Building 147 – Replace Chiller #3
Alexandria VA Medical Center

Pineville, LA

Bid Documents

Design Analysis

November 09, 2022
Project Number: 502-21-110

TOLAND MIZELL MOLNAR

TOLAND
MIZELL
MOLNAR

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9 September 2022

Building 147 – Replace Chiller #3
at the
Alexandria VAMC
Pineville, LA

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APPENDICES

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I. Executive Summary

I. Executive Summary

A. Goals and Needs:

1. The primary goal is to complete replacement of Chiller #3, located in the Central Chiller Plant at the Alexandria VA Health Care System, Pineville, LA. Chiller #3 is currently decommissioned. It is recommended to replace the chilled water pump due to known issues.
2. The main objectives to replace Chiller #3 with a new chiller that will effectively serve VA priorities, including (in this order):
    a. Range of capacities required to support VA hospital, pharmacy, residential facilities, employee work stations, and supporting facilities.
    b. Reliability under extreme conditions. These conditions include Central Louisiana's climate, hurricanes and other disasters, and VA emergency response and disaster relief efforts.
    c. Simplicity of operation.
    d. Ease of maintenance.
    e. Smooth integration into existing central chiller plant.
3. Additional scope is to replace deteriorated areas of chilled water piping insulation as well as widen the door opening to accommodate chiller replacement and reinstall existing door and frame with new louver sidelite.

B. Existing Conditions

The existing 1-story structure consists of a main building with one main space and smaller ancillary rooms. Structure of the building consists of a precast concrete double-T's roof slab supported on load bearing CMU/brick veneer exterior walls. Floor is concrete slab-on-grade. Structural calculations of the existing structure are not available.

C. Construction Cost Analysis

1. [redacted]
2. [redacted] are not [redacted]

D. Project Schedule

[redacted]

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II. Environmental

(Not Applicable)

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III. Civil

(Not Applicable)

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IV. Structural

IV. Structural

A. Goals and Needs:

1. Structural work on this project includes the design of a new wider door opening in the exterior existing masonry wall in order to better facilitate installation of new chiller equipment. The new design will comply with all state and VA building code requirements.

B. Existing Conditions

1. The existing structure is comprised of precast double tee roof panels supported by 8in masonry walls founded on conventionally reinforced concrete wall foundations. Exact wall reinforcing is not known and will require verification by the contractor during construction.

C. Scope of Demolition:

1. Partial demolition of existing wall to widen the existing opening.

D. Scope of New Work:

1. Install new HSS steel lintel.

2. Install new reinforcing steel in wall.

E. Potential Owner Furnished and Installed Items:

None Anticipated

F. Items Needed From VA

1. None anticipated drawings

G. Codes and Standards:

As Listed in Attachment 1 Design Criteria

H. Applicable Specifications

1. 05 12 00 Structural Steel
2. 01 45 35 Special Inspections

I. Attachments

1. Attachment 1: Design Criteria
2. Attachment 2: Structural Calculations

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Attachment No. 1

Design Criteria

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1. Codes & Standards:
    a. International Building Code (IBC) 2018 Edition as modified by:
        i. Seismic Design Requirements, H-18-8, Department of Veterans Affairs.
    b. ANSI/ASCE 7-16, Minimum Design Loads for Buildings and Other Structures
    c. ACI 318-14 Building Code Requirements for Structural Concrete
    d. AISC 360-16, Specification for Steel Buildings
2. Design Loads
    a. Dead Loads
        i. Existing Roof and Existing Floor: Self weight of building materials
    b. Collateral Loads
        i. Existing Roof and Existing Floor: 10 psf
    c. Live Loads
        i. Roof: 20 psf unreducible
        ii. Walls: 5 psf minimum
    d. Snow Loads: 5 psf
    e. Wind loads
        i. Ultimate Wind Speed: V=120 mph
        ii. Risk Category: IV
        iii. Wind Importance Factor: I_W=1.0
        iv. Wind Exposure: B
        v. Internal Pressure Coefficient:
            a) $\pm$ 0.18 “Enclosed”
    f. Seismic Loads
        i. Risk Category: IV
        ii. Seismic Importance Factor: I_E=1.5
        iii. Mapped Spectral Response Accelerations:
            a) S_S=0.111
            b) S_1=0.063

iv. Site Class: D

v. Spectral Response Coefficients:

a) S_{DS}=0.118

b) S_{D1}=0.101

vi. Seismic Design Category: C

vii. Basic Seismic-Force-Resisting System

a) Ordinary Reinforced Masonry Shearwall (Assumed)

viii. Response Modification Factor(s): R =2

ix. Analysis Procedure Used: Equivalent Lateral Force Procedure

x. Seismic Response Coefficient(s): C_S =0.089

3. Serviceability

a. Drift & Deflection Criteria: The criteria used shall be compatible with finish materials for the building that are connected to the building structure.

i. Vertical Deflection

a) New HSS Lintel:

1) Live Load: L/600

2) Dead + Live Load: L/600

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V. Architectural

V. Architectural

A. Goals and Needs:

1. The primary goal is to complete replacement of Chiller #3, located in the Central Chiller Plant at the Alexandria VA Health Care System, Pineville, LA. Chiller #3 is currently decommissioned. It is recommended to replace the chilled water pump due to known issues.
2. See mechanical narrative for detailed discussion of primary requirements for this project.
3. Additional scope is to replace deteriorated areas of chilled water piping insulation as well as widen the door opening to accommodate chiller replacement and reinstall existing door and frame with new louver sidelite.

B. Existing Conditions

The existing 1-story structure consists of a main building with one main space and smaller ancillary rooms. Structure of the building consists of a precast concrete double tees roof slab supported on load bearing CMU/brick veneer exterior walls. Floor is concrete slab-on-grade. Structural calculations of the existing structure are not available.

C. Scope of Demolition

Demolition will be limited to careful removal of the existing door and frame and the widening of the opening to facilitate the removal of the existing Chiller #3. This includes the existing screen door and frame attached to the HM frame. Door, frame and all hardware are to be salvaged and reinstalled after installation of new chiller.

D. Scope of New Work:

New work will consist of making repairs to the existing CMU/brick and floor slab plus the new aluminum louver sidelite to infill at the widened opening. See Mechanical Narrative for more detail

E. Phasing:

The project will not require a phased approach since the Owner will move all operations elsewhere during the course of demolition and repairs. The sequence of renovation work will be addressed by the A/E in more detail in the Mechanical narrative.

F. Codes and Standards:

1. VA Design Guides-Technical Information Library
2. VA Directive 1061
3. International Building Code, Latest Edition with Louisiana Amendments
4. International Fire Code/ Life Safety Code, Latest Edition with Louisiana Amendments
5. NFPA 101 – Latest Edition
6. VA Accessibility Standards
7. NFPA 99
8. NFPA 13 – Latest Edition

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VI. Fire Protection

(Not Applicable)

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VII. Plumbing

(Not Applicable)

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VIII. Mechanical

VIII. Mechanical

A. Design Requirements:

1. The scope of this project is to provide a replacement for Chiller #3 located at the central chilled water plant. The replacement will include removal and introduction of major equipment, pumping modifications to incorporate new chiller, and controls integration.

2. The design will require connection to existing systems as follows:

   a. Existing chilled water loops and equipment will be used and interconnected with the new chiller.

   b. All upgrades will include DDC controls integrated to the existing Siemens BAS system.

3. Design criteria. In addition to "Applicable Codes and Standards" listed below, the following VA required design criteria is to be used for design development:

   a. Department of Veterans Affairs HVAC Design Manual, 2022.

   b. VA Physical Security and Resiliency Design Manual (PSRDM), 2020.

4. Design documents and other deliverables. As required by the contract the following products will be completed and delivered:

   a. This design analysis.

   b. Construction drawings.

   c. Construction specifications.

   d. Construction cost estimate.

B. Existing Conditions:

1. An initial survey was performed 1/27/2022 to review existing conditions. See TAB B – Site Survey for additional information.

2. Chiller 3 utilizes two pumps for flow. P-6 serves as the chilled water pump and P-7 serves as the condenser water pump.

3. P-6 was found to have a lot of corrosion and had reportedly not been operated in roughly 5 years. (B&G 6x8x12; 1560 GPM; 152 FT; HP not listed).

4. P-7 was found to be in reasonable shape but in need of touchup painting and grouting. (B&G 8x10x17.5; 1950 GPM; 83 FT; 60 HP)

5. Much of the original chilled water piping had damaged insulation and resulting condensation was apparent. It is recommended to replace select areas while insulation trade contractors are onsite.

C. Owner Furnished or Installed Items:

1. Owner furnished items: None.

2. Owner installed items: None.

3. Existing items to be reused: Existing DDC control system will be used to integrate the new chiller.

D. Applicable Codes and Standards: *(The primary resource used in this design will be VA publications. Where additional information is required to complete the design the below codes and standards will be used.)*

1. ASHRAE Standard 90.1 – 2013 Energy Standard for Buildings Except Low-Rise Residential Buildings.

2. ASHRAE Standard 170-2017– Ventilation of Health Care Facilities.

3. ASME B31.1 – 2017 Building Pressure Piping.

4. ASME B31.9 – 2017 Building Services Piping.

5. International Mechanical Code (IMC), 2018 with Addendum.

6. NFPA 70 – National Electric Code.

7. NFPA 90A – 2018 Installation of Air Conditioning and Ventilating Systems.

8. NFPA 90B – 2018 Installation of Warm Air Heating and Air Conditioning Systems.

9. NFPA 110 – Standard for Emergency and Standby Power Systems.

10. SMACNA - HVAC Air Duct Leakage Test Manual, 2012

11. SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 2005

E. <u>Technical Analysis:</u>

1. Phasing requirements: This project has minimal phasing requirements.

2. Critical path issues: None currently.

3. Climatic Conditions: From the VA HVAC Design Manual 2017 with 2019 Revision the climatic design conditions are as follow:

   a. Winter: 27.4 F db

   b. Winter extreme: 21.5 F db

   c. Summer: 97.2/77.1 db/wb

   d. Refer to TAB A.1.

4. VA HVAC Criteria per space.

   a. This project has no space requirements and is primarily equipment replacement.

5. Chilled Water Plant.

   a. The chilled water plant has 4 water cooled chillers served by multiple celled cooling towers located in the adjacent equipment yard. Chillers 1, 2, and 4 are functioning to provide chilled water to the campus. Chiller 3 is offline and non-functional. The recommendation is to replace this chiller in kind.

   b. Chiller 3: This 650-ton York machine is the oldest chiller in the plant. It has not functioned properly in several years.

   c. Chiller capacity is low for the campus in the summer months. Likely this project will not be completed before summer so the facility will require temporary chillers to supplement the existing equipment to meet summer load. As such it is recommended to replace Chiller 3.

      1. New Chiller: 650 Tons; 1560 GPM; EWT 52 F; LWT 42 F.

         a. The 65% design included a layout basis of Daikin WME106CSCSNA. This unit fits through the door, is magnetic bearing and can turn down to 10% capacity. **<u>The</u>**

VA rejected this chiller selection due to the chiller having magnetic bearing compressor.

b. The new layout basis is a Carrier 19DV. This model is larger than the existing openings and requires widening of the existing opening. Additionally, it requires the unit to be shipped dry (charged with nitrogen) and assembled in the field due to existing height constraints.

d. One challenge is introducing the equipment into the space. Previous equipment replacements have required equipment access doors to be removed, widened, and replaced. This has successfully been done by extending the existing lintel and adding a new louver in place of the removed wall. The VA is pleased with this approach and the A/E will proceed with the same strategy if necessary. However, the original layout basis chiller fit through the door. **The new layout basis does not fit through the door and widening will be part of the base project.**

e. The chiller will be delivered dry and unassembled. The manufacturer or manufacturer representative will be required to assemble and charge the chiller.

f. The intent of the project is to replace only the chiller, however the chilled water pump that is existing (P-6) is recommended to be replaced. This pump has much wear and corrosion apparent and has not been operated in 5 years.

1. New Chilled Water Pump (P-6): 1560 GPM; 150 Ft.HD (head matches existing); 100 HP.

F. Information for Discussion / RFI:

1. None.

G. HVAC Team Items to Complete:

1. None.

H. Equipment Catalog Sheets:

1. TAB C – Major Equipment Sections

I. Appendixes:

1. TAB A.1 – Weather and Climate Data

2. TAB B – On-Site Survey

3. TAB C – Major Equipment Sections

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IX. Electrical

IX. Electrical

1. Applicable Codes, Standards & Guidelines

The engineering calculations will be based on the latest recommendations of ASHRAE, NEC and good engineering practices consistent with industry standards. Mechanical equipment electrical requirements will be evaluated based on the current standards.

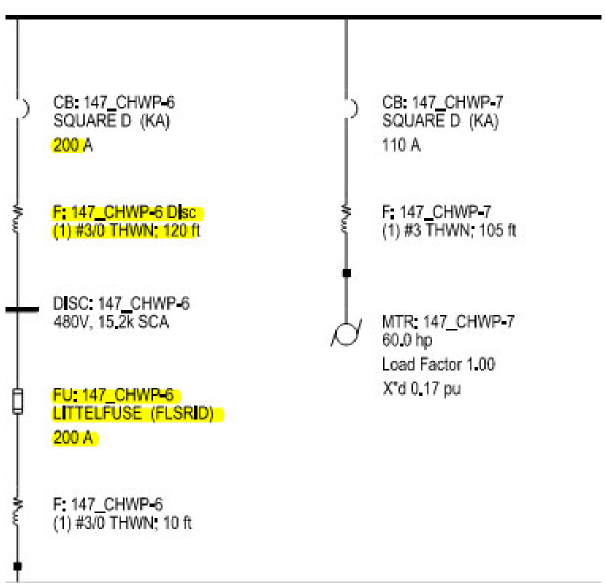
Codes applicable to the design are as follows.

- International Energy Code.
- NFPA 70 - National Electrical Code.
- NFPA 99 – Health Care Facilities
- NFPA 101 – Life Safety Code
- VA Electrical Design Manual for Hospital Projects

1.1 Electrical Service

Demolition:

Existing electrical power connected to the existing chiller #3 and chilled water pump #6 shall be demolished back to source. All exiting conductors and accessories shall be demolished. Conduits concealed in concrete walls or slabs shall be abandoned. Wiring in abandoned conduits shall be demolished back to source. Existing circuit breakers and disconnect switches shall be demolished back to source. Existing conductors shall be pulled back to the branch circuit protective device and such device shall be identified as a spare. Existing conduit shall be reused if adequate for the new circuit breaker to be installed.



Existing One-line diagram showing 200A breaker for CHWP-6

Existing MCC disconnect and starter for CWHP-6

New Work:

A new 480V 3-phase 800A NEMA-3R rated disconnect switch shall be provided for new chiller #3. Disconnects shall be circuited to spare breakers or a new 1200A adjustable circuit breaker shall be provided in existing main distribution panelboard spaces that became available during demolition. Circuit breaker shall be adjusted to 800A per the manufacturer's recommendation. The electrical contractor shall provide all new conductors, conduits and appurtenances required for the complete installation of new mechanical equipment. Should a larger circuit breaker be needed, new feeders and conduits shall be provided to serve the new mechanical equipment.

A new 480V 3-phase 200A VFD shall be provided for the new chilled water pump #6. VFD shall be circuited to spare breakers, or a new 200A circuit breaker shall be provided in existing MCC spaces that became available during demolition. The electrical contractor shall provide all new conductors, conduits and appurtenances required for the complete installation of new mechanical equipment. Should a larger circuit breaker be needed, new feeders and conduits shall be provided to serve the new mechanical equipment.

All motors shall be provided with motor controllers and disconnect switches and major equipment will be provided with non-fused safety switches, based on equipment nameplate data. All motor controllers/starters shall be at minimum NEMA Size 1, unless required otherwise due to environmental conditions. All disconnect switches shall be heavy-duty NEMA Type 1.

Electrical Grounding System

Existing building grounding shall remain. No modifications shall be made to the existing building grounding.

1.2 Materials

The wiring conductors shall be required to meet the load criteria as well as the voltage drop criteria. In accordance with the codes (ASHRAE 90.1, and NEC) impose a maximum 5% voltage drop from the service to any load.

All branch circuit wiring will be with 600 volt rated copper conductors, type THWN or THHN, minimum #12 AWG in minimum 3/4-inch conduits. All interior conduits will be Electrical Metallic Tubing (EMT) unless required otherwise by the code. All exterior exposed conduits will be Galvanized Rigid Steel (GRS) and all exterior underground conduits will be PVC Schedule 40, unless required otherwise by code.

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Appendix A
Functional Program

Please note that the requirements specified in the attached document are from the original scope of work provided to TMM. Subsequently, these requirements have been adjusted to reflect budgetary limitations.

DEPARTMENT OF VETERANS AFFAIRS
Network Contracting Office - 16
Alexandria VA Health Care System
2495 Shreveport Hwy, 71N
Pineville, LA 71360

Toland Mizell Molnar
Attn: Mr. James Molnar
2412 Ferrand St, Suite 5
Monroe, LA 71201

Dear Mr. Molnar:

Our Architect-Engineer Evaluation Board has selected your firm for negotiation of a contract to provide appropriate design services for Project No. 502-21-110 “Replace Chiller #3” for the VA Alexandria Health Care System, 2495 Shreveport Hwy, 71N, Pineville, LA 71360 under Solicitation No. 36C25621R0126.

Your firm is requested to contact the Staff Engineer, COR, Mr. Ken Dillard, at 318-466-2465 or via email at kenneth.dillard1@va.gov , to ascertain the exact nature of the specified work to be performed.

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

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Appendix B
Project Comments & Responses

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Appendix C
Meeting Minutes

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Appendix D
Cost Estimate

[redacted]

[redacted]

[redacted]

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Appendix E
Specifications

(Under Separate Cover)

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Appendix F
Asbestos & Lead-based Paint Survey

(Not Applicable)

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Appendix G
Mechanical

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TAB A.1 – Weather Data

Location	Weather Station	North Latitude	MSL Elevation	Col. 1a 0.4%		Col. 1b 99.6%	Col. 2a 1%		Col. 2b 99%	Col. 3 Wet Bulb		Annual Extreme Daily-Mean Db	
				Temperatures									
				Summer		Winter	Summer		Winter	0.4%	1%	Maximum	Minimum
				Db	Wb	Db	Db	Wb	Db				
KANSAS													
Leavenworth	Kansas City Intl AP, MO	39.30	1024	95.8	76.8	2.0	92.5	76.2	7.2	79.8	78.3	99.7	-4.5
Topeka	Topeka/Billard Municipal AP	39.07	886	97.1	76.2	3.1	93.9	75.9	8.7	79.0	77.8	101.1	-4.0
Wichita	Wichita/Mid-Continent AP	37.65	1339	100.1	73.7	7.4	97.0	73.8	12.2	77.7	76.5	128.5	72.9
KENTUCKY													
Lexington	Lexington Bluegrass AP	38.04	988	91.6	73.9	8.3	89.6	73.6	13.6	77.3	76.1	127.5	73.1
Louisville	Louisville	38.18	489	93.8	76.3	10.2	91.5	75.0	15.9	78.7	77.5	97.1	3.2
LOUISIANA													
Alexandria	Alexandra Intl AP	31.34	79	97.2	77.1	27.4	94.7	77.3	29.3	80.7	79.8	100.2	21.5
New Orleans	New Orleans Lakefront AP	30.04	10	93.3	78.7	35.6	91.8	78.2	38.6	81.4	80.6	96.9	29.7
Shreveport	Shreveport Regional AP	32.45	259	98.5	76.2	25.2	96.0	76.3	28.4	79.4	78.6	101.3	19.3
MAINE													
Togus	Augusta AP	44.32	361	87.5	70.9	-3.2	83.8	69.3	1.3	73.5	71.6	108.3	69.1

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TAB B – Site Survey

Existing Conditions

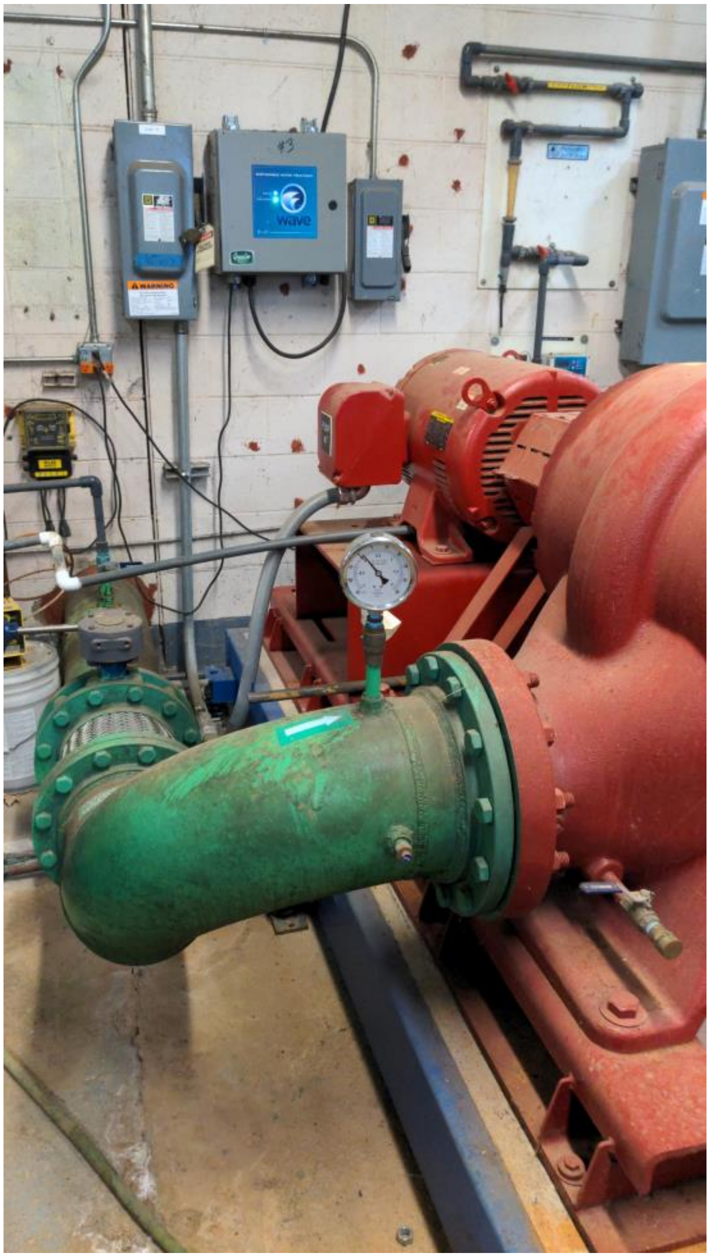
Thursday, January 27, 2022 9:30 AM

The project is to remove chiller number three which is a York 650 ton chiller.

Pumping configuration
Condenser water is provided directly to the chiller through pump number 7 a HSC pump that is in working order appears to be in good shape.

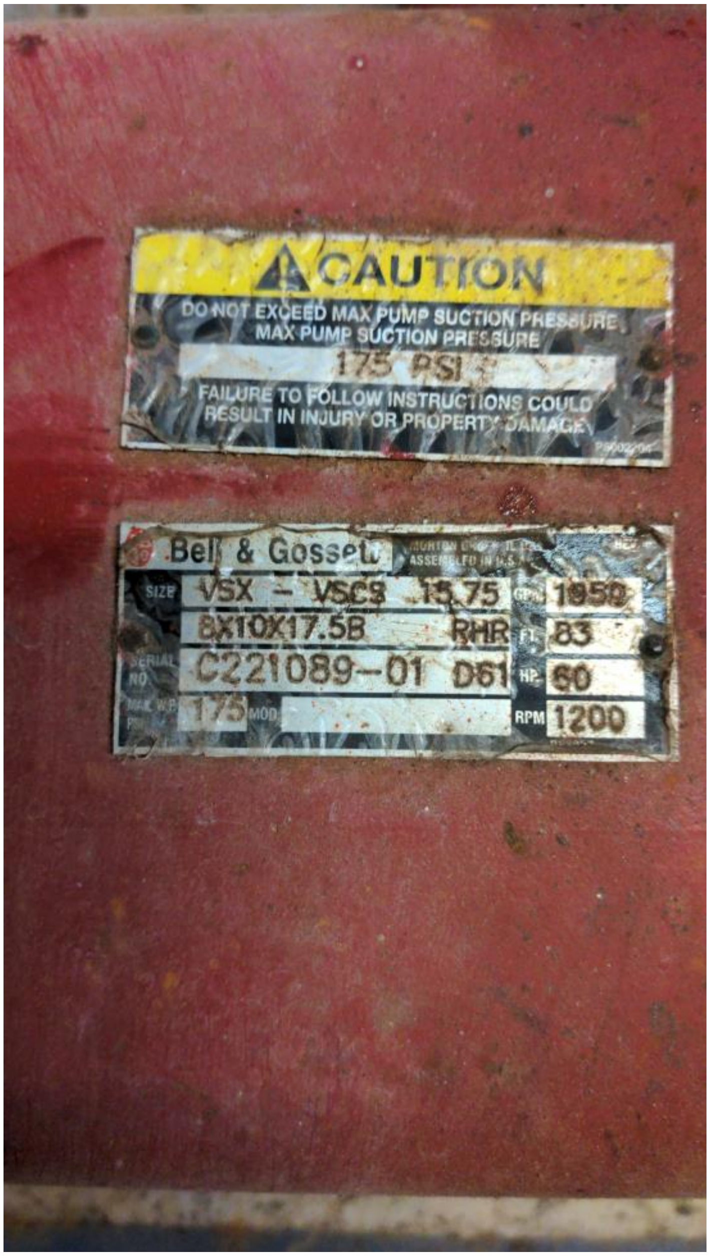
Chilled water is through a common loop that is on the roof. The VA said each pump stages on with its associated chiller. So each chiller has its own pump. Chiller number three is served by a HSC pump number 6. It is stated that this pump has not been operated in 5 years. It is recommended to replace this pump size it for coordinated flow with the new chiller number three.

Condenser water pump number 7


wave


FOR LIFTING
COMPONENT
THEY ARE A
FAILURE TO F
INSTRUCTIONS
IN INJURY OR
BALDOR · RELIANCE
Super-E Motor
CAT. NO. EM2548T
CUST. P/N
ENCL OPSB
SPEC 44E057W300G1
CC 010A
FRAME 404T
SER. NO. C1510071247
HP 60
CLASS F
HZ 60
R.P.M. 1185
PH. 3
DES. A
VOLTS 230/460
CODE H
AMPS 152/76
USABLE AT 208 160 A
BEARING SIZE
OPP. END 6312
DRIVE END 6316
GREASE
POLYREX EM
RATING 40C AMB-CONT
NEMA NOM. EFF. 94.5 %
P.F. 79 %
SER. F 1.15
THERMOSTAT LEADS
115 230 460 575
6.0 3.0 1.5 1.2
USE A MANUAL MOMENTARY
START SWITCH ONLY
LEADS H1-H2
SPACE HEATERS
VOLTS
AMPS
MAX. SPACE
HEATER TEMP
°C
BALDOR ELECTRIC CO. · FT. SMITH, AR. MFG. IN U.S.A.


PUMP
#7
CONDENSER WATER



chilled water pump number 6


CHILLED WATER RETURN


CONDENSER WATER RETURN


CHILLED WATER SUPPLY
PUMP
#6


CHILLED
weg


Bell & Gossett ITT Industries


WEG
LR-38324
EEV 78282
PH 3 FRAME 404/5TS 12JUL05 0A66604
HP(kW) 100(75) RPM 1775
ODP TYPE DP PF 0.87 IP23
1.15 INS CL F Δt 80 K CODE G HZ 60
NOM EFF 94.1 3/4LOAD EFF 93.6 DES B MAX AMB 40°C
208-230/460 A 253-230/115
CONT. SFA ALT 1000 m.a.s.l
6316-C3 POLYREX EM-EXXON
6314-C3 34 g 20000 h
925 Lbs
100

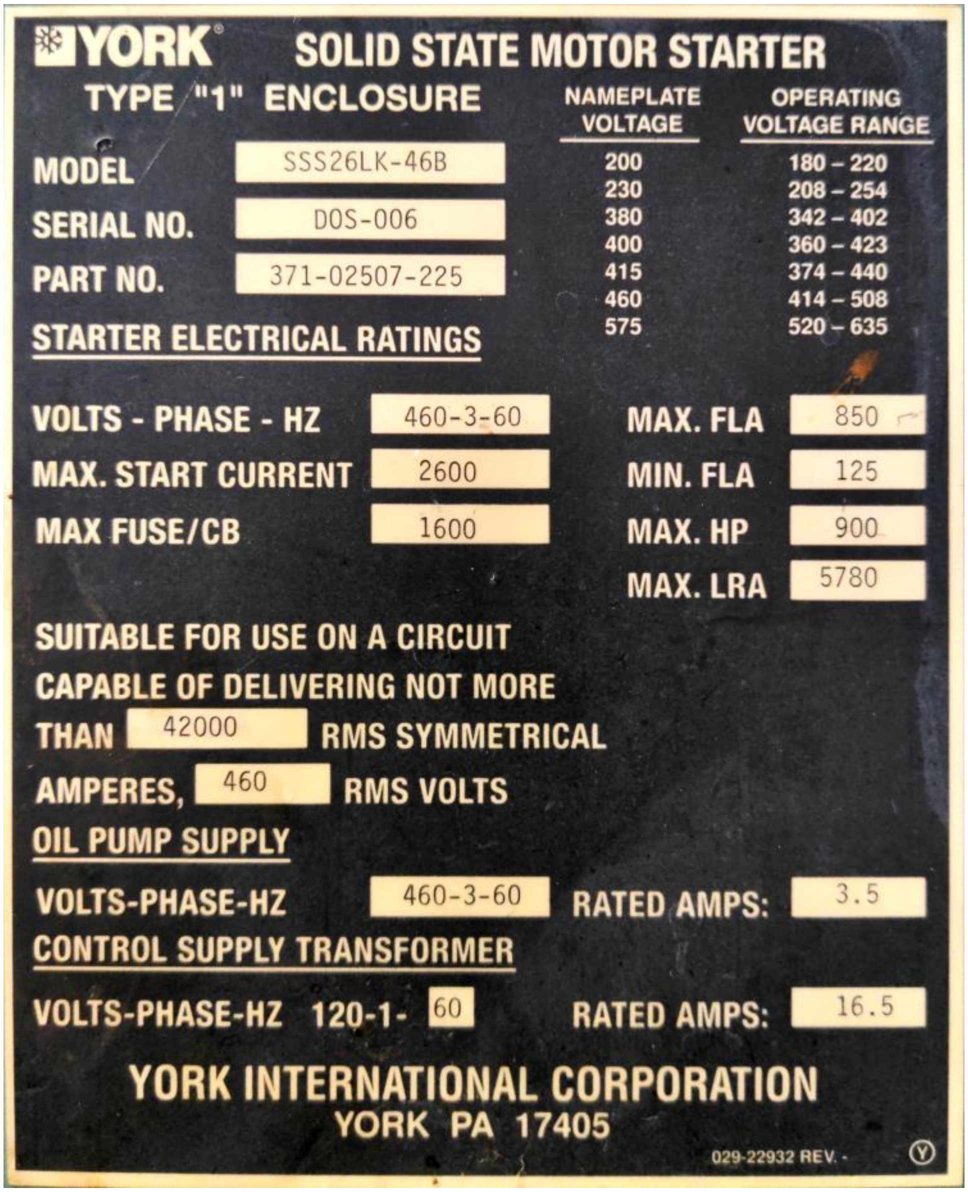
Chiller#3

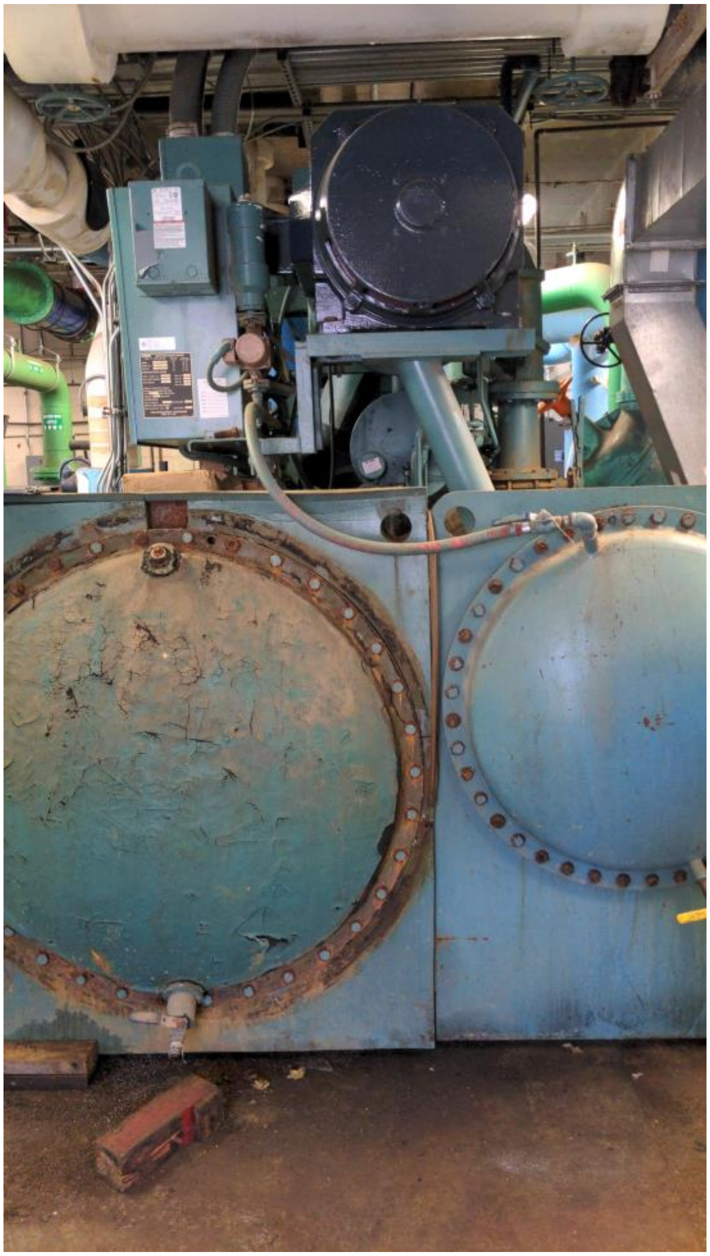

CHILLED WATER RETURN

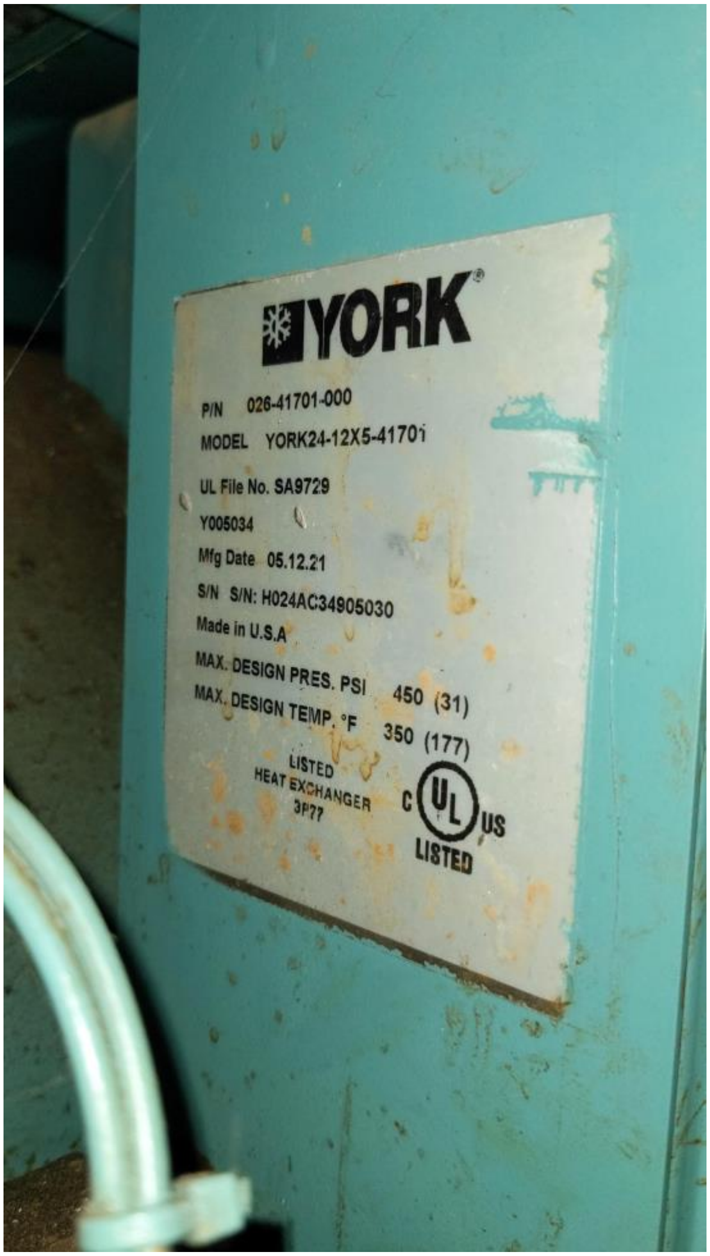

CHILLED WATER RETURN

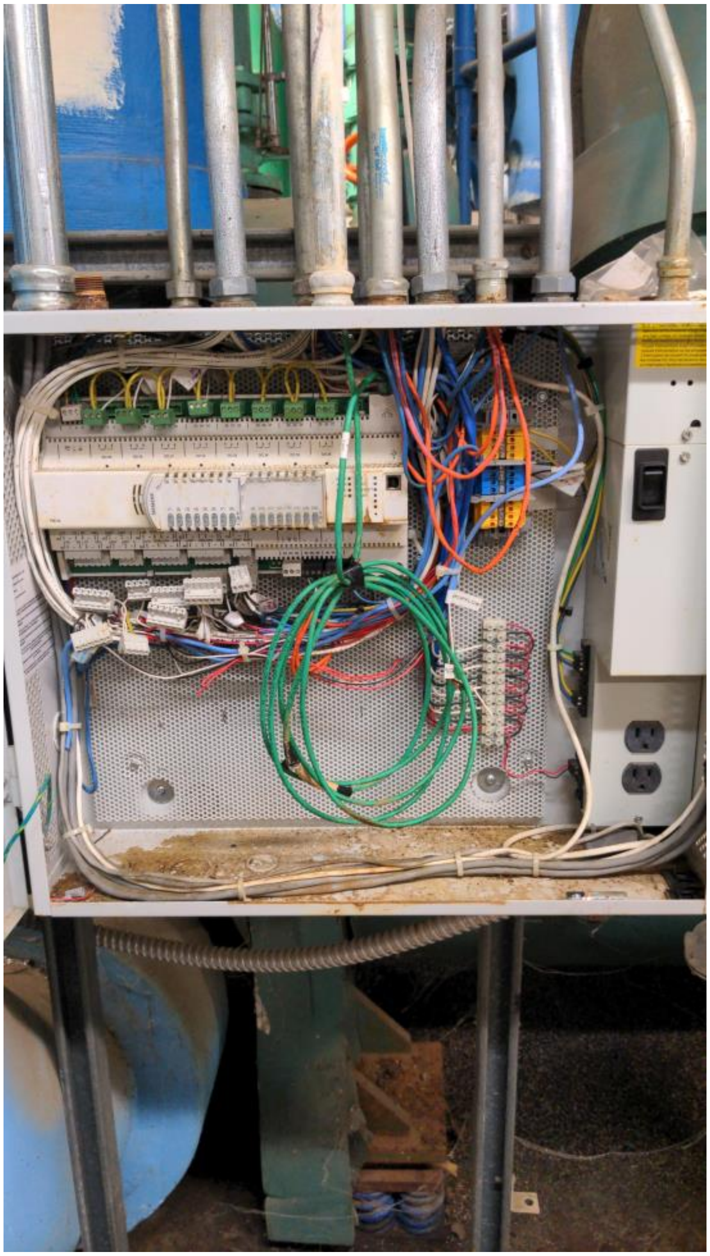

YORK
OPTIVIEW CONTROL CENTER
CHILLER
#3
MAX E
Centrifugal Chiller

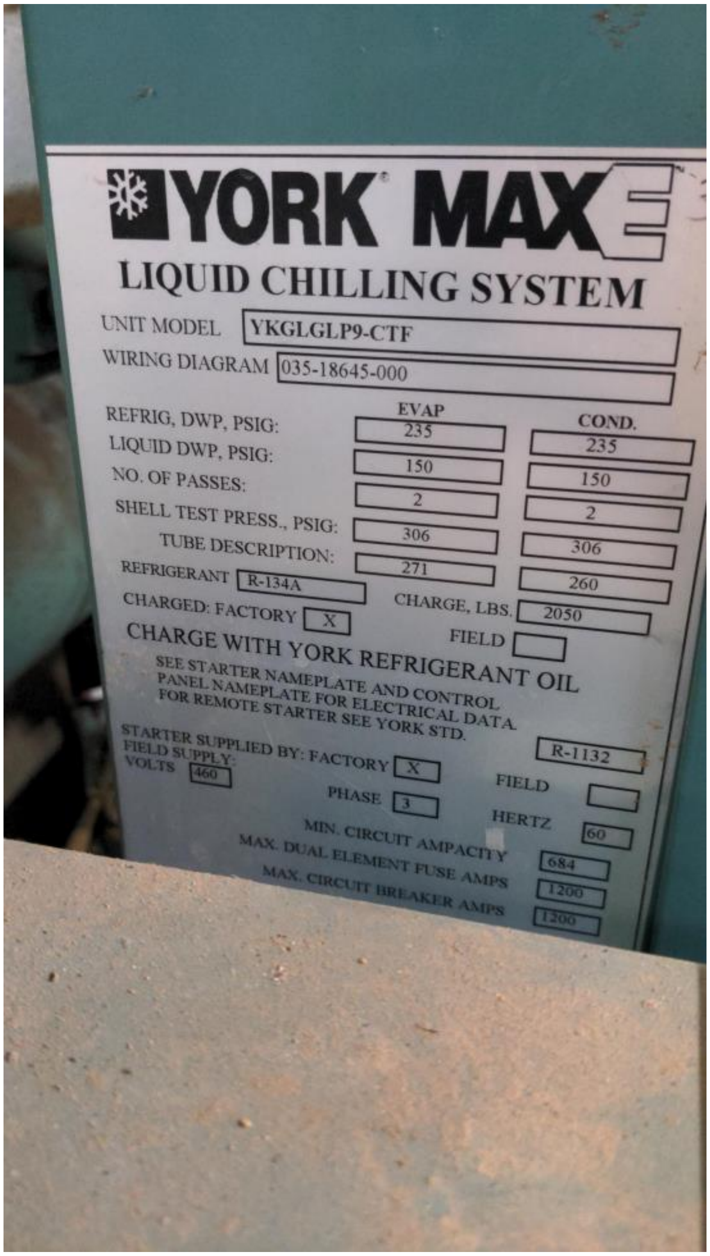

YORK
CONTROL CENTER
HILLER
#3
ugal Chiller


YORK
SOLID STATE MOTOR STARTER
TYPE "1" ENCLOSURE
NAMEPLATE VOLTAGE
OPERATING VOLTAGE RANGE
MODEL
SSS26LK-46B
SERIAL NO.
DOS-006
PART NO.
371-02507-225
200
180 – 220
230
208 – 254
380
342 – 402
400
360 – 423
415
374 – 440
460
414 – 508
575
520 – 635
STARTER ELECTRICAL RATINGS
VOLTS - PHASE - HZ
460-3-60
MAX. START CURRENT
2600
MAX FUSE/CB
1600
MAX. FLA
850
MIN. FLA
125
MAX. HP
900
MAX. LRA
5780
SUITABLE FOR USE ON A CIRCUIT
CAPABLE OF DELIVERING NOT MORE
THAN
42000
RMS SYMMETRICAL
AMPERES,
460
RMS VOLTS
OIL PUMP SUPPLY
VOLTS-PHASE-HZ
460-3-60
RATED AMPS:
3.5
CONTROL SUPPLY TRANSFORMER
VOLTS-PHASE-HZ 120-1-
60
RATED AMPS:
16.5
YORK INTERNATIONAL CORPORATION
YORK PA 17405
029-22932 REV. -




YORK
P/N 026-41701-000
MODEL YORK24-12X5-41701
UL File No. SA9729
Y005034
Mfg Date 05.12.21
S/N S/N: H024AC34905030
Made in U.S.A
MAX. DESIGN PRES. PSI 450 (31)
MAX. DESIGN TEMP. °F 350 (177)
LISTED
HEAT EXCHANGER
C UL US
LISTED



