York Screw Chiller Startup & Troubleshooting

10084DV001

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Agenda

Day 1 | Day 2 | Day 3 | Day 4 | Resources



Course Introduction



York Screw Chillers Overview



YCAV-YCIV System Overview



YVAA System Overview

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Agenda

Day 1 | Day 2 | Day 3 | Day 4 | Resources



YVWA System Overview



Troubleshooting from Control Panel



VSD Electronic Principles

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Day 1 | Day 2 | **Day 3** | Day 4 | Resources



VSD
Troubleshooting

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Day 1 | Day 2 | Day 3 | **Day 4** | Resources



Installation
Commissioning

Start-up and
Scheduled Service

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Course Introduction



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Objective

After completing this section, you will be able to identify:

- Course Goal
- Target Audience and Prerequisites
- Agenda
- Your Host/Facilitator
- Housekeeping Issues
- Learner Guide and Technical Manuals on Tablet
- Chiller Product Line
- Energy Usage in a Commercial Building
- Key Benefits



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Course Goal

By the end of this course, you will have the skills required to start and maintain the York chiller systems that share a common Variable Speed Drive (VSD) screw compressor:

- YCAV and YCIV
- YVAA
- YVWA

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Target Audience and Prerequisites

Target Audience

- Technicians who install, commission, start up, operate, troubleshoot, and maintain York VSD screw chiller

Expected Experience

- Working knowledge of chiller technology
- Minimum two years of hands-on chiller experience

Prerequisites

- Electrical Safety Training (C-8111-EN)
- Live Electrical Work Electrical Safety Training (C-8096-EN)
- Lockout/Tagout Training (C-8095-EN)
- VSD Basics (C-Y7052)

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Your Host/Facilitator

- Name
- Experience
- Other Experience

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Introduce Yourself

Tell us about:

- Name, role, and location
- Types of chiller systems worked on
- Any experience working on screw chillers
- Any experience working on VSDs
- Your expectations from this training

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Housekeeping Issues

- Tent name cards
- Security policies
  - Branch Access Badges
- Bathrooms
- Smoking
- Class/Lunch (Map)
- Break areas
- Fill out paperwork
  - Class roster
- USB flash drive files
- Tour lab facility
- Lab safety requirements
- Cellphones

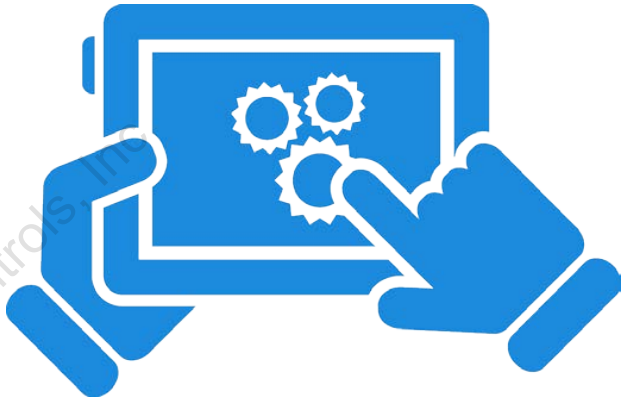


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Learner Guide and Technical Manuals on Tablet

What's unique about it?

- Using tablet saves money
- Similar to your smartphone
- Literature forms from support website
- Take notes — save the notes when you leave class

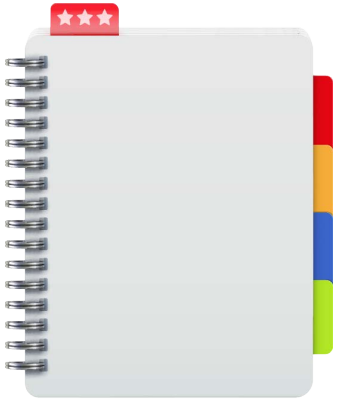


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Learner Guide

What's unique about it?

- Agenda
- Outline Headings for each lesson
- References and job aids included
- Workbook format — take notes and capture answers



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About this Course

This course covers all four chillers:

- YCAV
- YCIV
- YVAA
- YVWA

Some modules contain information common to all

Modules for Specific Systems will deal with significant differences

Our challenge for you:

Master all four systems





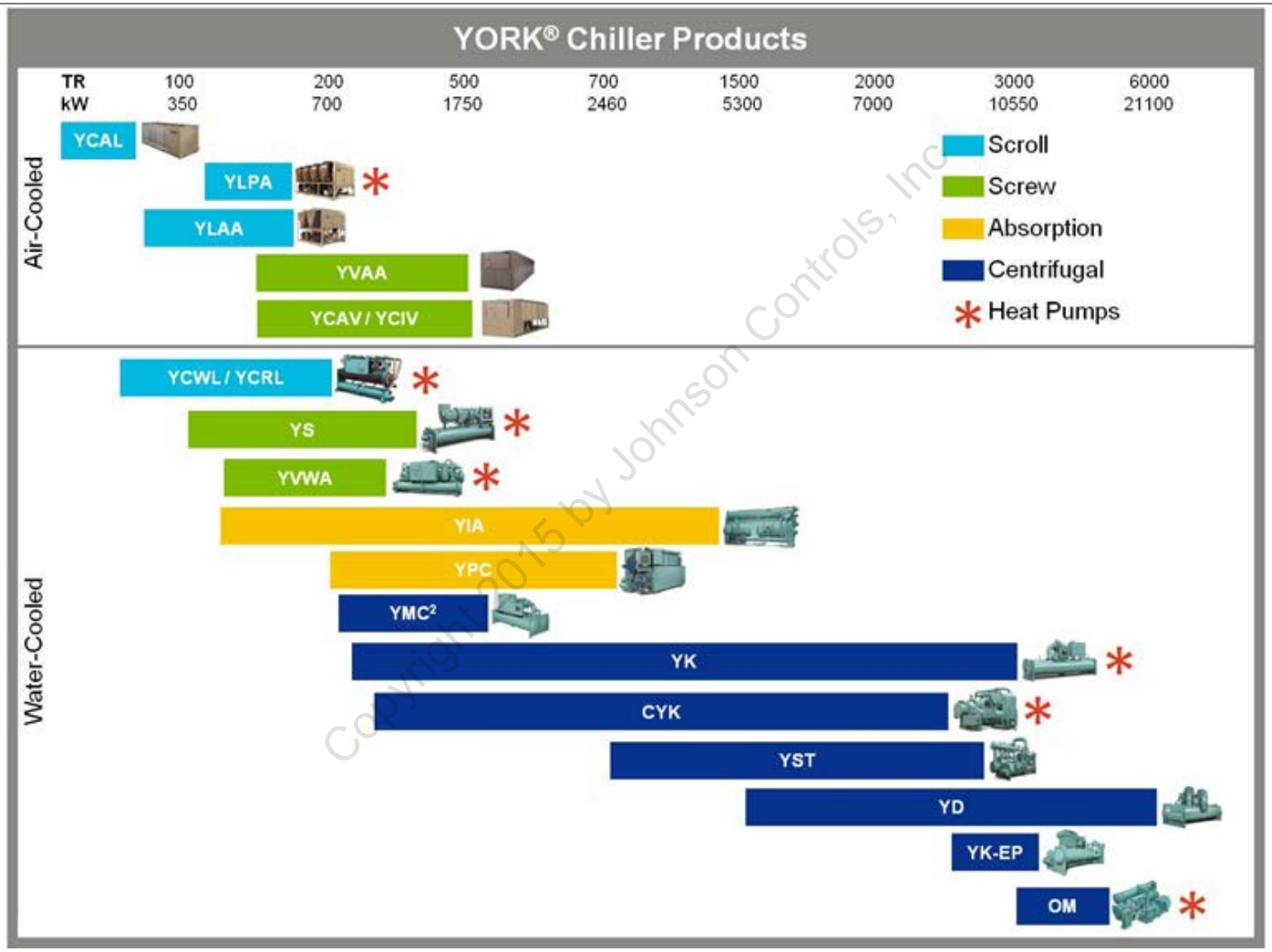




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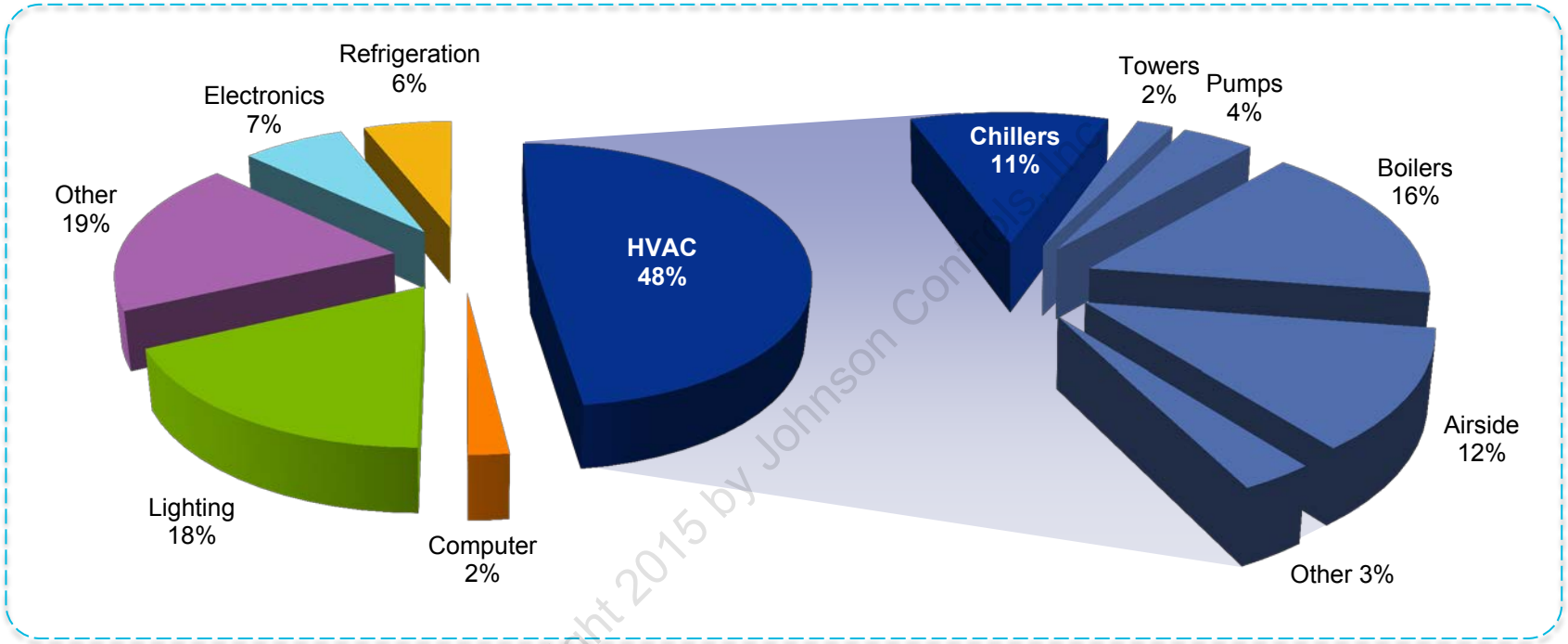
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Product Line Fit



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Energy Usage in a Commercial Building



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Typical Energy Use in a Commercial Building*

HVAC Energy Use with a Water-cooled System

* North America and Europe. Source: Energy Information Administration Commercial Buildings Energy Consumption Survey and Eurostat.

Key Benefits



Efficiency

Reduce your consumption



Sustainability

Improve your environmental footprint



Low Sound

Be a good neighbor by operating quietly



Confidence

Attain peace of mind by proven performance

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Ground Rules

- Ask questions throughout the session
- Take control of your own learning and be an active participant in the class
- Listen carefully to other participants' questions and answers. Many times, their questions/answers can help you learn more about the subject at hand
- Be courteous
- Be on time for all sessions

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York Screw Chillers Overview



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Objective

After completing this section, you will be able to:

- Contrast the technologies used in the YCAV/YCIV, YVAA, and YVWA chillers
- Identify the similarities among the YCAV/YCIV, YVAA, and YVWA chillers
- Illustrate the safety hazards of York screw chillers including refrigerant and other servicing materials

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Discussion: Chiller Technology



Have you repaired or maintained a chiller that used any of the following components?
Share your experience with the group.

- Screw compressor
- Hybrid falling film and flooded evaporator
- Electronic Expansion Valve (EEV)
- Economizer
- Refrigerant HFC-134a
- Variable Speed Drive (VSD)

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Shared Features and Technologies





YCAV



YCIV



YVAA



YVWA

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YCAV/YCIV — Air-cooled Variable Speed, Screw Chiller
150-515 TR (525-1,805 kW)





YCAV



YCIV

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YVAA — Air-cooled Variable Speed, Screw Chiller
150-500 TR (525-1,750 kW)



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YVWA — Water-cooled Variable Speed, Screw Chiller
125-300 TR (440-1,055 kW)



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Why R134a Refrigerant?





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R134a Refrigerant

Benefits of R134a



Reasons why R134a makes the York Screw Chillers more environment friendly:

- Direct emissions account for 2 percent of chiller Global Warming Potential (GWP)
- As with other HFC type refrigerants, R134a has no Ozone Depletion Potential (ODP)
- R134a has no phase-out date according to the Montreal Protocol
- Use of R134a qualifies a building for LEED Credit EAc4 for Enhanced Refrigerant Management

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Pressure/Temperature Tables



TEMPERATURE / PRESSURE TABLES

RED – VAC INCHES Hg
BLACK – P.S.I.G.

TEMP. °F.	REFRIGERANTS							
	123	11	134a	12	22	500	502	717
-50	29.2	28.9	28.5	25.4	6.2	12.6	0.0	14.3
-48	29.1	28.8	27.7	24.6	4.8	11.9	0.8	13.3
-46	29.1	28.7	27.0	23.8	3.5	10.9	1.6	12.2
-44	29.0	28.6	26.2	22.9	2.0	9.8	2.5	11.1
-42	29.0	28.5	25.5	21.9	0.5	8.6	3.4	10.0
-40	28.9	28.4	24.7	21.0	0.5	7.6	4.3	8.7
-38	28.8	28.3	23.7	20.0	1.3	6.4	5.2	7.4
-36	28.7	28.2	22.7	18.9	2.2	5.2	6.2	6.1
-34	28.7	28.1	21.7	17.8	2.0	3.9	7.2	4.7
-32	28.6	27.9	20.8	16.7	3.9	2.6	8.3	3.2
-30	28.5	27.8	19.8	15.5	4.9	1.2	9.4	1.6
-28	28.4	27.7	18.6	14.3	5.9	0.1	10.5	0.0
-26	28.2	27.5	17.4	13.0	6.9	0.9	11.7	0.8
-24	28.1	27.4	16.2	11.6	7.9	1.6	13.0	1.7
-22	27.9	27.2	15.0	10.3	9.0	2.4	14.2	2.6
-20	27.8	27.0	13.8	9.0	10.2	3.2	15.5	3.6
-18	27.6	26.8	12.5	7.6	11.3	4.1	16.9	4.5
-16	27.5	26.6	11.3	6.2	12.5	5.0	18.3	5.6
-14	27.3	26.4	10.6	4.8	13.8	5.9	19.7	6.7
-12	27.2	26.2	9.2	3.7	15.1	6.8	21.2	7.9
-10	27.0	26.0	7.8	2.5	16.5	7.8	22.8	9.0
-8	26.8	25.8	7.0	1.4	17.9	8.8	24.4	10.3
-6	26.6	25.5	6.2	0.3	19.3	9.9	26.0	11.5
-4	26.4	25.3	5.4	0.2	20.8	11.0	27.7	12.9
-2	26.2	25.0	5.4	0.2	22.4	12.1	29.4	14.3
0	26.0	24.7	6.3	0.2	24.0	13.3	31.2	15.7
2	25.7	24.4	7.4	10.2	25.6	14.5	33.1	17.2
4	25.5	24.1	8.4	11.2	27.3	15.7	35.0	18.8
6	25.2	23.8	9.5	12.3	29.1	17.0	37.0	20.4
8	25.0	23.4	10.5	13.5	30.9	18.4	39.0	22.1
10	24.7	23.1	11.6	14.8	32.8	19.7	41.1	23.8
12	24.4	22.7	12.9	15.8	34.7	21.2	43.2	25.6
14	24.0	22.3	14.2	17.1	36.7	22.6	45.5	27.5
16	23.7	21.9	15.4	18.4	38.7	24.1	47.7	29.4
18	23.3	21.5	16.7	19.7	40.9	25.7	50.1	31.4
20	23.0	21.1	18.0	21.0	43.0	27.3	52.5	33.5
22	22.6	20.6	19.5	22.4	45.3	28.9	54.9	35.7
24	22.1	20.1	21.0	23.9	47.6	30.6	57.4	37.9
26	21.7	19.7	22.5	25.4	50.0	32.4	60.0	40.2
28	21.2	19.1	24.1	26.9	52.4	34.2	62.7	42.6
30	20.8	18.6	25.6	28.5	54.9	36.0	65.4	45.0
32	20.3	18.1	27.4	30.1	57.5	37.9	68.2	47.5
34	19.8	17.5	29.2	31.7	60.1	39.9	71.1	50.2

TEMP. °F.	REFRIGERANTS							
	123	11	134a	12	22	500	502	717
36	19.2	16.9	30.9	33.4	62.8	41.9	74.1	52.9
38	18.7	16.3	32.7	35.2	65.6	43.9	77.1	55.7
40	18.2	15.6	34.5	37.0	68.5	46.1	80.2	58.6
42	17.6	15.0	36.6	38.8	71.5	48.2	83.4	61.6
44	16.9	14.3	38.7	40.7	74.5	50.5	86.6	64.7
46	16.3	13.6	40.7	42.7	77.6	52.8	90.0	67.9
48	15.6	12.8	42.8	44.7	80.8	55.1	93.4	71.1
50	15.0	12.0	44.9	46.7	84.0	57.6	96.9	74.5
52	14.2	11.2	47.3	48.8	87.4	60.1	100.5	78.0
54	13.5	10.4	49.7	51.0	90.8	62.6	104.1	81.5
56	12.7	9.6	52.1	53.2	94.3	65.2	107.9	85.2
58	12.0	8.7	54.5	55.4	97.9	67.9	111.7	89.0
60	11.2	7.8	56.9	57.7	101.6	70.6	115.6	92.9
62	10.3	6.8	59.7	60.1	105.4	73.5	119.6	96.9
64	9.4	5.9	62.4	62.5	109.3	76.3	123.7	101.0
66	8.4	4.9	65.2	65.0	113.2	79.3	127.9	105.3
68	7.5	3.8	67.9	67.6	117.3	82.3	132.2	109.6
70	6.6	2.8	70.7	70.2	121.4	85.4	136.6	114.1
72	5.5	1.6	73.8	72.9	125.7	88.6	141.1	118.7
74	4.4	0.5	77.0	75.6	130.0	91.8	145.6	123.4
76	3.3	0.3	80.1	78.4	134.5	95.1	150.3	128.3
78	2.2	0.9	83.3	81.3	139.0	98.5	155.1	133.2
80	1.1	1.5	86.4	84.2	143.6	102.0	159.9	138.3
82	0.0	2.2	90.0	87.2	148.4	105.6	164.9	143.6
84	0.7	2.8	93.5	90.2	153.2	109.2	170.0	149.0
86	1.3	3.5	97.1	93.3	158.2	112.9	175.1	154.5
88	1.9	4.2	100.6	96.5	163.2	116.7	180.4	160.1
90	2.6	4.9	104.2	99.8	168.4	120.6	185.8	165.9
92	3.3	5.6	108.2	103.1	173.7	124.5	191.3	171.9
94	4.0	6.3	112.2	106.5	179.1	128.6	196.9	178.0
96	4.7	7.1	116.3	110.0	184.6	132.7	202.6	184.2
98	5.5	7.9	120.3	113.5	190.2	136.9	208.4	190.6
100	6.3	8.8	124.3	117.2	195.9	141.2	214.4	197.2
102	7.1	9.6	128.8	120.9	201.8	145.6	220.4	203.9
104	7.9	10.5	133.3	124.6	207.7	150.1	226.6	210.7
106	8.7	11.3	137.8	128.5	213.8	154.7	232.9	217.8
108	9.6	12.3	142.3	132.4	220.0	159.4	239.3	225.0
110	10.5	13.2	146.8	136.4	226.4	164.1	245.8	232.3
112	11.4	14.2	151.8	140.5	232.8	169.0	252.4	239.8
114	12.4	15.1	156.8	144.7	239.4	173.9	259.2	247.5
116	13.4	16.1	161.9	148.9	246.1	179.0	266.1	255.4
118	14.4	17.2	166.9	153.2	252.9	184.2	273.1	263.5
–	–	–	–	–	–	–	–	–

TEMP. °F.	REFRIGERANTS							
	123	11	134a	12	22	500	502	717
120	15.4	18.2	171.9	157.7	259.9	189.4	280.3	271.7
122	16.5	19.3	177.5	162.2	267.0	194.8	287.5	280.1
124	17.5	20.5	183.1	166.7	274.3	200.2	295.0	288.7
126	18.7	21.6	188.6	171.4	281.6	205.8	302.5	–
128	19.8	22.8	194.2	176.2	289.1	211.5	310.2	–
130	21.0	24.0	199.8	181.0	296.8	217.2	318.0	–
132	22.2	25.2	205.9	185.9	304.6	223.1	325.9	–
134	23.4	26.5	212.1	191.0	312.5	229.1	334.0	–
136	24.7	27.8	218.2	196.1	320.6	235.2	342.3	–
138	26.0	29.1	224.4	201.3	328.9	241.4	350.6	–
140	27.3	30.4	230.5	206.6	337.3	247.7	359.1	–
142	28.7	31.8	237.3	212.0	345.8	254.2	367.8	–
144	30.1	33.2	244.1	217.5	354.5	260.7	376.6	–
146	31.5	34.7	250.1	223.1	363.3	267.4	385.6	–
148	32.9	36.2	257.6	228.8	372.3	274.2	394.7	–
150	34.5	37.7	264.4	234.6	381.5	281.1	403.9	–
152	36.1	39.2	271.8	240.5	390.8	288.1	413.4	–
154	37.7	40.8	279.2	246.5	400.3	295.3	422.9	–
156	39.3	42.4	286.7	252.6	410.0	302.5	432.7	–
158	40.9	44.1	294.1	258.8	419.8	309.9	442.5	–
160	42.5	45.8	301.5	265.1	429.8	317.4	452.6	–
162	44.3	47.5	309.6	271.5	440.0	325.1	–	–
164	46.1	49.2	317.7	278.1	450.4	332.9	–	–
166	47.9	51.0	325.8	284.7	460.9	340.8	–	–
168	49.7	52.9	333.9	291.5	471.7	348.8	–	–
170	51.5	54.8	342.0	298.3	482.6	357.0	–	–
172	53.5	56.8	350.8	305.3	493.7	365.3	–	–
174	55.5	58.8	359.6	312.4	505.0	373.7	–	–
176	57.4	60.7	368.3	319.6	516.5	382.3	–	–
178	59.4	62.7	377.1	326.9	528.2	391.0	–	–
180	61.4	64.7	385.9	334.3	540.1	399.9	–	–
182	63.6	66.9	395.4	341.9	552.2	408.8	–	–
184	65.8	69.1	405.0	349.5	564.5	418.0	–	–
186	68.0	71.3	414.5	357.3	577.1	427.3	–	–
188	70.2	73.5	424.1	365.2	589.9	436.7	–	–
190	72.5	75.7	433.6	373.3	602.9	446.3	–	–
192	74.9	78.1	443.9	381.4	616.1	456.0	–	–
194	77.4	80.5	454.2	389.7	629.6	465.9	–	–
196	79.8	83.0	464.4	398.2	643.4	475.9	–	–
198	82.3	85.4	474.7	406.7	657.4	486.1	–	–
200	84.7	87.8	485.0	415.4	671.7	496.4	–	–
–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–

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Thermodynamic properties of R134a Vs R22

- Provides better part load performance
- Hybrid of falling film and flooded technologies

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HCFC Phase-out Schedule



U.S HCFC Phase out Schedule

Clean Air Act

- R-141b, January 1, 2003
  - Complete phase-out of R-141b – no production or import
- R-22, R-142b, January 1, 2010
  - Ban on production and import unless used in equipment manufactured prior to January 1, 2010
- All HCFC's, January 1, 2015
  - Ban on production and import unless used in equipment manufactured prior to January 1, 2010
- R-22, R-142b, January 1, 2020
  - Complete phase-out of R-22 and R-142b – no production or import
- All remaining HCFC's, January 1, 2030
  - Complete phase-out – no production or import of any class II controlled Substance

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York Screw Compressor



- Semi-hermetic rotary twin-screw compressor
- Capacity controlled by a VSD instead of slide valves
- Fewer compressor moving parts
- Reduction in possibility of leaks in compressed gas bypass paths by 35%

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Exercise

Find the compressor cutaway diagram on the next page.

Mark the location of each of these major components:

- Motor Rotor
- Motor Stator
- Motor Connections
- Economizer Port
- Oil Filter
- Suction Strainer
- Male Screw Rotor
- Female Screw Rotor

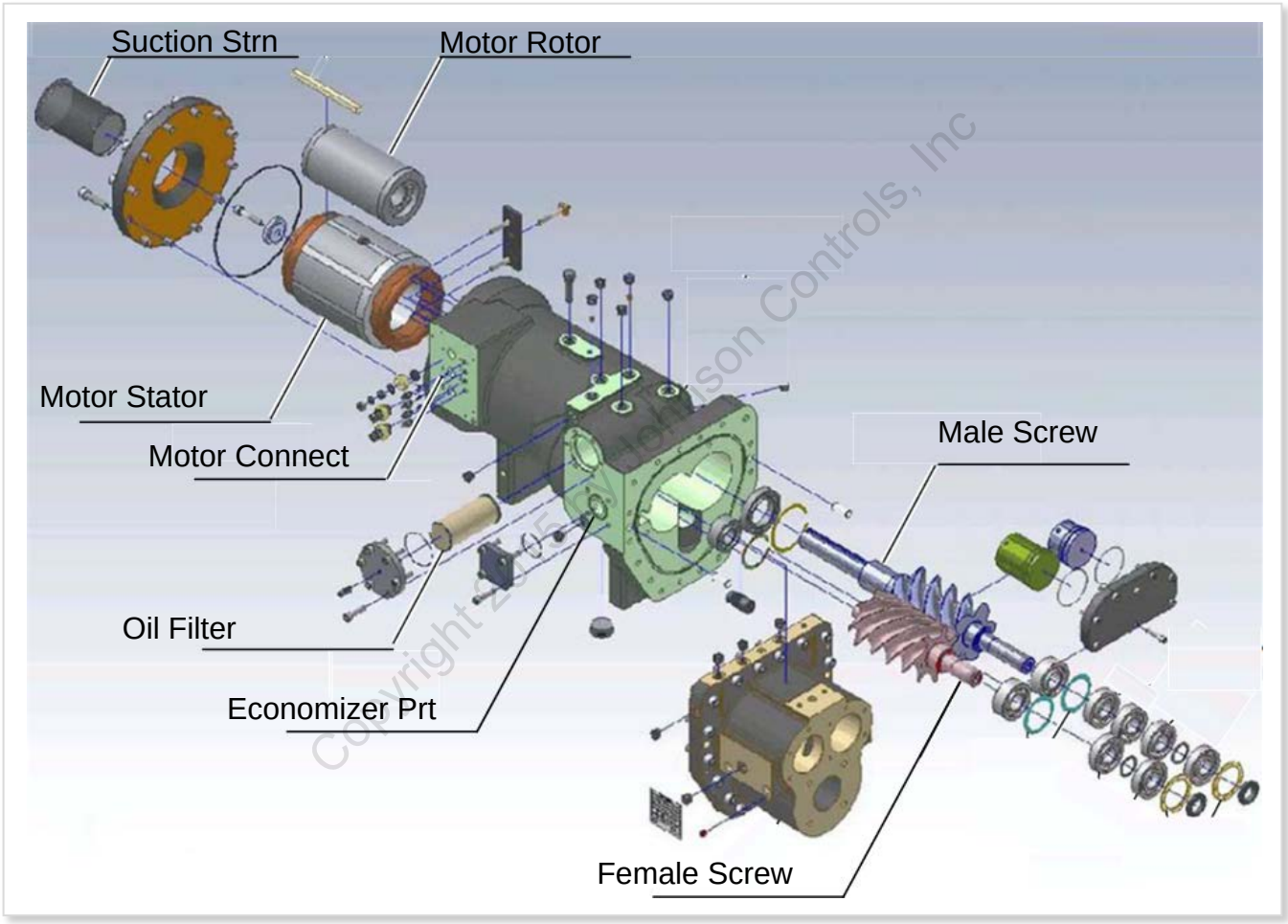
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Use figure 45 in the YCIV IOM if you need help.
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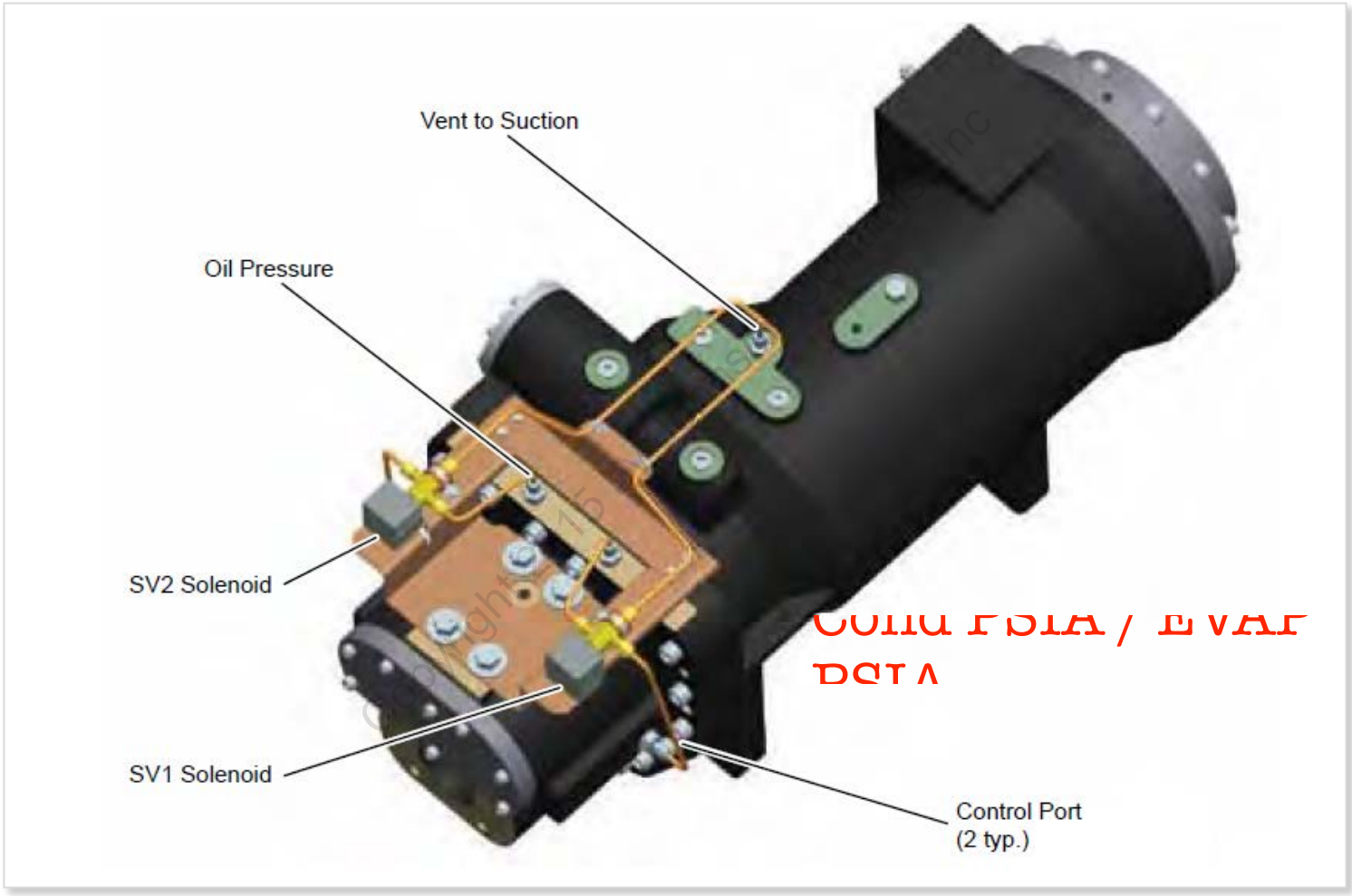
Compressor Component Identification





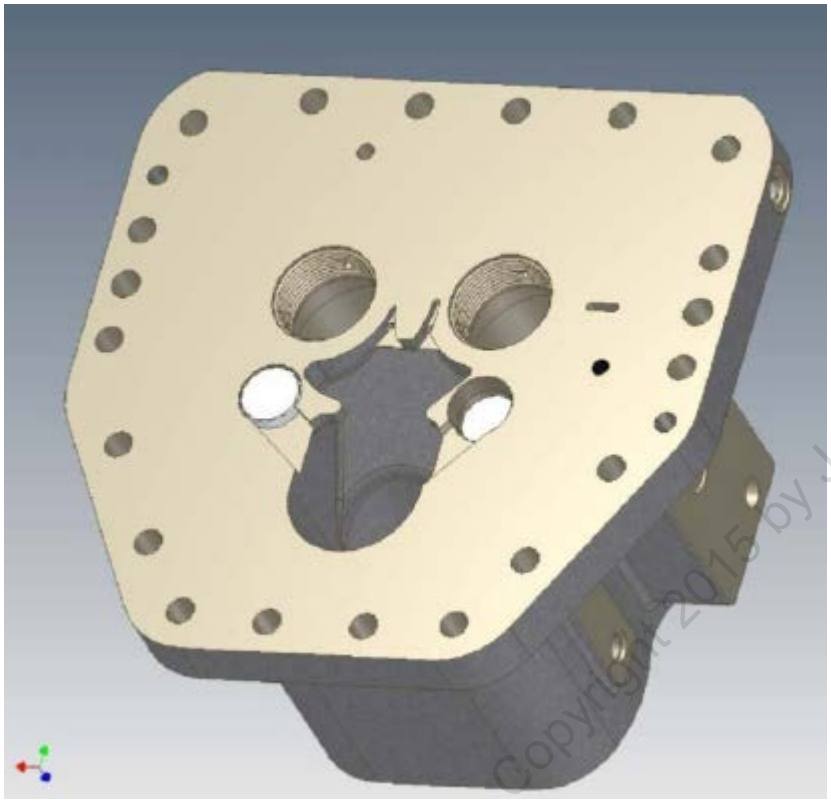
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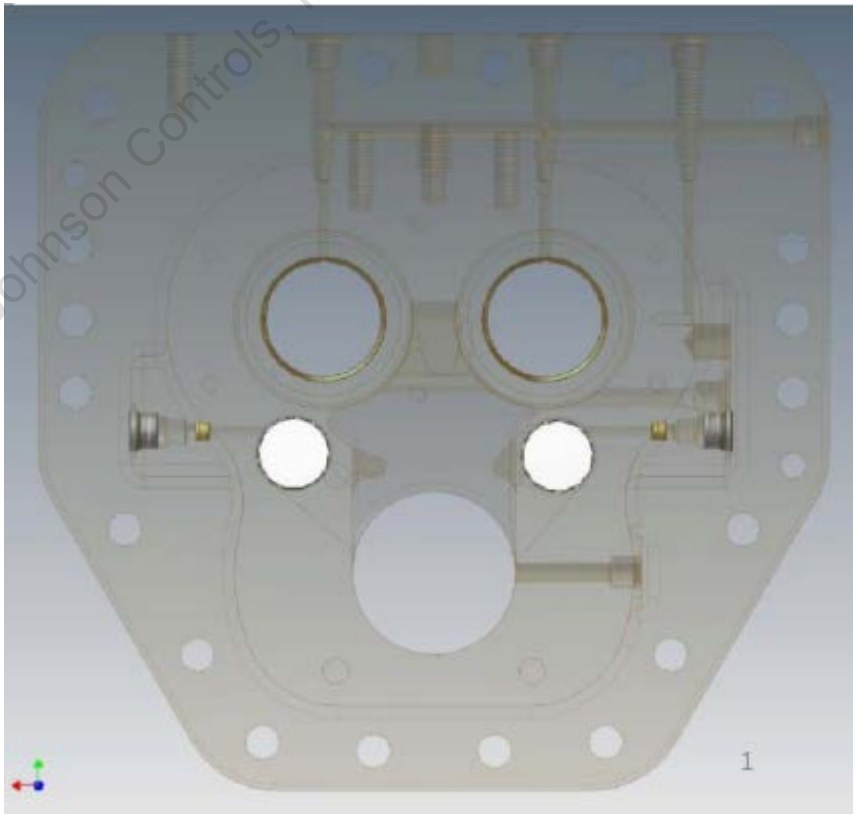
Variable Volume Ratio (Vi) Compressor Step Components (YVAA & YVWA Only)



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Step Vi Mechanism

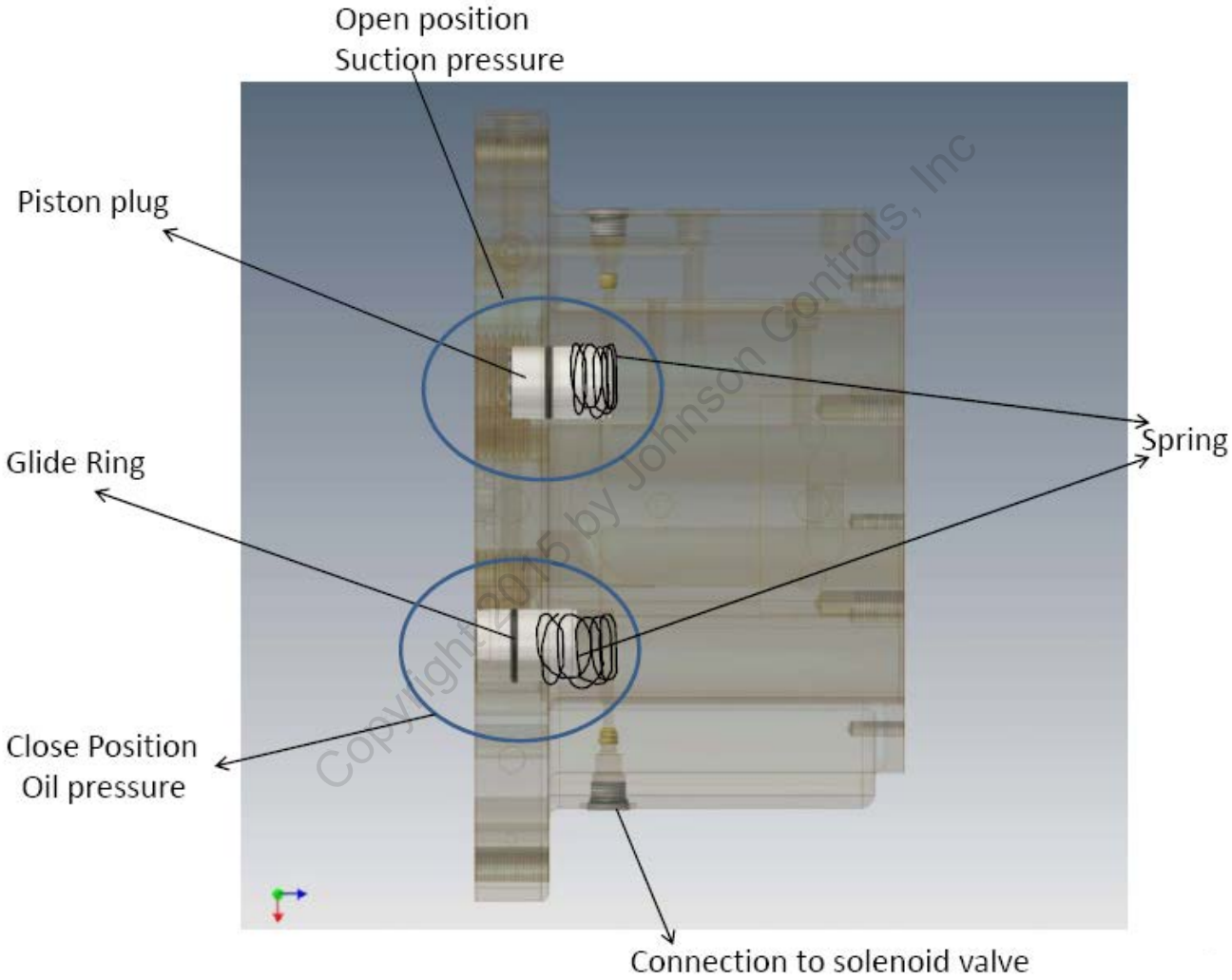




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Step Vi Mechanism (Contd.)





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Step Vi Mechanism (Contd.)





