuation (fire alarm) you are unexpectedly approached by an individual requiring assistance which you are unable to provide to them, please follow this protocol:

- report the situation immediately to the Building Fire Plan Manager at the annunciator panel (located in every building)
- advise the Building Fire Plan Manager of the location of the individual and details of assistance required
- The Building Fire Plan Manager will then advise the Fire Department

FIRE SAFETY: THE R.A.C.E. PROTOCOL

Nursing facilities report about 3,500 fires a year, and resident rooms are the leading place of origin for fires that lead to a death. Everyone has a role and responsibility in the event of a fire emergency, which may involve the rescue of residents and others, assisting with moving them to safety, sounding the alarm, or just staying out of the way of firefighters and other designated emergency response personnel. All healthcare staff should know the following:

- Their facility's Fire Emergency Plan;
- The location of pull/call boxes;
- The location of and how to use a fire extinguisher;
- Places of safe refuge; and
- Evacuation procedures.

If a fire occurs, there will be confusion, excitement, and nervousness. To help staff prepare, providers should routinely conduct fire safety training and practice drills using different scenarios. An easy acronym to help staff retain the information is **R.A.C.E.**, which stands for Rescue, Alert/Alarm, Confine/Contain, and Extinguish/Evacuate. Each of these steps should be accomplished while responding to a fire emergency at any location throughout the building.

Step 1: (R) Rescue – Remove residents and individuals in danger of immediate harm by assisting them from the room and closing the door. Rescuing residents is every healthcare worker's primary concern, and it is always the first step because a fire can quickly escalate with lethal results. Elderly people are especially susceptible to smoke inhalation, which is the primary killer in a fire.

Step 2: (A) Alert/Alarm – Whoever discovers the fire should call out to a co-worker to call the emergency number and activate the fire call box/pull station while rescuing the resident.

Facilities with intercom systems can utilize their facility's code words, such as "Code Red." When dialing the emergency number, staff members need to be prepared to state the following information: their name, the phone number from which they are calling, the exact location (building, floor and room number), and what they are reporting (sight or smell of smoke or fire and location).

Staff members need to be cognizant that alarms will trigger locked doors to unlock, even in an Alzheimer's wing, so exits should be quickly monitored.

Step 3: (C) Confine/Contain – Fire, smoke, and toxic combustion products must be confined to the area where the fire started as much as possible. Closing doors and windows can prevent the smoke from spreading, cut off the flow of oxygen to the fire, and save lives. Staff should never open a door if it is hot to the touch.

Step 4: (E) Extinguish/Evacuate – Staff should know the location of the fire extinguishers and be able to find them even if the lights are out and there's a lot of smoke. Fire extinguishers are labeled with the name or type of extinguisher, a picture of the type of fire it will extinguish, and operating instructions. Fortunately, all fire extinguishers operate in the same way, which can easily be remembered with another acronym, **P.A.S.S.**, which stands for:

P – Pull the pin in the nozzle of the extinguisher;
A – Aim the nozzle at the base of the fire;
S – Squeeze the handle; and
S – Sweep from side to side, covering the fire.

Staff should attempt to extinguish only small, contained fires (no larger than a waste basket) where their safety is assured, they have an escape route behind them, and other staff members are available to assist. The rescuing of those in immediate danger, sounding the alarm, and confining fire and smoke should be concurrently accomplished by sufficient numbers of other staff members. If the fire cannot be extinguished, staff should immediately leave, close-off the area, and let the fire department put it out.

Staff members should be prepared, so if there is danger from smoke or fire in their immediate work area, they will evacuate that smoke compartment. To do this, they should first initiate a horizontal evacuation by moving residents down the corridor, through at least one set of fire doors to a safe area. If there's continued danger from smoke or fire, they should next initiate a vertical evacuation by moving residents down the stairs to a lower level of safety and ultimately out of the building.

The means of assisting a resident varies, depending on the resident's frailty and the number of staff available. Ideally, staff can use a "team and chain" method where staff form a line and pass residents along a pathway, from one staff member to another, until the residents reach a safe smoke compartment. If there is insufficient staff and urgency is required, residents can be moved in blanket or sheet carries, where a resident is placed in a blanket and pulled down the hall to safety. As rooms are evacuated, identifying tags should be affixed to let others know that the room has been evacuated. It is important for staff to remember the following:

- Never use elevators to evacuate a fire area.
- Evacuate people closest to danger first, then ambulatory residents, followed by non-ambulatory residents, and lastly, critical residents on life support (because they are not in immediate danger and will need more time and care).
- If possible, move resident charts with the resident.

All staff members should know the primary and secondary safe areas and route of evacuation according to the facility's fire plan, which should be openly displayed. The plan should include a chain of command for clear and frequent communication so that staff members know what has been done and needs to happen next. Fire plans should be tailored to the facility and shared with the community fire department. Audits should be performed routinely to ensure exit doors are lit and paths to exits are never blocked.

The keys to protecting the health and safety of residents and staff are frequent in-services, varying practice drills, clear policies and communication, and a commitment from administration and staff.

(10.28.11)
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This material is for informational purposes only. It is not intended to give specific legal or risk management advice, nor are any suggested checklists or action plans intended to include or address all possible risk management exposures or solutions.

You are encouraged to consult with your own attorney or other expert consultants for a professional opinion specific to your situation.

GuideOne Risk Resources for Health Care
1111 Ashworth Road
West Des Moines, Iowa 50265

Be Red Cross Ready

Flood Safety Checklist

Floods are among the most frequent and costly natural disasters. Conditions that cause floods include heavy or steady rain for several hours or days that saturates the ground. Flash floods occur suddenly due to rapidly rising water along a stream or low-lying area.

Know the Difference

Flood/Flash Flood Watch—Flooding or flash flooding is possible in your area.

Flood/Flash Flood Warning—Flooding or flash flooding is already occurring or will occur soon in your area.

What should I do?



- ❑ Listen to area radio and television stations and a NOAA Weather Radio for possible flood warnings and reports of flooding in progress or other critical information from the National Weather Service (NWS).
- ❑ Be prepared to evacuate at a moment's notice.
- ❑ When a flood or flash flood warning is issued for your area, head for higher ground and stay there.
- ❑ Stay away from floodwaters. If you come upon a flowing stream where water is above your ankles, stop, turn around and go another way. Six inches of swiftly moving water can sweep you off of your feet.
- ❑ If you come upon a flooded road while driving, turn around and go another way. If you are caught on a flooded road and waters are rising rapidly around you, get out of the car quickly and move to higher ground. Most cars can be swept away by less than two feet of moving water.
- ❑ Keep children out of the water. They are curious and often lack judgment about running water or contaminated water.
- ❑ Be especially cautious at night when it is harder to recognize flood danger.
- ❑ Because standard homeowners insurance doesn't cover flooding, it's important to have protection from the floods associated with hurricanes, tropical storms, heavy rains and other conditions that impact the U.S. For more information on flood insurance, please visit the National Flood Insurance Program Web site at **www.FloodSmart.gov**.

What supplies do I need?



- ❑ Water—at least a 3-day supply; one gallon per person per day
- ❑ Food—at least a 3-day supply of non-perishable, easy-to-prepare food
- ❑ Flashlight
- ❑ Battery-powered or hand-crank radio (NOAA Weather Radio, if possible)
- ❑ Extra batteries
- ❑ First aid kit
- ❑ Medications (7-day supply) and medical items (hearing aids with extra batteries, glasses, contact lenses, syringes, cane)
- ❑ Multi-purpose tool
- ❑ Sanitation and personal hygiene items
- ❑ Copies of personal documents (medication list and pertinent medical information, deed/lease to home, birth certificates, insurance policies)
- ❑ Cell phone with chargers
- ❑ Family and emergency contact information
- ❑ Extra cash
- ❑ Emergency blanket
- ❑ Map(s) of the area
- ❑ Baby supplies (bottles, formula, baby food, diapers)
- ❑ Pet supplies (collar, leash, ID, food, carrier, bowl)
- ❑ Tools/supplies for securing your home
- ❑ Extra set of car keys and house keys
- ❑ Extra clothing, hat and sturdy shoes
- ❑ Rain gear
- ❑ Insect repellent and sunscreen
- ❑ Camera for photos of damage

What do I do after a flood?



- ❑ Return home only when officials have declared the area safe.
- ❑ Before entering your home, look outside for loose power lines, damaged gas lines, foundation cracks or other damage.
- ❑ Parts of your home may be collapsed or damaged. Approach entrances carefully. See if porch roofs and overhangs have all their supports.
- ❑ Watch out for wild animals, especially poisonous snakes that may have come into your home with the floodwater.
- ❑ If you smell natural or propane gas or hear a hissing noise, leave immediately and call the fire department.
- ❑ If power lines are down outside your home, do not step in puddles or standing water.
- ❑ Keep children and pets away from hazardous sites and floodwater.
- ❑ Materials such as cleaning products, paint, batteries, contaminated fuel and damaged fuel containers are hazardous. Check with local authorities for assistance with disposal to avoid risk.
- ❑ During cleanup, wear protective clothing, including rubber gloves and rubber boots.
- ❑ Make sure your food and water are safe. Discard items that have come in contact with floodwater, including canned goods, water bottles, plastic utensils and baby bottle nipples. When in doubt, throw it out!
- ❑ Do not use water that could be contaminated to wash dishes, brush teeth, prepare food, wash hands, make ice or make baby formula.
- ❑ Contact your local or state public health department for specific recommendations for boiling or treating water in your area after a disaster as water may be contaminated.

