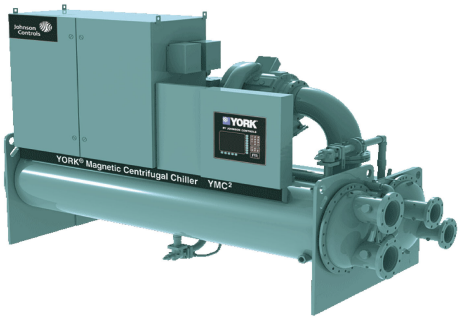
EQUIPMENT SUBMITTAL FOR APPROVAL

Project: Steamboat Grand Chiller Replacement

Location: Steamboat Springs, CO



YORK YMC2 MAGNETIC BEARING WATER COOLED CENTRIFUGAL CHILLER

EQUIPMENT	YMC2 Chillers
UNIT TAGS	CH-01, CH-02
QUANTITY	2

SOLD TO:
Steamboat Grand Resort Hotel Condominium Association

PREPARED BY:

Patrick Littlejohn
Johnson Controls, Inc.
720-935-6603
patrick.littlejohn@jci.com

DATE:
February 24th, 2025

REVISION:
0

CH-01

Notes:

- York YMC2 Magnetic Bearing Centrifugal Chiller
  - 425 Tons
    - 0.3842 kW/Ton – Full Load
    - 0.2960 kW/Ton - NPLV
  - R-513A Refrigerant
  - Electrical
    - 460/3/60
    - Single point power
    - 100k SCCR
    - Variable speed drive w/Circuit breaker
      - Harmonic Filter – IEEE519
  - BACnet
  - Evaporator
    - 3-Pass
    - 10’ Shell
    - ¾” Insulation
    - Compact water boxes
    - Grooved nozzles – 8”
      - Left hand inlet
      - Right hand outlet
    - Hinges – Left
    - Thermal switch (FLD)
  - Condenser
    - 2-Pass
    - 10’ Shell
    - Compact water boxes
    - Grooved nozzles – 10”
      - Right hand inlet & outlet
    - Hinges – Left
    - Thermal switch (FLD)
  - Neoprene isolators (FLD)
  - Warranty –
    - 36 months from start-up or 42 months from shipment, whichever comes first, whole unit parts & labor
    - 36 months from start-up or 42 months from shipment, whichever comes first, refrigerant
  - Form 1 Shipment
    - Chiller ships fully assembled w/refrigerant

Exclusions:

- Service contract – to be quoted separately.

CH-02

Notes:

- York YMC2 Magnetic Bearing Centrifugal Chiller
  - 425 Tons
    - 0.3842 kW/Ton – Full Load
    - 0.2960 kW/Ton - NPLV
  - R-513A Refrigerant
  - Electrical
    - 460/3/60
    - Single point power
    - 100k SCCR
    - Variable speed drive w/Circuit breaker
      - Harmonic Filter – IEEE519
  - BACnet
  - Evaporator
    - 3-Pass
    - 10’ Shell
    - ¾” Insulation
    - Compact water boxes
    - Grooved nozzles – 8”
      - Right hand inlet
      - Left hand outlet
    - Hinges – Left
    - Thermal switch (FLD)
  - Condenser
    - 2-Pass
    - 10’ Shell
    - Compact water boxes
    - Grooved nozzles – 10”
      - Left hand inlet & outlet
    - Hinges – Right
    - Thermal switch (FLD)
  - Neoprene isolators (FLD)
  - Warranty –
    - 36 months from start-up or 42 months from shipment, whichever comes first, whole unit parts & labor
    - 36 months from start-up or 42 months from shipment, whichever comes first, refrigerant
  - Form 1 Shipment
    - Chiller ships fully assembled w/refrigerant

Exclusions:

- Service contract – to be quoted separately.

TABLE OF CONTENTS

(YMC2 - Water-Cooled Chiller)

BOM Data

Product Type: YMC2 - Water-Cooled Chiller

Unit Tags: CH-01, CH-02

BID DATE: 01/07/2025 **LAST ADDEDNUM:** None
PROJECT: **Steamboat Grand Chiller Replacement** **NOTE(S)**

BILL OF MATERIAL

ITEM	QTY	TAGS	DESCRIPTION
I	2	CH-01 , CH-02	WATER-COOLED CENTRIFUGAL CHILLER

EQUIPMENT DESCRIPTIONS

Items Included by Johnson Controls

- Provide Model YMC2-S1495BBS Qty: 1
- Refrigerant Type: R-513A
- Motor, 460 volts, 3 phase, 60 Hz
- Motor Enclosure: Hermetically Sealed
- Isolation Valves
- Evaporator:
- Compact Water Boxes, rated for 150 [10.3] psig water-side pressure.
- Evaporator Grooved Nozzles Connection.
- Water Box Hinges Hinges On Left Evaporator Waterbox
- Evaporator Tube MTI 371, 0.75" OD, 0.025" Thk, Cu, Enhanced
- 3 Passes.
- Factory Thermal Insulation for Evaporator 3/4 inches.
- Flow Sensors, factory mounted and wired.
- Condenser:
- Compact Water Boxes, rated for 150 [10.3] psig water-side pressure.
- Condenser Grooved Nozzles Connection.
- Condenser Water Box Hinges Hinges On Left (CH-01) & Right (CH-02) Waterbox
- Condenser Tube MTI 471, 0.75" OD, 0.025 Thk, Cu, Enhanced
- 2 Passes.
- Flow Sensors, factory mounted and wired.
- Unit Warranty: 42 Month (2-3 Year) Entire Unit Parts and Labor (from date of shipment)
- Refrigerant Warranty: 42 Month (2-3 Year) (from date of shipment)
- Complete Chiller Bagging.
- Smart Equipment Board

Items Included for Field Installation

- 1" Thick Neoprene Pad
- Evaporator Thermal Switch.
- Condenser Thermal Switch.

Performance Ratings

Product Type: YMC2 - Water-Cooled Chiller

Unit Tags: CH-01, CH-02

Full Load - Design

PIN										
YMC2M2C_24	6FAC_0490C	_BEB331037	1B31GCLRLC	B2910471E2	1GCRRRS1SN	NCVB46060B	STU0101YNN	T01SSNYSAT	SYXISG149C	400W100W10
....5...10	....5...20	....5...30	....5...40	....5...50	....5...60	....5...70	....5...80	....5...90	....5...100	....5...110
0NNNPLPL04	2000042SS									
....5...120	....5...130									

Unit	
Model No.	YMC2-S1495BBS
Number of Compressors	1
Compressor Type	Centrifugal
Number of Compressor Circuits	1
Refrigerant	R-513A
Compressor	M2C_246FAC_
Variable Orifice	V2
Performance Data	
Specified Net Capacity [tons.R]	425.0
Rated Net Capacity [tons.R]	425.0
Full Load Efficiency [kW/tons.R]	0.3842
Part Load Efficiency (NPLV.IP) [kW/tons.R]	0.2960
Heat Rejection Capacity [MBtu/h]	5.680
A-Weighted Sound Pressure Level [dB(A)]	77.5
Electrical Data	
Power Supply [V/ph/Hz]	460/3/60.0
Total Input Power [kW]	163.3
Min. Circuit Ampacity [A]	273.0
Max. Circuit Breaker Amps [A]	450.0
Job FLA [A]	218.0
Unit Short Circuit Withstand (STD) [kA]	100
Performance Impacting Options	
Starter Type	Variable Speed Drive W/ Circuit Breaker
Starter Model	HYP0490XHC30*-**C
Isolation Valves	Yes
OptiSound Control	Yes

Weight & Dimensional Data	
Shipping Weight [lbs]	16382
Operating Weight [lbs]	18297
Refrigerant Charge [lbs]	882

Heat Exchanger Performance			
Evaporator		**Condenser**	
Model*	EB3310-371-BS	Model*	CB2910-471-ES
Fluid Type*	Water	Fluid Type*	Water
Tube MTI No.	371	Tube MTI No.	471 / 471
Passes*	3	Passes*	2
Fouling Factor* [h ft2 F/Btu]	0.000100	Fouling Factor* [h ft2 F/Btu]	0.000250
Entering Fluid Temperature [ºF]	57.94	Entering Fluid Temperature* [ºF]	71.00
Leaving Fluid Temperature* [ºF]	44.00	Leaving Fluid Temperature [ºF]	79.94
Flow Rate* [USGPM]	730.0	Flow Rate* [USGPM]	1275
Pressure Drop [ft H2O]	21.0	Pressure Drop [ft H2O]	9.09

* Designates user specified input

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. Auxiliary components included in total kW - Chiller controls.

Part Load Performance (Based on Minimum Condenser Water Temperature)										
CEFT [ºF]	**Percent Load**									
	100.0	90.0	80.0	70.0	60.0	50.0	40.0	30.0	20.0	10.0
71.00	0.3842	0.3699	0.3582	0.3470	0.3434	0.3482	0.3614	0.3858	0.4977	1.342
70.00	0.3739	0.3594	0.3472	0.3364	0.3308	0.3348	0.3471	0.3712	0.4596	1.181
65.00	0.3252	0.3092	0.2953	0.2843	0.2742	0.2716	0.2788	0.2967	0.3388	0.8895
60.00	0.2802	0.2625	0.2472	0.2343	0.2237	0.2150	0.2180	0.2285	0.2559	0.5603
55.00	0.2397	0.2194	0.2025	0.1878	0.1762	0.1667	0.1619	0.1668	0.1818	0.3153
50.00	0.2022	0.1817	0.1622	0.1463	0.1325	0.1210	0.1120	0.1088	0.1140	0.1666
45.00	0.1842	0.1537	0.1321	0.1124	0.09476	0.08179	0.07267	0.08212	0.1134	0.2563
40.00	0.1864	0.1611	0.1331	0.09980	0.08461	0.06706	0.07023	0.1017	0.1523	0.3032
39.00	0.1881	0.1638	0.1368	0.1021	0.08550	0.06622	0.07024	0.1003	0.1521	0.2992
38.00	0.1913	0.1679	0.1416	0.1052	0.08848	0.06842	0.06927	0.09879	0.1518	0.000
37.00	0.1963	0.1731	0.1478	0.1091	0.09249	0.07231	0.06835	0.09735	0.1511	0.2906
36.00	0.2024	0.1795	0.1558	0.1143	0.09590	0.07666	0.06748	0.09588	0.1504	0.2860

* Values are in kW/tons.R

Sound Pressure Levels (Standard)										
CEFT [°F]	Percent Load									
	100.0	90.0	80.0	70.0	60.0	50.0	40.0	30.0	20.0	10.0
71.00	77.5	77.5	77.0	77.0	77.0	77.5	78.5	80.0	82.5	85.0
70.00	77.5	77.0	77.0	77.0	77.0	77.0	78.0	79.5	82.0	84.5
65.00	76.5	76.0	76.0	75.5	75.5	75.5	76.0	77.0	78.5	84.0
60.00	75.5	75.0	74.5	74.0	73.5	73.5	74.0	75.0	76.5	81.0
55.00	74.5	74.0	73.0	72.5	71.5	71.5	71.5	72.0	73.0	75.0
50.00	73.5	72.5	71.5	71.0	71.0	71.0	71.0	71.5	72.5	72.0
45.00	72.5	71.5	70.5	70.5	71.0	72.0	73.5	74.5	76.0	78.0
40.00	72.5	71.5	71.5	72.0	73.0	76.0	78.0	79.5	79.5	79.0
39.00	72.5	72.0	71.5	72.0	74.0	77.0	79.0	79.5	80.0	79.0
38.00	73.0	72.0	72.0	72.5	74.5	78.5	79.0	79.5	80.0	79.0
37.00	73.0	72.5	72.5	73.5	76.0	78.5	79.0	79.5	80.0	79.0
36.00	73.5	73.0	73.0	74.0	76.0	78.5	79.0	79.5	80.0	79.0

The octave and A-weighted sound pressure levels are the levels expected to be obtained if measurements are performed in accordance with AHRI Standard 575-08, Method of Measuring Machinery Sound Within Equipment Rooms. Tolerances:The sound levels of identical unit selections can vary due to manufacturing tolerances and test repeatability. Variations of +/- 3dBA on the A-weighted levels and +/- 5dB on the octave band levels are possible.