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Vi Step Solenoid Control



Steps to control Vi step solenoid:

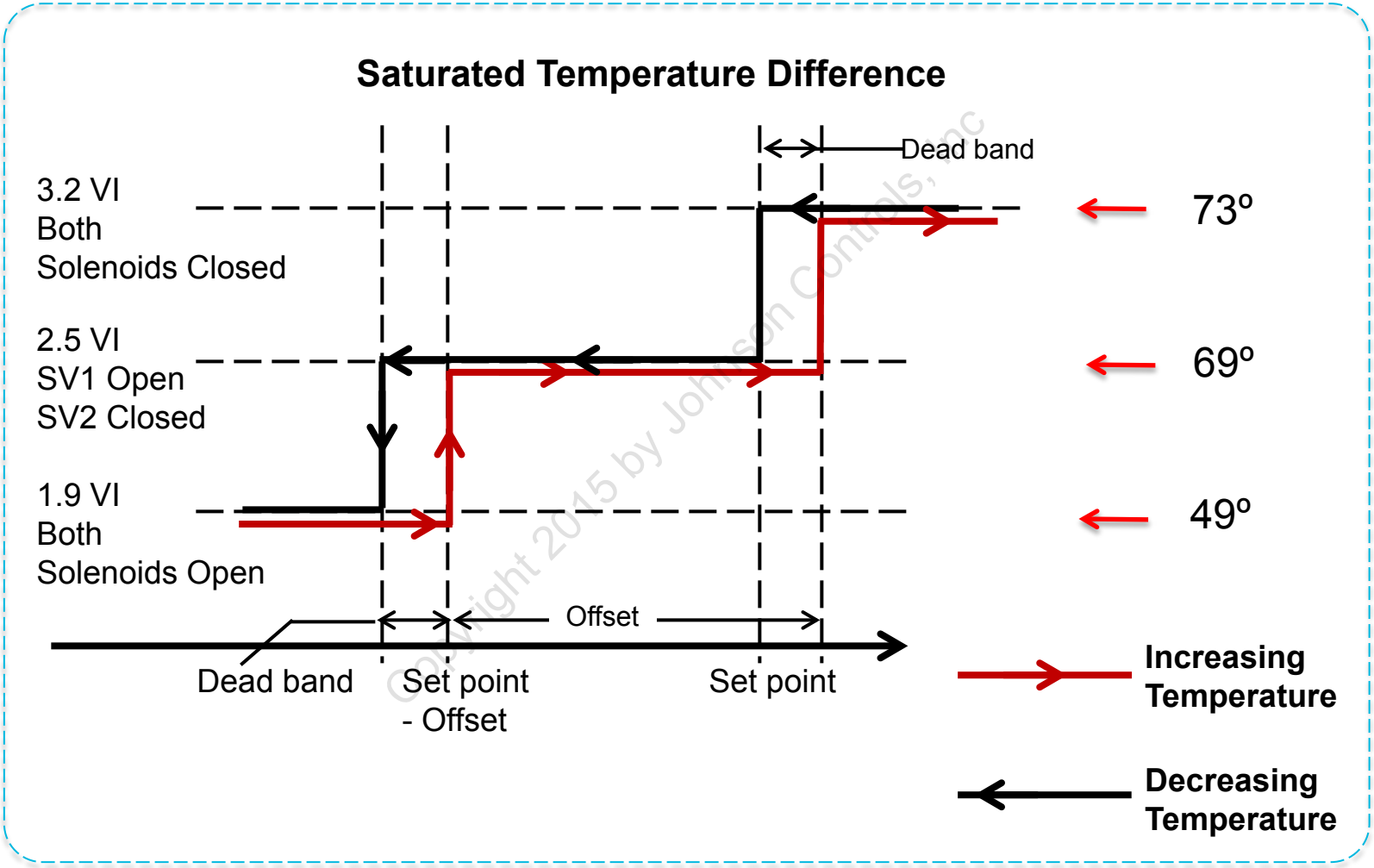
- The saturated temperature difference (saturated discharge temperature minus saturated evaporator temperature) is calculated to determine when to energize them
- The result is compared with the service-programmable setpoints:

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Setup Mode Value	Low Limit	High Limit	Default
Sys 1 Vi Differential Temp Setpt	60.0 °F	90.0 °F	73.0 °F
Sys 2 Vi Differential Temp Setpt	60.0 °F	90.0 °F	73.0 °F
Vi Dead band	2.0 °F	10.0 °F	4.0 °F
Vi Differential Temp Setpt Offset	2.0 °F	40.0 °F	20.0 °F

Vi Step Solenoid Control
Vs Saturated Temperature Difference





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VSD: Features

- Allows a fixed supply voltage and frequency as input
- Provides output of variable voltage and frequency
- Provides a dedicated output inverter for each compressor
- Enables drive cooling by Inhibited water
- Panel enclosures meet NEMA 1(IP20) rating





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VSD: Benefits



- Provides higher efficiency at part-load or off-design conditions compared to a fixed speed screw chiller
- Prevents motor heating and eliminates mechanical stress at startup
- Utilizes wide range of heat rejection methods to achieve efficiency
- Provides high displacement power factor of 95% as standard
- Prevents energy wastage
- Eliminates need for hot gas bypass

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Capacity control has the ability to reduce the cooling capacity to 10%.

Building Automation System (BAS) Interface Options





YCAV



YCIV



YVAA



YVWA

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BAS Options: Remote Inputs



- Remote Reset - Leaving Chilled Liquid Setpoint Reset
- Remote Reset - Current Limit Setpoint



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BAS Options: Remote Inputs (Contd.)



- SilentNight™ Sound Limit Control



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BAS Options: Networked Connectivity



- E-Link Integration
- York ISN MicroGateway



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Planned Maintenance Powered by Connected Services



Service North America

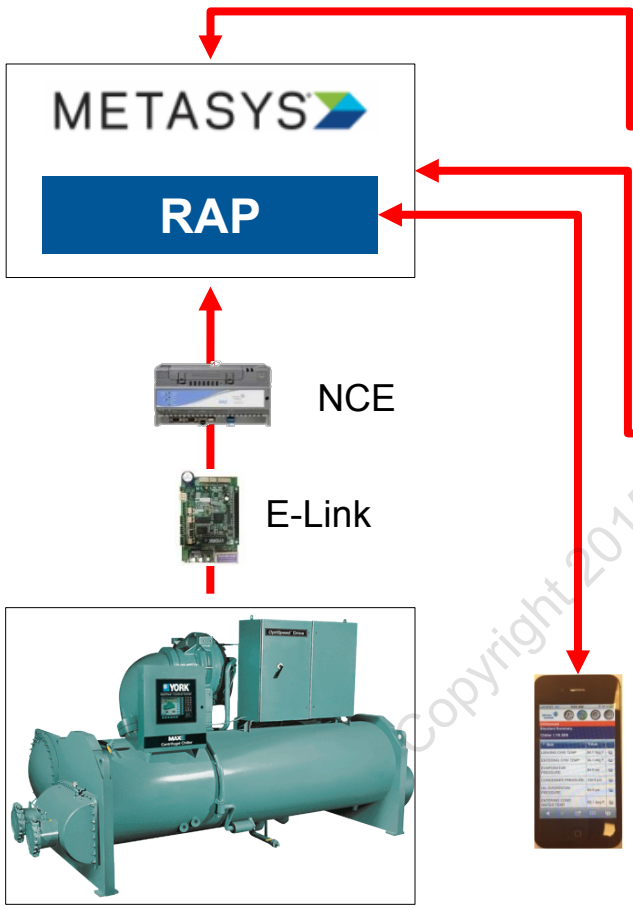


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Real-time Access to Vital Chiller Operating Information

Proactive Services



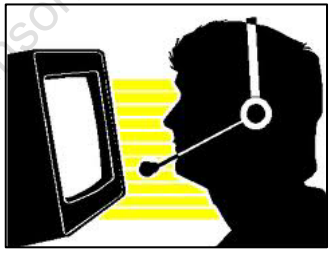


Branch and Operations Center



Dashboard Analytics

- 24 x 7 response
- Technician and branch
- YORK® product support



Branch

- Problem analysis
- Dispatch
- Respond to issues 24X7

Field Technician



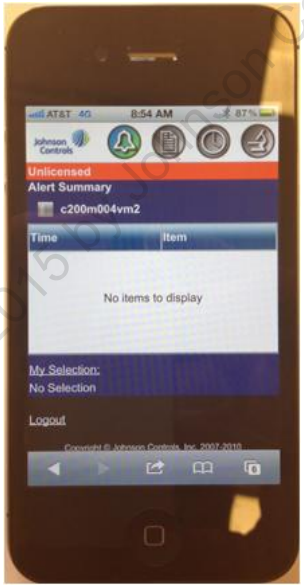
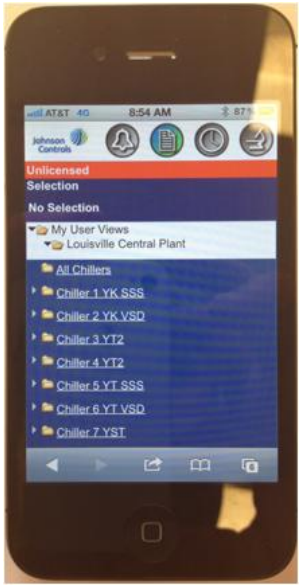
Anytime Access

- Service technicians have real-time access to chiller data
- Via Ready Access Portal

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Empowering Technicians

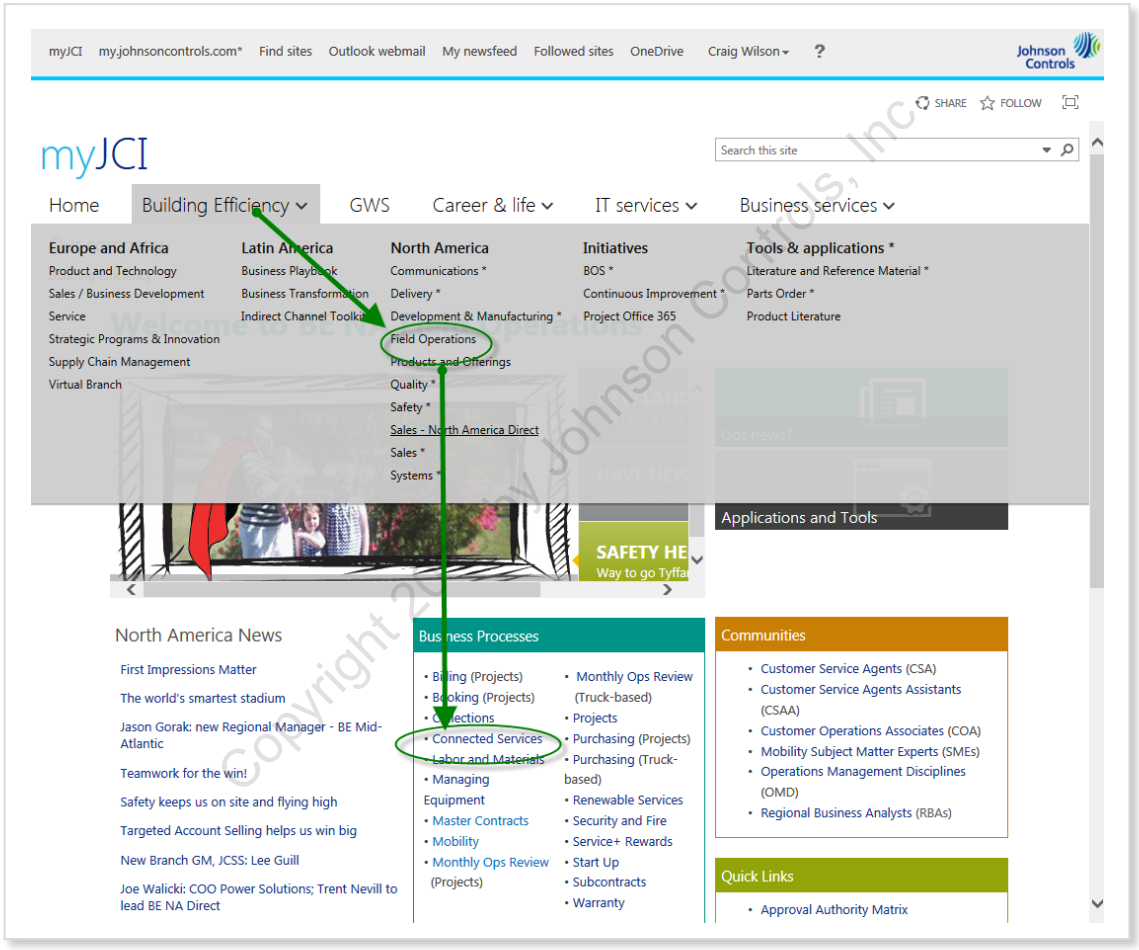


iPhone application	Secure login for Johnson Controls employees only	Personal alert page	Visibility to all Branch accounts & chillers in plant	Real-time chiller value status
				

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Connected Chillers on MyJCI

http://publish.johnsoncontrols.com/content/controls/us/eng/serv/Main_Service_Planning/connected-services.html



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Power Entry Options — Circuit Breaker

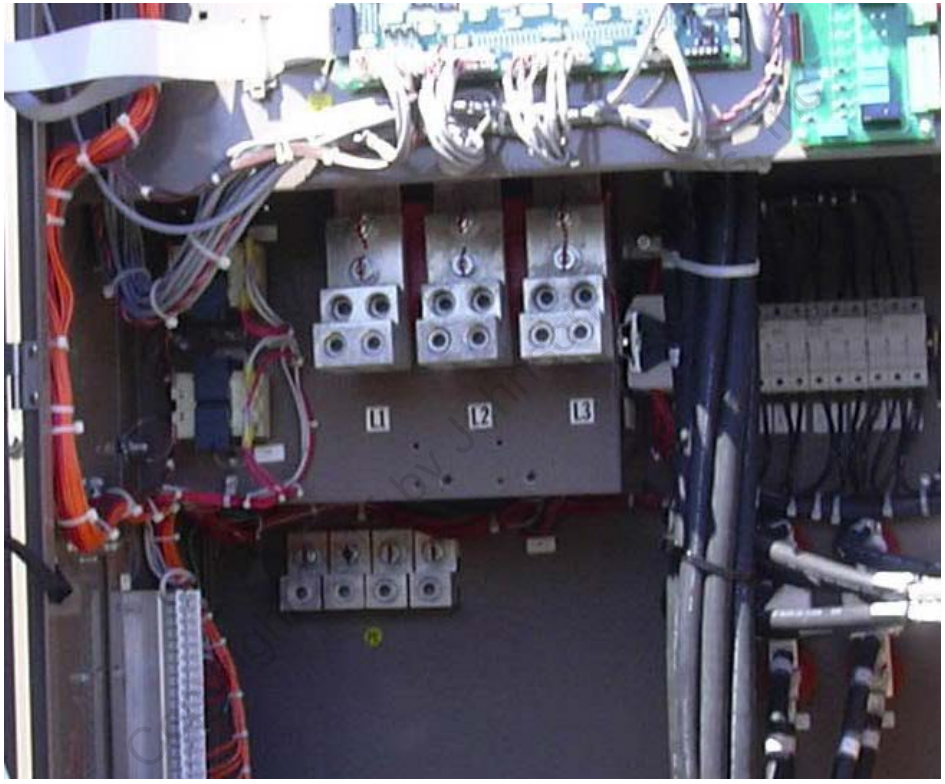




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Power Entry Options — Terminal Blocks





Protective Ground

Welding
Requires ground to be disconnected

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Vibration Isolation Options
(All Field Mounted)

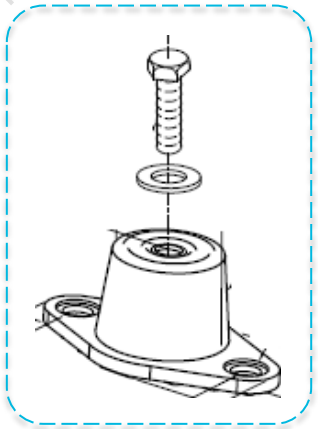


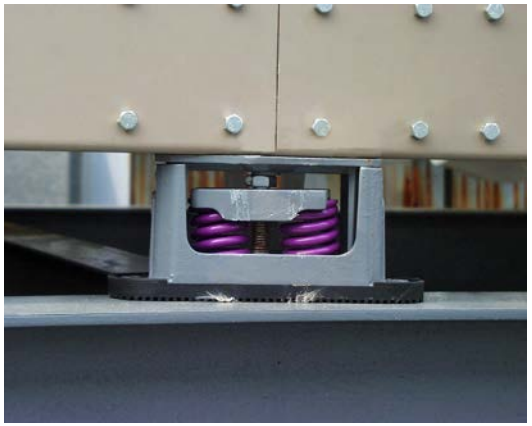






- Elastomer Mounts
- 1” (25 mm) Spring Isolator
- 2” (51 mm) Spring Isolator





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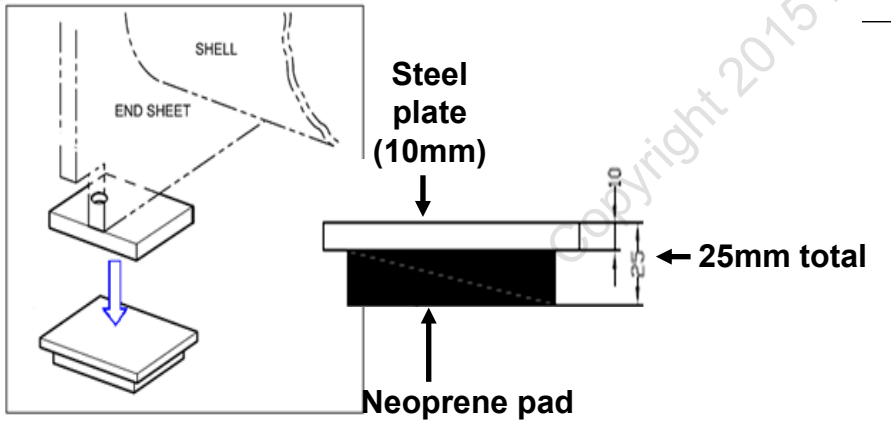
Vibration Isolation Options (Contd.)

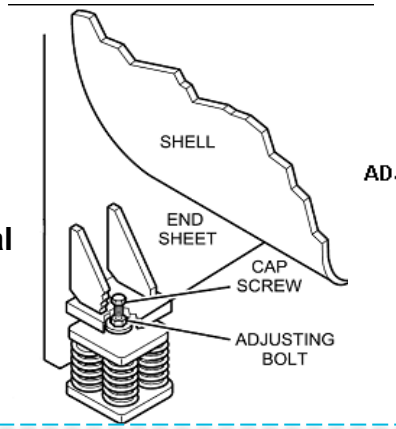
(All Field Mounted) (Contd.)

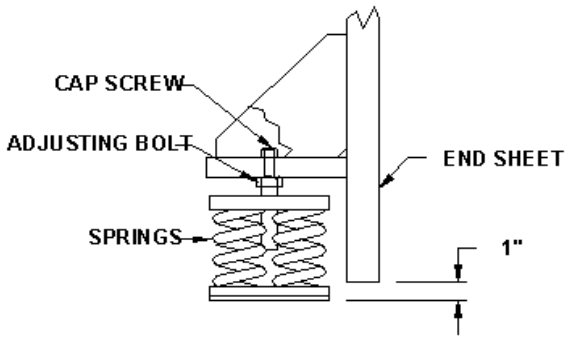


- Neoprene Pads

- Spring Isolator







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Shipment Options



- **Form 1**
  (Complete assembly and refrigerant charged)
- **Form 2**
  (Complete assembly without refrigerant)
- **Form 7**
  (Disassembled into packages)









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Key Takeaways — Chiller Overview



- Screw compressor
- Hybrid falling film and flooded evaporator
- Electronic Expansion Valve (EEV)
- Economizer
- Refrigerant HFC-134a
- Variable Speed Drive (VSD)
- BAS Interface Option

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YCAV-YCIV System Overview



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Objective

After completing this section, you will be able to:

- Describe the distinguishing features of the YCAV and YCIV chillers
- Describe the normal operational sequence of the YCAV/YCIV chiller

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YCAV and YCIV Technologies

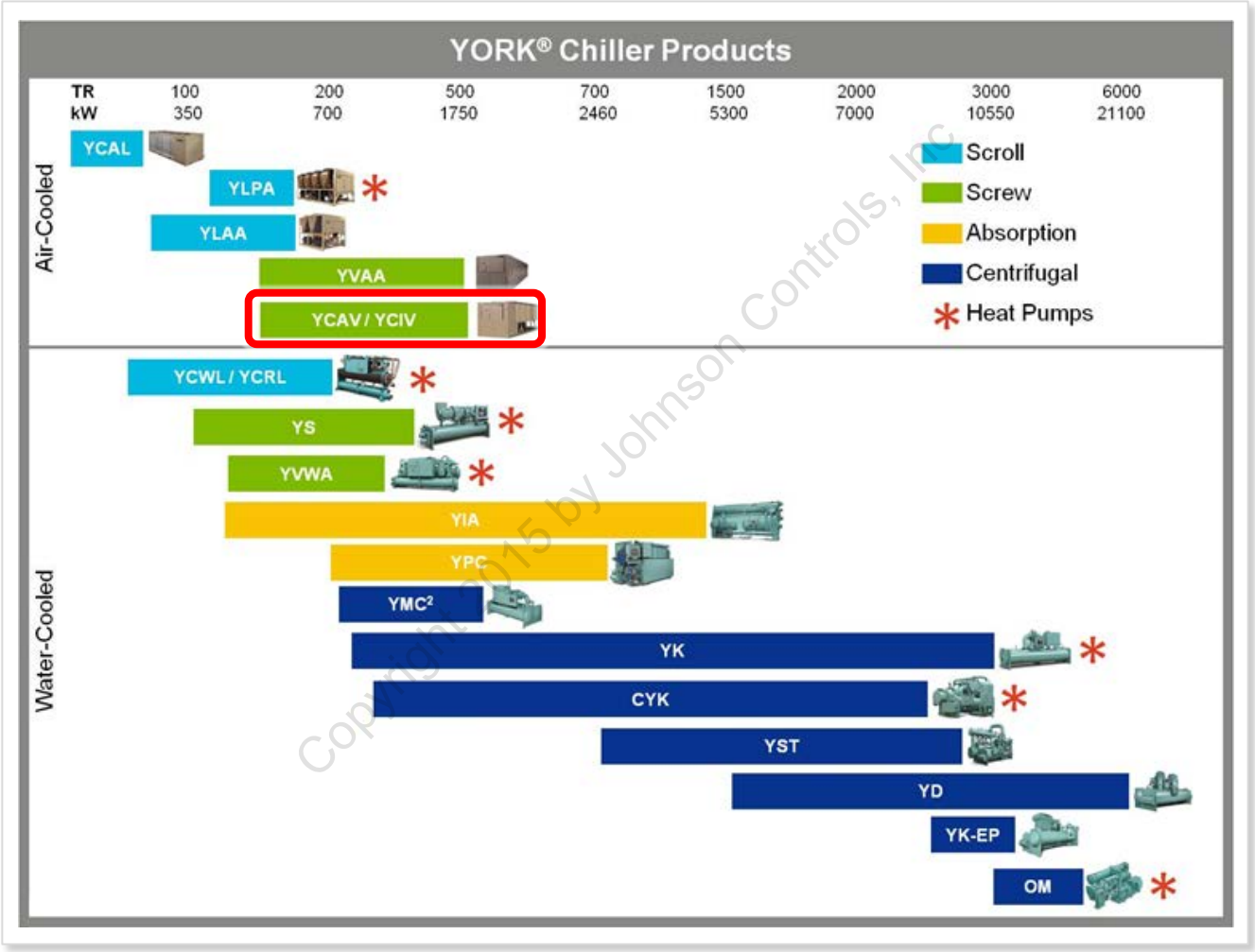


- Condenser
- Component Locations
- Refrigeration Cycle
- Lubrication System
- Condenser and Fans
- Sound Attenuation
- Other Enclosure Options
- Economizer
- Metering Device
- Evaporator

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Product Line Fit

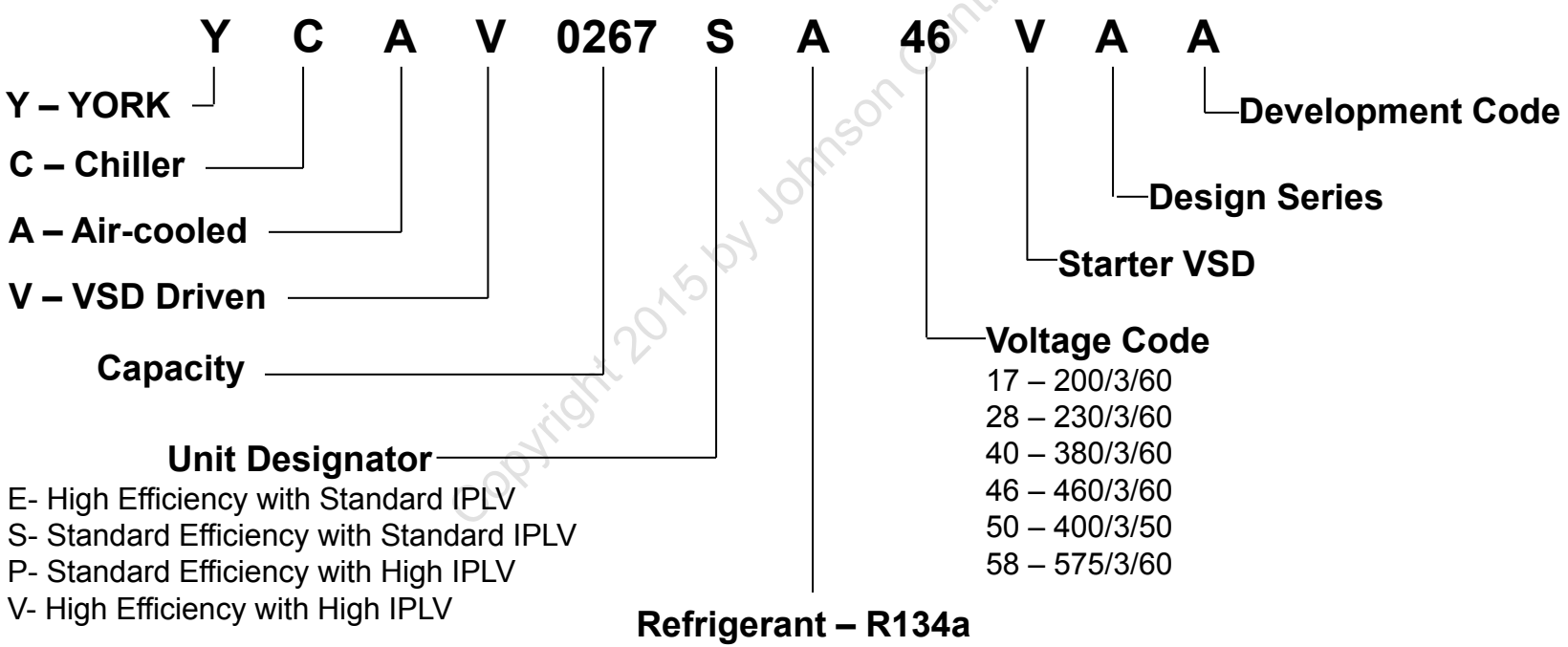


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Nomenclature

What does the chiller PIN tell us?

NOMENCLATURE



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Exercise

How do YCAV and YCIV differ?

Find the differences, identified by the PIN details, between the two chiller models.

Unit Model Number Nomenclature

YCAV IOM Form 201.21-NM1.pdf
YCIV IOM Form 201.23-NM1.pdf

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YCAV/YCIV Nomenclature Differences



FEATURE	DESCRIPTION	OPTION	DESCRIPTION
VESSEL	Vessel Codes (PIN 42)	A	ASME Pressure Vessel Codes
		E	PED Pressure Vessel Code
		Q	Special Pressure Vessel Codes
CLR	Cooler (PIN 43)	X	Standard Cooler
		R	Remote Cooler
		Q	Special Cooler requirements
PIN44	Connections (PIN 44)	L	Handed cooler left, view from control panel end
		R	Handed cooler right, view from control panel end
		Q	Special quote
HEAT	Heat Recovery (PIN 46)	X	Partial Heat Recovery not required
		H	Partial Heat Recovery required
		D	Desuperheater
		Q	Special quote
ACOUSTIC	Acoustical arrgt (PIN 49)	X	No Sound Enclosure required
		R	Reduced Noise
		N	Low Noise
		Q	Special Sound Enclosure required
WARRANTY	Warranty (PIN 55)		For Marketing Purposes
REFRIGERANT WTY	Refrigerant Wty (PIN 56)		For Marketing Purposes

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Chiller Model Specific Sections

- **Component locations**
- Refrigeration Cycle & Lubrication
  - Oil Injection
  - Separator
  - Oil cooling
- Condenser
  - Condenser Fans
- Sound Attenuation
- Enclosure
- Economizer
  - Metering Device
- Evaporator

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Similarities and Differences





YCAV



YCIV

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Exercise

Find the YCAV component layout diagram on the next page.

Mark the location of each of these components:

- Evaporator
- Liquid Line Filter
- Flash Tank Economizer
- Oil Line
- Compressor
- Economizer Solenoid
- Oil Separator

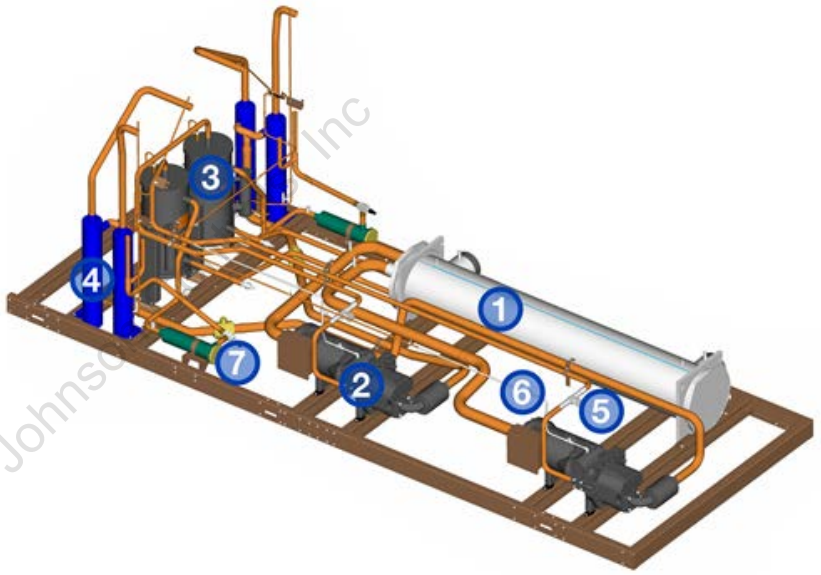
Use the YCAV IOM if you need help. (Form 201.21-nm1.pdf)

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YCAV Major Components

A. Evaporator
B. Liquid Line Filter
C. Flash Tank Economizer
D. Oil Line
E. Compressor
F. Economizer Solenoid
G. Oil Separator



1. Evap
2. Compressor
3. Flash Tank
4. Oil Separator
5. Econ. Sol
6. Oil Line
7. Liquid Line Filter

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YCIV – YCAV Comparison



Changes to Observe

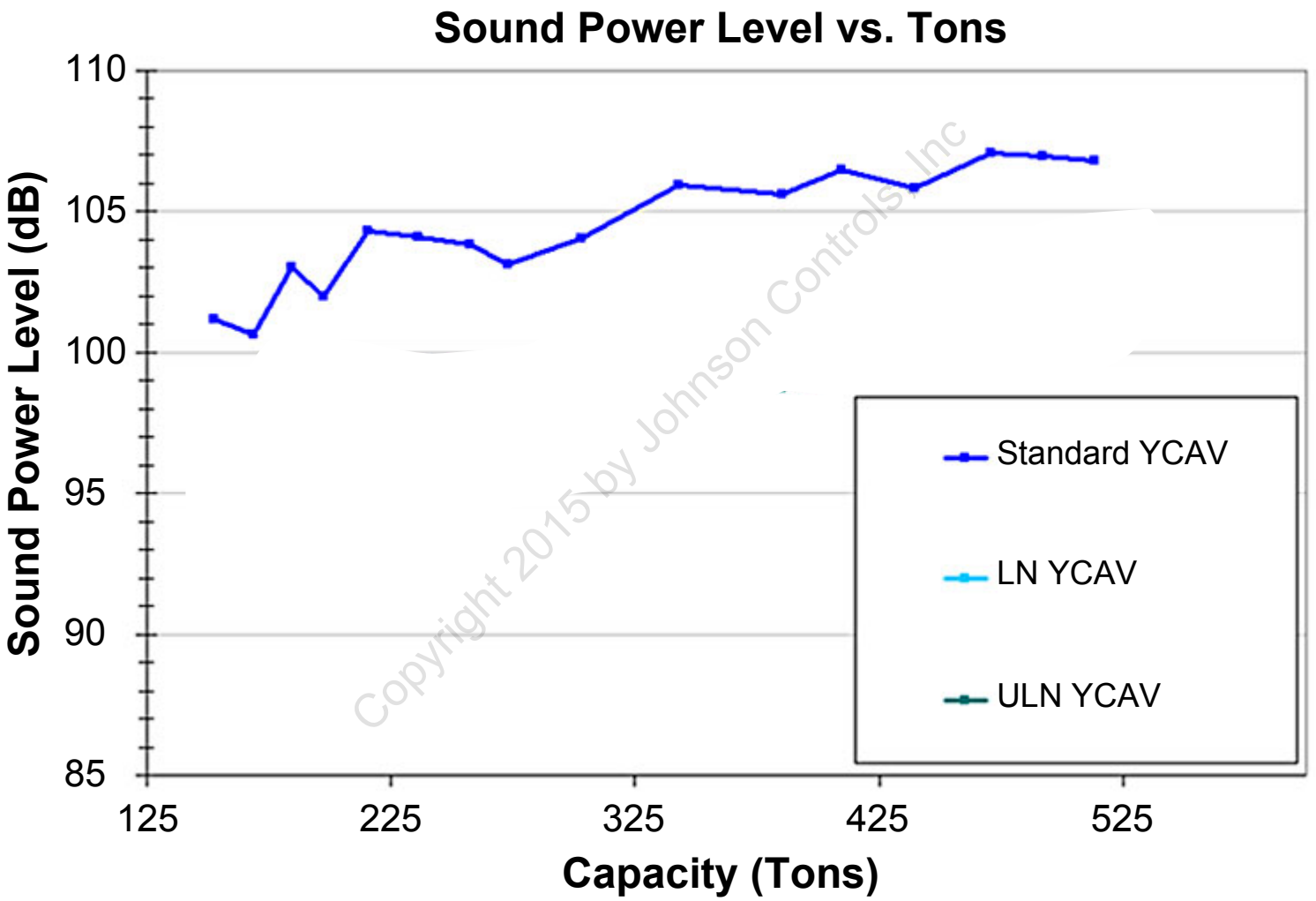
- Layout changes to reduce sound levels
- Left/right hand cooler connections
- Sound options



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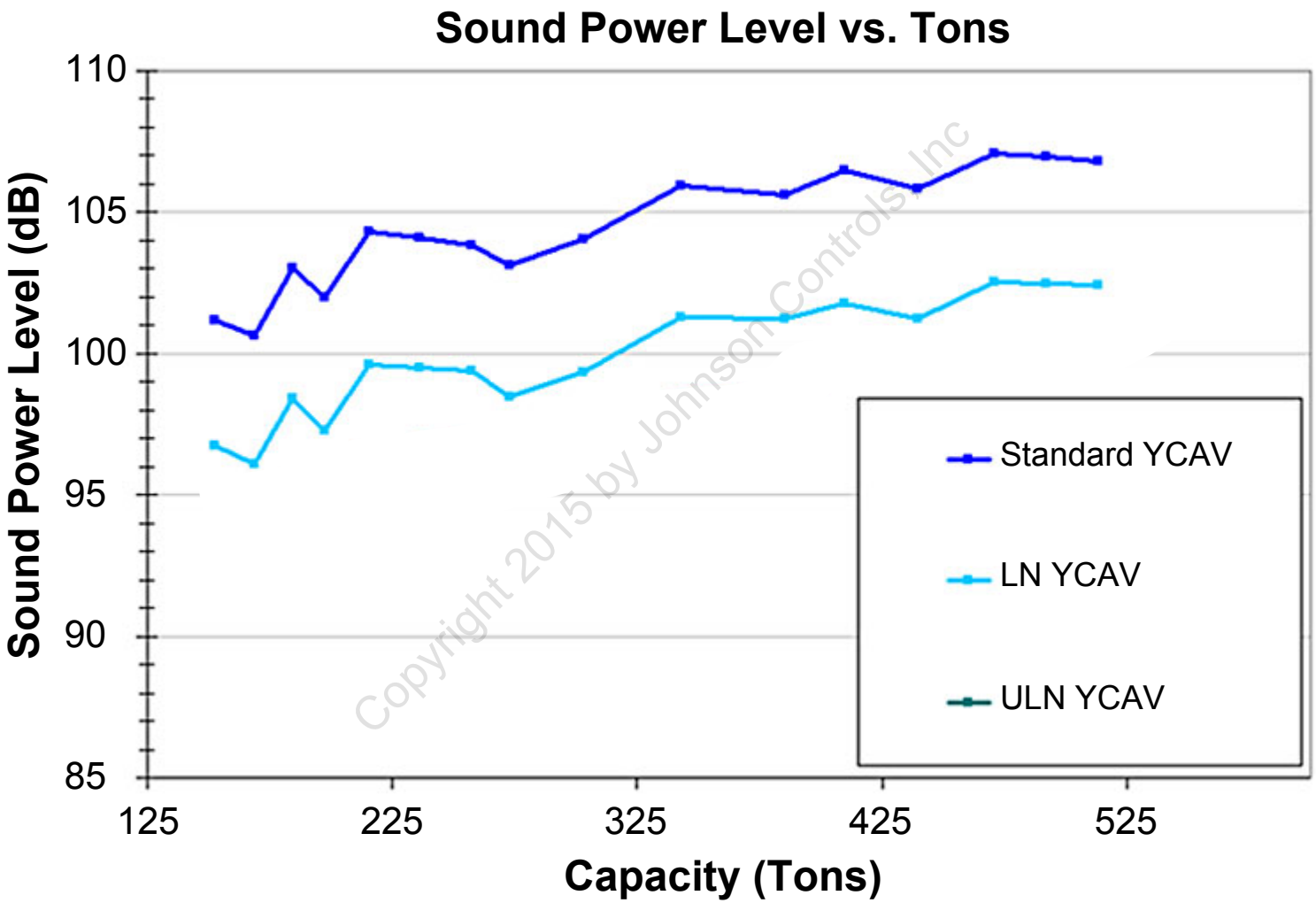
Sound Data Comparison





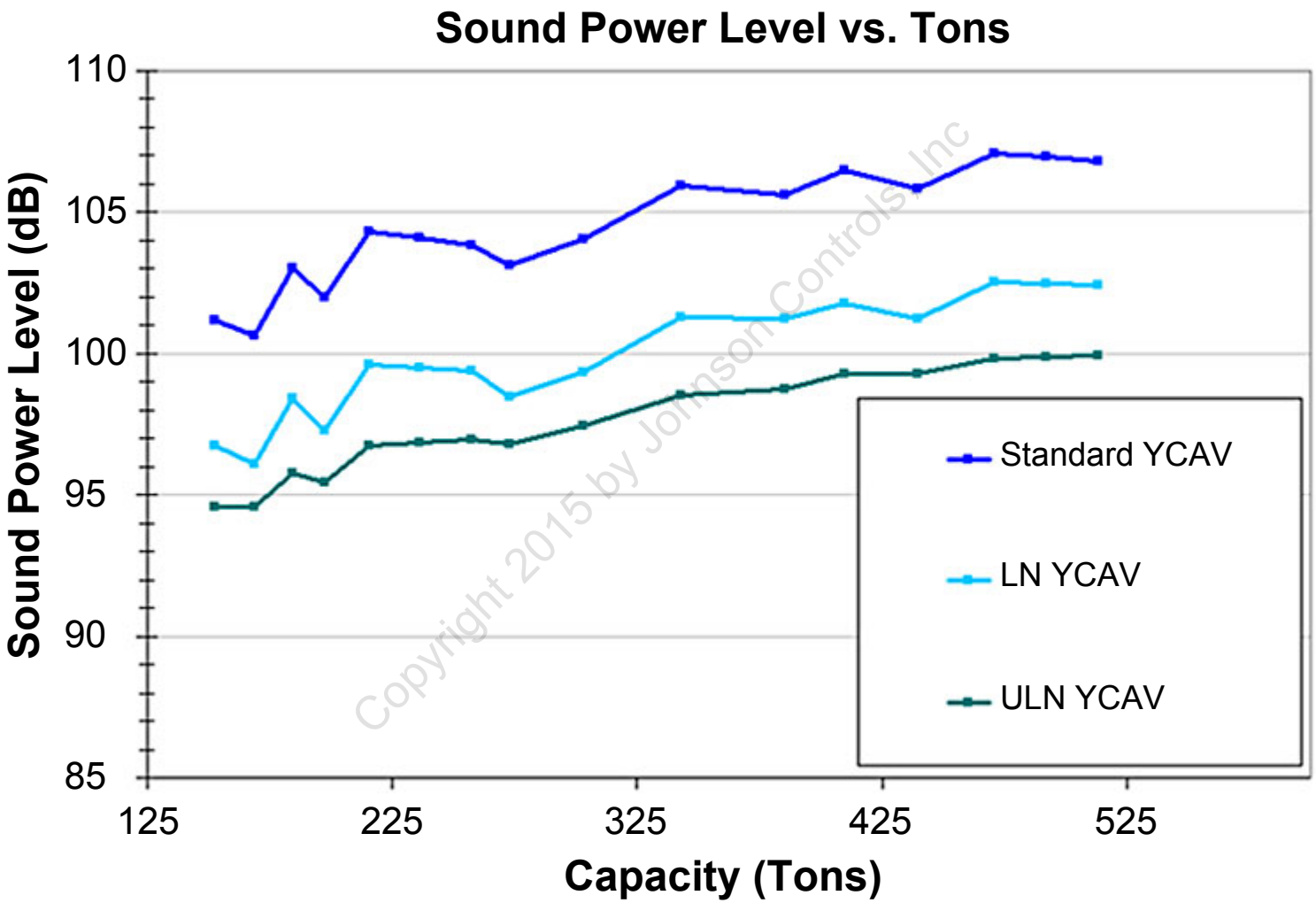
Sound Data Comparison (Contd.)