Let Your Family Know You're Safe

If your community experiences a flood, or any disaster, register on the American Red Cross Safe and Well Web site available through **RedCross.org/SafeandWell** to let your family and friends know about your welfare. If you don't have Internet access, call **1-866-GET-INFO** to register yourself and your family.

American Red Cross

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Be Red Cross Ready

Hurricane Safety Checklist

Hurricanes are strong storms that cause life- and property-threatening hazards such as flooding, storm surge, high winds and tornadoes.

Preparation is the best protection against the dangers of a hurricane.

Know the Difference

Hurricane Watch—Hurricane conditions are a threat within 48 hours. Review your hurricane plans, keep informed and be ready to act if a warning is issued.

Hurricane Warning—Hurricane conditions are expected within 36 hours. Complete your storm preparations and leave the area if directed to do so by authorities.

What should I do?



- ❑ Listen to a NOAA Weather Radio for critical information from the National Weather Service (NWS).
- ❑ Check your disaster supplies and replace or restock as needed.
- ❑ Bring in anything that can be picked up by the wind (bicycles, lawn furniture).
- ❑ Close windows, doors and hurricane shutters. If you do not have hurricane shutters, close and board up all windows and doors with plywood.
- ❑ Turn the refrigerator and freezer to the coldest setting and keep them closed as much as possible so that food will last longer if the power goes out.
- ❑ Turn off propane tanks and unplug small appliances.
- ❑ Fill your car's gas tank.
- ❑ Talk with members of your household and create an evacuation plan. Planning and practicing your evacuation plan minimizes confusion and fear during the event.
- ❑ Learn about your community's hurricane response plan. Plan routes to local shelters, register family members with special medical needs as required and make plans for your pets to be cared for.
- ❑ Evacuate if advised by authorities. Be careful to avoid flooded roads and washed out bridges.
- ❑ Because standard homeowners insurance doesn't cover flooding, it's important to have protection from the floods associated with hurricanes, tropical storms, heavy rains and other conditions that impact the U.S. For more information on flood insurance, please visit the National Flood Insurance Program Web site at **www.FloodSmart.gov**.

What supplies do I need?



- ❑ Water—at least a 3-day supply; one gallon per person per day
- ❑ Food—at least a 3-day supply of non-perishable, easy-to-prepare food
- ❑ Flashlight
- ❑ Battery-powered or hand-crank radio (NOAA Weather Radio, if possible)
- ❑ Extra batteries
- ❑ First aid kit
- ❑ Medications (7-day supply) and medical items (hearing aids with extra batteries, glasses, contact lenses, syringes, cane)
- ❑ Multi-purpose tool
- ❑ Sanitation and personal hygiene items
- ❑ Copies of personal documents (medication list and pertinent medical information, proof of address, deed/lease to home, passports, birth certificates, insurance policies)
- ❑ Cell phone with chargers
- ❑ Family and emergency contact information
- ❑ Extra cash
- ❑ Emergency blanket
- ❑ Map(s) of the area
- ❑ Baby supplies (bottles, formula, baby food, diapers)
- ❑ Pet supplies (collar, leash, ID, food, carrier, bowl)
- ❑ Tools/supplies for securing your home
- ❑ Extra set of car keys and house keys
- ❑ Extra clothing, hat and sturdy shoes
- ❑ Rain gear
- ❑ Insect repellent and sunscreen
- ❑ Camera for photos of damage

What do I do after a hurricane?



- ❑ Continue listening to a NOAA Weather Radio or the local news for the latest updates.
- ❑ Stay alert for extended rainfall and subsequent flooding even after the hurricane or tropical storm has ended.
- ❑ If you evacuated, return home only when officials say it is safe.
- ❑ Drive only if necessary and avoid flooded roads and washed-out bridges.
- ❑ Keep away from loose or dangling power lines and report them immediately to the power company.
- ❑ Stay out of any building that has water around it.
- ❑ Inspect your home for damage. Take pictures of damage, both of the building and its contents, for insurance purposes.
- ❑ Use flashlights in the dark. Do NOT use candles.
- ❑ Avoid drinking or preparing food with tap water until you are sure it's not contaminated.
- ❑ Check refrigerated food for spoilage. If in doubt, throw it out.
- ❑ Wear protective clothing and be cautious when cleaning up to avoid injury.
- ❑ Watch animals closely and keep them under your direct control.
- ❑ Use the telephone only for emergency calls.

Let Your Family Know You're Safe

If your community has experienced a hurricane, or any disaster, register on the American Red Cross Safe and Well Web site available through **RedCross.org/SafeandWell** to let your family and friends know about your welfare. If you don't have Internet access, call **1-866-GET-INFO** to register yourself and your family.

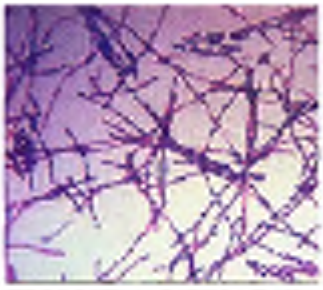
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Incident Response Plan Guidance

(42 CFR § 73.11, 7 CFR § 331.11, and 9 CFR § 121.11)

(May 2017)

Centers for Disease Control and Prevention (CDC)
Division of Select Agents and Toxins (DSAT)
Animal and Plant Health Inspection Service (APHIS)
Agriculture Select Agent Services (AgSAS)

Changes/Highlights

Revisions: This is a living document subject to ongoing improvement. Feedback or suggestions for improvement from registered Select Agent entities or the public are welcomed. Submit comments directly to the Federal Select Agent Program at:

CDC: LRSAT@cdc.gov
APHIS: AgSAS@aphis.usda.gov

Revision History:
October 12, 2012: Initial posting
June 19, 2013 (Revision 1): The revisions are primarily changes to correct editorial errors from previous version.
February 10, 2014: Added "Low probability/High consequence Events" to Appendix IV.
September 4, 2014: Added information about continuing laboratory operations after incident.
May 2017: The revisions are primarily changes to the organization to improve usability from previous version.

Introduction

Under the provisions of select agent regulations (7 CFR §331.14, 9 CFR §121.14, and 42 CFR §73.14), an entity registered with the Federal Select Agent Program is required to have plans in place in the event of a natural and/or man-made disaster. This guide is to assist the regulated community in developing a site-specific incident response plan to ensure the security and safeguarding of select agents and toxins from natural and man-made disasters.

Please feel free to use the new editable Incident Response Plan Template (link to template) as the foundation for your entity's incident response plan.

Incident Response Plan Requirements

Section 14 of the select agent regulations states that every registered entity must develop, implement, and maintain a written incident response plan.

The incident response plan must fully describe the entity's response to the following events:

- Loss, theft, or release of select agents and toxins
- Inventory discrepancies
- Security breaches
- Severe weather and natural disasters
- Workplace violence
- Bomb threats and suspicious packages
- Emergencies such as fired, gas leak, explosion, or power outage
- Other natural or man-made events that may threaten the entity

The incident response plan should also account for the hazards associated with the select agents and toxins. The plan should outline containment procedures for all select agents and toxins including infected animals and plants.

Incident Response Plan Information

According to section 14(d), the incident response plan should contain the following information as applicable for the entity's organization:

- Contact information for the Responsible Official and alternate Responsible Official (RO and ARO)
- Contact information for building owner/manager
- Tenant office contact information
- Contact information for entity's physical security official
- Personnel roles and lines of authority/communication
- Planning and coordination with local emergency responders
- Procedures to be followed by employees performing rescue or medical duties
- Emergency medical treatment and first aid
- Inventory of personal protective and emergency equipment and their locations
- Site security and control
- Procedures for emergency evacuation
    - Evacuation type
    - Exit route assignments
    - Safe distances
    - Places of refuge
- Decontamination procedures

Tier 1 Incident Response Plan Requirements

Entities that possess or use Tier 1 select agents and toxins must comply with additional incident response

planning requirements:

- Fully describe the response procedures for failure of intrusion detection or alarm system
- Describe notification procedures for the appropriate Federal, State, or local law enforcement agencies for suspected criminal activity related to the entity, its personnel, or its select agents and toxins

Effective Incident Response Planning

An incident response plan is a set of standard operating procedures that prevents the theft, loss, or release of select agents and toxins and/or protects human life and animal and plant health. An effective incident response plan prioritizes:

1. Protecting of human life before property.
2. Considering the impact to the laboratory instead of just the facility.
3. Collaborating between entity leadership and responders.
4. Entity training with responder participation.
5. Addressing the primary effect of the hazard, the secondary effects, and the impact the hazard has on the facility workers.
6. Focusing on areas inside the laboratory or registered space.

There are other statutes (federal, state and local government) that address emergency and incident response. The select agent incident response plan is not intended to preempt or supersede other response agreements or written plans provided that other plans and agreements address the requirements of section 14 of the select agent regulations. If an entity chooses to use other plans as a means of meeting these requirements, section 18 of the select agent regulations requires that this information be made available to Federal Select Agent Program inspectors when on-site inspections are conducted.

Creating a Successful Incident Response Plan

FSAP has developed a six-step cycle for creating a successful incident response plan. These steps are general guidelines for creating the series of standard operating procedures (SOPs) to be in compliance with section 14 of the select agents regulations and provide a safe environment for the entity's employees and community.

Step 1: Form a Team.