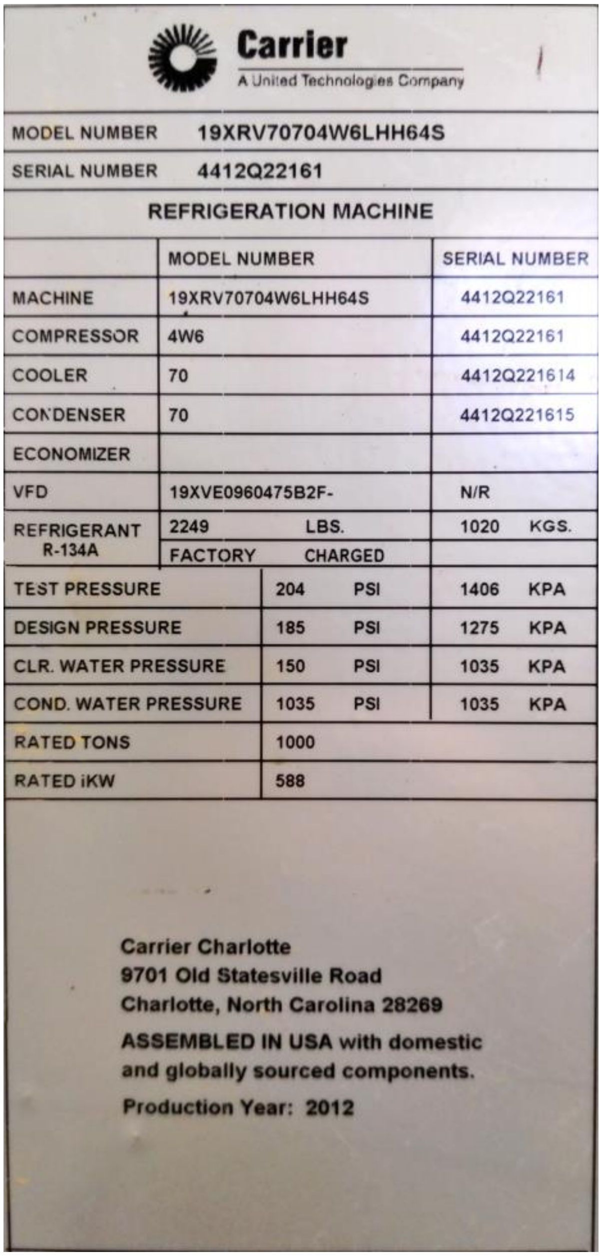

YORK MAX E
LIQUID CHILLING SYSTEM
UNIT MODEL YKGLGLP9-CTF
WIRING DIAGRAM 035-18645-000
EVAP
COND.
REFRIG, DWP, PSIG: 235 235
LIQUID DWP, PSIG: 150 150
NO. OF PASSES: 2 2
SHELL TEST PRESS., PSIG: 306 306
TUBE DESCRIPTION: 271 260
REFRIGERANT R-134A
CHARGE, LBS. 2050
CHARGED: FACTORY X
FIELD
CHARGE WITH YORK REFRIGERANT OIL
SEE STARTER NAMEPLATE AND CONTROL
PANEL NAMEPLATE FOR ELECTRICAL DATA
FOR REMOTE STARTER SEE YORK STD.
R-1132
STARTER SUPPLIED BY: FACTORY X
FIELD SUPPLY:
VOLTS 460
FIELD
PHASE 3
HERTZ 60
MIN. CIRCUIT AMPACITY 684
MAX. DUAL ELEMENT FUSE AMPS 1200
MAX. CIRCUIT BREAKER AMPS 1200

STARTER SUPPLIED BY: FACTORY
X
HERTZ
PHASE
3
684
MIN. CIRCUIT AMPACITY
1200
MAX. DUAL ELEMENT FUSE AMPS
1200
MAX. CIRCUIT BREAKER AMPS
RJ
MODEL
YDHE-62VDD
GEAR
SERIAL NO.
SDRM-150250
VOLTS-PHASE-HZ
FLA.
460-3-60
3.6
YORK INTERNATIONAL CORPORATION
YORK, PA. 17405 USA
029-24115-000 REV A


YORK CONTROL PANEL
E187435
TYPE 1
371-04118-105
035-18637-000
VOLTS
115
PHASE
1
HZ
50/60
20
AMPS
20
AMPS
COR-104
YORK INTERNATIONAL CORPORATION
YORK PA 17405 USA
029-22924C REV.
ASHRAE

Chiller #1


CHILLER
#1
SIEMENS



Carrier
A United Technologies Company

MODEL NUMBER	19XRV70704W6LHH64S
SERIAL NUMBER	4412Q22161

REFRIGERATION MACHINE

	MODEL NUMBER		SERIAL NUMBER
MACHINE	19XRV70704W6LHH64S		4412Q22161
COMPRESSOR	4W6		4412Q22161
COOLER	70		4412Q221614
CONDENSER	70		4412Q221615
ECONOMIZER			
VFD	19XVE0960475B2F-		N/R
REFRIGERANT R-134A	2249	LBS.	1020 KGS.
	FACTORY	CHARGED	
TEST PRESSURE	204	PSI	1406 KPA
DESIGN PRESSURE	185	PSI	1275 KPA
CLR. WATER PRESSURE	150	PSI	1035 KPA
COND. WATER PRESSURE	1035	PSI	1035 KPA
RATED TONS	1000		
RATED iKW	588		

Carrier Charlotte
9701 Old Statesville Road
Charlotte, North Carolina 28269

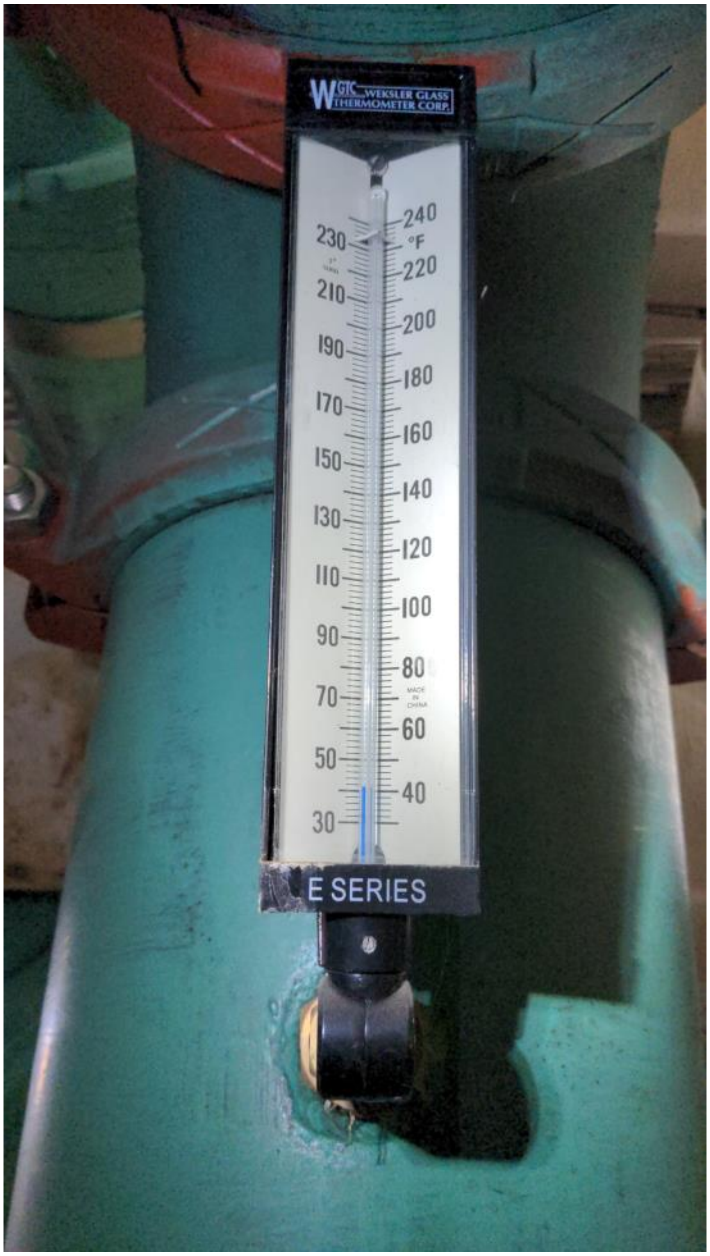
ASSEMBLED IN USA with domestic and globally sourced components.

Production Year: 2012


CHILLER
#1
CHW IN
47.7
CHW OUT
45.5
EVAP REF
41.0
CDW IN
40.9
CDW OUT
40.8
COND REF
43.0
OILPRESS
-0.3
OIL TEMP
150.0
%AMPS IN
0.0
CCN
LOCAL
RESET
MENU


WINTERS
F
C
120
110
100
90
80
70
60
50
40
30
20
10
0
45
40
35
30
25
20
15
10
5
0
5
10
15

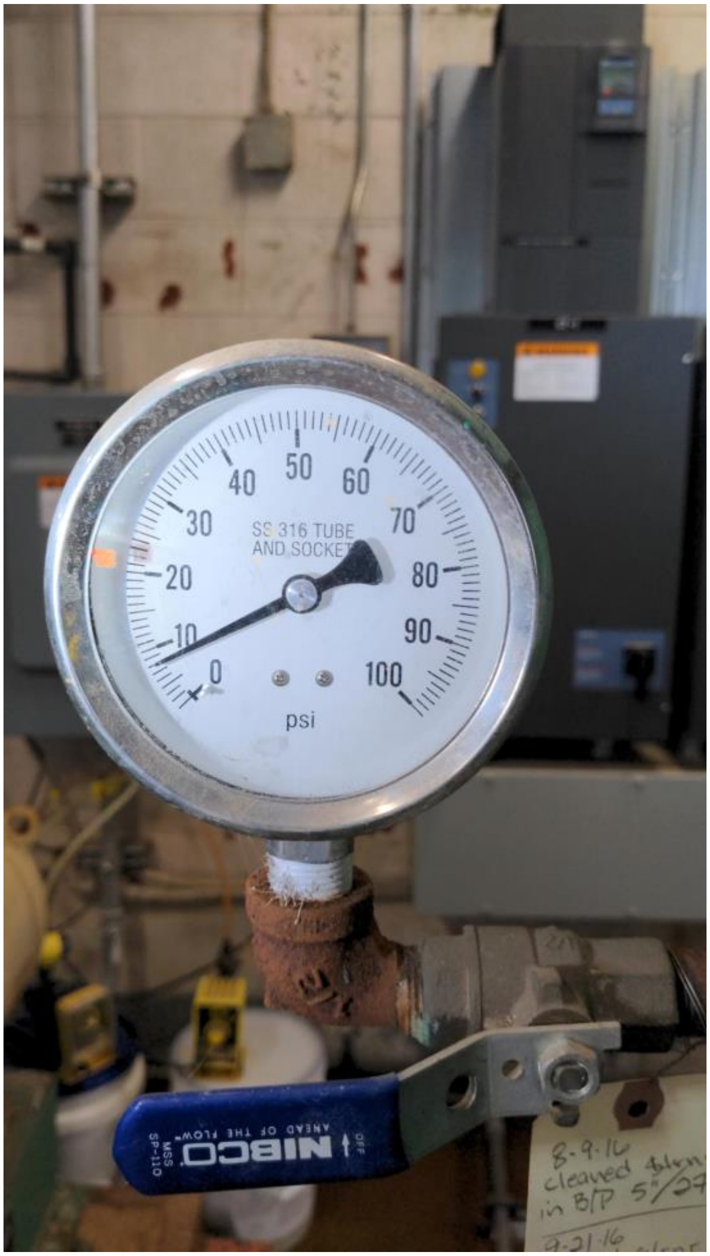

70
60
50
40
30
20
10
20
15
10
5
0
5
10
15


WGTC WEKSLER GLASS THERMOMETER CORP.
240
°F
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
MADE IN CHINA
60
50
40
30
E SERIES


Taco
SHOP ORDER
EC85887/11
MODEL NO.
TA2524B2X1B6W0
CAP-GPM
3000.00
HEAD FT
71.00
IMP DIA
10.30
MFG DATE
09/12
MOTOR HP
RPM
TACO INC., CRANSTON,R.I. U.S.A. 0


BALDOR
Super-E
PUMP 3


SS 316 TUBE
AND SOCKET
inHg
psi


SS 316 TUBE
AND SOCKET
psi
NIBCO
8-9-16


PUMP #2
Super-E


ASHCROFT
psi
Bronze tube
Brass socket


SHOP ORDER
458782/1
Taco
MODEL NO.
TA2038B2S1C6L0
CAP-GPM
2400.00
HEAD FT
155.00
IMP DIA
13.40
MFG DATE
03/16
MOTOR HP
125
RPM
1750
Chiller 2

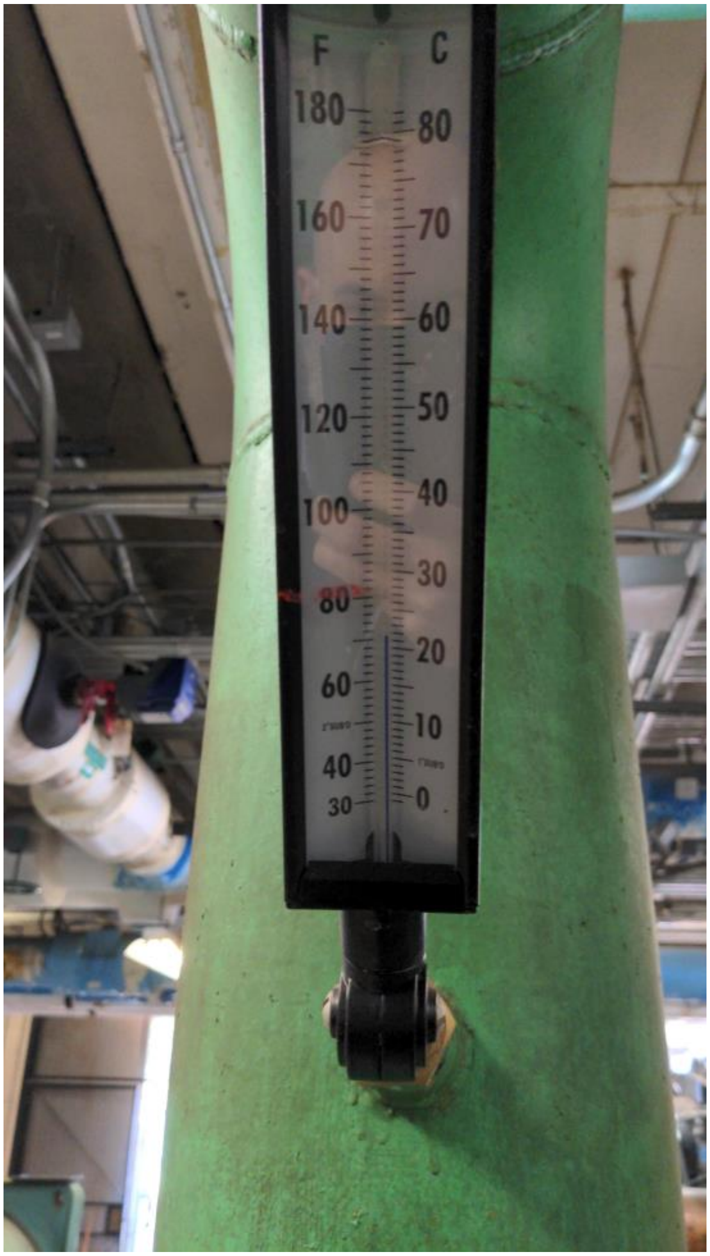

Chiller #2 in service 5 May 2016
SMARDT
CHILLER #2
WARNING
RISK OF ELECTRIC SHOCK CAN CAUSE INJURY OR DEATH. DISCONNECT ALL REMOTE ELECTRIC POWER SUPPLIES BEFORE SERVICING.

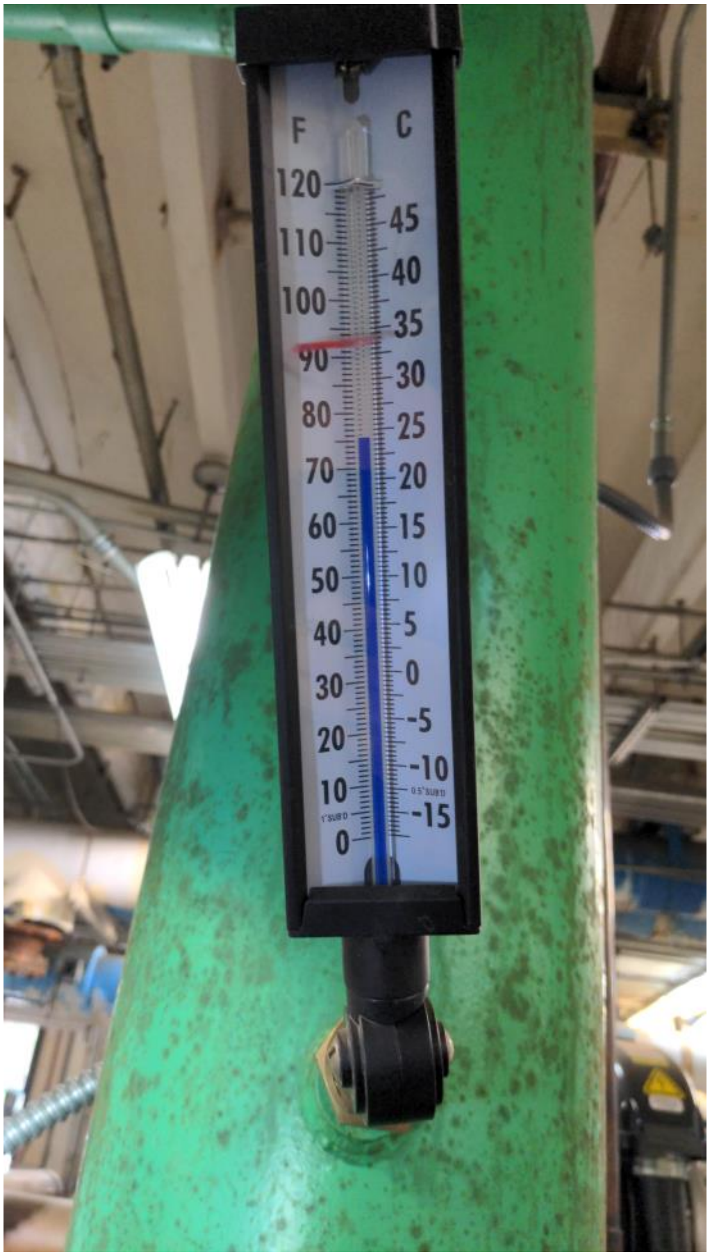

Certified by:
2722
Smardt Inc.
U
W
SHELL
Year 2015
MAWP 1320kPa at 53°C (191psi at 127°F)
S/N CO-15126
MDMT -10°C at 1320kPa (14°F at 191psi)
TUBES (non-code)
DWG. No. 11-0476 Rev.A
MAWP 1000kPa at 52°C (145psi at 126°F)
CRN / DAN N/A
MDMT -10°C at 1000kPa (14°F at 145psi)
CAUTION: The heat exchanger design has been evaluated for the range of conditions listed on form U5 of the MDR.
It shall be re-evaluated for conditions outside this range before being operated at them.
1800 Trans Canada Highway, Montreal, QC, Canada

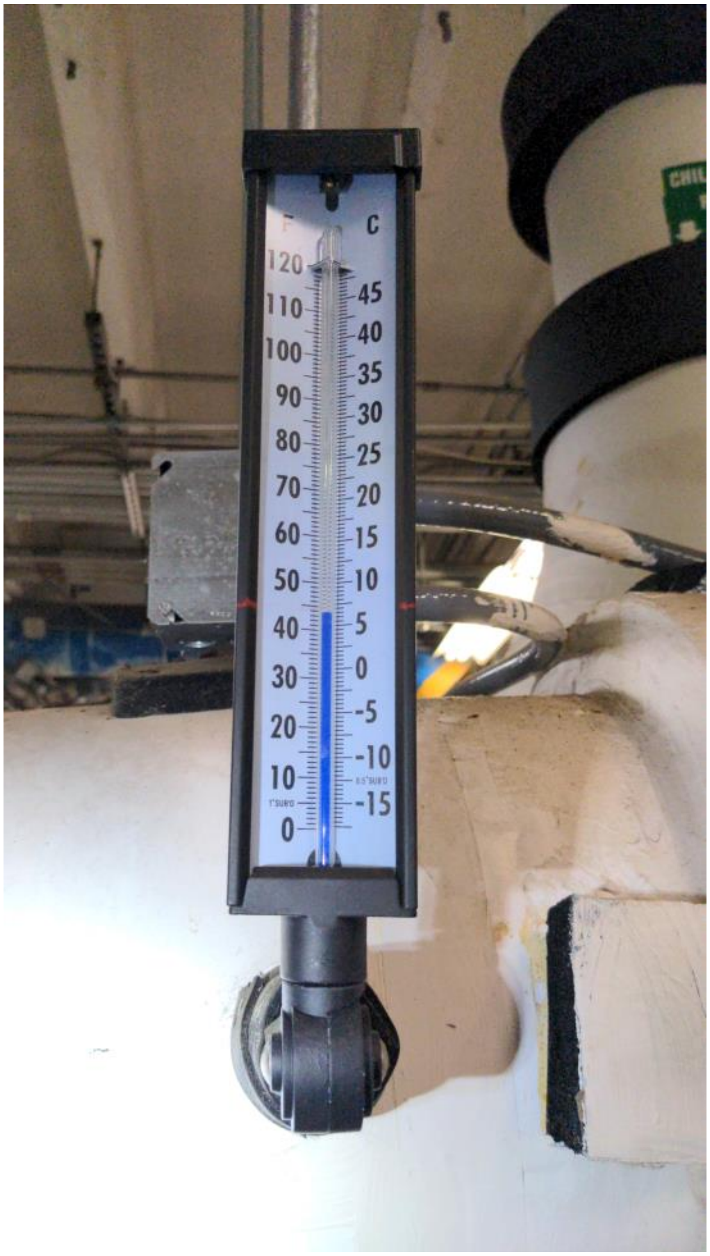

BALDOR
Super-E
PREMIUM EFFICIENT INDUSTRIAL MOTOR
PUMP #4


COND. WATER
RETURN
SUPPLY


Taco
SHOP ORDER
458782/3
MODEL NO.
TA2530B2Q1B6L0
CAP-GPM
HEAD FT
IMP DIA
10.70
MFG DATE
02/16
MOTOR HP
75
RPM
1750
TACO INC., CRANSTON,R.I. U.S.A. 0

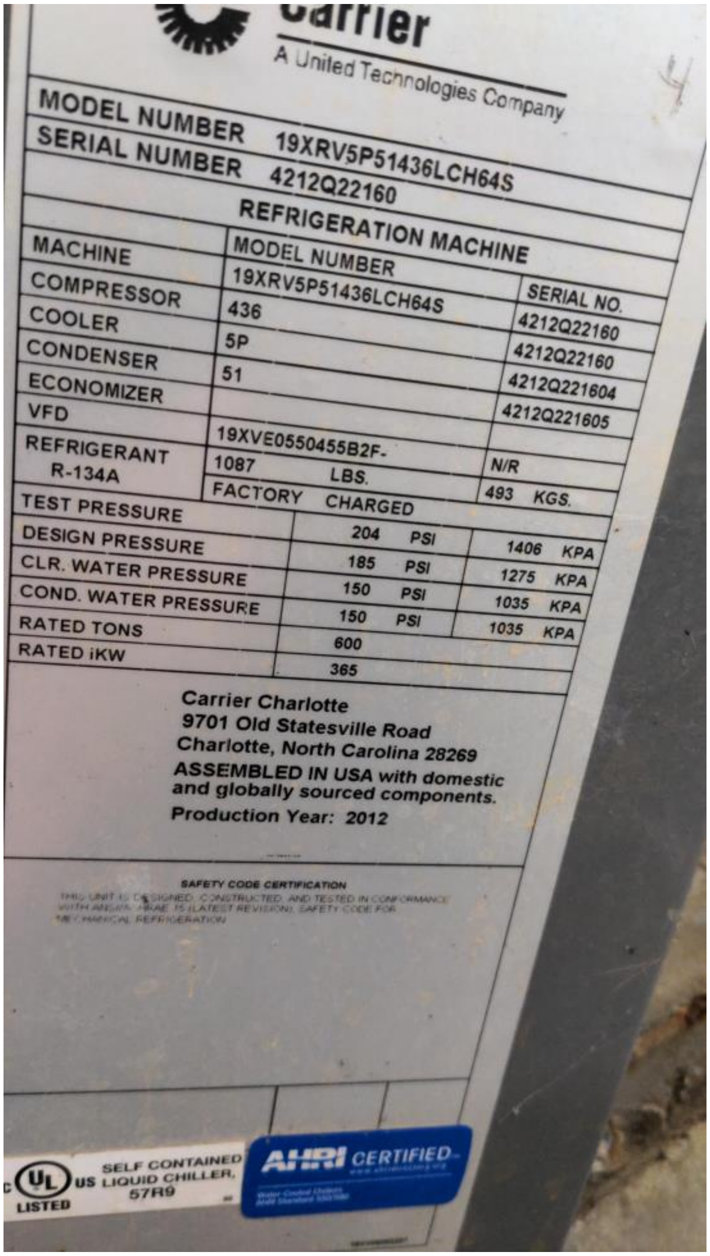

F
C
180
160
140
120
100
80
60
40
30
80
70
60
50
40
30
20
10
0

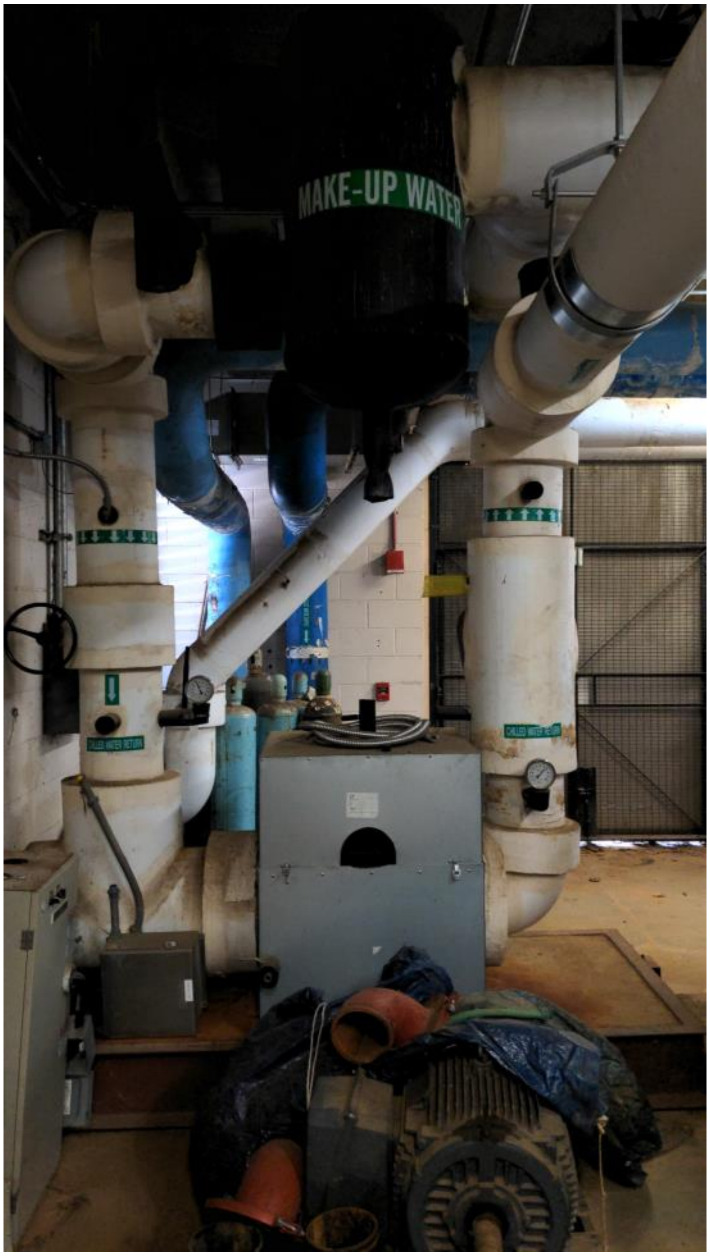

F
C
120
110
100
90
80
70
60
50
40
30
20
10
0
45
40
35
30
25
20
15
10
5
0
-5
-10
-15


F
C
120
110
100
90
80
70
60
50
40
30
20
10
0
45
40
35
30
25
20
15
10
5
0
-5
-10
-15

Chiller 4

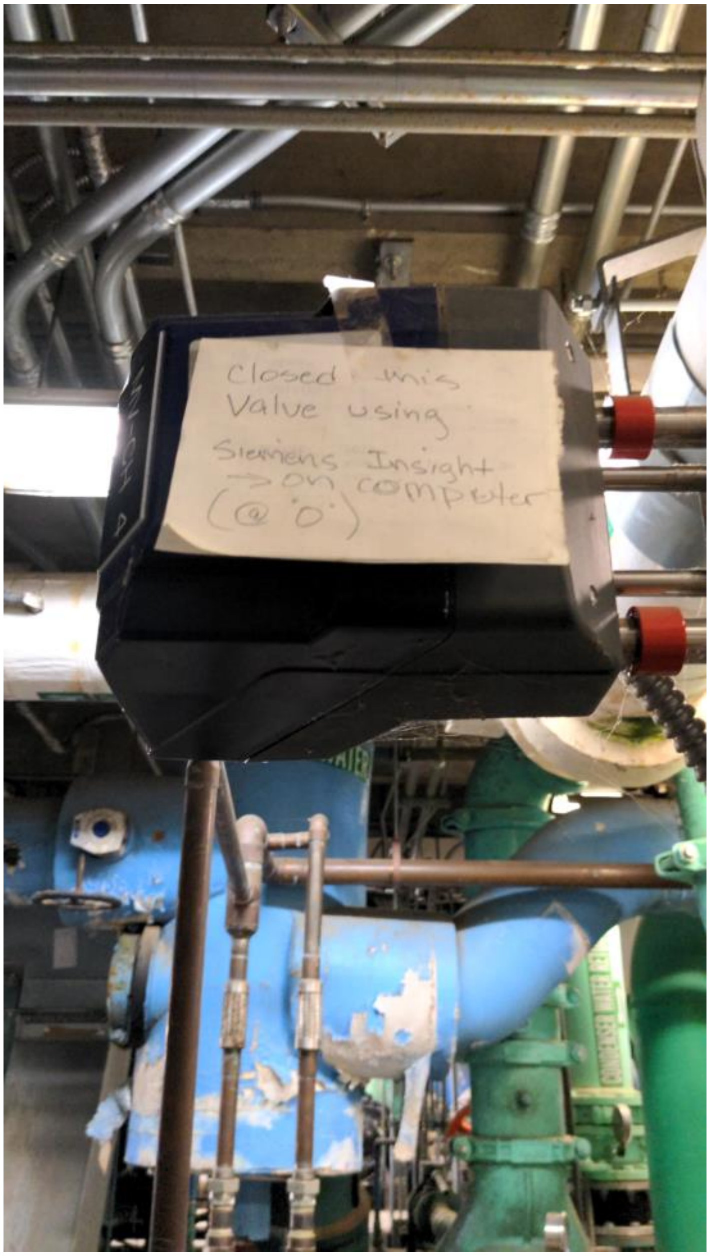

Carrier
Evergreen
CHILLER


Carrier
A United Technologies Company
MODEL NUMBER 19XRV5P51436LCH64S
SERIAL NUMBER 4212Q22160
REFRIGERATION MACHINE
MACHINE
MODEL NUMBER
SERIAL NO.
COMPRESSOR
19XRV5P51436LCH64S
4212Q22160
COOLER
436
4212Q22160
CONDENSER
5P
4212Q221604
ECONOMIZER
51
4212Q221605
VFD
19XVE0550455B2F-
N/R
REFRIGERANT R-134A
1087 LBS.
493 KGS.
FACTORY CHARGED
TEST PRESSURE
204 PSI
1406 KPA
DESIGN PRESSURE
185 PSI
1275 KPA
CLR. WATER PRESSURE
150 PSI
1035 KPA
COND. WATER PRESSURE
150 PSI
1035 KPA
RATED TONS
600
RATED iKW
365
Carrier Charlotte
9701 Old Statesville Road
Charlotte, North Carolina 28269
ASSEMBLED IN USA with domestic and globally sourced components.
Production Year: 2012
SAFETY CODE CERTIFICATION
c UL US LISTED
SELF CONTAINED LIQUID CHILLER, 57R9
AHRI CERTIFIED

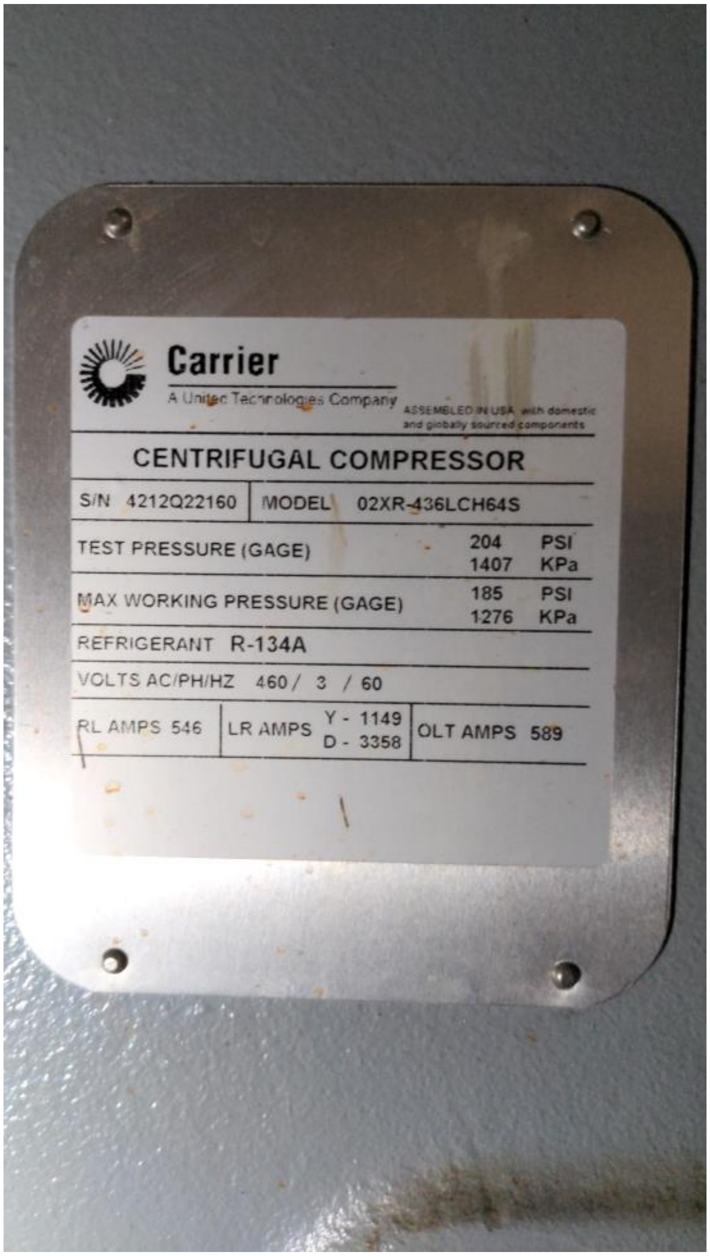

MAKE-UP WATER


CHILLED WATER RETURN
40
50
60
30
SS 316 TUBE
AND SOCK
70
20
80
10
90
0
100
psi


RETURN
NIBCO
psi


Closed this
Value using
Siemens Insight
→ on computer
(@ "0")


CHILLER
#4
CHW IN
CHW OUT
47.8
46.6
42.0
43.4
43.3
45.0
-0.3
145.3
0.0


Carrier
A United Technologies Company
ASSEMBLED IN USA with domestic and globally sourced components
CENTRIFUGAL COMPRESSOR
S/N 4212Q22160
MODEL 02XR-436LCH64S
TEST PRESSURE (GAGE) 204 PSI 1407 KPa
MAX WORKING PRESSURE (GAGE) 185 PSI 1276 KPa
REFRIGERANT R-134A
VOLTS AC/PH/HZ 460 / 3 / 60
RL AMPS 546
LR AMPS Y - 1149 D - 3358
OLT AMPS 589


PUMP
#8


PUMP
#9


PUMP
#6
SS 316 TUBE
AND SOCKET
psi

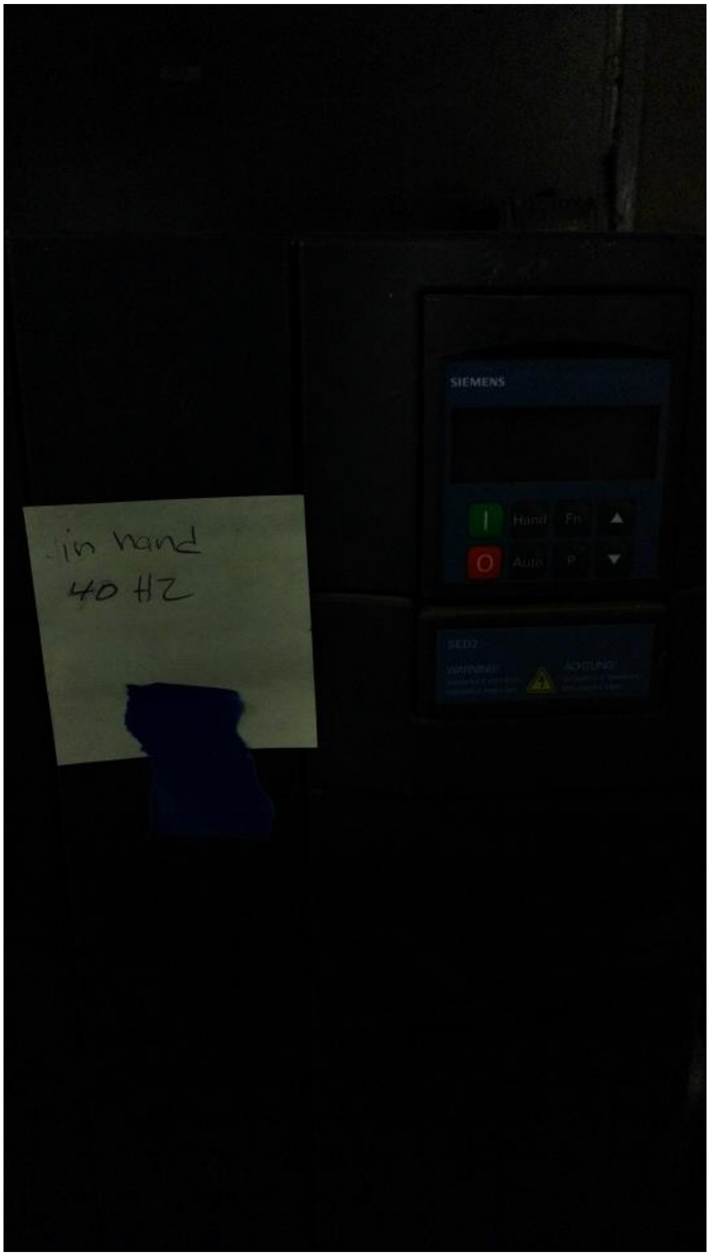

Taco
SHOP
MODEL NO.
TA2524B2X1B6W0
CAP-GPM
HEAD
3000.00
71.00
IMP DIA
10.30
09/12
MOTOR HP
RPM
TACO INC., CRANSTON, R.I.

Electrical


Cooling Tower Pump for Chiller #3
SIEMENS
Hand
Fn
Auto
P
SED2
WARNING!
ACHTUNG!


COND PUMP 7
CHILLER#3
BYPASS ON
OFF
DRIVE
BYPASS
OFF
ON
DRIVE TEST

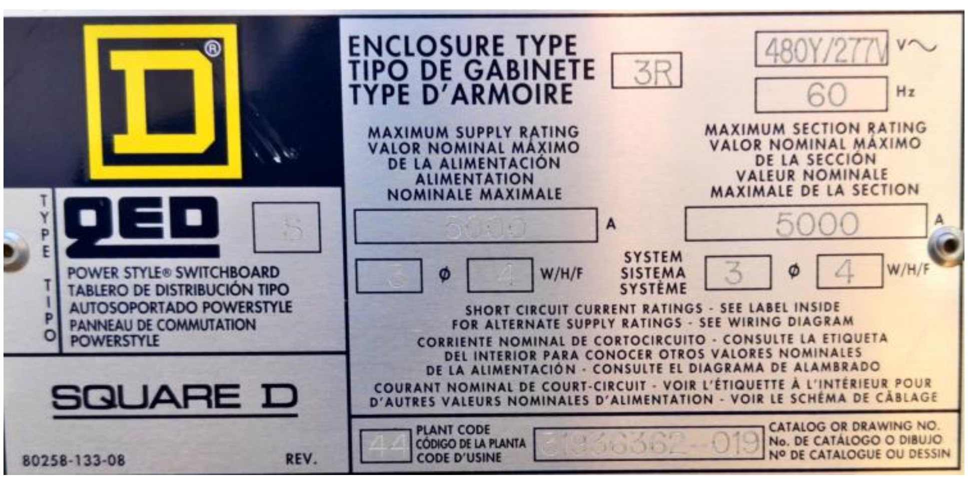

CHW PUMP 6
CHILLER#3
SIEMENS
OFF
Place select switch in DRIVE
-Press HAND
- use arrow incr/decr to 40HZ
BYPASS ON
OFF
DRIVE BYPASS
DRIVE TEST
OFF ON



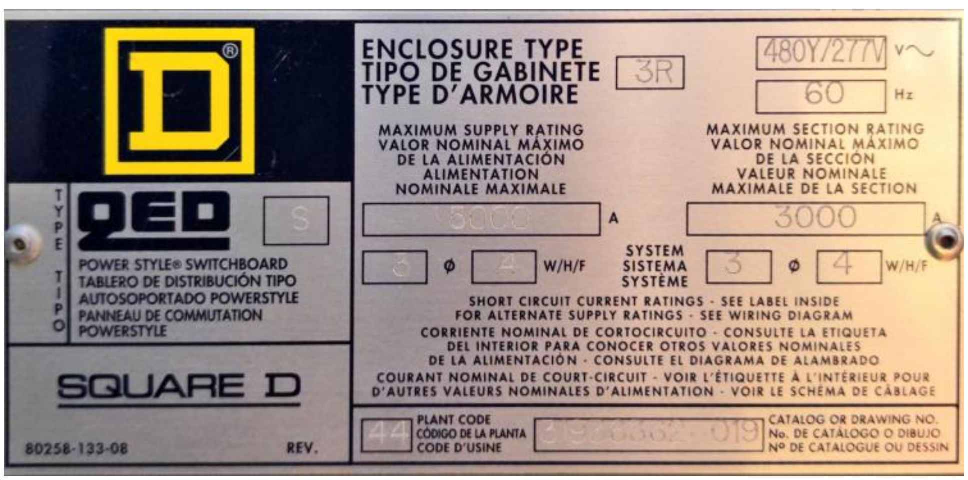
in hand
40 HZ
SIEMENS
Hand
Fn
Auto
P
SED2
WARNING!
ACHTUNG!

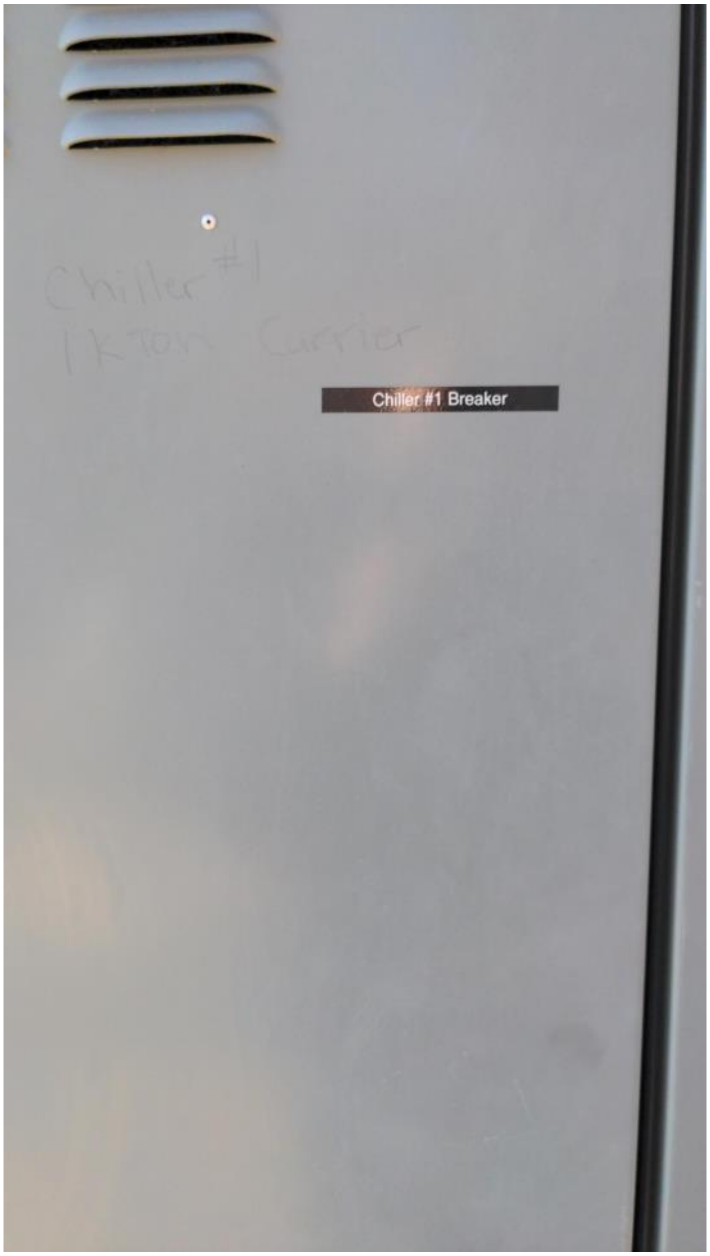

MSWBD
Main Breaker


ENCLOSURE TYPE
TIPO DE GABINETE
TYPE D'ARMOIRE
AmeriGrid Solutions
Assembled in USA
Ensamblado en EUA
Assemblé aux É.-U.
Schneider Electric
1-888-778-2733
MASTERPACT
NW 50 H3
Low-voltage Power Circuit Breaker
Interruptor de Potencia de Baja Tensión
Disjoncteur de Puissance à Basse Tension
O
Push to open
I
Push to close
MAIN BREAKER
SQUARE D
DANGER / PELIGRO


ENCLOSURE TYPE
TIPO DE GABINETE
TYPE D'ARMOIRE
3R
480Y/277V V~
60 Hz
MAXIMUM SUPPLY RATING
VALOR NOMINAL MÁXIMO
DE LA ALIMENTACIÓN
ALIMENTATION
NOMINALE MAXIMALE
5000 A
MAXIMUM SECTION RATING
VALOR NOMINAL MÁXIMO
DE LA SECCIÓN
VALEUR NOMINALE
MAXIMALE DE LA SECTION
5000 A
3 Ø 4 W/H/F
SYSTEM
SISTEMA
SYSTÈME
3 Ø 4 W/H/F
TYPE
TIPO
QED
S
POWER STYLE® SWITCHBOARD
TABLERO DE DISTRIBUCIÓN TIPO
AUTOSOPORTADO POWERSTYLE
PANNEAU DE COMMUTATION
POWERSTYLE
SHORT CIRCUIT CURRENT RATINGS - SEE LABEL INSIDE
FOR ALTERNATE SUPPLY RATINGS - SEE WIRING DIAGRAM
CORRIENTE NOMINAL DE CORTOCIRCUITO - CONSULTE LA ETIQUETA
DEL INTERIOR PARA CONOCER OTROS VALORES NOMINALES
DE LA ALIMENTACIÓN - CONSULTE EL DIAGRAMA DE ALAMBRADO
COURANT NOMINAL DE COURT-CIRCUIT - VOIR L'ÉTIQUETTE À L'INTÉRIEUR POUR
D'AUTRES VALEURS NOMINALES D'ALIMENTATION - VOIR LE SCHÉMA DE CÂBLAGE
SQUARE D
44
PLANT CODE
CÓDIGO DE LA PLANTA
CODE D'USINE
31936362-019
CATALOG OR DRAWING NO.
No. DE CATÁLOGO O DIBUJO
Nº DE CATALOGUE OU DESSIN
80258-133-08
REV.