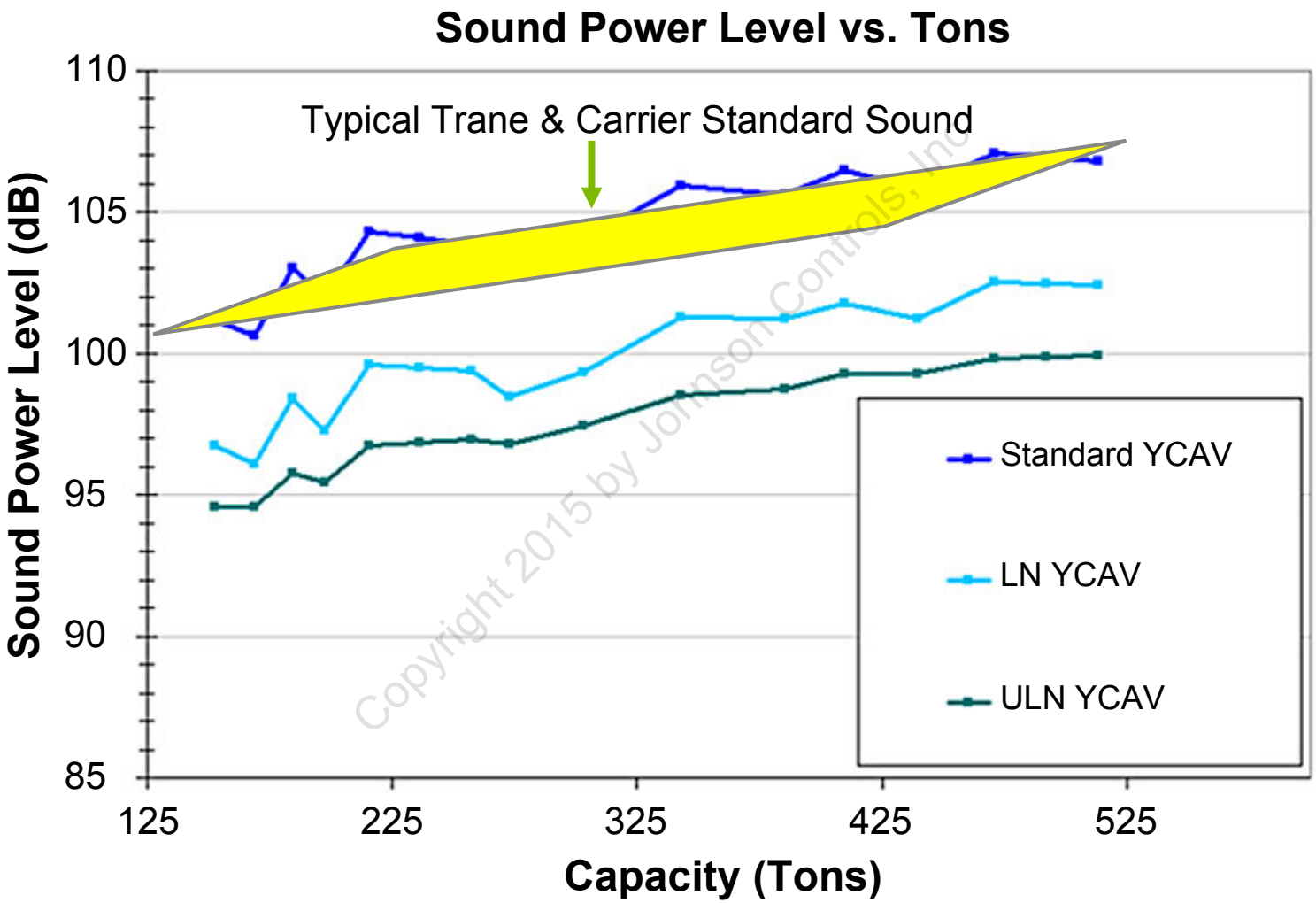
Sound Data Comparison (Contd.)





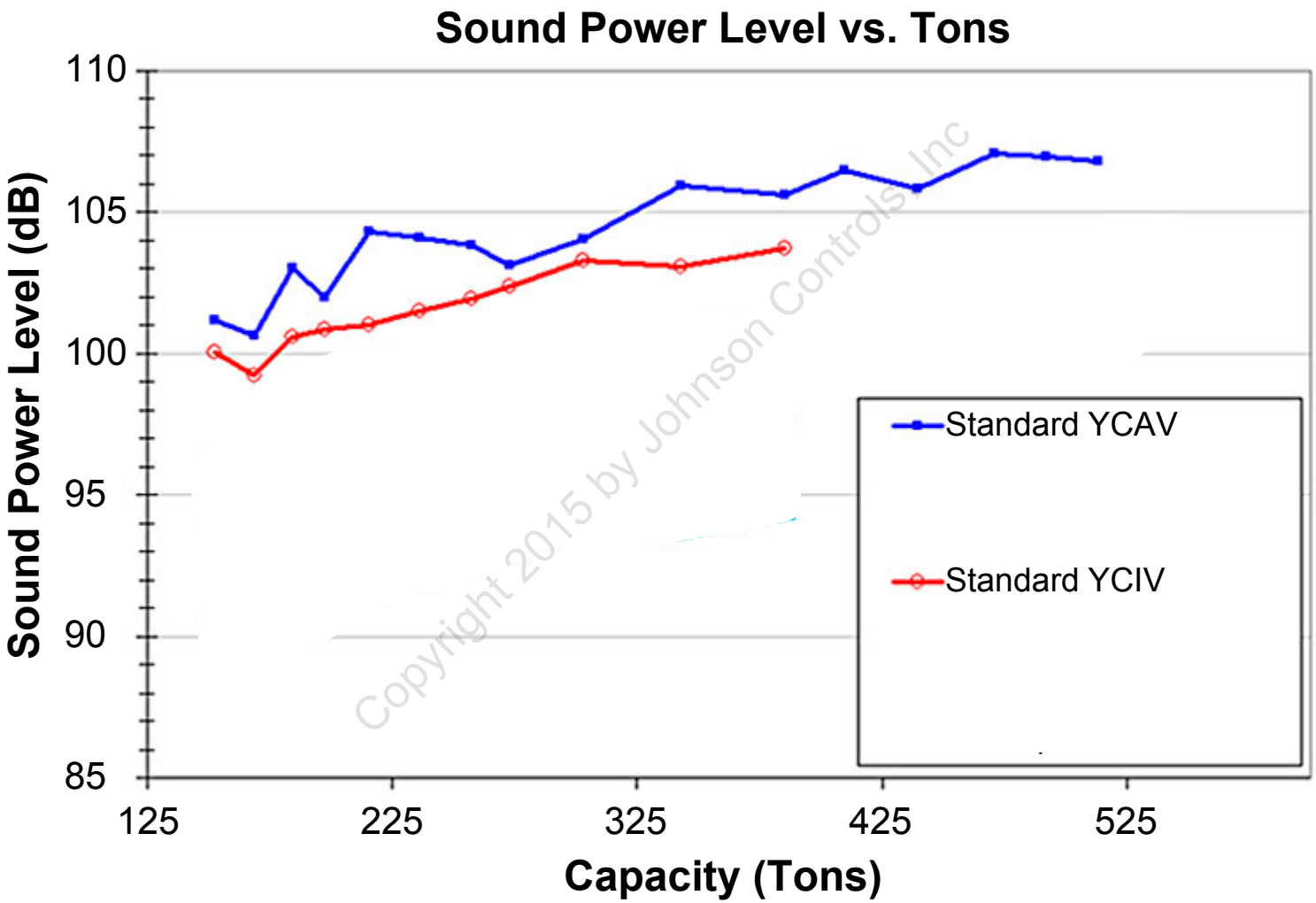
Sound Data Comparison (Contd.)





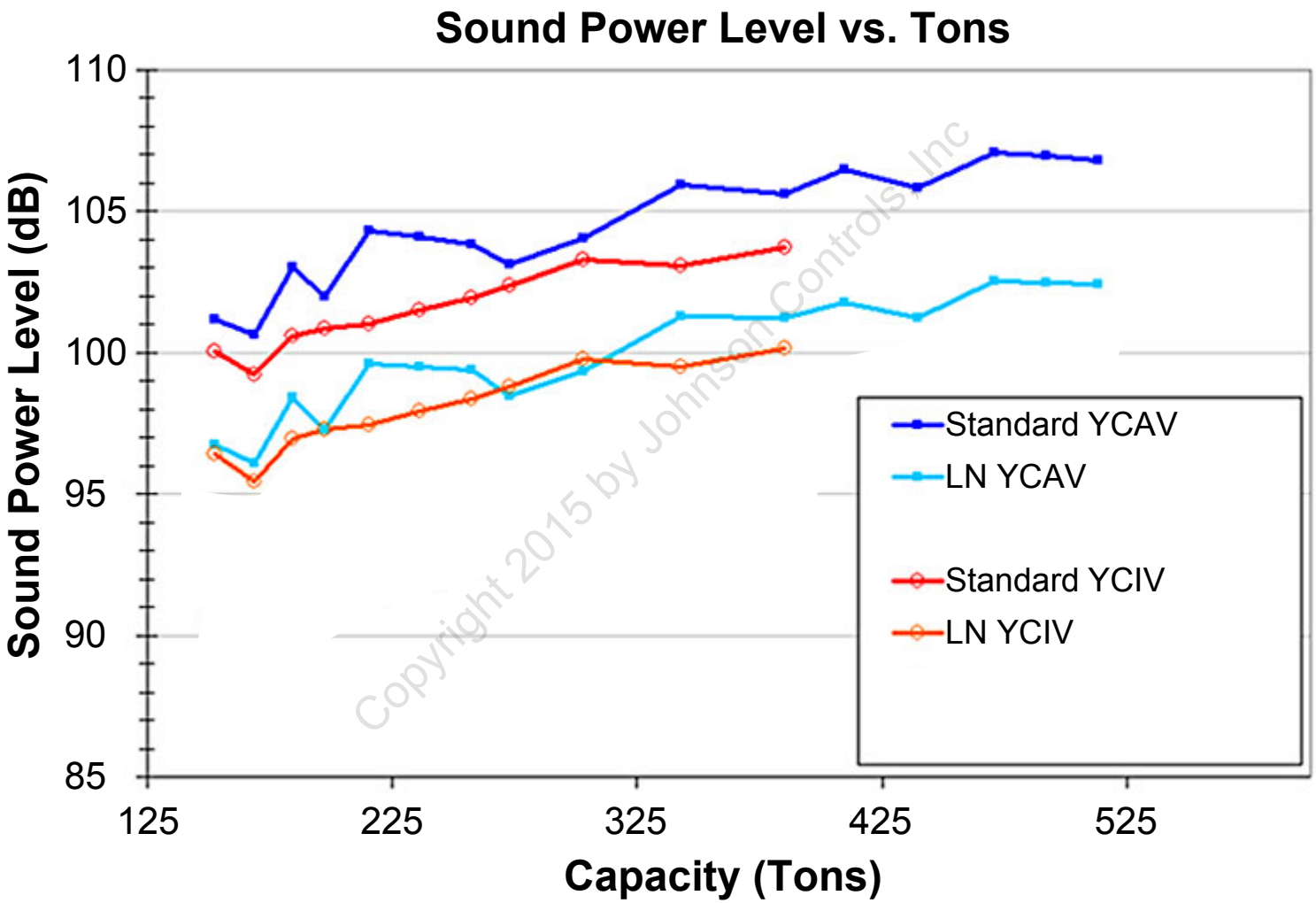
Sound Data Comparison (Contd.)





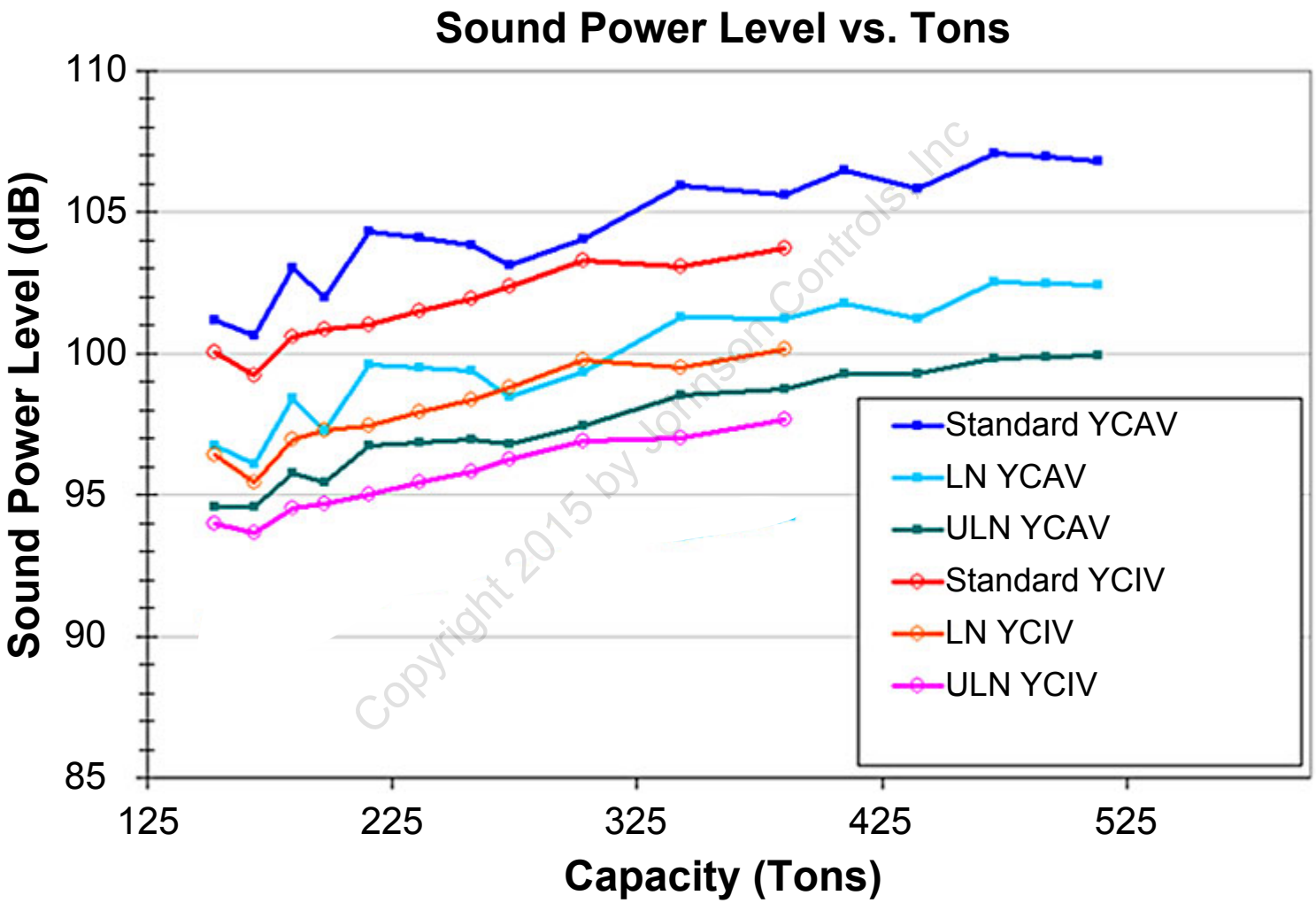
Sound Data Comparison (Contd.)





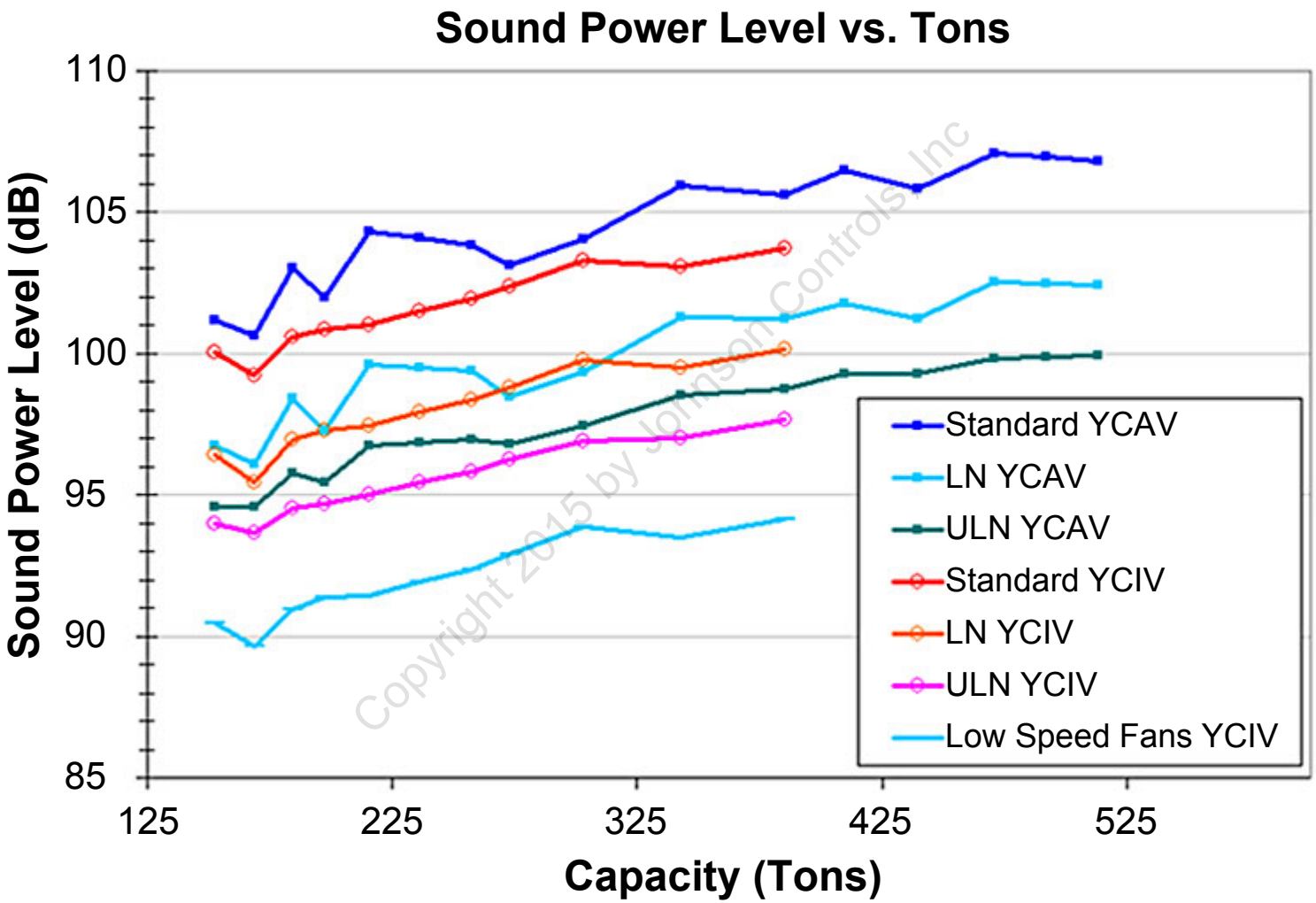
Sound Data Comparison (Contd.)





Sound Data Comparison (Contd.)





YCIV Introduction



Key components rearranged to simplify sound reduction.

YCIV 50Hz was developed and launched into production in 2006.

YCIV 60Hz was released in 2007.

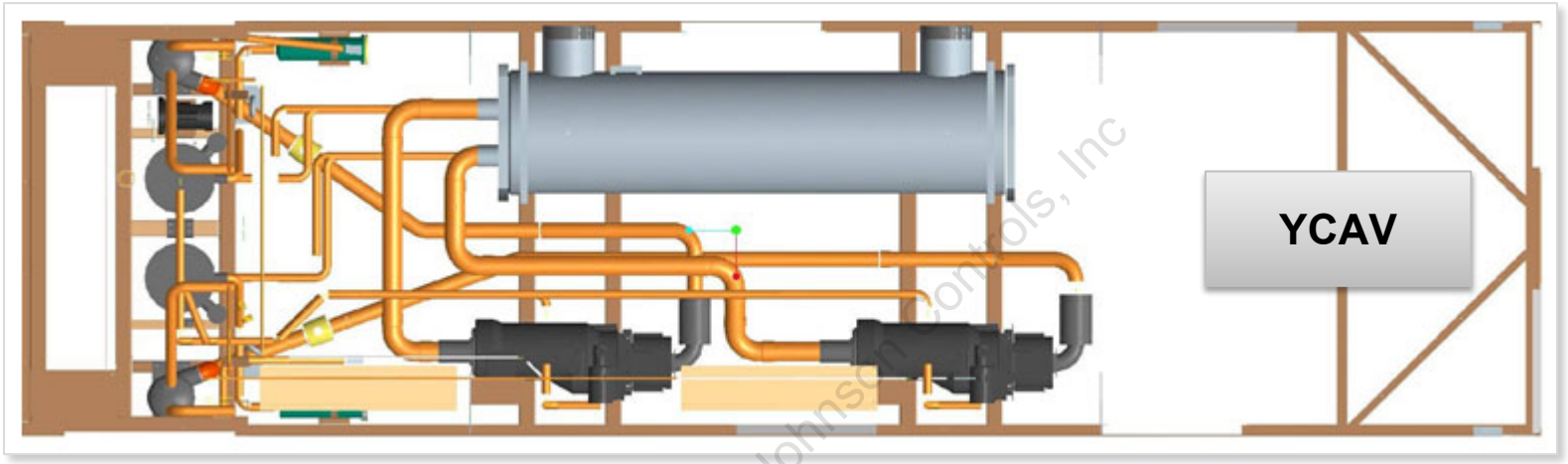
- Range of supply voltages
- Supports both 50 & 60 Hz systems
- Remote Evap YCAV only

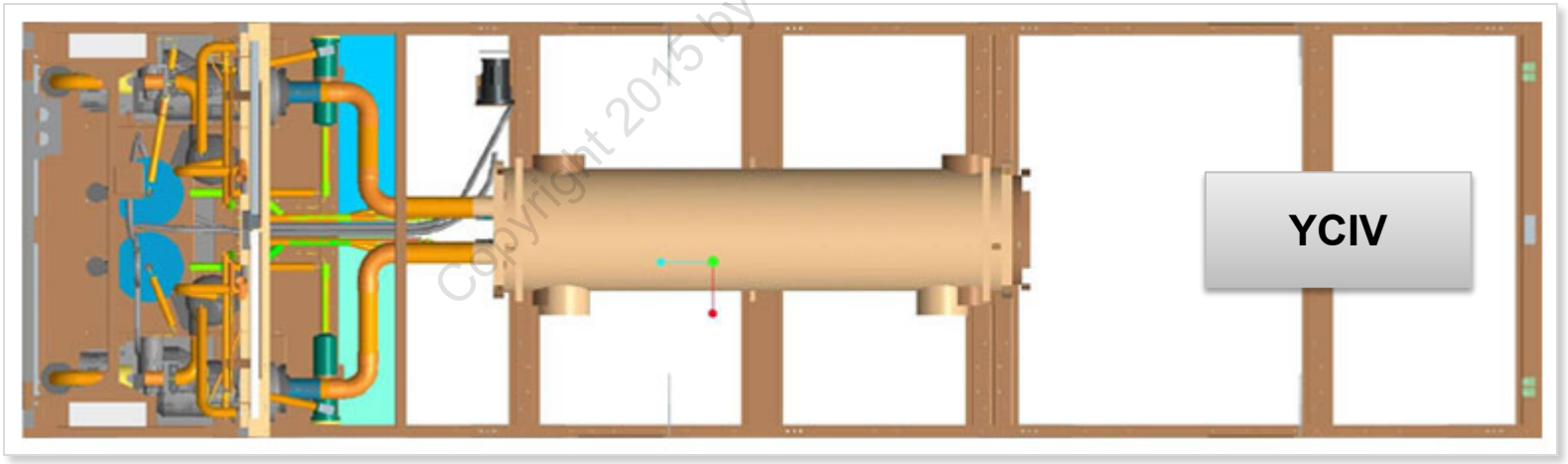
	2 & 3 Compressor	4 Compressor
200V/60Hz	YCAV	YCAV
230V/60Hz	YCAV	YCAV
460V/60Hz	YCIV	YCAV
400V/50Hz	YCIV	YCAV
380V/60Hz	YCIV	YCAV
575V/60Hz	YCAV	YCAV
Remote Evaporator (any voltage)	YCAV	YCAV

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Layout Changes

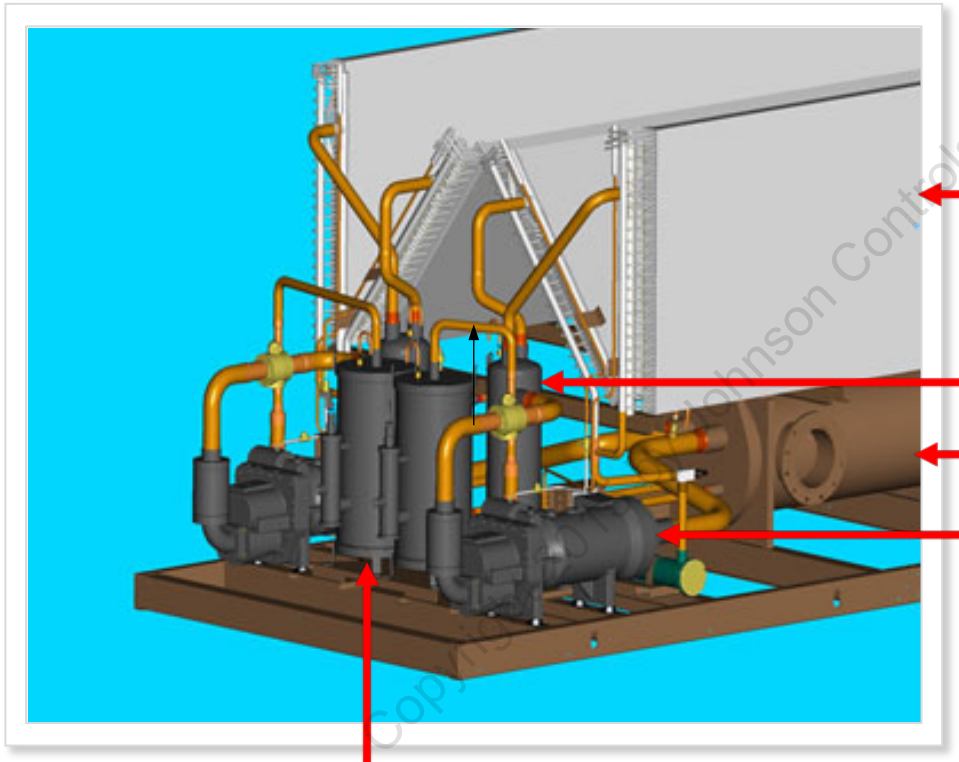






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Layout Changes (Contd.)



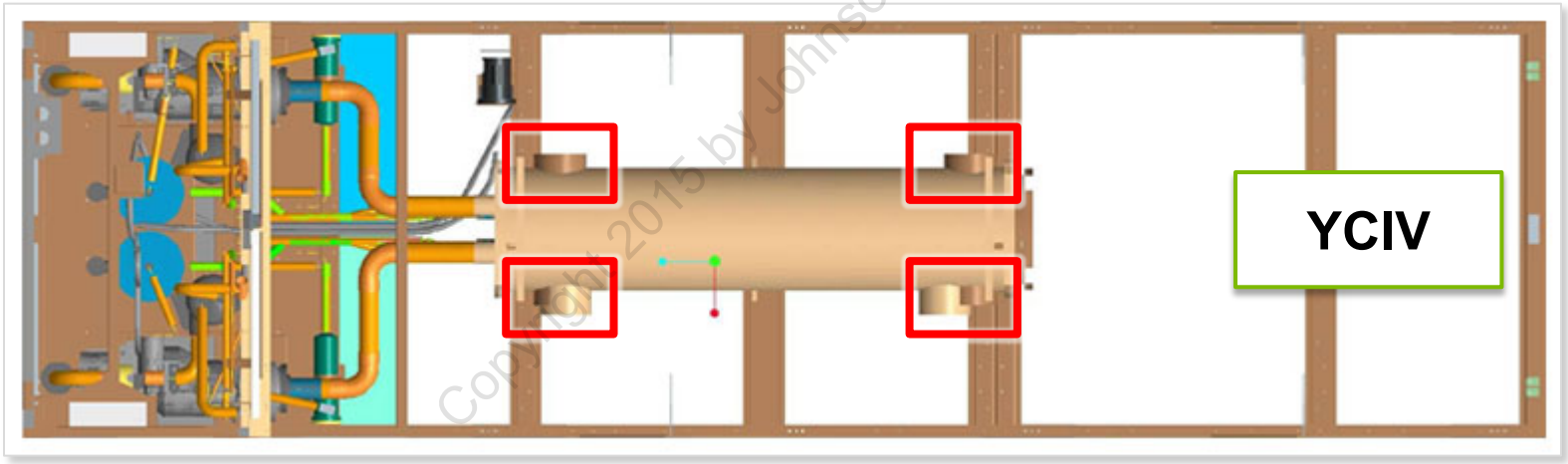
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Left/Right Hand Cooler Connections



Evaporator nozzles can be ordered as left or right hand

- Allows matching of existing building layouts for replacement
- For two chiller projects one left -- one right can consolidate piping and keep control panels on the same end



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Chiller Model Specific Sections

- Component locations
- **Refrigeration Cycle and Lubrication**
  - Oil Injection
  - Separator
  - Oil cooling
- Condenser
  - Condenser Fans
- Sound Attenuation
- Enclosure
- Economizer
  - Metering Device
- Evaporator

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Refrigerant Flow and Lubrication

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Chiller Model Specific Sections

- Component locations
- Refrigeration Cycle and Lubrication
  - Oil Injection
  - Separator
  - Oil cooling
- **Condenser**
  - Condenser Fans
- Sound Attenuation
- Enclosure
- Economizer
  - Metering Device
- Evaporator

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Condenser Sections



Top Section:
Oil Cooling

Middle Section:
Refrigerant Cooling

Bottom Section:
VSD Glycol Cooling



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Condenser Coil Protection Options



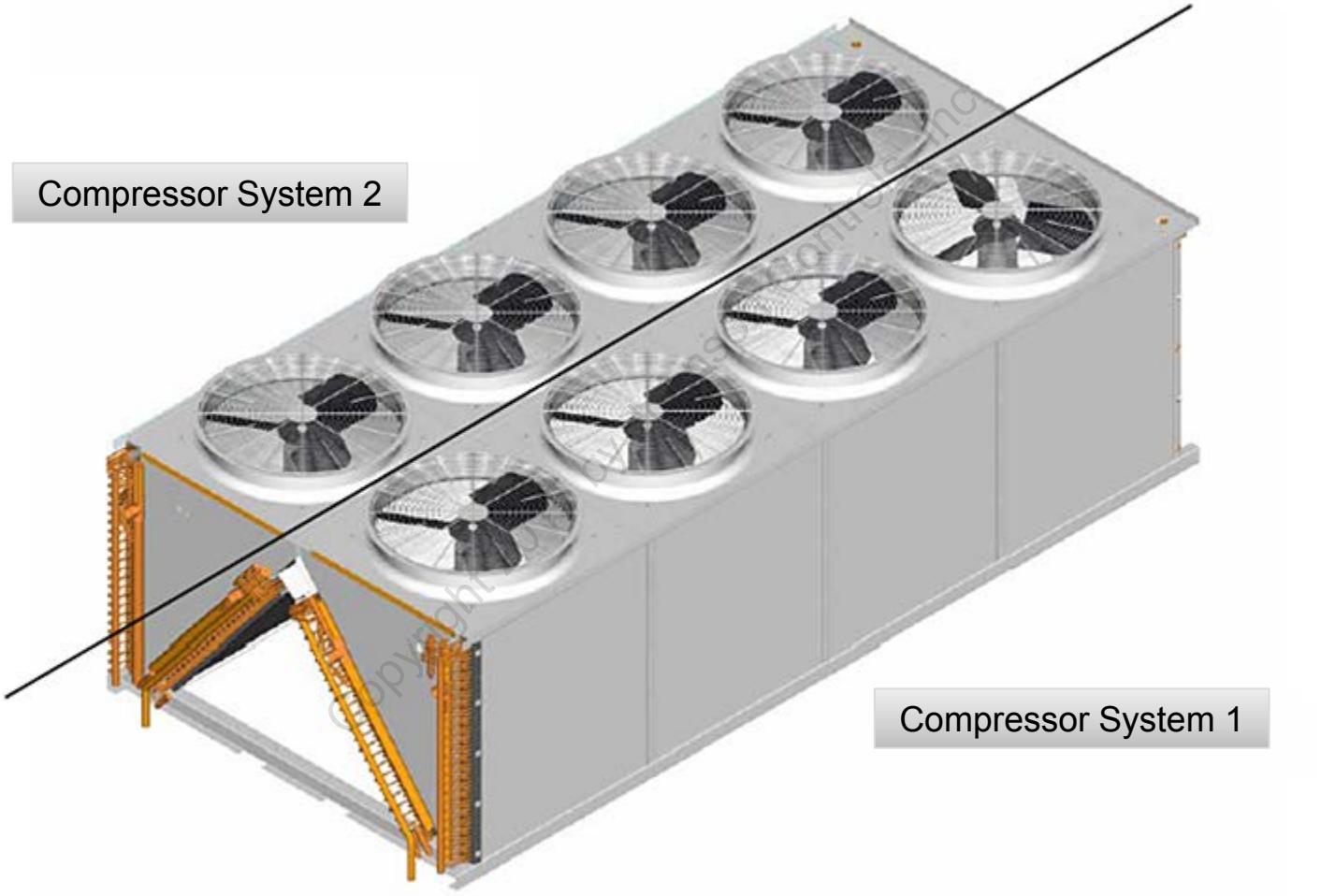
- Black Fin Condenser Coils
- Copper Fin Condenser Coils
- Epoxy Coated Condenser Coils



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YCAV Condenser Coil Sections





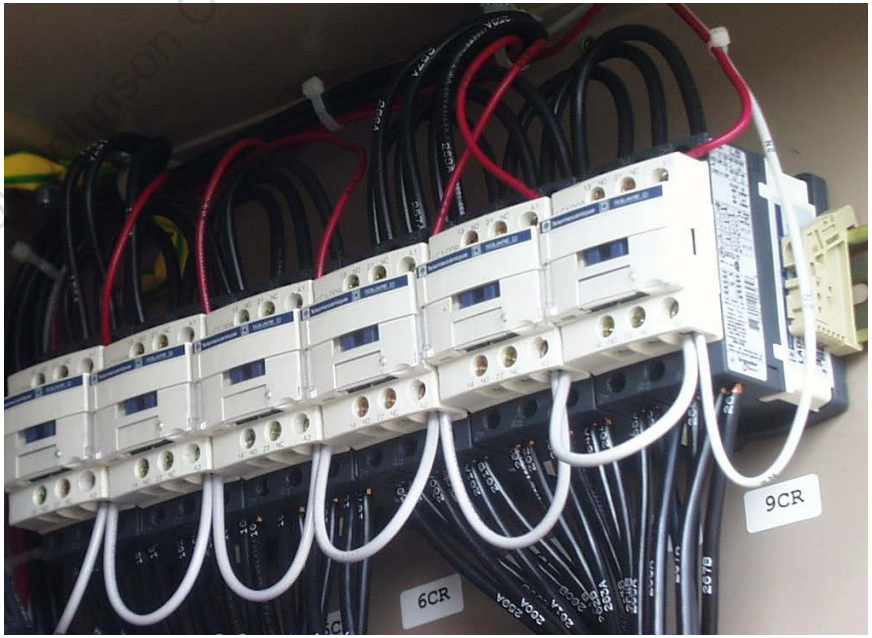
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Condenser Fan Contactors



- Up to eight possible stages of fan control
- Four outputs per system
- Four to 14 fans per system

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Condenser Fan Options



- Low Sound Fans {Standard}
- Ultra Quiet Fans {Optional}
- High Static Pressure (hi pwr motor) {Optional}





- Two Speed {Optional}

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Chiller Model Specific Sections

- Component locations
- Refrigeration Cycle and Lubrication
  - Oil Injection
  - Separator
  - Oil cooling
- Condenser
  - Condenser Fans
- **Sound Attenuation**
- Enclosure
- Economizer
  - Metering Device
- Evaporator

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More Sound Reduction Options

- LN-Compressor Sound Enclosure
- ULN-Compressor Sound Enclosure + Pipe Lagging
- SilentNight (Control speed limits)



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More Sound Reduction Options (Contd.)