The incident response planning team should include the following as applicable to the entity's organization and biosafety level (BSL):

- Entity Subject Matter Experts (SMEs) – Responsible Official, Principle Investigator, Biosafety Officer
- First Responders – Fire Department, Police, Emergency Medical
- Governmental – State, Federal, Local
- Organization – Facility Manager, Security, Leadership

Once the team is formed, it should remain engaged throughout the process. Each team member brings both skills and a unique perspective to the situation. At each step, the entity is strongly encouraged to consult team members.

Step 2: Perform a Risk Assessment.

Begin the discussion by describing the entity to the responders, with particular attention to the layout of registered spaces. Each group of SMEs in the incident response planning team provides a different perspective and key pieces of information for identifying risks and mitigation methods.

The Entity

1. Identify risks (probable hazards, high consequence events) that cannot be mitigated before a response is required. This should include those required by regulation, regional natural disasters, and other site-specific hazards.
2. Identify what protective measures/equipment is in place and where it is located.
3. Discuss SOPs which may take place during incidents, including man-down drills, evacuation procedures, and others.

First Responders

1. Identify what capabilities can be managed by first responders (HAZMAT, police).
2. Calculate response times to the entity by hazard type for multiple situations.
3. Discuss contact and communication procedures beyond calling 911.

Facility Management and Safety/Security Personnel

1. Be familiar with the physical capabilities of the building and available emergency equipment.
2. Understand the existing organizational policies and procedures for managing incidents.
3. Take responsibility for escorting or granting access to first responders.

Step 3: Analyze Facility Capabilities against Hazards

Conduct an analysis of various hazards that may result in the theft, loss, or release of a select agent or toxin. FSAP requires that the entity addresses certain specific hazards, which form the core of the incident response plan. The

entity should also analyze their capabilities against any additional hazards identified during the risk analysis.

To conduct a facility analysis, create scenarios that demonstrate a series of incident driven actions and events and provide a factual and logical framework for developing an SOP. The scenarios can assist in guiding discussion and help create an appropriate sequence response actions. Some different methods of working through incident response scenarios include:

- **Action/Response** – Each action leads to a reaction and so on until the tasks are complete.
- Functional – Each organization talks through its internal SOPs and determines where they should overlap.
- **Walk-Through** – The team physically determines what resources are available, where equipment sits, and where the clean/dirty areas are. Focus on the inside of the laboratory. Building codes will generally ensure the facility can survive likely disasters but may not address loss of primary and secondary containment, animal husbandry issues, spilled, loss of power to a freezer, etc.
- **Second Order Effects** – The team discusses and determines incidents that may lead to other incidents. For example:
    - Earthquake may cause power outage or fire.
    - Hurricane may prevent facility access.
    - Fire suppression system may flood a containment system

As the team conducts the facility analysis, consider the following questions:

- Who must do what, when, and where?
- What must team members know for each incident type?
- Who conveys incident response information to team members?
- What crucial information must be conveyed about the lab and facility?
- What equipment is needed during a given incident/incident response?
- Who is in charge at each step of the incident response? What decisions must be made?

The answers to these questions will allow the Incident Response planning team to identify the key information that forms the basis of the incident response plan:

- Condition Expectations and Assumptions – Assumptions that must be made as a part of incident response planning but may disrupt the plan if they are not met (i.e. clear roads, first responder presence).
- Logistical Constraints – Limitations of response team members (i.e. equipment access, mobility limitations).
- Capability Gaps – Required capabilities that team members do not have (i.e. missing Personal Protective Equipment, training, etc.).

Step 4: Develop Plans by Incident Type

Create a series of standard operating procedures (SOPs) based on each scenario. An SOP should be a list of simple instructions that anyone can quickly read and follow. Focus on creating plans with common steps that can be applied to various incidents to improve comprehension and reduce training.

Entities are encouraged to develop playbooks. A playbook is a series of simple plans / SOPs that cover the multiple incidents identified in the analysis stage. Instead of focusing on nuances of each event, focus on common steps

and then apply them to various incidents. This not only makes incident response easier for individuals to understand it also makes it much easier to train.

Notice Based

- No Notice
- Minimal Notice
- With Notice
- After the Fact

Risk Based

- High (Potential for serious threat/damage)
- Medium
- Low

Incident Based

- Case-by-case
- Natural Disasters
- Facility Emergencies
- Severe Weather

Each SOP should include the following crucial information:

1. What incidents the plan covers?
2. Concept (What are you trying to do? When are you done?)
3. Entity and organizational responsibilities/tasks (What will the entity do? Who does it/when? What is the entity responsible for?)
4. First responder actions/tasks (What will they/won't they do?)
5. Entity lines of authority (Who has the authority to call this kind of response? Who's next in charge?)
6. Decontamination procedures (Do you doff? If not, how do you separate contaminated personnel?)
7. Emergency equipment (Where is it? How does it apply? Who uses it?)
8. Procedures for emergency evacuation, including type of evacuation, exit route assignments, safe distances, and places of refuge (How do you get out? Where do you go once you leave the lab?)
9. Personnel accountability (Who accounts for personnel and who is notified once personnel are accounted for?)
10. Procedures to be followed by employees performing rescue or medical duties and the location (Where do you conduct immediate care? Where do you conduct follow up?)
11. Location where the first responders will pick up a patient and what amount of decontamination must be done (Doffing, showering out—consult the first responders on their requirements for transport)
12. Contacts and communication plan (Who calls 911? Who notifies the RO or management? Is anyone else notified?)
13. Site security and control (How do you manage access to the facility during and after the incident, where's the perimeter, etc.?)
14. Return procedures (Under what conditions and how do you return to the lab, check containment, etc.)

15. Select agent and toxin (and other high value items) accountability
16. Medical Surveillance (if required)

Create a Recovery Plan

Create a recovery phase for incidents that may cause damage to a laboratory. The recovery plan should include procedures for emergencies that would prevent entities from returning to normal operating conditions (i.e. laboratory is damaged and nonoperational). This section of the plan should answer the following questions:

- What happens when the laboratory cannot return to normal operations after an incident?
- When will the laboratory be able to return to normal operations?
- Will work with select agents and toxins continue in another registered space?
- Will select agents and toxins be stored in another registered space until the damaged area is operational?
- Will select agents be transferred to another registered entity until the damaged laboratory is operational?

Step 5: Review and Test the Incident Response Plan

To stay in compliance with Section 14 of the select agent regulations, review and exercise the incident response plan at least once annually. See the Drills and Exercise guidance document for FSAP recommendations for successful drills and exercises.

Step 6: Refine and Update Plans

Refine and update their plan(s) at least annually, after each exercise or after a plan is executed. Work with the incident response planning team to review the document and make any necessary changes to address the following:

- Results of training (what went well, what can be improved, changes made)
- Any changes to threats or hazards
- Any changes to expectations or assumptions from the original plan
- Any new equipment, its capabilities and locations including first responders (new PPE, new HAZMAT vehicle)
- Any changes to the entity (additional registered space)
- Any changes in key personnel or organizations, including first responders
- Changes to the agents which affect response (adding a Tier 1 agent)
- Specific threats against the entity or its personnel
- Any changes in communications
- Critical changes to regulatory requirements, including those which affect first responders

Regional Natural Disasters

Go to each of the following websites to determine if the organization is at reasonable risk for any of these incidents. Ensure that any reasonable risks are accounted for in a SOP in the Incident Response Plan.

- General: U.S. Geological Survey Website
- Flood: U.S. Federal Emergency Management for Floods
- Earthquake: Earthquake Hazard Map

- Hurricane: National Hurricane Center
- Tornado: Tornado Alley Map
- Tsunami: Tsunami Hazard Map
- Volcano: Volcano Hazard Map
- Wildfire: Wildfire Hazard Map

Low Probability/High Consequence Events

Entities are encouraged to plan for "low probability/high consequence" events. A low probability/high consequence event is any event which adversely: 1) affects the safety and security of a registered facility; 2) affects human health and safety; and 3) causes environmental degradation.

Consider not only these types of events but potential secondary incidents that may occur as a result of an incident, such as:

- System Failures
- Radioactive Leaks
- Extreme Flooding
- Power Failures
- Access Loss
- Damaged Equipment

Regulatory Requirements

Section 14 (b) Requirements:

The incident response plan must fully describe the entity's response for the following procedures in the chart below.

Incident	Definition of Incident	Examples	Incident Notice
Theft, loss or release of a select agent or toxin	**Theft:** Unauthorized removal of select agent or toxin. **Loss:** A failure to account for select agent or toxin **Release:** A discharge of a select agent or toxin outside the primary containment barrier due to a failure in the containment system, an accidental spill, occupational exposure, or a theft. Any incident that results in the activation of a post exposure medical surveillance/prophylaxis protocol should be reported as a release.	Vial containing select agent missing or stolen; spills; needle stick;	No Notice
Inventory discrepancies	Inventory discrepancies occur when inventory (e.g., vials, containers) do not match the record data.	Mislabeled vials	No Notice
Security breaches/ Suspicious Activity	A security breach occurs when there is a disruption in the established security network or a failure to follow the entity's written security policies and procedures. Breaches involve all levels of security including physical security (hardened, fixed systems), operational security (personnel reliability) and information systems (electronic and hard copy material).	Computer hacking; unauthorized personnel in laboratory	No Notice
Severe weather and other natural disasters	Severe weather and natural disasters vary from one geographic location to another within the United States. Severe weather situations and natural disasters include tropical storms, hurricanes, tornadoes, windstorms, thunderstorms, lightning, hail, floods, earthquakes, fires and winter storms (not all inclusive). To assist in determining if the entity is in an affected area, refer to Tab IV "Evaluating Natural Hazard."	Tornado Warnings; Flood Warnings	Minimal Notice for tornado, severe weather or storm, hurricane, floods No Notice for earthquakes
Bomb Threats	Bomb threats have become common means to disrupt workplace activity. Most agencies at the academic, state, and federal levels have their own bomb threat policy.	Any object that appears suspicious or looks like it might be explosive.	Minimal Notice
Gas leak	A gas leak is a non-expected release of gas that can create a potentially dangerous situation - either because the released gas is poisonous or because it can ignite and create an explosion.	Smell of gas; sound of air being released from an open gas valve	Minimal Notice
Explosion	Explosion is the sudden loud release of energy and a rapidly expanding volume of gas that occurs when a bomb detonates or gas explodes	Bomb detonates or gas explodes	No Notice

Section 14 (c) Requirements:

Emergency Contact Information – Collect and document site- specific contact information for each person identified as having an incident response role. Focus on support units that are available within the geographic region of the facility, especially if the entity is relying on local support of first responders. Entities associated with larger parent organizations (i.e., colleges, universities, federal or state campuses and research medical institutions) need to incorporate or integrate their site-specific incident response requirements with established entity-wide emergency response programs.