AmeriGrid Solutions
Assembled in USA
Ensamblado en EUA
Assemblé aux É.-U.
Schneider
MASTERPACT
NW 30 H
Circuit Breaker
Push to close
EXISTING MDP
DANGER / PELIGRO


QED
S
POWER STYLE® SWITCHBOARD
TABLERO DE DISTRIBUCIÓN TIPO AUTOSOPORTADO POWERSTYLE
PANNEAU DE COMMUTATION POWERSTYLE
TYPE TIPO
SQUARE D
80258-133-08
REV.
ENCLOSURE TYPE
TIPO DE GABINETE
TYPE D'ARMOIRE
3R
480Y/277V V~
60 Hz
MAXIMUM SUPPLY RATING
VALOR NOMINAL MÁXIMO DE LA ALIMENTACIÓN
ALIMENTATION NOMINALE MAXIMALE
5000 A
MAXIMUM SECTION RATING
VALOR NOMINAL MÁXIMO DE LA SECCIÓN
VALEUR NOMINALE MAXIMALE DE LA SECTION
3000 A
3 ø 4 W/H/F
SYSTEM SISTEMA SYSTÈME
3 ø 4 W/H/F
SHORT CIRCUIT CURRENT RATINGS - SEE LABEL INSIDE FOR ALTERNATE SUPPLY RATINGS - SEE WIRING DIAGRAM
CORRIENTE NOMINAL DE CORTOCIRCUITO - CONSULTE LA ETIQUETA DEL INTERIOR PARA CONOCER OTROS VALORES NOMINALES DE LA ALIMENTACIÓN - CONSULTE EL DIAGRAMA DE ALAMBRADO
COURANT NOMINAL DE COURT-CIRCUIT - VOIR L'ÉTIQUETTE À L'INTÉRIEUR POUR D'AUTRES VALEURS NOMINALES D'ALIMENTATION - VOIR LE SCHÉMA DE CÂBLAGE
44
PLANT CODE
CÓDIGO DE LA PLANTA
CODE D'USINE
CATALOG OR DRAWING NO.
No. DE CATÁLOGO O DIBUJO
Nº DE CATALOGUE OU DESSIN


Chiller #1
1K ton Carrier
Chiller #1 Breaker


Basin Heater #3
Cooling Tower #1 & #2
Pump #8..Chiller #4 Chilled Water Pump
Chiller#4 Breaker
SQUARE D
Pump #3..Ch#1 Condsr Pump
Pump #9..Ch#4 Condsr Pump
Cooling Tower #3
DANGER
Temp. Emergency Chiller
Pump #1..Chiller #1 Chilled Water Pump

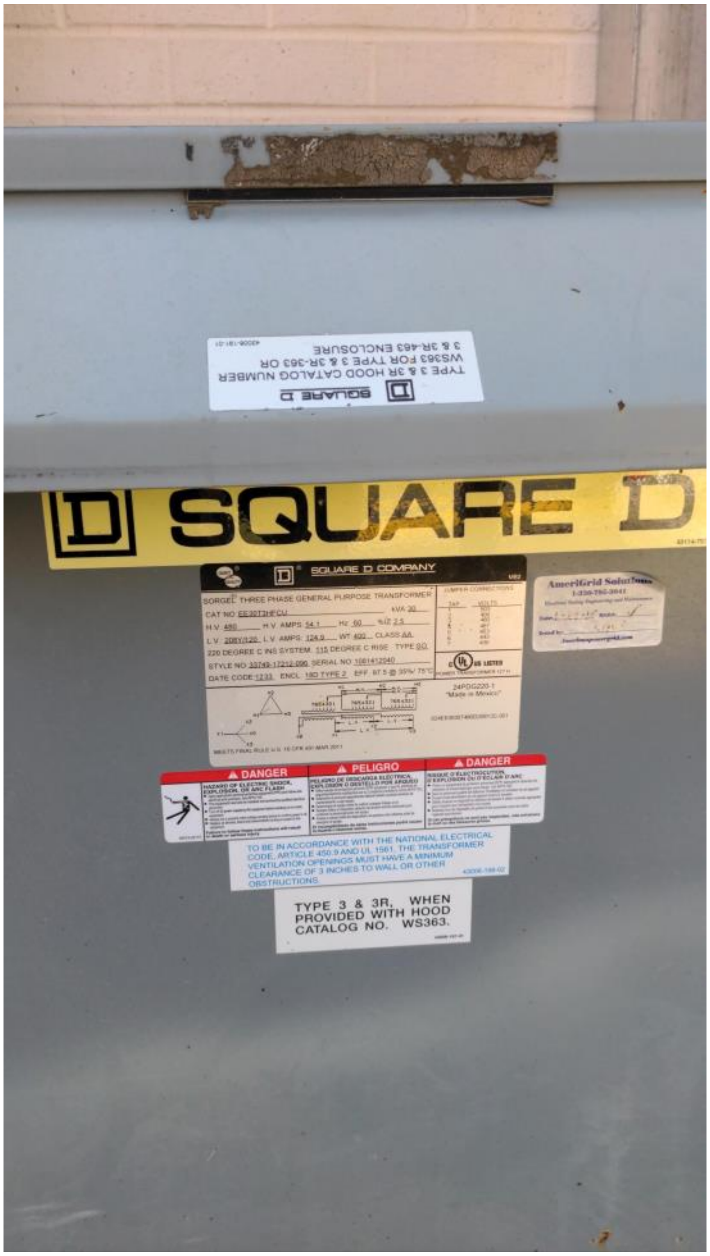

Generator
TYPE 3R ENCLO
GABINETE TIP
ARMOIRE TYPE
SQUARE
DANGER / PELIGRO
DANGE
NO SAFE PPE EXISTS
ENERGIZED WORK PROHIBITED


GENERATOR CONNECTION
PANEL MSWB


SURGE PROTECTION
XFMR CTV
WARNING

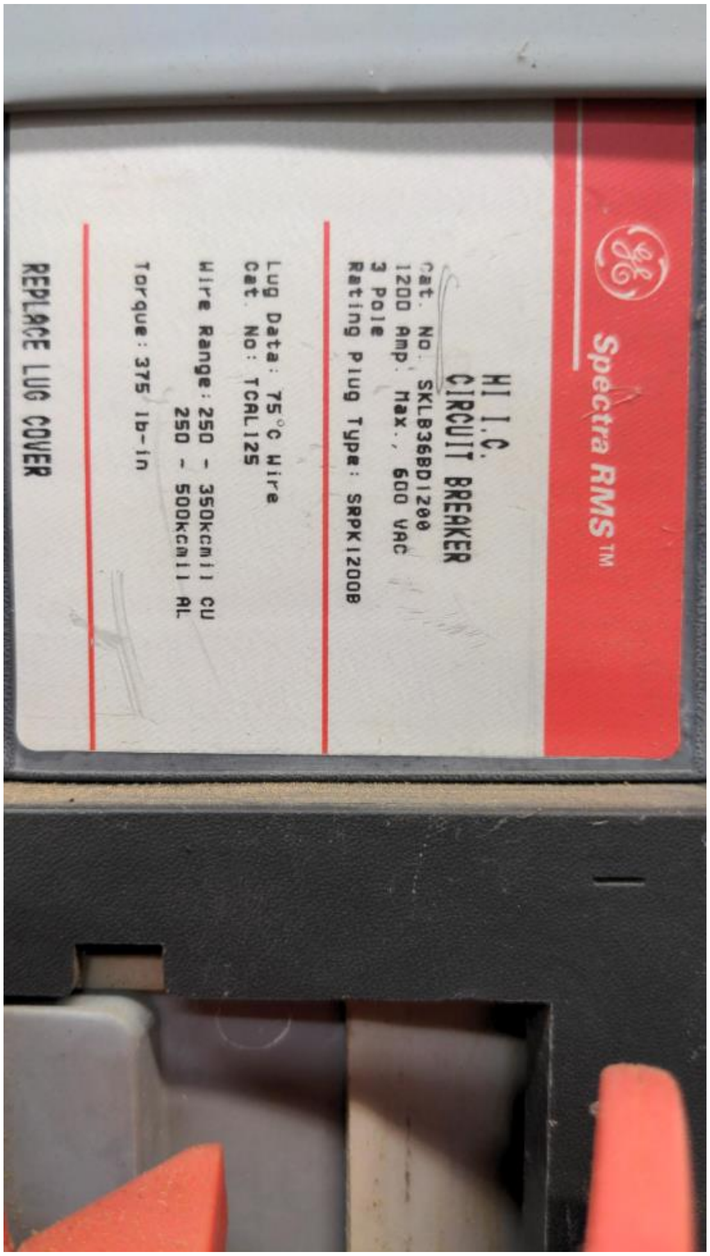

= OK
= Replace Module / Sustituya el módulo / Remplacer le module
Push-to-Test / Botón de prueba / Bouton pousser pour vérifier
AØ
BØ
CØ
Counter /
Contador /
Compteur
SURGELOGIC ™
Surge Protective Device
Dispositivo de Protección contra
Sobretensiones Transitorias /
Dispositif de Protection contre
les Surtensions
DANGER
PELIGRO
DANGER
OFF
ON

Made in USA / Hecho en E.U.A. / Fabriqué aux É.-U.
www.SquareD.com
= OK
= Replace Module / Sustituya el módulo / Remplacer le module
Push-to-Test / Botón de prueba / Bouton pousser pour vérifier
AØ
BØ
CØ
Counter / Contador / Compteur
SURGELOGIC ™
Surge Protective Device
Dispositivo de Protección contra Sobretensiones Transitorias / Dispositif de Protection contre les Surtensions
DAN
PELI
DAN
TECTION


SQUARE D
SQUARE D COMPANY
DANGER
PELIGRO
DANGER
TO BE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE, ARTICLE 450.9 AND UL 1561, THE TRANSFORMER VENTILATION OPENINGS MUST HAVE A MINIMUM CLEARANCE OF 3 INCHES TO WALL OR OTHER OBSTRUCTIONS.
TYPE 3 & 3R, WHEN PROVIDED WITH HOOD CATALOG NO. WS363.

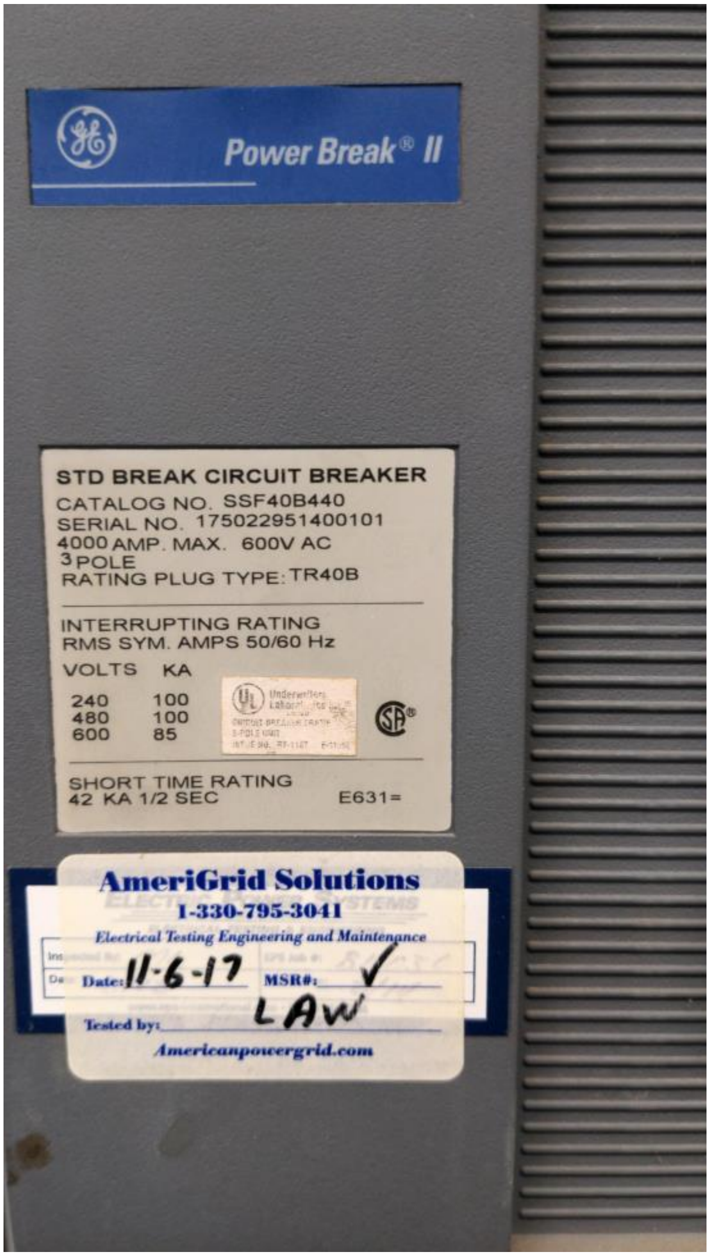

MODEL
6
WARNING
WARNING
WARNING
WARNING
DANGER


CHILLER #3
DANGER


Spectra RMS TM
HI I.C.
CIRCUIT BREAKER
Cat. No. SKLB36BD1200
1200 Amp. Max., 600 VAC
3 Pole
Rating Plug Type: SRPK1200B
Lug Data: 75°C Wire
Cat. No: TCAL125
Wire Range: 250 - 350kcmil CU
250 - 500kcmil AL
Torque: 375 lb-in
REPLACE LUG COVER


AmeriGrid Solutions
1-330-795-3041
Electrical Testing Engineering and Maintenance
Date: 11-5-17
MSB#: ✓
Tested by: LAW
Americanpowergrid.com
DANGER
DO NOT REMOVE THIS TAG
Remarks:
PROPER
21
21
21

WARNING
Arc Flash and Shock Risk
Appropriate PPE Required
SHOCK PROTECTION
400 VAC
MDP
MAIN BREAKER
Power Break II
ON
PUSH OFF
AmeriGrid Solutions
11-6-17
LAW



Power Break® II
STD BREAK CIRCUIT BREAKER
CATALOG NO. SSF40B440
SERIAL NO. 175022951400101
4000 AMP. MAX. 600V AC
3 POLE
RATING PLUG TYPE: TR40B
INTERRUPTING RATING
RMS SYM. AMPS 50/60 Hz
VOLTS KA
240 100
480 100
600 85
SHORT TIME RATING
42 KA 1/2 SEC
E631=
AmeriGrid Solutions
1-330-795-3041
Electrical Testing Engineering and Maintenance
Date: 11-6-17
MSR#: ✓
Tested by: LAW
Americanpowergrid.com


AmeriGrid Solutions
Electrical Testing Engineering and Maintenance
Date: 11-6-17
Tested by: L AW
Americanpowergrid.com
Power Break® II
STD. BREAK CIRCUIT BREAKER
CATALOG NO: SSF16G216
SERIAL NO: S61001621592001
1600 AMP MAX. 600V AC
3 POLE
RATING PLUG TYPE: GTP16
INTERRUPTING RATING
RMS SYM AMPS 50/60 Hz
VOLTS KA
240 85
480 65
600 50
LISTED
SHORT TIME RATING
60 KA 1/2 SEC
NEW CHILLER #2
June 18, 2020


ON
OFF
RESET
OFF
HAND
AUTO
P-6 CHW
Motor Logic Plus™ MMS
Motor Management System
SQUARE D
REAL TIME
FAULT
HISTORY
SETPOINT
SETUP
MODE
SCROLL
RUN
STOP/RESET
RUN
FAULT
CHANGE
SETUP
ENTER
COMM
STATUS


WARNING
CT-1
WARNING
CT-2
SPARE

Electrical

Thursday, January 27, 2022 10:54 AM

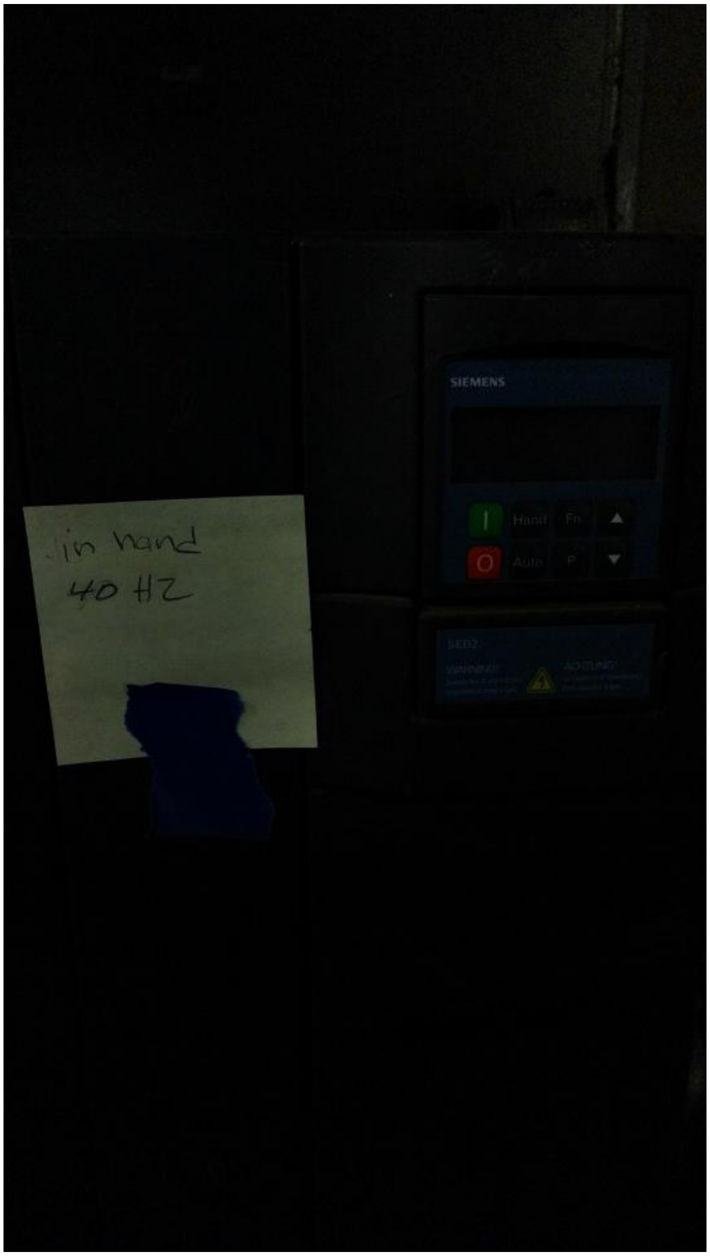

ON
OFF
RESET
HAND
OFF
AUTO
P-6 CHW
Motor Logic Plus™ MMS
Motor Management System
SQUARE D
REAL TIME
FAULT HISTORY
SETPOINT
SETUP
MODE
SCROLL
RUN
STOP/RESET
RUN
FAULT
CHANGE SETUP
ENTER
COMM STATUS

Electrical


Cooling Tower Pump for Chiller #3
SIEMENS
Hand
Fn
Auto
P
SED2
WARNING!
ACHTUNG!


COND PUMP 7
CHILLER#3
BYPASS ON
OFF
DRIVE
BYPASS
OFF
ON
DRIVE TEST

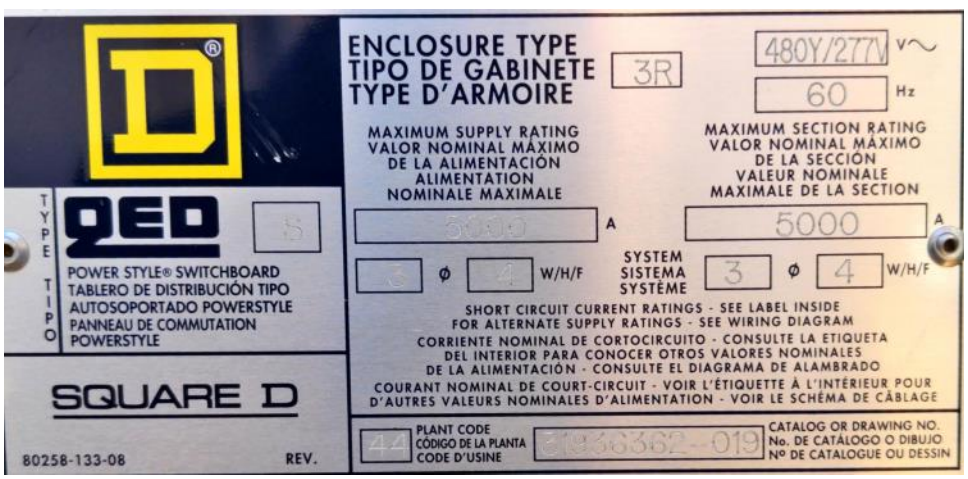

CHW PUMP 6
CHILLER#3
-Press HAND
BYPASS ON
DRIVE TEST
SIEMENS
OFF


in hand
40 HZ
SIEMENS
Hand
Fn
Auto
P
SED2
WARNING!
ACHTUNG!


SQUARE

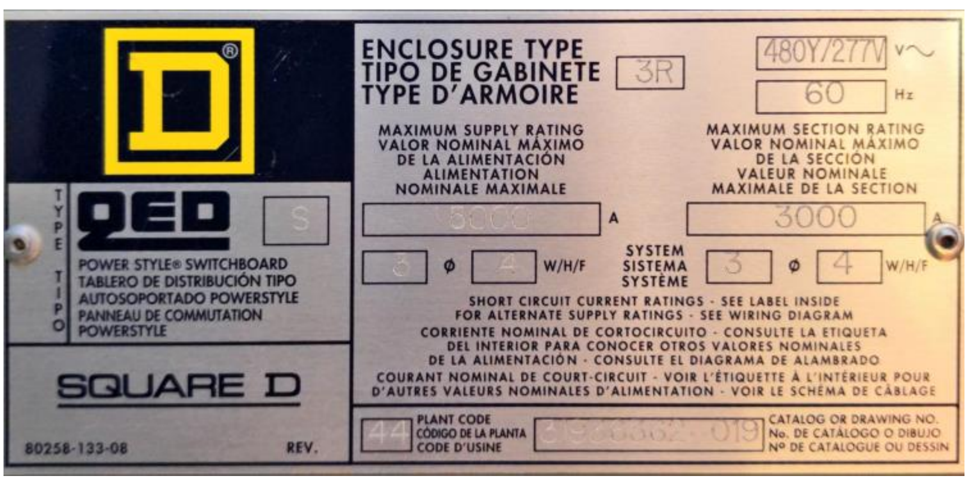

MSWBD
Main Breaker

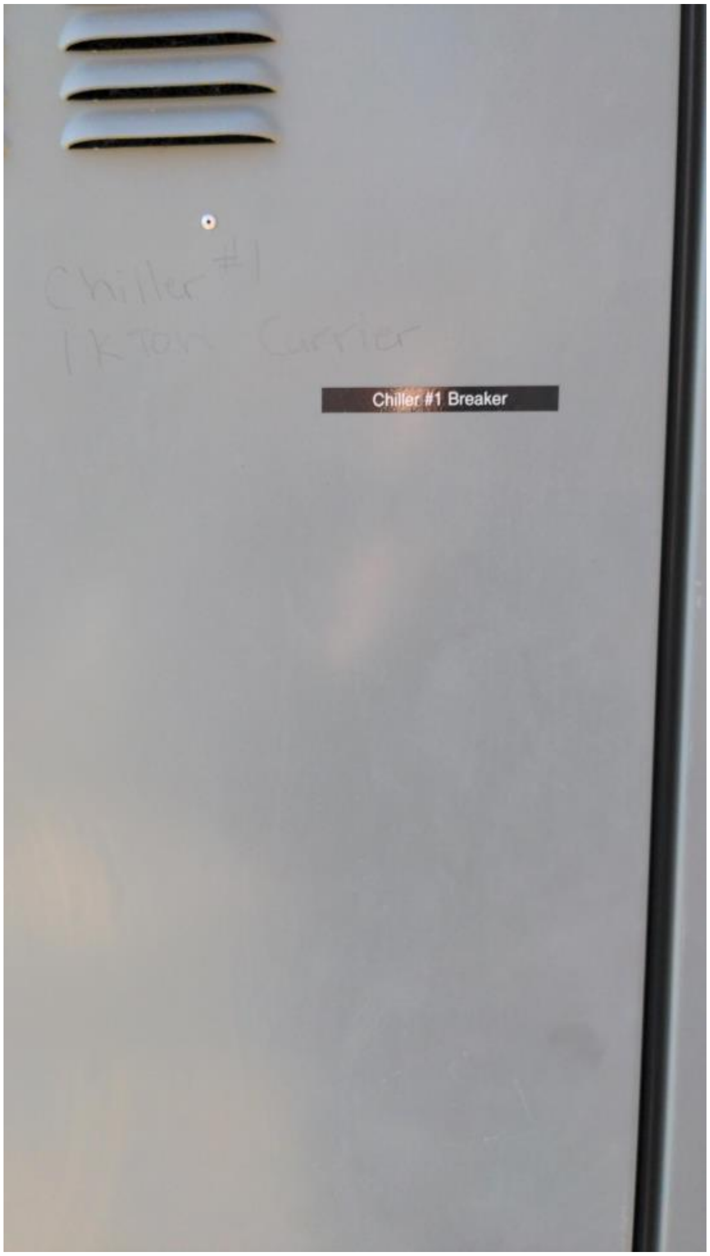
ENCLOSURE TYPE
TIPO DE GABINETE
TYPE D'ARMOIRE
AmeriGrid Solutions
Assembled in USA
Ensamblado en EUA
Assemblé aux É.-U.
Schneider Electric
1-888-778-2733
Push to open
Push to close
MASTERPACT
NW 50 H3
Low-voltage Power Circuit Breaker
MAIN BREAKER
SQUARE D
DANGER / PELIGRO



QED
S
TYPE
TIPO
POWER STYLE® SWITCHBOARD
TABLERO DE DISTRIBUCIÓN TIPO AUTOSOPORTADO POWERSTYLE
PANNEAU DE COMMUTATION POWERSTYLE
SQUARE D
80258-133-08
REV.
ENCLOSURE TYPE
TIPO DE GABINETE
TYPE D'ARMOIRE
3R
480Y/277V V~
60 Hz
MAXIMUM SUPPLY RATING
VALOR NOMINAL MÁXIMO DE LA ALIMENTACIÓN
ALIMENTATION NOMINALE MAXIMALE
5000 A
MAXIMUM SECTION RATING
VALOR NOMINAL MÁXIMO DE LA SECCIÓN
VALEUR NOMINALE MAXIMALE DE LA SECTION
5000 A
3 ø 4 W/H/F
SYSTEM
SISTEMA
SYSTÈME
3 ø 4 W/H/F
SHORT CIRCUIT CURRENT RATINGS - SEE LABEL INSIDE
FOR ALTERNATE SUPPLY RATINGS - SEE WIRING DIAGRAM
CORRIENTE NOMINAL DE CORTOCIRCUITO - CONSULTE LA ETIQUETA DEL INTERIOR PARA CONOCER OTROS VALORES NOMINALES DE LA ALIMENTACIÓN - CONSULTE EL DIAGRAMA DE ALAMBRADO
COURANT NOMINAL DE COURT-CIRCUIT - VOIR L'ÉTIQUETTE À L'INTÉRIEUR POUR D'AUTRES VALEURS NOMINALES D'ALIMENTATION - VOIR LE SCHÉMA DE CÂBLAGE
44
PLANT CODE
CÓDIGO DE LA PLANTA
CODE D'USINE
31936362--019
CATALOG OR DRAWING NO.
No. DE CATÁLOGO O DIBUJO
Nº DE CATALOGUE OU DESSIN


AmeriGrid Solutions
Assembled in USA
Ensamblado en EUA
Assemblé aux É.-U.
MASTERPACT
NW 30 H
Push to close
EXISTING MDP
DANGER / PELIGRO


ENCLOSURE TYPE
TIPO DE GABINETE
TYPE D'ARMOIRE
3R
480Y/277V
60
Hz
MAXIMUM SUPPLY RATING
VALOR NOMINAL MÁXIMO
DE LA ALIMENTACIÓN
ALIMENTATION
NOMINALE MAXIMALE
5000
A
MAXIMUM SECTION RATING
VALOR NOMINAL MÁXIMO
DE LA SECCIÓN
VALEUR NOMINALE
MAXIMALE DE LA SECTION
3000
A
3 Ø 4 W/H/F
SYSTEM
SISTEMA
SYSTÈME
3 Ø 4 W/H/F
TYPE TIPO
QED
S
POWER STYLE® SWITCHBOARD
TABLERO DE DISTRIBUCIÓN TIPO
AUTOSOPORTADO POWERSTYLE
PANNEAU DE COMMUTATION
POWERSTYLE
SHORT CIRCUIT CURRENT RATINGS - SEE LABEL INSIDE
FOR ALTERNATE SUPPLY RATINGS - SEE WIRING DIAGRAM
CORRIENTE NOMINAL DE CORTOCIRCUITO - CONSULTE LA ETIQUETA
DEL INTERIOR PARA CONOCER OTROS VALORES NOMINALES
DE LA ALIMENTACIÓN - CONSULTE EL DIAGRAMA DE ALAMBRADO
COURANT NOMINAL DE COURT-CIRCUIT - VOIR L'ÉTIQUETTE À L'INTÉRIEUR POUR
D'AUTRES VALEURS NOMINALES D'ALIMENTATION - VOIR LE SCHÉMA DE CÂBLAGE
SQUARE D
44
PLANT CODE
CÓDIGO DE LA PLANTA
CODE D'USINE
CATALOG OR DRAWING NO.
No. DE CATÁLOGO O DIBUJO
Nº DE CATALOGUE OU DESSIN
80258-133-08
REV.


Chiller #1
1K Ton Carrier
Chiller #1 Breaker


Basin Heater #3
Cooling Tower #1 & #2
Pump #8..Chiller #4 Chilled Water Pump
Chiller#4 Breaker
Pump #3..Chl#1 Condsr Pump
Pump #9..Chl#4 Condsr Pump
Cooling Tower #3
SQUARE D
DANGER
Temp. Emergency Chiller
Pump #1..Chiller #1 Chilled Water Pump

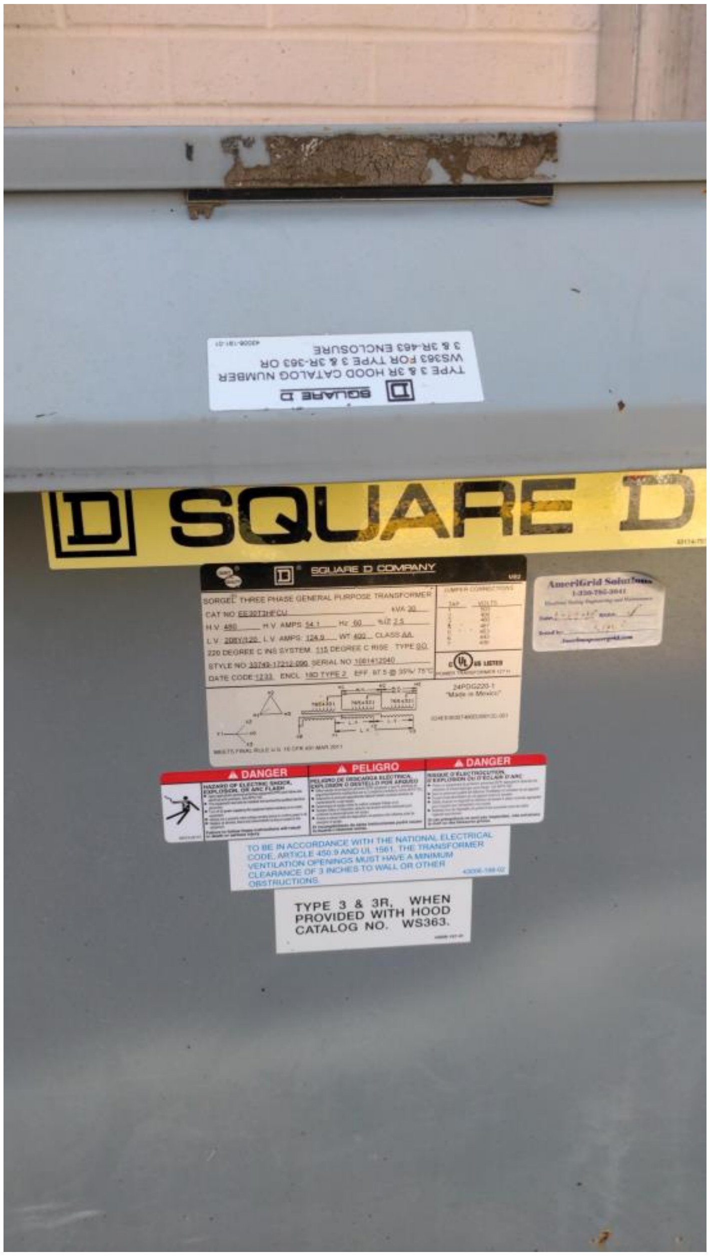

Generator
DANGER / PELIGRO
NO SAFE PPE EXISTS


GENERATOR CONNECTION
PANEL MSWB


SURGE PROTECTION
XFMR CTV
WARNING

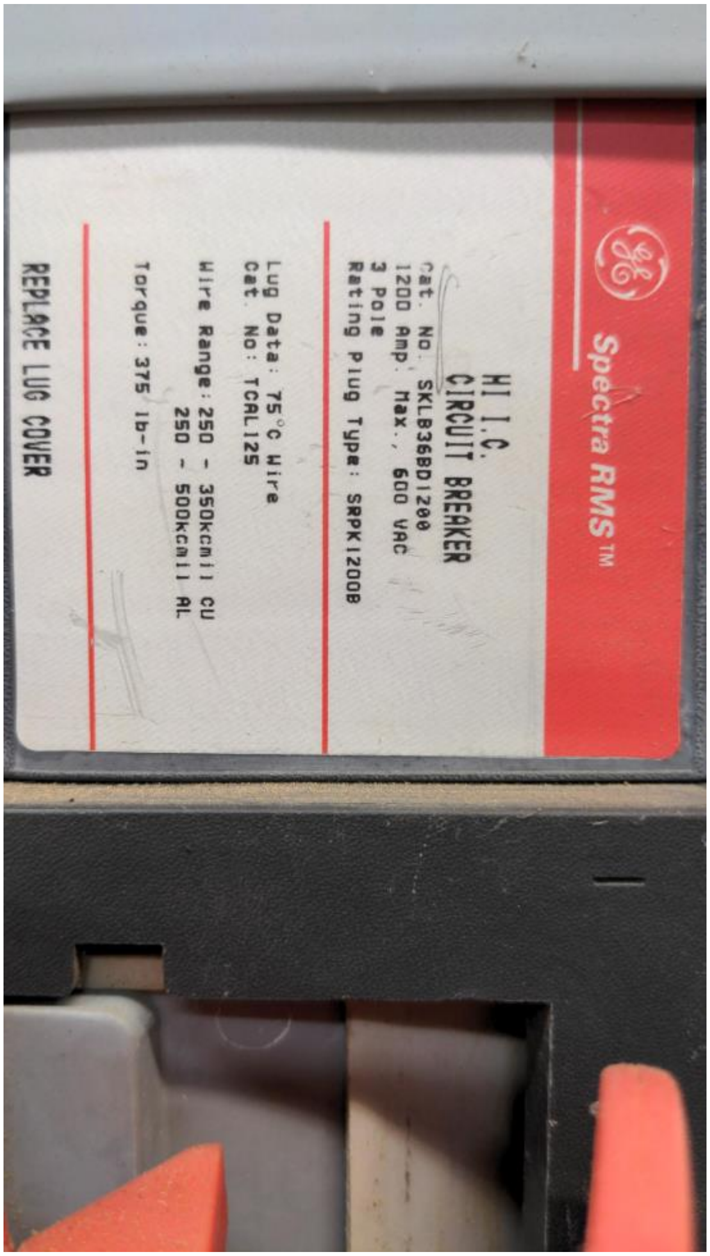

= OK
= Replace Module / Sustituya el módulo / Remplacer le module
Push-to-Test / Botón de prueba / Bouton pousser pour vérifier
AØ
BØ
CØ
Counter /
Contador /
Compteur
SURGELOGIC™
Surge Protective Device
Dispositivo de Protección contra
Sobretensiones Transitorias /
Dispositif de Protection contre
les Surtensions
DANGER
PELIGRO
DANGER
ON
OFF


Made in USA / Hecho en E.U.A. / Fabriqué aux É.-U. www.SquareD.com
= OK
= Replace Module / Sustituya el módulo / Remplacer le module
Push-to-Test / Botón de prueba / Bouton pousser pour vérifier
AØ
BØ
CØ
Counter / Contador / Compteur
SURGELOGIC™
Surge Protective Device
Dispositivo de Protección contra Sobretensiones Transitorias / Dispositif de Protection contre les Surtensions
DAN
PELI
DAN


SQUARE D
TYPE 3 & 3R HOOD CATALOG NUMBER
WS363 FOR TYPE 3 & 3R-363 OR
3 & 3R-463 ENCLOSURE
SQUARE D
SQUARE D COMPANY
SORGEL THREE PHASE GENERAL PURPOSE TRANSFORMER
CAT NO EE30T3HFCU
KVA 30
H.V. 480
H.V. AMPS 54.1
HZ 60
%IZ 2.5
L.V. 208Y/120
L.V. AMPS 124.9
WT 400
CLASS AA
220 DEGREE C INS SYSTEM
115 DEGREE C RISE
TYPE SQ
STYLE NO 33749-17212-090
SERIAL NO 1061412040
DATE CODE 1233
ENCL 180 TYPE 2
US LISTED
24PDG220-1
"Made in Mexico"
DANGER
HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH
PELIGRO
PELIGRO DE DESCARGA ELECTRICA, EXPLOSION O DESTELLO POR ARQUEO
DANGER
RISQUE D'ELECTROCUTION, D'EXPLOSION OU D'ECLAIR D'ARC
TO BE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE, ARTICLE 450.9 AND UL 1561, THE TRANSFORMER VENTILATION OPENINGS MUST HAVE A MINIMUM CLEARANCE OF 3 INCHES TO WALL OR OTHER OBSTRUCTIONS.
TYPE 3 & 3R, WHEN PROVIDED WITH HOOD CATALOG NO. WS363.

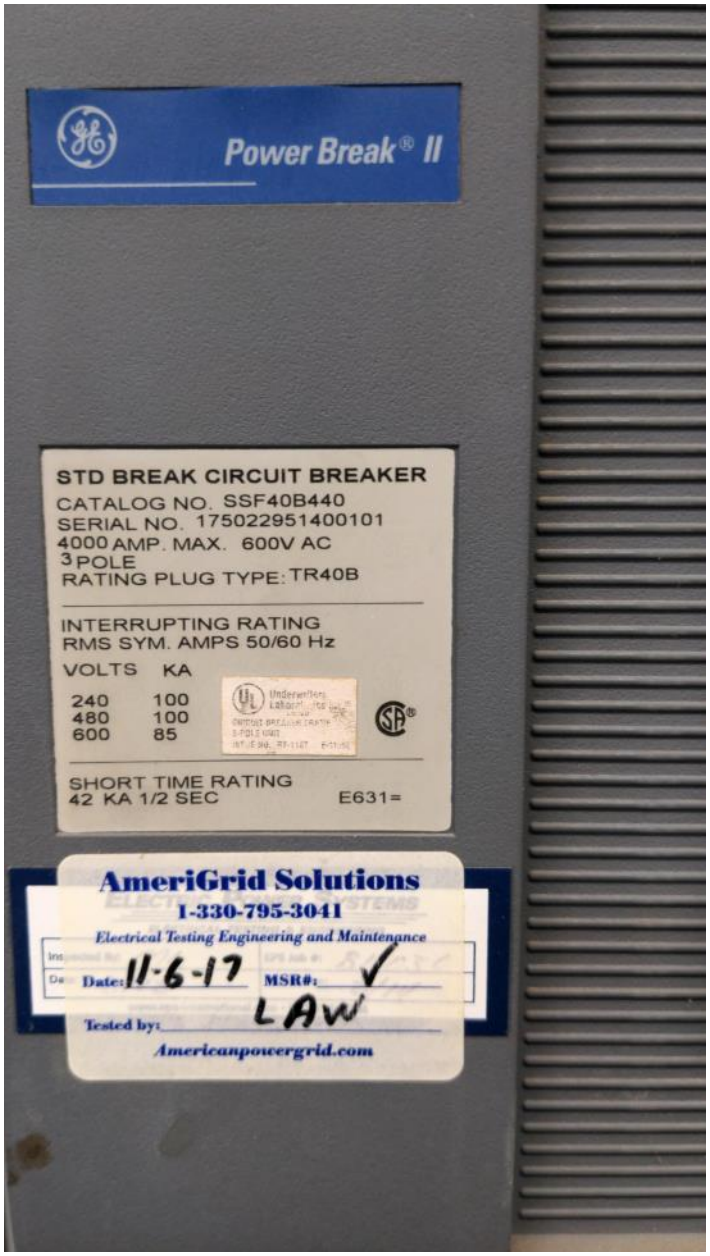
MODEL
6
MOTOR
CONTROL
CENTER
WARNING
WARNING
WARNING
DANGER


CHILLER #3
DANGER


Spectra RMS™
HI I.C.
CIRCUIT BREAKER
Cat. No. SKLB36BD1200
1200 Amp. Max., 600 VAC
3 Pole
Rating Plug Type: SRPK1200B
Lug Data: 75°C Wire
Cat. No: TCAL125
Wire Range: 250 - 350kcmil CU
250 - 500kcmil AL
Torque: 375 lb-in
REPLACE LUG COVER


AmeriGrid Solutions
1-330-795-3041
Electrical Testing Engineering and Maintenance
Date:
MSB#:
Tested by:
Americanpowergrid.com
PROPER
21
21
21
DANGER
DO NOT REMOVE THIS TAG
Remarks:


WARNING
Arc Flash and Shock Risk
Appropriate PPE Required
SHOCK PROTECTION
Shock Hazard Exposure 480 VAC
Glove Class: 00
Limited Approach: 42 in
Restricted Approach: 12 in
Shock Hazard exists when covers are removed and exposed to energized parts.
MDP
MAIN BREAKER
Power Break II
ON
PUSH OFF
AmeriGrid Solutions
11-6-17
LAW



Power Break® II
STD BREAK CIRCUIT BREAKER
CATALOG NO. SSF40B440
SERIAL NO. 175022951400101
4000 AMP. MAX. 600V AC
3 POLE
RATING PLUG TYPE: TR40B
INTERRUPTING RATING
RMS SYM. AMPS 50/60 Hz
VOLTS KA
240 100
480 100
600 85
SHORT TIME RATING
42 KA 1/2 SEC
E631=
AmeriGrid Solutions
1-330-795-3041
Electrical Testing Engineering and Maintenance
Date: 11-6-17
MSR#:
Tested by: LAW
Americanpowergrid.com


AmeriGrid Solutions
Electrical Testing Engineering and Maintenance
Date: 11-6-17 MSRP: ✓
Tested by: L AW
Americanpowergrid.com
Power Break® II
STD. BREAK CIRCUIT BREAKER
CATALOG NO: SSF16G216
SERIAL NO: 561001621592001
1600 AMP MAX. 600V AC
3 POLE
RATING PLUG TYPE: GTP16
INTERRUPTING RATING
RMS SYM AMPS 50/60 Hz
VOLTS KA
240 85
480 65
600 50
LISTED
SHORT TIME RATING
40 KA 1/2 SEC
NEW CHILLER #2
G
VAC
covers are
nergized
June 18, 2020


ON
OFF
RESET
OFF
HAND
AUTO
P-6 CHW
Motor Logic Plus™ MMS
Motor Management System
SQUARE D
REAL TIME
FAULT HISTORY
SETPOINT
SETUP
MODE
SCROLL
RUN
STOP/RESET
RUN
FAULT
COMM STATUS
CHANGE SETUP
ENTER


WARNING
CT-1
WARNING
CT-2
CT-3
SPARE

-

Water treatment

Thursday, January 27, 2022 10:57 AM

EC Architecture

Thursday, January 27, 2022 11:09 AM

Previous door widening


ON
OFF


NATIONAL

Existing to be widened


CONSTRUCTION SITE


A
TEMP EMER

Remove remove existing doors and replace in kind or replace with new roll up door. Either are acceptable to the VA. Previous projects where chillers were introduced the height of the opening remain the same however they had to widen the opening instead of feeling with brick, the contractor put in louver. This is acceptable to the VA as well.