Unit Configuration Details		
	Evaporator	**Condenser**
Water Box Type	Compact	Compact
Waterside Design Working Pressure [psig]	150	150
Entering Water Nozzle @ Location	L	R
Leaving Water Nozzle @ Location	R	R
Water Box Weight [lbs]	502	424
Cover Plate Weight [lbs]	N/A	N/A
Return Head Weight [lbs]		
Water Weight [lbs]	875	1041

Weight Breakdown Details					
Operating Weight [lbs]	18297	Per Isolator	TBD	Refrigerant (R-513A) Weight [lbs]	882
Compressor Weight [lbs]	3156	Shipping Weight [lbs]	16382		

Warnings:

Notes:

Compliant with the requirements of the LEED Energy and Atmosphere Enhanced Refrigerant Management Credit (EAc4).

Materials and construction per mechanical specifications - Form 160.84-EG1.

Compliant with ASHRAE 90.1 - 2004, 2007, 2010, 2013, 2013(2015), 2016, 2019.

Compliant with IECC - 2012,2015,2018,2021.

N/A

The product image shown is for illustrative purposes only and is not representative of selected options.

Unit Drawings

Product Type: YMC2 - Water-Cooled Chiller

Unit Tags: CH-01, CH-02

CH-01

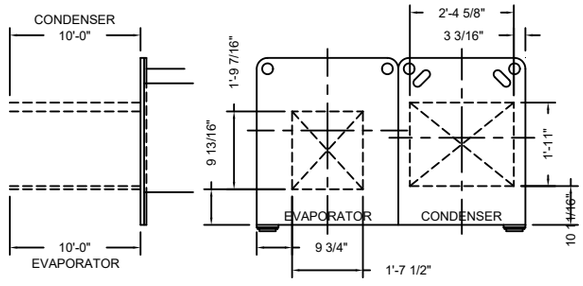
NOZZLE LEGEND

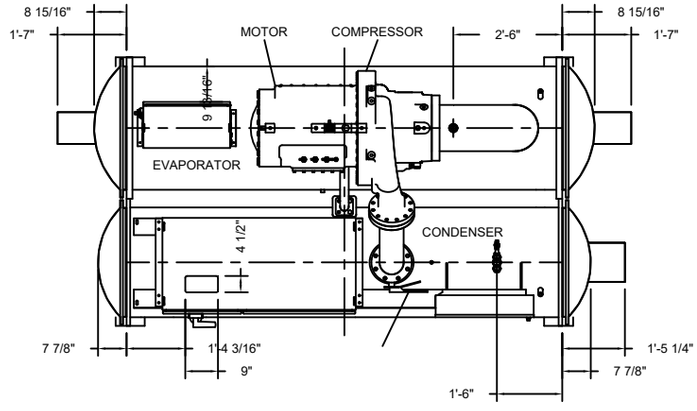
EVAPORATOR INLET	LEFT SIDE	3 PASSES	8 DIA.	(150 Psig DWP)
EVAPORATOR OUTLET	RIGHT SIDE	3 PASSES	8 DIA.	(150 Psig DWP)
CONDENSER INLET	RIGHT SIDE	2 PASSES	10 DIA.	(150 Psig DWP)
CONDENSER OUTLET	RIGHT SIDE	2 PASSES	10 DIA.	(150 Psig DWP)

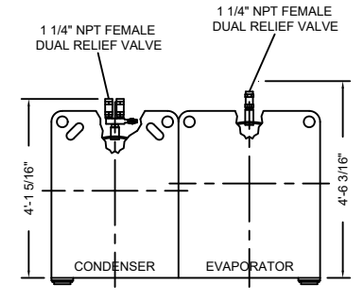
Victaulic Grooved Nozzles (per ANSI / AWWA C-606)

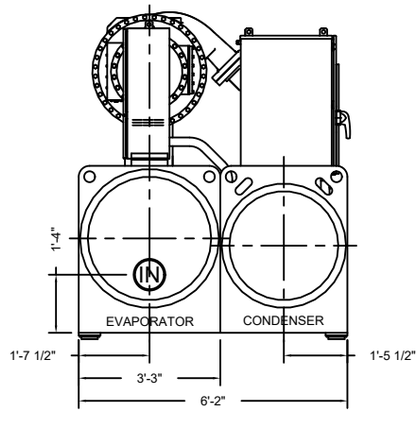
Optional water box hinges not shown.
Overall unit width and inlet nozzle length may increase up to 8".

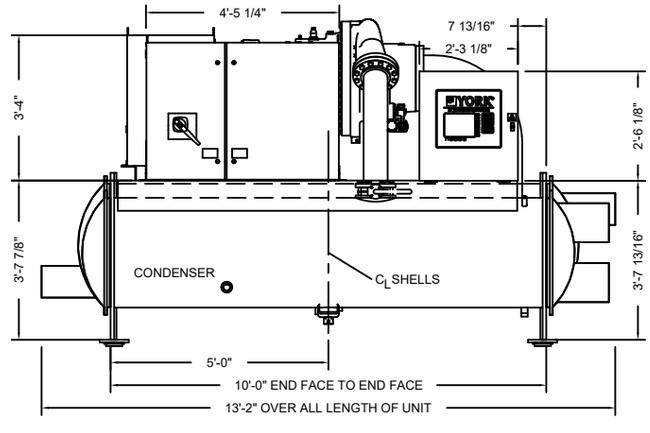
TUBE PULL AREA DETAIL

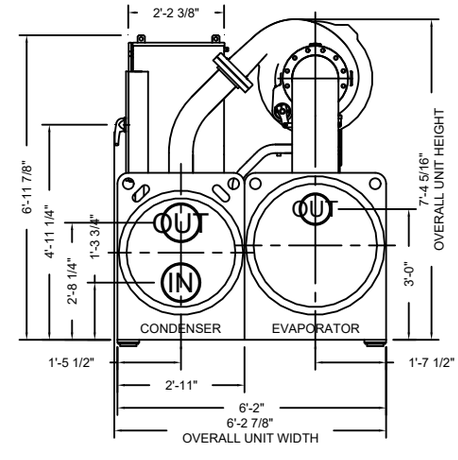










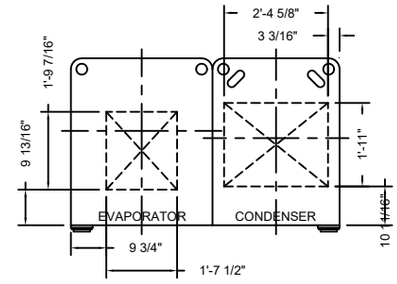


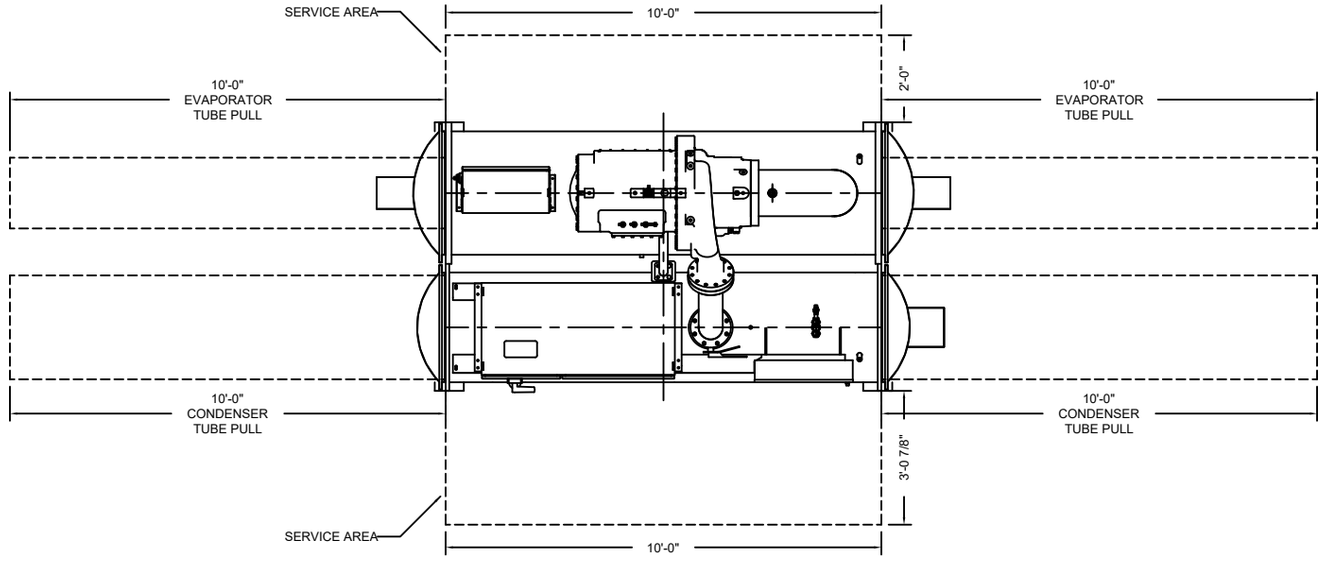
SHIPPING WT.SHIPPING WT. OF HEAVIEST COMPONENT: 16,382 LBS, OPERATING WT. 18,297 LBS, LOAD PER ISOLATOR 0 LBS
(SEE PERFORMANCE PAGE FOR ADDITIONAL SHIPPING WEIGHTS)

PRODUCT DRAWING YORK Magnetic Centrifugal Chiller MODEL: YMC2 **NOT FOR CONSTRUCTION**	COMPRESSOR: M2M2C_246FAC_ EVAPORATOR: EB3310-371-BS1-3GSL CONDENSER: CB2910-471-ES1-2GSR VSD: HYP0490XHC30B-46C SALES MODEL:	Steamboat Grand Chiller Replacement UNIT TAG: CH-01	Date: January 07, 2025 Rev. Date: January 07, 2025 Form No.: 160.78-EG1 Dwg. Lev.: 0410 Dwg. Scale: NTS	Johnson Controls

CH-01

TUBE PULL AREA DETAIL





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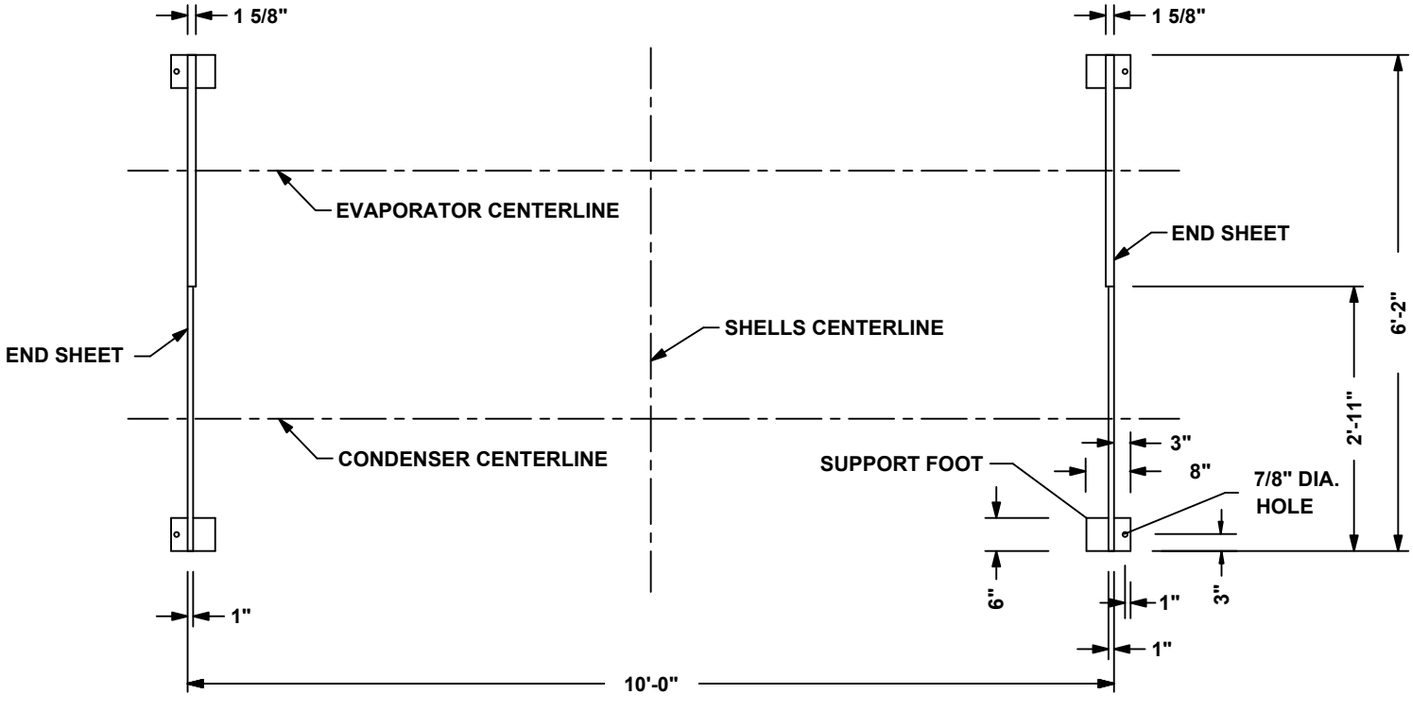
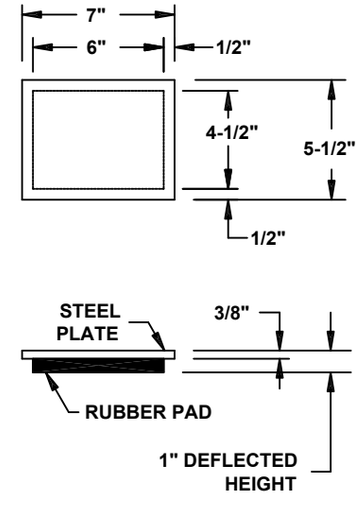
CH-01



DIMENSIONS ARE TYPICAL ALL FOUR CORNERS

ISOLATOR DETAIL (N.T.S.)