- LN-Compressor Sound Enclosure
- ULN-Compressor Sound Enclosure + Pipe Lagging
- SilentNight (Control speed limits)



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- LN-Unlined Panels
- ULN-Acoustic Lined Panel
- SilentNight (Control speed limits)

YCIV Sound Options



Model	Sound Reduction Option Definition	
	LN Includes Ultra Quiet Fans and . . .	**ULN** Includes Ultra Quiet Fans and . . .
YCAV	Compressor Sound Enclosure	Compressor Sound Enclosure + Pipe Lagging
YCIV	Unlined Acoustic Enclosure	Lined Acoustic Enclosure

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Other YCAV and YCIV Unit Enclosure Options



- Wire Enclosure
- Louvered Panels and Wire Guards
- Louvered Panels (Condenser Coils Only)
- Louvered Panels (Full Unit) Enclosure



Copyright 201

Chiller Model Specific Sections

- Component locations
- Refrigeration Cycle and Lubrication
  - Oil Injection
  - Separator
  - Oil cooling
- Condenser
  - Condenser Fans
- Sound Attenuation
- Enclosure
- **Economizer**
  - Metering Device
- Evaporator

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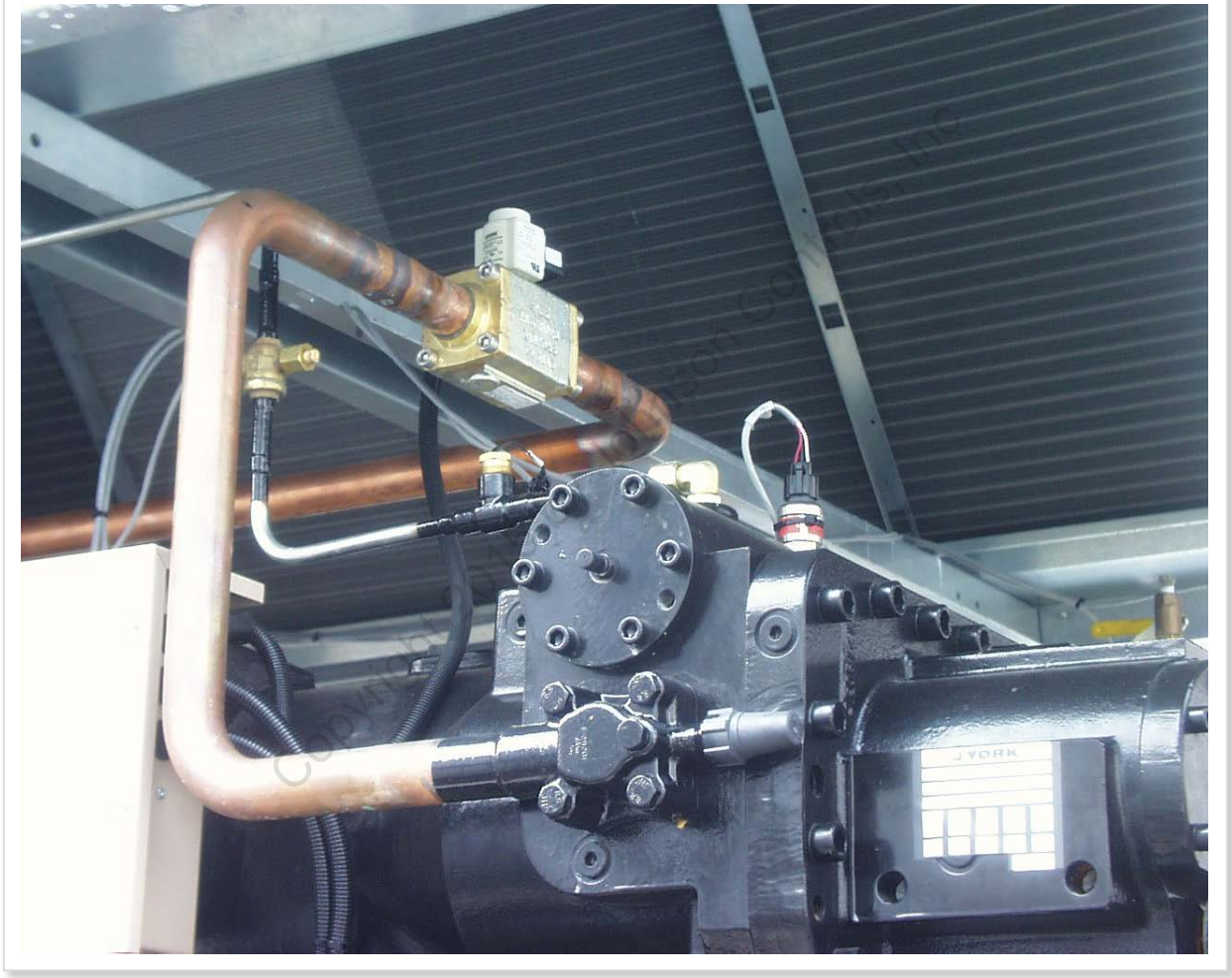
YCAV Flash Tank Economizer System



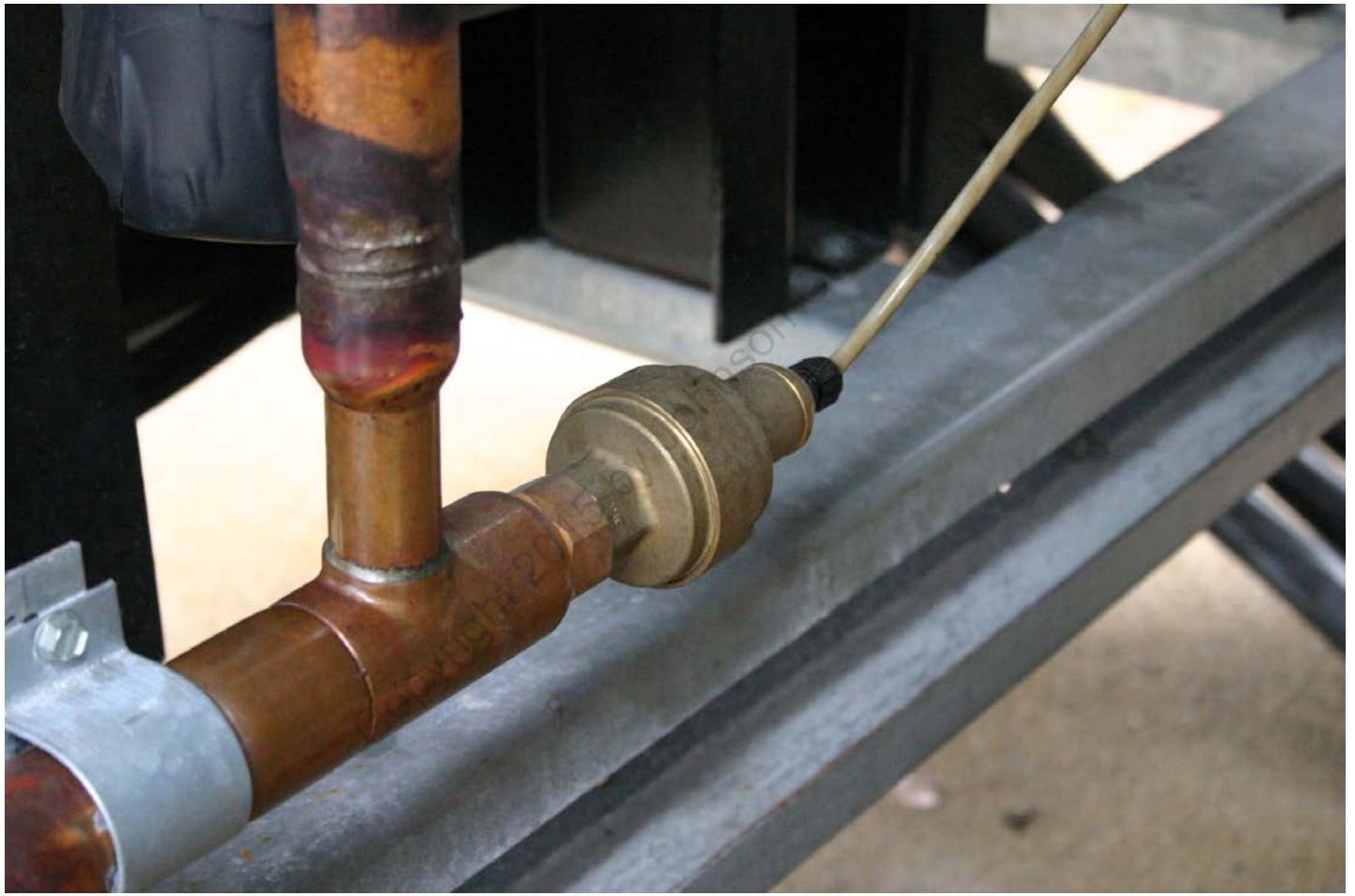




Economizer Solenoid Valve



YCAV Stepper Valves – Old Style

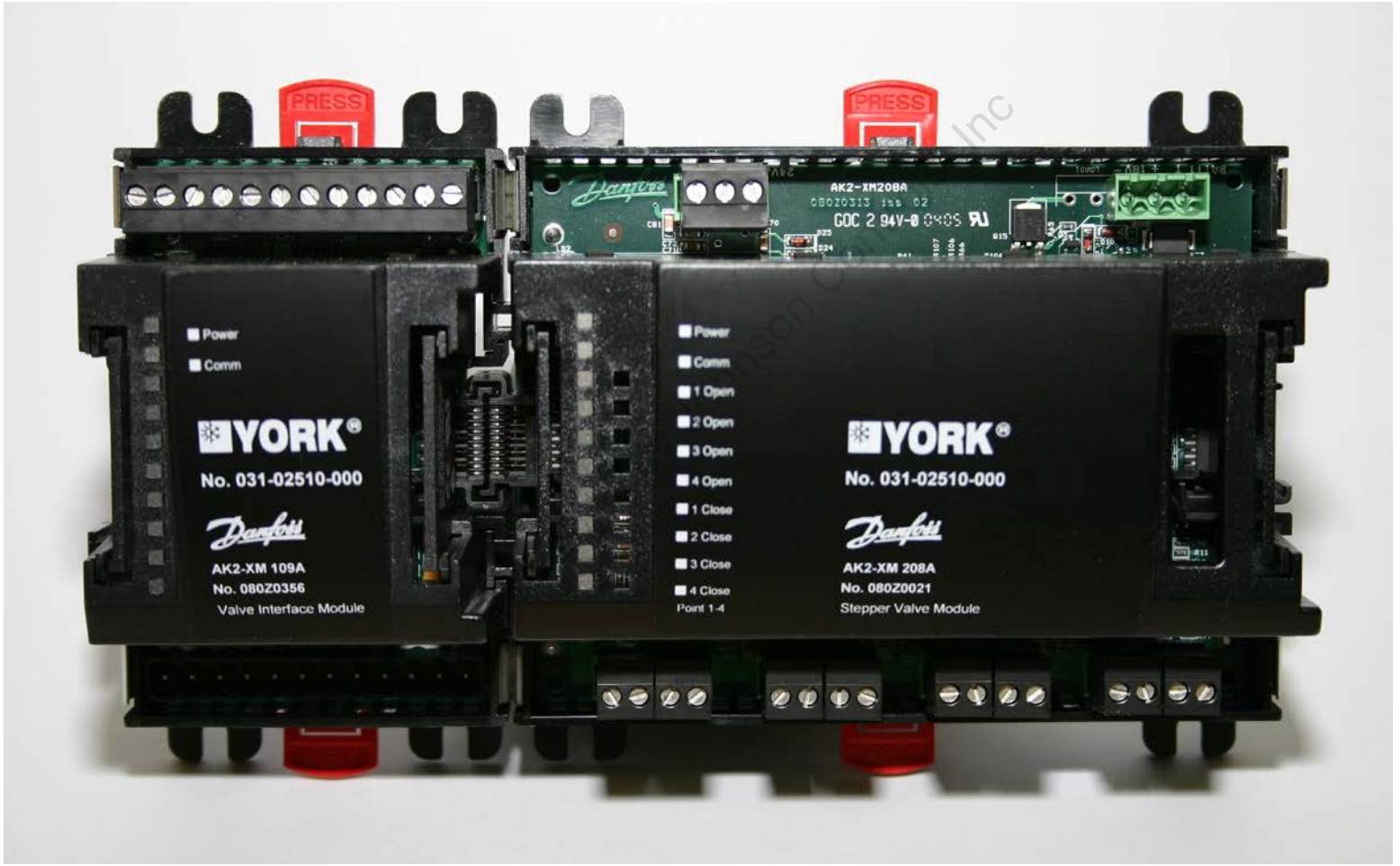


YCAV Stepper Valves – New Style



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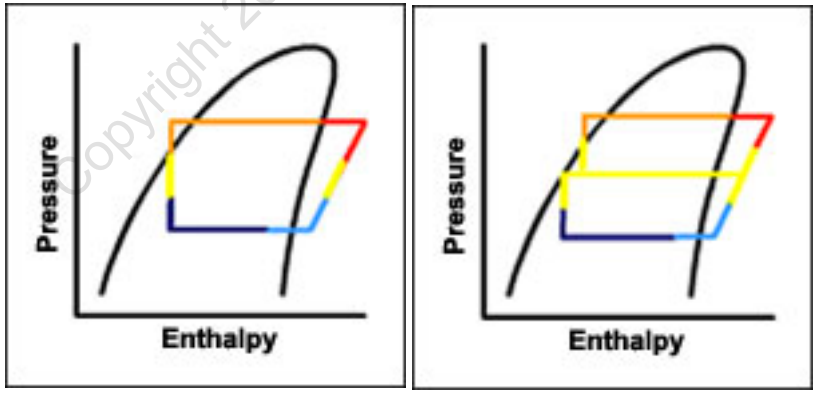
Flash Tank Feed and Drain Valve PI Controller



YCAV Flash Tank Economizer System



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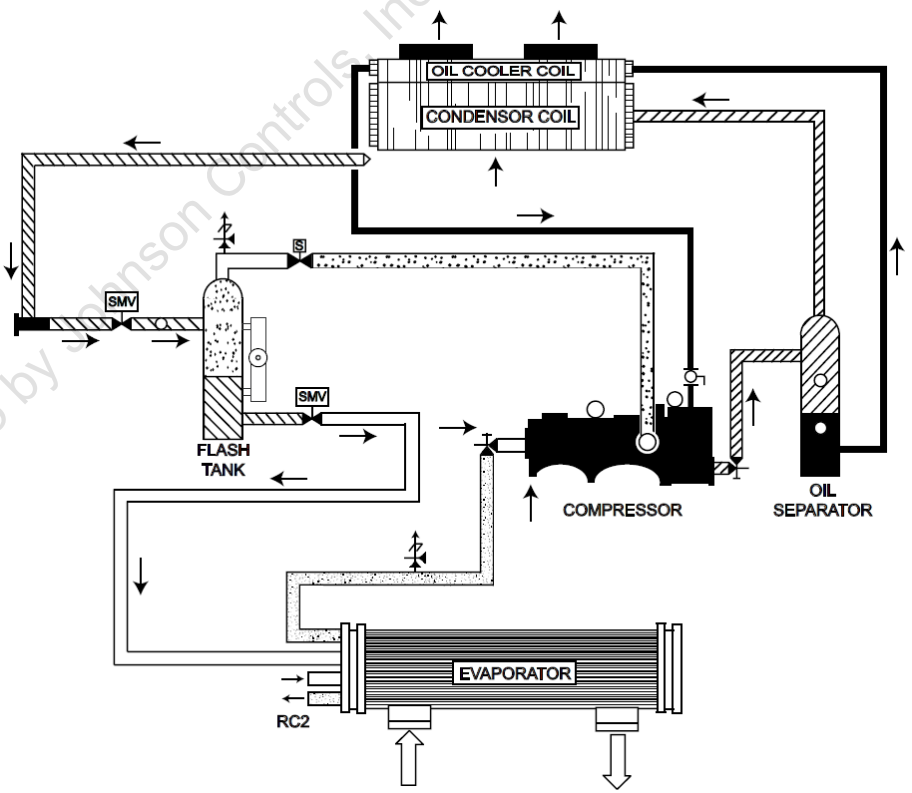
Evaporator



- Direct-expansion cooler
- Refrigerant in tubes; chilled liquid through shell
- Independent refrigerant circuits for each compressor
- Thermostatically controlled heater for low temperature protection (to 0 ° F)

- Options:
- Remote Evaporator {YCAV only}
- Left or right chilled liquid connections {YCIV only}
- Double thick (1½") insulation

REFRIGERANT FLOW DIAGRAM



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A Few More Options



- 300 PSIG Waterside Design Working Pressure
- Flange Accessory
- Flow Switch Accessory



Co

Service Valve Option





Key Takeaways – YCAV / YCIV Chiller Technology



- Product Fit & Nomenclature
- YCAV Component Layout
- YCIV Component Layout
- YCIV Sound Improvements
- Refrigeration Cycle & Lubrication
- Major Component Functions:
  - Condenser & Fans
  - Economizer
  - Evaporator & Metering Device

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YVAA System Overview



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Objective

After completing this section, you will be able to:

- Describe the distinguishing features of the YVAA chiller
- Delineate the normal operational sequence of the YVAA chiller

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YVAA Technologies

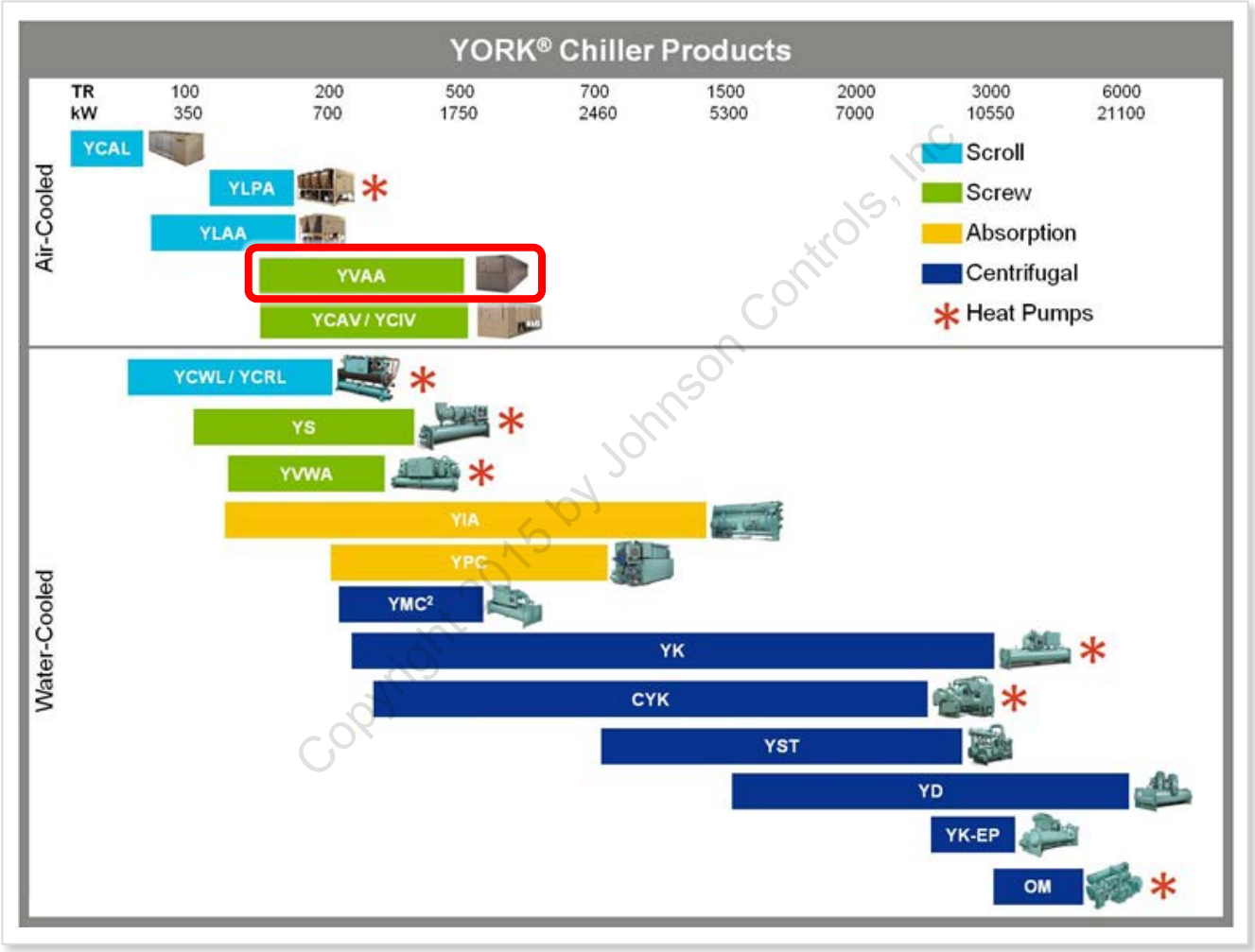


- Condenser
- Component locations
- Refrigeration Cycle
- Lubrication System
  - Eductor
- Condenser and Fans
- Sound Attenuation
- Other Enclosure Options
- Economizer
- Metering Device
- Evaporator

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Chiller Product Line



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Chiller Model Number

What does the chiller PIN tell us?

NOMENCLATURE

Y V A A 021 3ADV 46 B A

- **Y – YORK**
- **V – Variable Speed**
- **A – Air-cooled**
- **A – Design Series**
- **Frame Size**
- **Selected Configuration**
  - Condenser Code
  - Evaporator Code
  - Compressor Code
  - Condenser fan & sound kit code
- **Voltage Code**
  - 17 – 200/3/60
  - 28 – 230/3/60
  - 40 – 380/3/60
  - 46 – 460/3/60
  - 50 – 400/3/50
  - 58 – 575/3/60
- **Development Level**
- **A – Refrigerant R134a**

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Exercise

Can you tell what's different?

Model Number

Nomenclature

Vs

Complete PIN

- Find the differences, identified by the **PIN** details, between the two chillers identified on the next page

YVAA Service Instructions
Form **201.28-M1.pdf**

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Activity: Complete YVAA PIN



	BAS Reset/Offset	Compressor Frequency	Extended Warranty	Fan Type	Flow Switch	Maximum Fan Frequency	Power Field	System Parameter
YVAA 0183AO V46AAVBxxx TAxLxxxxxx 45xOSxxV19 7x1SxSA2BM xV3xNxxxxx xH5Sx								
YVAA 0273DU V46BAVNxxx EASLxxxx60 44xOSxxV19 9x1DxDA2BM xV1RNxxxxx x31Sx								

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Chiller Model Specific Sections

- **Component locations**
- Refrigeration Cycle and Lubrication
  - Oil Injection
  - Separator
  - Oil cooling
  - Eductor
- Condenser
  - Condenser Fans
- Sound Attenuation
- Enclosure
- Economizer
- Metering Device
- Evaporator

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Air – Cooled Similarities and Differences





YCAV



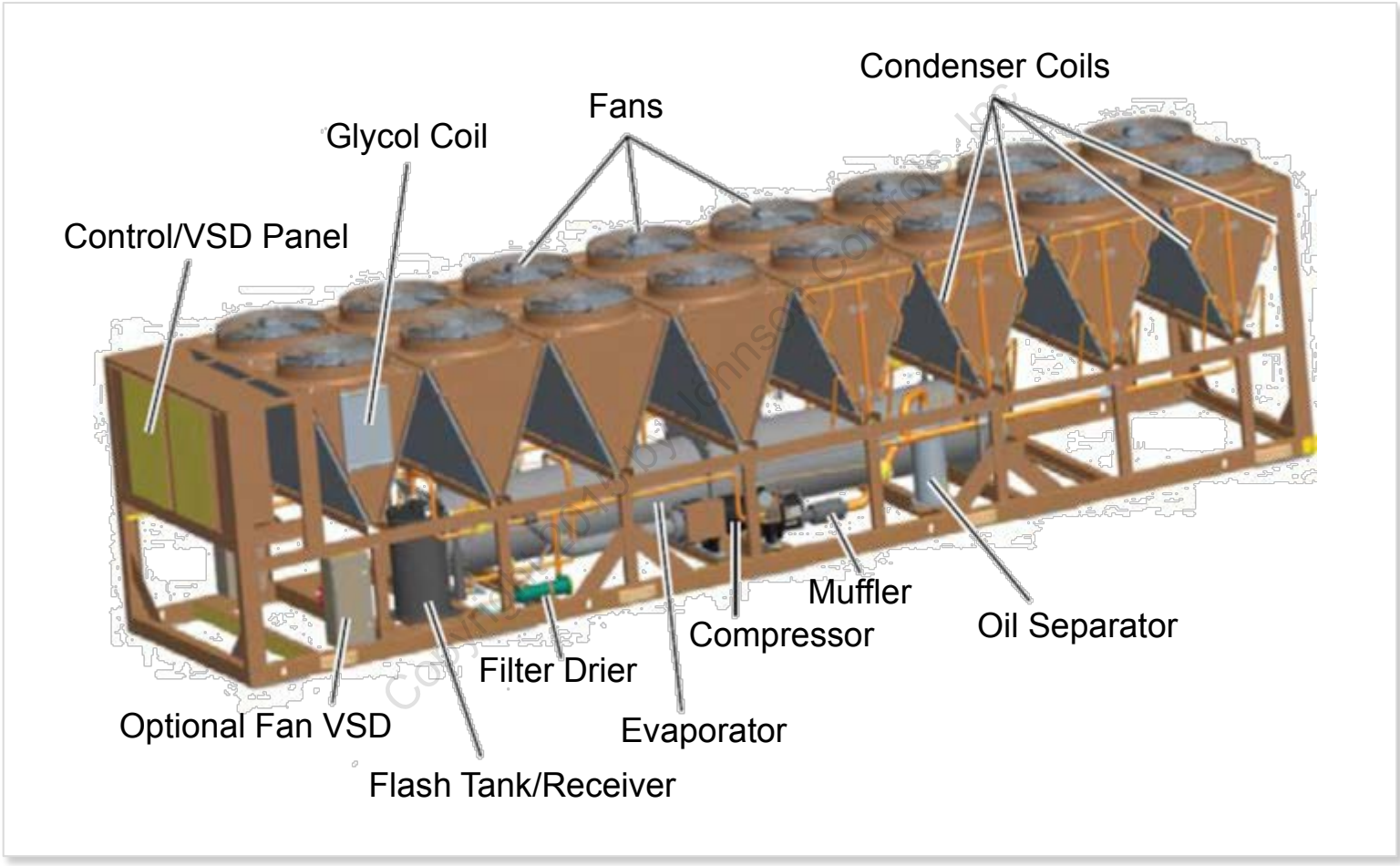
YCIV



YVAA

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YVAA Components



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Exercise

Find the YVAA component layout diagram on the next page.

Mark the location of each of these components:

- Compressors
- Evaporator
- Flash tanks
- Control panel/VSD
- Oil Eductors
- Oil separators

Use the YVAA IOM if you need help. (Form 201.28-nm1.pdf)

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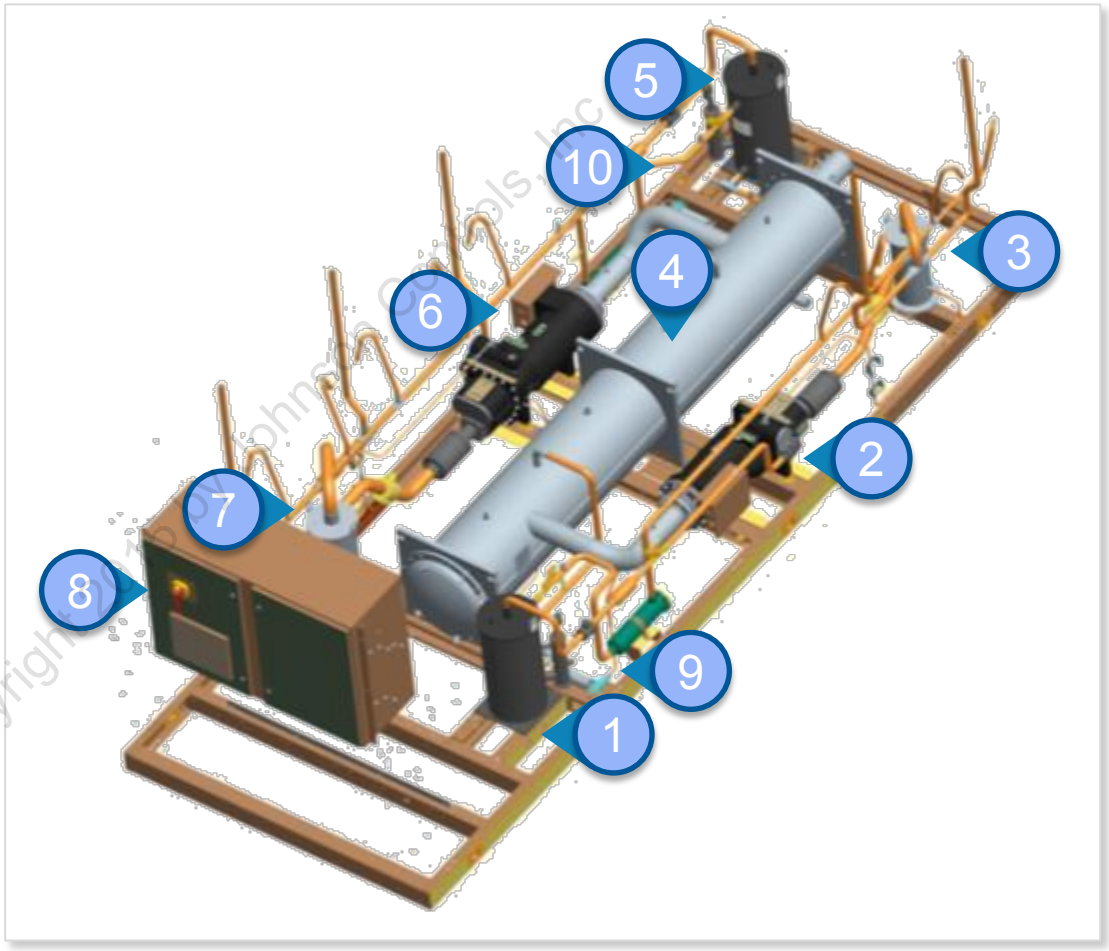
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YVAA Internal Components

Locate:

A. Compressors
B. Evaporator
C. Flash tanks
D. Control panel/VSD
E. Oil eductors
F. Oil separators
G. Economizer feed line

1. Flash Tank
2. Econ Feed Line
3. Oil Separator
4. Evaporator
5. Flash Tank
6. Compressors
7. Oil Separator
8. Control Panel/VSD
9. Oil Eductor
10. Econ. Feed Line



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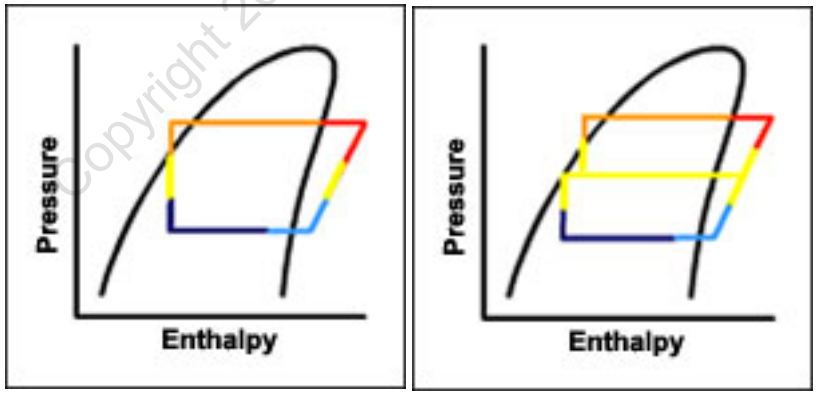
Chiller Model Specific Sections

- Component locations
- **Refrigeration Cycle and Lubrication**
  - Oil Injection
  - Separator
  - Oil cooling
  - Eductor
- Condenser
  - Condenser Fans
- Sound Attenuation
- Enclosure
- Economizer
- Metering Device
- Evaporator

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Refrigerant Flow



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Chiller Model Specific Sections

- Component locations
- Refrigeration and Lubrication
  - Oil Injection
  - Separator
  - Oil cooling
  - Eductor
- **Condenser**
  - **Condenser Fans**
- Sound Attenuation
- Enclosure
- Economizer
- Metering Device
- Evaporator

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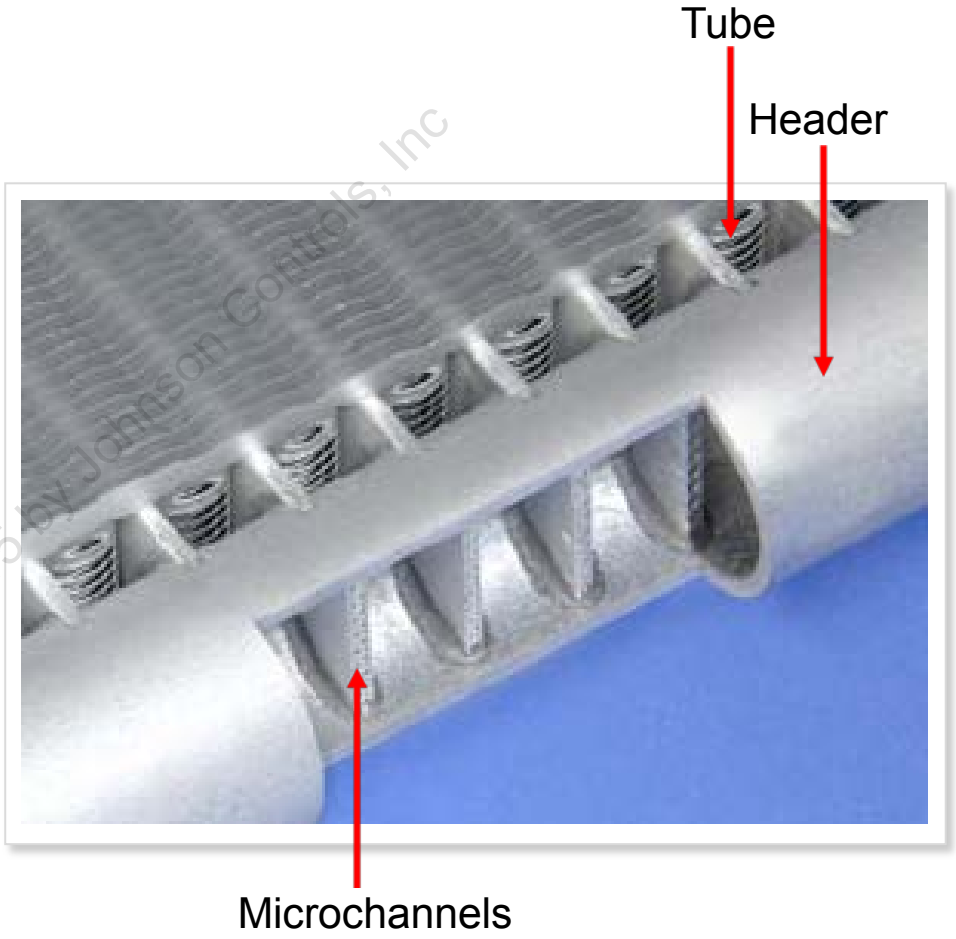
Condenser Sections



Microchannel Condenser

All-aluminum

- Improved performance
- Reduction in chiller weight
- Less refrigerant charge
- Better corrosion resistance
- Ease of cleaning

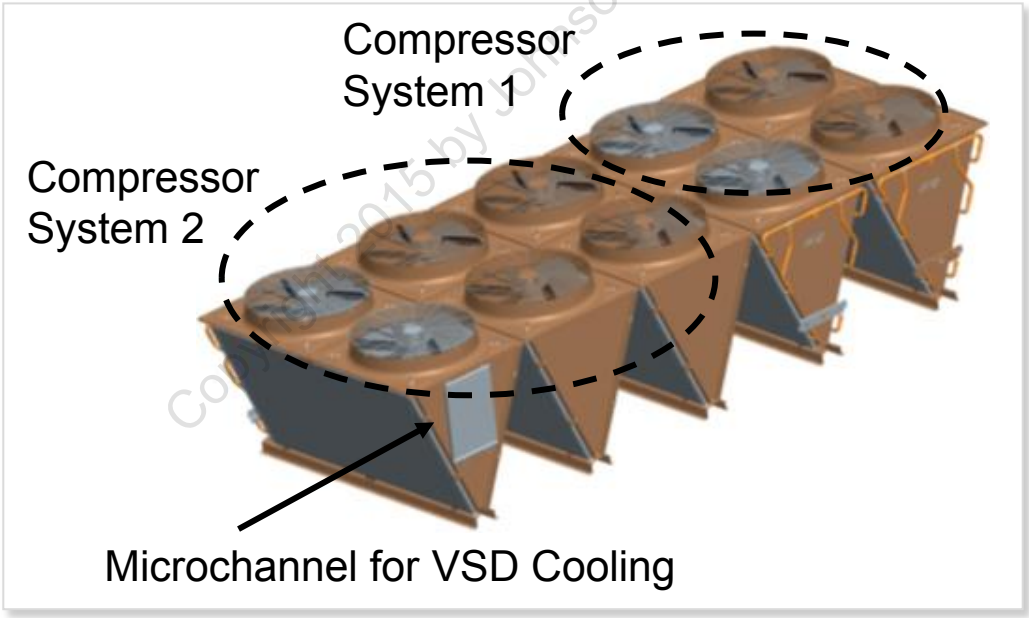


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YVAA Condenser Coil Sections



- All YVAAs have only two compressors
- Condenser coil sections are side-by-side instead of being parallel as in YCAV/YCIV
- Each compressor is served by four or more fans to cool the compressed refrigerant



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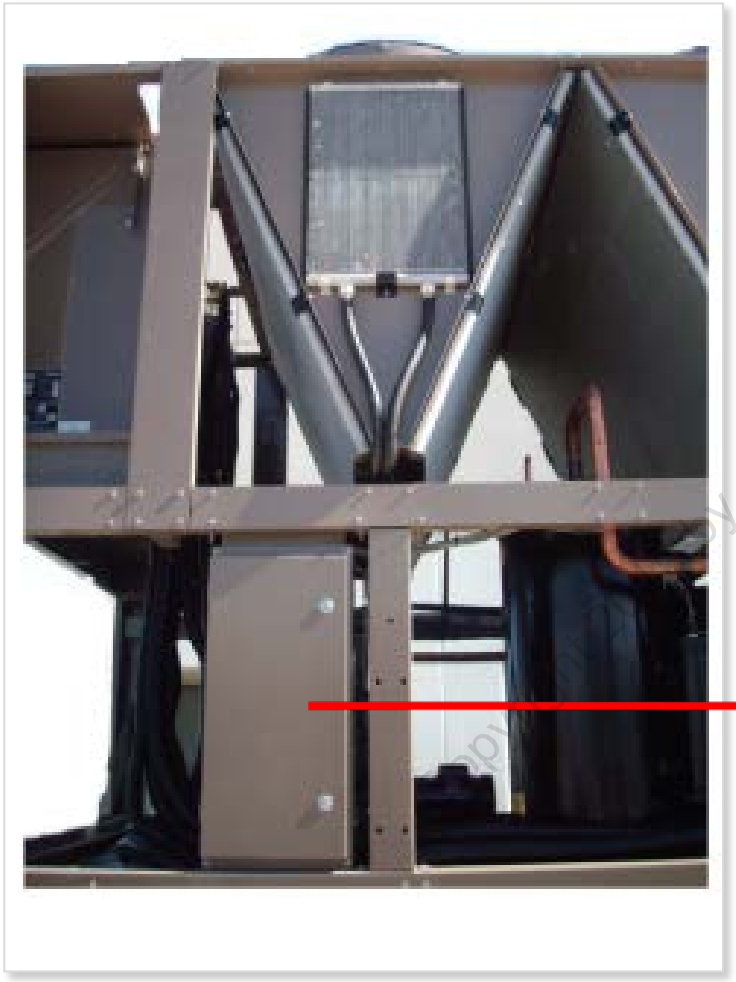
Condenser Fan Options

- Low Sound Fans {Standard}
- Ultra Quiet Fans {Optional}
- High Static Pressure (high power motor) {Optional}
- High Air Flow (high power motor) and airfoil blades {Optional}



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Condenser Fan VSD (Optional)





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Chiller Model Specific Sections

- Component locations
- Refrigeration and Lubrication
  - Oil Injection
  - Separator
  - Oil cooling
  - Eductor
- Condenser
  - Condenser Fans
- **Sound Attenuation**
- **Enclosure**
- Economizer
- Metering Device
- Evaporator

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Sound Reduction Options

- Acoustic Treatments on Lines and Compressors {Standard}
- Level 1: Compressor Enclosure
- Level 2: Compressor Enclosure + sound absorptive interior lining, Ultra Quiet Fans & Fan VSD
- SilentNight



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YVAA Unit Enclosure Options



- Wire Panels (Full Unit)
- Louvered Panels and Wire Guards
- Louvered Panels (Condenser Coils Only)
- Louvered Panels (Full Unit)
- Louvered (Condenser) and Wire Panels
- End Hail Guard
- V-Gard Panels



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Chiller Model Specific Sections

- Component locations
- Refrigeration and Lubrication
  - Oil Injection
  - Separator
  - Oil cooling
  - Eductor
- Condenser
  - Condenser Fans
- Sound Attenuation
- Enclosure
- **Economizer**
- Metering Device
- Evaporator

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YVAA Flash Tank Economizer System

Terms

- Liquid fill port or condenser drain valve
- Liquid drain port with orifice
- Economizer vapor port
- High level switch

Flash Tank Economizer

- Flash tank
- Danfoss stepper valves for filling
- Economizer stepper valve
- Fixed orifice metering device





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YVAA Stepper Valves

- Stepper valves modulate open and close to control liquid subcooling and the flow of economizer gas
- Micro-panel controls valve operation



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Fill Valve or Economizer Valve

- Controlled by control panel
- Gas from the flash tank enters the compressor through the side access port
- Port passage is connected through the **Closed Thread** portion to the screw rotors



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Flash Tank Economizer

Flash Tank Economizer subcools the refrigerant

Active

- Compressor frequency attains 120 Hz

Responds to control

- Opens or closes in 1% increments every 2 seconds
- Holds if flash tank level activates level switch

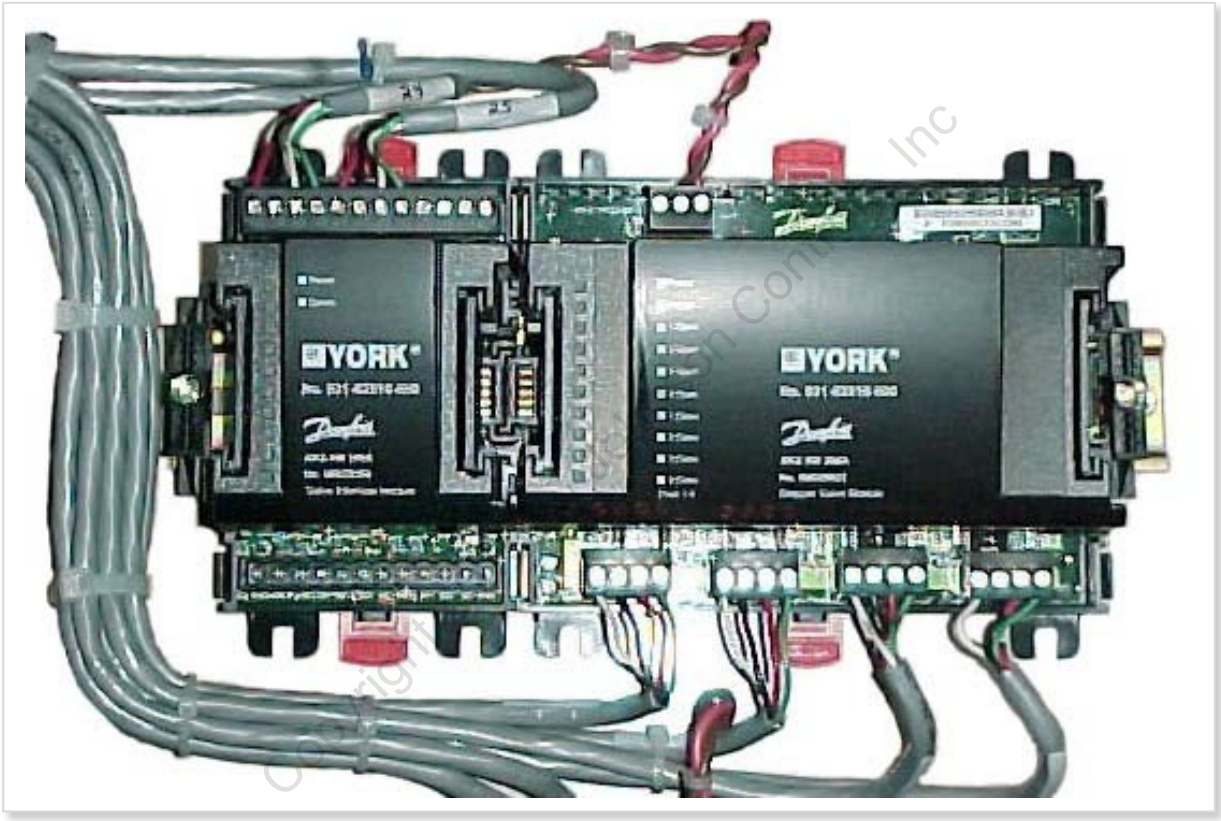
Close completely

- When compressor frequency is below 100 Hz



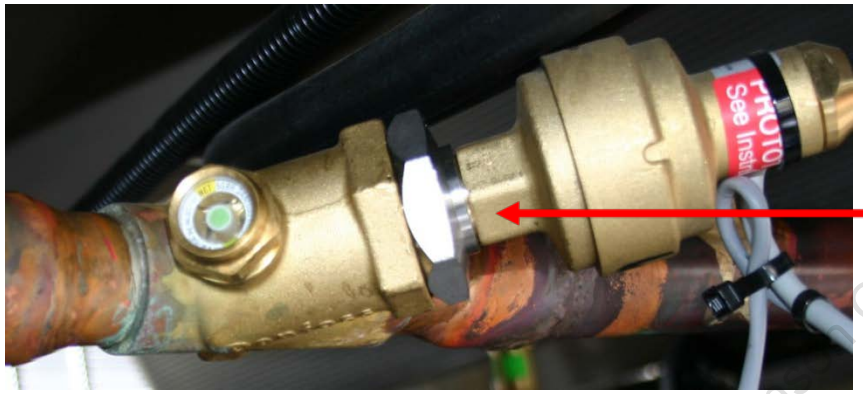
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Flash Tank Feed and Economizer Valve PI Controller(s)



Supplies drive signals to open and close the flash tank feed and the economizer valve

Flash Tank Feed Valve and Orifice



Flash Tank
Feed Valve



Orifice

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Economizer Stepper Motor Valve

Controls vapor feed to the economizer port from the top of the flash tank



When open, it releases gas in the flash tank, increasing capacity and efficiency.