Personnel roles and lines of authority and communication – Assess the roles and responsibilities of each identified person ahead of time. Ensure that all participants understand the lines of authority and how information is communicated both up and down the chain of command.

Planning and coordination with local emergency responders – Meet with local emergency responders to discuss large scale disasters is important. Discuss the roles and responsibilities of each party with first responders in the event of a disaster that affects the select agent laboratory.

Procedures to be followed by employees performing rescue and medical duties – Rescue and medical duties should be limited to only those individuals that are qualified to perform these duties (paramedic, EMT, registered nurse, physician assistant, medical doctor, osteopathic physician). When qualified individuals are not available, 911 should be called. Train staff to perform emergency first aid and CPR if laboratories located in remote areas that may cause delayed ambulance response time.

Emergency medical treatment and first aid – Establish provisions for emergency medical treatment and first aid for employees injured on the job. Since occupational injuries and illnesses are work related, worker's compensation rules may apply. Check with the personnel department (human resources) to determine if employees have to report to a prearranged emergency treatment center or clinic. Inform workers of where to go or be transported for emergency medical treatment or first aid. In laboratories that are regulated by state or federal OSHA (Occupational Safety and Health Administration), an injury log (e.g., OSHA 300) will be required to record all injuries that result in lost time or in medical treatment.

List of personal protective and emergency equipment, and their locations – Identify what personal protective equipment (PPE) and emergency equipment is needed and state where it is located. Include a floor plan showing the PPE and emergency equipment locations in the incident response plan. Examples of PPE include, but are not limited to: gloves, protective eyewear, face shields, respirators, foot protection, gowns, and scrubs. Examples of emergency equipment include, but are not limited to: fire extinguishers, emergency showers, fire blankets, eye wash stations, and portable lighting.

Site security and control – Maintain site security and control to the best of your ability at all times. During incident response planning, inform first responders that access to restricted areas needs to be controlled during and after each incident. Some of the typical methods used to maintain site security control include a posted armed police officer or guard, yellow "caution" tape around the perimeter, "keep out" signs, emergency lighting, etc.

Procedures for emergency evacuation – The incident response plan should define the different types of

evacuations that may be encountered during an emergency. Post floor plans that show the primary and secondary emergency exit routes on each floor. Include these floor plans in the incident response plan. Determine safe distances for evacuation in the event of a worst case scenario. When a warning is received regarding an impending disaster, the incident response plan should designate areas for safe refuge until the warning expires or the threat no longer exists.

Decontamination procedures – Describe decontamination procedures in the incident response plan. Include decontamination procedures for spills, injured select agent workers, emergency responders and laboratory rooms and areas that require mass decontamination.

Annual Training – Provide and document annual incident response training for personnel who have access to select agents or toxins. The documentation of incident response training must include: name of trained personnel, date, name of training, and how it verified that personnel understood training goals and objectives. For entities with Tier 1 agents insider threat awareness training must be conducted annually with all personnel who have access to select agents or toxins.

Tier 1 Requirements – Entities with Tier 1 agents must provide the following additional information in the incident response plan:

- A plan for how the entity will respond to the activation of the alarm system or information on an intruder in the lab.
- Procedure for how the entity will notify the appropriate Federal, State, or local law enforcement agencies of suspicious activity that may be criminal in nature and related to the entity, its personnel, or its select agents or toxins.

LOCKDOWN PROCEDURES

1. If you hear, "**LOCKDOWN**" over the intercom or an administrator announces the lockdown in person:
    a. Everyone is to stay where they are.
    b. **Classroom teachers** are to:
        I. Quickly glance outside the room to direct any students or staff members in the hall into your room immediately.
        ii. Lock your door.
        iii. Lower or close any blinds.
        iv. Place students against the wall, so that the intruder cannot see them looking in the door. Look for the '**Safe Corner**'.
        v. Turn out lights and computer monitors.
        vi. Keep students quiet.

Note: All staff members should locate and hold on to their roll book prior to turning out the lights. This will aid in accounting for all students should an evacuation be necessary.

    c. Physical education classes being held in the gym should move into a locker room, lock all doors, and find a safe area.
    d. Any students in the cafeterias should move to the nearest classrooms.
    e. If students and teachers are outside the school building, they should stop, drop, and remain still. You will be directed where to relocate depending on the situation.
    f. If teachers and students are in the bathrooms, they should move to a stall, lock it and stand on the toilet.
    g. Anyone in the hallway should move to the closest classroom immediately.
    h. Nurses/cafeteria workers/support staff should stay in the area they are in, secure the doors, and turn out the lights.
    I. Students and staff in the library should remain in the library. Librarians should lock the doors, turn out the lights, and locate a safe area.

2. Stay in safe areas until directed by law enforcement officers or an administrator to move or evacuate. Never open doors during a lockdown, even in the event of a fire alarm. For further directives, law enforcement officers and administrators will have keys to open the doors or announcements will be made over the intercom.

3. An administrator will signal all personnel if the lockdown has been lifted.

4. If an evacuation occurs, all persons/classrooms will be directed by a law enforcement officer or administrator to a safe location. Once evacuated from the building, teachers should take roll to account for all students present in class. Administrators will divide and keep in communication with radios or cell phones.

EVACUATION PROCEDURE

1. Possible reasons for an evacuation to be initiated:
   - An incident after a lockdown;
   - Fire;
   - Natural gas leak;
   - Hazardous chemical leak inside the building;
   - Localized flooding;
   - Fumes from an unknown source;

2. Persons who can call for an evacuation:
   - Administrators;
   - Office staff;
   - Law enforcement;

3. Office staff or campus administrators are to call 911 and notify Central Office.

4. Central Office will notify the school board.

Evacuation Drill

1. An evacuation drill maybe initiated by personal contact from an administrator or law enforcement officers or via an announcement over the intercom.

Classroom teachers should:

- Listen for specific directions.
- Immediately instruct students to shut off monitors, Bunsen burners, welding equipment, etc.
- Locate and take attendance book;
- Turn off air conditioner if possible;
- Turn off lights;
- Close windows;
- Close doors but do not lock;
- Exit quickly but do not run;
- While exiting, scan areas for anything out of the ordinary and to ensure all students have exited;
- Go to a safe distance as designated;
- Keep students quiet in the event of further directives;

2. An administrator will signal all personnel when the building is safe to re-enter.

BOMB THREAT PROCEDURE

1. As caller calls in threat, 'Bomb Threat Information Form' should be completed.
2. Immediately after receiving a bomb threat call, hang up and dial '9' and '*57'.
3. Notify 911 (use non-emergency number if it is a drill – state that the campus is having a drill.
4. Quickly scan your immediate area of building prior to evacuation. (Devices are more likely to be outside or in a common area.)
5. If bomb threat is determined to be real, follow 'Evacuation Procedure' or 'Lockdown Procedure' as determined by threat.

Note: Radios/cell phones/pagers should be turned off during a bomb threat. Electronic communication signals could trigger certain types of bombs.

BOMB THREAT INFORMATION FORM

(Be calm and courteous; do not interrupt the caller; quietly notify an administrator)

Name of person receiving the call:
_____

Time: ____ Date: ____ Length of call: ____

Caller ID #: _____ Race: _____

Check appropriate information:
Caller is:
____male; ____female; ____adult; ____ youth;
Caller's Voice Characteristics:
____loud; ____soft; ____deep; ____raspy;
____high-pitched; ____persistent;
Caller's Language:
____excellent; ____poor; ____fair; ____profane;
Caller's Manner:
____irrational; ____rational; ____angry;
____calm; ____nervous; ____sober; ____drunk;
____emotional; ____incoherent; ____laughing;
____voice is familiar;
Background Noises:
____street; ____animals; ____music; ____voices;
____work place noises;

Sample questions to ask caller:
When will it go off?_____
How much time is left before it goes off?_____
What kind of bomb?_____
Where are you now?_____
How do you know so much about the bomb?__
What is your name?_____
Why did you plant the bomb?_____

LOCKDOWN PROCEDURE

The lockdown/shelter-in-place code is "Lockdown" or an administrator will inform you in person.

1. Reasons for a lockdown to be initiated:
   - An out of control student who is a threat to the safety of our students, staff, or himself/herself;
   - Someone who has a gun or weapon;
   - An intruder;
   - Hazardous chemical outside the building;
   - A weather related event;

2. Persons who can call a lockdown;
   - Administrator;
   - Law enforcement;
   - Office staff;

Campus office staff is to notify Central Office; Central Office staff will notify Palacios ISD School Board.