Mechanical Scope

Thursday, January 27, 2022 11:18 AM

Remove existing chiller number three.

Disconnect chilled water supply downstream of control valve mv-ch-3. Replace control valve and all associated controls. Onikon flow meter to be repaired and made operational according to new sequence. Flow meter to be reused.

Remove chill water return from isolation valve the chiller 3. She'll want to return maybe isolated from or at rather the chill water loop on the roof. Replace isolation valve. Replace thermometers and gauges.


CHILLED WATER RETURN

Remove pump number 6 and its entirety. Exercise valves to ensure blocking capability before beginning work. Remove existing isolation base and prepare for new installation. Isolation valves to remain. Replace gauges and repair pipe. Remove and replace variable speed drive associated with pump.

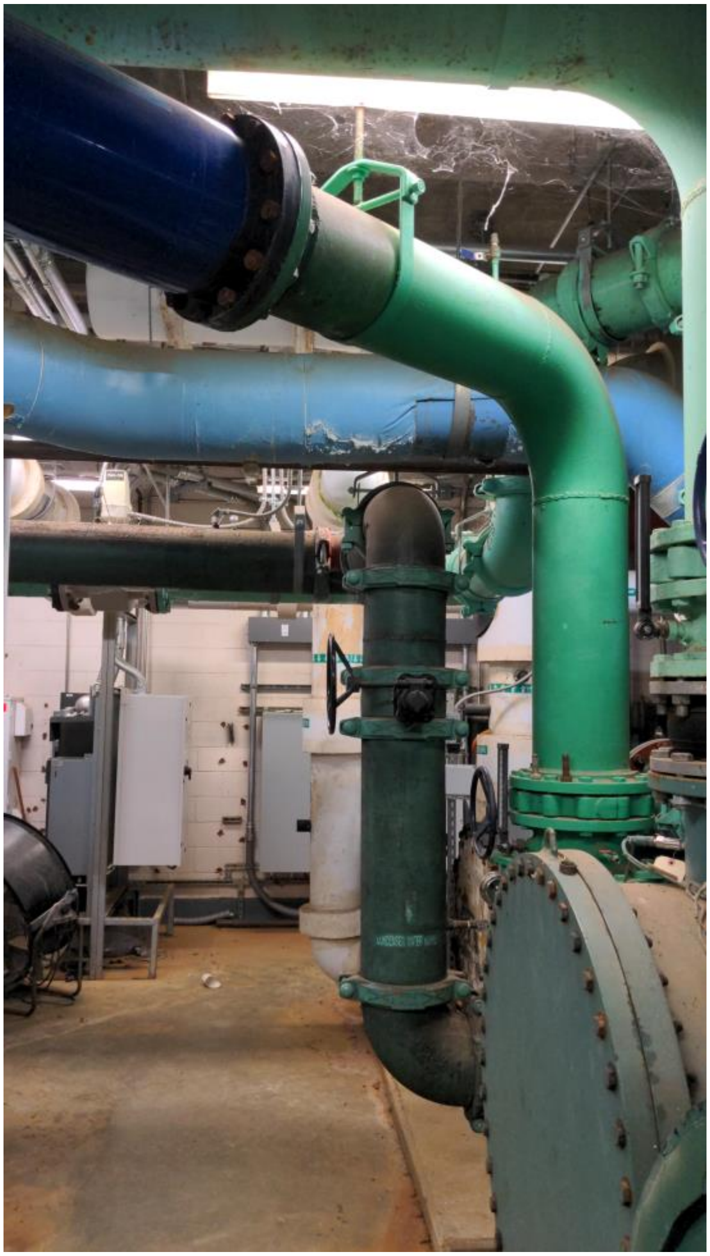

CHILLED WATER RETURN
CHILLED WATER RETURN


LLED WATER RETURN

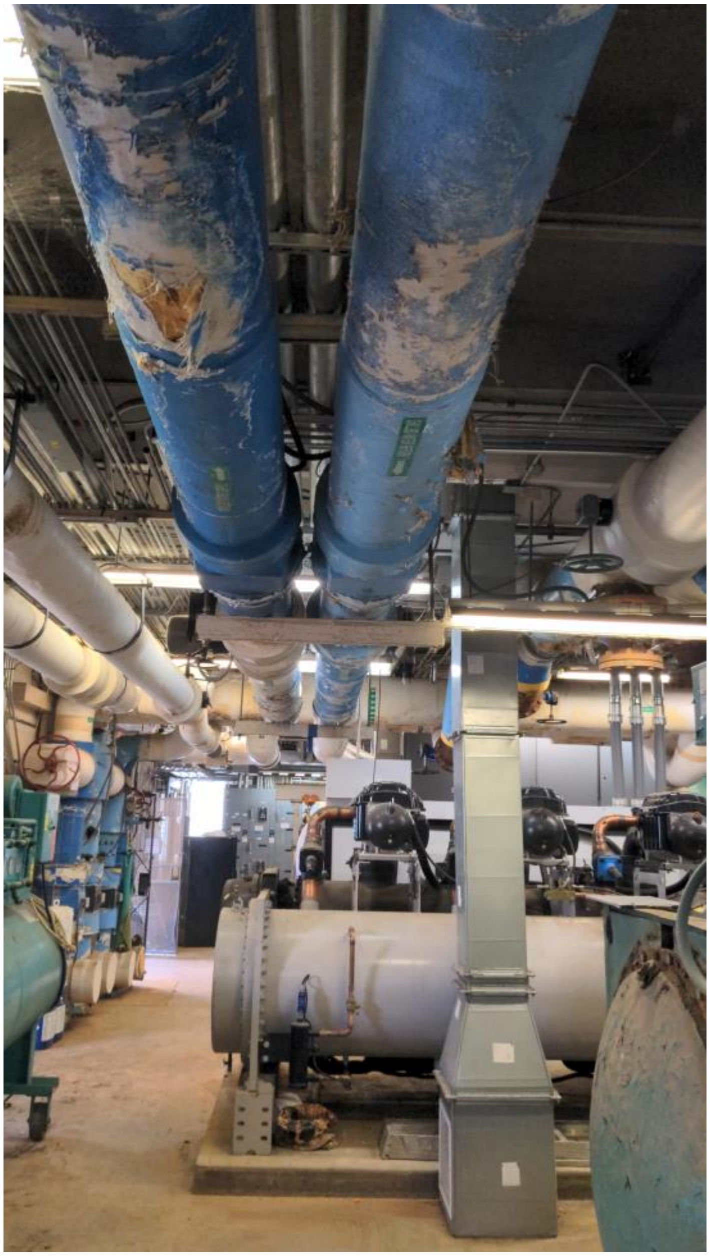
Remove abandoned chillwater treatment connected to inlet and outlet of pump number 6.

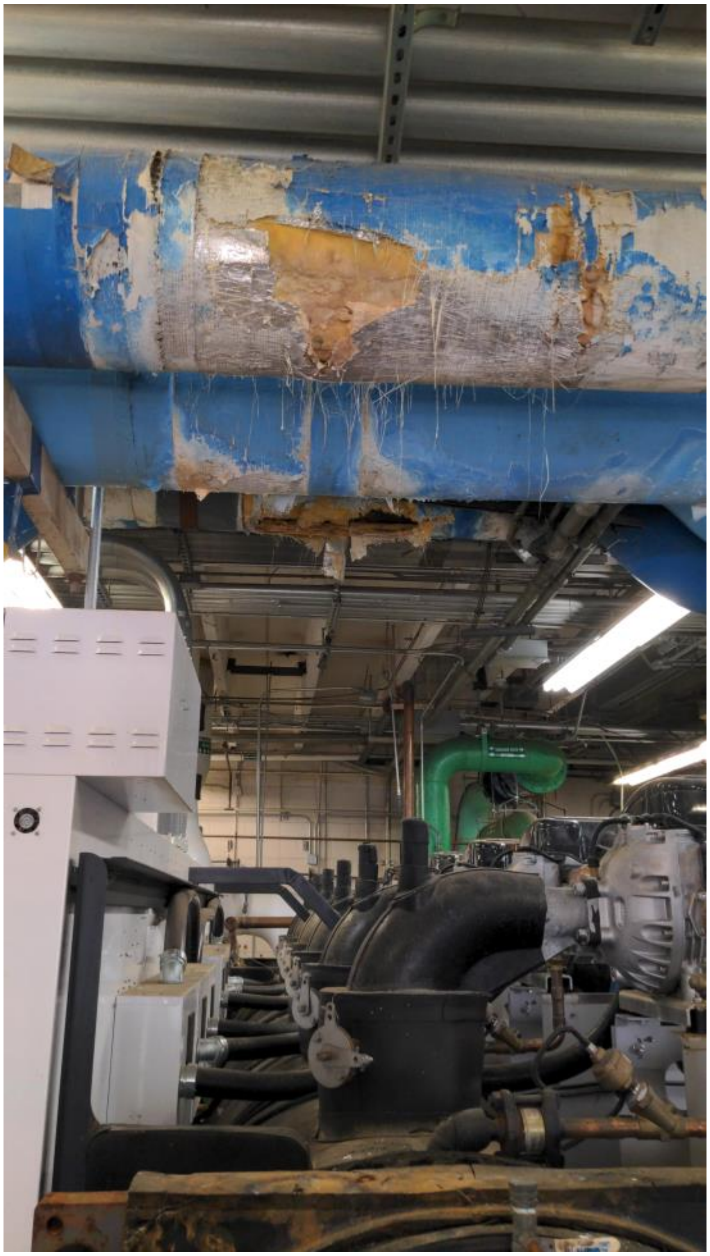
Condensed water pump number 7 to remain

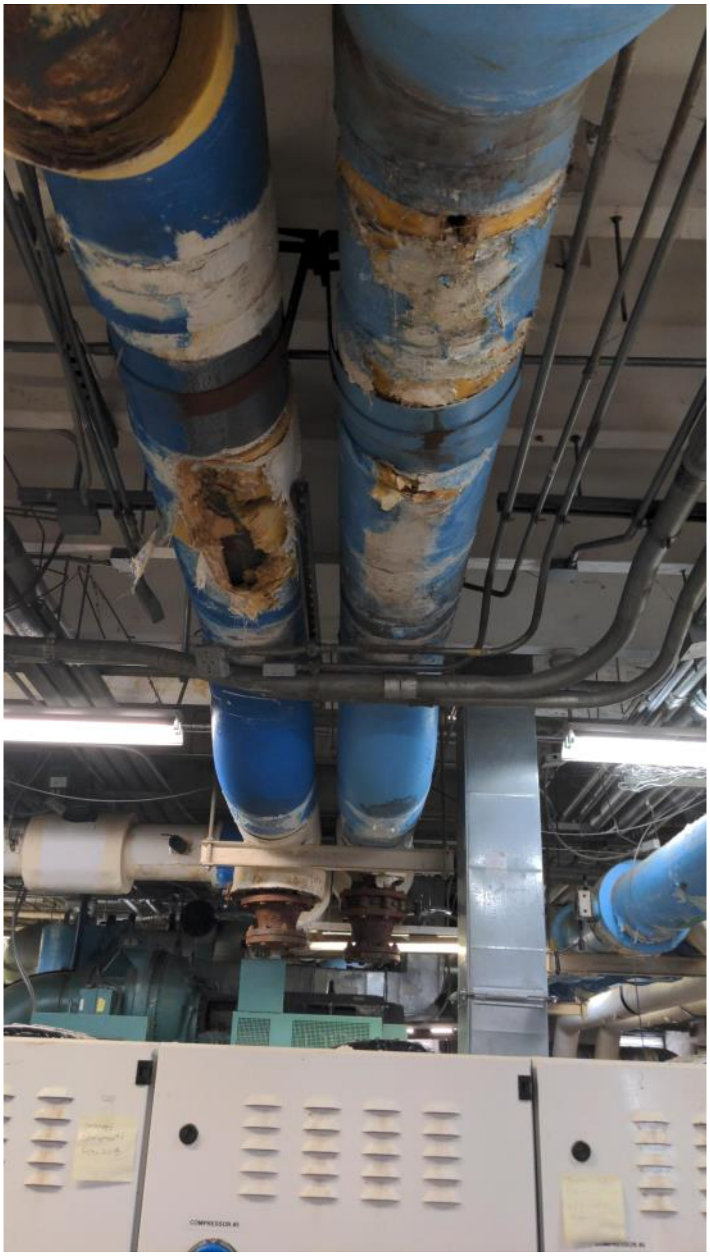
Green green line in line wave water treatment to remain reconfigure piping to connect to new chiller from flange at water treatment outlet.



Remove and replace insulation on chilled water piping in area of work and above chiller number two and as noted on drawings.







Controls

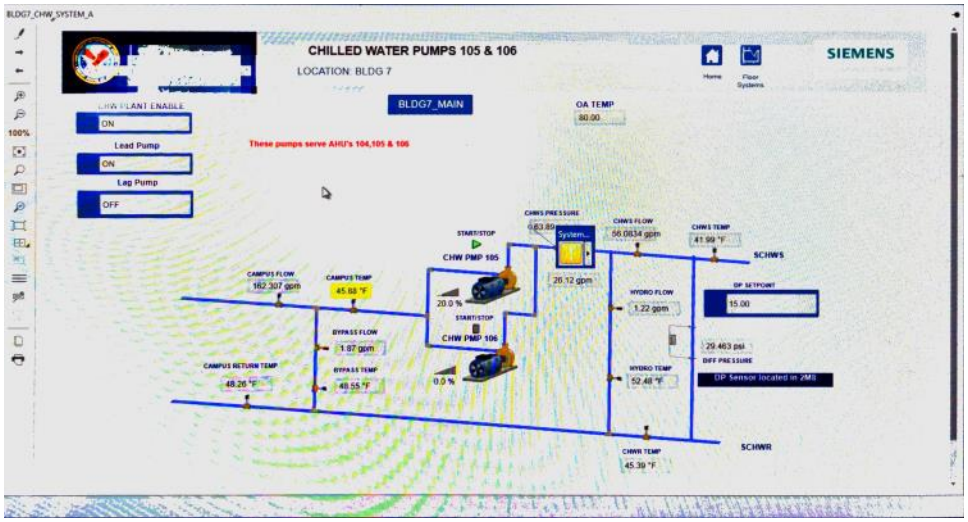
Thursday, January 27, 2022 11:35 AM

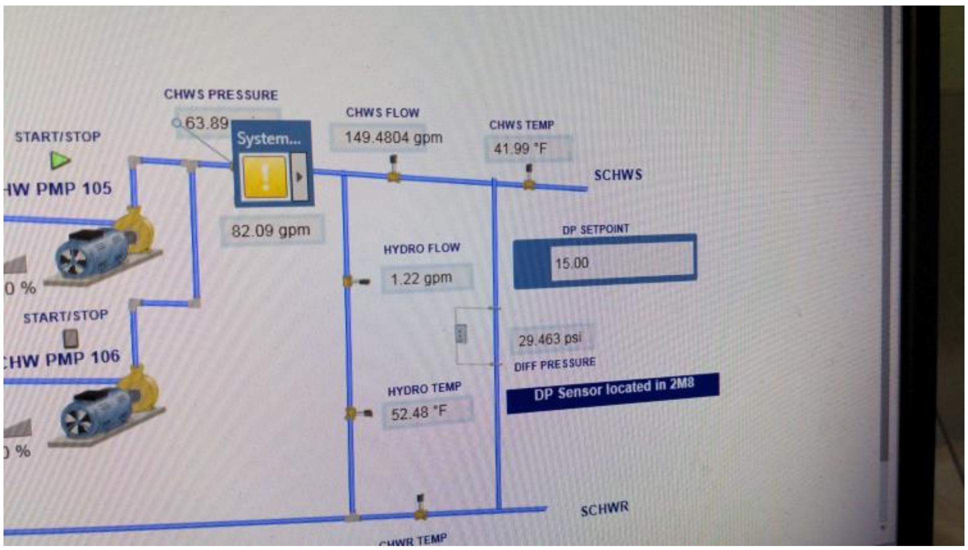
Chiller shall operate under its own control Siemens system shall have capability to overwrite set points start stop unit open close isolation valves and read all data from chiller control panel.

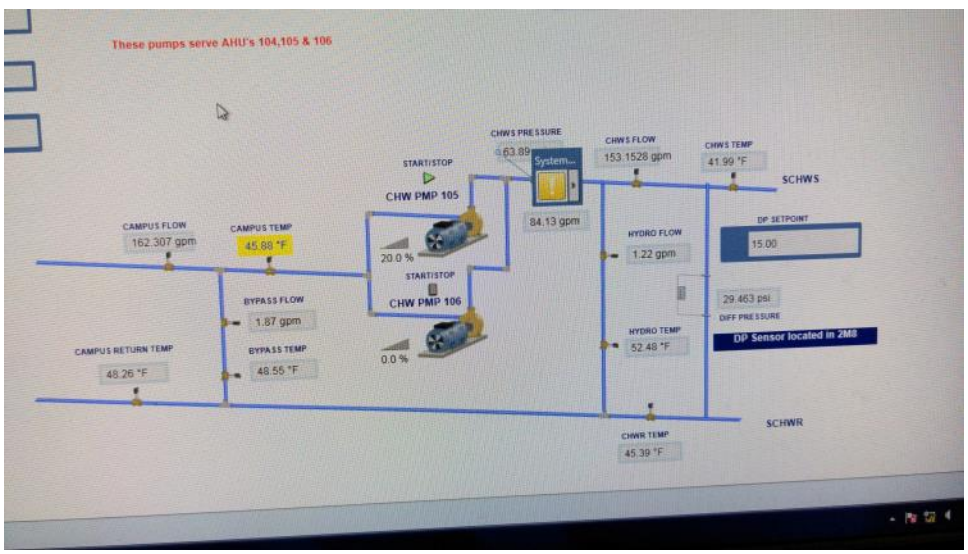
Provide new control panel for chiller remove existing.

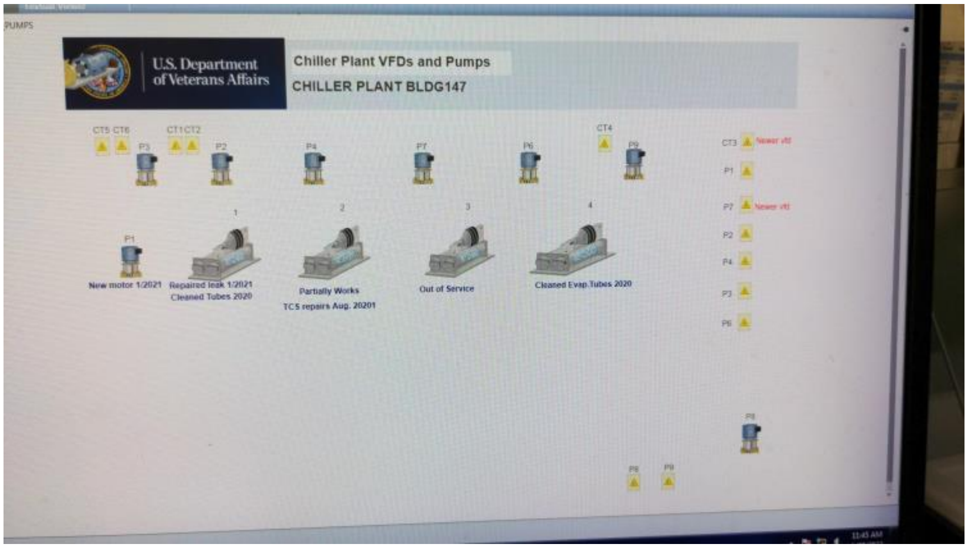
Reuse existing onicon flow meter on chill water supply. Repair and re-sequence.

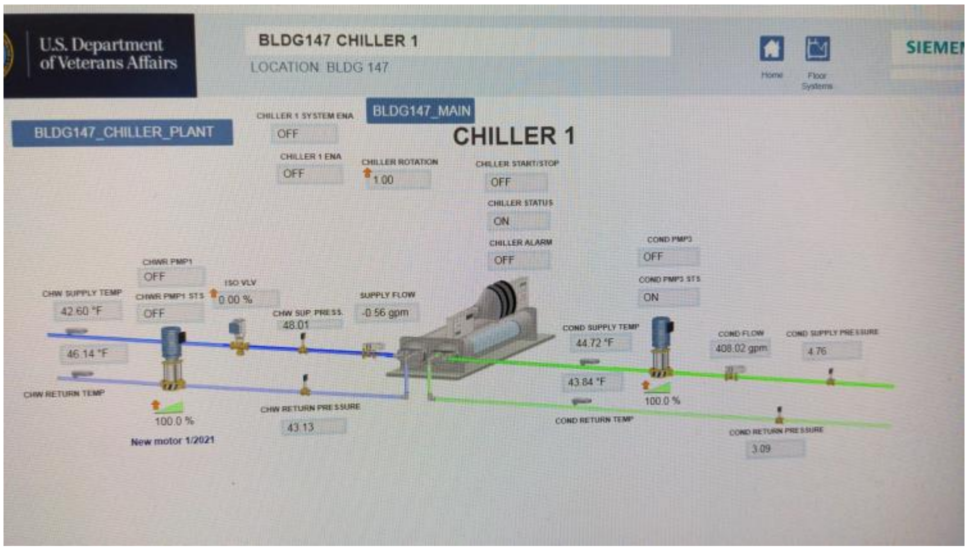
Reuse existing flow meter on condenser water piping no work required.

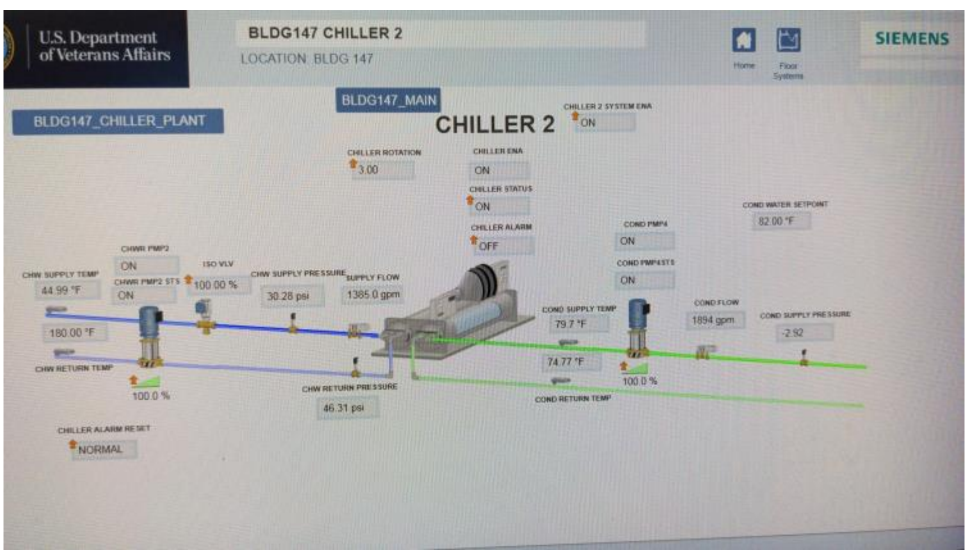

BLDG7_CHW_SYSTEM_A
CHILLED WATER PUMPS 105 & 106
LOCATION: BLDG 7
SIEMENS
BLDG7_MAIN
CHW PLANT ENABLE
ON
Lead Pump
ON
Lag Pump
OFF
These pumps serve AHU's 104,105 & 106
OA TEMP
80.00
CHWS PRESSURE
63.89
System...
CHWS FLOW
56.0834 gpm
CHWS TEMP
41.99 °F
SCHWS
START/STOP
CHW PMP 105
26.12 gpm
CAMPUS FLOW
162.307 gpm
CAMPUS TEMP
45.88 °F
20.0 %
START/STOP
CHW PMP 106
HYDRO FLOW
1.22 gpm
DP SETPOINT
15.00
BYPASS FLOW
1.87 gpm
29.463 psi
DIFF PRESSURE
CAMPUS RETURN TEMP
48.26 °F
BYPASS TEMP
48.55 °F
0.0 %
HYDRO TEMP
52.48 °F
DP Sensor located in 2M8
CHWR TEMP
45.39 °F
SCHWR

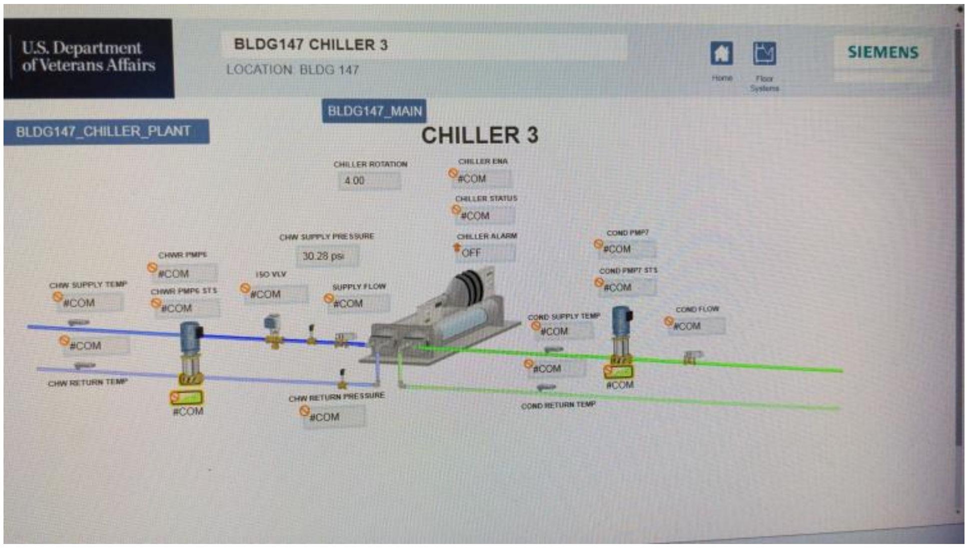

CHWS PRESSURE
63.89
System...
CHWS FLOW
149.4804 gpm
CHWS TEMP
41.99 °F
SCHWS
START/STOP
HW PMP 105
82.09 gpm
HYDRO FLOW
1.22 gpm
DP SETPOINT
15.00
START/STOP
HW PMP 106
29.463 psi
DIFF PRESSURE
HYDRO TEMP
52.48 °F
DP Sensor located in 2M8
SCHWR
CHWR TEMP

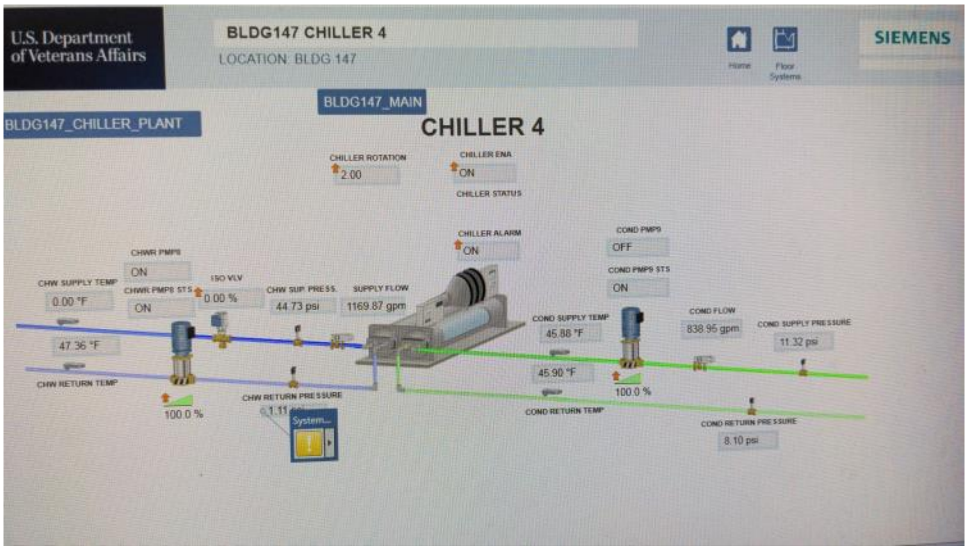

These pumps serve AHU's 104,105 & 106
CHWS PRESSURE
63.89
System...
CHWS FLOW
153.1528 gpm
CHWS TEMP
41.99 °F
SCHWS
START/STOP
CHW PMP 105
84.13 gpm
CAMPUS FLOW
162.307 gpm
CAMPUS TEMP
45.88 °F
20.0 %
HYDRO FLOW
1.22 gpm
DP SETPOINT
15.00
START/STOP
CHW PMP 106
BYPASS FLOW
1.87 gpm
29.463 psi
DIFF PRESSURE
CAMPUS RETURN TEMP
48.26 °F
BYPASS TEMP
48.55 °F
0.0 %
HYDRO TEMP
52.48 °F
DP Sensor located in 2M8
SCHWR
CHWR TEMP
45.39 °F

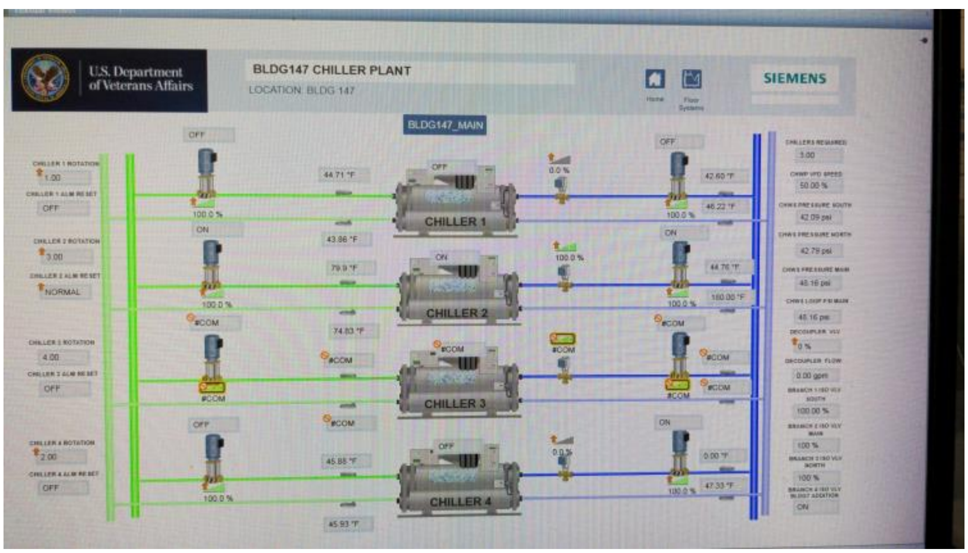

U.S. Department of Veterans Affairs
Chiller Plant VFDs and Pumps
CHILLER PLANT BLDG147
New motor 1/2021
Repaired leak 1/2021
Cleaned Tubes 2020
Partially Works
TCS repairs Aug. 20201
Out of Service
Cleaned Evap.Tubes 2020

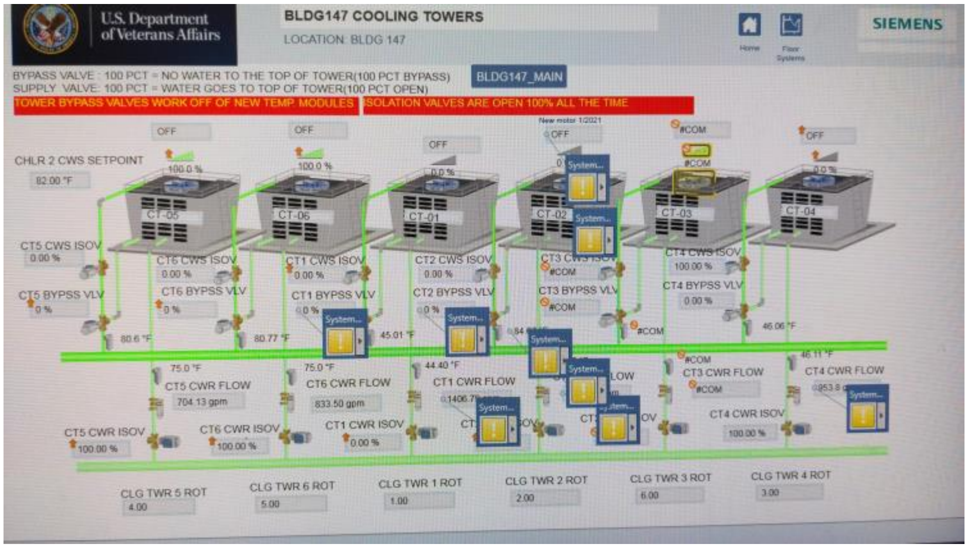

U.S. Department of Veterans Affairs
BLDG147 CHILLER 1
LOCATION: BLDG 147
Home
Floor Systems
BLDG147_CHILLER_PLANT
BLDG147_MAIN
CHILLER 1
CHILLER 1 SYSTEM ENA
OFF
CHILLER 1 ENA
OFF
CHILLER ROTATION
1.00
CHILLER START/STOP
OFF
CHILLER STATUS
ON
CHILLER ALARM
OFF
CHWR PMP1
OFF
CHWR PMP1 STS
OFF
ISO VLV
0.00 %
CHW SUPPLY TEMP
42.60 °F
46.14 °F
CHW RETURN TEMP
CHW SUP. PRESS.
48.01
SUPPLY FLOW
-0.56 gpm
CHW RETURN PRESSURE
43.13
100.0 %
New motor 1/2021
COND PMP3
OFF
COND PMP3 STS
ON
COND SUPPLY TEMP
44.72 °F
43.84 °F
COND RETURN TEMP
100.0 %
COND FLOW
408.02 gpm
COND SUPPLY PRESSURE
4.76
COND RETURN PRESSURE
3.09

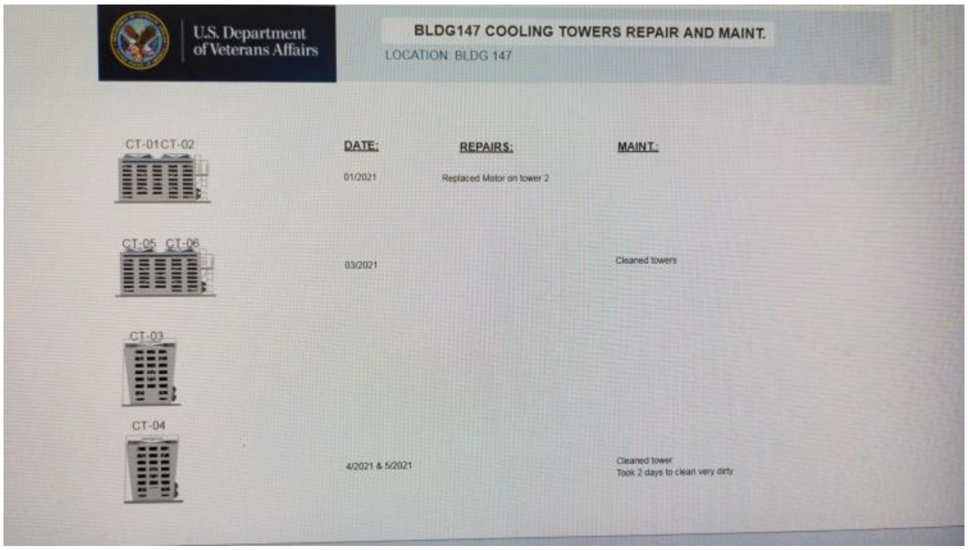

U.S. Department of Veterans Affairs
BLDG147 CHILLER 2
LOCATION: BLDG 147
Home
Floor Systems
SIEMENS
BLDG147_CHILLER_PLANT
BLDG147_MAIN
CHILLER 2
CHILLER 2 SYSTEM ENA
ON
CHILLER ROTATION
3.00
CHILLER ENA
ON
CHILLER STATUS
ON
CHILLER ALARM
OFF
CHWR PMP2
ON
CHWR PMP2 STS
ON
ISO VLV
100.00 %
CHW SUPPLY TEMP
44.99 °F
180.00 °F
CHW RETURN TEMP
CHW SUPPLY PRESSURE
30.28 psi
SUPPLY FLOW
1385.0 gpm
CHW RETURN PRESSURE
46.31 psi
100.0 %
CHILLER ALARM RESET
NORMAL
COND WATER SETPOINT
82.00 °F
COND PMP4
ON
COND PMP4STS
ON
COND SUPPLY TEMP
79.7 °F
74.77 °F
COND RETURN TEMP
100.0 %
COND FLOW
1894 gpm
COND SUPPLY PRESSURE
-2.92

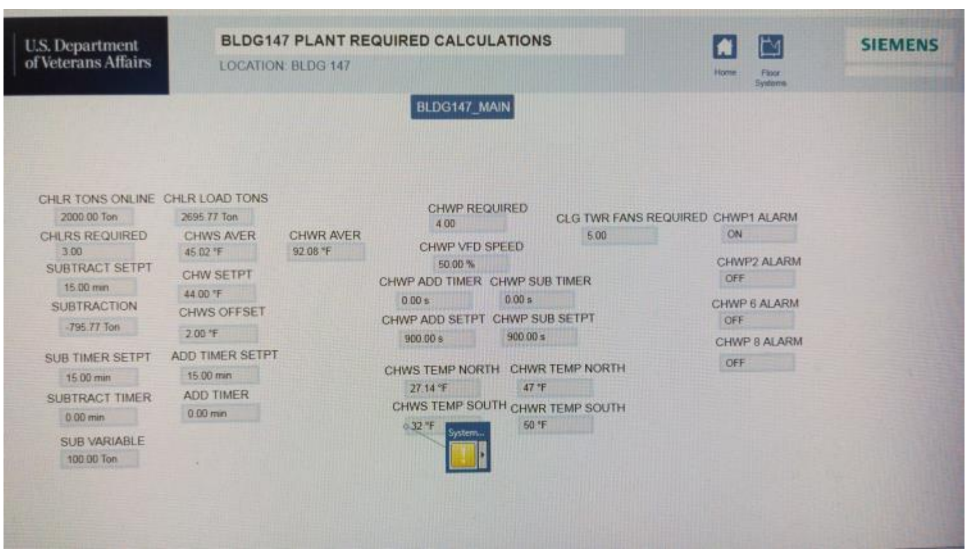

U.S. Department of Veterans Affairs
BLDG147 CHILLER 3
LOCATION: BLDG 147
SIEMENS
BLDG147_MAIN
BLDG147_CHILLER_PLANT
CHILLER 3
CHILLER ROTATION
4.00
CHW SUPPLY PRESSURE
30.28 psi
CHW SUPPLY TEMP
CHW RETURN TEMP
CHW RETURN PRESSURE
COND RETURN TEMP
#COM

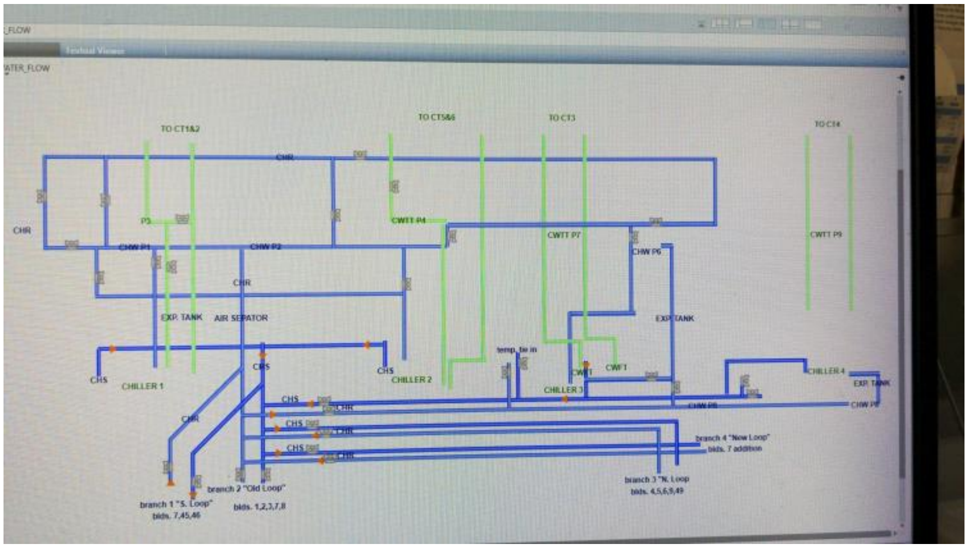

U.S. Department of Veterans Affairs
BLDG147 CHILLER 4
LOCATION: BLDG 147
SIEMENS
BLDG147_MAIN
BLDG147_CHILLER_PLANT
CHILLER 4
CHILLER ROTATION
2.00
CHILLER ENA
ON
CHILLER STATUS
CHILLER ALARM
ON
COND PMP9
OFF
COND PMP9 STS
ON
CHW SUPPLY TEMP
0.00 °F
47.36 °F
CHW RETURN TEMP
ISO VLV
0.00 %
CHW SUP. PRESS.
44.73 psi
SUPPLY FLOW
1169.87 gpm
COND SUPPLY TEMP
45.88 °F
45.90 °F
COND FLOW
838.95 gpm
COND SUPPLY PRESSURE
11.32 psi
COND RETURN TEMP
COND RETURN PRESSURE
8.10 psi
CHW RETURN PRESSURE
100.0 %


U.S. Department of Veterans Affairs
BLDG147 CHILLER PLANT
LOCATION: BLDG 147
SIEMENS
BLDG147_MAIN
CHILLER 1
CHILLER 2
CHILLER 3
CHILLER 4


U.S. Department of Veterans Affairs
BLDG147 COOLING TOWERS
LOCATION: BLDG 147
SIEMENS
BYPASS VALVE : 100 PCT = NO WATER TO THE TOP OF TOWER(100 PCT BYPASS)
SUPPLY VALVE: 100 PCT = WATER GOES TO TOP OF TOWER(100 PCT OPEN)
BLDG147_MAIN
TOWER BYPASS VALVES WORK OFF OF NEW TEMP MODULES
ISOLATION VALVES ARE OPEN 100% ALL THE TIME
CHLR 2 CWS SETPOINT
82.00 °F
CT-05
CT-06
CT-01
CT-02
CT-03
CT-04
CT5 CWS ISOV
CT6 CWS ISOV
CT1 CWS ISOV
CT2 CWS ISOV
CT4 CWS ISOV
CT5 BYPSS VLV
CT6 BYPSS VLV
CT1 BYPSS VLV
CT2 BYPSS VLV
CT3 BYPSS VLV
CT4 BYPSS VLV
CT5 CWR FLOW
704.13 gpm
CT6 CWR FLOW
833.50 gpm
CT1 CWR FLOW
CT3 CWR FLOW
CT4 CWR FLOW
CT5 CWR ISOV
CT6 CWR ISOV
CT1 CWR ISOV
CT4 CWR ISOV
CLG TWR 5 ROT
4.00
CLG TWR 6 ROT
5.00
CLG TWR 1 ROT
1.00
CLG TWR 2 ROT
2.00
CLG TWR 3 ROT
6.00
CLG TWR 4 ROT
3.00


U.S. Department of Veterans Affairs
BLDG147 COOLING TOWERS REPAIR AND MAINT.
LOCATION: BLDG 147
CT-01CT-02
CT-05 CT-06
CT-03
CT-04
DATE:
REPAIRS:
MAINT.:
01/2021
Replaced Motor on tower 2
03/2021
Cleaned towers
4/2021 & 5/2021
Cleaned tower
Took 2 days to clean very dirty

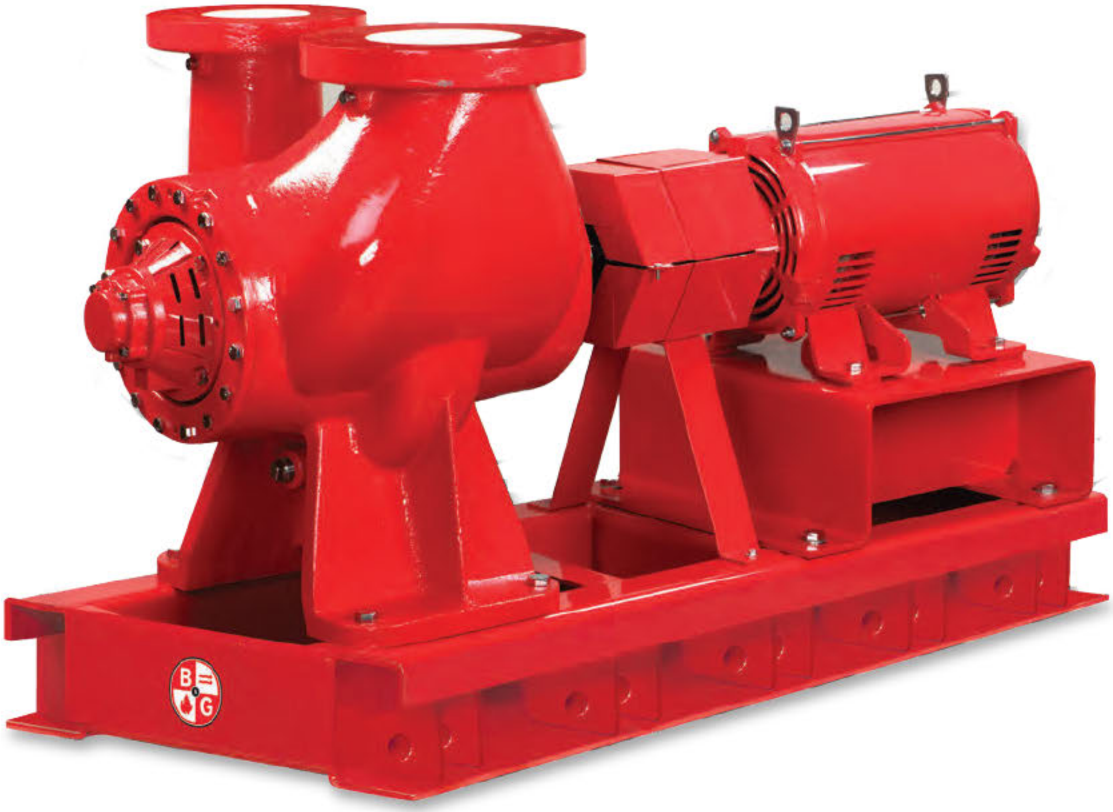

U.S. Department of Veterans Affairs
BLDG147 PLANT REQUIRED CALCULATIONS
LOCATION: BLDG 147
SIEMENS
BLDG147_MAIN
CHLR TONS ONLINE
2000.00 Ton
CHLR LOAD TONS
2695.77 Ton
CHLRS REQUIRED
3.00
CHWS AVER
45.02 °F
CHWR AVER
92.08 °F
SUBTRACT SETPT
15.00 min
CHW SETPT
44.00 °F
SUBTRACTION
-795.77 Ton
CHWS OFFSET
2.00 °F
SUB TIMER SETPT
15.00 min
ADD TIMER SETPT
15.00 min
SUBTRACT TIMER
0.00 min
ADD TIMER
0.00 min
SUB VARIABLE
100.00 Ton
CHWP REQUIRED
4.00
CHWP VFD SPEED
50.00 %
CHWP ADD TIMER
0.00 s
CHWP SUB TIMER
0.00 s
CHWP ADD SETPT
900.00 s
CHWP SUB SETPT
900.00 s
CHWS TEMP NORTH
27.14 °F
CHWR TEMP NORTH
47 °F
CHWS TEMP SOUTH
32 °F
CHWR TEMP SOUTH
50 °F
CLG TWR FANS REQUIRED
5.00
CHWP1 ALARM
ON
CHWP2 ALARM
OFF
CHWP 6 ALARM
OFF
CHWP 8 ALARM
OFF



_FLOW
ATER_FLOW
TO CT1&2
TO CT5&6
TO CT3
TO CT4
CHR
CHR
P5
CWTT P4
CWTT P7
CWTT P9
CHW P1
CHW P2
CHW P6
CHR
EXP. TANK
AIR SEPARATOR
EXP TANK
CHS
CHILLER 1
CHS
CHS
CHILLER 2
temp. tie in
CWFT
CWFT
CHILLER 3
CHILLER 4
EXP. TANK
CHW P8
CHW P7
CHR
CHS
CHR
CHS
CHR
CHS
CHR
branch 4 "New Loop"
blds. 7 addition
branch 3 "N. Loop
blds. 4,5,6,9,49
branch 2 "Old Loop"
branch 1 "S. Loop"
blds. 7,45,46
blds. 1,2,3,7,8

Bid Documents Submittal

TAB C – Major Equipment Selections



VSX

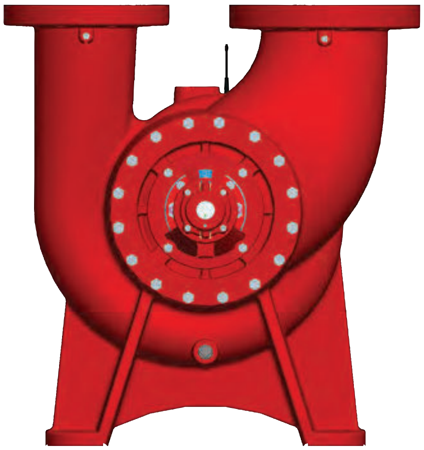
DOUBLE-SUCTION, SPLIT-CASE PUMPS

BUILT IN THE USA
ENGINEERED, ASSEMBLED & TESTED

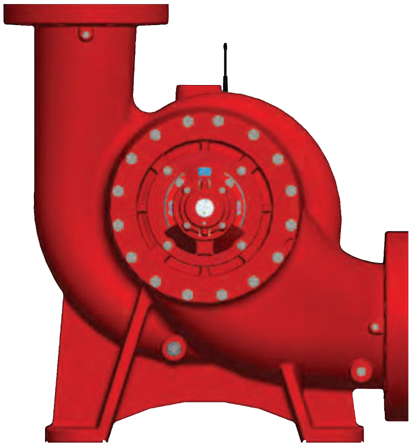
Bell & Gossett
a xylem brand

B-475E

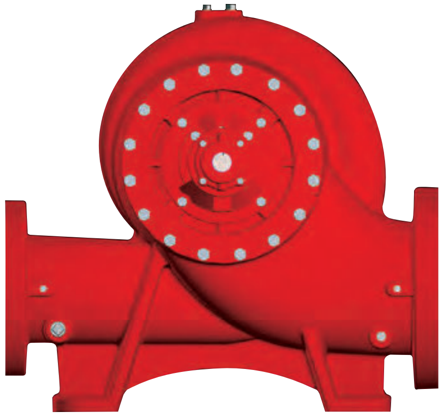
You asked for the impossible. So we built it.