ISOLATOR TO BE CENTERED
UNDER SUPPORT FOOT

FLOOR LAYOUT (NOT TO SCALE)

PRODUCT DRAWING FLOOR LAYOUT W/NEOPRENE ISOLATORS MODEL: YMC2 **NOT FOR CONSTRUCTION**	COMPRESSOR: M2M2C_246FAC_ EVAPORATOR: EB3310-371-BS1-3GSL CONDENSER: CB2910-471-ES1-2GSR VSD: HYP0490XHC30B-46C SALES MODEL:	Steamboat Grand Chiller Replacement UNIT TAG: CH-01	Date: January 07, 2025 Rev. Date: January 07, 2025 Form No.: Dwg. Lev.: Dwg. Scale: NTS

Johnson Controls

CH-02

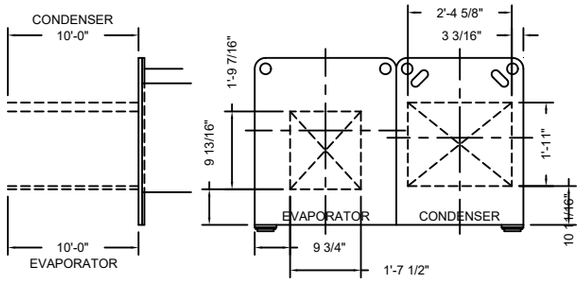
NOZZLE LEGEND

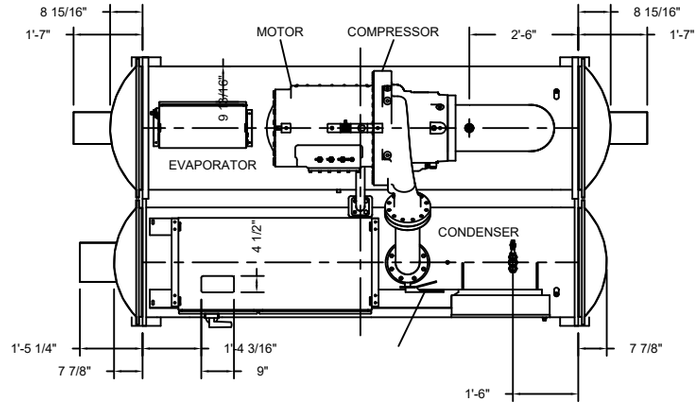
EVAPORATOR INLET	RIGHT SIDE	3 PASSES	8 DIA.	(150 Psig DWP)
EVAPORATOR OUTLET	LEFT SIDE	3 PASSES	8 DIA.	(150 Psig DWP)
CONDENSER INLET	LEFT SIDE	2 PASSES	10 DIA.	(150 Psig DWP)
CONDENSER OUTLET	LEFT SIDE	2 PASSES	10 DIA.	(150 Psig DWP)

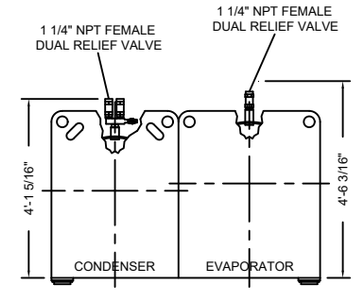
Victaulic Grooved Nozzles (per ANSI / AWWA C-606)

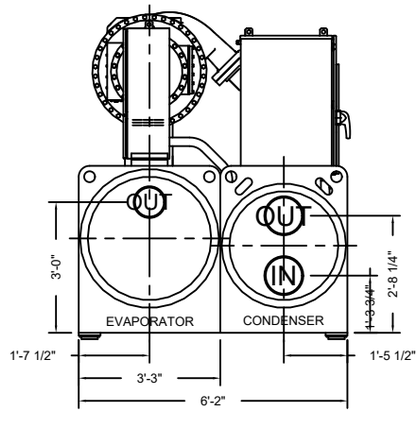
Optional water box hinges not shown.
Overall unit width and inlet nozzle length may increase up to 8".

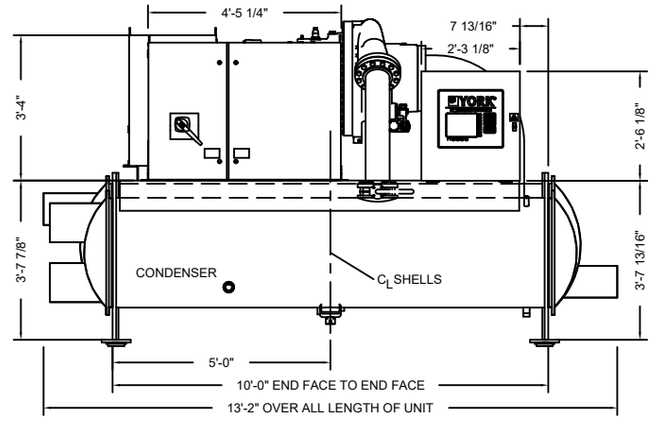
TUBE PULL AREA DETAIL

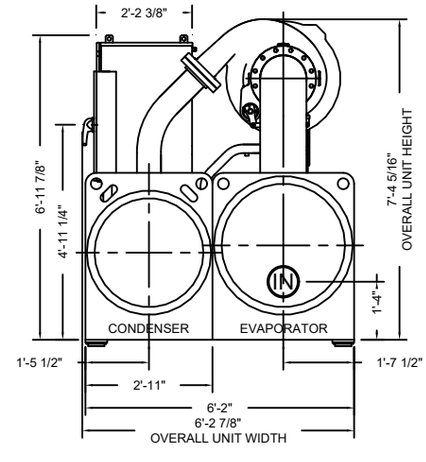












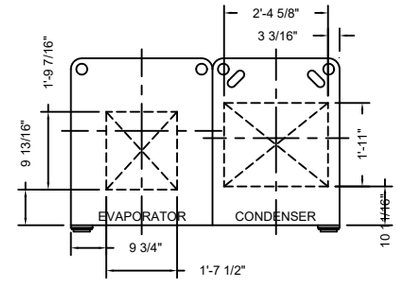
SHIPPING WT.SHIPPING WT. OF HEAVIEST COMPONENT: 16,382 LBS, OPERATING WT. 18,297 LBS, LOAD PER ISOLATOR 0 LBS
(SEE PERFORMANCE PAGE FOR ADDITIONAL SHIPPING WEIGHTS)

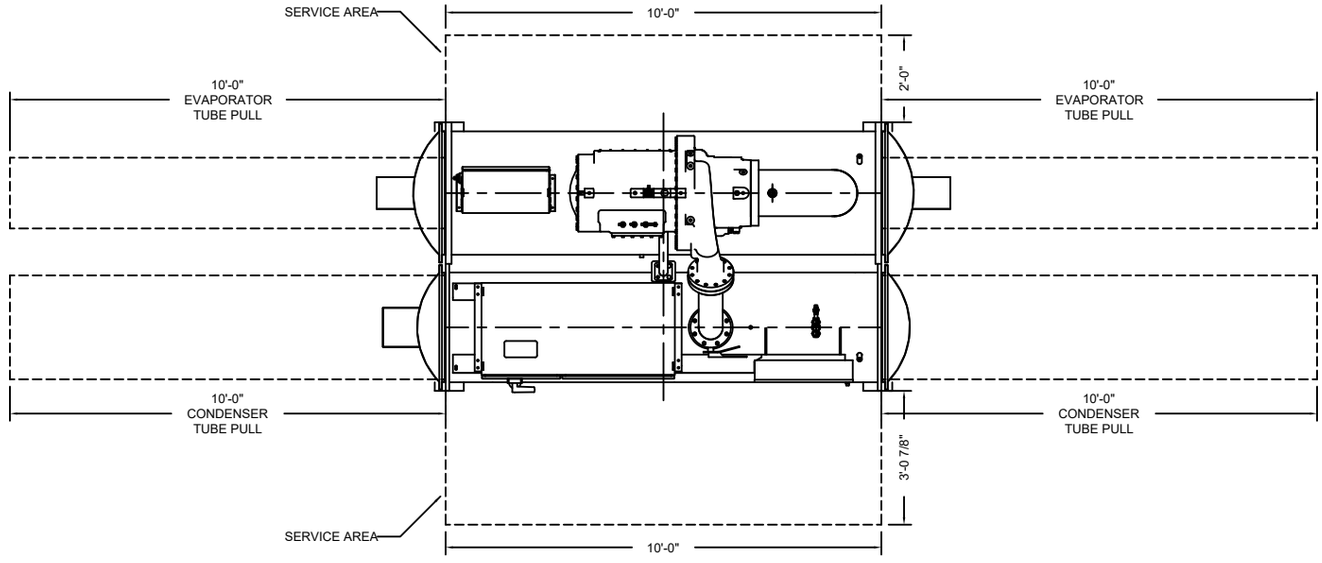
PRODUCT DRAWING YORK Magnetic Centrifugal Chiller MODEL: YMC2 **NOT FOR CONSTRUCTION**	COMPRESSOR: EVAPORATOR: CONDENSER: VSD: SALES MODEL:	M2M2C_246FAC_ EB3310-371-BS1-3GSR CB2910-471-ES1-2GSL HYP0490XHC30B-46C	Steamboat Grand Chiller Replacement UNIT TAG: CH-02	Date: January 07, 2025 Rev. Date: January 07, 2025 Form No.: 160.78-EG1 Dwg. Lev.: 0410 Dwg. Scale: NTS