YVAA Flash Tank Economizer System



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Chiller Model Specific Sections

- Component locations
- Refrigeration and Lubrication
  - Oil Injection
  - Separator
  - Oil cooling
  - Eductor
- Condenser
  - Condenser Fans
- Sound Attenuation
- Enclosure
- Economizer
- Metering Device
- **Evaporator**

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Evaporator: How Does the Falling Film Flooded Evaporator Work?



- Hybrid of falling film and flooded technologies
- Shell and tube, hybrid falling film and flooded heat exchanger, with a combination of:
  - Evaporator tubes that are cooled by a falling film
  - Evaporator tubes that are submerged in a liquid refrigerant pool at the bottom

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Key Takeaways – YVAA Chiller Technology



- Product Fit and Nomenclature
- YVAA Component Layout
- Refrigeration Cycle and Lubrication
- Major Component Functions:
  - Condenser and Fans
  - Economizer
  - Evaporator and Metering Device

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YVWA System Overview



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Objective

After completing this section, you will be able to:

- Describe the distinguishing features of the YVWA chillers
- Describe the normal operational sequence of the YVWA chiller

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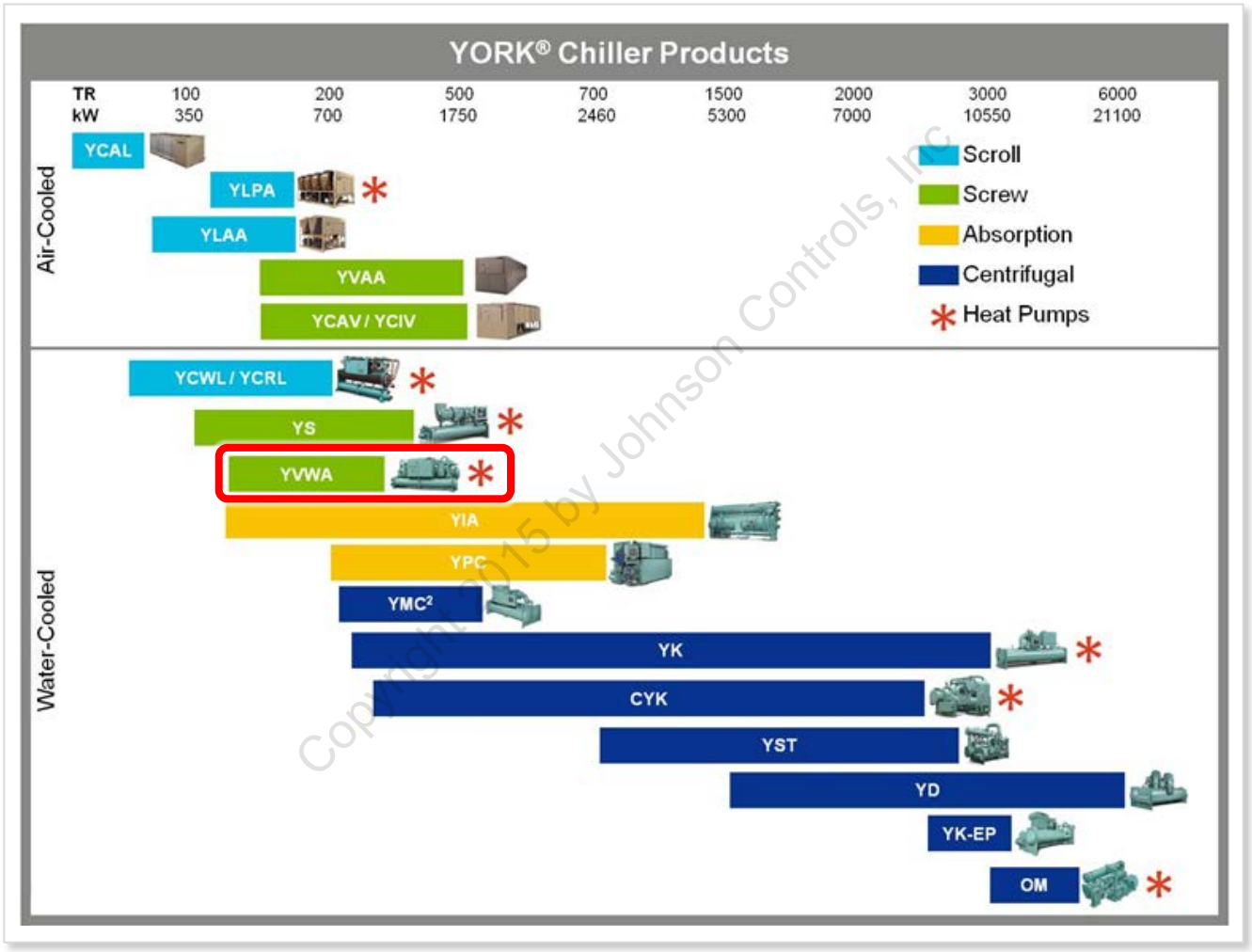
YVWA Technologies

- Condenser
- Component locations
- Refrigeration Cycle
- Lubrication System
- Condenser
- Sound Attenuation
- Economizer
- Evaporator

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Chiller Product Line



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Chiller Model Number



What does the chiller **Model Number** tell us?

NOMENCLATURE

YVWA MB MB EE AB 0200 S A X

- **Y –** YORK
- **V –** Variable Speed
- **W –** Water-cooled
- **A –** Design Series
- **Evaporator tubes**
- **Condenser tubes**
- **Compressor**
- **Starter | Pass**
- **Capacity**
- **Application**
- **Model**
- **Special Quote**

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Exercise

Can you find the details?

Nomenclature
Vs
Complete PIN

- Find the descriptions for the **PIN** options indicated for the two chillers identified on the next page

YWAA Service Instructions
Form **201.30-M1.pdf**
Form **201.30-icom2**

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Nomenclature PIN Descriptions



These PIN entries are from **actual Sales Orders**.
Write down the **Service Manual Description** for each of the **PIN** entries below.

1 - 4	5-6	9-10	17	19	22	29	30	31	34	40	41	52-53	65-66	74
YVWA	**NE**	**EE**	**X**	**X**	**S**	**A**	**A**	**L**	**S**	**L**	**A**	**45**	**40**	**K**
YORK Variable Speed Screw Water-Cooled Chiller Design 'A'	14 ft x 24 in, 260 x 1 in (4.2 m x 610mm, 260 x 25mm)													
YVWA	**ND**	**FF**	**S**	**Q**	**B**	**M**	**A**	**L**	**S**	**X**	**A**	**45**	**94**	**H**
YORK Variable Speed Screw Water-Cooled Chiller Design 'A'	14 ft x 24 in, 230 x .75 in (4.2 m x 610mm, 230 x 19mm)													

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Nomenclature PIN Description – Service Manual Errors

Table 24 - Complete PIN Description



FEATURE	DESCRIPTION	OPTION	DESCRIPTION	-M1 Option	-M1 Description
POWER	Power Field (PIN 22)	B	SP Circuit Breaker w/ Lockable Handle	BX	Circuit Breaker, Lockable
		N	SP NF Disconnect Switch w/Lockable Handle	SX	NF Disconnect Switch, Lockable
		N	SP Supply TB	SS	Supply Terminal Block
		Q	Special quote	CS	Special Quote
BAS	BAS Interface (PIN 29)	B	BAS/EMS Temp & Cur Reset/Offset	B	BAS/EMS Temp & Cur Reset/Offset
		C	BAS/EMS Current Reset/Offset	C	BAS/EMS Current Reset/Offset
		T	BAS/EMS Temp Reset/Offset	T	BAS/EMS Temp Reset/Offset
		A	BACnet ELink		
		M	Modbus ELink		
		L	LON ELink		
		N	N2 ELink		
		Q	Special quote		
LANGDESP	Language Display (PIN 30)	A	English	X	English
SAFETY	Safety Code (PIN 31)	G	China Safety Code (GB)	L	China Safety Code (GB)
		L	N American Safety Code (cUL/cETL)	Q	N American Safety Code (cUL/cETL)
UNLOAD	PIN 34	S	Standard unloading		
PIN40	PIN 40	L	Liquid injection kit		
REF	Refrigerant R-134a (PIN 41)	A	R-134a	X	No Selection
EVAPCOAT	Evaporator Epoxy Coating (PIN 58)	X	No Selection	C	Compact water boxes
CONDDWP	Condenser Waterside DWP (PIN 73)	S	150 psig DWP waterside		
		H	300 psig DWP waterside	C	150 psig DWP waterside
		Q	Special Quote	K	Special Quote
CONDWP	Cond design pressure (PIN 77)	L	Low pressure	X	Elastomeric pad
		M	Medium Pressure	Q	1-in deflection spring isol
		H	High Pressure		

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Chiller Model Specific Sections

- **Component locations**
- Refrigeration Cycle and Lubrication
  - Oil Injection
  - Oil Separator
  - Oil cooling
  - Eductor
- Condenser
- Economizer
- Metering Device
- Evaporator
- Sound Attenuation

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Water – Cooled Similarities and Differences



YCAV



YCIV



YVAA



YVWA

Different in component design but similar in operation and refrigerant flow

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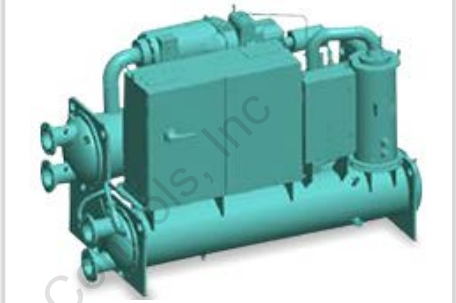
Compressor Configuration





Style A: Dual Circuit

- 2 compressors
- 2 Oil Separators
- 2 economizers
- 2 EEVs
- 2 evaporators
- 2 condensers



Style B: Single Circuit

- 1 compressor
- 1 Oil Separator
- 1 economizer
- 1 EEV
- 1 evaporator
- 1 condenser

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Single and Dual circuit YVWA chillers provide a wider range of cooling/heating capacities.

Exercise

Find the YVWA component layout diagram.

Mark the location of each of these components:

- Compressors
- Condenser
- Control Panel/VSD
- Economizer
- Evaporator
- Oil Eductors
- Oil Separators

Use the YVWA IOM if you need help. (Form 201.30-ICOM2.pdf)

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Activity: Identify the Major Components

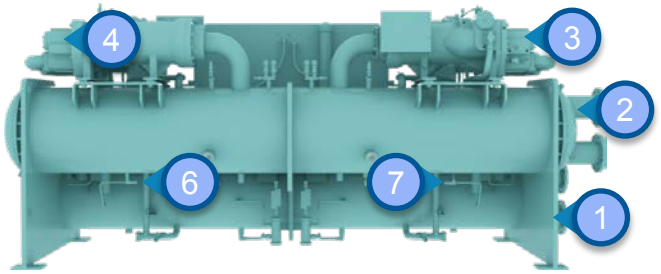
Locate:

A. Compressors
B. Condenser
C. Control Panel/VSD
D. Economizers
E. Evaporator
F. Oil Eductors
G. Oil Separators

1. Condenser
2. Evaporator
3. Compressor
4. Compressor
5. Control Panel/VSD
6. Oil Eductor
7. Oil Eductor
8. Oil Separator
9. Economizer
10. Oil Separator



Front View



Rear View

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Chiller Model Specific Sections

- Component locations
- **Refrigeration Cycle and Lubrication**
  - Oil Injection
  - Oil Separator
  - Oil cooling
  - Eductor
- Condenser
- Economizer
- Metering Device
- Evaporator
- Sound Attenuation

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Refrigerant Flow and Lubrication: Chiller



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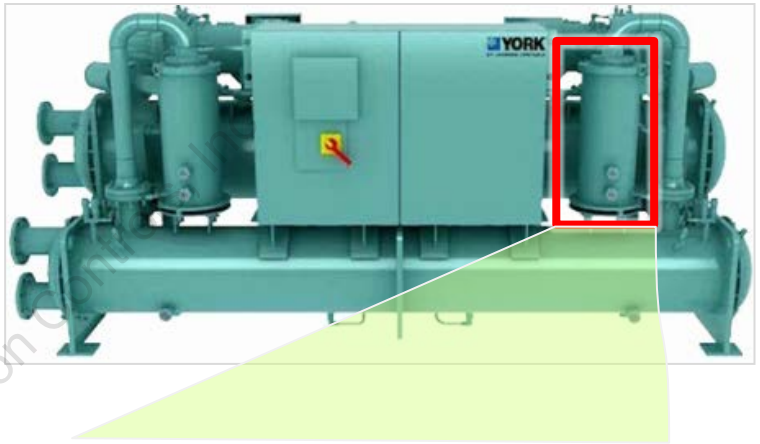
Refrigerant Flow and Lubrication: Heat Pump



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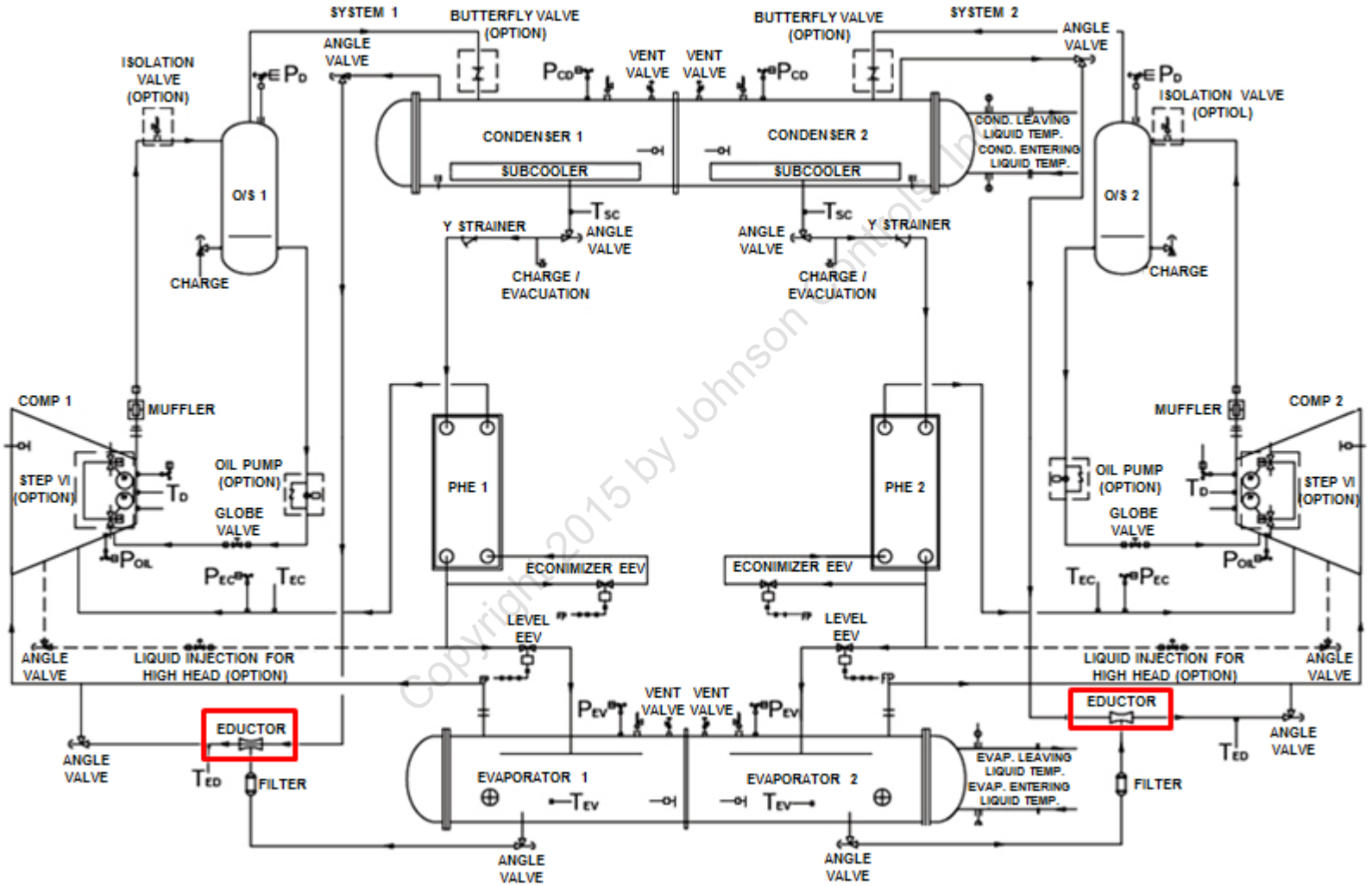
Oil Separators

- Separates oil from the refrigerant
- Uses centrifugal force and heat
- Since the YVWA chiller uses the hybrid falling film evaporator, the Oil Separator can be made compact as compared to the size of the Oil Separator used along with the flooded evaporator



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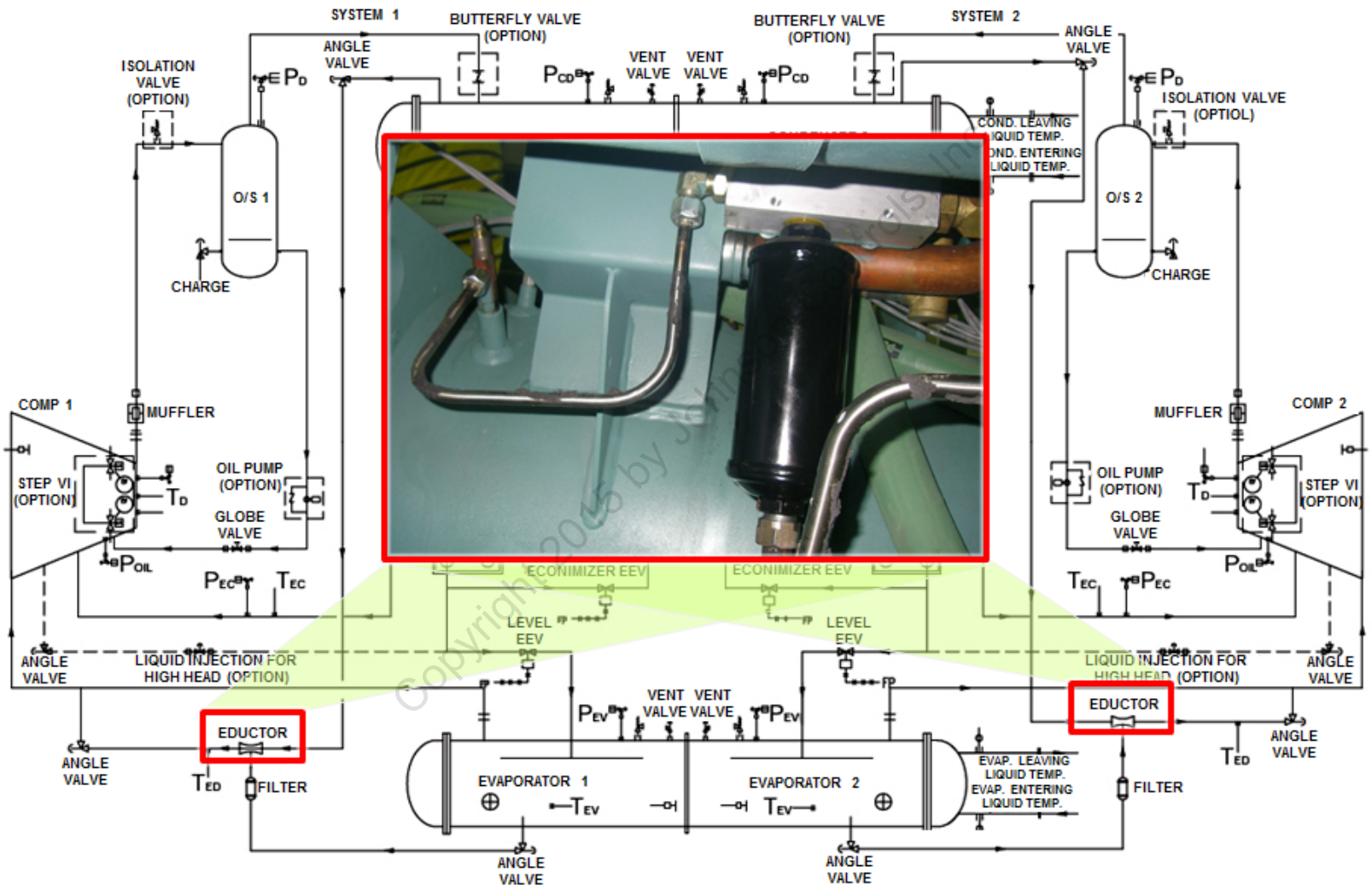
P&ID Diagram: Eductors



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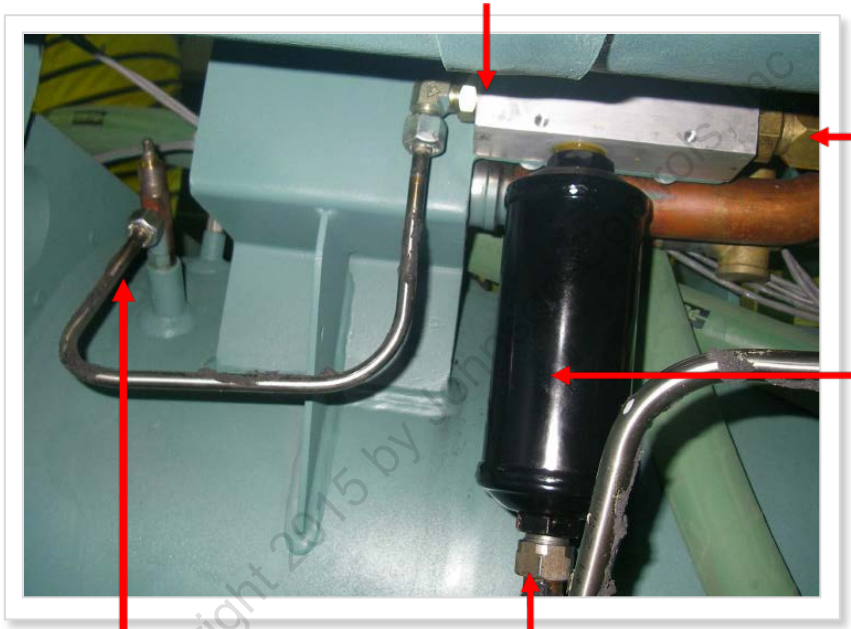
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P&ID Diagram: Eductors (Contd.)



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Eductors



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What would happen if the evaporator becomes oil-logged?

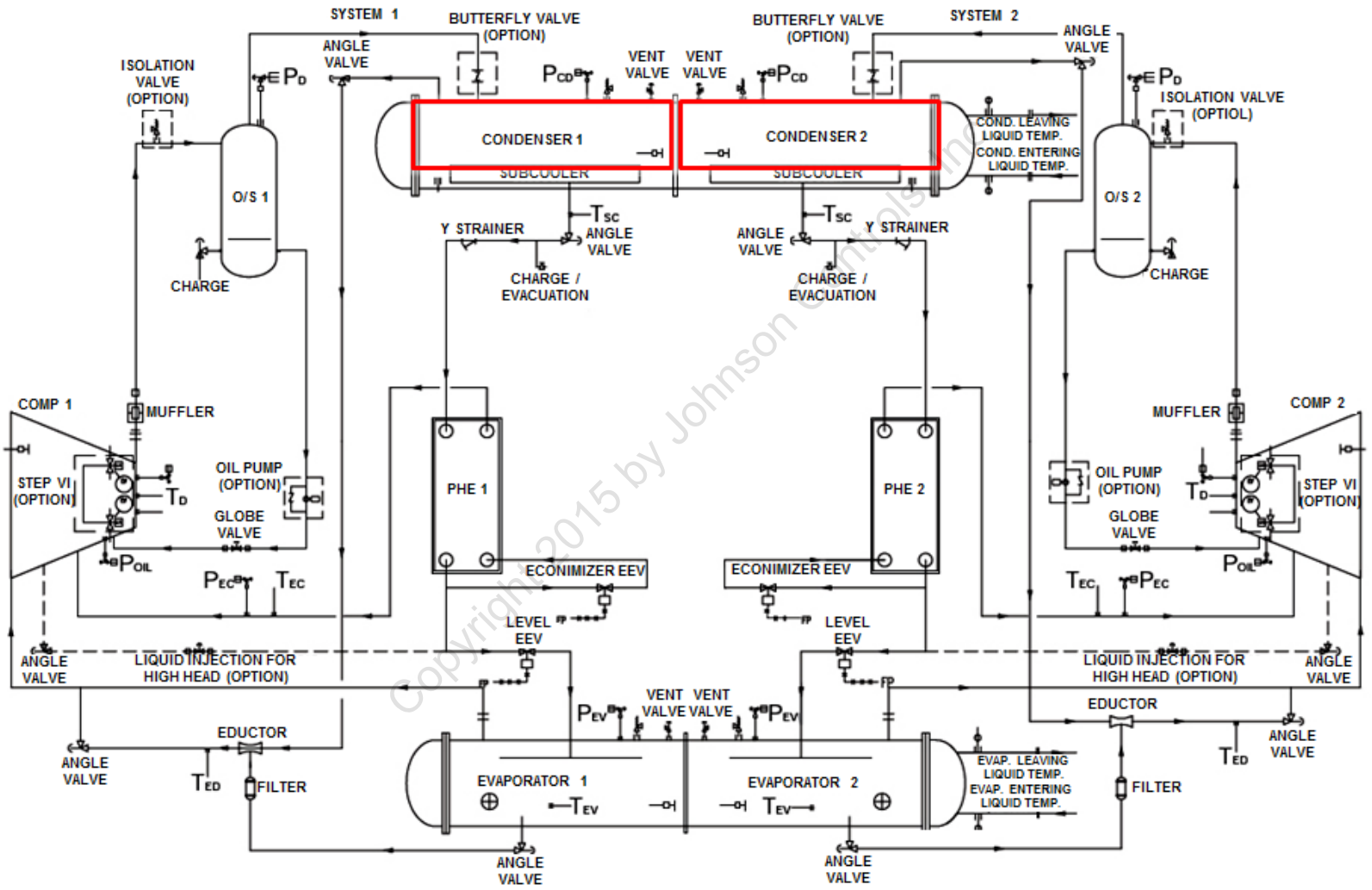
Chiller Model Specific Sections

- Component locations
- Refrigeration Cycle and Lubrication
  - Oil Injection
  - Oil Separator
  - Oil cooling
  - Eductor
- **Condenser**
- Economizer
- Metering Device
- Evaporator
- Sound Attenuation

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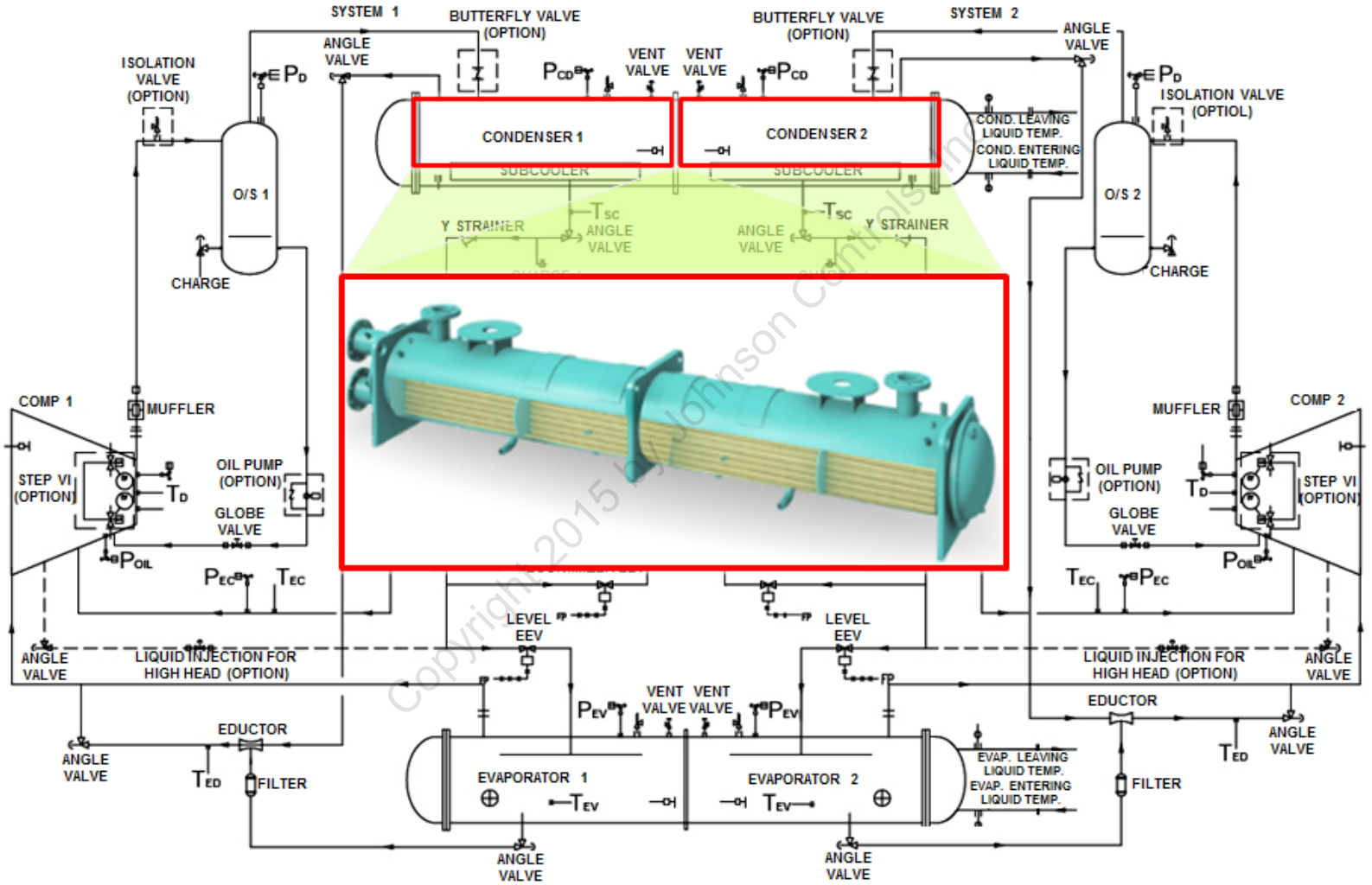
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P&ID Diagram: Condenser



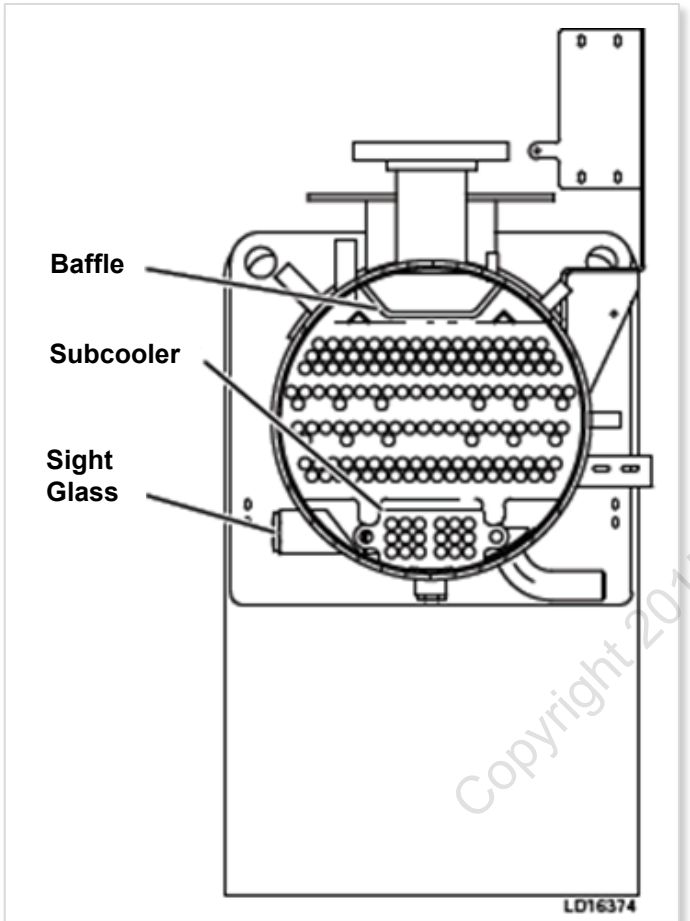
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P&ID Diagram: Condenser (Contd.)

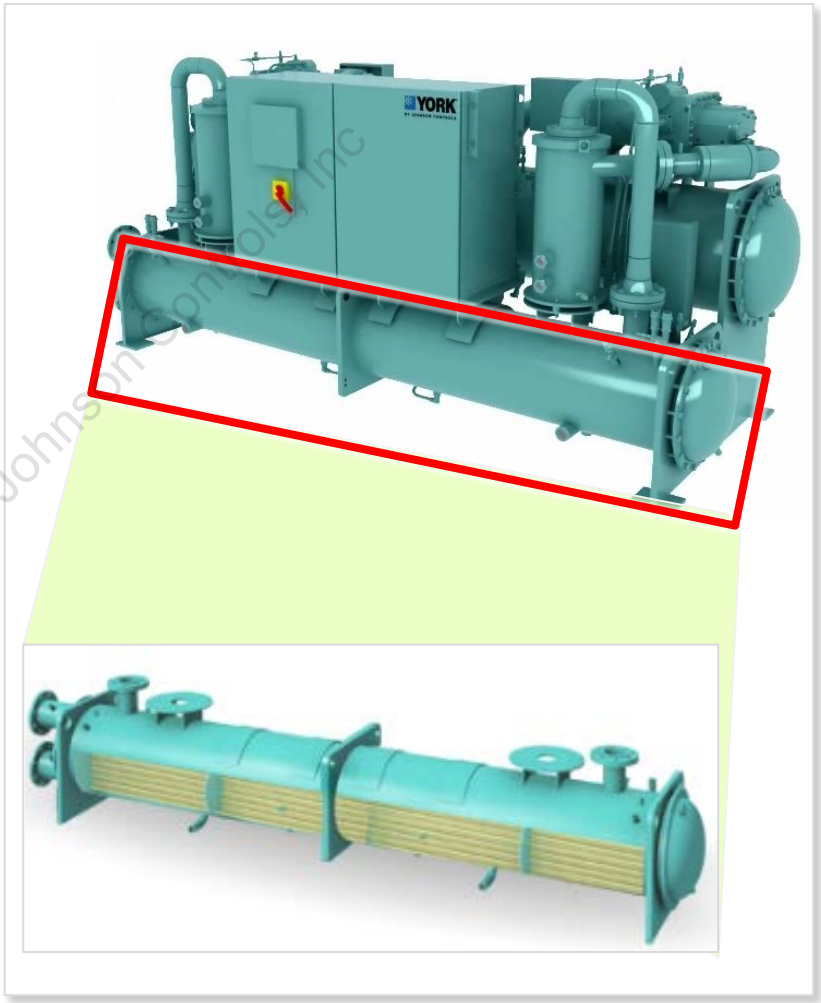


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Condenser



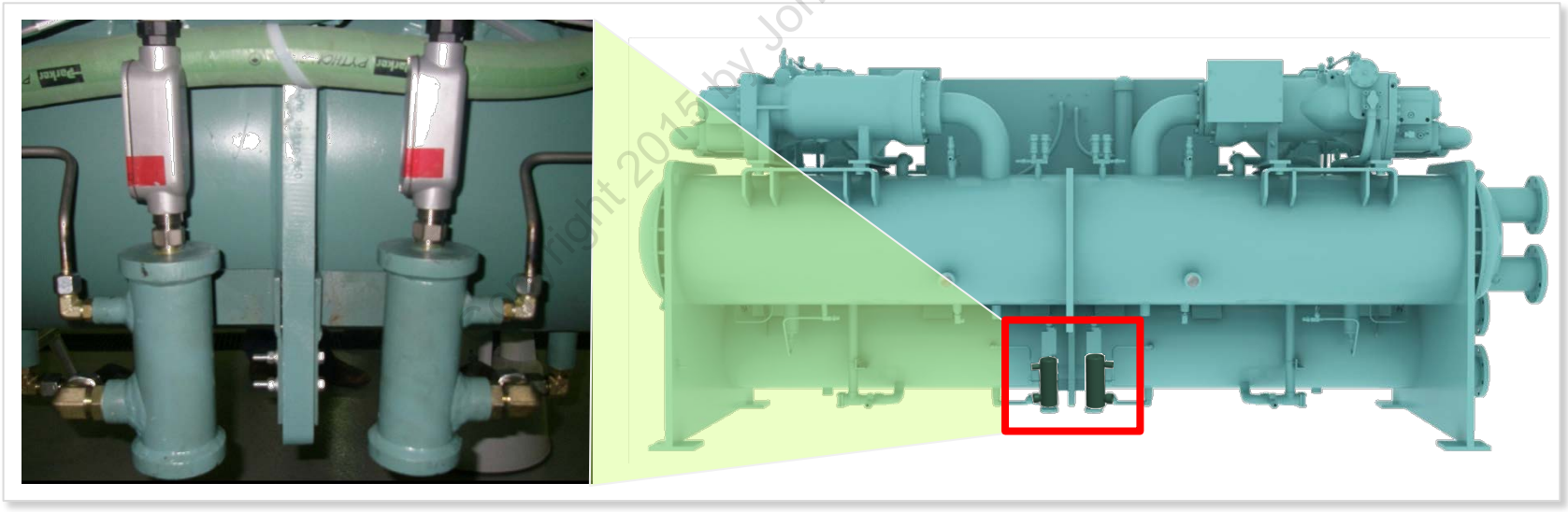
Condenser Cross-section View



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Condenser Level Sensor

- Capacitance-type sensor with 4-20 mA transmitter output proportional to refrigerant level on the probe
- 0% of probe coverage is 4.00 mA + 5%
- Full 100% coverage is 20.00 mA + 5%
- Sensor is factory-calibrated and cannot be adjusted in the field



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Condenser Drain Evaporator EEV

- Controlled by condenser liquid level
- Condenser level is measured to control condenser drain evaporator EEV
- Condenser level sensor's running set point is programmable although 50% is the default value. There is a hold delay at startup. After the hold delay, the setpoint will ramp from where it was at the end of the hold delay

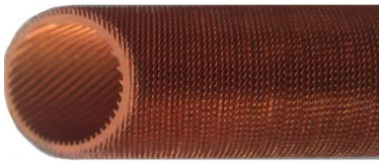


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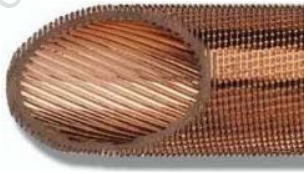
Condenser Tube Types

Options

- Copper for standard duty
- Copper-Nickel (Cu-Ni) and Titanium tubes for severe duty applications



3/4” Copper Tube (Standard)



1’’ Copper Tube (Standard)



3/4’’ Cu-Ni Tube (SQ)



3/4’’ Titanium Tube (SQ)

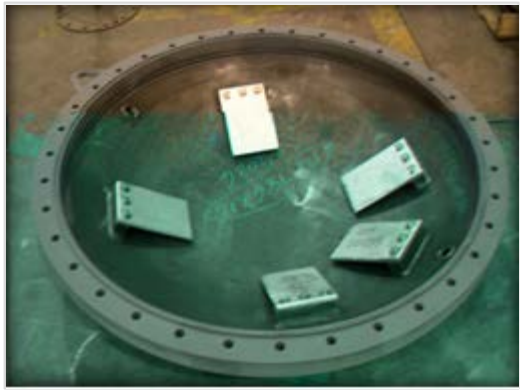
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Corrosion Prevention Options

- Tube sheet epoxy coating: 18-month warranty from the factory ship date.
  - Steel surface is blast cleaned and coated
  - Two coats of epoxy - minimum thickness 16 mils (0.016” or 0.406 mm)
- Stainless steel anode mounting blocks welded to water boxes
- Zinc anodes secured with stainless steel hardware



Epoxy coated tube sheets



Anodes

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Factory Insulation of Condenser



Insulation is factory applied to the condenser for specific applications such as heat pump and heat recovery.