VSC



VSCS



VSH

At Bell & Gossett, we have over 100 years of experience in designing pumps and knowing how they work in complex systems. But when it comes to the challenges specifiers and contractors face every day in the field, no one knows pumps better than our customers. So when we began designing our new VSX pump, we knew we needed to talk to the experts. We needed to talk to you.

We took a revolutionary approach to design. We listened to you.

You told us what you wanted: a truly innovative pump. One that saves space, is highly efficient and installs easily. You asked for total reliability and enough flexibility to suit nearly any application.

Our new VSX platform retains the innovative and time-proven space saving VSC® design. The VSC model has reduced your pump room footprint by up to 40% when compared to traditional split-case and vertical inline pumps. The time-proven VSC design now becomes even better within the new VSX platform. The high-efficiency VSX hydraulic design and robust construction deliver proven Bell & Gossett reliability, and the unique platform design provides complete installation versatility. Simply select your hydraulic requirements and then pick any one of three different suction and discharge flange orientations that best suit your installation requirements. In short, VSX is everything you asked for, and then some.

Here's what you told us.

"Mechanical room space keeps shrinking. I need one pump that can provide me with the flexibility to meet my space challenges."

"We want a pump that was engineered using today's technology, not something that was designed 40 years ago and adapted for today's uses."

"Labor is the only item I can control, so installation time is critical to me."

"Hydraulic performance and efficiency are the key points that we look at when selecting the right pump to match up with the chillers and towers. Why can't we have a pump that runs at 1750 RPM but acts like it is at 1150 RPM to match up with our real-world application requirements?"

"Serviceability and minimal downtime are important to us in our operations. Simplicity of maintenance is absolutely our number one issue."

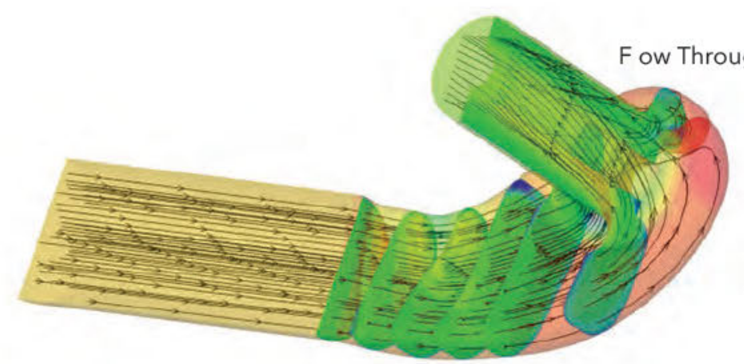
You asked for a completely new hydraulic design. We gave it to you.

Until now, pump flow in traditional split-case pumps was maximized in the industry by pushing extreme velocities through the same 50-year-old pump volute.

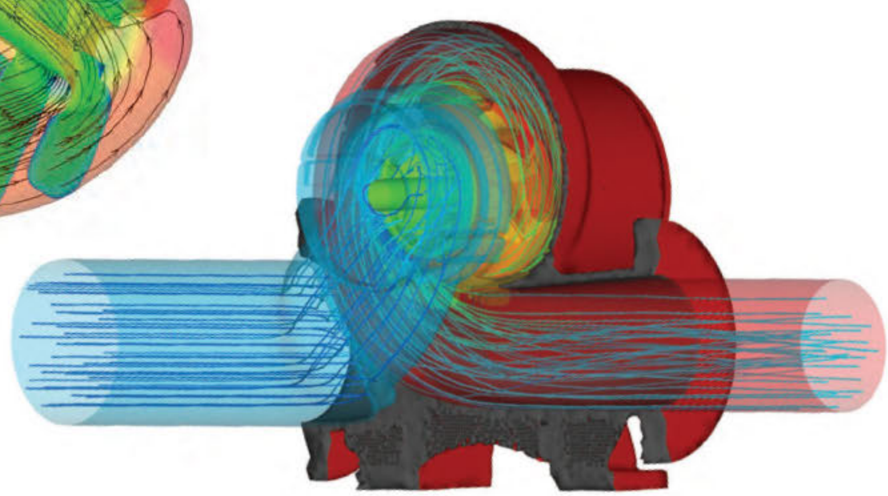
Today, hydraulic design begins with the end requirements in mind. When we engineered the VSX platform, we started by identifying your chiller, cooling tower and general pumping requirements. We matched the best efficiency points (BEP) to common chiller and tower sizes, and normal industrially-specified flows and head conditions.

- Hydraulic coverage to meet all your design requirements
- Flows from 500 to 28,000 GPM / 114 to 6400 m^3/h
- Heads from 30 to 530 feet / 9 to 161 meters
- Working pressures of 175 and 300 psig / 12 and 20 Bar
- ANSI flange ratings of 125# and 250#
- Temperature 0 to 300°F / -17 to 148°C

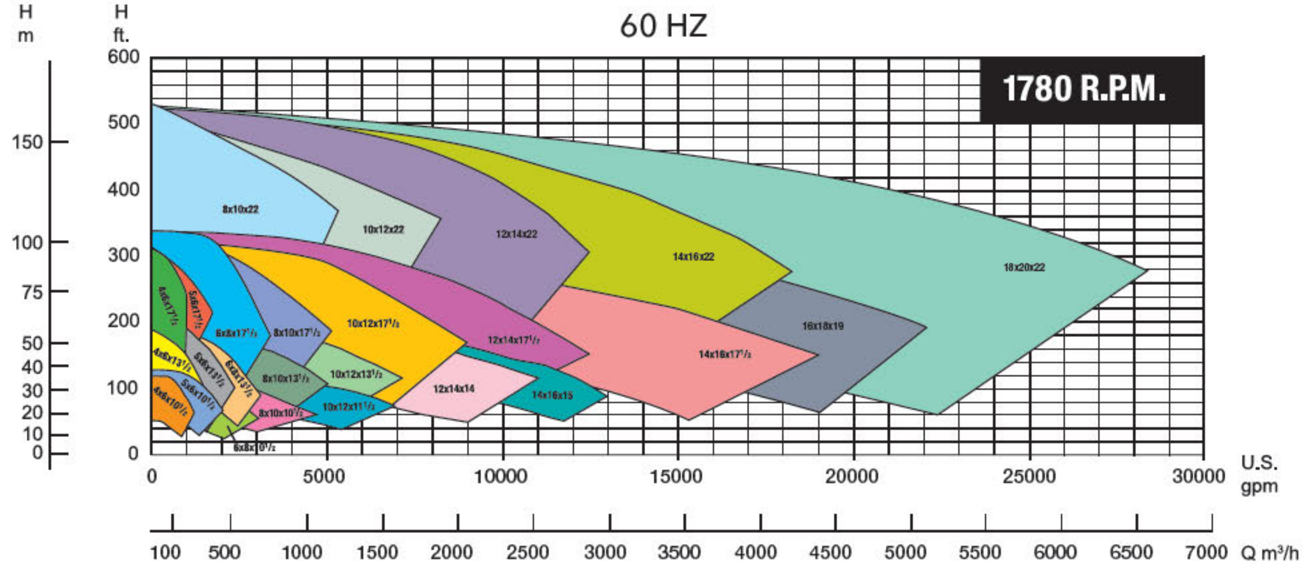
We took our tried-and-true design methods and digitized them by simulating the pumps using Computational Fluid Dynamics (CFD). CFD is no simple task; it takes a bank of 18 computers up to 30 hours to solve equations for just one hydraulic analysis. By using this technique, you can actually see the flows and pressures like never before. Where our engineers once relied solely on years of experience, CFD helps out by letting them see exactly what's going on inside the pump. They can analyze several different design ideas rapidly to bring the optimal design to the table for every pump, whether it is in the VSC, VSH or VSCS flange configuration.

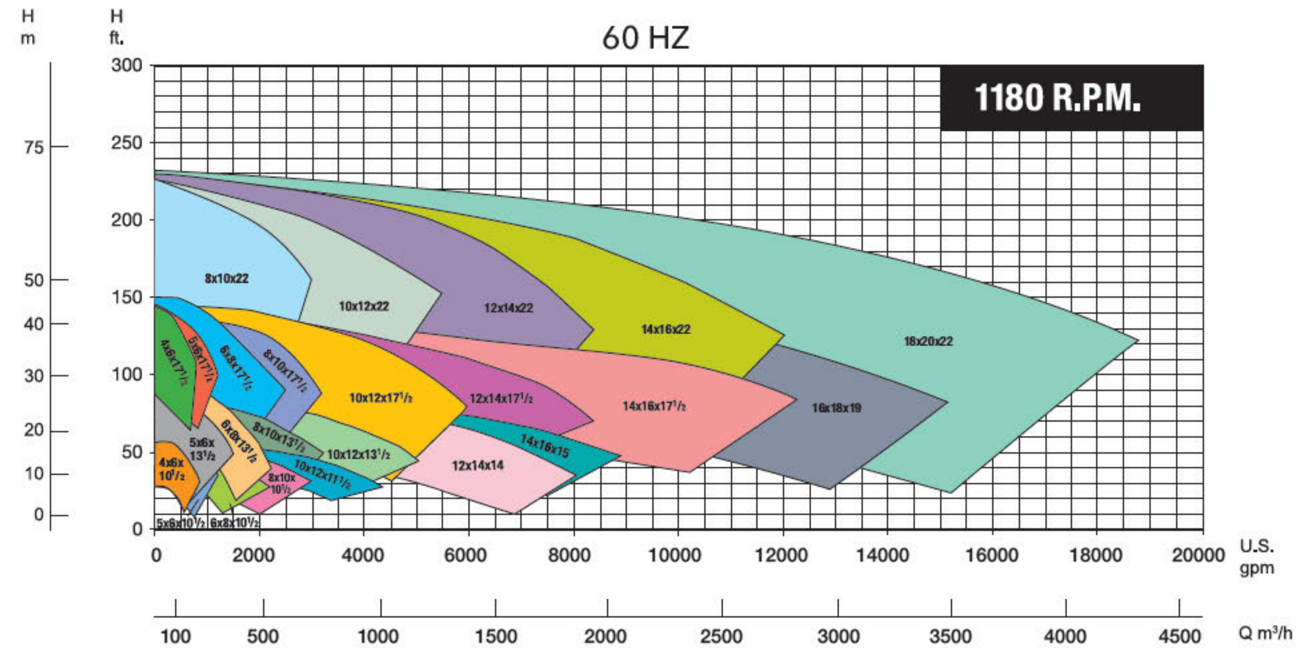


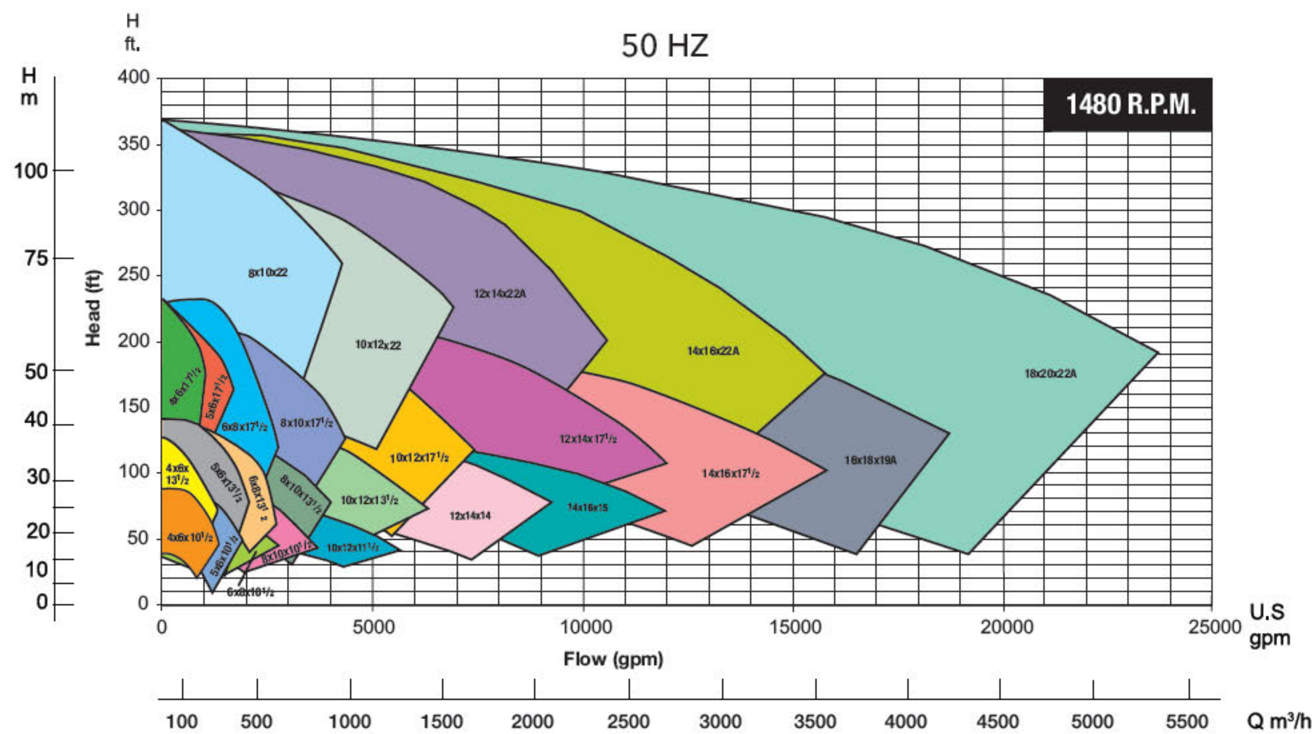
F ow Through the VSX Suct on Passage



VSX Fu F ow Performance Va dat on


60 HZ
1780 R.P.M.
H m
H ft.
8x10x22
10x12x22
12x14x22
14x16x22
18x20x22
16x18x19
14x16x17½
12x14x17½
10x12x17½
8x10x17½
6x8x17½
5x6x17½
4x6x17½
12x14x14
14x16x15
10x12x13½
10x12x11½
8x10x13½
8x10x10½
6x8x13½
5x6x13½
4x6x13½
5x6x10½
4x6x10½
6x8x10½
U.S. gpm
Q m³/h


60 HZ
1180 R.P.M.
H m
H ft.
8x10x22
10x12x22
12x14x22
14x16x22
18x20x22
16x18x19
14x16x17½
12x14x17½
10x12x17½
8x10x17½
6x8x17½
5x6x17½
4x6x17½
12x14x14
14x16x15
10x12x13½
10x12x11½
8x10x13½
8x10x10½
6x8x13½
5x6x13½
4x6x10½
5x6x10½
6x8x10½
U.S. gpm
Q m³/h

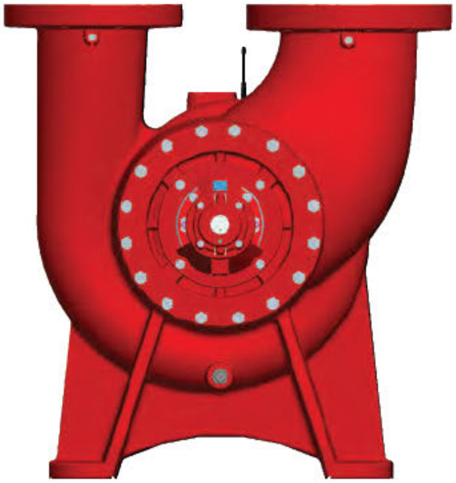

50 HZ
1480 R.P.M.
H m
H ft.
Head (ft)
8x10x22
10x12x22
12x14x22A
14x16x22A
18x20x22A
16x18x19A
14x16x17½
12x14x17½
10x12x17½
8x10x17½
6x8x17½
5x6x17½
4x6x17½
12x14x14
14x16x15
10x12x13½
10x12x11½
8x10x13½
8x10x10½
6x8x13½
5x6x13½
4x6x13½
4x6x10½
5x6x10½
6x8x10½
Flow (gpm)
U.S gpm
Q m³/h

You said you needed one pump that does it all.

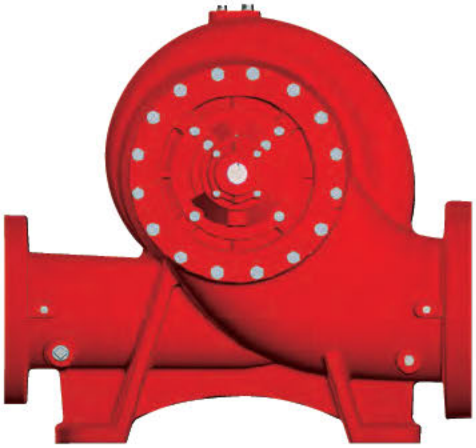
When it comes to the VSX platform, our revolutionary approach to hydraulic design is just the beginning. This one-of-a-kind pump has what it takes to make your job easier, simplifying installation and minimizing service.

Multiple suction and discharge flange orientations

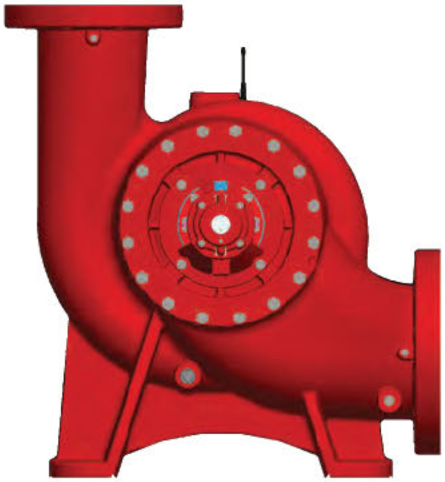
Only the VSX platform offers so many installation options, thanks to its revolutionary design. Using CFD technology, we can deliver identical performance in any flange configuration. The result is that you can maximize your piping possibilities and meet a broad hydraulic range for chillers, towers, distributive and general pumping requirements.



VSC®



VSH™



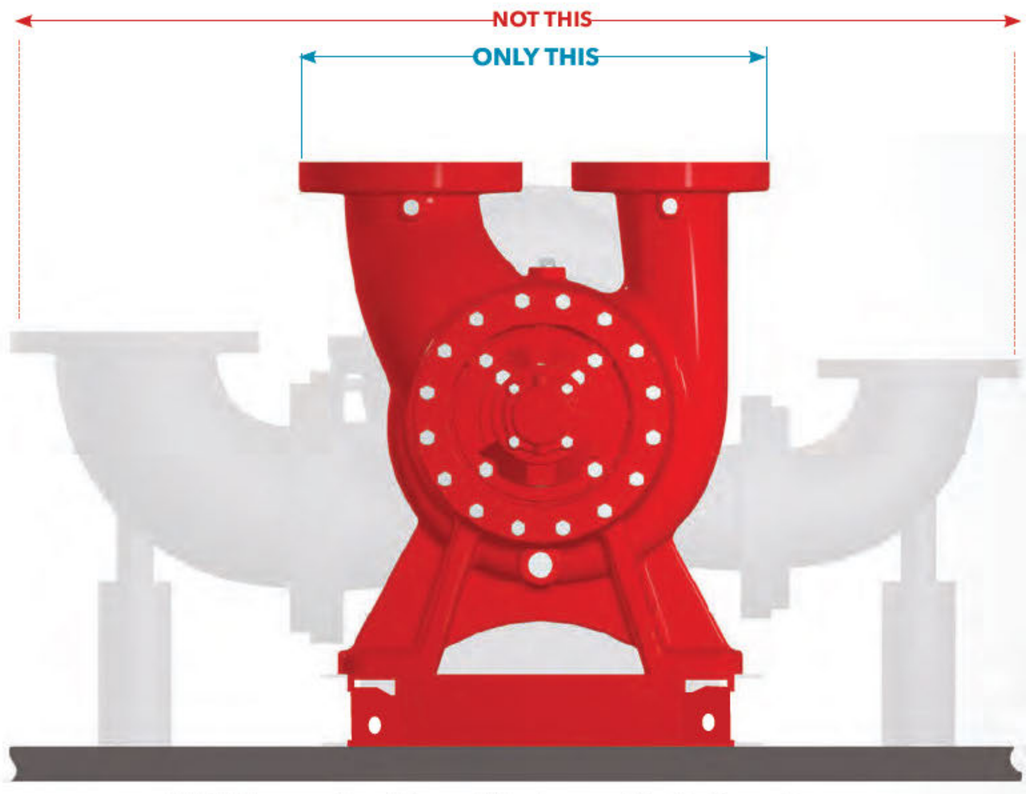
VSCS®

Vertical Static Flange Loading

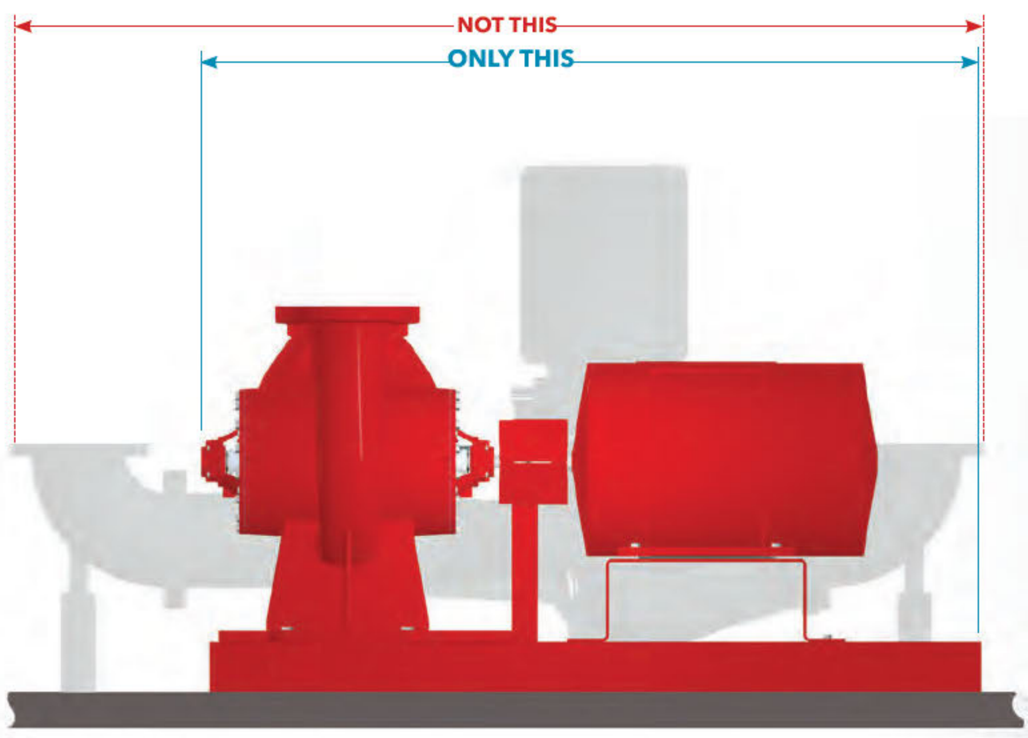
The vertical split-case volute design of the VSX provides optimum nozzle loading capability that others just can't match. In the vertical flange configuration (VSC model), the pump flanges easily support the weight of heavy piping directly on its nozzles. The pump flanges sit directly under the load – right where it's needed the most – without impairing pump operation.

Space-Saving Footprint

VSX lets you reduce the overall equipment footprint by up to 40 percent over horizontal double-suction and large inline pumps with the VSC configuration. The VSX pump optimizes the advantages of vertical piping applications by eliminating the space-robbing elbows, protruding accessories and pipe supports.



VSC Versus Traditional Horizontal Split-Case Pump



VSC Versus Traditional Vertical Inline Pump

You were looking for simplicity. So we found it

One of the most remarkable things about the new VSX pump is how easy it is to install and maintain. Based on your input, we looked at every component of our pumps with the goal of streamlining and simplifying. Our goal: to make your life easier.

A Simplified Service

No rigging or heavy-duty material handling equipment is necessary to gain access to the bearing, mechanical seals or shaft sleeves. Unlike older horizontal double-suction, split-case and larger vertical inline pumps, there are no heavy top casings or motors to lift off, saving cost, reducing risk and providing easy access to the rotating assembly.

The VSX platform makes bearing, mechanical seal and shaft sleeve inspection easy. The VSX design makes these components readily accessible from both sides of the pump, so that you can service from the inboard* or outboard side without disturbing the piping or the motor. You can also replace just one bearing, mechanical seal or sleeve without disturbing the other side.

B Maintenance-Free Bearings

Our maintenance-free bearings eliminate the need for regular maintenance, documentation logs, over-greasing problems and the risk of mixing greases that can cause early failure. This design not only reduces maintenance time and costs, but also helps extend pump life.

C New One-Piece Unitized Seal

Bell & Gossett's new one-piece unitized seal eliminates multiple seal components and simplifies replacement. Because it uses a one-piece elastomeric bellows, it has fewer parts than competitive seals, resulting in significantly fewer installation errors.

D Groutless Base Plate

Another industry first! Our new groutless baseplate design saves valuable time and money to speed installation. Advanced finite element analysis and design provides a modern state-of-the-art baseplate that is rock-solid.

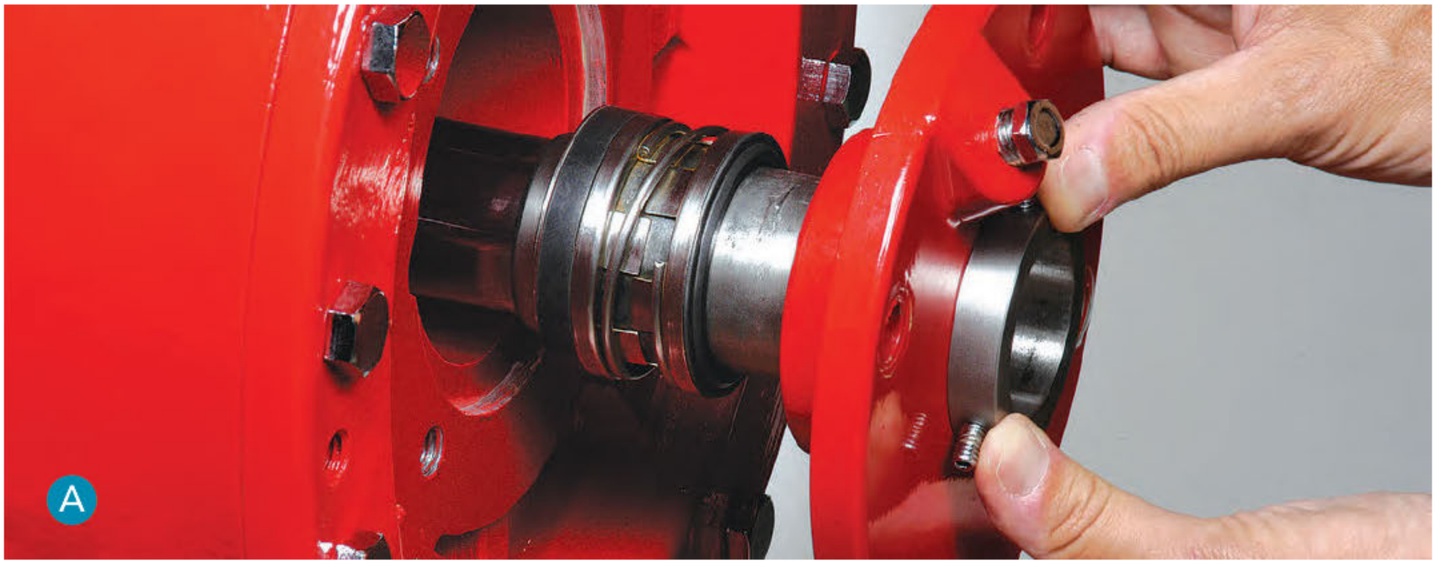
E Alignment-Friendly Coupling†

Reduce installation time further by maximizing your alignment protection. Designed with finite element analysis to maximize performance and overall life. Easy split element design avoids movement of hubs during inspection or replacement. Moreover, an ANSI/OSHA coupling guard surrounds the coupling to protect personnel.

F ANSI/OSHA Coupling Guard

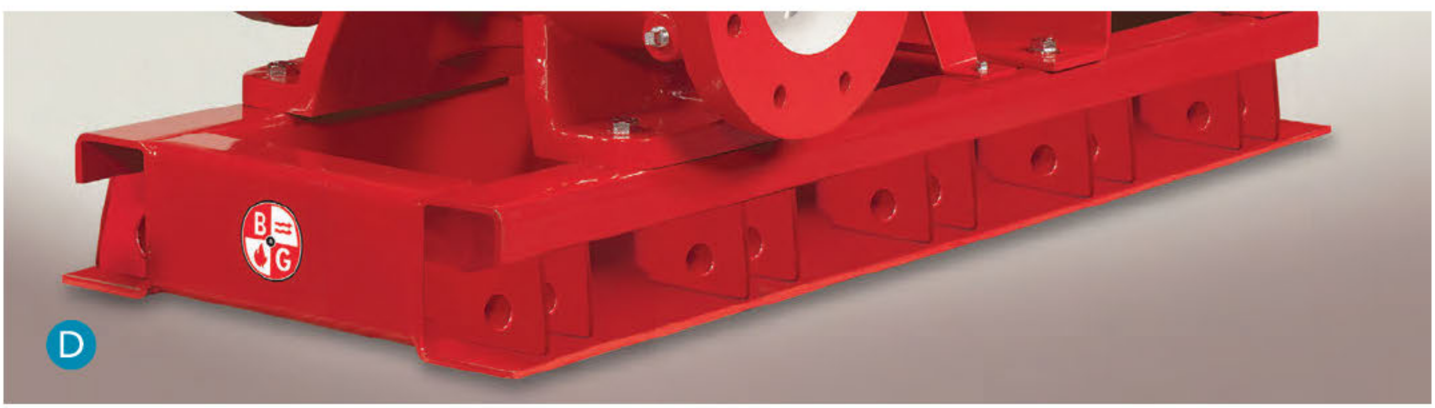
ANSI B15.1 and OSHA 1910.219 compliant coupling guard shields the coupler during operation. The VSX coupler guard is dual designed and contains viewing windows for inspection of the coupling. No more than .25 inch opening in the guard around the rotating assembly is visible.

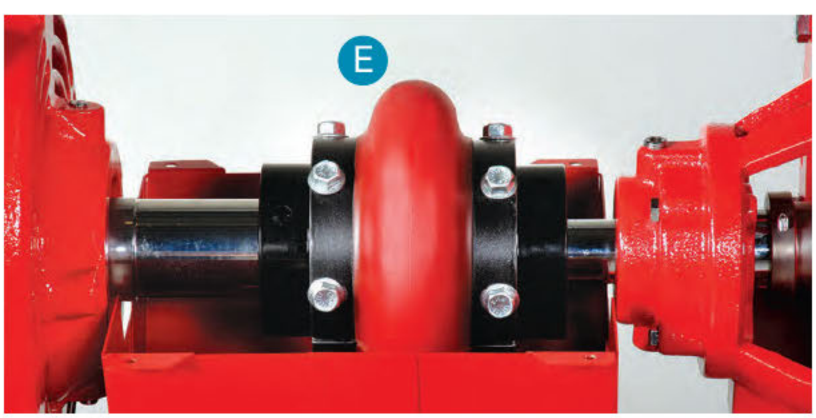
* Requ res opt ona spacer coup ng
† Up to 000 HP at 750 RPM

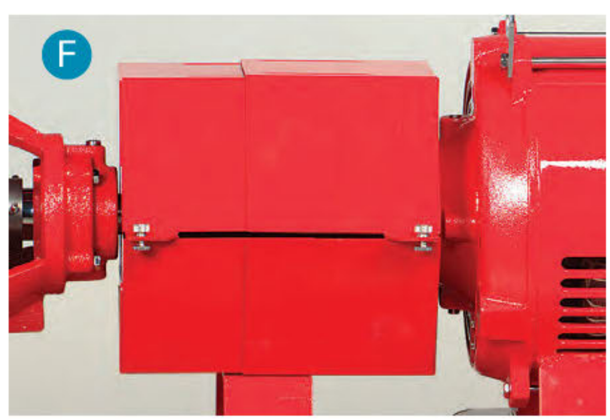

A


B


C


D


E


F

Service and support from the most trusted name in the industry – Bell & Gossett.

The Bell & Gossett name has always stood for uncompromising quality and dependability. That's evident in the way every one of our centrifugal pumps is built and backed by our outstanding customer service and support team.

Your local Bell & Gossett representative is available any time and is an experienced professional with a wealth of technical expertise. In addition to expert system and product application assistance and a wide product inventory warehoused locally, we offer ESP-Systemwize software selection program.

ESP-Systemwize is a Bell & Gossett web-based software that helps you design HVAC systems accurately, effectively and very quickly. You get fast, precise equipment selection, pump performance curves and equipment schedules, submittals, specifications and more.

ESP-Systemwize includes:

- Centrifugal Pumps
- Air/Dirt Separators
- Heat Exchangers
- Pump Suction Diffuser and Triple Duty Valve
- Expansion Tanks
- PIC Valves

With more than 100 years' experience as an industry leader, we know how to design, build, and support centrifugal pumps. Our hallmarks are excellence and dependability.

An award-winning pump

The VSX pump continues to receive major awards:

- Consulting-Specifying Engineer Product of the Year
  Silver Award in the HVAC Category
- AHR Innovation Award
  Honorable Mention in the Heating Category
- India Water Digest Water Award
  Best Water R&D and Technological Breakthrough
- HPAC Engineering Readers' Choice Award
- Plumbing Engineer – One of the Top Ten Products

Bell & Gossett. We make the difference. By design.

Pump us for information

Our comprehensive Web site (www.bellgossett.com) makes it easier for you to find, specify and understand the VSX pump, fluid handling systems, parts, specifications and applications.

Xylem |'zīləm|

1) The tissue in plants that brings water upward from the roots;
2) a leading global water technology company.

We're a global team unified in a common purpose: creating advanced technology solutions to the world's water challenges. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. Our products and services move, treat, analyze, monitor and return water to the environment, in public utility, industrial, residential and commercial building services, and agricultural settings. With its October 2016 acquisition of Sensus, Xylem added smart metering, network technologies and advanced data analytics for water, gas and electric utilities to its portfolio of solutions. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise with a strong focus on developing comprehensive, sustainable solutions.

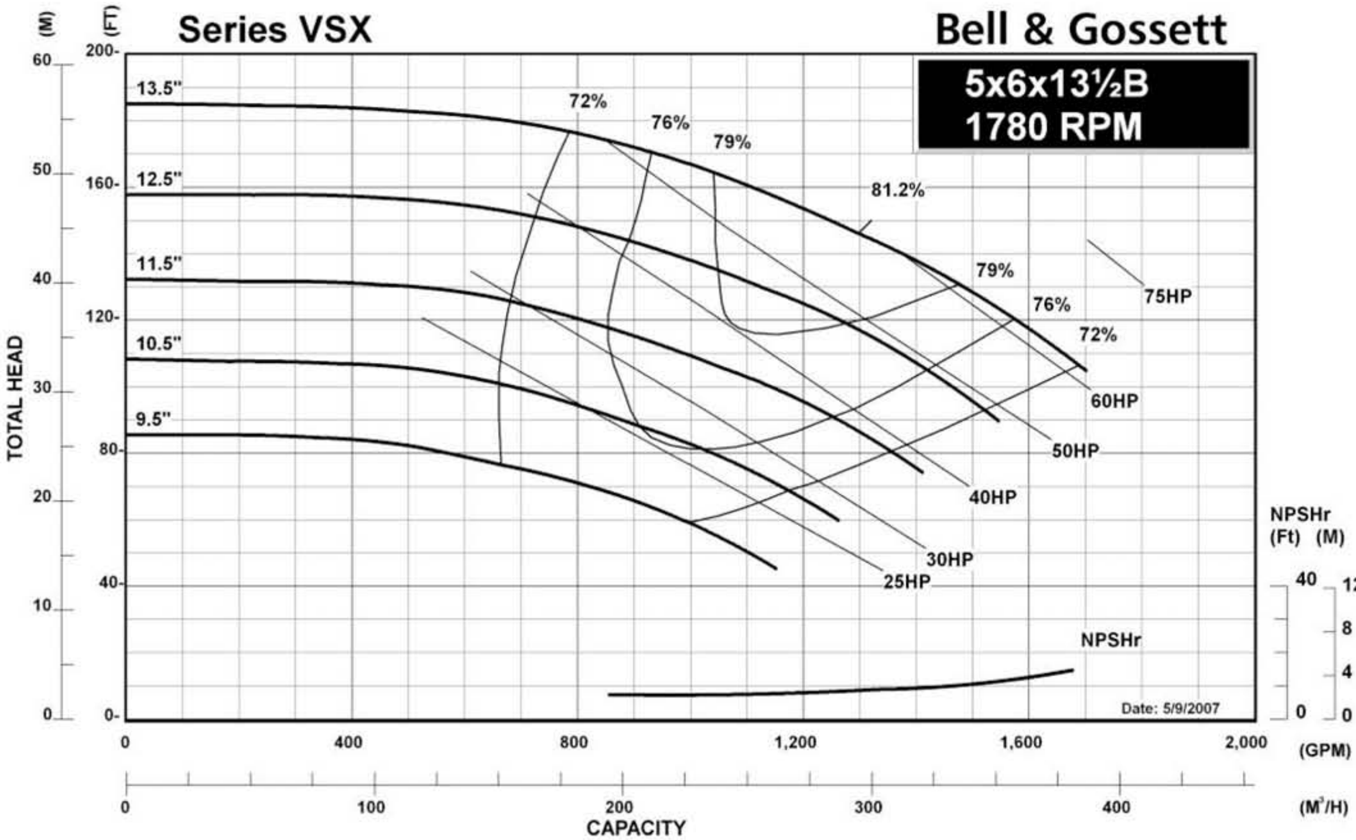
For more information on how Xylem can help you, go to www.xyleminc.com

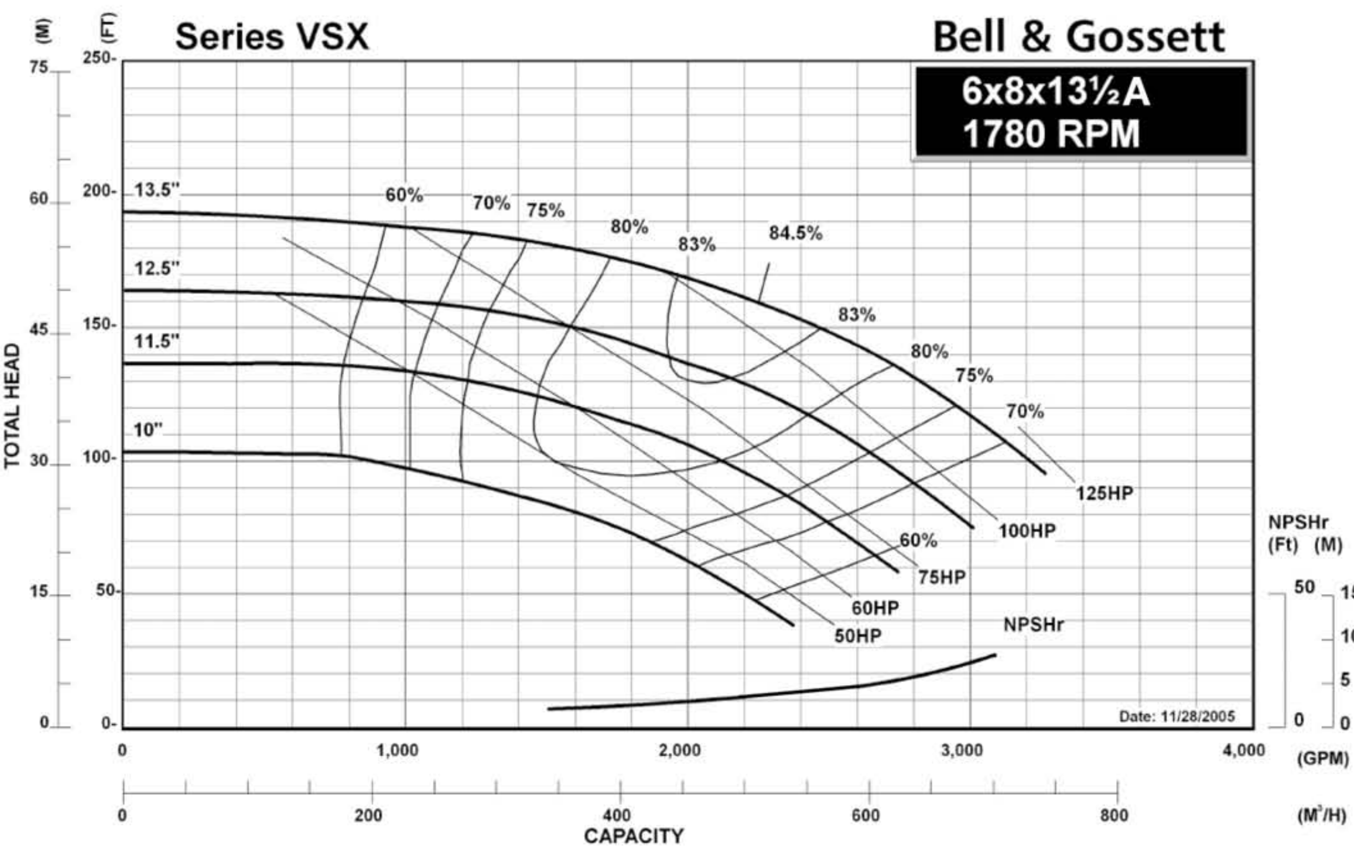
We value your feedback. Please take our 3 question survey at **bellgossett.com/survey** to let us know how we are doing.

xylem
Let's Solve Water

Xy em, Inc.
8200 N. Aust n Avenue
Morton Grove, I no s 60053
Phone: (847) 966 3700
Fax: (847) 965 8379
www.be gossett.com

1780 RPM PUMP CURVES





Performance Report

Alexandria Veterans Health Care - CH-3_19MV (2)

Carrier NAC Sales Office

Date: 06/16/2022 4:54 PM

Prepared By: William Harris

19DV-G44G444425B5

Chiller	
Starter / VFD	Unit Mounted VFD (Harmonic Mi igation)
Refrigerant Type	R-1233zd(E)
Operation Type	Cooling
Manufacturing Source	Charlotte, NC USA

Configuration	Evaporator	Condenser
Size	G44	G44
Waterbox Type	Marine Waterbox, 150 psi	Marine Waterbox, 150 psi
Passes	2	2
Nozzle Arrangement	C - 2 Pass, Inlet on 2nd Stage End	R - 2 Pass, Inlet on 2nd Stage End
Tubing	3/4" 0.025" Copper Cross Hatched Evaporator Tubes	3/4" 0.025" Copper Cross Hatched Condenser Tubes
Fluid Type	Fresh Water	Fresh Water
Fouling Factor	0.000100 (hr-sqft-F)/BTU	0.000250 (hr-sqft-F)/BTU
Tube Quantity	549	702

Compressor	
Size	442
Weights	
Total Rigging Weight	34995 lb
Total Operating Weight	41679 lb
Refrigerant Weight	1637 lb
Motor & Motor Controller	
Size	NBH
Line Voltage-Phase-Hertz	460(V)-3-60(Hz)
VFD Code	5
VFD Size	D
VFD Lug Size	4x4 / 0 - 500 kcmil ABB KT7X1200 - 3
Flow Controls	
Condenser Float Valve	HN
Economizer Float Valve	LN
Envelope Stability Control	Installed
Economizer Bypass	Not Installed
Dimensions	
Length	213 in
Width	108 in
Height	120 in

Full Load

Full Load Performance	Percent Load
Chiller	
Percent Load	100.00
Chiller Capacity	650.0 Tons
Chiller Power	334 9 kW
Chiller Efficiency	0.5152 kW/TonR
Chiller COPR	6.827 kW/kW
IPLV.IP	0.2906 kW/TonR
IPLV, COPR	12.10
NPLV.IP	0.3096 kW/TonR
NPLV, COPR	11.36
Evaporator	
Entering Temperature	52.00 °F
Leaving Temperature	42.00 °F
Flow Rate	1557 gpm
Pressure Drop	17.4 ft H_2O
Fouling Temp Adj	0.18 °F
Condenser	
Heat Rejection	8943 MBH
Leaving Temperature	94.30 °F
Entering Temperature	85.00 °F
Flow Rate	1933 gpm
Pressure Drop	17.8 ft H_2O
Fouling Temp Adj	0.50 °F
Motor & Motor Controller	
Motor Rated Load KW	323 kW
Motor Amps	488
Motor OLTA	527
Chiller Line Amps	444
Chiller Inrush Amps	444
Max Fuse/ CB Amps	800
Min Circuit Ampacity	555
Heat Exchangers	
Evaporator Tube Vel	5.53 ft/s
Cond Tube Vel	5.92 ft/s

AHRI CERTIFIED® www.ahridirectory.org
Water-Cooled Water Chilling and Heat Pump Water-Heating Packages AHRI Standards 550/590 and 551/591

Certified in accordance with the AHRI Water-Cooled Water-Chilling and Heat Pump Water-Heating Packages Certification Program, which is based on AHRI Standard 550/590 (I-P) and AHRI Standard 551/591 (SI). Certified units may be found in the AHRI Directory at www.ahridirectory.org.

http://www.ahrinet.org/WCCL.aspx

This unit complies with the efficiency requirements of ASHRAE 90.1 2013/2016 Path B.