Johnson Controls

CH-02

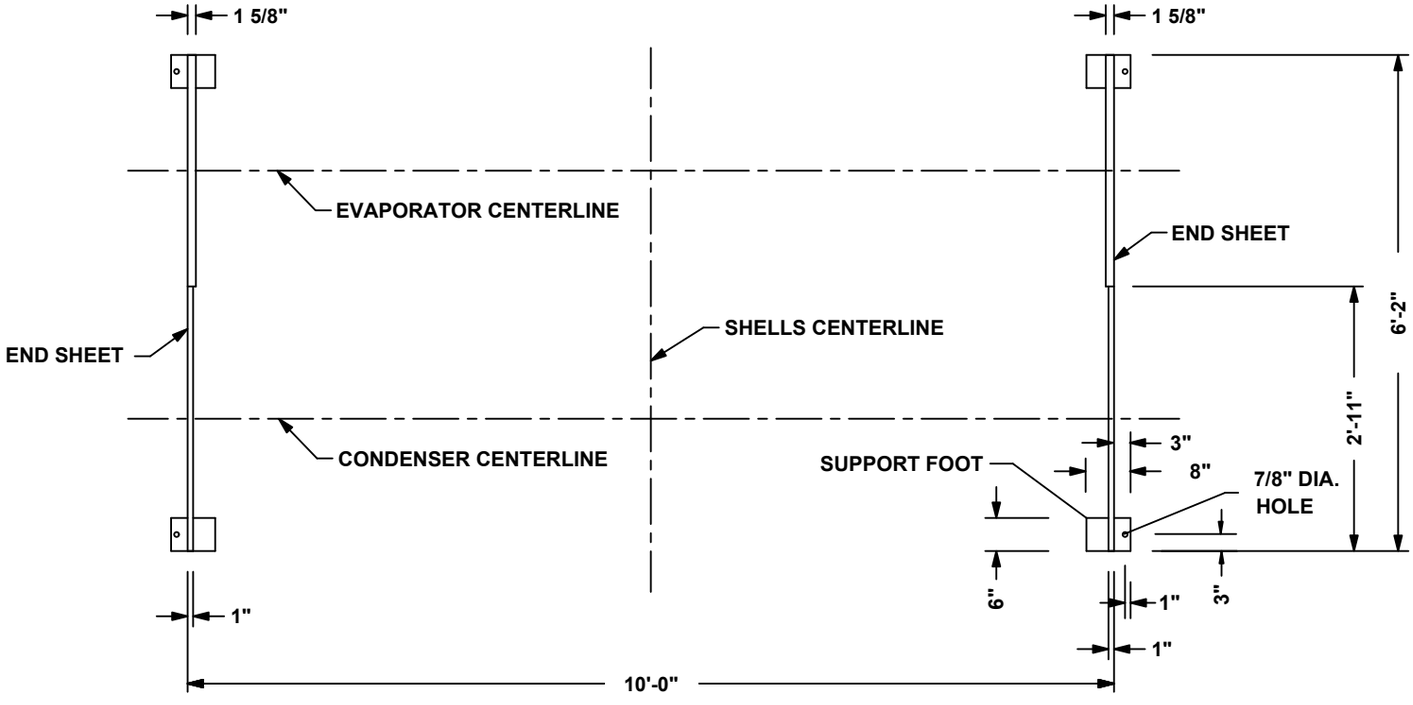
TUBE PULL AREA DETAIL





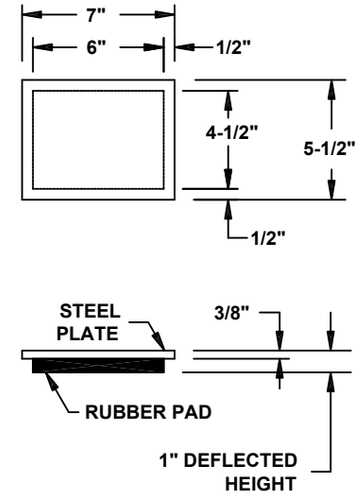
PRODUCT DRAWING YORK Magnetic Centrifugal Chiller MODEL: YMC2 **NOT FOR CONSTRUCTION**	COMPRESSOR: M2M2C_246FAC_ EVAPORATOR: EB3310-371-BS1-3GSR CONDENSER: CB2910-471-ES1-2GSL VSD: HYP0490XHC30B-46C SALES MODEL:	Steamboat Grand Chiller Replacement UNIT TAG: CH-02	Date: January 07, 2025 Rev. Date: January 07, 2025 Form No.: 160.78-EG1 Dwg. Lev.: 0410 Dwg. Scale: NTS	Johnson Controls

CH-02



DIMENSIONS ARE TYPICAL ALL FOUR CORNERS

ISOLATOR DETAIL (N.T.S.)



ISOLATOR TO BE CENTERED
UNDER SUPPORT FOOT

FLOOR LAYOUT (NOT TO SCALE)

PRODUCT DRAWING FLOOR LAYOUT W/NEOPRENE ISOLATORS MODEL: YMC2 **NOT FOR CONSTRUCTION**	COMPRESSOR: M2M2C_246FAC_ EVAPORATOR: EB3310-371-BS1-3GSR CONDENSER: CB2910-471-ES1-2GSL VSD: HYP0490XHC30B-46C SALES MODEL:	Steamboat Grand Chiller Replacement UNIT TAG: CH-02	Date: January 07, 2025 Rev. Date: January 07, 2025 Form No.: Dwg. Lev.: Dwg. Scale: NTS

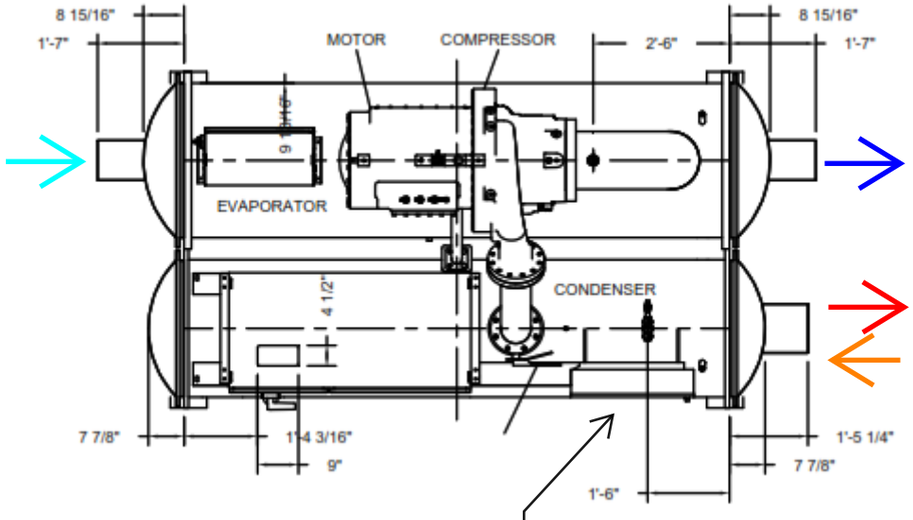
Johnson Controls

CH-01 & CH-02 Nozzle Handing Coordination

CH-01

NOZZLE LEGEND

EVAPORATOR INLET	LEFT SIDE	3 PASSES	8 DIA.	(150 Psig DWP)
EVAPORATOR OUTLET	RIGHT SIDE	3 PASSES	8 DIA.	(150 Psig DWP)
CONDENSER INLET	RIGHT SIDE	2 PASSES	10 DIA.	(150 Psig DWP)
CONDENSER OUTLET	RIGHT SIDE	2 PASSES	10 DIA.	(150 Psig DWP)



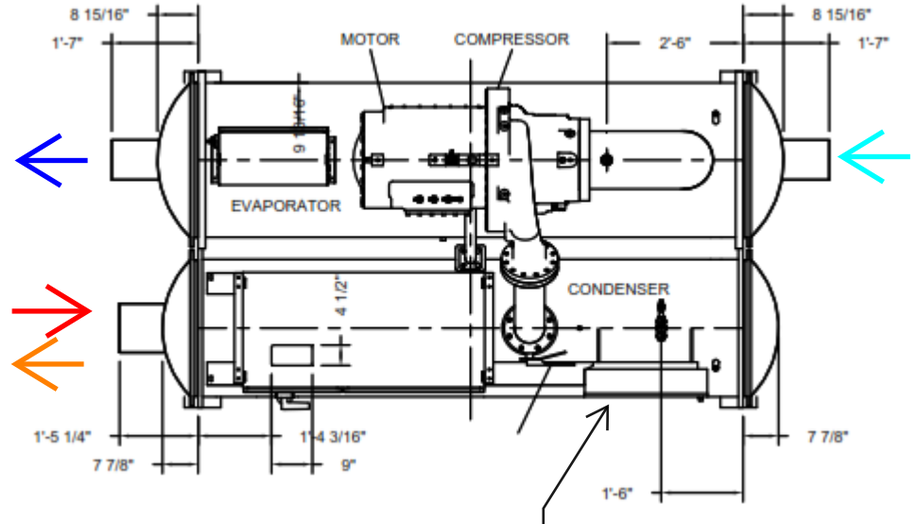
Control Panel

Overhead Door

CH-02

NOZZLE LEGEND

EVAPORATOR INLET	RIGHT SIDE	3 PASSES	8 DIA.	(150 Psig DWP)
EVAPORATOR OUTLET	LEFT SIDE	3 PASSES	8 DIA.	(150 Psig DWP)
CONDENSER INLET	LEFT SIDE	2 PASSES	10 DIA.	(150 Psig DWP)
CONDENSER OUTLET	LEFT SIDE	2 PASSES	10 DIA.	(150 Psig DWP)



Control Panel

Wiring Diagrams

Product Type: YMC2 - Water-Cooled Chiller

Unit Tags: CH-01, CH-02

YORK	Supersedes: 160.84-PW1 (1117) Form: 160.84-PW1 (718)
WIRING DIAGRAMS	**FIELD CONNECTIONS DIAGRAM FOR MODEL YMC² CHILLER WITH M2 COMPRESSOR**
CONTRACTOR _____ ORDER NO. _____ JCI CONTRACT NO. _____ JCI ORDER NO. _____	PURCHASER _____ JOB NAME _____ LOCATION _____ ENGINEER _____
☐ REFERENCE DATE _____	☐ APPROVAL DATE _____ ☐ CONSTRUCTION DATE _____

JOB DATA:

CHILLER MODEL NO. YMC² _____ NO. OF UNITS _____

MOTOR/VARIABLE SPEED DRIVE POWER: 460V, 60Hz; 380V, 60Hz; 415V, 50Hz or 380/400V, 50Hz

Issue Date:
July 31, 2018

IMPORTANT!

READ BEFORE PROCEEDING!

GENERAL SAFETY GUIDELINES

This equipment is a relatively complicated apparatus. During installation, operation maintenance or service, individuals may be exposed to certain components or conditions including, but not limited to: refrigerants, materials under pressure, rotating components, and both high and low voltage. Each of these items has the potential, if misused or handled improperly, to cause bodily injury or death. It is the obligation and responsibility of operating/service personnel to identify and recognize these inherent hazards, protect themselves, and proceed safely in completing their tasks. Failure to comply with any of these requirements could result in serious damage to the equipment and the property in which it is situated, as well as severe personal injury or death to themselves and people at the site.

This document is intended for use by owner-authorized rigging, installation, and operating/service personnel. It is expected that these individuals possess independent training that will enable them to perform their assigned tasks properly and safely. It is essential that, prior to performing any task on this equipment, this individual shall have read and understood the on-product labels, this document and any referenced materials. This individual shall also be familiar with and comply with all applicable industry and governmental standards and regulations pertaining to the task in question.

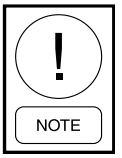
SAFETY SYMBOLS

The following symbols are used in this document to alert the reader to specific situations:

Indicates a possible hazardous situation which will result in death or serious injury if proper care is not taken.

Identifies a hazard which could lead to damage to the machine, damage to other equipment and/or environmental pollution if proper care is not taken or instructions and are not followed.

Indicates a potentially hazardous situation which will result in possible injuries or damage to equipment if proper care is not taken.



Highlights additional information useful to the technician in completing the work being performed properly.

External wiring, unless specified as an optional connection in the manufacturer's product line, is not to be connected inside the control cabinet. Devices such as relays, switches, transducers and controls and any external wiring must not be installed inside the micro panel. All wiring must be in accordance with Johnson Controls' published specifications and must be performed only by a qualified electrician. Johnson Controls will NOT be responsible for damage/problems resulting from improper connections to the controls or application of improper control signals. Failure to follow this warning will void the manufacturer's warranty and cause serious damage to property or personal injury.

CHANGEABILITY OF THIS DOCUMENT

In complying with Johnson Controls' policy for continuous product improvement, the information contained in this document is subject to change without notice. Johnson Controls makes no commitment to update or provide current information automatically to the manual owner. Updated manuals, if applicable, can be obtained by contacting the nearest Johnson Controls Service office or accessing the Johnson Controls QuickLIT website at http://cgproducts.johnsoncontrols.com.

Operating/service personnel maintain responsibility for the applicability of these documents to the equipment. If there is any question regarding the applicability of these documents, the technician should verify whether the equipment has been modified and if current literature is available from the owner of the equipment prior to performing any work on the chiller.

CHANGE BARS

Revisions made to this document are indicated with a line along the left or right hand column in the area the revision was made. These revisions are to technical information and any other changes in spelling, grammar or formatting are not included.

LIST OF FIGURES

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VARIABLE SPEED DRIVE (MODEL 0490A)

NOTES:

1. All field wiring shall be done in accordance with the NEC codes listed within this manual. NEC articles and paragraphs cited are for reference only and may not be current NEC code.
2. 

PROPER GROUNDING IS REQUIRED:
   - Variable Speed Drive (VSD) shall be grounded in accordance with the 2017 NEC (Paragraph 250.118).
   - Ground wires must be copper only and sized per the NEC See Table 250.122.
   - A separate grounding conductor shall be run in each conduit or for each 3 phase bundle within a cable tray. See *Figure 1 on page 5*.
   - Each ground wire shall be connected directly between the supply transformer's secondary ground and the VSD ground lug.
   - Flexible conduit is required for final connection to the VSD for vibration isolation.
   - Conduit is not an acceptable grounding means.
   - See *Table 1 on page 5* for VSD ground lug sizing.
3. Wiring, electrical conduit, junction boxes, fused disconnect switches (FDS), or circuit breakers, starters (M), pushbutton stations (PB), manual-off-automatic switch (S), flow switch (FLS), and control relays furnished by others unless otherwise specified.
4. Items marked * furnished by Johnson Controls.
5. Items marked ** available from Johnson Controls at additional cost.
6. Control power supply 115V - 50/60 Hz, 2.0 KVA capacity for control center only, is supplied by (1)-2.0 KVA control power transformer (1T) mounted Inside the VSD, it is factory wired.
7. A removable cover plate with pilot knockouts is supplied for connection of power supply conduits. VSD power conduit connection removable cover plate (cut holes to suit) locations per *Figure 5 on page 17*. Flexible conduit must be used for final connections to VSD. **Multiple conduits shall contain an equal number of wires from each phase in each conduit to prevent overheating per the 2017 NEC (Paragraph 300-20(a)). Use copper conductors only; DO NOT USE aluminum conductors.** *See Table 1 on page 5* for factory furnished VSD terminal lug wire ranges and conduit connection provisions.