Option

- ¾”(19 mm) thick insulation

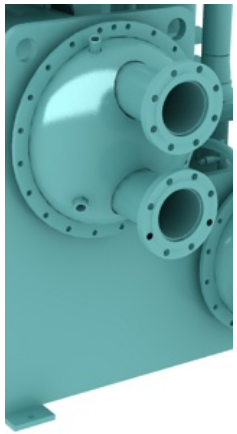
Not included

- Insulation of water boxes and nozzles

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Water Box





- Compact water box standard



Optional Marine water box

- Simplifies tube cleaning
- Facility piping remains connected

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Water Box Hinges (Optional)

- Improves serviceability
- Provides easy access to chiller tubes for cleaning
- Increases plant room safety



Compact water box hinge



Marine water box hinge

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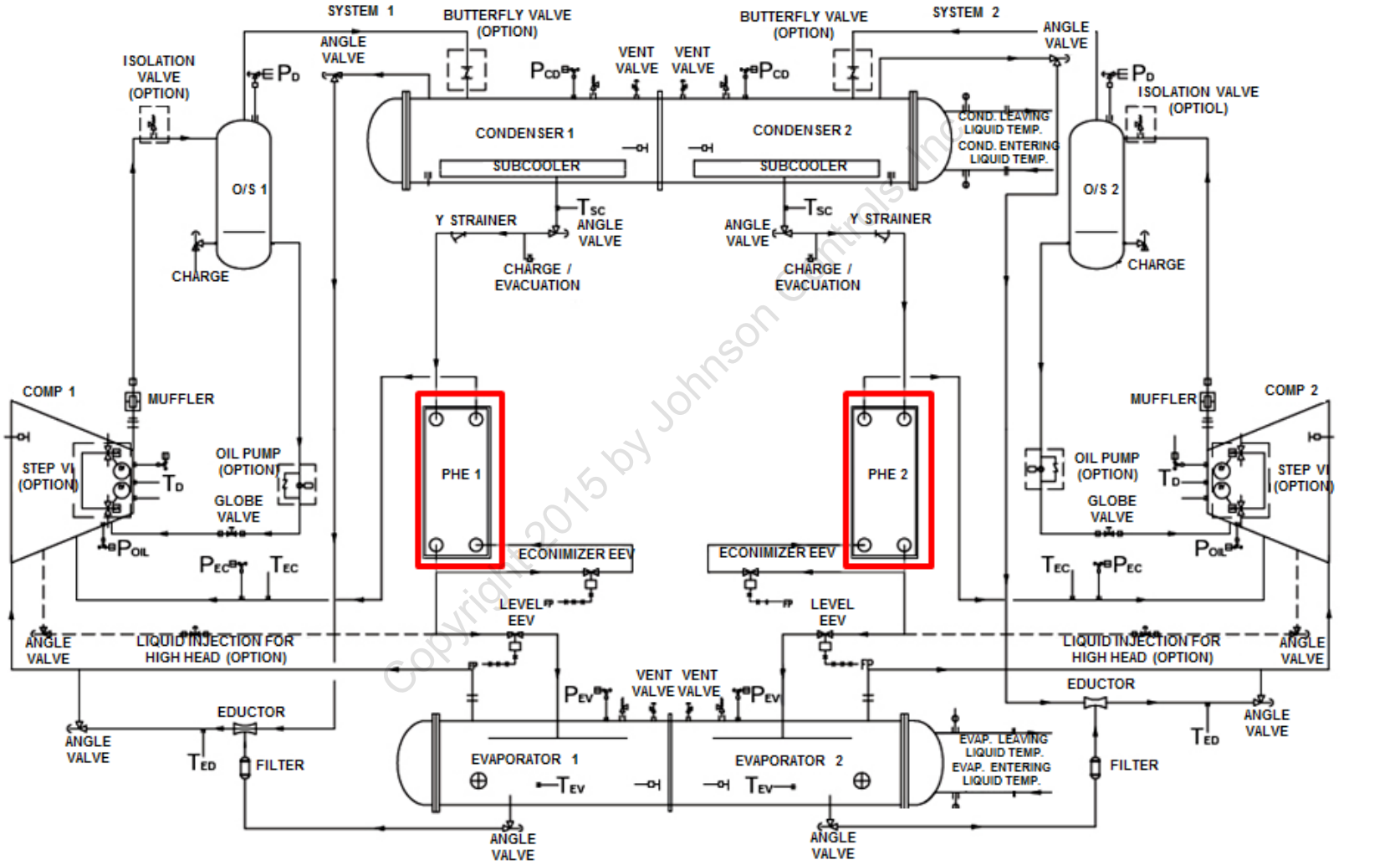
Chiller Model Specific Sections

- Component locations
- Refrigeration Cycle and Lubrication
  - Oil Injection
  - Oil Separator
  - Oil cooling
  - Eductor
- Condenser
- **Economizer**
- Metering Device
- Evaporator
- Sound Attenuation

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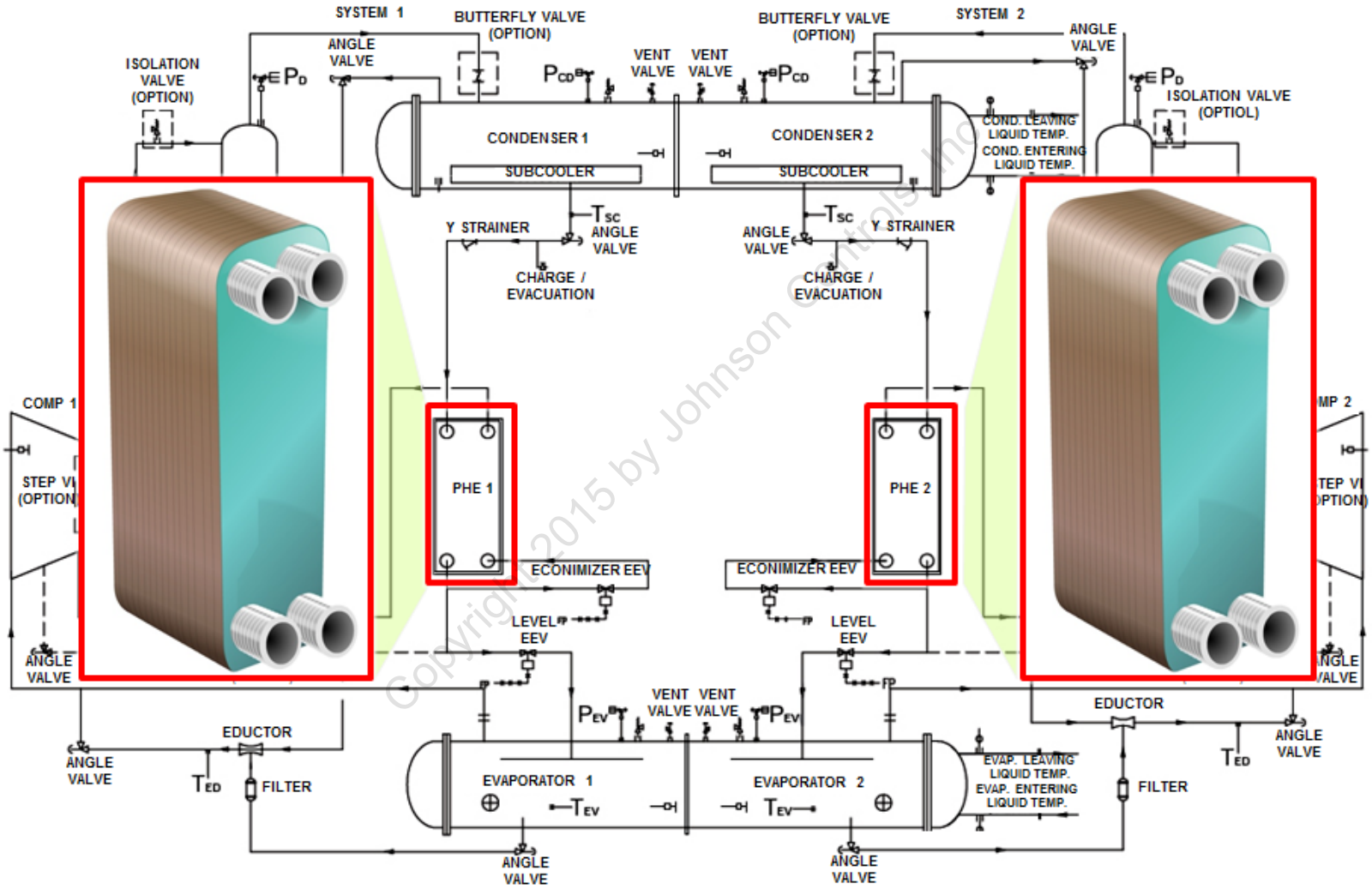
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P&ID Diagram: Economizer



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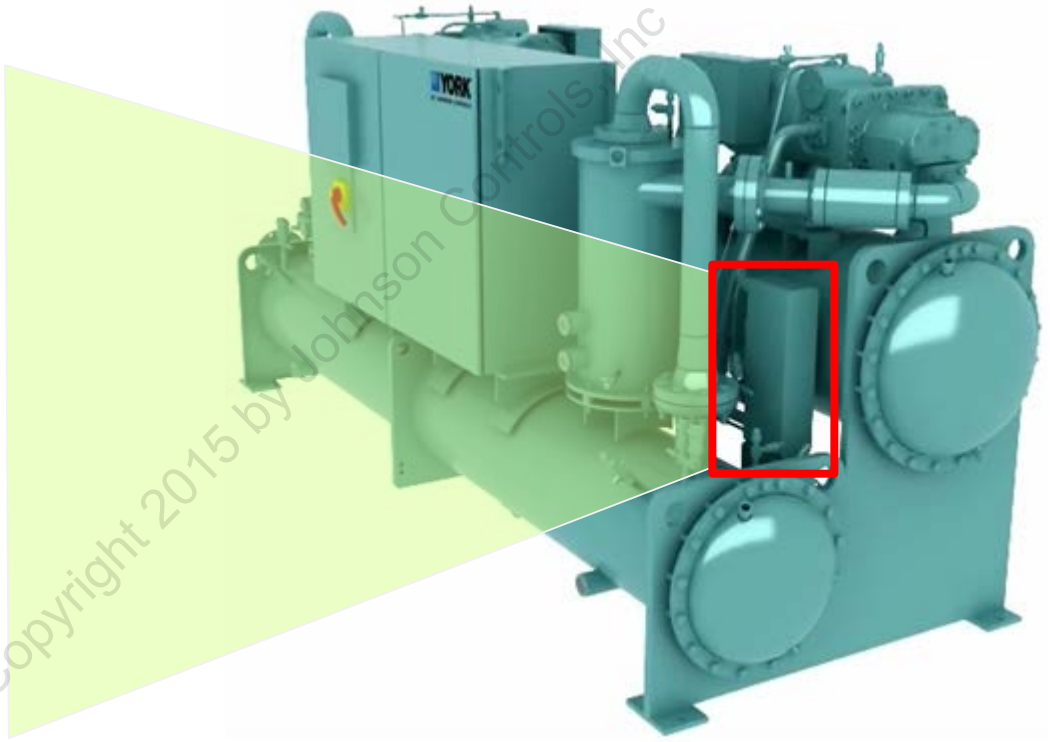
P&ID Diagram: Economizer (Contd.)



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Economizer

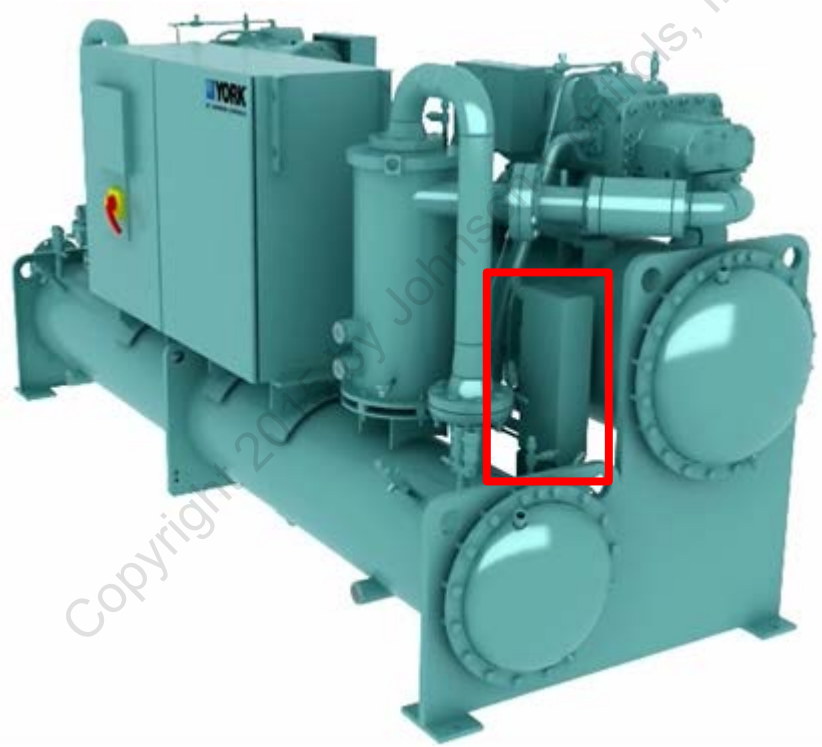
What other chiller products use a flat plate heat exchanger for an economizer?



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Economizer (Contd.)

What do you know about brazed flat plate heat exchanger?



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Economizer EEV

- Stepper Motor Valve controls vapor feed to economizer port on compressor
- Port passage is connected through the Closed Thread portion to the screw rotors
- Modulates loading according to the system parameters



Controlled by control panel:

- **Economizer superheat:** difference of economizer temperature and economizer saturation temperature
- Activated by a PI controller
- Feed valve, positioned to economizer, holds when:
  - System is not running
  - VSD frequency is below the economizer off-frequency

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When opened, the Economizer EEV controls via pressure and temperature.

Chiller Model Specific Sections

Component locations

Refrigeration Cycle & Lubrication

- Oil Injection
- Oil Separator
- Oil cooling
- Eductor

Condenser

Economizer

Metering Device

Evaporator

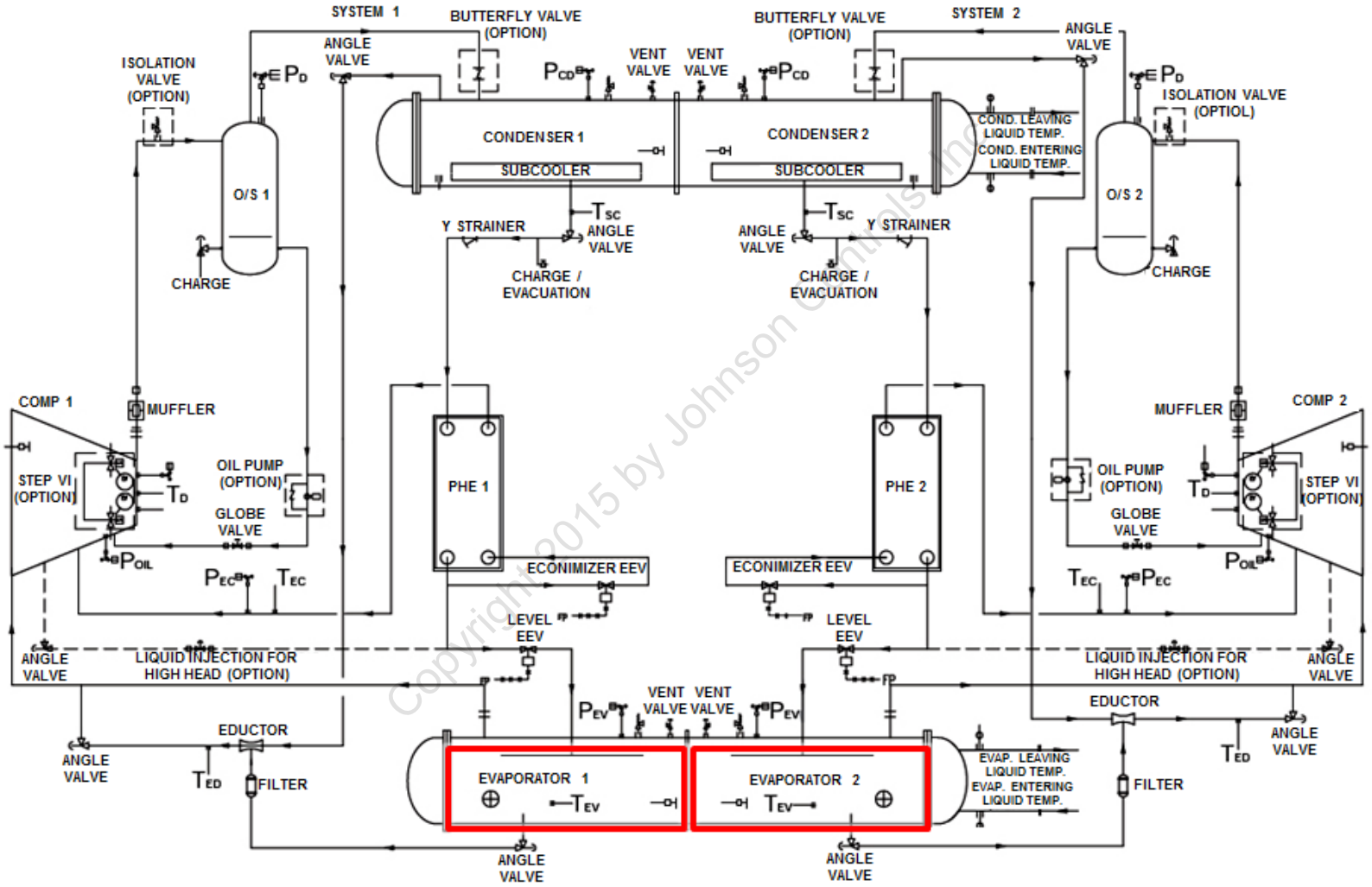
Sound Attenuation

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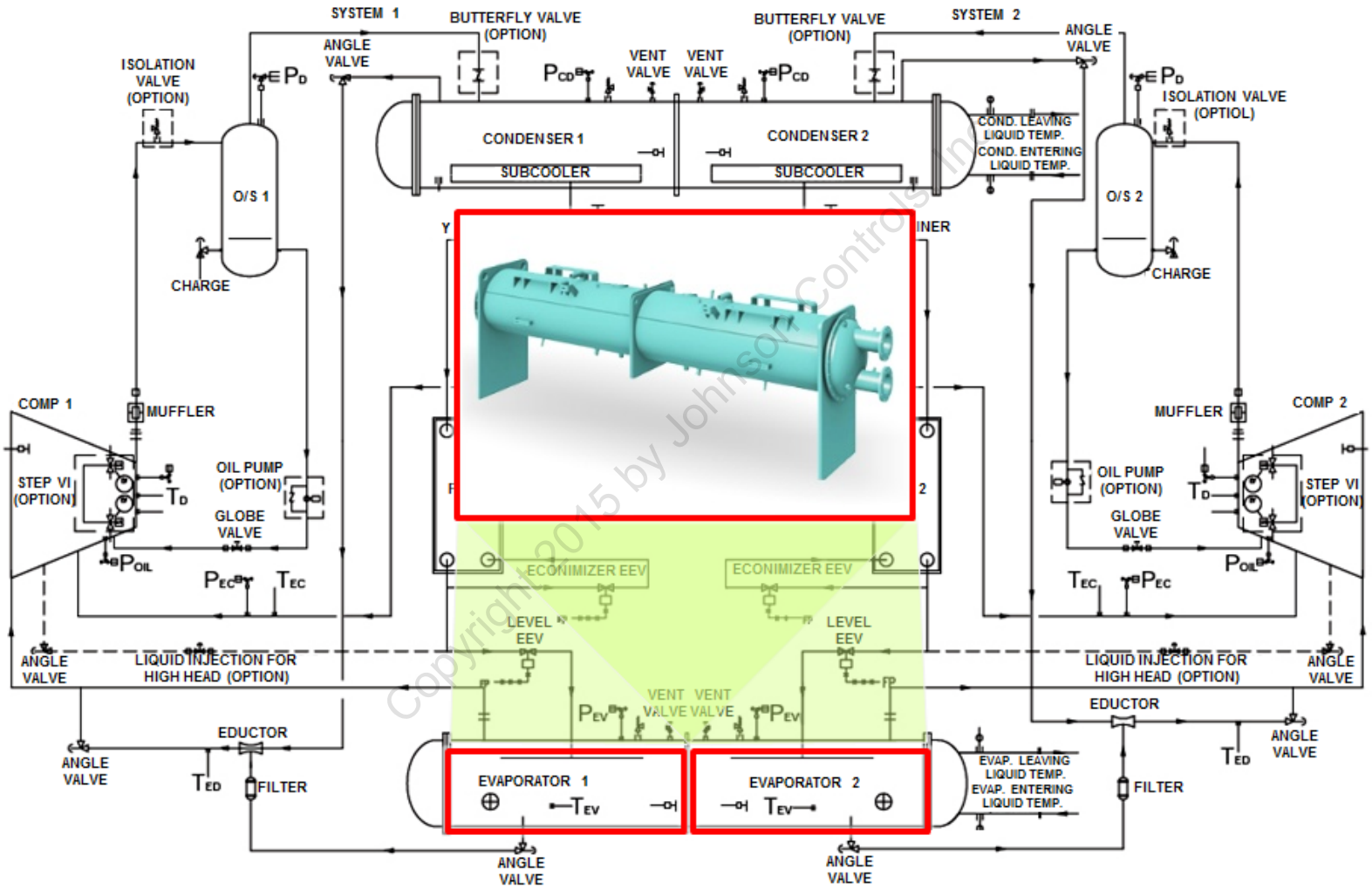
Processes and Instrumentation





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Processes and Instrumentation (Contd.)

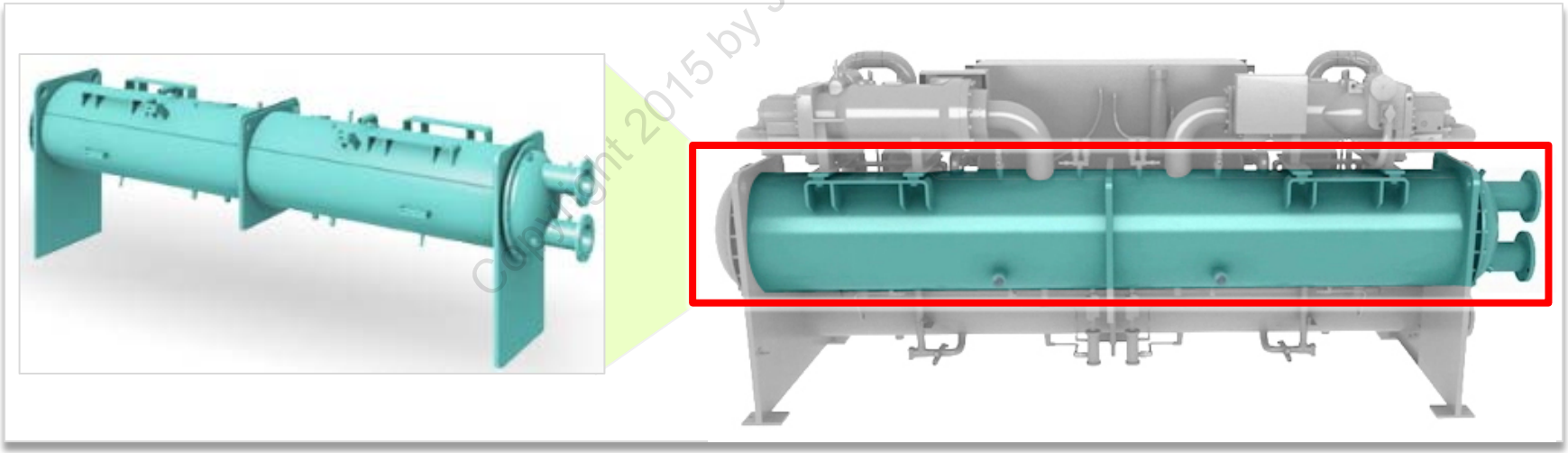


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Hybrid Falling Film and Flooded Evaporator

Features

- High-efficiency, internally and externally enhanced type copper tubes with:
  - 0.025'' minimum wall thickness
  - ¾'' and 1" diameter
- Follows standard 2-pass arrangement
- Requires 30% less refrigerant than standard flooded evaporator design



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Evaporator: How Does the Falling Film Flooded Evaporator Work?

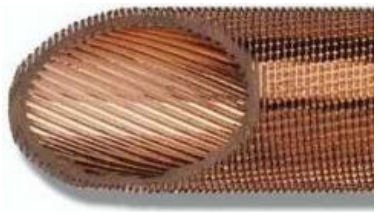


- Hybrid of falling film and flooded technologies
- Shell and tube, hybrid falling film and flooded heat exchanger, with a combination of:
  - Evaporator tubes that are cooled by a falling film
  - Evaporator tubes that are submerged in a liquid refrigerant pool at the bottom

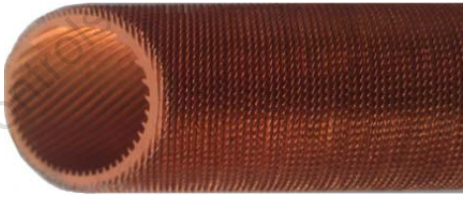
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Evaporator Tube Types

- Size determined by system application and capacity



1’’ Copper Tube (Standard)



3/4’’ Copper Tube (Standard)

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More Heat Exchanger Options

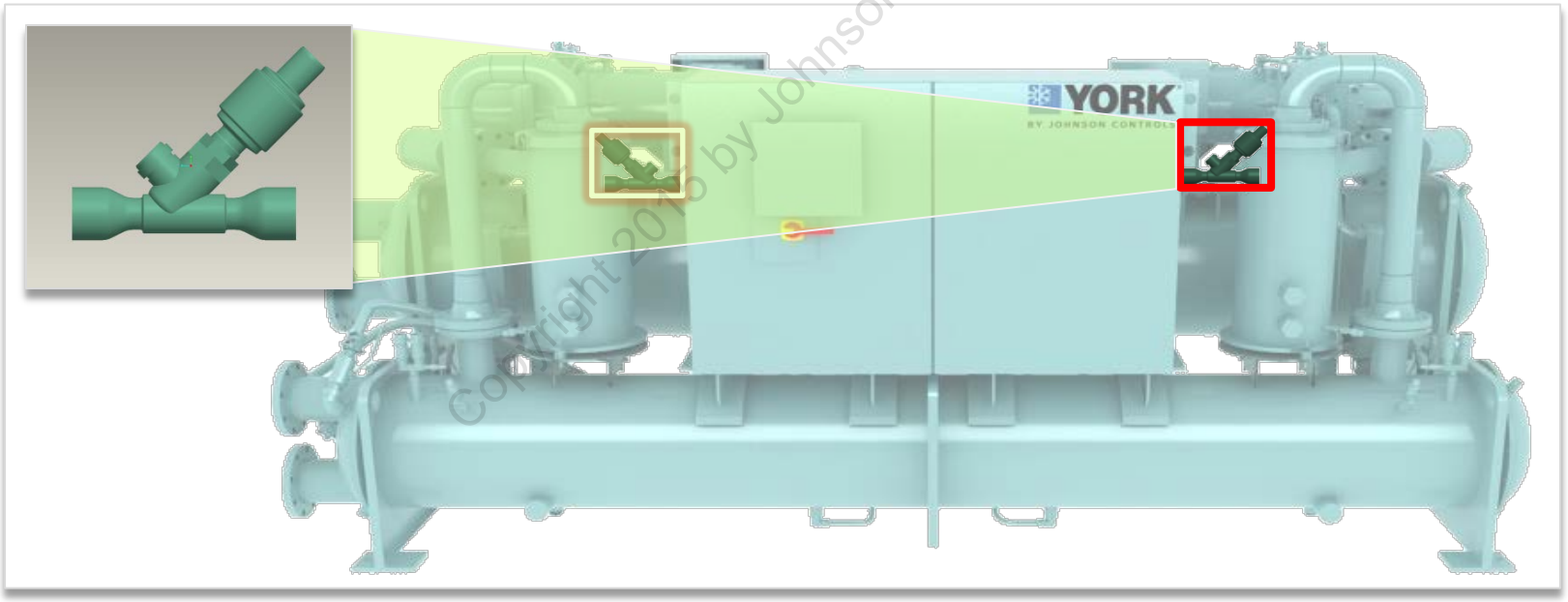
- Factory Insulation of Evaporator
- Right or Left Nozzle Arrangement
- 1 (Standard), 2 or 3 Pass Condenser
- 2 (Standard) or 3 Pass Evaporator
- Welded flanges – Factory or Field



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Electronic Expansion Valve (EEV)

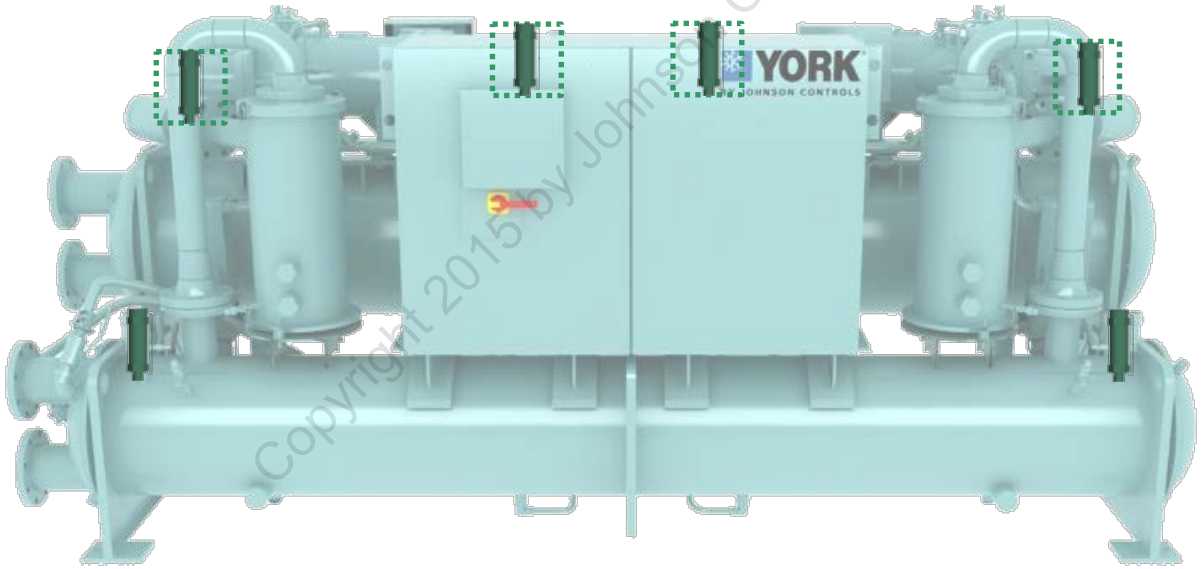
- Accommodates varying head and load conditions
- Controlled according to condenser level at the subcooler
- Maintains constant level of refrigerant to keep subcooler liquid seal
- Provides condenser level sensor set-point at 30% during startup



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Relief Valves

- Emergency safety device to handle unusual circumstances
- Each circuit equipped with relief valves on evaporator, condenser, and Oil Separator discharge line
- Relieves excess refrigerant charge pressure to atmosphere



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Single relief valves standard

Chiller Model Specific Sections

- Component locations
- Refrigeration Cycle and Lubrication
  - Oil Injection
  - Oil Separator
  - Oil cooling
  - Eductor
- Condenser
- Economizer
- Metering Device
- Evaporator
- **Sound Attenuation**

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Acoustic Treatment Options



"Sound Kit 1" is the standard offering.

Options:

- Sound Kit 2 (quieter)
- No attenuation (louder and less expensive)

Evaporator attenuation holds the same thermal characteristics as the ¾" thermal insulation.

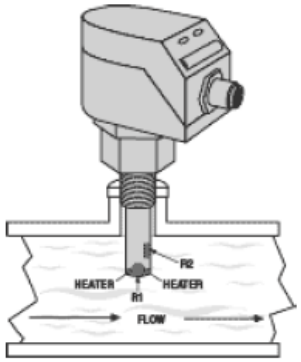


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Treated Parts	Sound Kit#1 (Standard)	Sound Kit#2 (Optional)	No Sound Kit (Optional)
	82-85 dBA	78-82 dBA	As Rated
Compressor	✓	✓	✗
Suction and Discharge Pipes	✓	✓	✗
Oil Separator	✓	✓	✗
Evaporator		✓	✗



Other Options



SI tip design

- **Thermal Flow Switch**
  - Factory mounted in evaporator and condenser nozzles
  - Can be oriented in any configuration
  - No moving parts - less susceptible to contamination
  - Provides basic freeze protection



- **Differential Pressure Switch**
  - Pressure drop across chiller tube bundle indicates flow
  - Offers more adjustment for flow rate

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Check Your Understanding – 1

What are the advantages of a YVWA dual circuit chiller?

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Duration: 5 minutes

Check Your Understanding – 2

The YVWA has a brazed plate economizer. What elements of the YVWA chiller do you need to be concerned with because of the economizer?

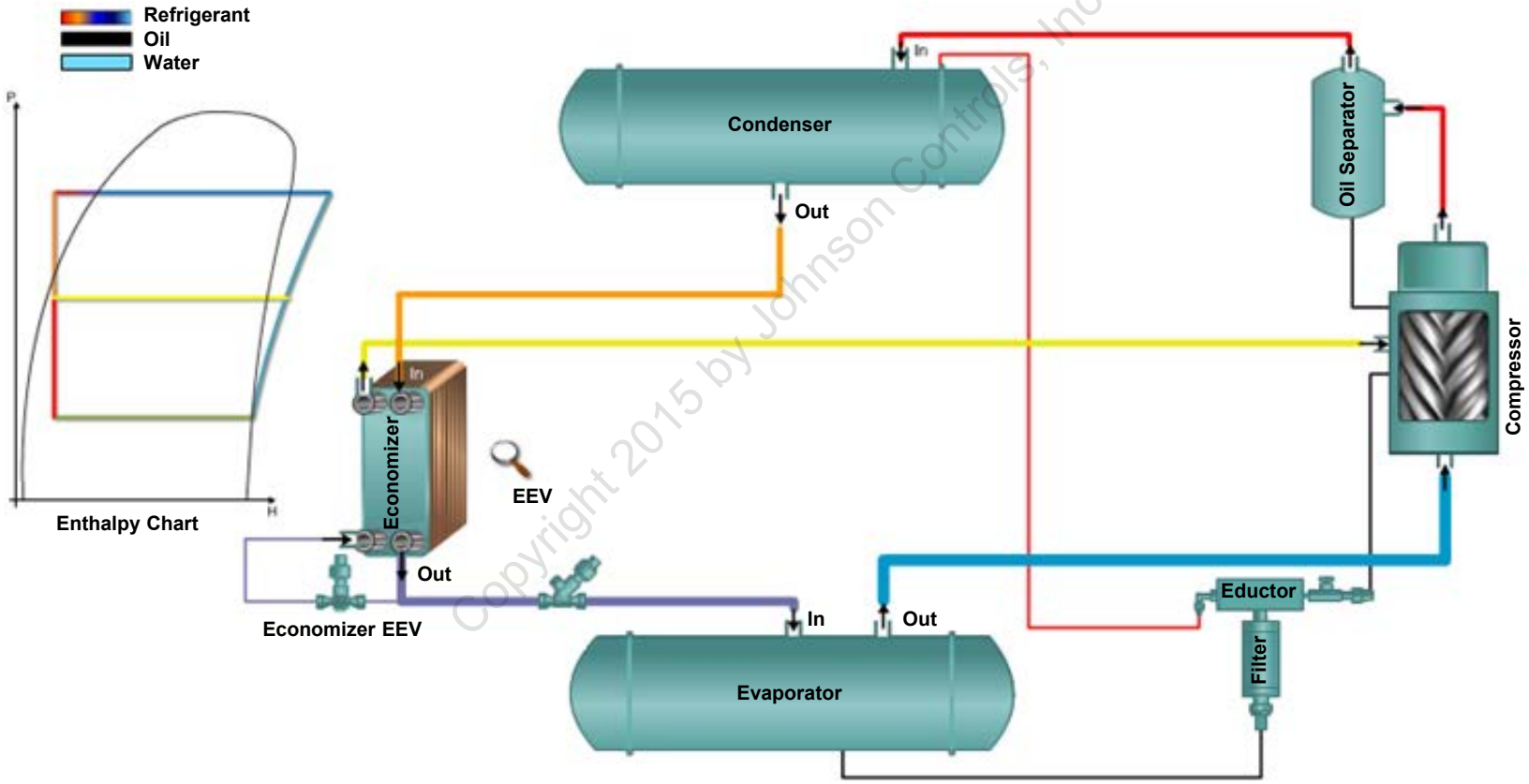
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Duration: 5 minutes

Check Your Understanding – 3

Which part of the chiller controls the amount of the refrigerant flow?



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Key Takeaways – YVWA Chiller Technology



- Product Fit and Nomenclature
- YVWA Component Layout
- Refrigeration Cycle & Lubrication
- Major Component Functions:
  - Condenser
  - Economizer
  - Evaporator & Metering Device

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Troubleshooting from Control Panel



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Objective

After completing this section, you will be able to:

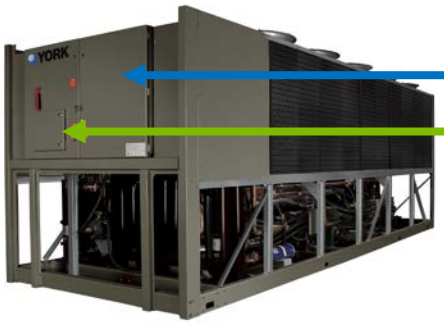
- Operate York Screw Chillers
- Use the control panel to:
  - View the I/O status in service mode to verify proper operation
- Troubleshoot York Screw Chillers
- Use the control panel to:
  - Locate I/O on electrical schematics, chiller control board and VSD logic board.
  - Perform necessary electrical checks
  - Identify and prioritize the causes
  - Locate additional information

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System Control – Cooled Similarities and Differences



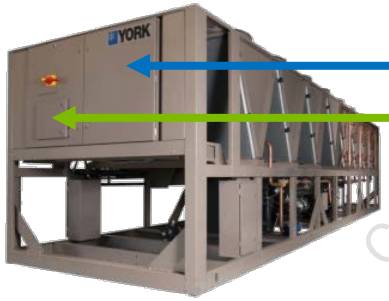


YCAV

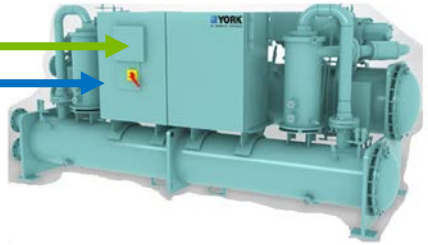


YCIV

Control Panel



YVAA



YVWA

Control and VSD Circuits

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All Chiller Models

- **Component locations**
  - Control Panel Operation
- Control Panel to VSD Logic and Control Flow
- Tracing wiring diagrams
- Troubleshooting from Control Panel

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Exercise

Which Manual Should You Use?