1 Point LEED EAC4 can be earned when selecting the 19DV AquaEdge

IPLV.IP				
	Percent Load			
Chiller				
Percent Load	100.00	75.00	50.00	25.00
Chiller Capacity	650.0 Tons	487.5 Tons	325.0 Tons	162.5 Tons
Chiller Power	319.7 kW	176.6 kW	80.79 kW	43.20 kW
Chiller Efficiency	0.4919 kW/TonR	0.3622 kW/TonR	0.2486 kW/TonR	0.2658 kW/TonR
Chiller COPR	7.150 kW/kW	9.711 kW/kW	14.15 kW/kW	13.23 kW/kW
IPLV.IP	0.2906 kW/TonR	NA	NA	NA
IPLV, COPR	12.10	NA	NA	NA
NPLV.IP	0.3096 kW/TonR	NA	NA	NA
NPLV, COPR	11.36	NA	NA	NA
Evaporator				
Entering Temperature	54.00 °F	51.50 °F	49.00 °F	46.50 °F
Leaving Temperature	44.00 °F	44.00 °F	44.00 °F	44.00 °F
Flow Rate	1558 gpm	1558 gpm	1558 gpm	1558 gpm
Pressure Drop	17.4 ft H_2O	17.4 ft H_2O	17.4 ft H_2O	17.4 ft H_2O
Fouling Temp Adj	0.17 °F	0.13 °F	0.10 °F	0.06 °F
Condenser				
Heat Rejection	8891 MBH	6452 MBH	4176 MBH	2097 MBH
Leaving Temperature	94.30 °F	81.74 °F	69.35 °F	67.19 °F
Entering Temperature	85.00 °F	75.00 °F	65.00 °F	65.00 °F
Flow Rate	1922 gpm	1922 gpm	1922 gpm	1922 gpm
Pressure Drop	17.6 ft H_2O	17.7 ft H_2O	17.6 ft H_2O	17.6 ft H_2O
Fouling Temp Adj	0.50 °F	0.36 °F	0.24 °F	0.12 °F
Motor & Motor Controller				
Motor Rated Load KW	308 kW	168 kW	76 kW	40 kW
Motor Amps	470	313	223	189
Motor OLTA	508	NA	NA	NA
Chiller Line Amps	424	237	110	61
Chiller Inrush Amps	424	NA	NA	NA
Max Fuse/ CB Amps	800	NA	NA	NA
Min Circuit Ampacity	530	NA	NA	NA
Heat Exchangers				
Evaporator Tube Vel	5.53 ft/s	5.53 ft/s	5.53 ft/s	5.53 ft/s
Cond Tube Vel	5.88 ft/s	5.89 ft/s	5.90 ft/s	5.90 ft/s

AHRI CERTIFIED® www.ahridirectory.org
Water-Cooled Water Chilling and Heat Pump Water-Heating Packages AHRI Standards 550/590 and 551/591

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http://www.ahrinet.org/WCCL.aspx

This unit complies with the efficiency requirements of ASHRAE 90.1 2013/2016 Path B.

1 Point LEED EAC4 can be earned when selecting the 19DV AquaEdge

NPLV.IP				
	Percent Load			
Chiller				
Percent Load	100.00	75.00	50.00	25.00
Chiller Capacity	650.0 Tons	487.5 Tons	325.0 Tons	162.5 Tons
Chiller Power	334.9 kW	186.0 kW	86.67 kW	46.23 kW
Chiller Efficiency	0.5152 kW/TonR	0.3815 kW/TonR	0.2667 kW/TonR	0.2845 kW/TonR
Chiller COPR	6.827 kW/kW	9.218 kW/kW	13.19 kW/kW	12.36 kW/kW
IPLV.IP	0.2906 kW/TonR	NA	NA	NA
IPLV, COPR	12.10	NA	NA	NA
NPLV.IP	0.3096 kW/TonR	NA	NA	NA
NPLV, COPR	11.36	NA	NA	NA
Evaporator				
Entering Temperature	52.00 °F	49.50 °F	46.99 °F	44.50 °F
Leaving Temperature	42.00 °F	42.00 °F	42.00 °F	42.00 °F
Flow Rate	1557 gpm	1557 gpm	1557 gpm	1557 gpm
Pressure Drop	17.4 ft H_2O	17.4 ft H_2O	17.4 ft H_2O	17.4 ft H_2O
Fouling Temp Adj	0.18 °F	0.13 °F	0.10 °F	0.07 °F
Condenser				
Heat Rejection	8943 MBH	6485 MBH	4196 MBH	2108 MBH
Leaving Temperature	94.30 °F	81.73 °F	69.35 °F	67.18 °F
Entering Temperature	85.00 °F	75.00 °F	65.00 °F	65.00 °F
Flow Rate	1933 gpm	1933 gpm	1933 gpm	1933 gpm
Pressure Drop	17.8 ft H_2O	17.9 ft H_2O	17.8 ft H_2O	17.8 ft H_2O
Fouling Temp Adj	0.50 °F	0.36 °F	0.24 °F	0.12 °F
Motor & Motor Controller				
Motor Rated Load KW	323 kW	178 kW	82 kW	43 kW
Motor Amps	488	320	222	185
Motor OLTA	527	NA	NA	NA
Chiller Line Amps	444	250	118	65
Chiller Inrush Amps	444	NA	NA	NA
Max Fuse/ CB Amps	800	NA	NA	NA
Min Circuit Ampacity	555	NA	NA	NA
Heat Exchangers				
Evaporator Tube Vel	5.53 ft/s	5.53 ft/s	5.53 ft/s	5.53 ft/s
Cond Tube Vel	5.92 ft/s	5.93 ft/s	5.93 ft/s	5.93 ft/s

AHRI CERTIFIED® www.ahridirectory.org
Water-Cooled Water Chilling and Heat Pump Water-Heating Packages AHRI Standards 550/590 and 551/591

Certified in accordance with the AHRI Water-Cooled Water-Chilling and Heat Pump Water-Heating Packages Certification Program, which is based on AHRI Standard 550/590 (I-P) and AHRI Standard 551/591 (SI). Certified units may be found in the AHRI Directory at www.ahridirectory.org.

http://www.ahrinet.org/WCCL.aspx

This unit complies with the efficiency requirements of ASHRAE 90.1 2013/2016 Path B.

1 Point LEED EAC4 can be earned when selecting the 19DV AquaEdge

AquaEdge Chiller Configuration

Alexandria Veterans Health Care - CH-3_19MV (2)

Carrier NAC Sales Office

Date: 06/16/2022 4:54 PM

Prepared By: William Harris

19DV-G44G444425B5

Chiller	
Starter / VFD	Unit Mounted VFD (Harmonic Mitigation)
Refrigerant Type	R-1233zd(E)
Evaporator	
Size	G44
Waterbox Type	Marine Waterbox, 150 psi
Passes	2
Nozzle Arrangement	C - 2 Pass, Inlet on 2nd Stage End
Nozzle Options	Victaulic Evaporator Nozzles
Evaporator Hinges	None
Tubing	3/4" 0.025" Copper Cross Hatched Evaporator Tubes
Fluid Type	Fresh Water
Weights	
Total Rigging Weight	34995 lb
Total Operating Weight	41679 lb
Refrigerant Weight	1637 lb
Condenser	
Size	G44
Waterbox Type	Marine Waterbox, 150 psi
Passes	2
Nozzle Arrangement	R - 2 Pass, Inlet on 2nd Stage End
Nozzle Options	Victaulic Condenser Nozzles
Condenser Hinges	None
Tubing	3/4" 0.025" Copper Cross Hatched Condenser Tubes
Fluid Type	Fresh Water
Motor & Motor Controller	
Motor Size	NBH
Line Voltage-Phase-Hertz	460(V)-3-60(Hz)
Refrigerant Pump Voltage-Phase-Hertz	460(V)-3-60(Hz)
VFD Code	32VS Unit Mounted VFD (STD Tier)
VFD Size	D
Interrupt	100k Amp Interrupt
VFD Lug Size	4x4 / 0 - 500 kcmil ABB KT7X1200 - 3
Flow Controls	
Condenser Float Valve	HN
Economizer Float Valve	LN
Envelope Stability Control	Installed
Economizer Bypass	Not Installed
Dimensions	
Length	213 in
Width	108 in
Height	120 in

Shipment & Packaging	
Packaging Options	Chiller Bagging (Standard for domestic travel only)

Miscellaneous Options	
Evaporator Insulation	STD.
Sensor Package	Not Selected
Soleplates	Not Selected
Spring Isolation Package	Not Selected
Controls & Power	
HMI Communication Protocol	CCN / BACNet Enabled
Fourth IOB	Not Selected

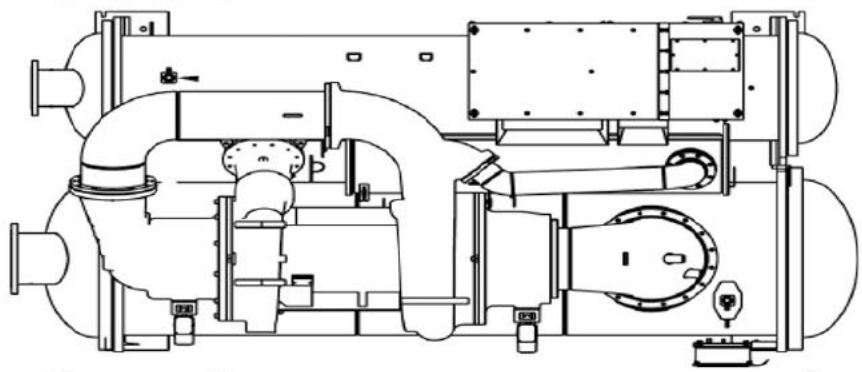
Note: This list of specified chiller options does not include any of the separate-ship accessories (gasket kits, refrigerant cylinders, standalone pumpout units, or storage tank / pumpout units), nor any items specified on a Quote Control. These items are specified as part of a bid, and not in the chiller tag. The Pricing Report includes all of these items as specified in a bid.

1 Point LEED EAC4 can be earned when selecting the 19DV AquaEdge

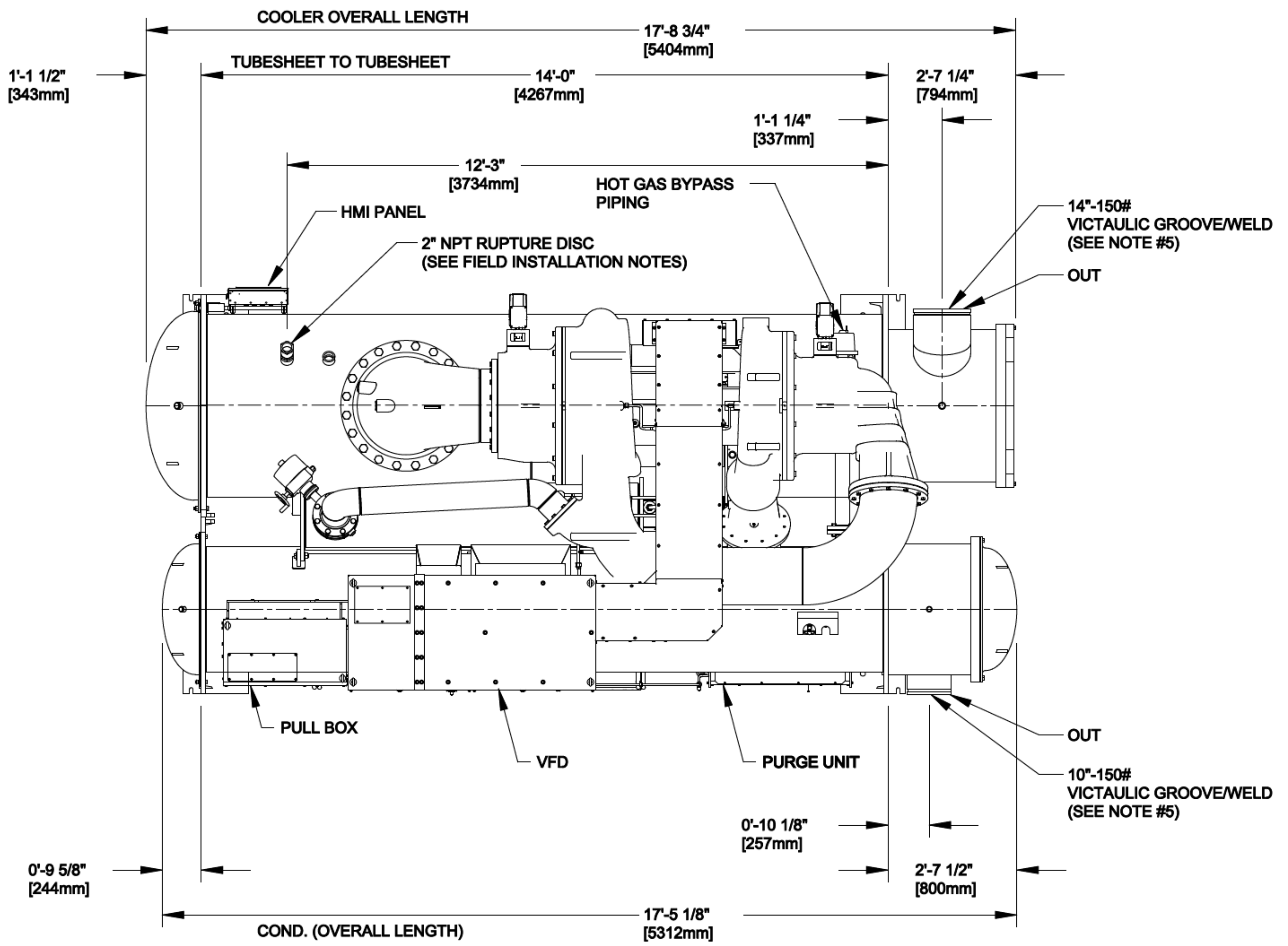
19DV-G44G444425B5

Chiller Rigging weight(no water no refrigerant weights)	34995.00 lb
Chiller Operation weight(with water and refrigerant weights)	41679.00 lb
Chiller Refrigerant weight	1637.00 lb

		Corner A	Corner B	Corner C	Corner D
Corner Weight	lb	10319	8878	12234	10248
Spring Corner		C12T-1D-14400	C12T-1D-10800	C12T-1D-16320	C12T-1D-14400
Spring Color		Gray	Dark Green	White	Gray



Note: Reference chiller shown, see chiller drawing for actual water box arrangement



1ST STAGE END

PLAN VIEW

2ND STAGE END

COMPRESSOR 19DV4	HEAT EXCHANGERS										MACHINE OPTIONS			
	COOLER: 19DVG40-44, G4A-G4E					CONDENSER: 19DVG42-44, G4C-G4E								
MOTOR VOLTAGE	PASS	NOZZLE CODE	PRESSURE	W/B COVER WT. 1ST. STAGE END	W/B COVER WT. 2ND. STAGE END	PASS	NOZZLE CODE	PRESSURE	W/B COVER WT. 1ST. STAGE END	W/B COVER WT. 2ND. STAGE END	HARMONIC FILTER	HOT GAS BYPASS	FREE COOLING	PULL BOX
LOW	2	C	150 PSIG	404 LBS. [183 KG.]	668 LBS. [303 KG.]	2	R	150 PSIG	155 LBS. [70 KG.]	172 LBS. [78 KG.]	✓ NOT SHOWN	✓	–	✓

NOTES:
1. TOLERANCES ON NOZZLE LOCATIONS AND OVERALL DIMENSIONS ARE 1" [25mm].
2. CARRIER DOES NOT RECOMMEND PRE-FAB WATER PIPING.
3. IF HINGED WATERBOXES ARE INCLUDED, THE HINGES ARE NOT SHOWN ON THIS DRAWING AND MAY CHANGE THE MACHINE OVERALL LENGTH AND WIDTH. PLEASE CONSULT THE HINGED WATERBOX DRAWING FOR MORE DETAILS.
4. ✓ DENOTES APPLICABLE CONDITIONS
5. FOR VICTAULIC GROOVE DETAIL SEE DRAWING 19XR24VG.

Carrier
A United Technologies Company
P.O. BOX 4808, SYRACUSE, N.Y. 13221

BUYER:

JOB NAME:
Alexandria Veterans Health Care

SALES ENG.:

MODEL NO.:
19DV-G44G444425B5

JOB NO.:

P.O. NO.:

PREPARED BY:

ELECTRICAL CHARACTERISTICS:
460/3/60

JOBSITE LOCATION:

SALES OFFICE:
NAC

REFRIGERANT NO.:
R-1233ZD

NOTES:

COMP'R: 19DV4
COOLER: 19DVG40-G44
19DVG4A-G4E
COND: 19DVG42-G44
19DVG4C-G4E
MACHINE ASSEMBLY
PLAN VIEW

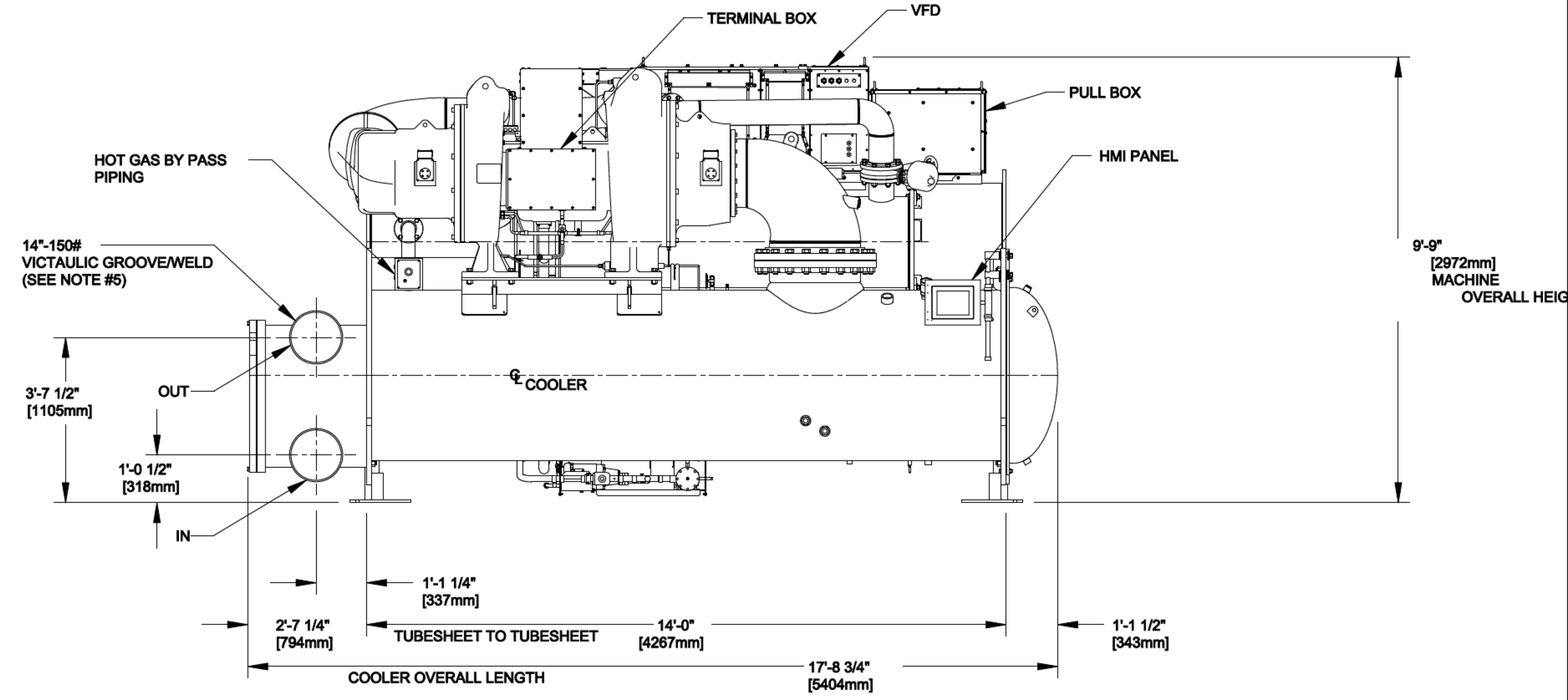
DATE: 6/17/2022

REVISION:

CARRIER DWG # 19DVG4-P
REV. C SHT 03F 01
DATE: 5/2/2019
SUPERSEDES DWG. DATED:
5/1/2018

19DVG4

SHT 03F 04



2ND STAGE END

FRONT VIEW

1ST STAGE END

COMPRESSOR 19DV4	HEAT EXCHANGERS										MACHINE OPTIONS			
	COOLER: 19DVG40-44, G4A-G4E					CONDENSER: 19DVG42-44, G4C-G4E								
MOTOR VOLTAGE	PASS	NOZZLE CODE	PRESSURE	W/B COVER WT. 1ST. STAGE END	W/B COVER WT. 2ND. STAGE END	PASS	NOZZLE CODE	PRESSURE	W/B COVER WT. 1ST. STAGE END	W/B COVER WT. 2ND. STAGE END	HARMONIC FILTER	HOT GAS BYPASS	FREE COOLING	PULL BOX
LOW	2	C	150 PSIG	404 LBS. [183 KG.]	668 LBS. [303 KG.]	FOR CONDENSER ARRANGEMENTS SEE REAR VIEW					✓ NOT SHOWN	✓	–	✓

NOTES:
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4. ✓ DENOTES APPLICABLE CONDITIONS
5. FOR VICTAULIC GROOVE DETAIL SEE DRAWING 19XR24VG.

Carrier
A United Technologies Company
P.O. BOX 4808, SYRACUSE, N.Y. 13221

BUYER:

JOB NAME:
Alexandria Veterans Health Care

SALES ENG.:

MODEL NO.:
19DV-G44G444425B5

JOB NO.:

P.O. NO.:

PREPARED BY:

ELECTRICAL CHARACTERISTICS:
460/3/60

JOBSITE LOCATION:

SALES OFFICE:
NAC

REFRIGERANT NO.:
R-1233ZD

NOTES:

COMP'R: 19DV4
COOLER: 19DVG40-G44
19DVG4A-G4E
COND: 19DVG42-G44
19DVG4C-G4E
MACHINE ASSEMBLY
FRONT VIEW

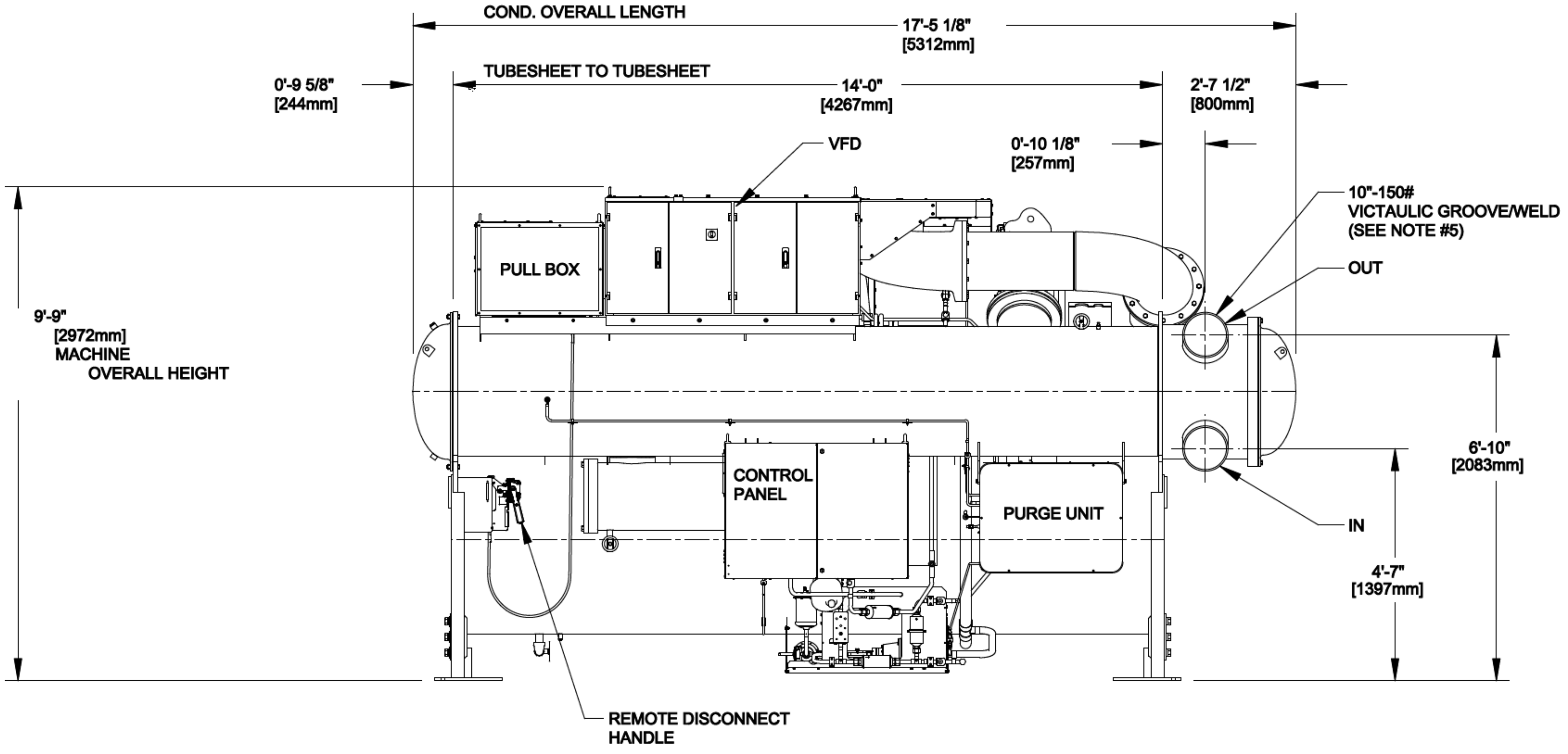
DATE: 6/17/2022

REVISION:

CARRIER DWG # 19DVG4-F
REV. C SHT 03F 01
DATE: 5/2/2019
SUPERSEDES DWG. DATED: 5/1/2018

19DVG4

SHT 02F 04



1ST STAGE END

REAR VIEW

2ND STAGE END

COMPRESSOR 19DV4	HEAT EXCHANGERS										MACHINE OPTIONS			
	COOLER: 19DVG40-44, G4A-G4E					CONDENSER: 19DVG42-44, G4C-G4E								
MOTOR VOLTAGE	PASS	NOZZLE CODE	PRESSURE	W/B COVER WT. 1ST. STAGE END	W/B COVER WT. 2ND. STAGE END	PASS	NOZZLE CODE	PRESSURE	W/B COVER WT. 1ST. STAGE END	W/B COVER WT. 2ND. STAGE END	HARMONIC FILTER	HOT GAS BYPASS	FREE COOLING	PULL BOX
LOW	FOR COOLER ARRANGEMENTS SEE FRONT VIEW					2	R	150 PSIG	155 LBS. [70 KG.]	172 LBS. [78 KG.]	✓ NOT SHOWN	✓ NOT SHOWN	–	✓

NOTES:
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4. ✓ DENOTES APPLICABLE CONDITIONS
5. FOR VICTAULIC GROOVE DETAIL SEE DRAWING 19XR24VG.

Carrier
A United Technologies Company
P.O. BOX 4808, SYRACUSE, N.Y. 13221

BUYER:

JOB NAME:
Alexandria Veterans Health Care

SALES ENG.:

MODEL NO.:
19DV-G44G444425B5

JOB NO.:

P.O. NO.:

PREPARED BY:

ELECTRICAL CHARACTERISTICS:
460/3/60

JOBSITE LOCATION:

SALES OFFICE:
NAC

REFRIGERANT NO.:
R-1233ZD

NOTES:

COMP'R: 19DV4
COOLER: 19DVG40-G44
19DVG4A-G4E
COND: 19DVG42-G44
19DVG4C-G4E
MACHINE ASSEMBLY
REAR VIEW

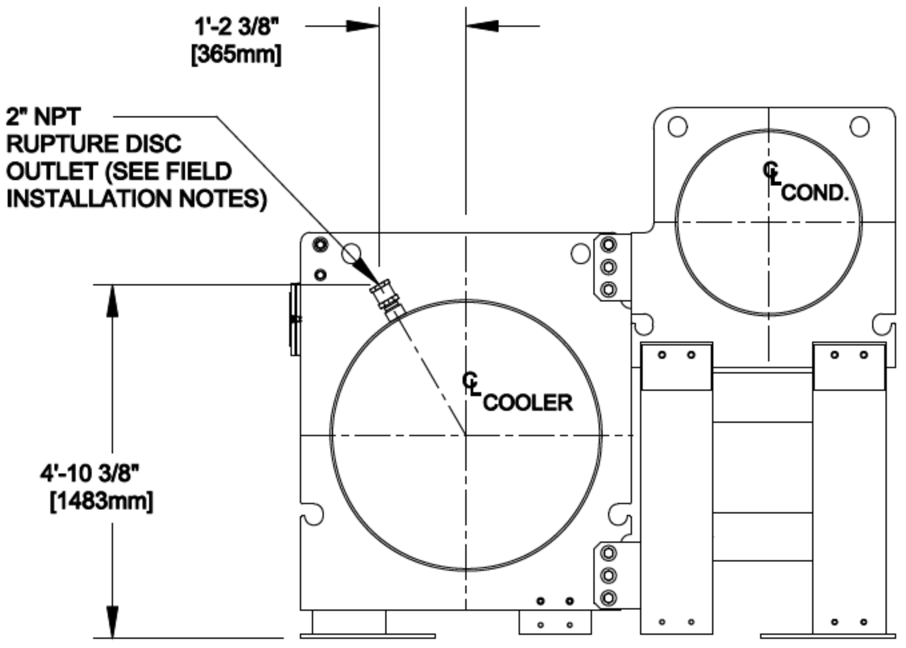
DATE: 6/17/2022

REVISION:

CARRIER DWG # 19DVG4-R
REV. C SHT 03F 01
DATE: 5/2/2019
SUPERSEDES DWG. DATED:
5/1/2018

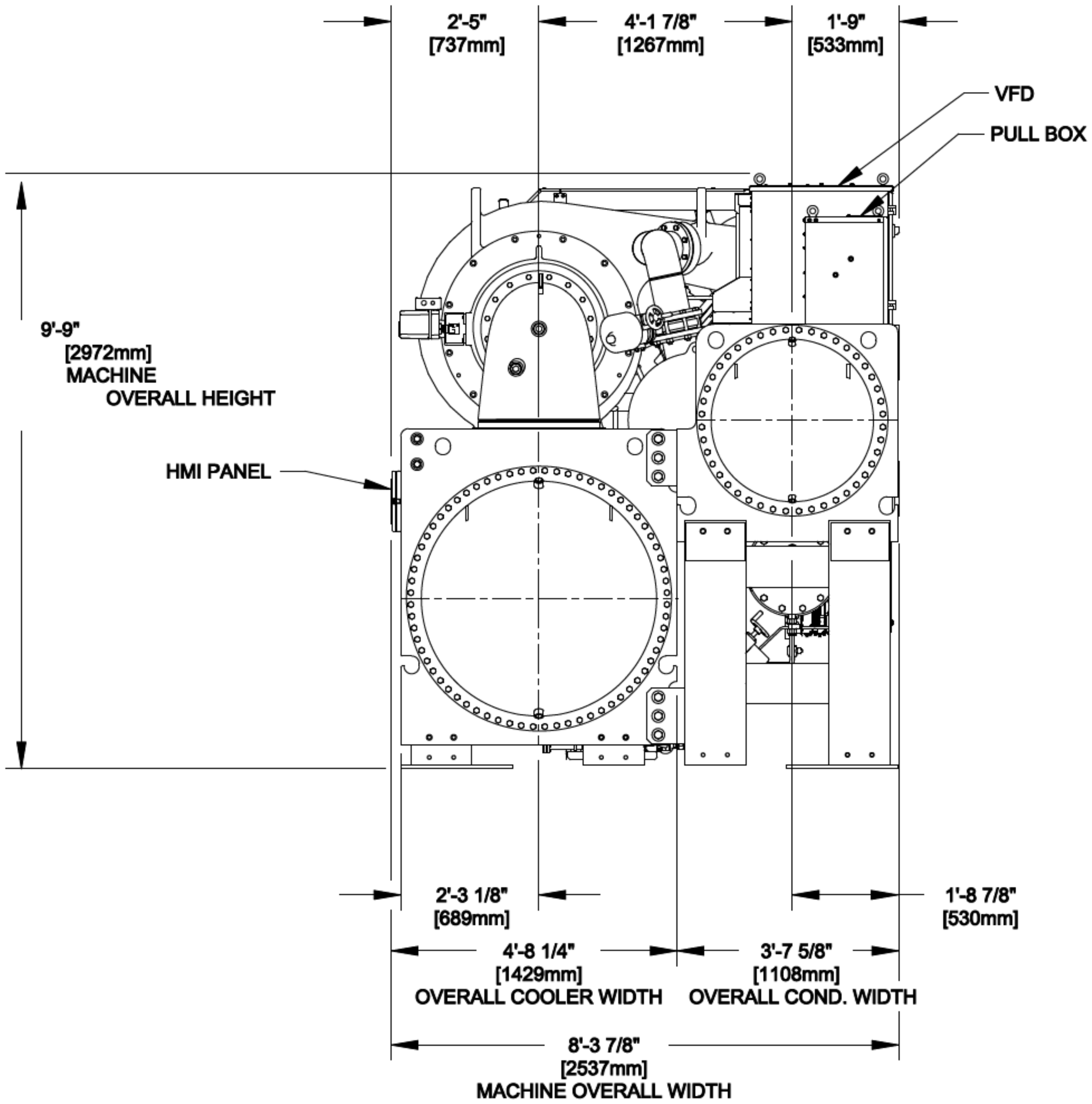
19DVG4

SHT 03F 04



RUPTURE DISC LOCATION

FIRST STAGE END
COMPRESSOR: 19DV4
VIEWING RUPTURE DISC FROM 1ST STAGE END
WATERBOXES AND ENDPLATES NOT SHOWN



1ST STAGE END

COMPRESSOR 19DV4	HEAT EXCHANGERS										MACHINE OPTIONS			
	COOLER: 19DVG40-44, G4A-G4E					CONDENSER: 19DVG42-44, G4C-G4E								
MOTOR VOLTAGE	PASS	NOZZLE CODE	PRESSURE	W/B COVER WT. 1ST. STAGE END	W/B COVER WT. 2ND. STAGE END	PASS	NOZZLE CODE	PRESSURE	W/B COVER WT. 1ST. STAGE END	W/B COVER WT. 2ND. STAGE END	HARMONIC FILTER	HOT GAS BYPASS	FREE COOLING	PULL BOX
LOW	2	C	150 PSIG	404 LBS. [183 KG.]	668 LBS. [303 KG.]	2	R	150 PSIG	155 LBS. [70 KG.]	172 LBS. [78 KG.]	✓ NOT SHOWN	✓ NOT SHOWN	–	✓

NOTES:
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4. ✓ DENOTES APPLICABLE CONDITIONS
5. FOR VICTAULIC GROOVE DETAIL SEE DRAWING 19XR24VG.

Carrier
A United Technologies Company
P.O. BOX 4808, SYRACUSE, N.Y. 13221

BUYER:

JOB NAME:
Alexandria Veterans Health Care

SALES ENG.:

MODEL NO.:
19DV-G44G444425B5

JOB NO.:

P.O. NO.:

PREPARED BY:

ELECTRICAL CHARACTERISTICS:
460/3/60

JOBSITE LOCATION:

SALES OFFICE:
NAC

REFRIGERANT NO.:
R-1233ZD

NOTES:

COMP'R: 19DV4
COOLER: 19DVG40-G44
19DVG4A-G4E
COND: 19DVG42-G44
19DVG4C-G4E
MACHINE ASSEMBLY
1ST STAGE END VIEW

DATE: 6/17/2022

REVISION:

CARRIER DWG # 19DVG4-1SE
REV. C SHT 03F 01
DATE: 5/2/2019
SUPERSEDES DWG. DATED:
5/1/2018

19DVG4

SHT 03F 04

Bid Documents Submittal

Appendix H
Structural Calculations

Attachment 2
Structural Calculations

STRUCTURAL CALCULATIONS

FOR

VA Alexandria - Chiller Replacement

Alexandria, LA

Code Search

Code: International Building Code 2018

Occupancy:

Occupancy Group = I Institutional

Risk Category & Importance Factors:

Risk Category =	IV
Wind factor =	1.00
Snow factor =	1.20
Seismic factor =	1.50

Type of Construction:

Fire Rating:

Roof =	0.0 hr
Floor =	0.0 hr

Building Geometry:

Roof angle (θ)	0.50 / 12	2.4 deg
Building length (L)	92.0 ft	
Least width (B)	44.0 ft	
Mean Roof Ht (h)	16.0 ft	
Parapet ht above grd	0.0 ft	
Minimum parapet ht	0.0 ft	

Live Loads:

Roof	0 to 200 sf:	20 psf
	200 to 600 sf:	24 - 0.02Area, but not less than 12 psf
	over 600 sf:	12 psf

Floor:

Typical Floor	40 psf
Partitions	15 psf
Lobbies & first floor corridors	100 psf
Corridors above first floor	80 psf
Balconies (1.5 times live load)	60 psf

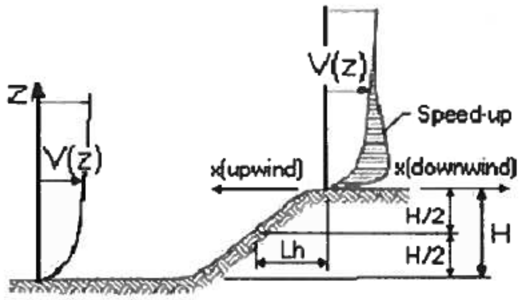
Innovative Engineering Inc.
3380 Trickum Road Bldg 500 Ste 100
Woodstock, GA 30188
770-517-5507

Wind Loads : ASCE 7- 16

Ultimate Wind Speed	120 mph
Nominal Wind Speed	93 mph
Risk Category	IV
Exposure Category	B
Enclosure Classif.	Enclosed Building
Internal pressure	+/-0.18
Directionality (Kd)	0.85
Kh case 1	0.701
Kh case 2	0.585
Type of roof	Monoslope

Topographic Factor (Kzt)

Topography	Flat
Hill Height (H)	80.0 ft
Half Hill Length (Lh)	100.0 ft
Actual H/Lh =	0.80
Use H/Lh =	0.50
Modified Lh =	160.0 ft
From top of crest: x =	50.0 ft
Bldg up/down wind?	downwind

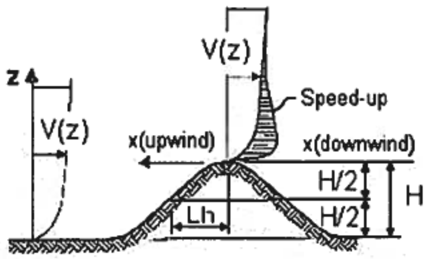


ESCARPMENT

H/Lh= 0.50	K_1 = 0.000
x/Lh = 0.31	K_2 = 0.792
z/Lh = 0.10	K_3 = 1.000

At Mean Roof Ht:

$Kzt = (1+K_1K_2K_3)^2 =$ 1.00



2D RIDGE or 3D AXISYMMETRICAL HILL

Gust Effect Factor

h =	16.0 ft
B =	44.0 ft
/z (0.6h) =	30.0 ft

Flexible structure if natural frequency < 1 Hz (T > 1 second).
If building h/B>4 then may be flexible and should be investigated.
h/B = 0.36 Rigid structure (low rise bldg)

G = 0.85 Using rigid structure default

Rigid Structure

ē =	0.33
ℓ =	320 ft
z_{min} =	30 ft
c =	0.30
g_Q, g_v =	3.4
L_z =	310.0 ft
Q =	0.90
I_z =	0.30
G =	0.87 use G = 0.85

Flexible or Dynamically Sensitive Structure

34 ıcy (η_1) =	0.0 Hz				
Damping ratio (β) =	0				
/b =	0.45				
/α =	0.25				
Vz =	77.3				
N_1 =	0.00				
K_n =	0.000				
R_h =	28.282	η =	0.000	h =	16.0 f
R_B =	28.282	η =	0.000		
R_L =	28.282	η =	0.000		
g_R =	0.000				
R =	0.000				
Gf =	0.000				

Innovative Engineering Inc.
3380 Trickum Road Bldg 500 Ste 100
Woodstock, GA 30188
770-517-5507

JOB TITLE	VA Alexandria - Chiller Replacement		
JOB NO.		SHEET NO.	
CALCULATED BY	SLM	DATE	4/24/22
CHECKED BY		DATE	

Seismic Loads: IBC 2018

Strength Level Forces

Risk Category : IV
Importance Factor (I) : 1.50
Site Class : D

Ss (0.2 sec) = 11.10 %g
S1 (1.0 sec) = 6.30 %g

Fa =	1.600	Sms =	0.178	S_{DS} =	0.118	Design Category =	A
Fv =	2.400	Sm1 =	0.151	S_{D1} =	0.101	Design Category =	C

Seismic Design Category = **C**

Redundancy Coefficient ρ = 1.30
Number of Stories: 5
Structure Type: All other building systems
Horizontal Struct Irregularities: No plan Irregularity
Vertical Structural Irregularities: No vertical Irregularity

Flexible Diaphragms: No
Building System: **Bearing Wall Systems**
Seismic resisting system: **Ordinary reinforced masonry shear walls**
System Structural Height Limit: **160 ft**
Actual Structural Height (hn) = 16.9 ft

DESIGN COEFFICIENTS AND FACTORS

Response Modification Coefficient (R) = 2
Over-Strength Factor (Ωo) = 2.5
Deflection Amplification Factor (Cd) = 1.75
S_{DS} = 0.118
S_{D1} = 0.101

Seismic Load Effect (E) = Eh +/-Ev = $\rho Q_E \pm 0.2S_{DS} D$ = 1.3Qe +/- 0.000D Q_E = horizontal seismic force
Special Seismic Load Effect (Em) = Emh +/- Ev = $\Omega o\, Q_E \pm 0.2S_{DS} D$ = 2.5Qe +/- 0.024D D = dead load