TABLE 1 - LUG DETAILS

Option	Input Voltage/ Frequency	Line Side Lugs BBL Per Terminal	Wire Range	Grounding Lug Wire Range, Qty.
Circuit Breaker	380/460 60 Hz 400/415 50 Hz	2	2/0 - 350 mcm	#14-2/0, 2 bbl
Disconnect	380/460 60 Hz 400/415 50 Hz	2	2/0 - 350 mcm	#14-2/0, 2 bbl

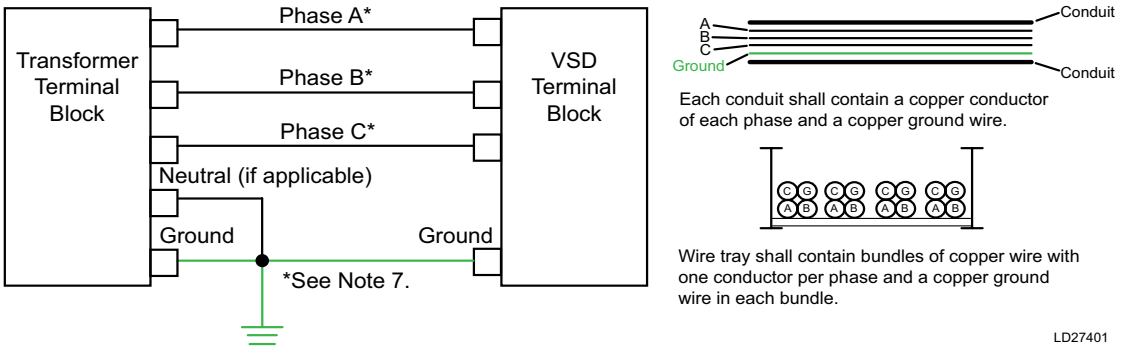

FIGURE 1 - GROUNDING VSD (0490A)

VARIABLE SPEED DRIVE (MODEL 0490A)

8. The following terminal lugs are factory furnished for field wiring supply connections. All lugs are rated AL9CU.
9. Condenser water pump motor starter (3M) holding coil to be furnished for 115V - 50/60 Hz. The power requirements for the water pump starter (3M) must be a max. of 1 Amp holding and 10 Amps inrush. If power requirements exceed this value, furnish coil for line voltage, and control relay with 115V coil (*see Note 20*).
10. Automatic control of the chilled water pump by the control center is shown. Chilled water pump motor starter (5M) holding coil to be furnished for 115V – 50/60 Hz. The power requirements for the water pump starter (5M) must be a maximum of 1 Amp holding and 8 Amps inrush. If power requirements exceed this value, furnish coil for line voltage, and control relay with 115V coil (*see Note 20*).
    - The pumps operate during compressor operation & during cycling shutdown.
    - For manual chilled water pump control, connect a manual start/stop switch as shown in the Field Connections diagram for 115VAC coils only.

TABLE 2 - CONDUIT DETAILS

INPUT VOLTAGE/ FREQUENCY	CHILLER MOTOR CODE	MAX. NO. OF CONDUITS
380/460 60 Hz 400/415 50 Hz	M2	(2) 3 in.

11. Units shipped knocked down require field connection of harnesses to control center, power wiring between compressor motor and VSD. These harnesses and power wiring are furnished by Johnson Controls for field assembly and consist of proper lengths of flexible conduit with necessary connectors, and contain the wires (shown in *Note 12*) properly terminated and marked.
12. Wire #14 AWG copper for one way distance of less than 175 feet. Wire #12 AWG copper for one way distance of more than 175 feet, but less than 300 feet.
13. Wiring diagram for YORK control center and Field Control Modifications *Form 160.84-PW2*.
15. The branch circuit overcurrent protection device for the YORK VSD must be a time delay type with a rating which is the standard fuse/circuit breaker size required to protect the field supply wiring conductors per the N.E.C.
16. The YORK Variable Speed Drive power supply wiring ampacity shall be calculated as follows: Model YMC2 minimum circuit ampacity:

    Ampacity = 1.25 (Job FLA)
    Where 125% factor per 2017 N.E.C.
    (Para. 440-33).
17. The VSD is equipped with a U.L. Listed rotary disconnect switch or optional circuit breaker. In both cases, fast acting semiconductor fuses, downstream of the disconnecting device, to provide additional protection to the VSD. Ground fault is employed on both circuit breaker and disconnect switch models via the VSD logic control board using a hall effect current sensor one per phase. Ground fault protection is also provided as part of the circuit breaker protection.
18. The minimum value of line impedance shall be determined by the case in which the VSD is fed from a transformer whose kVA rating is equal to 5 times rated power of the VSD. The transformer shall be specified to have 3% impedance. The supply voltage, at VSD input terminals, during start-up must be maintained above 391 volts for 440V/460V/480V 60 Hz units, above 323 volts for 380V/400V 50/60 Hz units, above 353 volts for 415V 50 Hz units. The following Table provides allowable supply voltage range during normal operation.

TABLE 3 - VOLTAGE RANGES

Input Voltage	Voltage Range
380/400V 50/60 Hz	342-423
415V 50 Hz	374-456
440/460V 60 Hz	414-508

VARIABLE SPEED DRIVE (MODEL 0490A)

19 Maximum line voltage imbalance (calculated as the difference between any of the three line voltages and the average of the three line voltages, and multiplied by 100%) will be 5%. Maximum line voltage total harmonic distortion (THD) will be 5% per phase (from n=2nd to n=50th harmonic) when line impedance is specified as follows:

- Minimum value of line impedance will be determined by the case in which the VSD is fed from a transformer whose kVA rating is equal to 5 times the rated power of the VSD. The transformer will be specified to have 3% impedance.
- Maximum value of line impedance will be determined by the case in which the VSD is fed from a transformer whose kVA rating is equal to the rated power of the VSD. The transformer will be specified to have 7% impedance.

The VSD will comply with IEEE Std. 519-1992 section 10.3.

20. Each 115VAC field-connected inductive load, i.e. relay coil, motor starter coil, etc. will have a transient suppressor wired (by others) in parallel with its coil, physically located at the coil. Spare transient suppressors are factory supplied in a bag attached to the keypad cable clamp in the OptiView Control Center.

21. All switches and circuit breakers used as switches will be located so they may be operated from a readily accessible place. They will be installed per 2017 N.E.C. (Para. 404.8).Switches and circuit breakers installed adjacent (close-coupled) to motors, appliances, or other equipment that they supply shall be permitted to be located higher than 6'-7" (2m) and to be accessible by portable means per 2017 N.E.C. (Para. 404.8 Exception No. 2).

VARIABLE SPEED DRIVE (MODEL 0490A)

Input Voltage/ Frequency	Chiller Motor Code	VSD Circuit Breaker Rating @ 480VAC, 60 Hz or 400VAC, 50 Hz		Semiconductor Fuse Rating (Amps) @ 660 VAC	Ground Fault Trip
		Trip	Withstand		
380/460 60 Hz 400/415 50 Hz	M2	600A	100,000*†	700A	60A

* Per U.L. Listing of VSD
† RMS Symmetrical Amperes

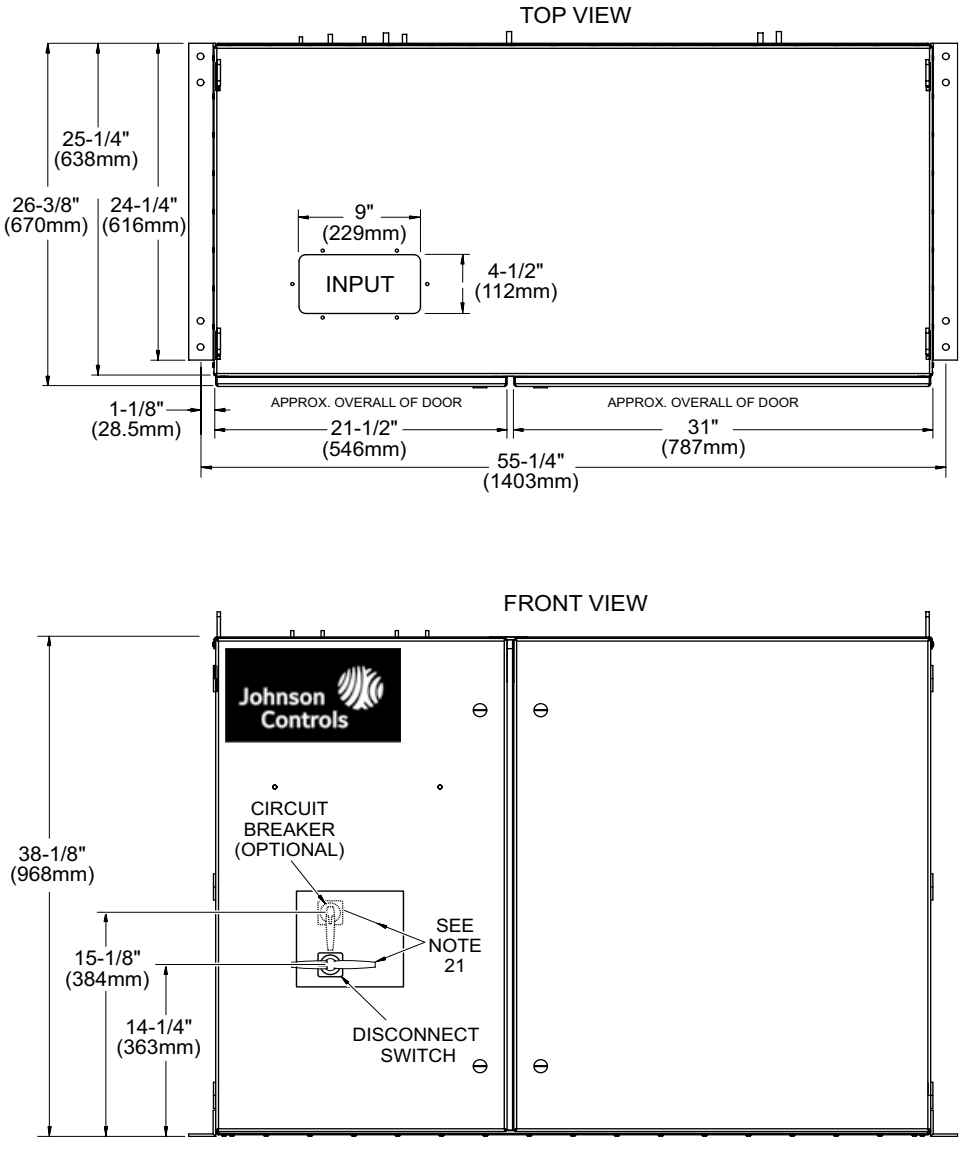

FIGURE 5 - VARIABLE SPEED DRIVE (0490A)