LOCKDOWN CHECKLIST

1. Parents were informed prior to a drill or after an actual event. _____
2. Scenario was reviewed with staff prior to the event. _____
3. Student/staff went inside, closed the doors, and closed and locked all windows. _____
4. Hang signs on outside doors and office indicating a lockdown is occurring. _____
5. Roll call of students and staff. _____
6. Turn off air conditioning/exhaust fans. _____
7. Close drapes and curtains. Window panel in door should be unobstructed. _____
8. Rooms were designated for people to go to during a drill. _____
9. Turn off pilot lights, but electricity should remain on. _____
10. Call 911 (non emergency # during drill) and alert central office. _____
11. Check whether anyone left the building during drill or actual event. _____
12. Debriefing after drill or event. _____

SAMPLE 1 - GENERAL LOCKOUT/TAGOUT PROCEDURE

Purpose

This procedure establishes the minimum requirements for lockout of energy sources that could cause injury to personnel. All employees shall comply with the procedure.

Responsibility

The responsibility for seeing that this procedure is followed is binding upon all employees. All employees shall be instructed in the safety significance of the lockout procedure by (designated individual). Each new or transferred affected employee shall be instructed by (designated individuals) in the purpose and use of the lockout procedure.

Preparation for Lockout

Employees authorized to perform lockout shall be certain as to which switch, valve, or other energy isolating devices apply to the equipment being locked out. More than one energy source (electrical, mechanical, or others) may be involved. Any questionable identification of sources shall be cleared by the employees with their supervisors. Before lockout commences, job authorization should be obtained.

Sequence of Lockout Procedure

1. Notify all affected employees that a lockout is required and the reason therefor.
2. If the equipment is operating, shut it down by the normal stopping procedure (such as: depress stop button, open toggle switch).
3. Operate the switch, valve, or other energy isolating devices so that the energy source(s) (electrical, mechanical, hydraulic, other) is disconnected or isolated from the equipment.
4. Lockout energy isolating devices with an assigned individual lock.
5. Stored energy, such as that in capacitors, springs, elevated machine members, rotating fly wheels, hydraulic systems, and air, gas, steam or water pressure, must also be dissipated or restained by methods such as grounding, repositioning, blocking, bleeding down.
6. After ensuring that no personnel are exposed and as a check on having disconnected the energy sources, operate the push button or other normal operating controls to make certain the equipment will not operate. CAUTION: Return operating controls to neutral position after the test.
7. The equipment is now locked out.

Restoring Equipment to Service

1. When the job is complete and equipment is ready for testing or normal service, check the equipment area to see that no one is exposed.
2. When equipment is clear, remove all locks. The energy isolating devices may be operated to restore energy to equipment.

Procedure Involving More Than One Person

In the preceding steps, if more than one individual is required to lock out equipment, each shall place his/her own personal lock on the energy isolating device(s). One designated individual of a work crew or a supervisor, with the knowledge of the crew, may lock out equipment for the whole crew. In such cases, it may be the responsibility of the individual to carry out all steps of the lockout procedure and inform the crew when it is safe to work on the equipment. Additionally, the designated individual shall not remove a crew lock until it has been verified that all individuals are clear.

Rules for Using Lockout Procedure

All equipment shall be locked out to protect against accidental or inadvertent operation when such operation could cause injury to personnel. Do not attempt to operate any switch, valve, or other energy isolating device bearing a lock.

SAMPLE 2 - EQUIPMENT LOCKOUT/TAGOUT PROCEDURE



Equipment Number	Equipment Type	MCC	Row	Bucket	Department
0600 - 01	*Motor 1*	*019*	*B*	*01*	*Board Plant*

Equipment Name: *Belt Transfer On-Rolls Table No. 1*

MCC Location: *Old Boiler Room*

Potential Hazards:	☐ Electrical	☑ Pneumatic	☐ Mechanical	☑ Multiple Lockouts
	☐ Hydraulic	☐ Chemical	☐ Combustables	☐ Confined Space
Methods of Neutralizing Energy:	☑ Relieve Pressure	☐ Block/Bleed	☑ Lockout/Tagout	
	☐ Disconnect Lines	☐ Set Fire Watch	☐ Confined Space Permit	
Permits Required:	☐ Safe Work	☐ Hot Work	☐ Line Blanking	☐ Confined Space

Lockout Procedure:

1. Notify Production Supervisor and ALL affected personnel.
2. After completing Step 1, Shut down equipment, if running, as trained. If you are not sure how, contact your supervisor for instructions.
3. Lockout the equipment following the lockout procedure at the WET TRANSFER ON ROLLS cabinet local disconnect on the north wall. This equipment can also be locked out at MCC 19 ROW B bucket 01 in the OLD BOILER ROOM.

   Note: Turn off the MAIN Air supply on the North wall to right of the ON ROLL control cabinet and lock the cover. Then isolate both of the surge tanks under the crossover walkway. Close and tag the ball valves before each tank. Push and lock out Dump Valves numbers 4 and 5. LOCK OUT the CROSSBELT #1 at the Crossover walkway local disconnect.

   Test the equipment at the “WET END Control Panel” located on the North wall by pushing the “Green Board Transfer start” pushbutton. You can also test this equipment from the crossover pushbutton station at the WET Transfer station by pushing the START SYSTEM pushbuton.

4. After ALL previous steps have been completed, begin your work assignment.
5. After completion of the work, assure that your work area is clean, clear of ALL debris and that ALL guards are secured in place.
6. Notify the Production Supervisor and ALL affected personnel that the equipment is operational and that removal of the lock-outs will occur.
7. Remove ALL locks and tags following the Lock-Out I Tag-Out Program instructions.
8. Prior to start-up of the equipment, inspect the area to ensure that ALL employees, contractors and any other personnel are safely positioned.
9. When production is ready, verify that equipment is operating correctly.
10. Close out any applicable permit/s and return them to your supervisor.

* MCC means Motor Control Center

Review Date:
Revision Date:

SAMPLE 3 - EQUIPMENT LOCKOUT/TAGOUT PROCEDURE



Equipment Number	Equipment Type	MCC *	Row	Bucket	Department
0594 - 01	*Motor*	*019*	*B*	*03*	*Board Plant*

Equipment Name
Cutoff Knife Drive

MCC Location
Old Boiler Room

Potential Hazards:
- [x] Electrical
- [ ] Pneumatic
- [ ] Mechanical
- [x] Multiple Lockouts
- [ ] Hydraulic
- [ ] Chemical
- [ ] Combustables
- [ ] Confined Space

Methods of Neutralizing Energy:
- [ ] Relieve Pressure
- [ ] Block/Bleed
- [x] Lockout/Tagout
- [ ] Disconnect Lines
- [ ] Set Fire Watch
- [ ] Confined Space Permit

Permits Required:
- [ ] Safe Work
- [ ] Hot Work
- [ ] Line Blanking
- [ ] Confined Space

Lockout Procedure:

1. Notify Production Supervisor and ALL affected personnel.
2. After completing Step 1, if running, shut down the equipment as trained. If you are not sure how, SEE YOUR SUPERVISOR.
3. “Lock” and “Tag” the equipment out at the “Knife Drives Cabinet’’, located across from the knife on the north wall, following the lockout procedure. CAUTION! THE COMPLETE LIVE ROLL SECTION MUST ALSO BE LOCKED OUT. REFER TO THE SPECIFIC LOCKOUT PROCEDURES FOR THAT EQUIPMENT. Test the equipment at the Knife control panel.
4. After ALL the previous steps have been completed, begin your work assignment.
5. After the completion of the work assignment, assure that the work area is clean.
6. Notify the Production Supervisor and/or ALL affected personnel that the equipment is operational and that removal of lock ous will occur.
7. Remove ALL locks and tags following the lockout procedure.
8. When production is ready, verify that the equipment is operating correctly.
9. When Production is ready, verify that equipment is operating correctly.
10. Close out any applicable permit/s and return them to your supervisor.

* MCC means Motor Control Center

Review Date:
Revision Date:

Reverse Evacuation

Critical Information

Reverse evacuation procedures are implemented when conditions inside the building are safer than outside.

Reverse evacuation procedures are often implemented in combination with other procedures (e.g. lockdown, shelter-in-place) in order to ensure the safety of students and staff who are outside the building.

When implementing Reverse Evacuation procedures:

Building Administration

- Make an announcement or sound alarm for reverse evacuation
- Direct staff to physically notify any classes that may be too far away from the building to hear the announcement or alarm
- Monitor the situation
- Provide staff with any updates or additional instructions
- Announce “all clear” signal when the emergency has ceased

Staff

- Move all students and staff inside as quickly as possible
- Assist those needing additional assistance
- Report to classroom
- Take attendance
- Report any missing, extra or injured students to building administration
- Wait for further instructions

American Red Cross

FACT SHEET ON SHELTER-IN-PLACE

What Shelter-in-Place Means:

One of the instructions you may be given in an emergency where hazardous materials may have been released into the atmosphere is to shelter-in-place. This is a precaution aimed to keep you safe while remaining indoors. (This is not the same thing as going to a shelter in case of a storm.) Shelter-in-place means selecting a small, interior room, with no or few windows, and taking refuge there. It does not mean sealing off your entire home or office building. If you are told to shelter-in-place, follow the instructions provided in this Fact Sheet.