Operating
and
Troubleshooting

- Select the most appropriate manual to use for troubleshooting each the York Screw Chillers
- Select the most appropriate manual to use for troubleshooting the VSD for any of the York Screw Chillers

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All documents may be found at:

http://publish.johnsoncontrols.com/content/controls/us/eng/prod_lit/YORKairhandling/york_sb_chillers/york_sb_chillers_rotaryscrews.html

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IOM (ICOM) Manuals





YCAV



YCIV



YVAA



YVWA

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IOM (ICOM) Manuals (Contd.)



SB Number	Subject
	YCAV: Installation, Operation, & Maintenance
201.21-NM1	IOM - YCAV-**0157 - 0267 60 Hz** Style A Air Cooled Screw Chiller with VSD
201.21-NM1 (LS01)	Literature Supplement - IOM - YCAV-0157 - 0267 60 Hz Air Cooled Screw Chiller with VSD
201.21-NM3	IOM - YCAV-**0267 - 0527 60 Hz** Style A Air Cooled Screw Chiller with VSD Large
201.21-NM3 (LS01)	Literature Supplement - IOM - YCAV-0267 - 0527 60 Hz Air Cooled Screw Chiller with VSD
201.21-NM3 (LS02)	Literature Supplement IOM - YCAV-0267 - 0527 60 Hz Style A Air Cooled Screw Chiller with VSD
	YCIV: Installation, Operation & Maintenance
201.23-NM1	IOM - Latitude™ Air-Cooled Screw Liquid Chillers Style A, Models YCIV0**590-1500**, 50 Hz, **590-1500** kW, E/V High Efficiency and S/P Standard Efficiency
201.23-NM1 (LS01)	YCIV 50 Hz Literature Supplement - Revised Isolator Data
201.23-NM1 (LS02)	YCIV 50 Hz Literature Supplement - New Isolator Reference Table
201.23-NM2	IOM - Latitude™ Air-Cooled Screw Liquid Chillers Style A, Models YCIV0157-0397, 60 Hz, **150-260** Tons, E/V High Efficiency and S/P Standard Efficiency
	YVAA - Installation, Operation & Maintenance
201.28-NM1.1	IOM - YVAA Air-Cooled Screw Liquid Chiller with VSD, Style A, 150-500 ton, 2-Compressor, 50 and 60 Hz, HFC-134A
	YVWA: Installation, Operations & Maintenance
201.30-ICOM1.EN.UL	IOM - YVWA Single Compressor**, Style B**, 50 Hz and 60Hz, 702 - 1055 kW
201.30-ICOM2	IOM - YVWA Dual Compressor, **Style A**, 50 Hz and 60 Hz, 200-300 Tons, 703-1055kW

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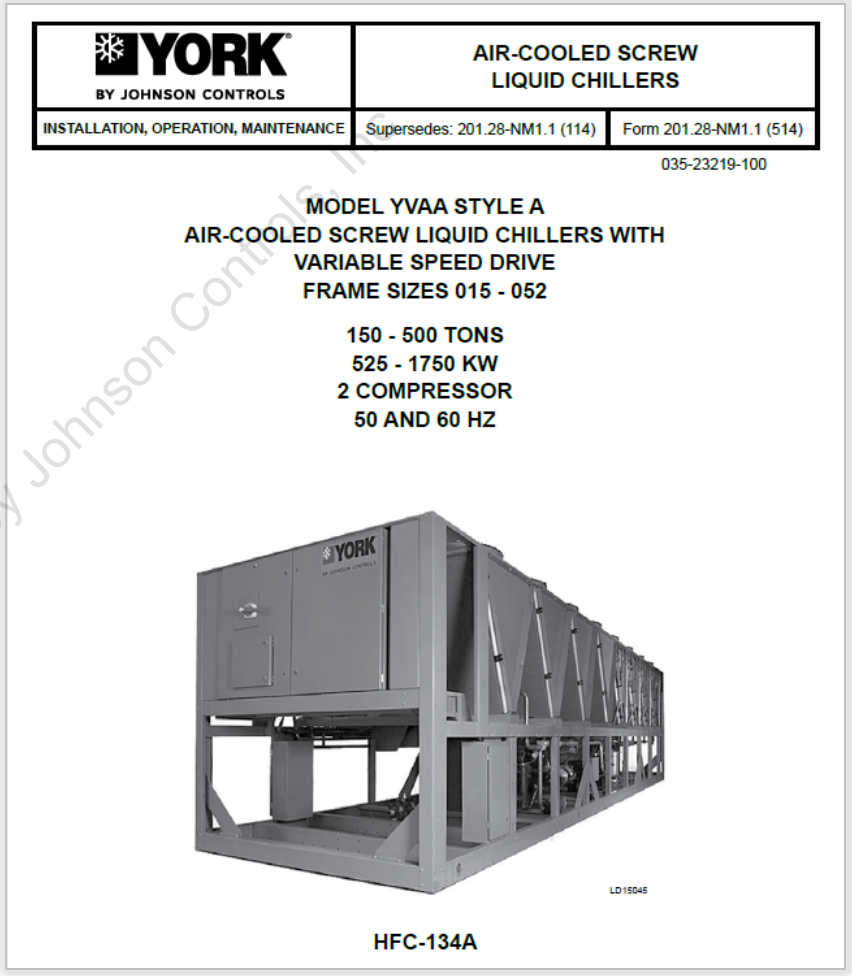
Today's Manual



Open
IOM (201.28-NM1.1)

SECTION
Operation

SECTION
Micropanel



YORK BY JOHNSON CONTROLS

AIR-COOLED SCREW LIQUID CHILLERS

INSTALLATION, OPERATION, MAINTENANCE | Supersedes: 201.28-NM1.1 (114) | Form 201.28-NM1.1 (514)

035-23219-100

MODEL YVAA STYLE A
AIR-COOLED SCREW LIQUID CHILLERS WITH
VARIABLE SPEED DRIVE
FRAME SIZES 015 - 052

150 - 500 TONS
525 - 1750 KW
2 COMPRESSOR
50 AND 60 HZ

HFC-134A

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Control Panel



Inputs
Pressure Transducers
Temperature Sensors

Switches
- Liquid Flow
- High Pressure
- Start/Stop Level

Customer Supplied Contacts

Chiller Control System

Control Panel
(Chiller Control Board)

Microprocessor
User Interface
Display

Outputs
(Relay Output Board)

Solenoids
Alarm
Pump
Compressor Heater
Run Status

Communications
Building Automation
Printer and Modem

VSD
VSD Logic Board
SCR Trigger Board
Power Components
PWM (Speed Control)

Display

Keypad

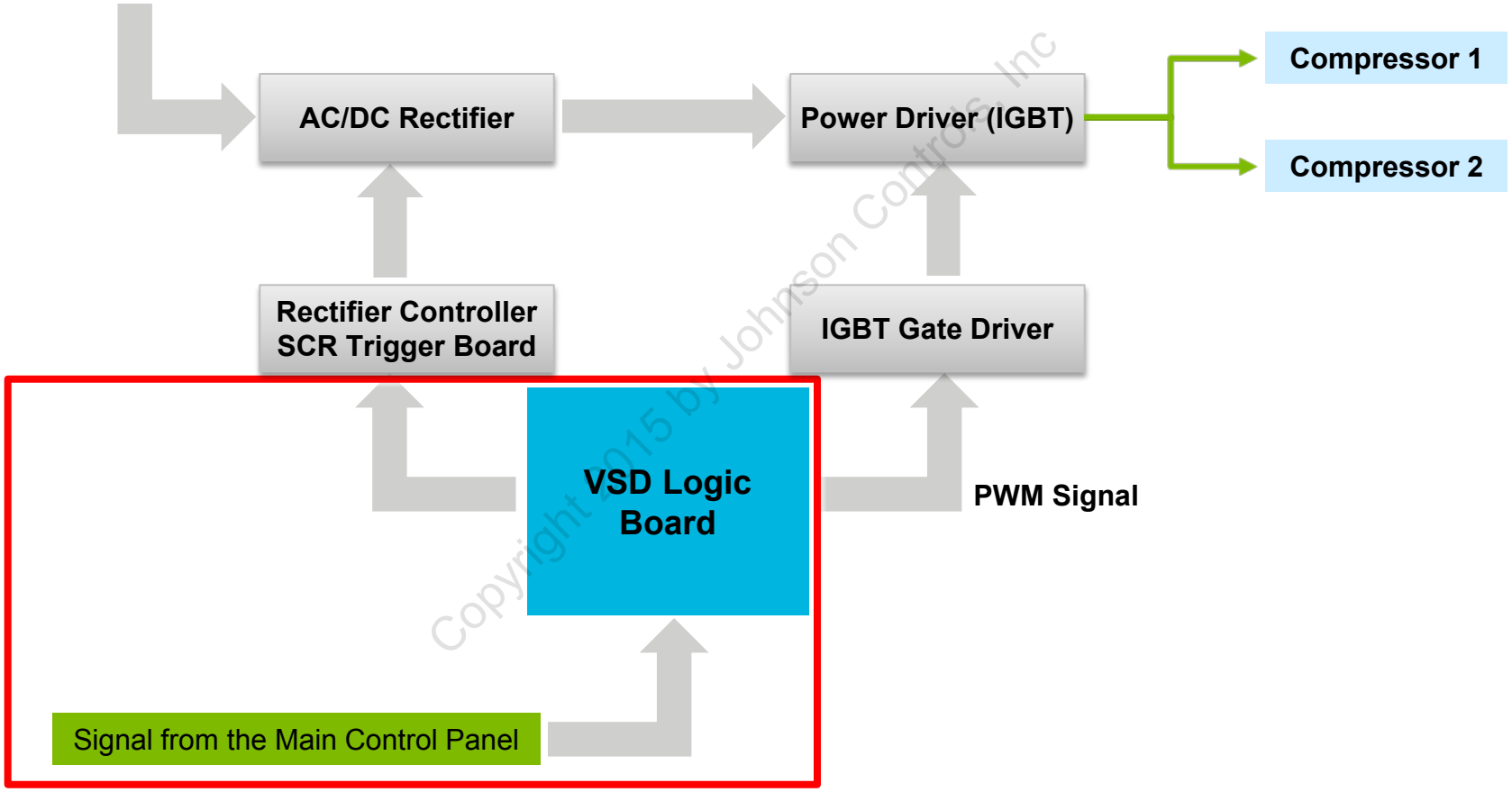
Motor

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VSD Logic Board



Three-phase Power Line

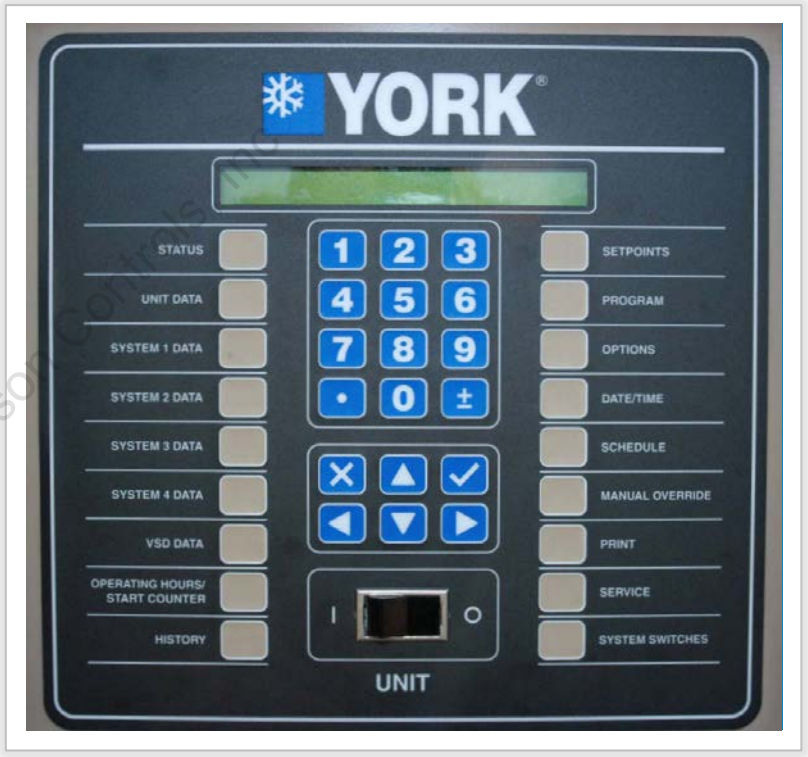


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Control Center



- Provides automatic control of chiller operation
- Continuously monitors all variables
- Controls the unit's capacity by matching the actual Leaving Chilled Liquid Temperature (LCHLT) to the user-defined set point
- When YVWA is configured as a heat pump in heating mode, controls leaving condenser water temperature



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Unit Switch



- Located on the front of the control panel and is used to turn the chiller On and Off
- Used to shutdown the chiller only in an emergency

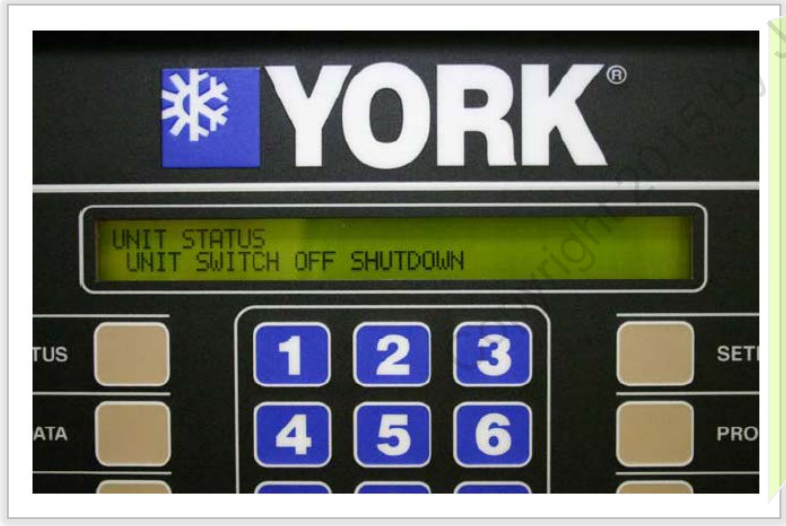


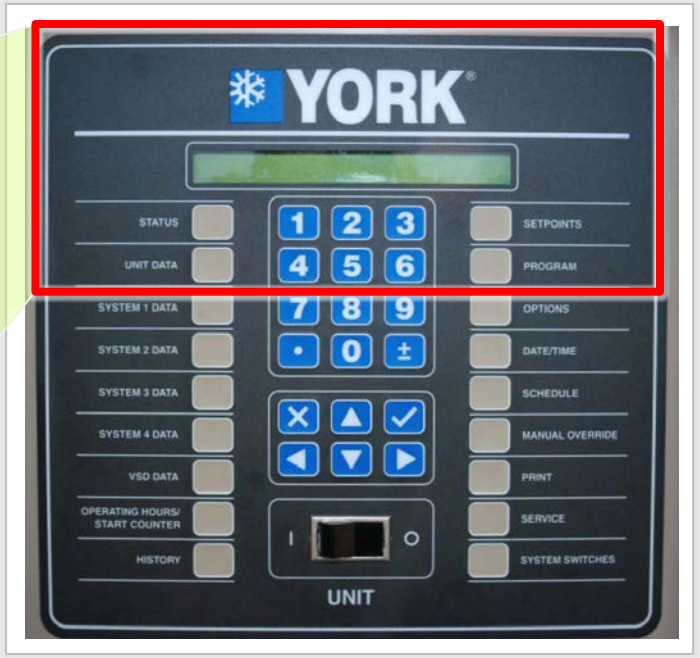
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LCD Display and Keypad



- The optical panel controls the entire system from one central location
- The keypad offers several command keys to access displays, program setpoints, display histories, and initiate system commands
- It provides two rows of 40 characters each
- It provides backlighting for outdoor viewing





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Data Entry Keys



Numeric keypad and supporting keys:

- Confirm setpoint changes
- Cancel inputs
- Advance day
- Change AM/PM



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Display Panel – Accessible Parameters



- **Temperatures:** Entering/leaving chilled liquid and ambient
- **Dates:** Start/stop times. Holiday and manual override status
- **Operating hours:** Compressor hours/starts. Automatic/manual lead/lag. Lead compressor identification
- **Status:** Run permissive and compressor run, evaporator heater, condenser fans, load/unload timers, and chilled water pump
- **Timers:** Anti-recycle
- **System:** Suction, discharge, subcooling temperature, oil pressures, liquid temperature, percent full load and average, and motor speed
- **Cutout status/setpoints:** Supply chilled liquid temperature, low suction pressure, high discharge pressure and temperature, low ambient, and low leaving liquid temperature, unloading limits for high discharge pressure, and compressor motor current
- **Messages:** Out-of-range
- **Histories:** Fault shutdowns

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System Data Keys



Sensor Data: Example of R134a System Data

Sensor/Input	Type	Minimum Value	Maximum Value
Condenser Pressure	Transducer	0 psig/0 kPa	400.0 psig (2.76 MPa)
Discharge Pressure	Transducer	0 psig/0 kPa	400.0 psig (2.76 MPa)
Oil Pressure	Transducer	0 psig/0 kPa	400.0 psig (2.76 MPa)
Economizer Pressure	Transducer	0 psig/0 kPa	275 psig (1.89 MPa)
Evaporator Pressure	Transducer	0 psig/0 kPa	125.0 psig (.086 MPa)
Cond Liquid Refrig Level	Capacitance	0%	100%
Economizer Temp	3 K Thermistor	18.83°F (-7.31°C)	175.61°F (79.7°C)
Leaving Condenser Liquid Temp	3 K Thermistor	18.83°F (-7.31°C)	175.61°F (79.7°C)
Entering Condenser Liquid Temp	3 K Thermistor	18.83°F (-7.31°C)	175.61°F (79.7°C)
Leaving Chilled Liquid Temp	3 K Thermistor	-19.1°F (-28.49°C)	110.2°F (43.4°C)
Entering Chilled Liquid Temp	3 K Thermistor	-19.1°F (-28.49°C)	110.2 °F (43.4°C)
Compressor Motor Temp	10 K Thermistor	-30.2°F (-34.56°C)	302.0° F (150°C)
Discharge Temp	50 K Thermistor	40.3°F (4.61°C)	302.0° F (150°C)
Evaporator Temp	3 K Thermistor	-4.87°F (-20.3°C)	158.34°F (70.2°C)
Subcooled Liquid Refrig Temp	3 K Thermistor	18.83°F (-7.31°C)	175.61°F (79.7°C)
Remote Temp Reset	4-20mA/2-10V 0-20mA/0-10V	0%	100%
Remote Current Limit	4-20mA/2-10V 0-20mA/0-10V	0%	100%
Condenser Hot Water Leaving Temp	3 K Thermistor	0%	100%
Condenser Hot Water Entering Temp	3 K Thermistor	0%	100%
Remote Heat Recovery Temp Reset Option	4-20mA/2-10V 0-20mA/0-10V	0%	100%
Eductor Temp	3 K Thermistor	18.83°F (-7.31°C)	175.61°F (79.7°C)

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Setpoints Key



Minimum, maximum, and default values allowed under the **setpoints** key

Program Value	Mode	Low Limit	High Limit	Default
Leaving Chilled Liquid Setpoint	Water Cooling	40.0° F (4.4° C)	60.0° F (15.5° C)	44.0° F (6.7° C)
		4.4° C	15.6° C	6.7° C
	Glycol Cooling	15.0° F (-9.4° C)	158.0° F (70.0° C)	44.0° F (6.7° C)
		-9.4° C	60.1° F (15.6° C)	6.7° C
Leaving Chilled Liquid Control Range	–	1.5° F (-16.9° C)	2.5° F (-16.3° C)	2.0° F (-17° C)
		33.4° F (0.8° C)	34.5° F (1.4° C)	34.0° F (1.1°) C
Max. Remote Temperature Reset	–	2° F (-17° C)	40° F (4° C)	20° F (-7° C)
		33.8° F (1° C)	72° F (22° C)	52° F (11° C)

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SETPOINTS ◄DEF XXXXX LO XXXXX HI XXXXX
LOCAL COOLING SETPOINT = XXX.X °F

SETPOINTS ◄DEF XXXXX LO XXXXX HI XXXXX
MAXIMUM REMOTE TEMP RESET = XXX.X °F

SETPOINTS ◄DEF XXXXX LO XXXXX HI XXXXX
LOCAL CONTROL RANGE = +/- X.X °F

SETPOINTS REMOTE SETPOINT = XXX.X °F
REMOTE CONTROL RANGE = +/- X.X °F

Programmable Operation Parameters and Limits
(YVAA)



Program Value	Mode	Low Limit	High Limit	Default
Suction Pressure Cutout	Water Cooling	24.0 PSIG	36.0 PSIG	24.0 PSIG
		1.65 Bars	2.48 Bars	1.65 Bars
	Glycol Cooling	5.0 PSIG	36.0 PSIG	24.0 PSIG
		0.34 Bars	2.48 Bars	1.65 Bars
Low Ambient Air Temp. Cutout	–	-2.0° F (-18.9° C)	50.0° F (10.0° C)	25.0° F (-3.9° C)
Leaving Chilled Liquid Temp Cutout	Water Cooling	–	–	36.0° F (2.2° C)
	Glycol Cooling	11.0° F (-11.7° C)	36.0° F (2.2° C)	36.0° F (2.2° C)
Motor Current Limit	–	30% FLA	103% FLA	103% FLA
Pulldown Motor Current Limit	–	30% FLA	100% FLA	100% FLA
Pulldown Motor Current Limit Time	–	0 Min	255 Min	0 Min
Condenser Subcooling Setpoint	–	0.0° F (-17.8° C)	20.0° F (-6.7°C)	5.0° F (-15.0° C)
		32.0° F (0.0° C)	52.0° F (11.1° C)	37.0° F (2.8° C)
Unit ID Number	–	0	7	0
		0%	100%	0%
Sound Limit Setpoint	Sound Limit Option Enabled	5.0° F (-15.0° C)	50.0° F (10.0° C)	5.0°F (-15.0° C)
Eductor Temp Differential	–	-15.0° C	10.0° C	-15.0° C
		10 Min	1000 Min	10 Min
Eductor Safety Time	–	150.0° F (65.6° C)	250.0° F (121.1° C)	240.0°F (115.5° C)
Motor Temperature Unload	–	65.6° C	121.1° C	115.5° C

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Manual Override Key

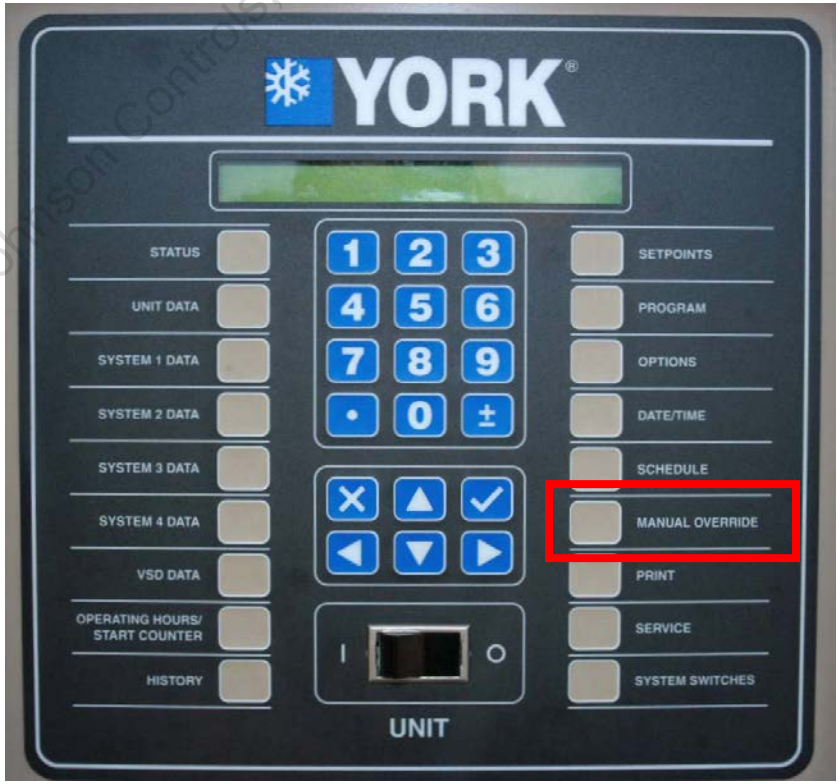


Manual Override is only for emergencies or servicing

- If **MANUAL OVERRIDE** is pressed during scheduled shutdown, the following message appears:

MANUAL OVERRIDE

Indicates Daily Schedule is being ignored. The chiller will start when the chilled liquid temperature allows it to, and the Remote Contacts, UNIT switch and SYSTEM switches permit it. This priority message cannot be overridden by anti-recycle messages, fault messages, etc. Therefore, do not expect to see any other STATUS messages.

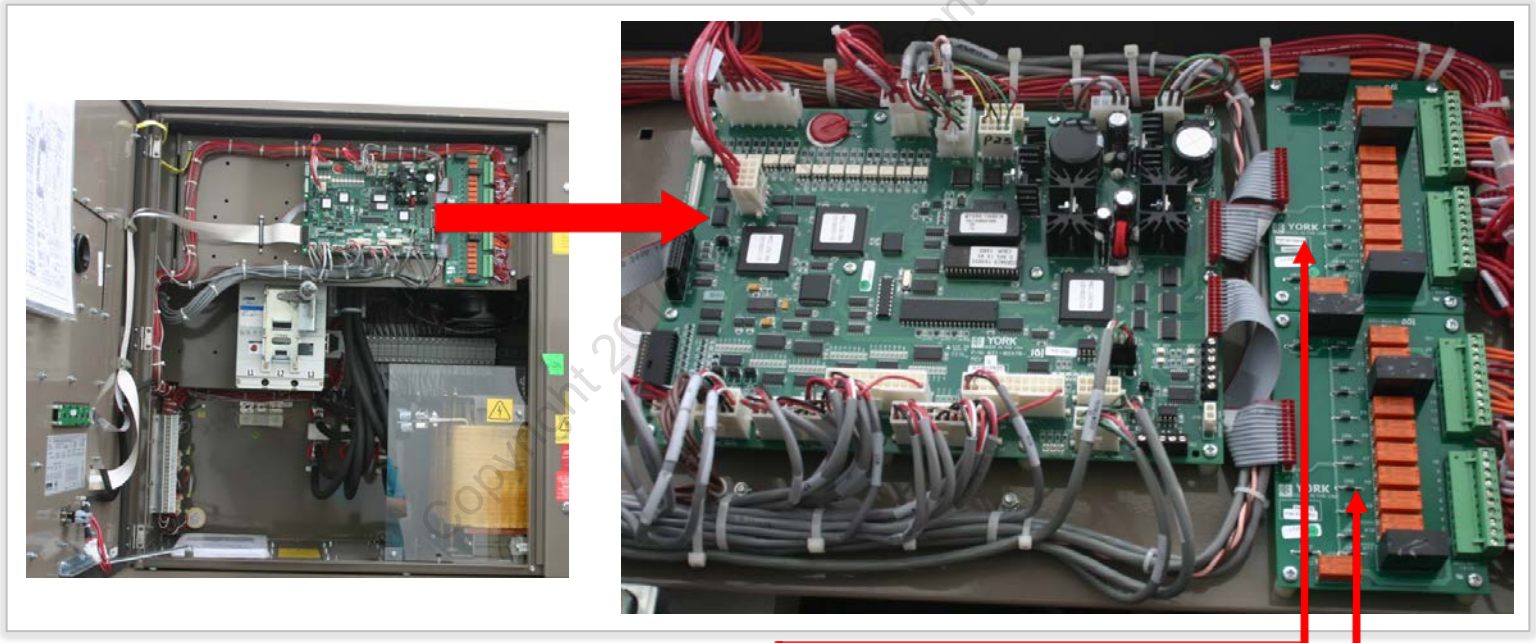


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YVAA Chiller Control Board



Analog	Digital
~ 48 inputs	~ 10 inputs
~ 12 outputs	~ 24 outputs



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Single Circuit YVWA Control Board



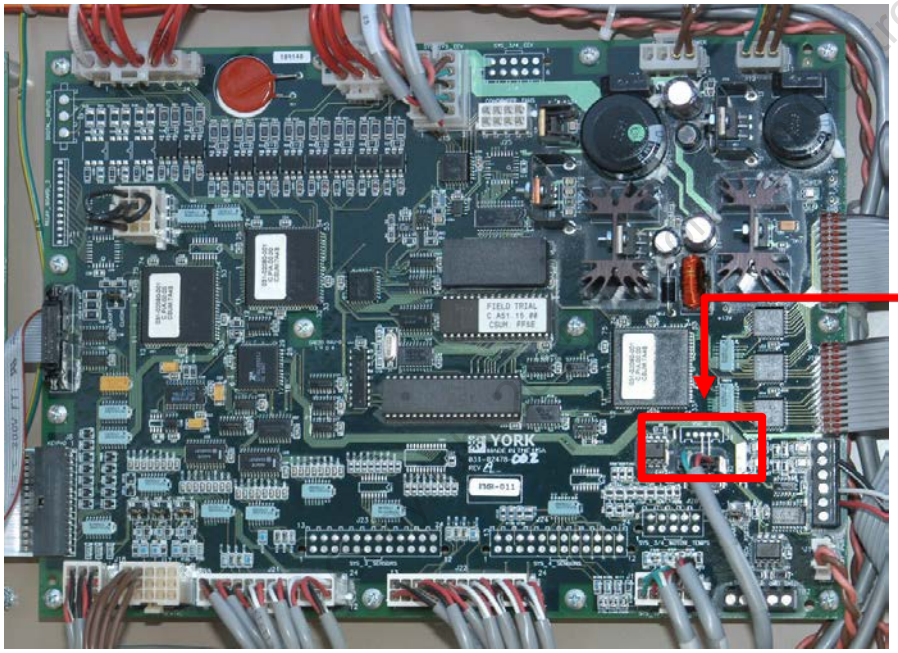


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Control Board



- Analog and digital inputs connect directly to the control board in the control panel.
- Serial bus connection provides communication to VSD Logic Board

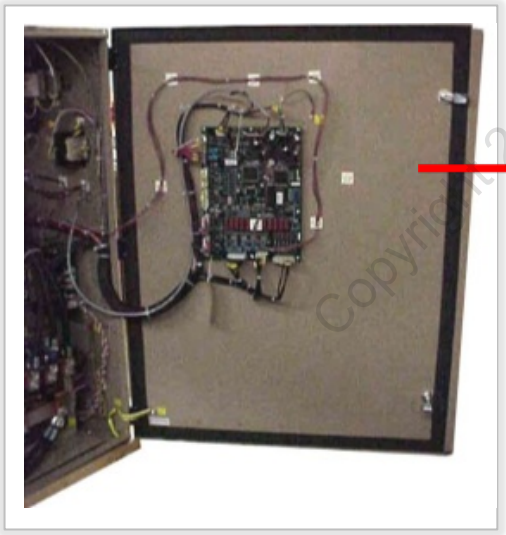


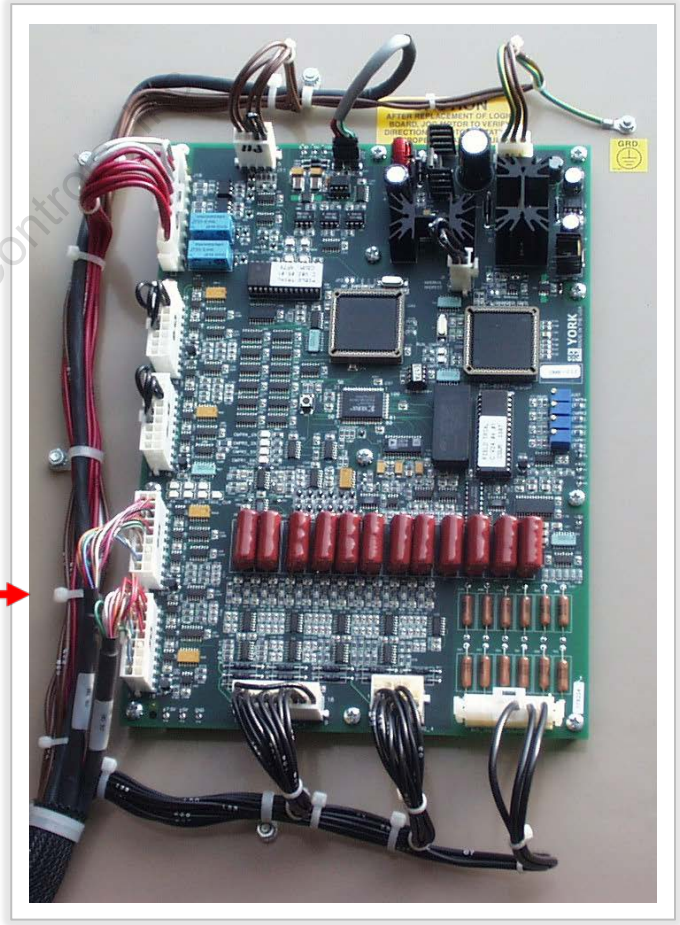
Control board is a master decision maker. Note that the analog and digital inputs connect directly to the control board in the control panel.

VSD Logic Board



- Controls the VSD functions
- Communicates serially with the control board via J2
  - Uses Modbus-ASCII protocol
  - Via RS-485 optocoupled data link



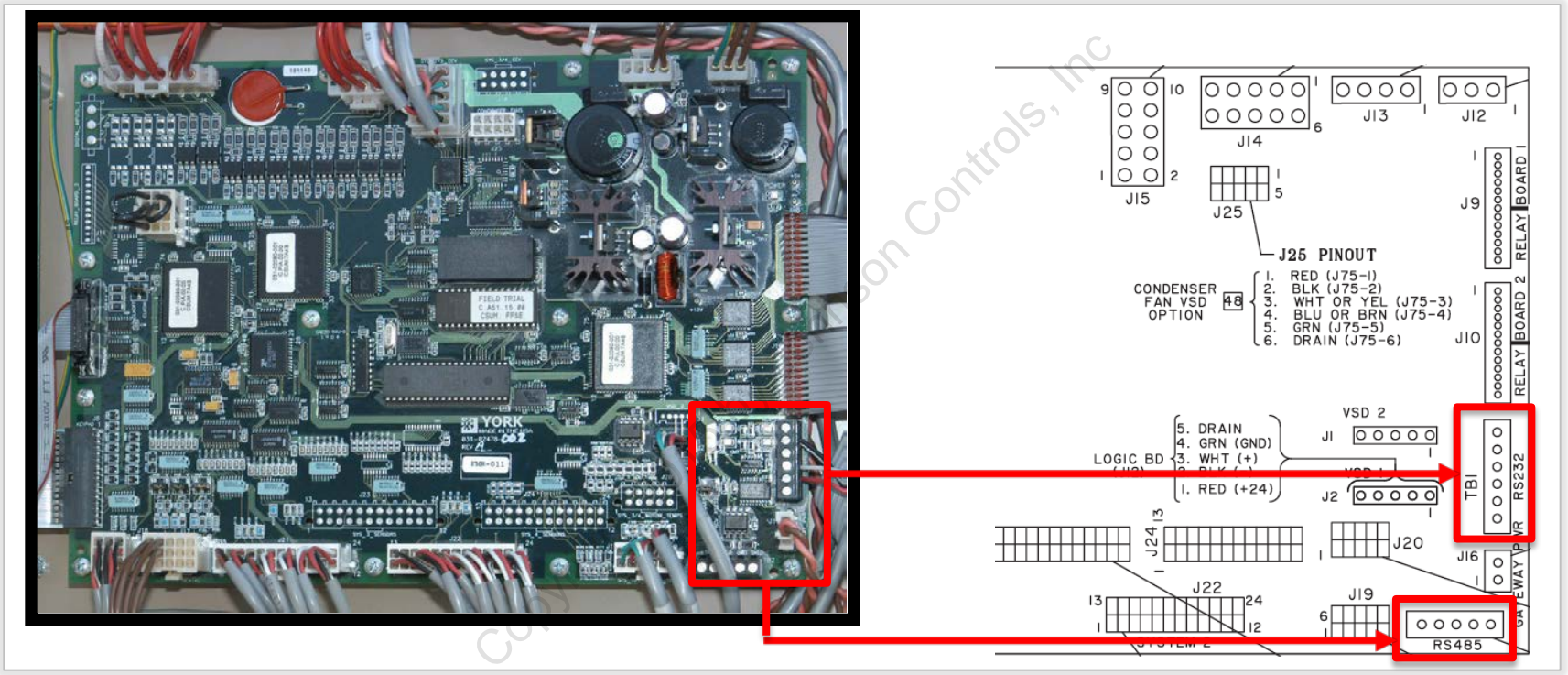


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Serial Communications Port



Provides communication between the chiller and the external devices outside the chiller

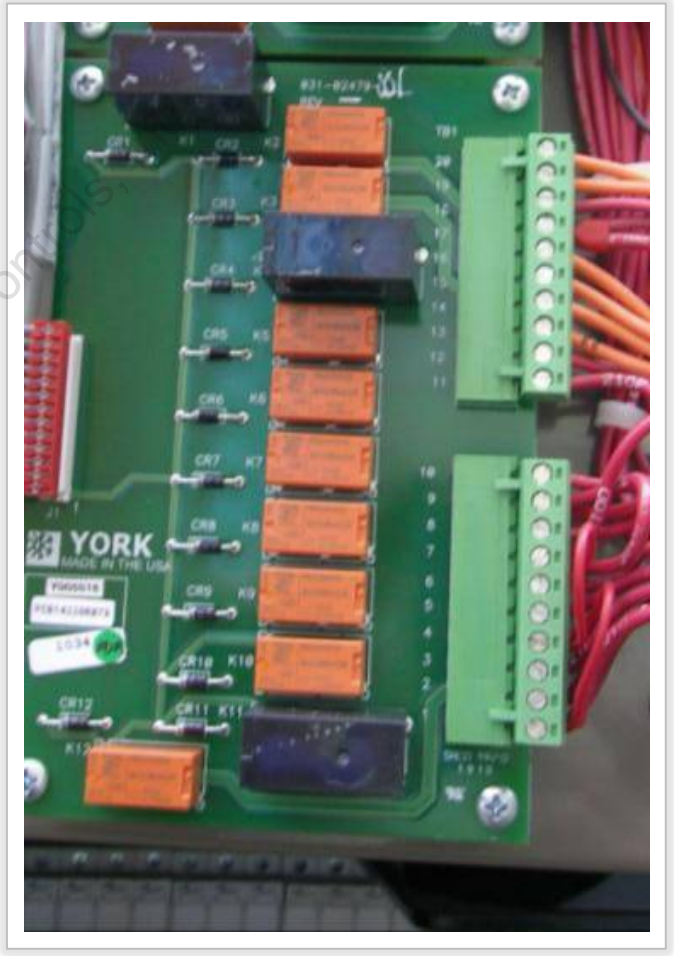


TB2 allows connecting either a micro-gateway or E-Link.

Relay Output Boards



- One relay output board required for each refrigeration circuit
- It connects to the control board via J9, J10, & J11



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Summary

You should now be able to recognize, locate, and describe the functionality of the major components associated with a York Screw Chiller control panel.



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Exercise

Trace the Wiring Diagrams

Reference the laminated electrical schematics: 035-22287-001 and 035-22287-002.