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FIELD CONNECTIONS

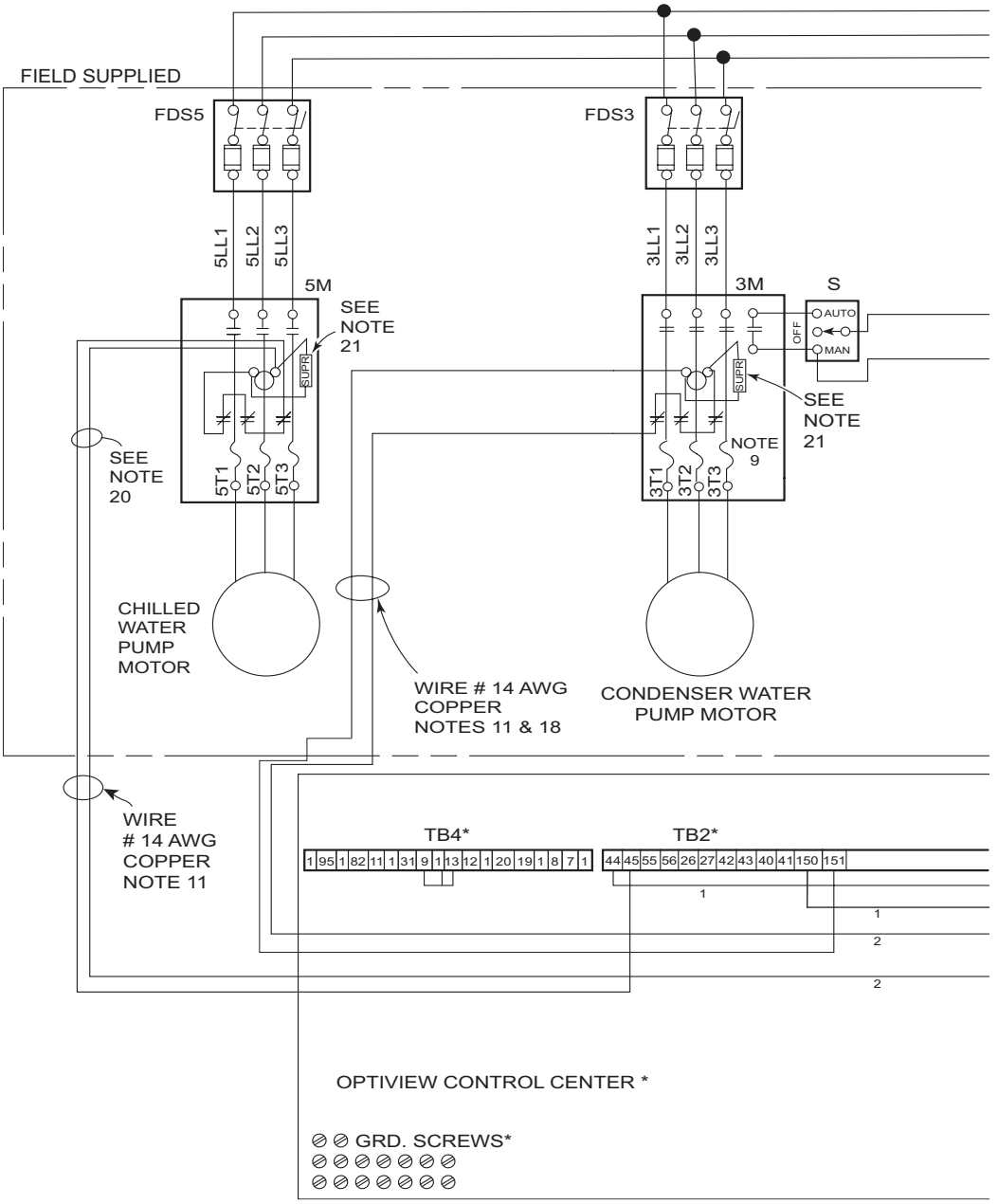

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FIGURE 9 - FIELD CONNECTIONS

FIELD CONNECTIONS (CONT'D)

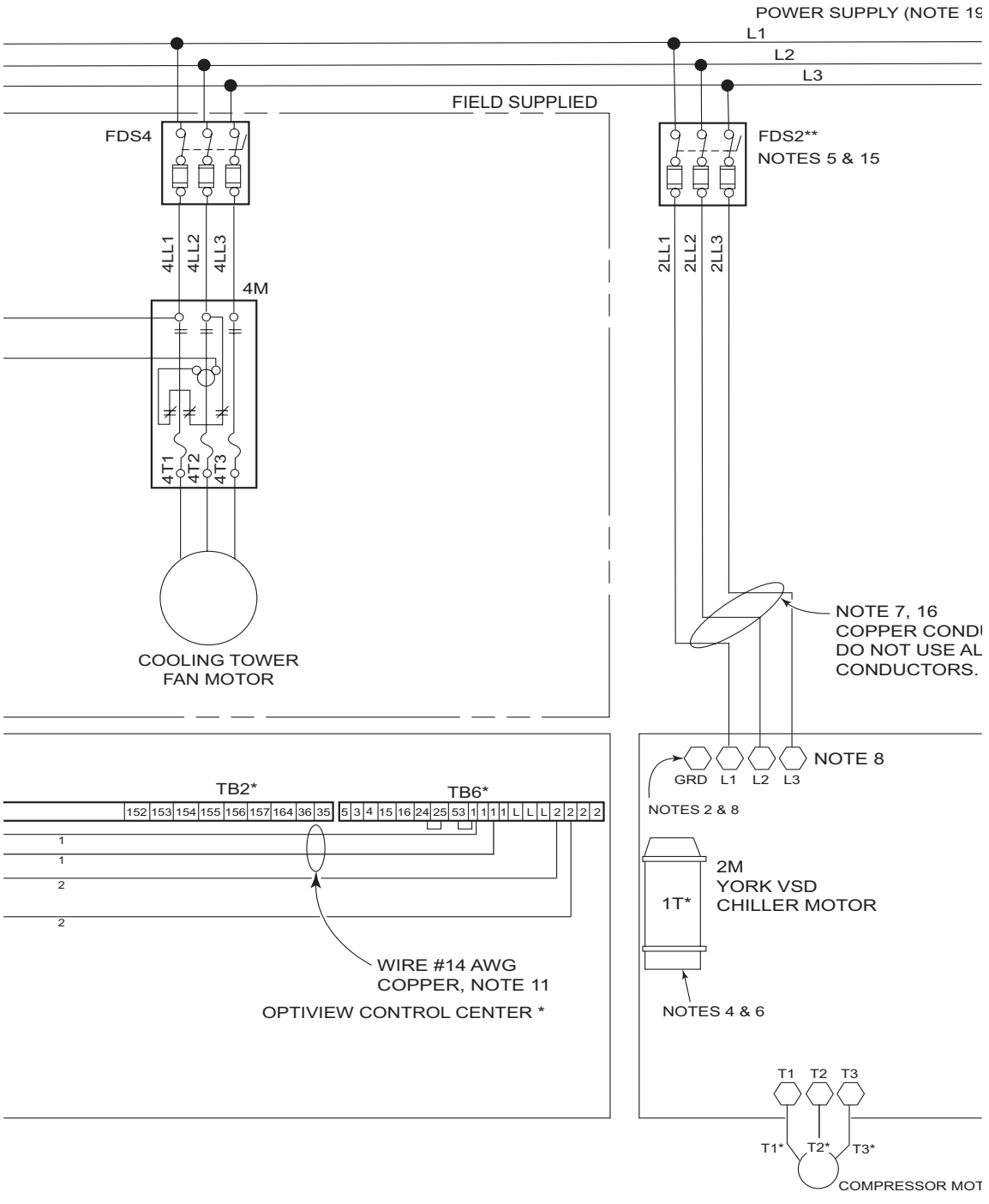

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FIGURE 9 – FIELD CONNECTIONS (CONT'D)

5000 Renaissance Drive, New Freedom, Pennsylvania USA 17349
800-861-1001
www.johnsoncontrols.com

Form 160.84-PW1 (718)
Issue Date: July 31, 2018
Supersedes: 160.84-PW1 (1117)

YMC² Refrigerant Relief Valve Vent Sizing

Form Number: 160.84-AD1 (324)
Supersedes: 160.84-AD1 (321)
Issue Date: 2024-03-13

Application data

The *ASHRAE Standard 15*, *Safety Standard for Refrigeration Systems*, provides guidelines for sizing refrigerant relief valves and vent piping. Without attempting to provide a complete and thorough interpretation, this document provides the necessary data to correctly determine piping requirements.

Relief valve sizing

YORK® YMC² units are supplied with pressure-relieving devices that are correctly sized, selected, and installed on each unit. Owners, facility managers, or consulting engineers need relief valve rated discharge capacities [C_r] to adequately size relief vent piping from the chiller. *ASHRAE Standard 15, Section 9.4*, provides guidelines for selecting the type of pressure-relief protection, such as relief valves, rupture discs, or fusible plugs. *Section 9.7* provides the criteria for correctly sizing the relief valve and vent piping from the chiller.

Section 9.7.5 defines the minimum required discharge capacity [C] of the relief device as follows:

$$C = f\,DL \quad \text{[lb of air per minute (kg/s)]} \qquad \text{Eq. 1}$$

Where:

- f = factor dependent upon type of refrigerant {= 1.6 for R-134a}
- D = outside diameter of vessel in feet (meters)
- L = length of vessel in feet (meters)

Note:

- When combustible materials are used within 20 ft (6.1 m) of a pressure vessel, multiply the value of f (or C as provided in tabular form) by 2.5.
- The formula is based on fire conditions. Other heat sources are calculated separately.

Table 1: Pressure relief capacity factor, *f*, according to refrigerant type and design pressure

Design pressure (psig)	R-134a		R-513A or R-1234ze		R-515B	
	I-P (lb/[ft²·min])	SI (kg/[m²·s])	I-P (lb/[ft²·min])	SI (kg/[m²·s])	I-P (lb/[ft²·min])	SI (kg/[m²·s])
180	1.356	0.1103	1.504	0.1224	1.544	0.1256
235	1.488	0.1210	1.669	0.1358	1.719	0.1399
280	1.600	0.1302	1.808	0.1471	1.872	0.1523

When one pressure-relief device or fusible plug is used to protect more than one pressure vessel, the required capacity is the sum of the capacities required for each pressure vessel.

The rated discharge capacities [C_r] for relief valves on YORK® YMC² equipment are provided in the tables in YMC2 Mod A refrigerant relief valve characteristics and YMC2 Mod B refrigerant relief valve characteristics.

Section 9.7.6 specifies that the rated discharge capacity of each relief device must be determined in accordance with the *ASME Boiler and Pressure Vessel Code* (paragraph *UG-131, Section VIII, Division I*)

and that pipe and fittings between the pressure-relief valve and the parts of the system it protects must have at least the area of the pressure-relief valve inlet area.

Section 9.7.2.3 requires that vessels or systems with refrigerant capacity greater than 10 ft^3 (0.28 m^3) are provided with one or more rupture members or a dual relief valve assembly. A single relief valve is adequate for all vessels less than 10 ft^3 (0.28 m^3) and low side vessels equipped with isolation valves.

Additionally, every pressure vessel that contains liquid refrigerant and is capable of being isolated by stop valves requires over-pressure relief protection (*Section 9.7.2*).

YMC² Mod A refrigerant relief valve characteristics

Table 2: YMC² Mod A condenser R-134a, R-513A, R-515B, and R-1234ze

Shells	Without isolation valves		C_r #air/min	Relief valve outlet size (NPT)
	Quantity of valves	Dual relief valves (see Note)		
235 psig set pressure				
CA2110	2		1 at 55.9	1 in.
CA2510	2		1 at 55.9	1 in.
CA2514	2		1 at 55.9	1 in.

Where: C_r = Rated capacity of YORK supplied relief valves.

Table 3: YMC² Mod A evaporator R-134a, R-513A, R-515B, and R-1234ze

Shells	With isolation valves		Without isolation valves		C_r #air/min	Relief valve outlet size (NPT)
	Quantity of valves	Single relief valves	Quantity of valves	Dual relief valves (see Note)		
235 psig set pressure						
EA2510	1		2		1 at 55.9	1 in.
EA2514	1		2		1 at 55.9	1 in.

Where: C_r = Rated capacity of YORK supplied relief valves.

YMC² Mod B refrigerant relief valve characteristics

Table 4: YMC² Mod B condenser R-134a, R-513A, R-515B, and R-1234ze (235# shells)

Shells	Without isolation valves		C_r #air/min	Relief valve outlet size (NPT)
	Quantity of valves	Dual relief valves (see Note)		
235 psig set pressure				
CA2110	2		1 at 55.9	1 in.
CA2510	2		1 at 55.9	1 in.
CA2514	2		1 at 55.9	1 in.

Table 4: YMC² Mod B condenser R-134a, R-513A, R-515B, and R-1234ze (235# shells)

Shells	Without isolation valves		C_r #air/min	Relief valve outlet size (NPT)
	Quantity of valves	Dual relief valves (see Note)		
235 psig set pressure				
CB2110	2		1 at 55.9	1 in.
CB2510	2		1 at 55.9	1 in.
CB2514	2		1 at 55.9	1 in.
CB2910	2		1 at 91.8	1 1/4 in.
CB2914	2		1 at 91.8	1 1/4 in.
CB3310	2		1 at 91.8	1 1/4 in.
CB3314	2		1 at 91.8	1 1/4 in.
CB3914	2		1 at 91.8	1 1/4 in.
CC2508	2		1 at 55.9	1 in.

Where: C_r = Rated capacity of YORK supplied relief valves.