Why You Might Need to Shelter-in-Place:

Chemical, biological, or radiological contaminants may be released accidentally or intentionally into the environment. Should this occur, information will be provided by local authorities on television and radio stations on how to protect you and your family. Because information will most likely be provided on television and radio, it is important to keep a TV or radio on, even during the workday. The important thing is for you to follow instructions of local authorities and know what to do if they advise you to shelter-in-place.

How to Shelter-in-Place

***At Home**:*

- Close and lock all windows and exterior doors.
- If you are told there is danger of explosion, close the window shades, blinds, or curtains.
- Turn off all fans, heating and air conditioning systems.
- Close the fireplace damper.
- Get your family disaster supplies kit http://www.redcross.org/services/disaster/beprepared/supplies.html, and make sure the radio is working.
- Go to an interior room without windows that's above ground level. In the case of a chemical threat, an above-ground location is preferable because some chemicals are heavier than air, and may seep into basements even if the windows are closed.
- Bring your pets with you, and be sure to bring additional food and water supplies for them.
- It is ideal to have a hard-wired telephone in the room you select. Call your emergency contact and have the phone available if you need to report a life-threatening condition. Cellular telephone equipment may be overwhelmed or damaged during an emergency.
- Use duct tape and plastic sheeting (heavier than food wrap) to seal all cracks around the door and any vents into the room.
- Keep listening to your radio or television until you are told all is safe or you are told to evacuate. Local officials may call for evacuation in specific areas at greatest risk in your community.

At Work:

- Close the business.
- Bring everyone into the room(s). Shut and lock the door(s).
- If there are customers, clients, or visitors in the building, provide for their safety by asking them to stay – not leave. When authorities provide directions to shelter-in-place, they want everyone to take those steps now, where they are, and not drive or walk outdoors.
- Unless there is an imminent threat, ask employees, customers, clients, and visitors to call their emergency contact to let them know where they are and that they are safe.
- Turn on call-forwarding or alternative telephone answering systems or services. If the business has voice mail or an automated attendant, change the recording to indicate that the business is closed, and that staff and visitors are remaining in the building until authorities advise it is safe to leave.
- Close and lock all windows, exterior doors, and any other openings to the outside.
- If you are told there is danger of explosion, close the window shades, blinds, or curtains.
- Have employees familiar with your building's mechanical systems turn off all fans, heating and air conditioning systems. Some systems automatically provide for exchange of inside air with outside air – these systems, in particular, need to be turned off, sealed, or disabled.
- Gather essential disaster supplies, such as nonperishable food, bottled water, battery-powered radios, first aid supplies, flashlights, batteries, duct tape, plastic sheeting, and plastic garbage bags.
- Select interior room(s) above the ground floor, with the fewest windows or vents. The room(s) should have adequate space for everyone to be able to sit in. Avoid overcrowding by selecting several rooms if necessary. Large storage closets, utility rooms, pantries, copy and conference rooms without exterior windows will work well. Avoid selecting a room with mechanical equipment like ventilation blowers or pipes, because this equipment may not be able to be sealed from the outdoors.
- It is ideal to have a hard-wired telephone in the room(s) you select. Call emergency contacts and have the phone available if you need to report a life-threatening condition. Cellular telephone equipment may be overwhelmed or damaged during an emergency.
- Use duct tape and plastic sheeting (heavier than food wrap) to seal all cracks around the door(s) and any vents into the room.

- Write down the names of everyone in the room, and call your business' designated emergency contact to report who is in the room with you, and their affiliation with your business (employee, visitor, client, customer.)
- Keep listening to the radio or television until you are told all is safe or you are told to evacuate. Local officials may call for evacuation in specific areas at greatest risk in your community.

At School:

- Close the school. Activate the school's emergency plan. Follow reverse evacuation procedures to bring students, faculty, and staff indoors.
- If there are visitors in the building, provide for their safety by asking them to stay – not leave. When authorities provide directions to shelter-in-place, they want everyone to take those steps now, where they are, and not drive or walk outdoors.
- Provide for answering telephone inquiries from concerned parents by having at least one telephone with the school's listed telephone number available in the room selected to provide shelter for the school secretary, or person designated to answer these calls. This room should also be sealed. There should be a way to communicate among all rooms where people are sheltering-in-place in the school.
- Ideally, provide for a way to make announcements over the school-wide public address system from the room where the top school official takes shelter.
- If children have cell phones, allow them to use them to call a parent or guardian to let them know that they have been asked to remain in school until further notice, and that they are safe.
- If the school has voice mail or an automated attendant, change the recording to indicate that the school is closed, students and staff are remaining in the building until authorities advise that it is safe to leave.
- Provide directions to close and lock all windows, exterior doors, and any other openings to the outside.
- If you are told there is danger of explosion, direct that window shades, blinds, or curtains be closed.
- Have employees familiar with your building's mechanical systems turn off all fans, heating and air conditioning systems. Some systems automatically provide for exchange of inside air with outside air – these systems, in particular, need to be turned off, sealed, or disabled.
- Gather essential disaster supplies, such as nonperishable food, bottled water, battery-powered radios, first aid supplies, flashlights, batteries, duct tape, plastic sheeting, and plastic garbage bags.
- Select interior room(s) above the ground floor, with the fewest windows or vents. The room(s) should have adequate space for everyone to be able to sit in. Avoid overcrowding by selecting several rooms if necessary. Classrooms may be used if there are no windows or the windows are sealed and can not be opened. Large storage closets, utility rooms, meeting rooms, and even a gymnasium without exterior windows will also work well.
- It is ideal to have a hard-wired telephone in the room(s) you select. Call emergency contacts and have the phone available if you need to report a life-threatening condition. Cellular telephone equipment may be overwhelmed or damaged during an emergency.
- Bring everyone into the room. Shut and lock the door.
- Use duct tape and plastic sheeting (heavier than food wrap) to seal all cracks around the door(s) and any vents into the room.
- Write down the names of everyone in the room, and call your schools' designated emergency contact to report who is in the room with you.
- Listen for an official announcement from school officials via the public address system, and stay where you are until you are told all is safe or you are told to evacuate. Local officials may call for evacuation in specific areas at greatest risk in your community.

In Your Vehicle:

If you are driving a vehicle and hear advice to "shelter-in-place" on the radio, take these steps:

- If you are very close to home, your office, or a public building, go there immediately and go inside. Follow the shelter-in-place recommendations for the place you pick described above.
- If you are unable to get to a home or building quickly and safely, then pull over to the side of the road. Stop your vehicle in the safest place possible. If it is sunny outside, it is preferable to stop under a bridge or in a shady spot, to avoid being overheated.
- Turn off the engine.
- Close windows and vents.
- If possible, seal the heating/air conditioning vents with duct tape.
- Listen to the radio regularly for updated advice and instructions.
- Stay where you are until you are told it is safe to get back on the road. Be aware that some roads may be closed or traffic detoured. Follow the directions of law enforcement officials.

Local officials on the scene are the best source of information for your particular situation. Following their instructions during and after emergencies regarding sheltering, food, water, and clean up methods is your safest choice.

Remember that instructions to shelter-in-place are usually provided for durations of a few hours, not days or weeks. There is little danger that the room in which you are taking shelter will run out of oxygen and you will suffocate.

Be Red Cross Ready

Tsunami Safety Checklist

Tsunamis are a series of large ocean waves generated by major earthquakes beneath the ocean floor or major landslides into the ocean. When the waves enter shallow water, they may rise to several feet or, in rare cases, tens of feet, striking the coast with devastating force. People on the beach or in low coastal areas need to be aware that a tsunami could arrive within minutes after a severe earthquake. The tsunami danger period can continue for many hours after a major earthquake. A tsunami can occur during any season of the year and at any time, day or night.

Be aware of the signs of a tsunami:

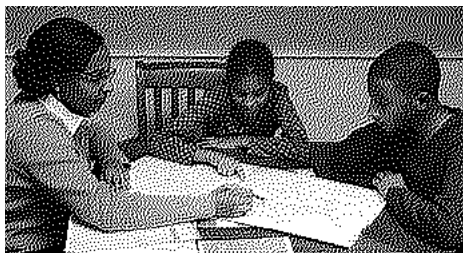
- A strong earthquake lasting 20 seconds or more near the coast.
- A noticeable rapid rise or fall in coastal waters.

What is the best source of information in a tsunami situation?

The International Tsunami Warning System monitors ocean waves after any Pacific earthquake with a magnitude greater than 6.5. If waves are detected, warnings are issued to local authorities who can order the evacuation of low-lying areas if necessary. The National Oceanic and Atmospheric Administration (NOAA)'s National Weather Service operates two tsunami warning centers:

1. **West Coast/Alaska Tsunami Warning Center (WC/ATWC), Palmer, Alaska.** Serves Alaska, Washington, Oregon, California, the U.S. Atlantic and Gulf of Mexico coasts, Puerto Rico, the U.S. Virgin Islands and Canada.
2. **Pacific Tsunami Warning Center (PTWC), Ewa Beach, Hawaii.** Serves Hawaii and the U.S. Pacific territories, and as an international warning center for the Pacific and Indian oceans and the Caribbean Sea.

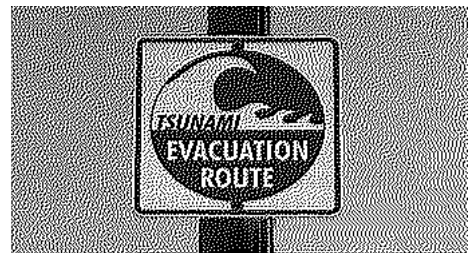
How can I prepare ahead of time?