PERMITTED ANALYTICAL PROCEDURES

Simplified Analysis - Use Equivalent Lateral Force Analysis

Equivalent Lateral-Force Analysis - Permitted

Building period coef. (C_T) = 0.020 Cu = 1.70
Approx fundamental period (Ta) = $C_T h_n^{\wedge}$ = 0.167 sec x= 0.75 Tmax = CuTa = 0.283
User calculated fundamental period (T) = sec Use T = 0.167
Long Period Transition Period (TL) = ASCE7 map = 12
Seismic response coef. (Cs) = $S_{DS}I/R$ = 0.089
need not exceed Cs = Sd1 I /RT = 0.453
but not less than Cs = 0.010
USE Cs = 0.089
Design Base Shear V = 0.089W

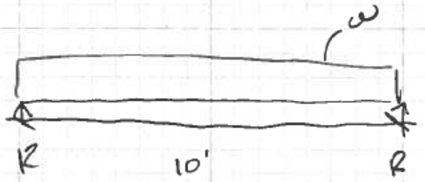
Model & Seismic Response Analysis - Permitted (see code for procedure)

ALLOWABLE STORY DRIFT

Structure Type: All other structures

Allowable story drift Δa = 0.010hsx where hsx is the story height below level x

New HSS Lintel



$\Delta_{D+L} \leq l/600$

$R_{DL} = 9.26^k$

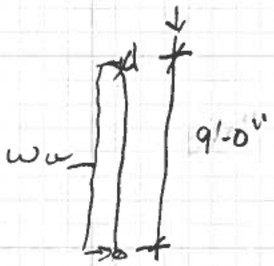
$R_{LL} = 3.23^k$

$w_{DL} = 1.82$ klf

$w_{LL} = 645$ plf

USE HSS 12x8x1/4 LSH

MASONRY JAMB



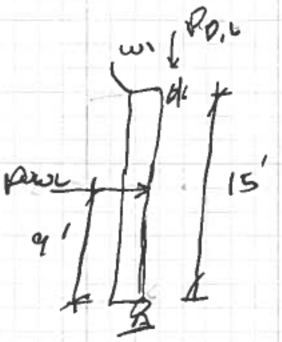
$P_{DL} = 9.26^k$

$P_{LL} = 3.23^k$

$w_{WL} = 5\,psf \times 10'/2 + 2' = 50\,plf$

USE (1) #5 @ JAMB

MASONRY KING JAMB



$w_{1\,WL} = 26\,psf \times 4' = 104\,plf$

$P_{WL} \quad 26\,psf \times \frac{10'}{2} \times \frac{9'}{2} = .585^k$

$P_{DL} = \frac{44}{2} \times 83\,psf \times 4 = 7.3^k$

$P_{LL} = \frac{44'}{2} \times 20\,psf \times 4' = 1.76^k$

Steel Beam

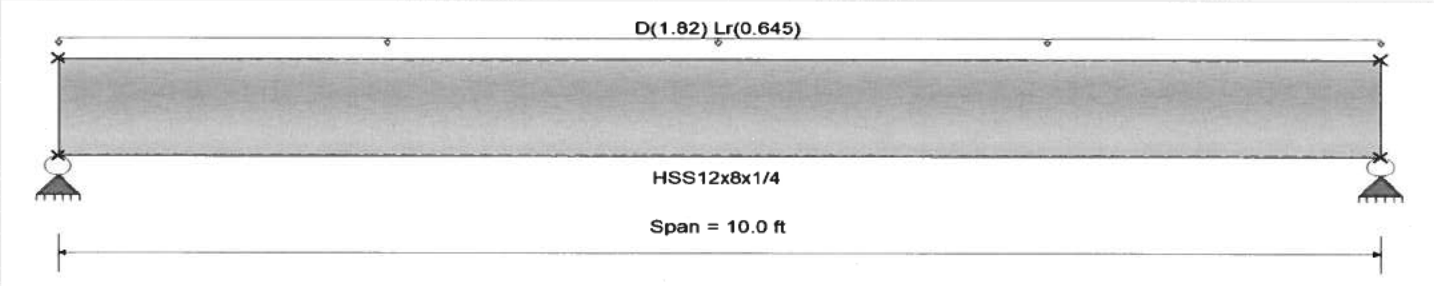
DESCRIPTION: New Opening Tube Option

CODE REFERENCES

Calculations per AISC 360-16, IBC 2018, CBC 2019, ASCE 7-16
Load Combination Set : ASCE 7-16

Material Properties

Analysis Method :	Allowable Strength Design	Fy : Steel Yield :	46.0 ksi
Beam Bracing :	Completely Unbraced	E: Modulus :	29,000.0 ksi
Bending Axis :	Minor Axis Bending		



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loading
Uniform Load : D = 1.820, Lr = 0.6450 k/ft, Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.650** : 1	Maximum Shear Stress Ratio =	**0.222** : 1
Section used for this span	**HSS12x8x1/4**	Section used for this span	**HSS12x8x1/4**
Ma : Applied	31.220 k-ft	Va : Applied	12.488 k
Mn / Omega : Allowable	48.049 k-ft	Vn/Omega : Allowable	56.229 k
Load Combination	+D+Lr+H	Load Combination	+D+Lr+H
Location of maximum on span	5.000 ft	Location of maximum on span	0.000 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.051 in	Ratio =	2,358 >=600.
Max Upward Transient Deflection	0.000 in	Ratio =	0 <600.0
Max Downward Total Deflection	0.197 in	Ratio =	609 >=600.
Max Upward Total Deflection	0.000 in	Ratio =	0 <600.0

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	Mmax +	Mmax -	Ma Max	Mny	Mny/Omega	Cb	Rm	Va Max	Vny	Vny/Omega
+D+H													
Dsgn. L = 10.00 ft	1	0.482	0.165	23.16		23.16	80.24	48.05	1.14	1.00	9.26	93.90	56.23
+D+L+H													
Dsgn. L = 10.00 ft	1	0.482	0.165	23.16		23.16	80.24	48.05	1.14	1.00	9.26	93.90	56.23
+D+Lr+H													
Dsgn. L = 10.00 ft	1	0.650	0.222	31.22		31.22	80.24	48.05	1.14	1.00	12.49	93.90	56.23
+D+S+H													
Dsgn. L = 10.00 ft	1	0.482	0.165	23.16		23.16	80.24	48.05	1.14	1.00	9.26	93.90	56.23
+D+0.750Lr+0.750L+H													
Dsgn. L = 10.00 ft	1	0.608	0.208	29.20		29.20	80.24	48.05	1.14	1.00	11.68	93.90	56.23
+D+0.750L+0.750S+H													
Dsgn. L = 10.00 ft	1	0.482	0.165	23.16		23.16	80.24	48.05	1.14	1.00	9.26	93.90	56.23
+D+0.60W+H													
Dsgn. L = 10.00 ft	1	0.482	0.165	23.16		23.16	80.24	48.05	1.14	1.00	9.26	93.90	56.23
+D+0.750Lr+0.750L+0.450W+H													
Dsgn. L = 10.00 ft	1	0.608	0.208	29.20		29.20	80.24	48.05	1.14	1.00	11.68	93.90	56.23
+D+0.750L+0.750S+0.450W+H													
Dsgn. L = 10.00 ft	1	0.482	0.165	23.16		23.16	80.24	48.05	1.14	1.00	9.26	93.90	56.23
+0.60D+0.60W+0.60H													
Dsgn. L = 10.00 ft	1	0.289	0.099	13.89		13.89	80.24	48.05	1.14	1.00	5.56	93.90	56.23
+D+0.70E+0.60H													
Dsgn. L = 10.00 ft	1	0.482	0.165	23.16		23.16	80.24	48.05	1.14	1.00	9.26	93.90	56.23
+D+0.750L+0.750S+0.5250E+H													
Dsgn. L = 10.00 ft	1	0.482	0.165	23.16		23.16	80.24	48.05	1.14	1.00	9.26	93.90	56.23

Steel Beam

DESCRIPTION: New Opening Tube Option

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	Mmax +	Mmax -	Ma Max	Mnx	Mnx/Omega	Cb	Rm	Va Max	Vnx	Vnx/Omega
+0.60D+0.70E+H													
Dsgn. L = 10.00 ft	1	0.289	0.099	13.89		13.89	80.24	48.05	1.14	1.00	5.56	93.90	56.23

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+Lr+H	1	0.1970	5.029		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	12.488	12.488
Overall MINimum	3.225	3.225
+D+H	9.263	9.263
+D+L+H	9.263	9.263
+D+Lr+H	12.488	12.488
+D+S+H	9.263	9.263
+D+0.750Lr+0.750L+H	11.682	11.682
+D+0.750L+0.750S+H	9.263	9.263
+D+0.60W+H	9.263	9.263
+D+0.750Lr+0.750L+0.450W+H	11.682	11.682
+D+0.750L+0.750S+0.450W+H	9.263	9.263
+0.60D+0.60W+0.60H	5.558	5.558
+D+0.70E+0.60H	9.263	9.263
+D+0.750L+0.750S+0.5250E+H	9.263	9.263
+0.60D+0.70E+H	5.558	5.558
D Only	9.263	9.263
Lr Only	3.225	3.225
H Only		

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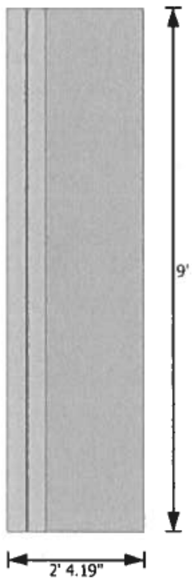
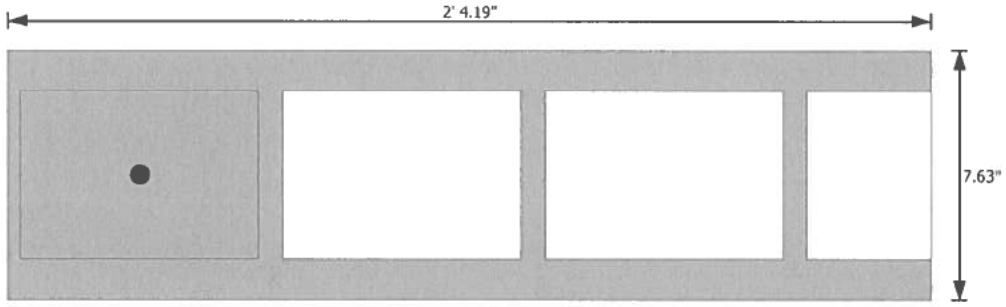
Pilaster 2

Masonry Pilaster Design Calculations





Design Criteria

Building Code: TMS 402-2016 (Strength Design)
Choose Load Combinations Manually: Yes
Strength Check Load Combinations: ASCE 7-16 Strength Combinations
Service Check Load Combinations: ASCE 7-16 ASD Combinations
Apply Sds to Seismic Combinations for Ev: No
f'm: 1500 psi
fy: 60000 psi
Mortar Type: Type M/S - PCL (Portland Cement/Lime)

Material (CMU/Clay): Taken from Unit
Average Unit Weight: 140 lb/ft^3
Secondary Moment Approach: Moment Magnifier
Include Self-Weight: Yes
Include Weight In Virtual Eccentricity: No

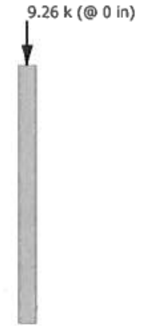
Checks Summary

☐	Ratio	Check	Critical Combination
Strength Checks			
✔	0.287	Axial Stress	1.2D + 1.6L
✔	0.000	Axial Stress (slender)	1.4D
✔	0.107	Axial Force	1.2D + 1.6L
✔	0.032	Shear	1.2D + 1.6L
✔	0.088	Moment	1.2D + 1.6L
✔	0.000	Max Reinforcement	1.4D
Service Checks			
✔	0.005	Deflection (TMS)	1D + 0.75L
✔	0.000	Deflection (IBC)	1D

☐	Ratio	Check

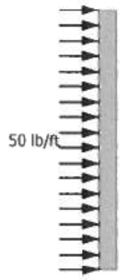
Applied Loads

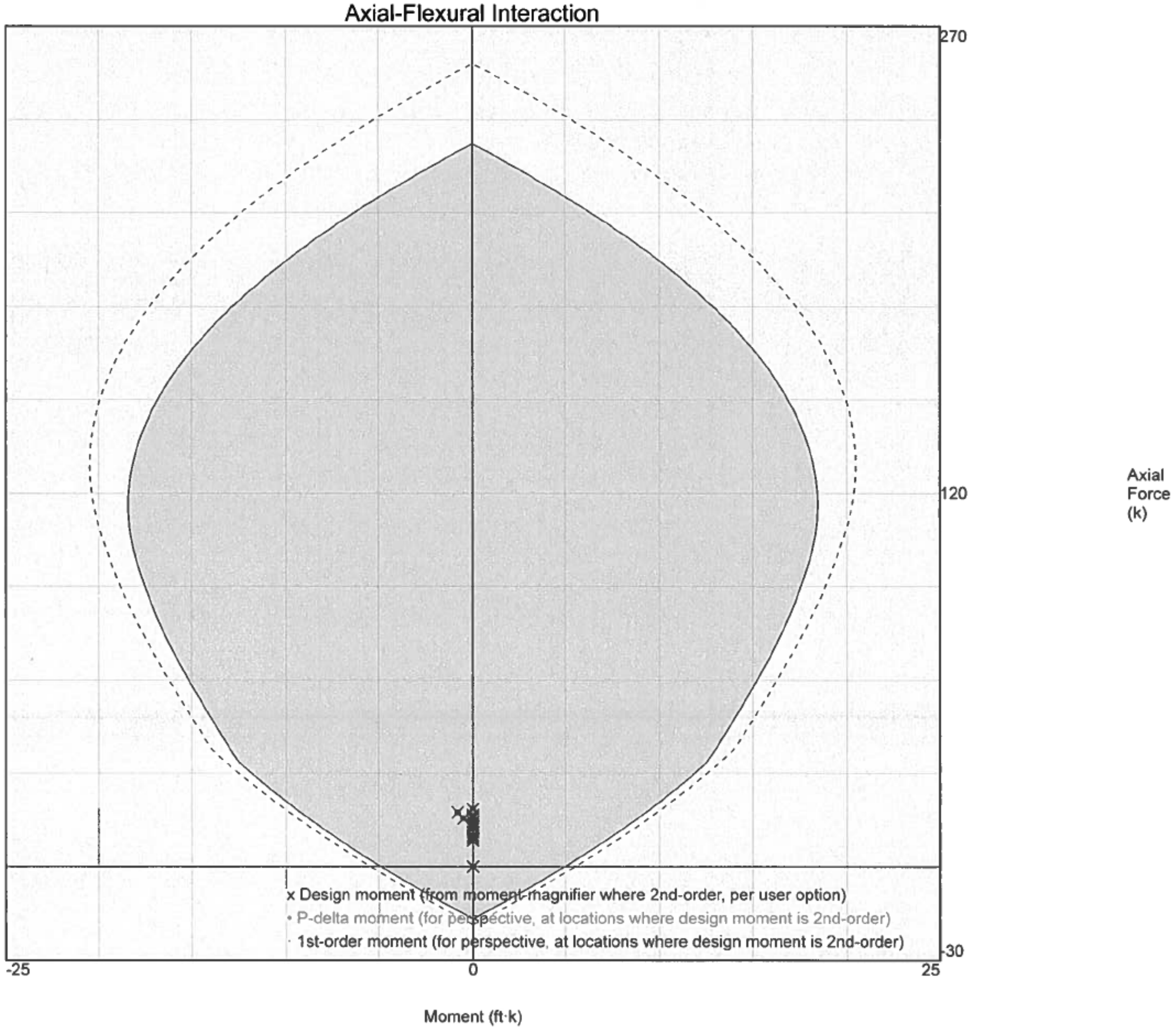
dead [Source: Dead]



live [Source: Live]

live2 [Source: Live]




Axial-Flexural Interaction
270
120
-30
Axial Force (k)
-25
0
25
Moment (ft·k)
x Design moment (from moment-magnifier where 2nd-order, per user option)
• P-delta moment (for perspective, at locations where design moment is 2nd-order)
· 1st-order moment (for perspective, at locations where design moment is 2nd-order)

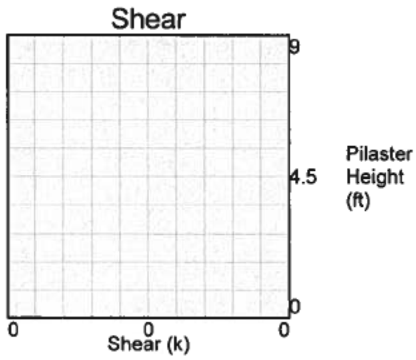
Strength Checks Design Calculations for Combination 1.4D

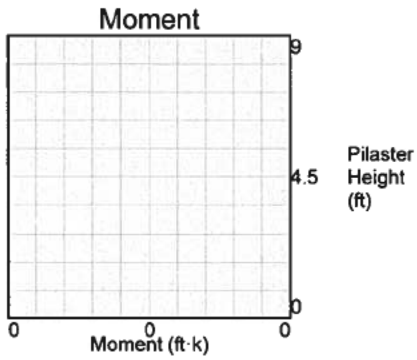
Load Combination: 1.4D

Pilaster weight: The unfactored weight is 1.88 k, of which 1.35 k is from the wall portion(s) and 0.53 k is from the 'column' portion.

Factored Pilaster weight = 2.63 k (total), 292.54 lb/ft (linear per height).

	Axial Force (k)	Shear (k)	Moment (ft·k)	P-δ Moment (ft·k)	Mag. Moment (ft·k)
9 ft from base	0 k	0 k	0 ft·k	0 ft·k	0 ft·k
	12.96 k	0 k	0 ft·k	N/A	N/A
4.45 ft from base	14.29 k	0 k	0 ft·k	0 ft·k	0 ft·k
0 ft from base	15.6 k	0 k	0 ft·k	N/A	N/A





Secondary Moments

The strength design provisions of TMS 402 require consideration of a secondary moment. Both P-Delta and moment magnifier options are given. The P-delta approach may be used under some conditions and the moment magnifier may be used under all conditions. Both are calculated here for perspective, but per user option the value used for design will be that from the moment magnifier approach.

Cracking Moment

The distance from the neutral axis to the extreme tension fiber 'c_t' is 3.81 in. This distance is calculated based on the effective cross section of the full wall. Note that because the masonry units used in this wall are not symmetrical, this value will be different when the moment is in the opposite direction such that the tension and compression faces are reversed.

$$S_n = I_n / c_t = \left(1{,}041.35\ in^4\right) / \left(3.81\ in\right) = 273.14\ in^3$$

$$f_r = 89.27\ psi$$

$$M_{cr} = S_n f_r = \left(273.14\ in^3\right)\left(89.27\ psi\right) = 2.03\ ft{\cdot}k$$

[NCMA TEK note 14-4B (2008), p. 3]

Secondary Moment Calculation (At Midspan)

Note that the I_{cr} value used here is interpolated from the values in the Section Analysis calculations based on the axial force at this location.

P-Delta

Because $M_{u1} < M_{cr}$, M_u is calculated by:

$$M_u = \frac{M_{u1}}{1 - \frac{5 P_u h^2}{48 E_m I_n}} = \frac{\left(\left(0\ ft{\cdot}k\right)\right)}{\left(1 - \frac{\left(5\left(14.29\ k\right)\left(9\ ft\right)^2\right)}{\left(48\left(1{,}350{,}000\ psi\right)\left(1{,}041.35\ in^4\right)\right)}\right)} = 0\ ft{\cdot}k$$

[Masonry Designers Guide 2016, Eqn 12.4-23 (substituting M_{u1} for first order moment expression)]

Moment Magnifier

Because $M_{u1} < M_{cr}$, $I_{eff} = 0.75 I_n$ = 0.75(1,041.35 in^4) = 781.01 in^4.

$$P_e=\frac{\pi^2 E_m I_{eff}}{h^2}=\left(\frac{\left((3.1416)^2(1{,}350{,}000\ \text{psi})(781.01\ \text{in}^4)\right)}{(9\ \text{ft})^2}\right)=892.16\ \text{k}$$

[TMS 402-16 Section 9.3.5.4.3, Equation 9-29]

$$\psi=\frac{1}{1-\frac{P_u}{P_e}}=\frac{1}{\left(1-\left(\frac{(14.29\ \text{k})}{(892.16\ \text{k})}\right)\right)}=1.0163$$

[TMS 402-16 Section 9.3.5.4.3, Equation 9-28]

$$M_u=\psi M_{u0}=(1.0163)(0\ \text{ft·k})=0\ \text{ft·k}$$

[TMS 402-16 Section 9.3.5.4.3, Equation 9-27]

Secondary Moment Calculation (At Max Moment Location)

Note that the I_{cr} value used here is interpolated from the values in the Section Analysis calculations based on the axial force at this location.

P-Delta

Because $M_{u1} < M_{cr}$, M_u is calculated by:

$$M_u=\frac{M_{u1}}{1-\frac{5P_u h^2}{48E_m I_n}}=\frac{\left((0\ \text{ft·k})\right)}{\left(1-\frac{(5(0\ \text{k})(9\ \text{ft})^2)}{(48(1{,}350{,}000\ \text{psi})(1{,}041.35\ \text{in}^4))}\right)}=0\ \text{ft·k}$$

[Masonry Designers Guide 2016, Eqn 12.4-23 (substituting M_{u1} for first order moment expression)]

Moment Magnifier

Because $M_{u1} < M_{cr}$, $I_{eff} = 0.75I_n$ = 0.75(1,041.35 in^4) = 781.01 in^4.

$$P_e=\frac{\pi^2 E_m I_{eff}}{h^2}=\left(\frac{\left((3.1416)^2(1{,}350{,}000\ \text{psi})(781.01\ \text{in}^4)\right)}{(9\ \text{ft})^2}\right)=892.16\ \text{k}$$

[TMS 402-16 Section 9.3.5.4.3, Equation 9-29]

$$\psi=\frac{1}{1-\frac{P_u}{P_e}}=\frac{1}{\left(1-\left(\frac{(0\ \text{k})}{(892.16\ \text{k})}\right)\right)}=1$$

[TMS 402-16 Section 9.3.5.4.3, Equation 9-28]

$$M_u=\psi M_{u0}=(1)(0\ \text{ft·k})=0\ \text{ft·k}$$

[TMS 402-16 Section 9.3.5.4.3, Equation 9-27]

Strength Checks: Combination 1.4D

Design forces for this load combination:

- P_u @ top = 12.96 k
- P_u @ mid-span = 14.29 k
- P_u @ base = 15.6 k
- P_u @ max moment = 0 k
- M_u @ top = 0 ft·k
- M_u @ mid-span = 0 ft·k
- Max M_u = 0 ft·k
- Max V_u = 0 k

Axial Stress Check

$$\sigma_p=P_u/A_g=(15.6\ \text{k})/(1.49\ \text{ft}^2)=72.57\ \text{psi}$$

[TMS 402-16 Section 9.3.5.4.2]

$\sigma_{pmax} = 0.2f'_m = 0.2\left(1{,}500\text{ psi}\right) = 300\text{ psi}$

[TMS 402-16 Section 9.3.5.4.2]

✔ $\sigma_{Pmax} \geq \sigma_P$ ...utilization ratio 0.242

Axial Stress Check with Slender Wall

$$\frac{h}{t} = \frac{\left(9\text{ ft}\right)}{\left(99{,}999{,}999\text{ in}\right)} = 0$$

[TMS 402-16 Section 9.3.5.4.2]

Slenderness ratio does not exceed 30; check does not apply

✔ $\sigma_{Pmax} \geq \sigma_P$ ...utilization ratio 0

Axial Force Check

$$\frac{h}{r} = \frac{\left(9\text{ ft}\right)}{\left(2.2\text{ in}\right)} = 49.07$$

[TMS 402-16 Section 9.3.4.1.1]

$$P_n = 0.80\left[0.80f'_m\left(A_n - A_{st}\right) + f_y A_{st}\right]\left[1 - \left(\frac{h}{140r}\right)^2\right] = 0.80\left(0.80\left(1{,}500\text{ psi}\right)\left(\left(1.49\text{ ft}^2\right) - \left(0\text{ in}^2\right)\right) + \left(60{,}000\text{ psi}\right)\left(0\text{ in}^2\right)\right)\left(1 - \left(\frac{\left(9\text{ ft}\right)}{\left(140\left(2.2\text{ in}\right)\right)}\right)^2\right) = 180.99\text{ k}$$

[TMS 402-16 Section 9.3.4.1.1, Equation 9-15]

$$\phi P_n = \phi P_n = \left(0.9\right)\left(180.99\text{ k}\right) = 162.89\text{ k}$$

[TMS 402-16 Section 9.1.3, 9.1.4.4]

$P_u = 14.29\text{ k}$

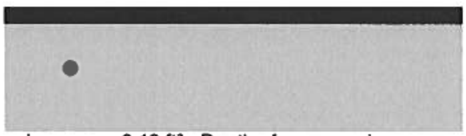
✔ $\phi P_n \geq P_u$ ...utilization ratio 0.088

Moment Check @ Axial Load Application Point

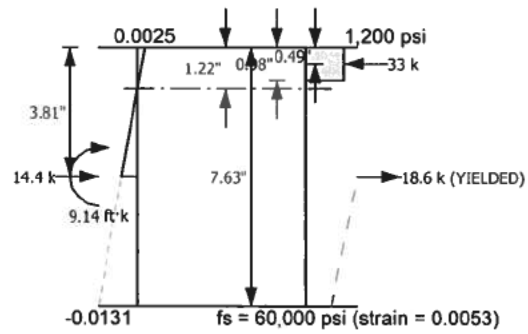
The moment capacity is determined by considering the point on the interaction diagram where ϕP_n is equal to the axial load at this section (12.96 k) and thus P_n = 14.4 k. The associated M_n (9.14 ft·k) is multiplied by ϕ to obtain design moment capacity.

At an axial load of 12.96 k, the interaction diagram gives a moment capacity of -8.23 ft·k.

✔ $\phi M_n \geq M_u$ ...utilization ratio 0



Compression area = 0.19 ft². Depth of compression zone = 0.98 in.

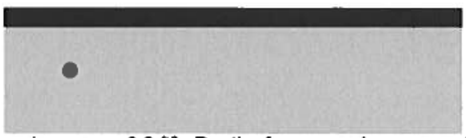


Moment Check @ Mid-span

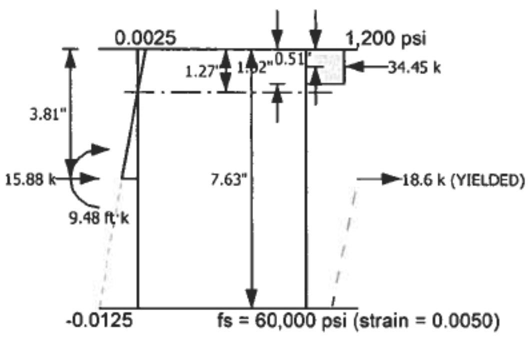
The moment capacity is determined by considering the point on the interaction diagram where ϕP_n is equal to the axial load at this section (14.29 k) and thus P_n = 15.88 k. The associated M_n (9.48 ft·k) is multiplied by ϕ to obtain design moment capacity.

At an axial load of 14.29 k, the interaction diagram gives a moment capacity of -8.54 ft·k.

✔ $\phi M_n \geq M_u$ ...utilization ratio 0



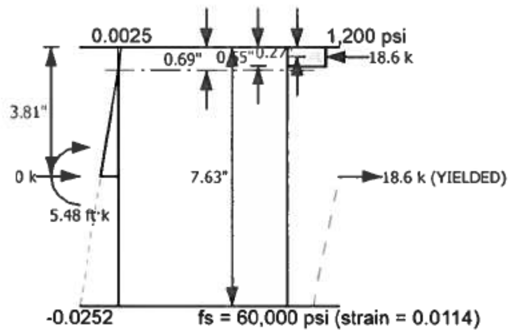
Compression area = 0.2 ft². Depth of compression zone = 1.02 in.



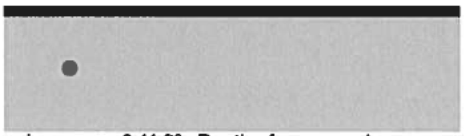
Moment Check @ Max Moment

The moment capacity is determined by considering the point on the interaction diagram where ϕP_n is equal to the axial load at this section (0 k) and thus P_n = 0 k. The associated M_n (5.48 ft·k) is multiplied by ϕ to obtain design moment capacity.

At an axial load of 0 k, the interaction diagram gives a moment capacity of -4.93 ft·k.



✔ $\phi M_n \geq M_u$ ...utilization ratio 0



Compression area = 0.11 ft². Depth of compression zone = 0.55 in.

Shear Check

There is no applied shear force in this load combination; check passes.

✔ $\phi V_n \geq V_u$ ...utilization ratio 0

Maximum Reinforcement Check

Maximum reinforcement is checked based on the provisions of TMS 402-16 9.3.3.2.

$$\frac{M_u}{V_u d_v} = \frac{(0\ \text{ft·k})}{((0\ \text{k})(99{,}999{,}999\ \text{in}))} = 0$$

[TMS 402-16 Section 9.3.4.1.2]

Because this ratio does not exceed 1.0 and R <= 1.5, there is no limit on flexural tensile reinforcement.

✔ $\varepsilon_s \geq \varepsilon_{min}$ ...utilization ratio 0

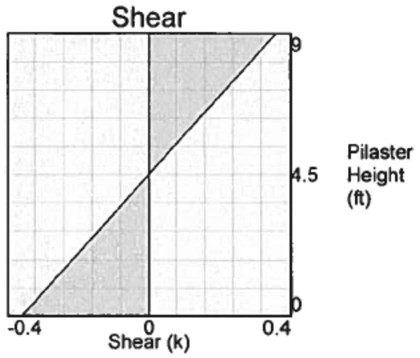
Strength Checks Design Calculations for Combination 1.2D + 1.6L

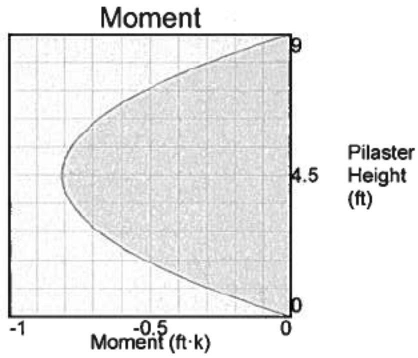
Load Combination: 1.2D + 1.6L

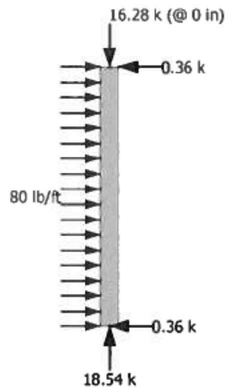
Pilaster weight: The unfactored weight is 1.88 k, of which 1.35 k is from the wall portion(s) and 0.53 k is from the 'column' portion.

Factored Pilaster weight = 2.26 k (total), 250.75 lb/ft (linear per height).

	Axial Force (k)	Shear (k)	Moment (ft·k)	P-δ Moment (ft·k)	Mag. Moment (ft·k)
9 ft from base	16.28 k	0.36 k	0 ft·k	N/A	N/A
4.45 ft from base	17.42 k	0 k	-0.81 ft·k	-0.82 ft·k	-0.83 ft·k
0 ft from base	18.54 k	-0.36 k	0 ft·k	N/A	N/A







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Cracking Moment (At Midspan)

The distance from the neutral axis to the extreme tension fiber 'c_t' is 3.81 in. This distance is calculated based on the effective cross section of the full wall. Note that because the masonry units used in this wall are not symmetrical, this value will be different when the moment is in the opposite direction such that the tension and compression faces are reversed.

$$S_n = I_n/c_t = \left(1{,}041.35\ in^4\right)/\left(3.81\ in\right) = 273.14\ in^3$$

$$f_r = 89.27\ psi$$

$$M_{cr} = S_n f_r = \left(273.14\ in^3\right)\left(89.27\ psi\right) = 2.03\ ft{\cdot}k$$

[NCMA TEK note 14-4B (2008), p. 3]

Cracking Moment (At Max Moment Location)

The distance from the neutral axis to the extreme tension fiber 'c_t' is 3.81 in. This distance is calculated based on the effective cross section of the full wall. Note that because the masonry units used in this wall are not symmetrical, this value will be different when the moment is in the opposite direction such that the tension and compression faces are reversed.

$$S_n = I_n/c_t = \left(1{,}041.35\ in^4\right)/\left(3.81\ in\right) = 273.14\ in^3$$

$$f_r = 89.27\ psi$$

$$M_{cr} = S_n f_r = \left(273.14\ in^3\right)\left(89.27\ psi\right) = 2.03\ ft{\cdot}k$$

[NCMA TEK note 14-4B (2008), p. 3]

Secondary Moment Calculation (At Midspan)

Note that the I_{cr} value used here is interpolated from the values in the Section Analysis calculations based on the axial force at this location.

P-Delta

Because $M_{u1} < M_{cr}$, M_u is calculated by:

$$M_u = \frac{M_{u1}}{1-\frac{5P_u h^2}{48E_m I_n}} = \left(\frac{((-0.81\ ft{\cdot}k))}{1-\frac{(5(17.42\ k)(9\ ft)^2)}{(48(1,350,000\ psi)(1,041.35\ in^4))}}\right) = -0.82\ ft{\cdot}k$$

[Masonry Designers Guide 2016, Eqn 12.4-23 (substituting M_{u1} for first order moment expression)]

Moment Magnifier

Because $M_{u1} < M_{cr}$, $I_{eff} = 0.75I_n = 0.75(1{,}041.35\ in^4) = 781.01\ in^4$.

$$P_e = \frac{\pi^2 E_m I_{eff}}{h^2} = \left(\frac{((3.1416)^2(1,350,000\ psi)(781.01\ in^4))}{(9\ ft)^2}\right) = 892.16\ k$$

[TMS 402-16 Section 9.3.5.4.3, Equation 9-29]

$$\psi = \frac{1}{1-\frac{P_u}{P_e}} = \frac{1}{\left(1-\left(\frac{(17.42\ k)}{(892.16\ k)}\right)\right)} = 1.0199$$

[TMS 402-16 Section 9.3.5.4.3, Equation 9-28]

$$M_u = \psi M_{u0} = (1.0199)(-0.81\ ft{\cdot}k) = -0.83\ ft{\cdot}k$$

[TMS 402-16 Section 9.3.5.4.3, Equation 9-27]

Strength Checks: Combination 1.2D + 1.6L

Design forces for this load combination:

- P_u @ top = 16.28 k
- P_u @ mid-span = 17.42 k
- P_u @ base = 18.54 k
- P_u @ max moment = 18.54 k
- M_u @ top = 0 ft·k
- M_u @ mid-span = -0.81 ft·k
- Max M_u = 0 ft·k
- Max V_u = 0.36 k

Axial Stress Check

$$\sigma_p = P_u/A_g = (18.54\ k)/(1.49\ ft^2) = 86.25\ psi$$

[TMS 402-16 Section 9.3.5.4.2]

$$\sigma_{pmax} = 0.2f'_m = 0.2(1,500\ psi) = 300\ psi$$

[TMS 402-16 Section 9.3.5.4.2]

✔ $\sigma_{Pmax} \geq \sigma_P$ ...utilization ratio 0.287

Axial Stress Check with Slender Wall

$$\frac{h}{t} = \frac{(9\ ft)}{(99,999,999\ in)} = 0$$

[TMS 402-16 Section 9.3.5.4.2]

Slenderness ratio does not exceed 30; check does not apply

✔ $\sigma_{Pmax} \geq \sigma_P$ ...utilization ratio 0

Axial Force Check

$$\frac{h}{r} = \frac{(9\ ft)}{(2.2\ in)} = 49.07$$

[TMS 402-16 Section 9.3.4.1.1]

$$P_n = 0.80\left[0.80f'_m\left(A_n - A_{st}\right) + f_yA_{st}\right]\left[1-\left(\frac{h}{140r}\right)^2\right] = 0.80\left(0.80\left(1{,}500\text{ psi}\right)\left(\left(1.49\text{ ft}^2\right)-\left(0\text{ in}^2\right)\right)+\left(60{,}000\text{ psi}\right)\left(0\text{ in}^2\right)\right)\left(1-\left(\frac{(9\text{ ft})}{\left(140\left(2.2\text{ in}\right)\right)}\right)^2\right) = 180.99\text{ k}$$

[TMS 402-16 Section 9.3.4.1.1, Equation 9-15]

$\phi P_n = \phi P_n = (0.9)(180.99\text{ k}) = 162.89\text{ k}$

[TMS 402-16 Section 9.1.3, 9.1.4.4]

$P_u = 17.42\text{ k}$

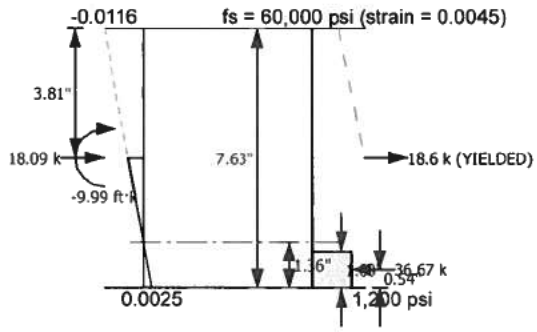
✔ $\phi P_n \geq P_u$ ...utilization ratio 0.107

Moment Check @ Axial Load Application Point

The moment capacity is determined by considering the point on the interaction diagram where ϕP_n is equal to the axial load at this section (16.28 k) and thus P_n = 18.09 k. The associated M_n (-9.99 ft·k) is multiplied by ϕ to obtain design moment capacity.

At an axial load of 16.28 k, the interaction diagram gives a moment capacity of 8.99 ft·k.

✔ $\phi M_n \geq M_u$ ...utilization ratio 0



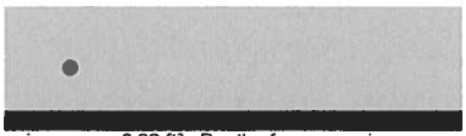
Compression area = 0.21 ft². Depth of compression zone = 1.08 in.

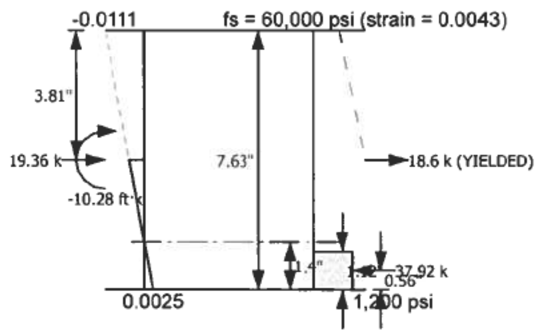
Moment Check @ Mid-span

The moment capacity is determined by considering the point on the interaction diagram where ϕP_n is equal to the axial load at this section (17.42 k) and thus P_n = 19.36 k. The associated M_n (-10.28 ft·k) is multiplied by ϕ to obtain design moment capacity.

At an axial load of 17.42 k, the interaction diagram gives a moment capacity of 9.25 ft·k.

✔ $\phi M_n \geq M_u$ ...utilization ratio 0.088





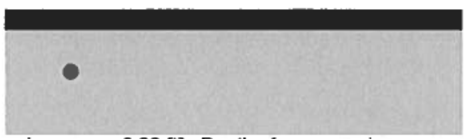
Compression area = 0.22 ft². Depth of compression zone = 1.12 in.

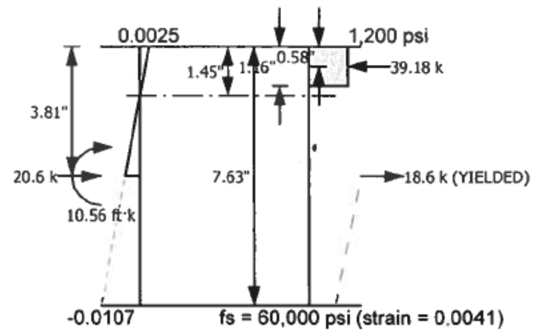
Moment Check @ Max Moment

The moment capacity is determined by considering the point on the interaction diagram where ϕP_n is equal to the axial load at this section (18.54 k) and thus P_n = 20.6 k. The associated M_n (10.56 ft·k) is multiplied by ϕ to obtain design moment capacity.

At an axial load of 18.54 k, the interaction diagram gives a moment capacity of -9.5 ft·k.

✔ $\phi M_n \geq M_u$ ...utilization ratio 0





Compression area = 0.23 ft². Depth of compression zone = 1.16 in.

Shear Check

The net shear area is taken as the area bounded by the extreme compression fiber and the reinforcement nearest the opposite face, subject to the effective compression width.

A_{nv}= 0.75 ft²

Shear capacity due to masonry, conservatively taking M/Vd = 1.0:

$$V_{nm}=\left[4.0-1.75(1.0)\right]A_{nv}\sqrt{f'_m}+0.25P_u=\left(4.0-1.75(1.0)\right)\left(0.75\text{ ft}^2\right)\sqrt{(1{,}500\text{ psi})}+0.25(18.54\text{ k})=14\text{ k}$$

[TMS 402-16 Section 9.3.4.1.2.1, Equation 9-20 with conservative M/Vd = 1.0]

No reinforcement for out-of-plane shear:

$$V_{ns}=0\text{ k}$$

Nominal shear capacity:

$$V_n=\left(V_{nm}+V_{ns}\right)\gamma_g=\left((14\text{ k})+(0\text{ k})\right)(1)=14\text{ k}$$

[TMS 402-16 Section 9.3.4.1.2, Equation 9-17]

Limited by:

$$V_{n\_limit}=\left(4A_{nv}\sqrt{f'_m}\right)\gamma_g=\left(4\left(0.75\text{ ft}^2\right)\sqrt{(1{,}500\text{ psi})}\right)(1)=16.65\text{ k}$$

[TMS 402-16 Section 9.3.4.1.2, Equation 9-19]

...Limit on V_n does not control

$$\phi V_n=\phi V_n=(0.8)(14\text{ k})=11.2\text{ k}$$

[TMS 402-16 Section 9.1.3, 9.1.4.5]

✔ $\phi V_n \geq V_u$ ...utilization ratio 0.032

Maximum Reinforcement Check

Maximum reinforcement is checked based on the provisions of TMS 402-16 9.3.3.2.

$$\frac{M_u}{V_u d_v}=\frac{(0\text{ ft}\cdot\text{k})}{\left((0.36\text{ k})(99{,}999{,}999\text{ in})\right)}=0$$

[TMS 402-16 Section 9.3.4.1.2]

Because this ratio does not exceed 1.0 and R <= 1.5, there is no limit on flexural tensile reinforcement.