Table 5: YMC² Mod B condenser R-134a, R-513A, R-515B, and R-1234ze (350# shells)

Shells	Without isolation valves		C_r #air/min	Relief valve outlet size (NPT)
	Quantity of valves	Dual relief valves (see Note)		
350 psig set pressure				
CB2110	2		1 at 134.3	1 in.
CB2510	2		1 at 134.3	1 in.
CB2514	2		1 at 134.3	1 in.
CB2910	2		1 at 134.3	1 1/4 in.
CB2914	2		1 at 134.3	1 1/4 in.
CB3310	2		1 at 134.3	1 1/4 in.
CB3314	2		1 at 134.3	1 1/4 in.
CC2508	2		1 at 134.3	1 in.

Where: C_r = Rated capacity of YORK supplied relief valves.

Table 6: YMC² Mod B evaporator R-134a, R-513A, R-515B, and R-1234ze (235# shells)

Shells	With isolation valves		Without isolation valves		C_r #air/min	Relief valve outlet size (NPT)
	Quantity of valves	Single relief valves	Quantity of valves	Dual relief valves (see Note)		
235 psig set pressure						
EA2510	1		2		1 at 55.9	1 in.
EA2514	1		2		1 at 55.9	1 in.
EB2508	1		2		1 at 55.9	1 in.
EB2510	1		2		1 at 55.9	1 in.
EB2514	1		2		1 at 55.9	1 in.
EB2910	1		2		1 at 91.8	1 1/4 in.
EB2914	1		2		1 at 91.8	1 1/4 in.
EB3310	1		2		1 at 91.8	1 1/4 in.
EB3314	1		2		1 at 91.8	1 1/4 in.
EC3312	1		2		1 at 91.8	1 1/4 in.
EC3314	1		2		1 at 91.8	1 1/4 in.
EC3914	1		2		1 at 91.8	1 1/4 in.
ED3314	1		2		1 at 91.8	1 1/4 in.
ED3914	1		2		1 at 91.8	1 1/4 in.

Where: C_r = Rated capacity of YORK supplied relief valves.

Table 7: YMC² Mod B evaporator R-134a, R-513A, R-515B, and R-1234ze (350# shells)

Shells	With isolation valves		Without isolation valves		C_r #air/min	Relief valve outlet size (NPT)
	Quantity of valves	Single relief valves	Quantity of valves	Dual relief valves (see Note)		
350 psig set pressure						
EA2510	1		2		1 at 134.3	1 in.
EA2514	1		2		1 at 134.3	1 in.
EB2508	1		2		1 at 134.3	1 in.
EB2510	1		2		1 at 134.3	1 in.
EB2514	1		2		1 at 134.3	1 in.

Table 7: YMC² Mod B evaporator R-134a, R-513A, R-515B, and R-1234ze (350# shells)

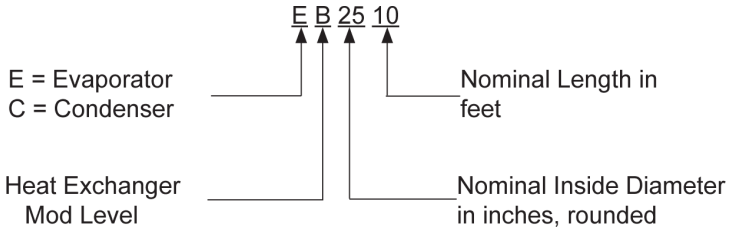
Shells	With isolation valves		Without isolation valves		C_r #air/min	Relief valve outlet size (NPT)
	Quantity of valves	Single relief valves	Quantity of valves	Dual relief valves (see Note)		
350 psig set pressure						
EB2910	1		2		1 at 134.3	1 1/4 in.
EB2914	1		2		1 at 134.3	1 1/4 in.
EB3310	1		2		1 at 134.3	1 1/4 in.
EB3314	1		2		1 at 134.3	1 1/4 in.
EC3312	1		2		1 at 134.3	1 1/4 in.
EC3314	1		2		1 at 134.3	1 1/4 in.
EC3914	1		2		1 at 134.3	1 1/4 in.
ED3314	1		2		1 at 134.3	1 1/4 in.
ED3914	1		2		1 at 134.3	1 1/4 in.

Where: C_r = Rated capacity of YORK supplied relief valves.

Note:

- YMC² chillers come with isolation valves as standard. They are shipped with a dual relief valve on the condenser and a single relief valve on the evaporator. The condenser and the evaporator relief valves must be considered when sizing the vent line(s).
- A dual relief valve consists of one three-way shut off valve and two single relief valves. The valve configuration does not allow both valves to be shut off at the same time, and valves are sized so that each relief valve has sufficient discharge capacity when used alone. The line sizing must be based on the capacity of one valve for each dual relief assembly. This permits safe removal of either relief valve for repair or replacement, while maintaining vessel protection.

Figure 1: Nomenclature



Vent line sizing

Piping: *ASHRAE Standard 15, Section 9.7.8* outlines acceptable relief piping locations and sizing. In summary, the relief piping must vent R-134a refrigerant at least 15 ft (4.57 m) above ground level (for exceptions, refer to *ASHRAE Standard 15-2019, Section 9.7.8.2.a*) and at least 20 ft (6.1 m) from

any window, ventilation opening, pedestrian walkway, or building exit. The discharge piping must prevent a discharged refrigerant from being sprayed directly on personnel and prevent foreign material or debris from entering the piping. Additionally, discharge piping for a fusible plug or rupture disc must have provisions to prevent plugging the pipe in the event of a discharge by the plug or disc.

As indicated in YORK® installation instructions, each vent line must contain a dirt trap in the vertical section to allow collection and removal of any stack condensation or debris (must comply with *Section 9.7.8.2.f*). The piping must be arranged to avoid strain on the relief valves; Johnson Controls recommends the use of a flexible connector. The vent line must be sized in accordance with *ANSI/ASHRAE Standard 15* and local code, but must never be smaller than the relief valve outlet sizes provided in the tables in YMC2 Mod A refrigerant relief valve characteristics and YMC2 Mod B refrigerant relief valve characteristics.

Common header: *Section 9.7.9.3.3* allows for multiple relief devices (on the same or multiple units) to be connected into a common line or header. The sizing of the common discharge header and vent piping for relief devices expected to operate simultaneously must be based on the sum of their outlet areas, with due allowance for the pressure drop in all downstream sections and back-pressure resulting from the discharge of multiple relief devices.

Maximum length: *Section 9.7.9.3.1* and *Appendix D* define the maximum length of discharge piping downstream of the pressure-relief device as follows:

$$L = \frac{0.2146 d^5 (P_0^2 - P_2^2)}{f C_r^2} - \frac{d * \ln(P_0 / P_2)}{6 f} \qquad \text{[feet]} \qquad \text{Eq.(2)a}$$

$$\left[L = \frac{7.4381 \times 10^{-15} d^5 (P_0^2 - P_2^2)}{f C_r^2} - \frac{d * \ln(P_0 / P_2)}{500 f} \right] \qquad \text{[meters]} \qquad \text{Eq.(2)b}$$

Where:

- L = equivalent length of discharge piping, ft (m)
- C_r = rated capacity as stamped on the device in lb/min (kg/s)
- f = Moody friction factor in fully turbulent flow, see Table 9
- d = inside diameter of pipe or tube, in. (mm)
- ln = natural logarithm
- P_2 = absolute pressure at outlet of discharge piping, psi (kPa)
- P_0 = allowed back pressure (absolute) at the outlet of pressure release device, psi (kPa)
  P_0= (0.15 x relief valve set pressure + atmospheric pressure)

For YMC² equipment:

- P_0 = 50.0 for 235 psig set pressure

The *ASHRAE Standard 15 User's Manual* provides that, when the length of vent pipe exceeds approximately 220 diameters (L/d > 220), the first term in equation (2)a or (2)b can be used to solve for the diameter, d.

An average friction factor f = 0.02 can be used when the pipe size is not known.

$$d = 1.36 * \left(\frac{f L C_r^2}{P_0^2 - P_2^2} \right)^{0.2} \qquad [inches] \qquad \text{Eq. (3)a}$$

$$\left[d = 2521 * \left(\frac{f L C_r^2}{P_0^2 - P_2^2} \right)^{0.2} \right] \qquad [millimeters] \qquad \text{Eq. (3)b}$$

The following table lists the maximum lengths of vent piping for various YMC² relief valve capacities and pipe sizes vented to atmosphere.

ⓘ **Note:** This document is to be used only as a guideline for estimating and is subject to changes made in *ASHRAE Standard 15* or overriding local code.

Table 8: Maximum length of discharge piping (ft)

Rated relief valve capacity, C_R (lb/min of air)	Relief valve pressure setting, psig nominal pipe size (in.) (calculations based on schedule 40 pipe)					
	235					
	1.25	1.5	2	2.5	3	4
55.9	24	68	289	761	—	—
81.8	4	23	123	341	—	—
91.8	—	15	93	265	876	-
111.8	—	5	56	170	579	—
147.7	—	—	22	85	316	—
163.6	—	—	14	64	251	—
183.6	—	—	7	45	192	891

Table 9: Steel pipe dimensions (schedule 40)

	Nominal pipe size (in.)								
	1	1 1/4	1 1/2	2	2 1/2	3	4	5	6
I. D. (in.)	1.049	1.380	1.610	2.067	2.469	3.068	4.026	5.047	6.065
Friction factor	0.0225	0.0209	0.0202	0.0190	0.0182	0.0173	0.0163	0.0155	0.0149

Example 1: Maximum length - single vent line per relief valve

A YMC² chiller with a EB2510 evaporator and a CB2110 condenser is to be installed in the equipment room. The relief valves will be vented to atmosphere, using standard schedule 40 pipe, at a distance of 40 ft from the valves.

Solution

From Table 4 and Table 6:

- C_r = 55.9 lb of air/min for each relief valve
- P_0 = (rated pressure x 0.15) + 14.7 = (235) (0.15) + 14.7 = 50.0 psia
- P_2 = 14.7 psia
- Valve outlet size = 1 in.

Using Table 8, scan down the first column to find the rated discharge capacity [C_r] of 55.9. Follow that row across to intersect a 235 psig set pressure column with a length that meets or exceeds the 40 ft requirement. The first intersection (for 1 1/4 in. diameter pipe) has a value of 24 ft, which does not meet the 40 ft minimum requirement. At the next intersection, you see that **1 1/2 in. diameter pipe** is good for a maximum of 68 ft, which satisfies the job requirements.

Alternatively, since L/d > 220, equation (3) may be used, assuming f = 0.02. The required pipe diameter is given by the following equation:

$$d = 1.36 * \left(\frac{fLC^2}{P_0^2 - P_2^2} \right)^{0.2} = 1.36 * \left(\frac{(0.02)(40)(55.9)^2}{50.0^2 - 14.7^2} \right)^{0.2} = 1.385"$$

From Table 9, we see that 1 1/2 in. diameter pipe is the smallest size having an inside diameter of 1.385 in. or more.

Example 2: Maximum length - common header vent line

A YMC^2 chiller with a EB2514 evaporator and a CB2514 condenser is to be installed in the equipment room. The relief valves will be vented to atmosphere, using standard schedule 40 pipe, at a distance of 50 ft from the valves.

Solution

From Table 4 and Table 6:

- EB2514 evaporator has one 1 in. valve, 55.9 lb of air/min each valve, 235 psig set pressure.
- CB2514 condenser has one (dual) 1 in. valve, 55.9 lb of air/min each valve, 235 psig set pressure.

The minimum line size of a common header application is based on the sum of the relief device discharge areas and the sum of the rated discharge capacities.

First, sum the discharge areas of the relief valves using actual I.D. values from Table 9.

$$\Sigma\ \pi r^2 = \Sigma\ 0.25\pi d^2 = 0.25\pi\ (\Sigma\ d^2)$$

$$\Sigma\ d^2 = (\ 1.049^{\ 2} + 1.049^{\ 2}\ ) = 2.2008$$

$$d_{(min)} = (2.2008)^{1/2} = 1.484"$$

From Table 9, you see that 1 1/2 in. pipe (1.610 in. I.D.) is the minimum size that meets or exceeds the sum of the relief valve discharge areas.

Sum the rated discharge capacities [C_r] to determine required flow capacity.

C_r(sum) = (55.9) + (55.9) = 111.8 lb air/min

ⓘ **Note:** Evaporator relief valves are sized such that gas is discharged quickly enough to prevent vessel damage at the discharge pressure. Therefore, refrigerant is discharged from the evaporator before the system pressure reaches 235 psig (condenser relief valve set pressure) in a fire condition. It is conservative to use the cumulative rated discharge capacities at the higher pressure.