Find out if your home, school, workplace or other frequently visited locations are in tsunami hazard areas.

- ❑ Know the height of your street above sea level and the distance of your street from the coast or other high-risk waters. Evacuation orders may be based on these numbers.
- ❑ Plan evacuation routes from your home, school, workplace and other places you could be where tsunamis present a risk. If possible, pick areas 100 feet (30 meters) above sea level or go as far as 2 miles (3 kilometers) inland, away from the coastline. If you cannot get this high or far, go as high or far as you can. Every foot inland or upward may make a difference. You should be able to reach your safe location on foot within 15 minutes.
- ❑ Find out what the school evacuation plan is. Find out if the plan requires you to pick your children up from school or from another location. Telephone lines during a tsunami watch or warning may be overloaded and routes to and from schools may be jammed.
- ❑ Practice your evacuation routes. Familiarity may save your life. Be able to follow your escape route at night and during inclement weather. Practicing your plan makes the appropriate response more of a reaction, requiring less thinking during an actual emergency.
- ❑ If you are a tourist, familiarize yourself with local tsunami evacuation protocols. You may be able to safely evacuate to the third floor and higher in reinforced concrete hotel structures.

What should I do during a potential tsunami situation?



If you are in a coastal area and feel an earthquake that lasts 20 seconds or longer:

- ❑ Drop, cover and hold on. You should first protect yourself from the earthquake.
- ❑ When the shaking stops, gather members of your household and move quickly to higher ground away from the coast. A tsunami may be coming within minutes.
- ❑ Avoid downed power lines and stay away from buildings and bridges from which heavy objects might fall during an aftershock.

What to do during a tsunami watch

- ❑ Use a NOAA Weather Radio or tune to a Coast Guard emergency frequency station or a local radio or television station for updated emergency information.
- ❑ Locate household members and review evacuation plans. Be ready to move quickly if a tsunami warning is issued.

What to do during a tsunami warning

- ❑ If you hear an official tsunami warning or detect signs of a tsunami, evacuate at once.
- ❑ Take your emergency preparedness kit. Having supplies will make you more comfortable during the evacuation.
- ❑ Take your pets with you. If it is not safe for you, it's not safe for them.
- ❑ Get to higher ground as far inland as possible. Watching a tsunami could put you in grave danger. If you can see the wave, you are too close to escape it.

What do I do after a tsunami?



- ❑ Continue using a NOAA Weather Radio or tuning to a Coast Guard station or a local radio or television station for the latest updates.
- ❑ Return home only after local officials tell you it is safe. A tsunami is a series of waves that may continue for hours. Do not assume that after one wave the danger is over. The next wave may be larger than the first one.
- ❑ Check yourself for injuries and get first aid as needed before helping injured or trapped persons.
- ❑ If someone needs to be rescued, call professionals with the right equipment to help. Many people have been killed or injured trying to rescue others.
- ❑ Help people who require special assistance—infants, elderly people, those without transportation, people with disabilities and large families who may need additional help in an emergency situation.
- ❑ Avoid disaster areas. Your presence might interfere with emergency response operations and put you at further risk from the residual effects of floods.
- ❑ Use the telephone only for emergency calls.
- ❑ Stay out of any building that has water around it. Tsunami water can cause floors to crack or walls to collapse.
- ❑ Use caution when re-entering buildings or homes. Tsunami-driven floodwater may have damaged buildings where you least expect it. Carefully watch every step you take.
- ❑ To avoid injury, wear protective clothing and be cautious when cleaning up.
- ❑ Watch animals closely and keep them under your direct control.

Let Your Family Know You're Safe

If your community has experienced a disaster, register on the American Red Cross Safe and Well Web site, available through **redcross.org/safeandwell**, to let your family and friends know about your welfare. You may also call **1-800-RED-CROSS (1-800-723-2767)** to register yourself and your family.

American Red Cross

For more information on disaster and emergency preparedness, please visit **redcross.org**.

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LARSON
Architects

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Portland, Oregon
503/223-4886

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These record drawings have been prepared, in part, on the basis of information compiled and furnished by others. The Architect has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result.

Date: AUG. 15, 1997
PACKAGE "D"

Revision No.:
1 ADDENDUM #1 AUG. 28, 1997
2 PROP. REQ. #10 NOV. 25, 1997
3 PROP. REQ. #12 JAN. 16, 1998
REISSUED: 1/27/98
4 PROP. REQ. #14 JAN. 30, 1998
RECORD DRAWINGS
5 MAR. 29, 1999

EFK MOB AND PARKING STRUCTURE

Drawing:
FLOOR PLAN
LEVEL L1

Job. No. 8019-01

Sheet:
A2.7

WALL RATING LEGEND
1 HOUR RATED SMOKE WALL SYSTEM
2 HOUR RATED WALL SYSTEM

SHEET A4.8
SHEET A4.7
SHEET A4.5
SHEET A4.6
SHEET A4.6
SHEET A4.7

1 A2.7 LEVEL L1 FLOOR PLAN
SCALE: 1/8" = 1'-0"

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MOUCHKA
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Architects

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Portland, Oregon
503/223-4886

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JAN. 16, 1998

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JAN. 30, 1998

RECORD DRAWING
4 MAR. 29, 1999

EFK MOB AND PARKING STRUCTURE

Drawing:
FLOOR PLAN
LEVEL L2

Job. No. 8019-01

Sheet:
A2.8

WALL RATING LEGEND

- 1 HOUR RATED SMOKE WALL SYSTEM
- 2 HOUR RATED WALL SYSTEM

1 / A2.8 LEVEL L2 FLOOR PLAN
SCALE: 1/8" = 1'-0"

NORTH

SHEET A4.9

SHEET A4.10

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VALLEY MEDICAL

BUILDING 4

2800 Medical Center Drive, Portland, OR 97035

Floor Plan Log Sheet

FLOOR	DESCRIPTION
Basement	Medical Supply Storage, Emergency Equipment, Shipping and Receiving.
Level 1	Main Entrance, Digital Imaging and Occupational Health.
Level 2	Pharmacy, Radiology, Surgery Prep and Pain Clinic.
Level 3	Surgery Center and Endoscopy Lab.
Roof	Exhaust Fan Openings, HVAC Units and Ducts, Ventilation, Elevator and Service Equipment.

VALLEY MEDICAL

BUILDING 4

2800 Medical Center Drive, Portland, OR 97035

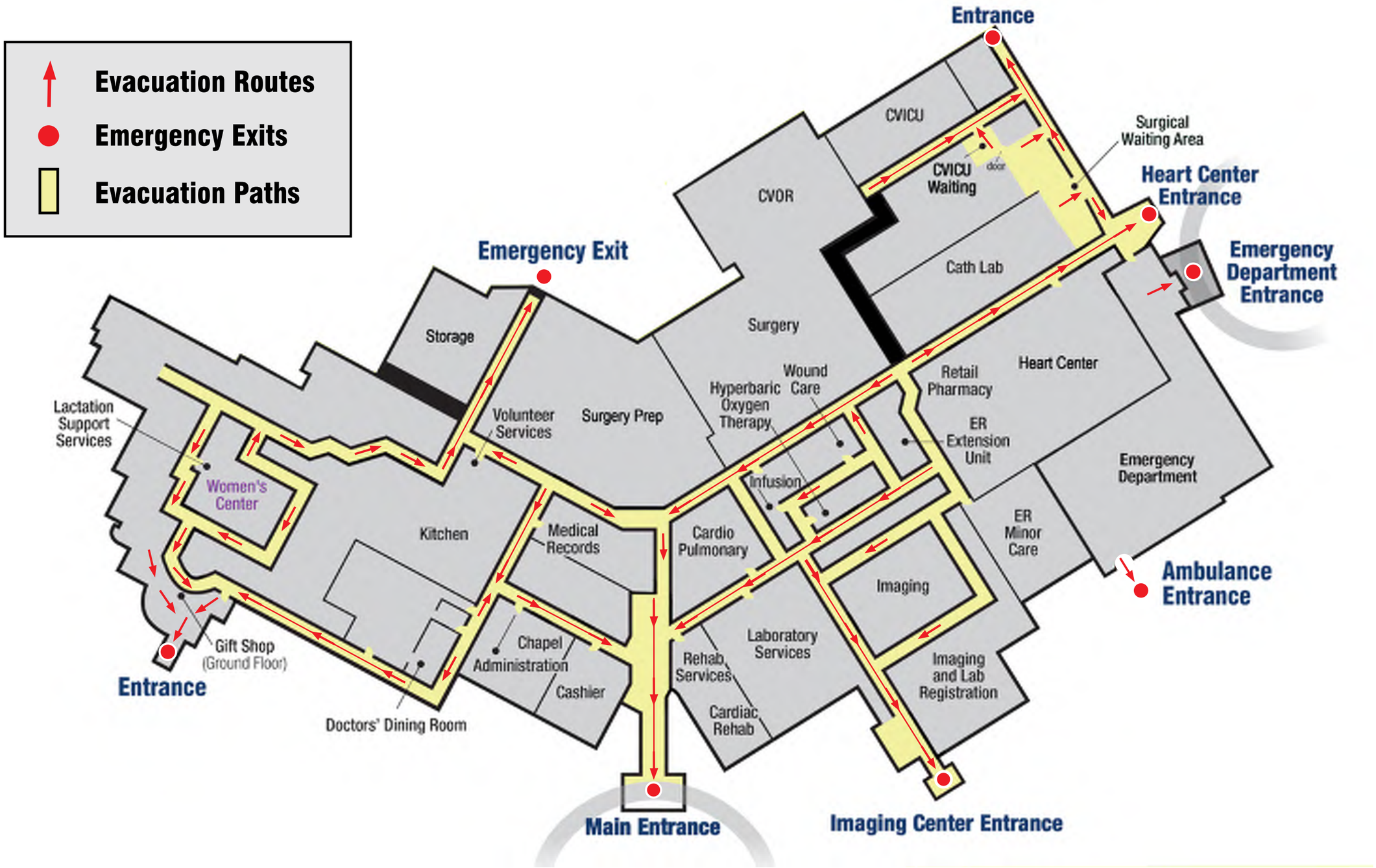
Training Log

DATE	DESCRIPTION
2017-07-03	Active Shooter
2017-04-28	Bomb Threat
2017-04-07	Earthquake
2017-03-23	Evacuation
2017-02-02	Fire
2016-11-01	Flood
2016-10-25	Hurricane
2016-10-20	Incident Response
2016-09-02	Lockdown
2016-07-25	Lockout
2016-07-23	Reverse Evacuation
2016-07-07	Shelter-In-Place
2016-06-29	Tsunami