✔ $\varepsilon_s \geq \varepsilon_{min}$ ...utilization ratio 0

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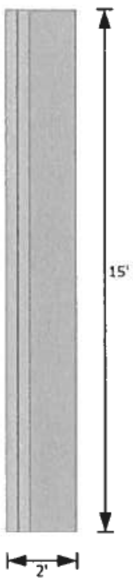
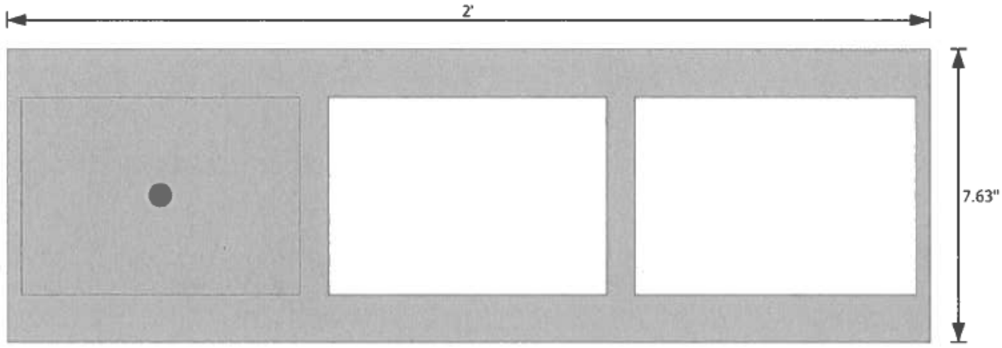
Masonry Pilaster Design Calculations





Design Criteria

Building Code: TMS 402-2016 (Strength Design)
Choose Load Combinations Manually: Yes
Strength Check Load Combinations: ASCE 7-16 Strength Combinations
Service Check Load Combinations: ASCE 7-16 ASD Combinations
Apply Sds to Seismic Combinations for Ev: No
f'm: 1500 psi
fy: 60000 psi
Mortar Type: Type M/S - PCL (Portland Cement/Lime)

Material (CMU/Clay): Taken from Unit
Average Unit Weight: 140 lb/ft^3
Secondary Moment Approach: Moment Magnifier
Include Self-Weight: Yes
Include Weight In Virtual Eccentricity: No

Checks Summary

☐	Ratio	Check	Critical Combination
Strength Checks			
✔	0.269	Axial Stress	1.2D + 1.6L
✔	0.000	Axial Stress (slender)	1.4D
✔	0.127	Axial Force	1.2D + 1.6L
✔	0.124	Shear	0.9D + 1Wind$_{C\&C+Wall}$
✔	0.726	Moment	0.9D + 1Wind$_{C\&C+Wall}$
✔	0.000	Max Reinforcement	1.4D
Service Checks			
✔	0.081	Deflection (TMS)	1D + 0.6Wind$_{C\&C+Wall}$
✔	0.056	Deflection (IBC)	1D + 0.6Wind$_{C\&C+Wall}$

☐	Ratio	Check

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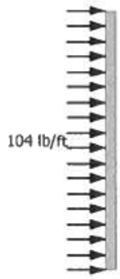
Applied Loads

Dead [Source: Dead]

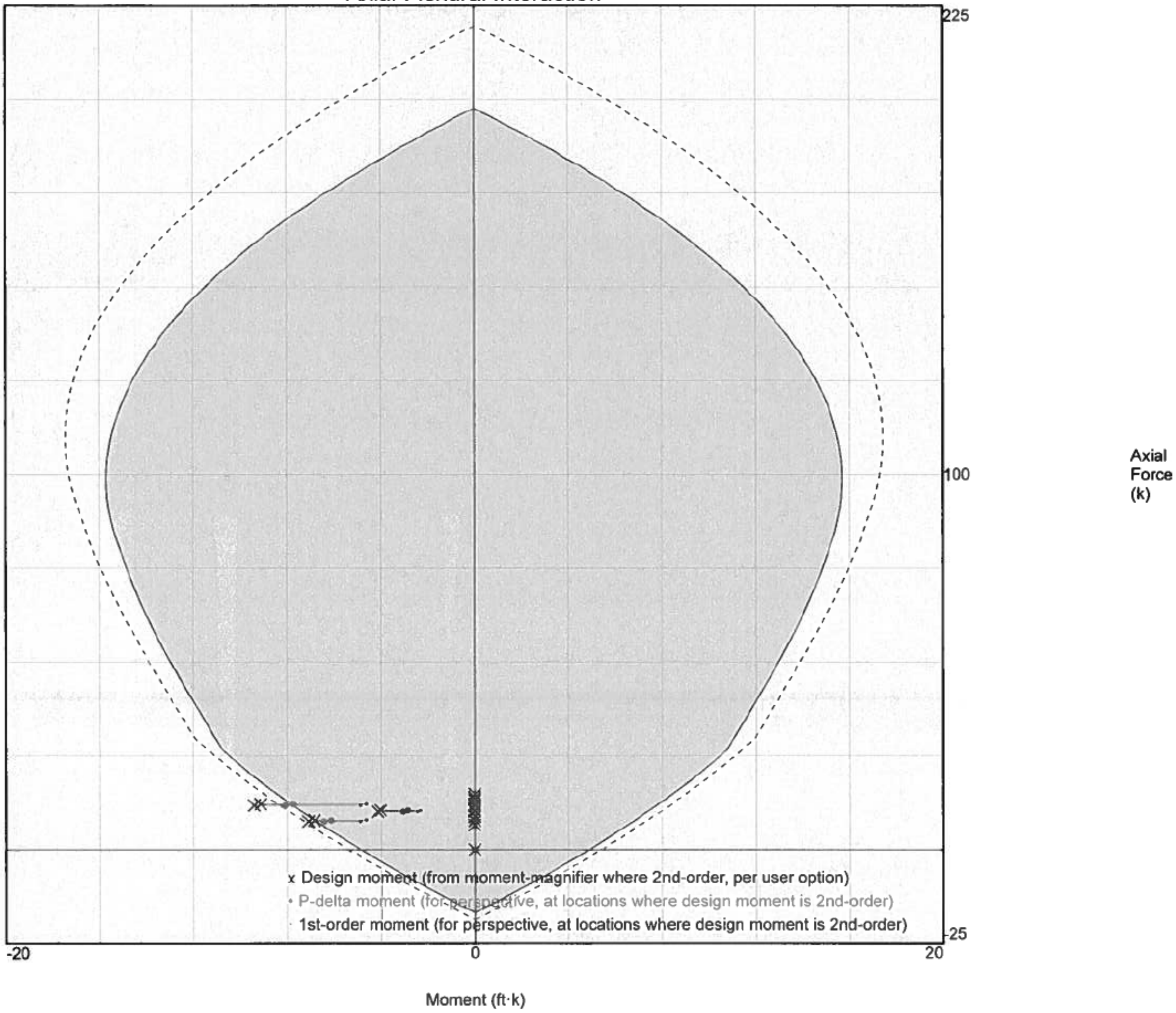
Live [Source: Live]

Wind [Source: WindCnCPositiveOnWall]

Wind2 [Source: WindCnCPositiveOnWall]



Axial-Flexural Interaction



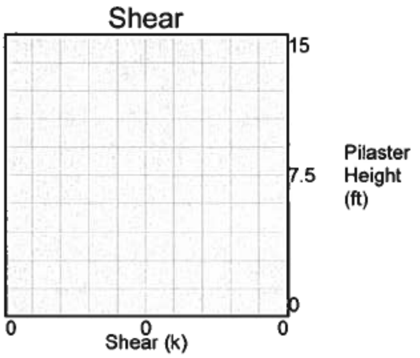
Strength Checks Design Calculations for Combination 1.4D

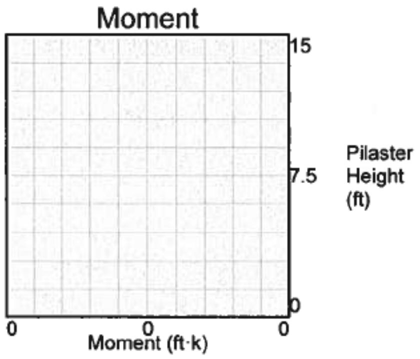
Load Combination: 1.4D

Pilaster weight: The unfactored weight is 2.67 k, of which 1.78 k is from the wall portion(s) and 0.89 k is from the 'column' portion.

Factored Pilaster weight = 3.74 k (total), 249.08 lb/ft (linear per height).

	Axial Force (k)	Shear (k)	Moment (ft·k)	P-δ Moment (ft·k)	Mag. Moment (ft·k)
15 ft from base	0 k	0 k	0 ft·k	0 ft·k	0 ft·k
	10.22 k	0 k	0 ft·k	N/A	N/A
7.42 ft from base	12.11 k	0 k	0 ft·k	0 ft·k	0 ft·k
0 ft from base	13.96 k	0 k	0 ft·k	N/A	N/A





Secondary Moments

The strength design provisions of TMS 402 require consideration of a secondary moment. Both P-Delta and moment magnifier options are given. The P-delta approach may be used under some conditions and the moment magnifier may be used under all conditions. Both are calculated here for perspective, but per user option the value used for design will be that from the moment magnifier approach.

Cracking Moment

The distance from the neutral axis to the extreme tension fiber 'c_t' is 3.81 in. This distance is calculated based on the effective cross section of the full wall. Note that because the masonry units used in this wall are not symmetrical, this value will be different when the moment is in the opposite direction such that the tension and compression faces are reversed.

$$S_n = I_n/c_t = \left(886.64\ \text{in}^4\right)/\left(3.81\ \text{in}\right) = 232.56\ \text{in}^3$$

$$f_r = 89.27\ \text{psi}$$

$$M_{cr} = S_n f_r = \left(232.56\ \text{in}^3\right)\left(89.27\ \text{psi}\right) = 1.73\ \text{ft·k}$$

[NCMA TEK note 14-4B (2008), p. 3]

Secondary Moment Calculation (At Midspan)

Note that the I_{cr} value used here is interpolated from the values in the Section Analysis calculations based on the axial force at this location.

P-Delta

Because $M_{u1} < M_{cr}$, M_u is calculated by:

$$M_u = \frac{M_{u1}}{1-\frac{5P_u h^2}{48E_m I_n}} = \frac{\left(\left(0\ \text{ft·k}\right)\right)}{\left(1-\frac{\left(5\left(12.11\ \text{k}\right)\left(15\ \text{ft}\right)^2\right)}{\left(48\left(1{,}350{,}000\ \text{psi}\right)\left(886.64\ \text{in}^4\right)\right)}\right)} = 0\ \text{ft·k}$$

[Masonry Designers Guide 2016, Eqn 12.4-23 (substituting M_{u1} for first order moment expression)]

Moment Magnifier

Because $M_{u1} < M_{cr}$, $I_{eff} = 0.75 I_n$ = 0.75(886.64 in^4) = 664.98 in^4.

$$P_e=\frac{\pi^2 E_m I_{eff}}{h^2}=\left(\frac{\left((3.1416)^2(1{,}350{,}000\text{ psi})(664.98\text{ in}^4)\right)}{(15\text{ ft})^2}\right)=273.46\text{ k}$$

[TMS 402-16 Section 9.3.5.4.3, Equation 9-29]

$$\psi=\frac{1}{1-\frac{P_u}{P_e}}=\frac{1}{\left(1-\left(\frac{(12.11\text{ k})}{(273.46\text{ k})}\right)\right)}=1.0463$$

[TMS 402-16 Section 9.3.5.4.3, Equation 9-28]

$$M_u=\psi M_{u0}=(1.0463)(0\text{ ft}\cdot\text{k})=0\text{ ft}\cdot\text{k}$$

[TMS 402-16 Section 9.3.5.4.3, Equation 9-27]

Secondary Moment Calculation (At Max Moment Location)

Note that the I_{cr} value used here is interpolated from the values in the Section Analysis calculations based on the axial force at this location.

P-Delta

Because $M_{u1} < M_{cr}$, M_u is calculated by:

$$M_u=\frac{M_{u1}}{1-\frac{5P_u h^2}{48E_m I_n}}=\frac{((0\text{ ft}\cdot\text{k}))}{\left(1-\frac{(5(0\text{ k})(15\text{ ft})^2)}{(48(1{,}350{,}000\text{ psi})(886.64\text{ in}^4))}\right)}=0\text{ ft}\cdot\text{k}$$

[Masonry Designers Guide 2016, Eqn 12.4-23 (substituting M_{u1} for first order moment expression)]

Moment Magnifier

Because $M_{u1} < M_{cr}$, $I_{eff} = 0.75I_n$ = 0.75(886.64 in^4) = 664.98 in^4.

$$P_e=\frac{\pi^2 E_m I_{eff}}{h^2}=\left(\frac{\left((3.1416)^2(1{,}350{,}000\text{ psi})(664.98\text{ in}^4)\right)}{(15\text{ ft})^2}\right)=273.46\text{ k}$$

[TMS 402-16 Section 9.3.5.4.3, Equation 9-29]

$$\psi=\frac{1}{1-\frac{P_u}{P_e}}=\frac{1}{\left(1-\left(\frac{(0\text{ k})}{(273.46\text{ k})}\right)\right)}=1$$

[TMS 402-16 Section 9.3.5.4.3, Equation 9-28]

$$M_u=\psi M_{u0}=(1)(0\text{ ft}\cdot\text{k})=0\text{ ft}\cdot\text{k}$$

[TMS 402-16 Section 9.3.5.4.3, Equation 9-27]

Strength Checks: Combination 1.4D

Design forces for this load combination:

- P_u @ top = 10.22 k
- P_u @ mid-span = 12.11 k
- P_u @ base = 13.96 k
- P_u @ max moment = 0 k
- M_u @ top = 0 ft·k
- M_u @ mid-span = 0 ft·k
- Max M_u = 0 ft·k
- Max V_u = 0 k

Axial Stress Check

$$\sigma_p=P_u/A_g=(13.96\text{ k})/(1.27\text{ ft}^2)=76.26\text{ psi}$$

[TMS 402-16 Section 9.3.5.4.2]

$\sigma_{pmax} = 0.2f'_m = 0.2(1{,}500\ \text{psi}) = 300\ \text{psi}$

[TMS 402-16 Section 9.3.5.4.2]

✔ $\sigma_{Pmax} \geq \sigma_P$ ...utilization ratio 0.254

Axial Stress Check with Slender Wall

$$\frac{h}{t} = \frac{(15\ \text{ft})}{(99{,}999{,}999\ \text{in})} = 0$$

[TMS 402-16 Section 9.3.5.4.2]

Slenderness ratio does not exceed 30; check does not apply

✔ $\sigma_{Pmax} \geq \sigma_P$ ...utilization ratio 0

Axial Force Check

$$\frac{h}{r} = \frac{(15\ \text{ft})}{(2.2\ \text{in})} = 81.78$$

[TMS 402-16 Section 9.3.4.1.1]

$$P_n = 0.80\left[0.80f'_m\left(A_n - A_{st}\right) + f_y A_{st}\right]\left[1 - \left(\frac{h}{140r}\right)^2\right] = 0.80\left(0.80\left(1{,}500\ \text{psi}\right)\left(\left(1.27\ \text{ft}^2\right) - \left(0\ \text{in}^2\right)\right) + \left(60{,}000\ \text{psi}\right)\left(0\ \text{in}^2\right)\right)\left(1 - \left(\frac{(15\ \text{ft})}{(140(2.2\ \text{in}))}\right)^2\right) = 115.74\ \text{k}$$

[TMS 402-16 Section 9.3.4.1.1, Equation 9-15]

$\phi P_n = \phi P_n = (0.9)(115.74\ \text{k}) = 104.17\ \text{k}$

[TMS 402-16 Section 9.1.3, 9.1.4.4]

$P_u = 12.11\ \text{k}$

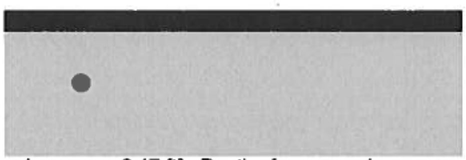
✔ $\phi P_n \geq P_u$ ...utilization ratio 0.116

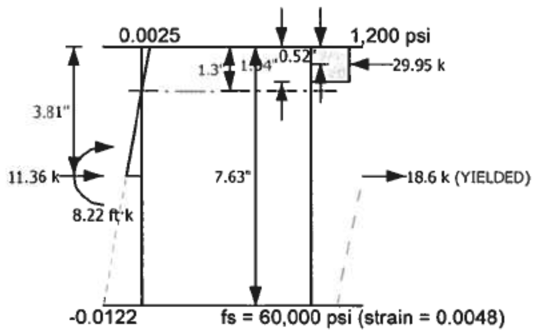
Moment Check @ Axial Load Application Point

The moment capacity is determined by considering the point on the interaction diagram where ϕP_n is equal to the axial load at this section (10.22 k) and thus P_n = 11.36 k. The associated M_n (8.22 ft·k) is multiplied by ϕ to obtain design moment capacity.

At an axial load of 10.22 k, the interaction diagram gives a moment capacity of -7.4 ft·k.

✔ $\phi M_n \geq M_u$ ...utilization ratio 0





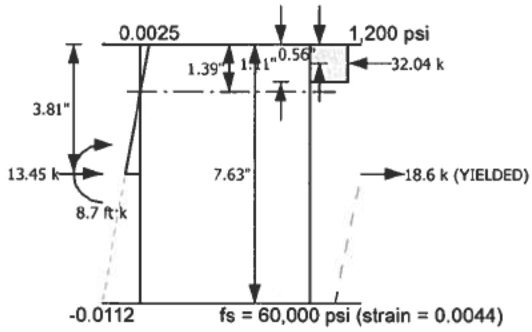
Compression area = 0.17 ft². Depth of compression zone = 1.04 in.

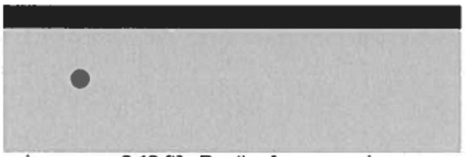
Moment Check @ Mid-span

The moment capacity is determined by considering the point on the interaction diagram where ϕP_n is equal to the axial load at this section (12.11 k) and thus P_n = 13.45 k. The associated M_n (8.7 ft·k) is multiplied by ϕ to obtain design moment capacity.

At an axial load of 12.11 k, the interaction diagram gives a moment capacity of -7.83 ft·k.

✔ $\phi M_n \geq M_u$ ...utilization ratio 0





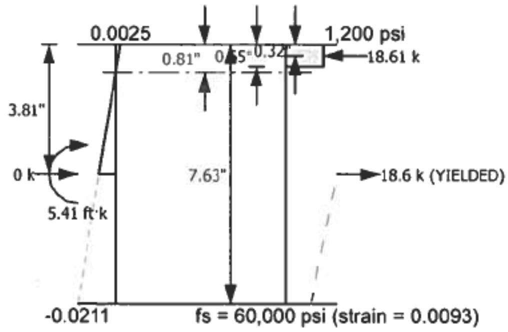
Compression area = 0.19 ft². Depth of compression zone = 1.11 in.

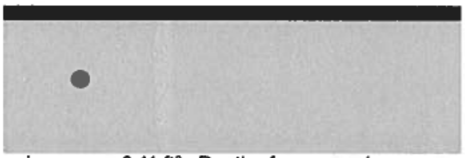
Moment Check @ Max Moment

The moment capacity is determined by considering the point on the interaction diagram where ϕP_n is equal to the axial load at this section (0 k) and thus P_n = 0 k. The associated M_n (5.41 ft·k) is multiplied by ϕ to obtain design moment capacity.

At an axial load of 0 k, the interaction diagram gives a moment capacity of -4.87 ft·k.

✔ $\phi M_n \geq M_u$ ...utilization ratio 0





Compression area = 0.11 ft². Depth of compression zone = 0.65 in.

Shear Check

There is no applied shear force in this load combination; check passes.

✔ $\phi V_n \geq V_u$ ...utilization ratio 0

Maximum Reinforcement Check

Maximum reinforcement is checked based on the provisions of TMS 402-16 9.3.3.2.

$$\frac{M_u}{V_u d_v} = \frac{(0\ \text{ft·k})}{((0\ \text{k})(99{,}999{,}999\ \text{in}))} = 0$$

[TMS 402-16 Section 9.3.4.1.2]

Because this ratio does not exceed 1.0 and R <= 1.5, there is no limit on flexural tensile reinforcement.

✔ $\varepsilon_s \geq \varepsilon_{min}$ ...utilization ratio 0

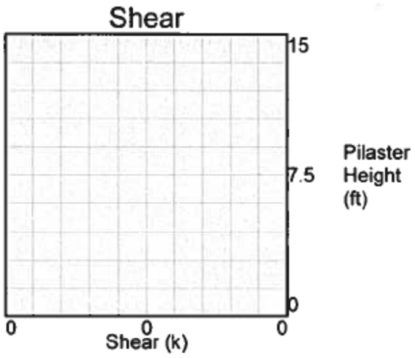
Strength Checks Design Calculations for Combination 1.2D + 1.6L

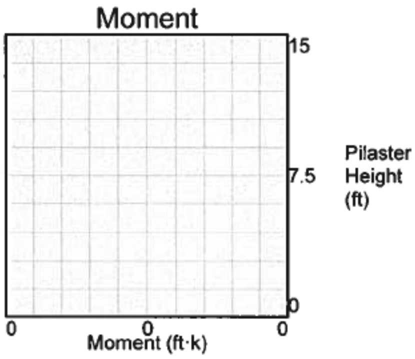
Load Combination: 1.2D + 1.6L

Pilaster weight: The unfactored weight is 2.67 k, of which 1.78 k is from the wall portion(s) and 0.89 k is from the 'column' portion.

Factored Pilaster weight = 3.2 k (total), 213.5 lb/ft (linear per height).

	Axial Force (k)	Shear (k)	Moment (ft·k)	P-δ Moment (ft·k)	Mag. Moment (ft·k)
15 ft from base	0 k	0 k	0 ft·k	0 ft·k	0 ft·k
	11.58 k	0 k	0 ft·k	N/A	N/A
7.42 ft from base	13.19 k	0 k	0 ft·k	0 ft·k	0 ft·k
0 ft from base	14.78 k	0 k	0 ft·k	N/A	N/A





Secondary Moments

The strength design provisions of TMS 402 require consideration of a secondary moment. Both P-Delta and moment magnifier options are given. The P-delta approach may be used under some conditions and the moment magnifier may be used under all conditions. Both are calculated here for perspective, but per user option the value used for design will be that from the moment magnifier approach.

Cracking Moment

The distance from the neutral axis to the extreme tension fiber 'c_t' is 3.81 in. This distance is calculated based on the effective cross section of the full wall. Note that because the masonry units used in this wall are not symmetrical, this value will be different when the moment is in the opposite direction such that the tension and compression faces are reversed.

$$S_n = I_n/c_t = \left(886.64\ in^4\right)/\left(3.81\ in\right) = 232.56\ in^3$$

$$f_r = 89.27\ psi$$

$$M_{cr} = S_n f_r = \left(232.56\ in^3\right)\left(89.27\ psi\right) = 1.73\ ft{\cdot}k$$

[NCMA TEK note 14-4B (2008), p. 3]

Secondary Moment Calculation (At Midspan)

Note that the I_{cr} value used here is interpolated from the values in the Section Analysis calculations based on the axial force at this location.

P-Delta

Because $M_{u1} < M_{cr}$, M_u is calculated by:

$$M_u = \frac{M_{u1}}{1-\frac{5P_u h^2}{48E_m I_n}} = \frac{\left(\left(0\ ft{\cdot}k\right)\right)}{\left(1-\frac{\left(5\left(13.19\ k\right)\left(15\ ft\right)^2\right)}{\left(48\left(1{,}350{,}000\ psi\right)\left(886.64\ in^4\right)\right)}\right)} = 0\ ft{\cdot}k$$

[Masonry Designers Guide 2016, Eqn 12.4-23 (substituting M_{u1} for first order moment expression)]

Moment Magnifier

Because $M_{u1} < M_{cr}$, $I_{eff} = 0.75I_n = 0.75(886.64\ in^4) = 664.98\ in^4$.

$$P_e=\frac{\pi^2 E_m I_{eff}}{h^2}=\left(\frac{\left((3.1416)^2(1{,}350{,}000\text{ psi})(664.98\text{ in}^4)\right)}{(15\text{ ft})^2}\right)=273.46\text{ k}$$

[TMS 402-16 Section 9.3.5.4.3, Equation 9-29]

$$\psi=\frac{1}{1-\frac{P_u}{P_e}}=\frac{1}{\left(1-\left(\frac{(13.19\text{ k})}{(273.46\text{ k})}\right)\right)}=1.0507$$

[TMS 402-16 Section 9.3.5.4.3, Equation 9-28]

$$M_u=\psi M_{u0}=(1.0507)(0\text{ ft·k})=0\text{ ft·k}$$

[TMS 402-16 Section 9.3.5.4.3, Equation 9-27]

Secondary Moment Calculation (At Max Moment Location)

Note that the I_{cr} value used here is interpolated from the values in the Section Analysis calculations based on the axial force at this location.

P-Delta

Because $M_{u1} < M_{cr}$, M_u is calculated by:

$$M_u=\frac{M_{u1}}{1-\frac{5P_u h^2}{48E_m I_n}}=\frac{((0\text{ ft·k}))}{\left(1-\frac{(5(0\text{ k})(15\text{ ft})^2)}{(48(1{,}350{,}000\text{ psi})(886.64\text{ in}^4))}\right)}=0\text{ ft·k}$$

[Masonry Designers Guide 2016, Eqn 12.4-23 (substituting M_{u1} for first order moment expression)]

Moment Magnifier

Because $M_{u1} < M_{cr}$, I_{eff} = 0.75I_n = 0.75(886.64 in^4) = 664.98 in^4.

$$P_e=\frac{\pi^2 E_m I_{eff}}{h^2}=\left(\frac{\left((3.1416)^2(1{,}350{,}000\text{ psi})(664.98\text{ in}^4)\right)}{(15\text{ ft})^2}\right)=273.46\text{ k}$$

[TMS 402-16 Section 9.3.5.4.3, Equation 9-29]

$$\psi=\frac{1}{1-\frac{P_u}{P_e}}=\frac{1}{\left(1-\left(\frac{(0\text{ k})}{(273.46\text{ k})}\right)\right)}=1$$

[TMS 402-16 Section 9.3.5.4.3, Equation 9-28]

$$M_u=\psi M_{u0}=(1)(0\text{ ft·k})=0\text{ ft·k}$$

[TMS 402-16 Section 9.3.5.4.3, Equation 9-27]

Strength Checks: Combination 1.2D + 1.6L

Design forces for this load combination:

- P_u @ top = 11.58 k
- P_u @ mid-span = 13.19 k
- P_u @ base = 14.78 k
- P_u @ max moment = 0 k
- M_u @ top = 0 ft·k
- M_u @ mid-span = 0 ft·k
- Max M_u = 0 ft·k
- Max V_u = 0 k

Axial Stress Check

$$\sigma_p=P_u/A_g=(14.78\text{ k})/(1.27\text{ ft}^2)=80.76\text{ psi}$$

[TMS 402-16 Section 9.3.5.4.2]

$$\sigma_{pmax} = 0.2f'_m = 0.2(1{,}500 \text{ psi}) = 300 \text{ psi}$$

[TMS 402-16 Section 9.3.5.4.2]

✔ $\sigma_{Pmax} \geq \sigma_P$ ...utilization ratio 0.269

Axial Stress Check with Slender Wall

$$\frac{h}{t} = \frac{(15 \text{ ft})}{(99{,}999{,}999 \text{ in})} = 0$$

[TMS 402-16 Section 9.3.5.4.2]

Slenderness ratio does not exceed 30; check does not apply

✔ $\sigma_{Pmax} \geq \sigma_P$ ...utilization ratio 0

Axial Force Check

$$\frac{h}{r} = \frac{(15 \text{ ft})}{(2.2 \text{ in})} = 81.78$$

[TMS 402-16 Section 9.3.4.1.1]

$$P_n = 0.80\left[0.80f'_m(A_n - A_{st}) + f_y A_{st}\right]\left[1 - \left(\frac{h}{140r}\right)^2\right] = 0.80(0.80(1{,}500 \text{ psi})((1.27 \text{ ft}^2) - (0 \text{ in}^2)) + (60{,}000 \text{ psi})(0 \text{ in}^2))\left(1 - \left(\frac{(15 \text{ ft})}{(140(2.2 \text{ in}))}\right)^2\right) = 115.74 \text{ k}$$

[TMS 402-16 Section 9.3.4.1.1, Equation 9-15]

$$\phi P_n = \phi P_n = (0.9)(115.74 \text{ k}) = 104.17 \text{ k}$$

[TMS 402-16 Section 9.1.3, 9.1.4.4]

$$P_u = 13.19 \text{ k}$$

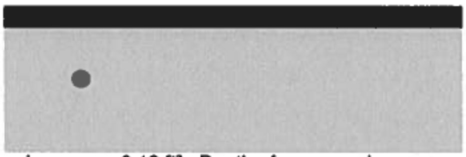
✔ $\phi P_n \geq P_u$ ...utilization ratio 0.127

Moment Check @ Axial Load Application Point

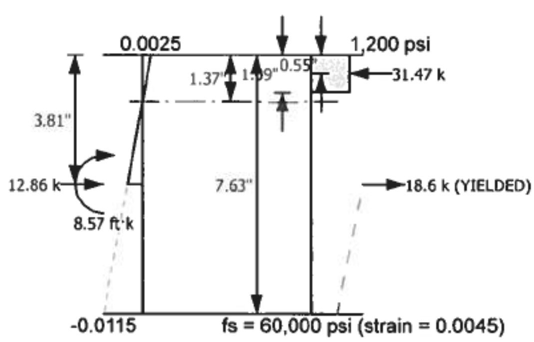
The moment capacity is determined by considering the point on the interaction diagram where ϕP_n is equal to the axial load at this section (11.58 k) and thus P_n = 12.86 k. The associated M_n (8.57 ft·k) is multiplied by ϕ to obtain design moment capacity.

At an axial load of 11.58 k, the interaction diagram gives a moment capacity of -7.71 ft·k.

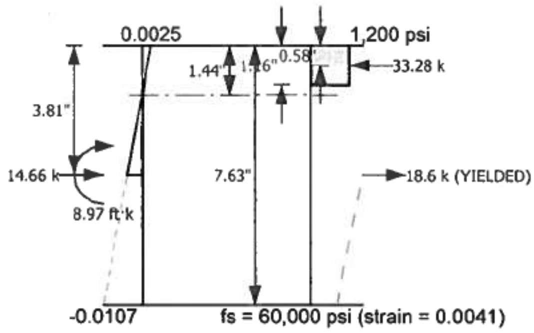
✔ $\phi M_n \geq M_u$ ...utilization ratio 0



Compression area = 0.18 ft². Depth of compression zone = 1.09 in.



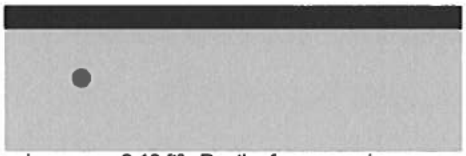
Moment Check @ Mid-span



The moment capacity is determined by considering the point on the interaction diagram where ϕP_n is equal to the axial load at this section (13.19 k) and thus P_n = 14.66 k. The associated M_n (8.97 ft·k) is multiplied by ϕ to obtain design moment capacity.

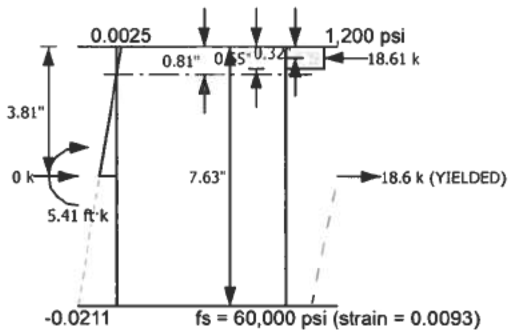
At an axial load of 13.19 k, the interaction diagram gives a moment capacity of -8.07 ft·k.

✔ $\phi M_n \geq M_u$ ...utilization ratio 0



Compression area = 0.19 ft². Depth of compression zone = 1.16 in.

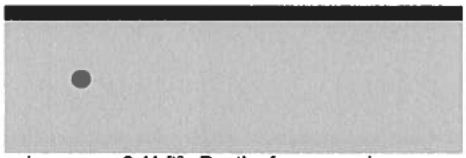
Moment Check @ Max Moment



The moment capacity is determined by considering the point on the interaction diagram where ϕP_n is equal to the axial load at this section (0 k) and thus P_n = 0 k. The associated M_n (5.41 ft·k) is multiplied by ϕ to obtain design moment capacity.

At an axial load of 0 k, the interaction diagram gives a moment capacity of -4.87 ft·k.

✔ $\phi M_n \geq M_u$ ...utilization ratio 0



Compression area = 0.11 ft². Depth of compression zone = 0.65 in.

Shear Check

There is no applied shear force in this load combination; check passes.

✔ $\phi V_n \geq V_u$ ...utilization ratio 0

Maximum Reinforcement Check

Maximum reinforcement is checked based on the provisions of TMS 402-16 9.3.3.2.

$$\frac{M_u}{V_u d_v} = \frac{(0\ \text{ft·k})}{((0\ \text{k})(99{,}999{,}999\ \text{in}))} = 0$$

[TMS 402-16 Section 9.3.4.1.2]

Because this ratio does not exceed 1.0 and R <= 1.5, there is no limit on flexural tensile reinforcement.

✔ $\varepsilon_s \geq \varepsilon_{min}$ ...utilization ratio 0

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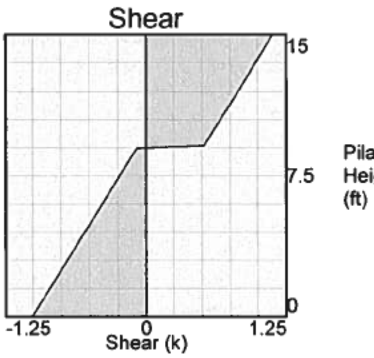
Strength Checks Design Calculations for Combination 0.9D + 1Wind$_{C\&C+Wall}$

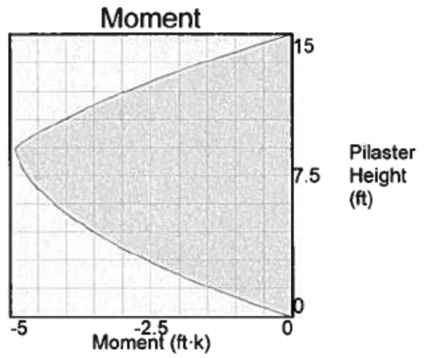
Load Combination: 0.9D + 1Wind$_{C\&C+Wall}$

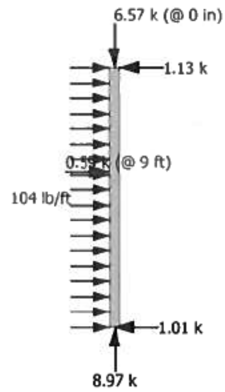
Pilaster weight: The unfactored weight is 2.67 k, of which 1.78 k is from the wall portion(s) and 0.89 k is from the 'column' portion.

Factored Pilaster weight = 2.4 k (total), 160.13 lb/ft (linear per height).

	Axial Force (k)	Shear (k)	Moment (ft·k)	P-δ Moment (ft·k)	Mag. Moment (ft·k)
15 ft from base	6.57 k	1.13 k	0 ft·k	N/A	N/A
8.94 ft from base	7.54 k	-0.08 k	-4.91 ft·k	-6.45 ft·k	-7.11 ft·k
7.42 ft from base	7.78 k	-0.24 k	-4.66 ft·k	-6.15 ft·k	-6.85 ft·k
0 ft from base	8.97 k	-1.01 k	0 ft·k	N/A	N/A







Secondary Moments

The strength design provisions of TMS 402 require consideration of a secondary moment. Both P-Delta and moment magnifier options are given. The P-delta approach may be used under some conditions and the moment magnifier may be used under all conditions. Both are calculated here for perspective, but per user option the value used for design will be that from the moment magnifier approach.

Cracking Moment

The distance from the neutral axis to the extreme tension fiber 'c_t' is 3.81 in. This distance is calculated based on the effective cross section of the full wall. Note that because the masonry units used in this wall are not symmetrical, this value will be different when the moment is in the opposite direction such that the tension and compression faces are reversed.

$$S_n = I_n/c_t = (886.64\ \text{in}^4)/(3.81\ \text{in}) = 232.56\ \text{in}^3$$

$$f_r = 89.27\ \text{psi}$$

$$M_{cr} = S_n f_r = (232.56\ \text{in}^3)(89.27\ \text{psi}) = 1.73\ \text{ft·k}$$

[NCMA TEK note 14-4B (2008), p. 3]

Secondary Moment Calculation (At Midspan)

Note that the I_{cr} value used here is interpolated from the values in the Section Analysis calculations based on the axial force at this location.

P-Delta

Because $M_{u1} >= M_{cr}$, M_u is calculated by:

$$M_u = \frac{M_{u1} + \frac{5M_{cr}P_u h^2}{48E_m}\left(\frac{1}{I_n} - \frac{1}{I_{cr}}\right)}{1 - \frac{5P_u h^2}{48E_m I_{cr}}} = \frac{(-4.66\ \text{ft·k}) + \left(\frac{(5(-1.73\ \text{ft·k})(7.78\ \text{k})(15\ \text{ft})^2)}{(48(1{,}350{,}000\ \text{psi}))}\right)\left(\left(\frac{1}{(886.64\ \text{in}^4)}\right) - \left(\frac{1}{(59.2\ \text{in}^4)}\right)\right)}{\left(1 - \frac{(5(7.78\ \text{k})(15\ \text{ft})^2)}{(48(1{,}350{,}000\ \text{psi})(59.2\ \text{in}^4))}\right)} = -6.15\ \text{ft·k}$$

[Masonry Designers Guide 2016, Eqn 12.4-25 (substituting M_{u1} for first order moment expression)]

Moment Magnifier

Because $M_{u1} >= M_{cr}$, $I_{eff} = I_{cr} = 59.2$ in^4.

$$P_e = \frac{\pi^2 E_m I_{eff}}{h^2} = \left(\frac{\left((3.1416)^2 (1{,}350{,}000\ psi)(59.2\ in^4)\right)}{(15\ ft)^2}\right) = 24.35\ k$$

[TMS 402-16 Section 9.3.5.4.3, Equation 9-29]

$$\psi = \frac{1}{1-\frac{P_u}{P_e}} = \frac{1}{\left(1-\left(\frac{(7.78\ k)}{(24.35\ k)}\right)\right)} = 1.4699$$

[TMS 402-16 Section 9.3.5.4.3, Equation 9-28]

$$M_u = \psi M_{u0} = (1.4699)(-4.66\ ft{\cdot}k) = -6.85\ ft{\cdot}k$$

[TMS 402-16 Section 9.3.5.4.3, Equation 9-27]

Secondary Moment Calculation (At Max Moment Location)

Note that the I_{cr} value used here is interpolated from the values in the Section Analysis calculations based on the axial force at this location.

P-Delta

Because $M_{u1} >= M_{cr}$, M_u is calculated by:

$$M_u = \frac{M_{u1} + \frac{5 M_{cr} P_u h^2}{48 E_m}\left(\frac{1}{I_n} - \frac{1}{I_{cr}}\right)}{1 - \frac{5 P_u h^2}{48 E_m I_{cr}}} = \frac{\left((-4.91\ ft{\cdot}k) + \left(\frac{\left(5(-1.73\ ft{\cdot}k)(7.54\ k)(15\ ft)^2\right)}{\left(48(1{,}350{,}000\ psi)\right)}\right)\left(\left(\frac{1}{(886.64\ in^4)}\right) - \left(\frac{1}{(59.22\ in^4)}\right)\right)\right)}{\left(1 - \frac{\left(5(7.54\ k)(15\ ft)^2\right)}{\left(48(1{,}350{,}000\ psi)(59.22\ in^4)\right)}\right)} = -6.45\ ft{\cdot}k$$

[Masonry Designers Guide 2016, Eqn 12.4-25 (substituting M_{u1} for first order moment expression)]

Moment Magnifier

Because $M_{u1} >= M_{cr}$, $I_{eff} = I_{cr}$ = 59.22 in^4.

$$P_e = \frac{\pi^2 E_m I_{eff}}{h^2} = \left(\frac{\left((3.1416)^2 (1{,}350{,}000\ psi)(59.22\ in^4)\right)}{(15\ ft)^2}\right) = 24.35\ k$$

[TMS 402-16 Section 9.3.5.4.3, Equation 9-29]

$$\psi = \frac{1}{1-\frac{P_u}{P_e}} = \frac{1}{\left(1-\left(\frac{(7.54\ k)}{(24.35\ k)}\right)\right)} = 1.4485$$

[TMS 402-16 Section 9.3.5.4.3, Equation 9-28]

$$M_u = \psi M_{u0} = (1.4485)(-4.91\ ft{\cdot}k) = -7.11\ ft{\cdot}k$$

[TMS 402-16 Section 9.3.5.4.3, Equation 9-27]

Strength Checks: Combination 0.9D + 1Wind$_{C\&C+Wall}$

Design forces for this load combination:

- P_u @ top = 6.57 k
- P_u @ mid-span = 7.78 k
- P_u @ base = 8.97 k
- P_u @ max moment = 7.54 k
- M_u @ top = 0 ft·k
- M_u @ mid-span = -4.66 ft·k
- Max M_u = -4.91 ft·k
- Max V_u = 1.13 k

Axial Stress Check

$\sigma_p = P_u/A_g = (8.97\ k)/(1.27\ ft^2) = 49.03\ psi$

[TMS 402-16 Section 9.3.5.4.2]

$\sigma_{pmax} = 0.2f'_m = 0.2(1{,}500\ psi) = 300\ psi$

[TMS 402-16 Section 9.3.5.4.2]

✔ $\sigma_{Pmax} \geq \sigma_P$ ...utilization ratio 0.163

Axial Stress Check with Slender Wall

$$\frac{h}{t} = \frac{(15\ ft)}{(99{,}999{,}999\ in)} = 0$$

[TMS 402-16 Section 9.3.5.4.2]

Slenderness ratio does not exceed 30; check does not apply

✔ $\sigma_{Pmax} \geq \sigma_P$ ...utilization ratio 0

Axial Force Check

$$\frac{h}{r} = \frac{(15\ ft)}{(2.2\ in)} = 81.78$$

[TMS 402-16 Section 9.3.4.1.1]

$$P_n = 0.80\left[0.80f'_m(A_n - A_{st}) + f_y A_{st}\right]\left[1 - \left(\frac{h}{140r}\right)^2\right] = 0.80(0.80(1{,}500\ psi)((1.27\ ft^2) - (0\ in^2)) + (60{,}000\ psi)(0\ in^2))\left(1 - \left(\frac{(15\ ft)}{(140(2.2\ in))}\right)^2\right) = 115.74\ k$$

[TMS 402-16 Section 9.3.4.1.1, Equation 9-15]

$\phi P_n = \phi P_n = (0.9)(115.74\ k) = 104.17\ k$

[TMS 402-16 Section 9.1.3, 9.1.4.4]

$P_u = 7.78\ k$

✔ $\phi P_n \geq P_u$ ...utilization ratio 0.075

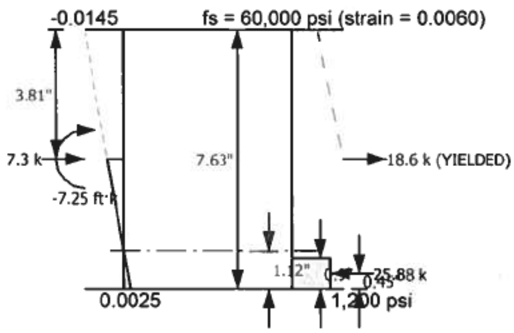
Moment Check @ Axial Load Application Point

The moment capacity is determined by considering the point on the interaction diagram where ϕP_n is equal to the axial load at this section (6.57 k) and thus P_n = 7.3 k. The associated M_n (-7.25 ft·k) is multiplied by ϕ to obtain design moment capacity.

At an axial load of 6.57 k, the interaction diagram gives a moment capacity of 6.53 ft·k.

✔ $\phi M_n \geq M_u$ ...utilization ratio 0

Compression area = 0.15 ft². Depth of compression zone = 0.9 in.

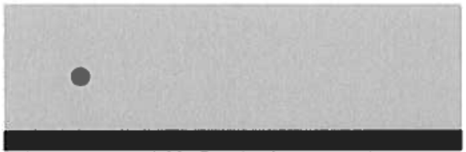


Moment Check @ Mid-span

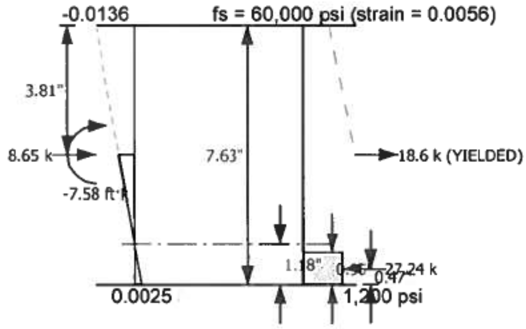
The moment capacity is determined by considering the point on the interaction diagram where ϕP_n is equal to the axial load at this section (7.78 k) and thus P_n = 8.65 k. The associated M_n (-7.58 ft·k) is multiplied by ϕ to obtain design moment capacity.

At an axial load of 7.78 k, the interaction diagram gives a moment capacity of 6.83 ft·k.

✔ $\phi M_n \geq M_u$ ...utilization ratio 0.683



Compression area = 0.16 ft². Depth of compression zone = 0.95 in.

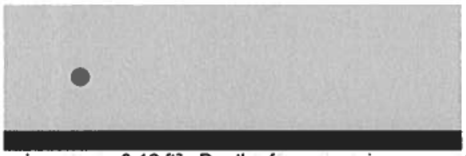


Moment Check @ Max Moment

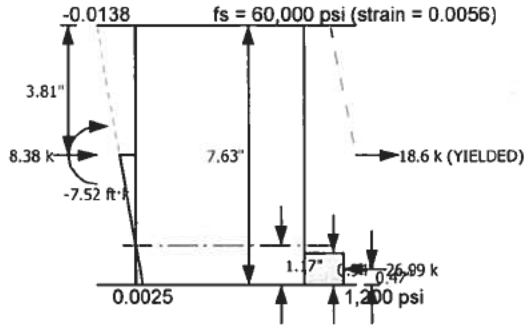
The moment capacity is determined by considering the point on the interaction diagram where ϕP_n is equal to the axial load at this section (7.54 k) and thus P_n = 8.38 k. The associated M_n (-7.52 ft·k) is multiplied by ϕ to obtain design moment capacity.

At an axial load of 7.54 k, the interaction diagram gives a moment capacity of 6.76 ft·k.

✔ $\phi M_n \geq M_u$ ...utilization ratio 0.726



Compression area = 0.16 ft². Depth of compression zone = 0.94 in.



Shear Check

The net shear area is taken as the area bounded by the extreme compression fiber and the reinforcement nearest the opposite face, subject to the effective compression width.

$$A_{nv} = 0.64\ \text{ft}^2$$

Shear capacity due to masonry, conservatively taking M/Vd = 1.0:

$$V_{nm} = \left[4.0 - 1.75(1.0)\right] A_{nv}\sqrt{f'_m} + 0.25P_u = (4.0 - 1.75(1.0))(0.64\ \text{ft}^2)\sqrt{(1{,}500\ \text{psi})} + 0.25(8.97\ \text{k}) = 10.22\ \text{k}$$

[TMS 402-16 Section 9.3.4.1.2.1, Equation 9-20 with conservative M/Vd = 1.0]

No reinforcement for out-of-plane shear:

$$V_{ns} = 0\ \text{k}$$

Nominal shear capacity:

$$V_n = (V_{nm} + V_{ns})\gamma_g = ((10.22\ \text{k}) + (0\ \text{k}))(1) = 10.22\ \text{k}$$

[TMS 402-16 Section 9.3.4.1.2, Equation 9-17]

Limited by:

$$V_{n\_limit} = \left(4A_{nv}\sqrt{f'_m}\right)\gamma_g = \left(4(0.64\ \text{ft}^2)\sqrt{(1{,}500\ \text{psi})}\right)(1) = 14.18\ \text{k}$$

[TMS 402-16 Section 9.3.4.1.2, Equation 9-19]

...Limit on V_n does not control

$$\phi V_n = \phi V_n = (0.8)(10.22\ \text{k}) = 8.17\ \text{k}$$

[TMS 402-16 Section 9.1.3, 9.1.4.5]

✔ $\phi V_n \geq V_u$ ...utilization ratio 0.124

Maximum Reinforcement Check

Maximum reinforcement is checked based on the provisions of TMS 402-16 9.3.3.2.

$$\frac{M_u}{V_u d_v} = \frac{(4.91\ ft{\cdot}k)}{((0.08\ k)(99{,}999{,}999\ in))} = 0$$

[TMS 402-16 Section 9.3.4.1.2]

Because this ratio does not exceed 1.0 and R <= 1.5, there is no limit on flexural tensile reinforcement.

✔ $\varepsilon_s \geq \varepsilon_{min}$ ...utilization ratio 0

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