Using Table 8, scan down the first column to find the rated discharge capacity [C_r] of 112. Next, follow that row across to intersect a 235 psig set pressure column with a length that meets or exceeds the 50 ft requirement. The first intersection (for 1 1/2 in. diameter pipe) has a value of 5 ft, which does not meet the 50 ft minimum requirement. At the next intersection, we find that **2 in. diameter pipe** is good for a maximum of 55 ft, which satisfies the job requirements.

Alternatively, since L/d > 220, equation (3) can be used, assuming f = 0.02:

$$d = 1.36 * \left(\frac{fLC^2}{P_0^2 - P_2^2} \right)^{0.2} = 1.36 * \left(\frac{(0.02)(50)(111.8)^2}{50.0^2 - 14.7^2} \right)^{0.2} = 1.91"$$

From Table 9, we see that 2 in. diameter pipe is the smallest size having an inside diameter of 1.91 in. or more.

Other methods

Equation (2) can be used to calculate the maximum length of vent piping for any relief valve rating and pipe or tubing diameter. *Appendix E* in *ASHRAE Standard 15* also lists flow capacities for various set pressures and line lengths.

Warranties

Product Type: YMC2 - Water-Cooled Chiller

Unit Tags: CH-01, CH-02

CERTIFICATE OF LIMITED WARRANTY
JOHNSON CONTROLS EQUIPMENT

Contract Number: Model No.: YMC2-S1495BBS Serial Number:
Ship Date: Start Date:

POLICY STATEMENT

Johnson Controls (JCI) warrants all equipment and associated factory supplied materials or start-up services performed by Johnson Controls in connection therewith, against defects in workmanship and material. **The warranty period begins at start up, or six (6) months from the ship date, whichever occurs first.** Subject to the exclusions listed below, Johnson Controls, at its option, will repair or replace, FOB point of shipment, such products or components as it finds defective.

Except for reciprocating replacement compressors, which Johnson Controls warrants for a period of twelve (12) months from date of shipment, Johnson Controls warrants Johnson Controls reconditioned or replacement materials, or installation or start-up services performed by Johnson Controls in connection therewith, against defects in workmanship and material for a period of (90) days from date of shipment.

The above represents the minimum warranty policy Johnson Controls will extend to customers. Additional product specific coverage is provided as outlined herein or in separate related warranty policies. No warranty repairs or replacements will be made until payment for all equipment, materials, components, or services has been received by Johnson Controls.

Warranty Type	Warranty Duration	Expiration Date
Standard - Entire Unit - Parts and Labor	1 Year	Not provided
Extended - Entire Unit - Parts and Labor	3 Years	Not provided
Extended - Refrigerant	3 Years	Not provided

EXCLUSIONS:

Unless specifically agreed to in the contract documents, or associated with additional warranty options listed above, this warranty does not include the following costs and expenses:

I. Labor to repair, remove, or reinstall any equipment, materials or components.

II. Special shipping, handling or transportation charges, including cranes, safety walks or other safety requirements specific to jobsites.

III. Cost of refrigerant.

IV. Freight damage.

V. Field applied coatings added to any surface or heat exchanger.

VI. Rental chillers.

VII. Normal wear and tear or corrosion.

ALL WARRANTIES ARE VOID IF:

A. Equipment is used with refrigerants, oil, additives, or antifreeze agents other than those authorized by supplying factory.

B. Equipment is used with any material or any equipment such as evaporators, tubing, other low side equipment or refrigerant controls not approved by supplying factory.

C. Equipment has been damaged by freezing because it was not properly protected during cold weather or damaged by fire or any other conditions not ordinarily encountered.

D. Equipment is not applied, installed, operated, maintained and serviced in accordance with instructions issued by Johnson Controls.

E. Equipment is damaged due to dirt, air, moisture, or other foreign matter entering the refrigerant system.

F. Equipment is not properly stored, protected, or inspected by customer during the period from date of shipment to date of initial start-up.

G. Field coating of coil has occurred.

H. Equipment is damaged due to acts of God, abuse, including shipping damage, neglect, sabotage, or acts of terrorists.

I. Equipment has modifications carried out that have an effect on the original design of the product without such work being authorized by the factory. Any on site design changes or unit modification/replacement shall be authorized in advance by the factory.

J. Equipment is moved from the location where it is originally placed in service, unless performed by certified Johnson Controls employees who have followed Johnson Controls' then-current installation and operations procedures as evidenced by signed start-up documentation.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES AND LIABILITIES, EXPRESS OR IMPLIED IN LAW OR IN FACT, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE WARRANTIES CONTAINED HEREIN SET FORTH BUYER' S SOLE AND EXCLUSIVE REMEDY IN THE EVENT OF A DEFECT IN WORKMANSHIP OR MATERIALS. IN NO EVENT SHALL JOHNSON CONTROLS' LIABILITY FOR DIRECT OR COMPENSATORY DAMAGES EXCEED THE PAYMENTS RECEIVED BY JOHNSON CONTROLS FROM BUYER FOR THE MATERIAL OR EQUIPMENT INVOLVED, NOR SHALL JOHNSON CONTROLS BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES. THESE LIMITATIONS ON LIABILITY AND DAMAGES SHALL APPLY UNDER ALL THEORIES OF LIABILITY OR CAUSES OF ACTION, INCLUDING BUT NOT LIMITED TO, CONTRACT, WARRANTY, TORT, (INCLUDING NEGLIGENCE) OR STRICT LIABILITY. THE ABOVE LIMITATIONS SHALL INURE TO THE BENEFIT OF JOHNSON CONTROLS SUPPLIERS AND SUBCONTRACTORS.

Products furnished, but not manufactured, by Johnson Controls are not covered by this warranty. Products furnished but not manufactured by Johnson Controls may be covered by the manufacturer of such products and Buyer's sole and exclusive remedy for such products is limited to any warranty given by said manufacturer.

To qualify for warranty consideration under this Johnson Controls warranty, Buyer must immediately notify Johnson Controls at the earlier of the Buyer's discovery of the defect or the time at which the Buyer should have discovered the defect with the exercise of due diligence. Buyer must also promptly thereafter return to Johnson Controls (freight pre-paid by Buyer) all defective parts. Nothing herein is intended to provide warranty coverage to lessees or anyone other than Buyer and no third-parties are intended to be beneficiaries of this Limited Warranty.

If you are interested in adding additional coverage, contact your local JCI branch for more information about extended warranty.

The extended warranty is in accordance with BE Global Intercompany Equipment Warranty Policy 17-16.101.BEQ.

Customer Signature: _____

Johnson Controls Representative: _____

Date: _____

STANDARD LIMITED WARRANTY
ENGINEERED SYSTEMS EQUIPMENT

SERVICE POLICY	Su persed es: 50.05-NM2 (812)	Form 50.05-NM2 (1212)

POLICY STATEMENT

Johnson Controls (JCI) warrants all equipment and associated factory supplied materials or start-up services performed by Johnson Controls in connection therewith, against defects in workmanship and material for a period of eighteen (18) months from date of shipment, or twelve (12) months from date of start up, whichever occurs first. Subject to the exclusions listed below, Johnson Controls, at its option, will repair or replace, FOB point of shipment, such products or components as it finds defective.

Except for reciprocating replacement compressors, which Johnson Controls warrants for a period of twelve (12) months from date of shipment, Johnson Controls warrants Johnson Controls reconditioned or replacement materials, or installation or start-up services performed by Johnson Controls in connection therewith, against defects in workmanship and material for a period of (90) days from date of shipment.

The above represents the minimum warranty policy Johnson Controls will extend to customers. Additional product specific coverage is provided as outlined in related warranty policies. No warranty repairs or replacements will be made until payment for all equipment, materials, or components has been received by Johnson Controls.

EXCLUSIONS:

Unless specifically agreed to in the contract documents, this warranty does not include the following costs and expenses:

1. Labor to remove or reinstall any equipment, materials or components.
2. Shipping, handling or transportation charges, including cranes, safety walks or other safety requirements specific to jobsites.
3. Cost of refrigerant.
4. Freight damage.
5. Field applied coatings added to any surface or heat exchanger
6. Rental Chillers.

ALL WARRANTIES ARE VOID IF:

1. Equipment is used with refrigerants, oil, additives, or antifreeze agents other than those authorized by supplying factory.
2. Equipment is used with any material or any equipment such as evaporators, tubing, other low side equipment or refrigerant controls not approved by supplying factory
3. Equipment has been damaged by freezing because it was not properly protected during cold weather or damaged by fire or any other conditions not ordinarily encountered.
4. Equipment is not installed, operated, maintained and serviced in accordance with instructions issued by Johnson Controls.
5. Equipment is damaged due to dirt, air, moisture, or other foreign matter entering the refrigerant system.
6. Equipment is not properly stored, protected, or inspected by the customer during the period from date of shipment to date of initial start-up.
7. Field coating of coil has occurred.
8. Equipment is damaged due to acts of god, abuse, including shipping damage, neglect, sabotage, or acts of terrorists.
9. Equipment has modifications carried out that have an effect on the original design of the product without such work being authorized by the factory. Any on site design changes or unit modification/replacement shall be authorized in advance by the factory.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES AND LIA BILITIES, EXPRESS OR IMPLIED IN LAW OR IN FACT, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE WARRANTIES CONTAINED HERE IN SET FORTH BUYER" S SOLE AND EXCLUSIVE REMEDY IN THE EVENT OF A DEFECT IN WORKMANSHIP OR MATERIALS. IN NO EVENT SHALL JOHNSON CONTROLS" LIABILITY FOR DIRECT OR COMPENSATORY DAMAGES EXCEED THE PAYMENTS RECEIVED BY JOHNSON CONTROLS FROM BUYER FOR THE MATERIAL OR EQUIPMENT INVOLVED, NOR SHALL JOHNSON CONTROLS BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES. THESE LIMITATIONS ON LIABILITY AND DAMAGES HALL APPLY UNDER ALL THEORIES OF LIABILITY OR CAUSES OF ACTION, INCLUDING BUT NOT LIMITED TO, CONTRACT, WARRANTY, TORT, (INCLUDING NEGLIGENCE) OR STRICT LIABILITY.THE ABOVE LIMITATIONS SHALL INURE TO THE BENEFIT OFJOHNSON CONTROLS SUPPLIERS AND SUBCONTRACTORS.

Equipment Release Approval Form

SUBMITTAL NOTES

Product Type: YMC2 - Water-Cooled Chiller

Unit Tags: CH-01, CH-02

The following table must be completed prior to releasing the equipment for fabrication. Please initial the column indicating the information contained in this submittal has been verified, or indicate to refer to a marked-up page.

SUBMITTAL VERIFICATION	
	Purchaser Initials
Electrical voltage and electrical connections are compatible with jobsite requirements.	
Piping / Ductwork connections shown in this submittal are correct .	
Unit tag designations are correct.	
Equipment dimensions (length, width, and height) and weights have been verified to comply with jobsite conditions and rigging requirements. Please indicate approval by your initials on all included drawings.	
Verify “Unit Hand” of any Air Handling Equipment per the definition provided on the **“Equipment Release / Configuration Process”** form.	

SUBMITTAL VERIFICATION	
	Purchaser Initials
Indicate equipment configuration choices on the **Equipment Release /Configuration Process** form (if included on this Submittal package), and sign the form.	

Important Notes:

1) Actual fabrication release cannot commence until this form is signed by the customer and returned to JCI along with a release notification want date and ship to address.

2) Equipment "lead-time" does not start until confirmed release documentation is received, and the order is actually released to the factory.

3) Modifications to equipment configurations after fabrication release may impact cost and lead-time

4) Attached configurations are as shown in the approved equipment submittals or as defined in superseding customer correspondence.

5) AHU "Side" / "Hand" orientation is relative to a person standing inside an AHU with air hitting the back of the head.

6) Note that once this document is confirmed, the equipment configurations defined by this document take precedence over all other documents.

7) "Want date" and/or "ship to address" changes made after this document is confirmed may impact cost and lead-time.

8) Air handler drawings also include shipping split explosions with corresponding weights and dimensions. If additional splits are required, there will be additional costs and the unit length will increase.

Please fill out the following table and refer to the receiving/rigging instructions in this submittal to help ensure a smooth delivery and installation of the equipment.

DELIVERY INFORMATION	
	Please fill out information below
Contact name for coordinating delivery of equipment with transportation company	
Contact phone number	
Advance notice required from transportation company prior to delivering equipment (typically 48 hours)	
Ship to address:	
Other special shipping instructions or requirements	

CUSTOMER APPROVAL:

Customer Name: _____

Signature (*) _____

Date: _____