VALLEY MEDICAL

EVACUATION MAP

2800 Medical Center Drive, Portland, OR 97035



VALLEY MEDICAL

FIRE EXTINGUISHERS

2800 Medical Center Drive, Portland, OR 97035

- FIRE EXTINGUISHERS
- DEFIBRILLATORS
- FIRE HOSES
- STANDPIPES
- FIRE ALARMS
- FIRE HYDRANTS
- PROPANE TANKS
- BACKUP GENERATORS



Tag

Training Video

Training Video Link


DO NOT
REMOVE
BY ORDER OF
THE STATE FIRE MARSHAL
Type ABC
L-748
EE 7808
(Cert. Reg. No.)
(Signature)
CAL FIRE
PROTECTION CO.
2691 W. Parkside Ln.
Anaheim, CA 92801
(714) 544-2482
ANNUAL MAINTENANCE PERFORMED
NEW EXTINGUISHER
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
2015 2016 2017 2018 2019


AED
AUTOMATIC EXTERNAL DEFIBRILLATOR
INSPECTION
SERIAL NO. _____
CHECK:
• Electrodes
• Status Indicator
• Battery
• General Condition
DATE BY DATE BY
DATE BY DATE BY
ZING www.zinggreenproducts.com #7018
Made in the USA out of recycled plastic.
2
PP
5

VALLEY MEDICAL

DEFIBRILLATORS

2800 Medical Center Drive, Portland, OR 97035

- FIRE EXTINGUISHERS
- **DEFIBRILLATORS**
- FIRE HOSES
- STANDPIPES
- FIRE ALARMS
- FIRE HYDRANTS
- PROPANE TANKS
- BACKUP GENERATORS





Tag

Training Video

Training Video Link



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FIRE HOSES

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- FIRE EXTINGUISHERS
- DEFIBRILLATORS
- **FIRE HOSES**
- STANDPIPES
- FIRE ALARMS
- FIRE HYDRANTS
- PROPANE TANKS
- BACKUP GENERATORS




FIRE HOSE

VALLEY MEDICAL

STANDPIPES

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- FIRE EXTINGUISHERS
- DEFIBRILLATORS
- FIRE HOSES
- **STANDPIPES**
- FIRE ALARMS
- FIRE HYDRANTS
- PROPANE TANKS
- BACKUP GENERATORS




BUILDING
STANDPIPE

VALLEY MEDICAL

FIRE ALARMS

2800 Medical Center Drive, Portland, OR 97035

- FIRE EXTINGUISHERS
- DEFIBRILLATORS
- FIRE HOSES
- STANDPIPES
- **FIRE ALARMS**
- FIRE HYDRANTS
- PROPANE TANKS
- BACKUP GENERATORS




FIRE
ALARM
PULL DOWN
Simplex

VALLEY MEDICAL

FIRE HYDRANTS

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- FIRE EXTINGUISHERS
- DEFIBRILLATORS
- FIRE HOSES
- STANDPIPES
- FIRE ALARMS
- **FIRE HYDRANTS**
- PROPANE TANKS
- BACKUP GENERATORS





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PROPANE TANKS

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- FIRE EXTINGUISHERS
- DEFIBRILLATORS
- FIRE HOSES
- STANDPIPES
- FIRE ALARMS
- FIRE HYDRANTS
- **PROPANE TANKS**
- BACKUP GENERATORS




Fuel Services

VALLEY MEDICAL

BACKUP GENERATORS

2800 Medical Center Drive, Portland, OR 97035

- FIRE EXTINGUISHERS
- DEFIBRILLATORS
- FIRE HOSES
- STANDPIPES
- FIRE ALARMS
- FIRE HYDRANTS
- PROPANE TANKS
- BACKUP GENERATORS





Air Conditioner

Clothes Dryer

Advantium Microwave

Dishwasher & Disposer

Cooktop

Wall Oven

Kitchen & Dining Room Receptacles

Clothes Washer

Furnace (FAU in Attic)

Garage Door Openers

Master Bath Receptacles

Bathroom Receptacles (Hall & Garage)

Living Room Receptacles

Dishwasher & Disposer

Cooktop

Refrigerator

Kitchen & Island Receptacles

Garage Receptacles

Bathroom Receptacles (Hall & Garage)

Living Room Receptacles

Smoke Detectors

Master Bedroom Receptacles

Middle Bedroom Receptacles

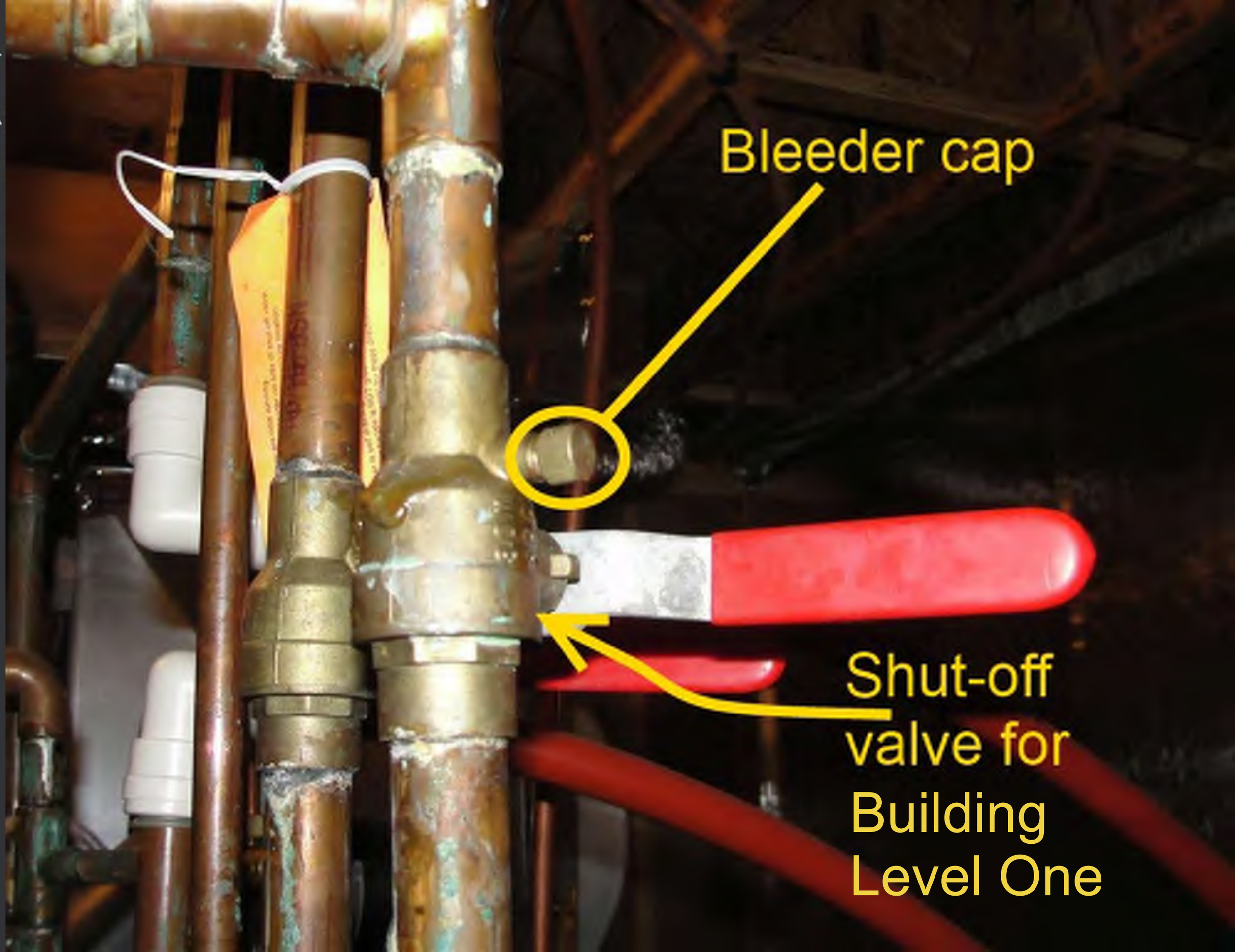
Front Bedroom Receptacles

Bedroom, Bathroom & Kitchen Lights

Garage, Laundry Hall & Porch Lights




Facility
Main Water
Shut-Off


Bleeder cap
Shut-off valve for Building Level One