- Trace each of the listed circuits on the schematics:
  - 460, 400, and 380 VAC power
  - 120 VAC power
  - 24 VAC power
  - Communication wiring

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Control Panel and VSD Wiring and Power Distribution Exercise



- Reference the following electrical schematics:
  - 035-22287-001
  - 035-22287-002
- Trace the 460, 400, and 380 VAC power using the **red** dry erase marker
- Trace the 120 VAC power using the **yellow** dry erase marker
- Trace the 24 VAC power using the **blue** dry erase marker
- Trace the communication wiring using the **green** dry erase marker

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Exercise

Troubleshooting from the Control Panel

For each of the following faults, you need to:

- Identify four potential causes for the fault
- Prioritize the causes
- Describe the troubleshooting steps for the fault

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Exercises



Exercise 1	High Discharge Pressure Cutout (Software) Fault
Exercise 2	High Discharge Pressure Cutout (Hardware – HPCO) Fault
Exercise 3	Low Suction Pressure Cutout (Software) Fault
Exercise 4	Low Motor Current Fault
Exercise 5	High Differential Oil Pressure Cutout Fault
Exercise 6	Low Differential Oil Pressure Cutout Fault
Exercise 7	High Discharge Temperature Cutout Fault
Exercise 8	Low Discharge Superheat Cutout Fault
Exercise 9	Sensor Failure Cutout Fault
Exercise 10	High Motor Temperature Cutout Fault
Exercise 11	System Control Voltage Cutout Fault
Exercise 12	Eductor Clog Fault

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Exercise 1:
High Discharge Pressure Cutout (Software) Fault



- Identify four potential causes.
- Prioritize the causes.
- Describe the troubleshooting methodology (steps).

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Exercise 2:
High Discharge Pressure Cutout (Hardware – HPCO) Fault



- Identify four potential causes.
- Prioritize the causes.
- Describe the troubleshooting methodology (steps).

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Exercise 3:
Low Suction Pressure Cutout (Software) Fault



- Identify four potential causes.
- Prioritize the causes.
- Describe the troubleshooting methodology (steps).

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Exercise 4:
Low Motor Current Fault



- Identify four potential causes.
- Prioritize the causes.
- Describe the troubleshooting methodology (steps).

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Exercise 5:
High Differential Oil Pressure Cutout Fault



- Identify four potential causes.
- Prioritize the causes.
- Describe the troubleshooting methodology (steps).

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Exercise 6:
Low Differential Oil Pressure Cutout Fault



- Identify four potential causes.
- Prioritize the causes.
- Describe the troubleshooting methodology (steps).

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Exercise 7:
High Discharge Temperature Cutout Fault



- Identify four potential causes.
- Prioritize the causes.
- Describe the troubleshooting methodology (steps).

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Exercise 8:
Low Discharge Superheat Cutout Fault



- Identify four potential causes.
- Prioritize the causes.
- Describe the troubleshooting methodology (steps).

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Exercise 9:
Sensor Failure Cutout Fault



- Identify four potential causes.
- Prioritize the causes.
- Describe the troubleshooting methodology (steps).

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Exercise 10:
High Motor Temperature Cutout Fault



- Identify four potential causes.
- Prioritize the causes.
- Describe the troubleshooting methodology (steps).

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Exercise 11:
System Control Voltage Cutout Fault



- Identify four potential causes.
- Prioritize the causes.
- Describe the troubleshooting methodology (steps).

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Exercise 12:
Eductor Clog Fault



Identify four potential causes.

Prioritize the causes.

Describe the troubleshooting methodology (steps).

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Key Takeaways – Troubleshooting from Control Panel



- You should now be able to troubleshoot the control panel on a YVAA chiller, including the identification and prioritization of the causes, and locating any additional information

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Summary

You should now be able to:

- Locate I/O on electrical schematics, chiller control board, and VSD logic board
- Perform necessary electrical checks
- View the I/O status in service mode to ensure proper operation



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VSD Electronic Principles



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Objective

After completing this lesson, you will be able to:

- Apply Ohm's Law
- Describe the fundamentals of a VSD
- Describe the harmonic filter in the single circuit VSD
- Describe the major components of the harmonic filter

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Shared Features and Technologies





YCAV



YCIV



YVAA



YVWA

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Variable Speed Drive

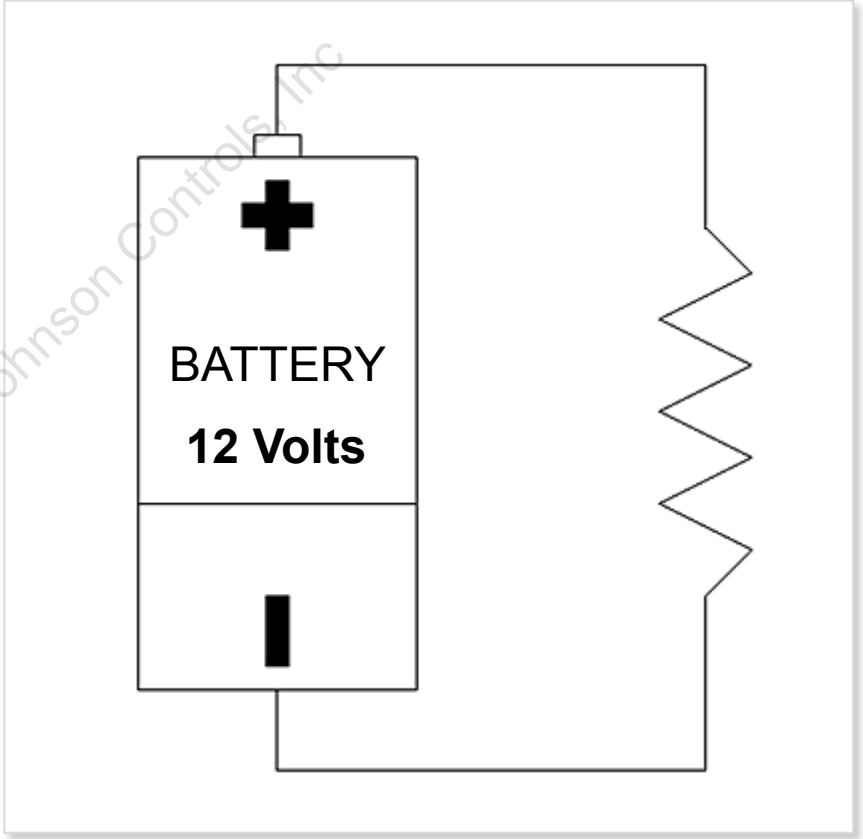
- **Basic Electronics**
  - **Ohm's Law**
  - Electronic Components
  - AC Circuits
- VSD Operation
  - VSD Major Components
  - V to F Ratio
  - PWM Wave Form
  - Harmonic Filter
- VSD Troubleshooting

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Electromotive Force

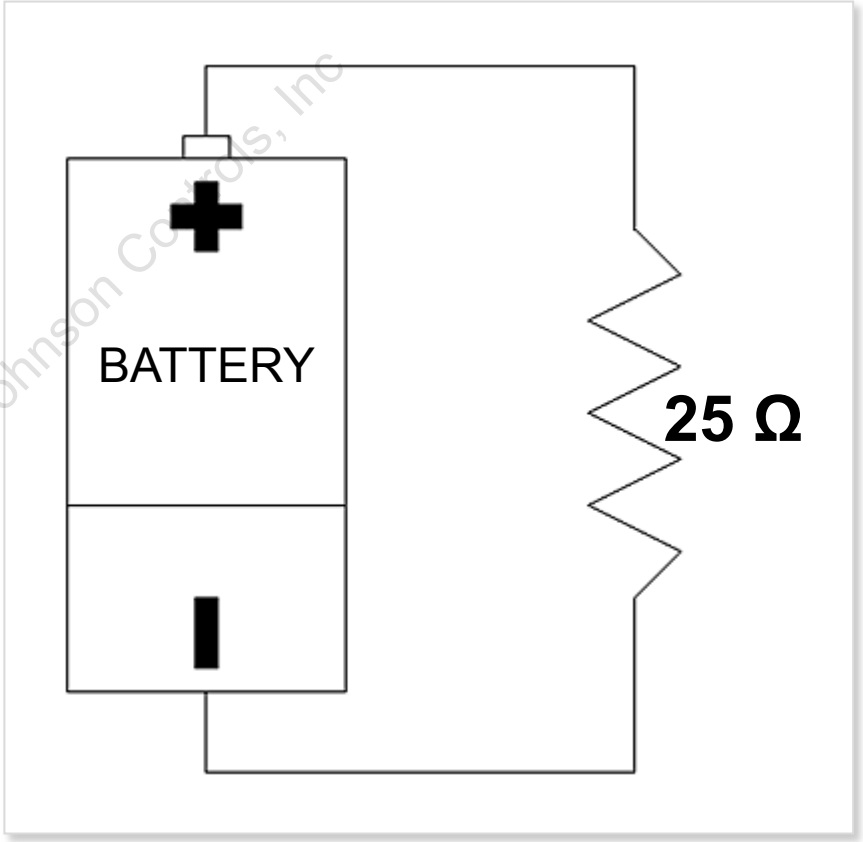
Electromotive force is the pressure that causes current to flow in an electrical circuit.



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Resistance

Resistance is the opposition to electromotive force in conductors.

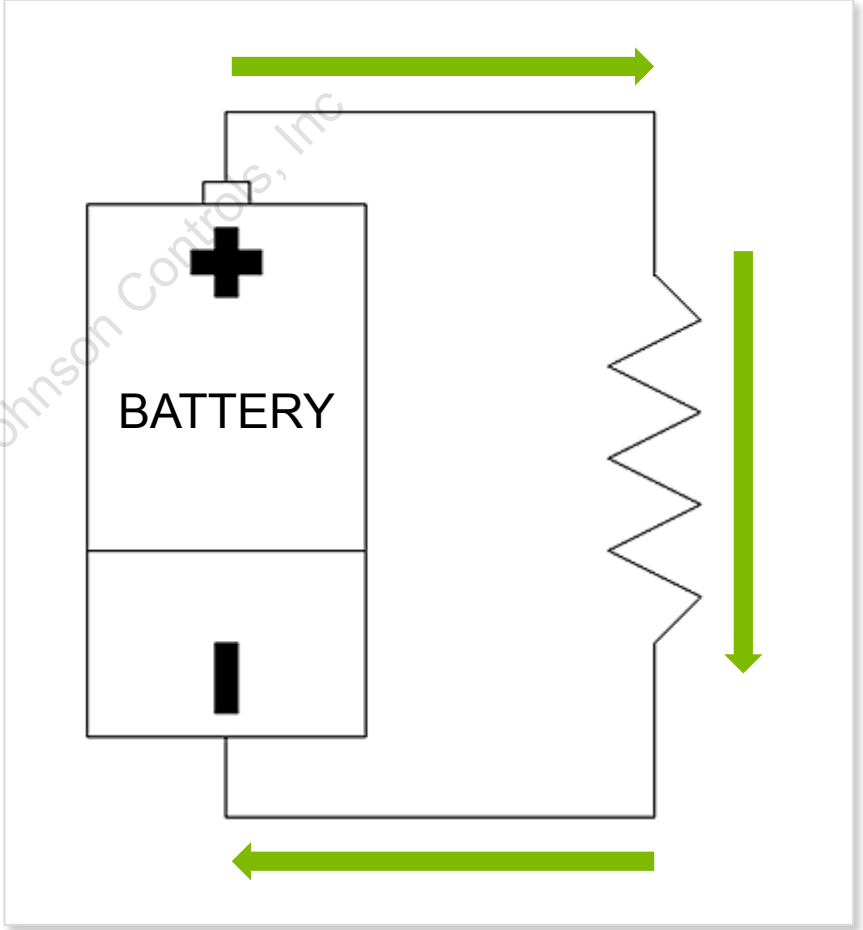


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Current

Current is the flow of energy forced into motion by voltage

Conventional Flow: From plus (+) to minus (-) signs.



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Ohm's Law

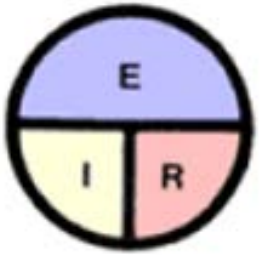
$$I = \frac{E}{R}$$

In an electrical circuit, the **current** (**I**) through a conductor between two points is directly proportional to the electromotive force or **voltage** (**V**) across the two points, as developed by the **resistance** to that current flow.

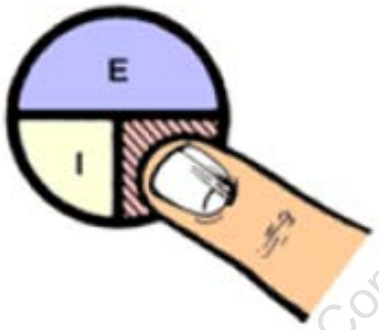
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Definition	Unit of Measure	Abbreviation
Voltage is the force or difference in charge felt between two points.	Volt	E
Current is the rate at which charge is flowing.	*Ampere* or Amp	I
Resistance is a material's tendency to oppose the flow of charge.	Ohm Ω	R

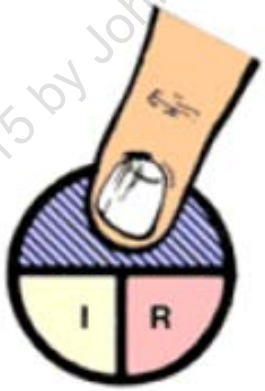
Ohm's Law Circle



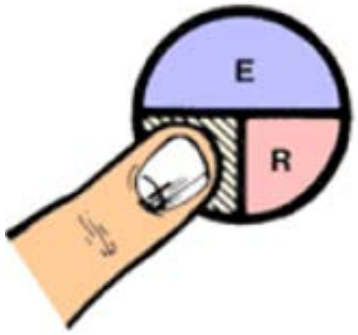
E = Electromotive Force (Volts)
I = Current (Amperes)
R = Resistance (Ohms)



$$R = \frac{E}{I}$$



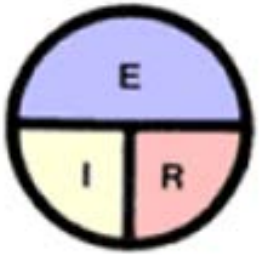
$$E = I \times R$$



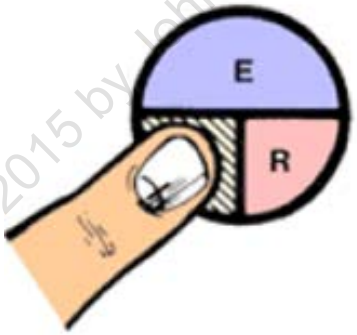
$$I = \frac{E}{R}$$

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Calculating Current



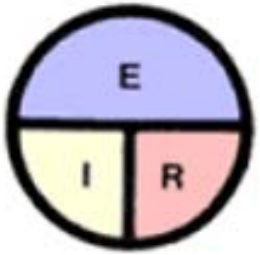
E = Electromotive Force (Volts)
I = Current (Amperes)
R = Resistance (Ohms)



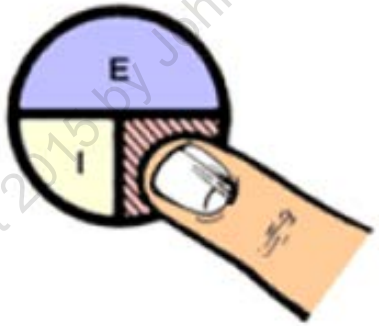
$$I = \frac{E}{R}$$

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Calculating Resistance



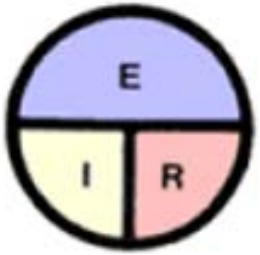
E = Electromotive Force (Volts)
I = Current (Amperes)
R = Resistance (Ohms)



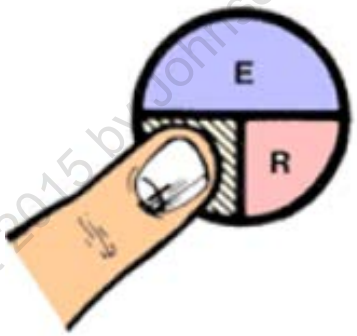
$$R = \frac{E}{I}$$

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Calculating Voltage



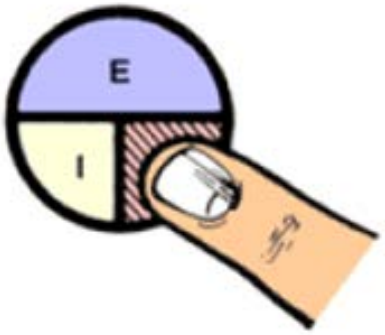
E = Electromotive Force (Volts)
I = Current (Amperes)
R = Resistance (Ohms)



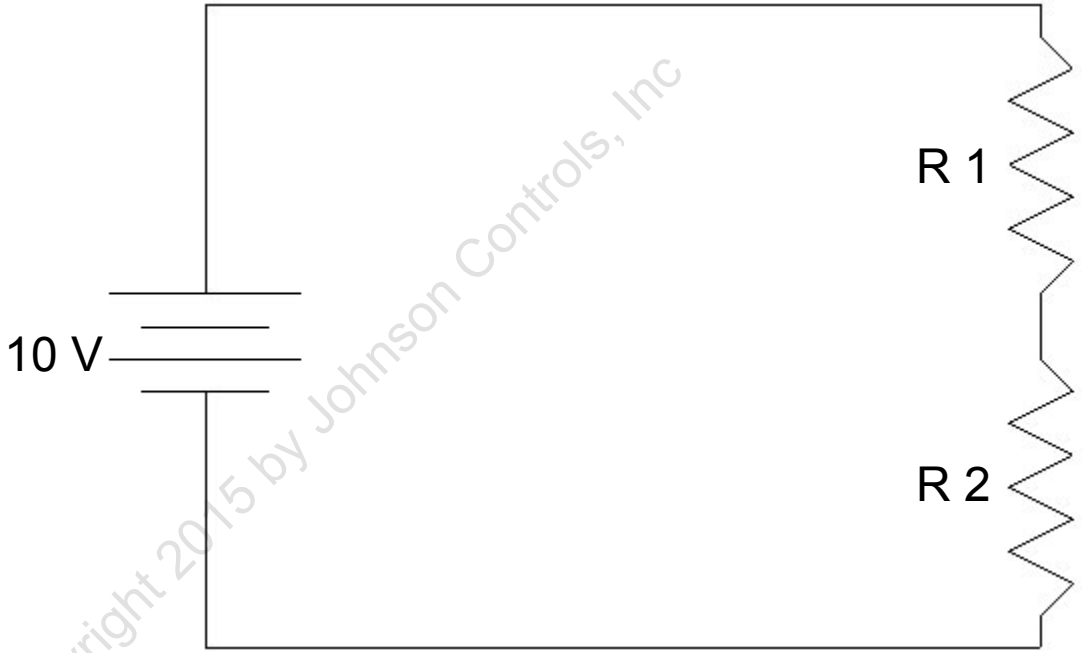
$$I = \frac{E}{R}$$

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Resistance in Series



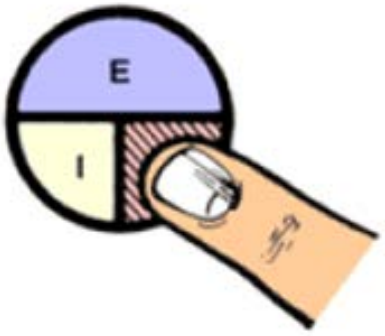
$$R = \frac{E}{I}$$



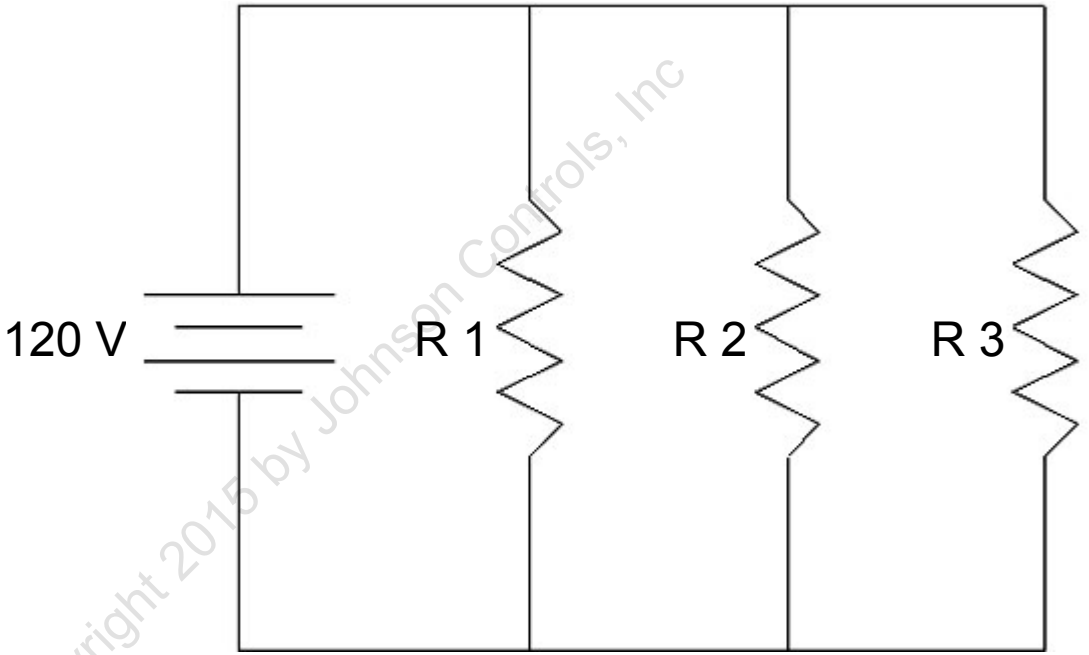
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Calculate the Current when 10 volts is applied to a circuit and R1 = 2 Ω and R2 = 2 Ω.

Resistance in Parallel



$$R = \frac{E}{I}$$

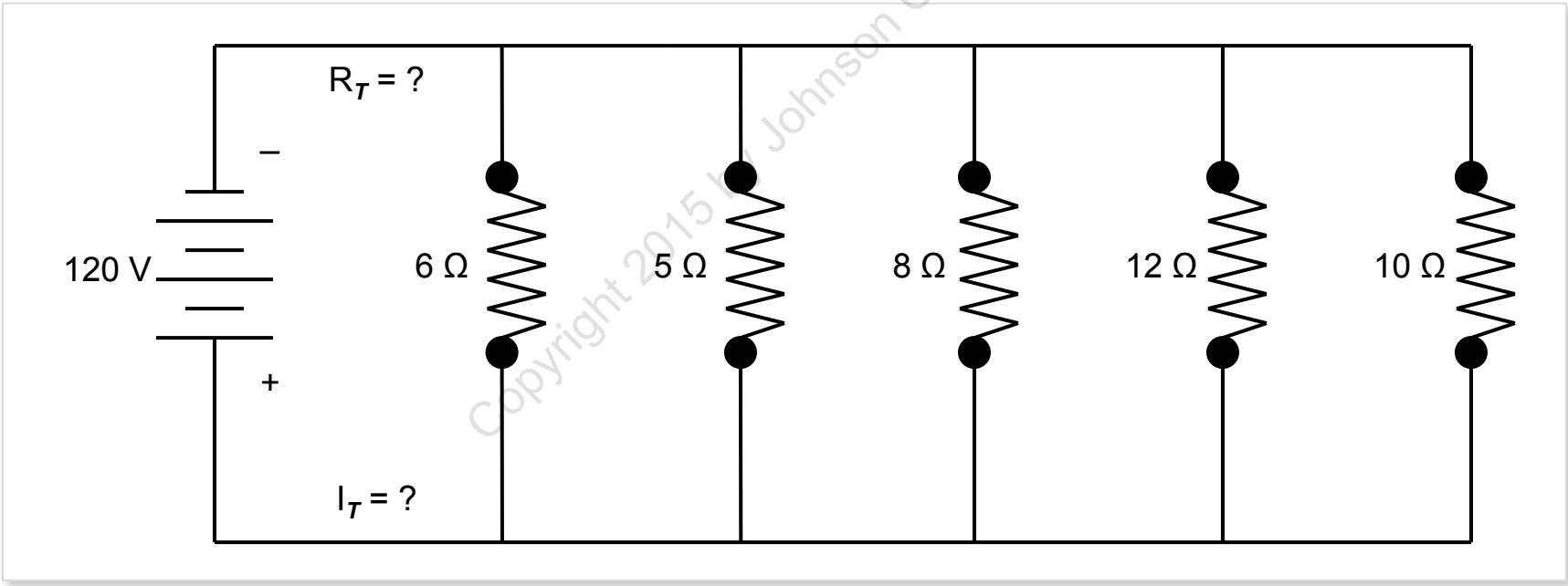


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Calculate the Total Resistance (R), when :
R1 = 150 Ω, R2 = 500 Ω, R3 = 650 Ω.
Also, calculate total current when the voltage is 120 volts.

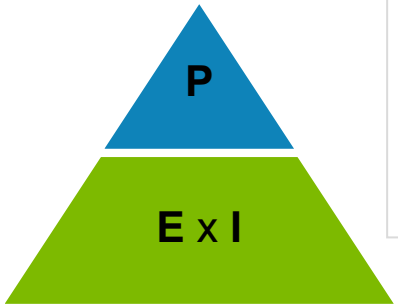
Parallel Circuit Current Analysis

$$\frac{E}{R_T} = \frac{1}{6} + \frac{1}{5} + \frac{1}{8} + \frac{1}{12} + \frac{1}{10}$$



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Ohm's Law of Power

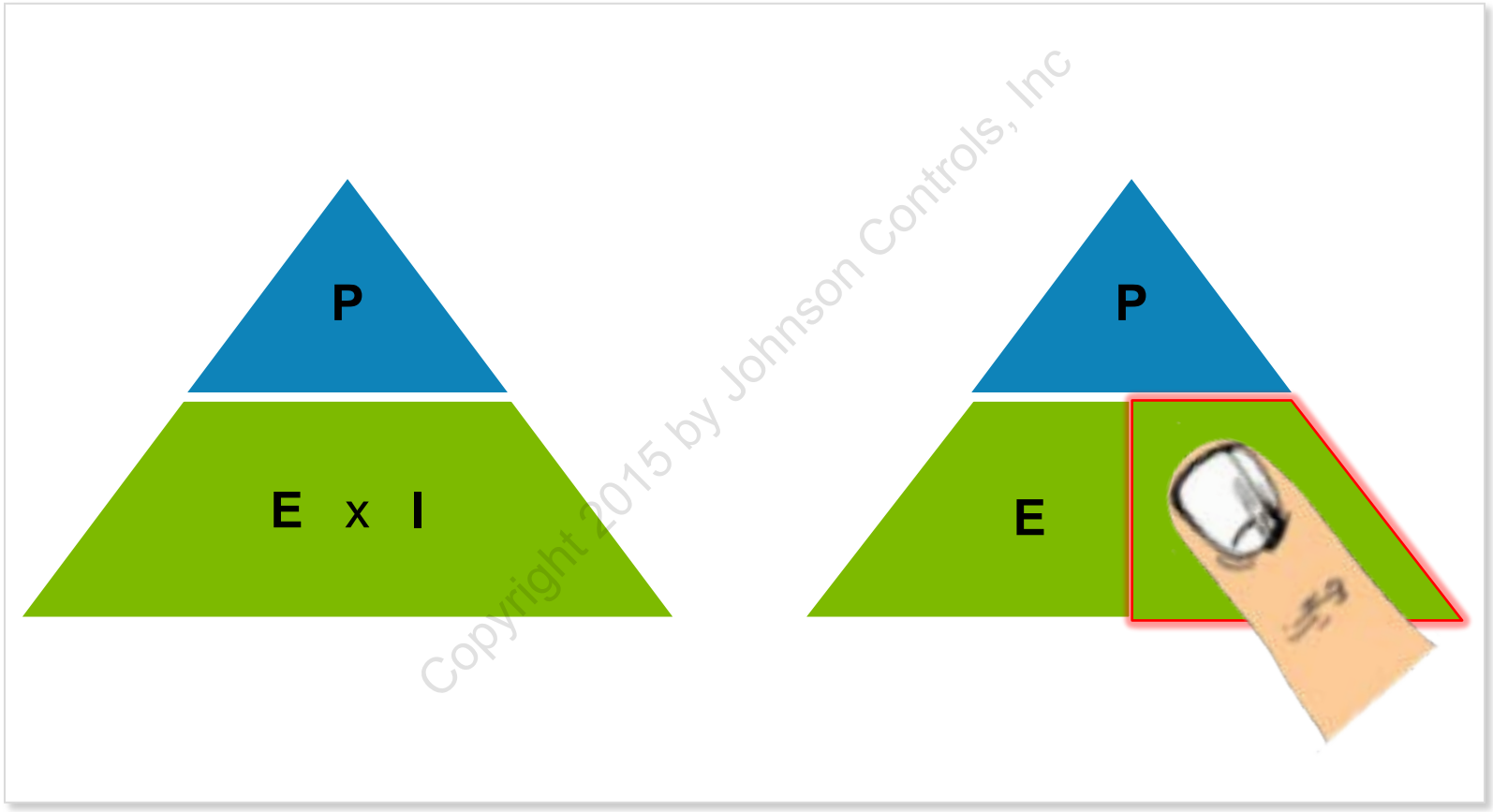


$$P = E * I$$

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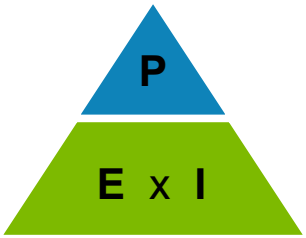
Definition	Unit of Measure	Abbreviation
Voltage is the force or difference in charge felt between two points.	Volt	E
Current is the rate at which charge is flowing.	*Ampere* or Amp	I
Resistance is a material's tendency to oppose the flow of charge.	Ohm Ω	R
Power the rate at which energy is consumed by a load.	Watt	W

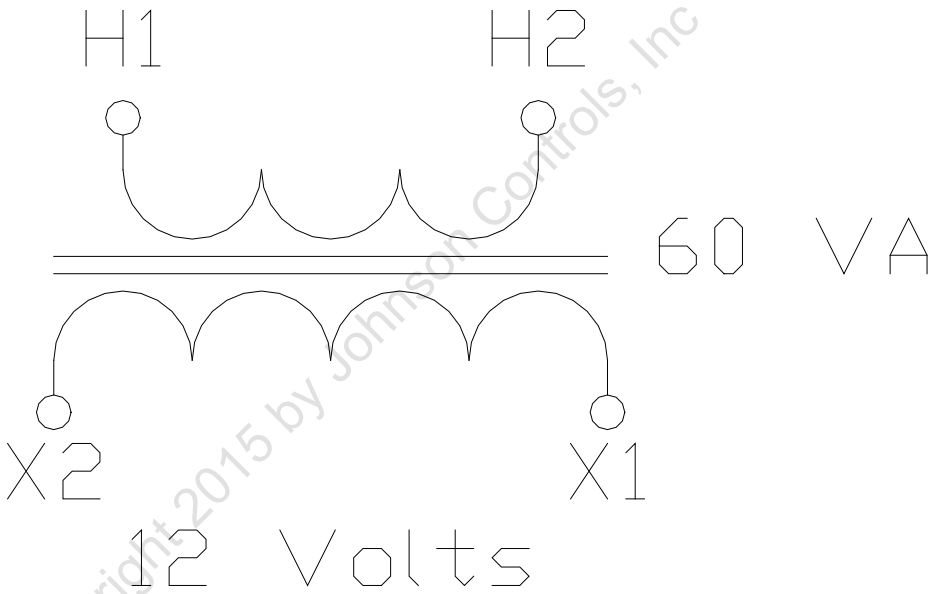
Calculating Power (Watts)



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Check Your Understanding - Calculating Current





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Calculate the Maximum Current (I) draw for the secondary winding of a 60 VA transformer with an output of 12 volts.

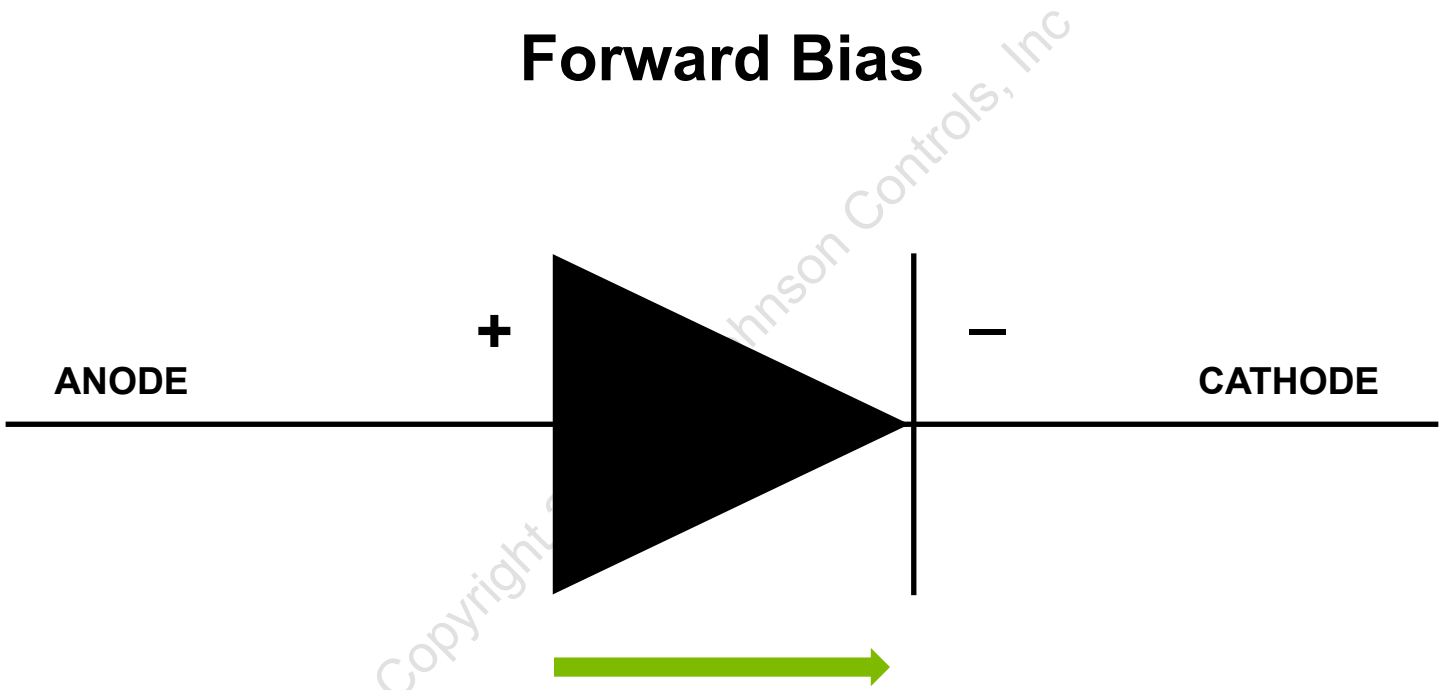
Variable Speed Drive

- **Basic Electronics**
  - Ohm's Law
  - **Electronic Components**
  - AC Circuits
- VSD Operation
- VSD Major Components
  - V to F Ratio
  - PWM Wave Form
  - Harmonic Filter
- VSD Troubleshooting

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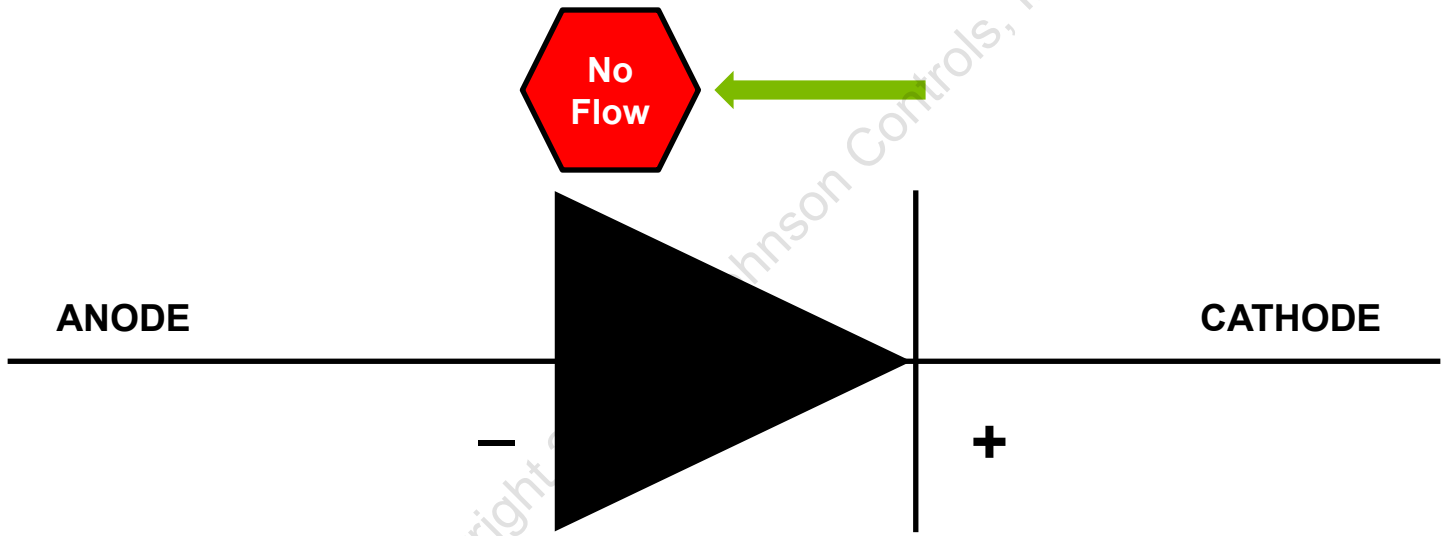
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Diode



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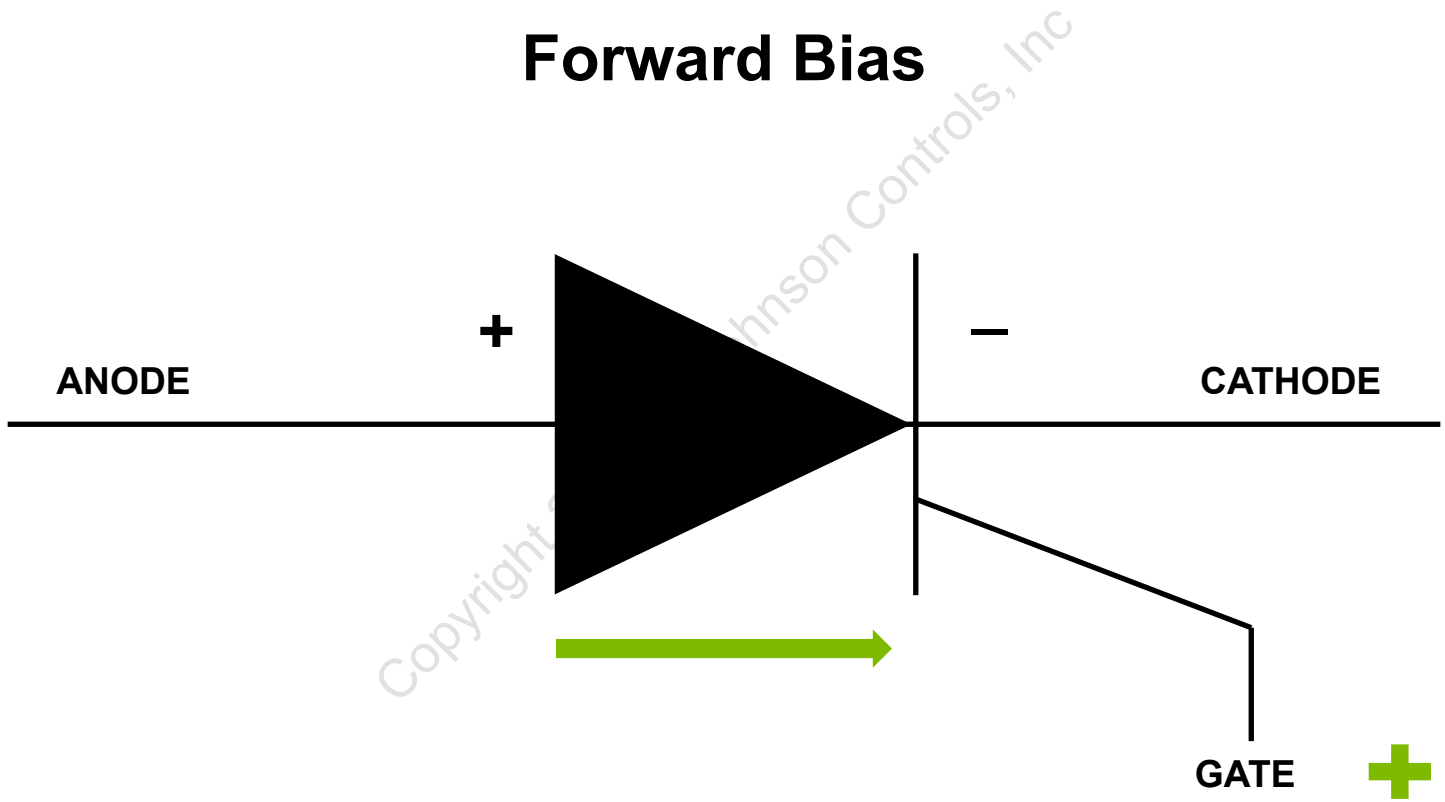
Diode (Contd.)



Reverse Bias

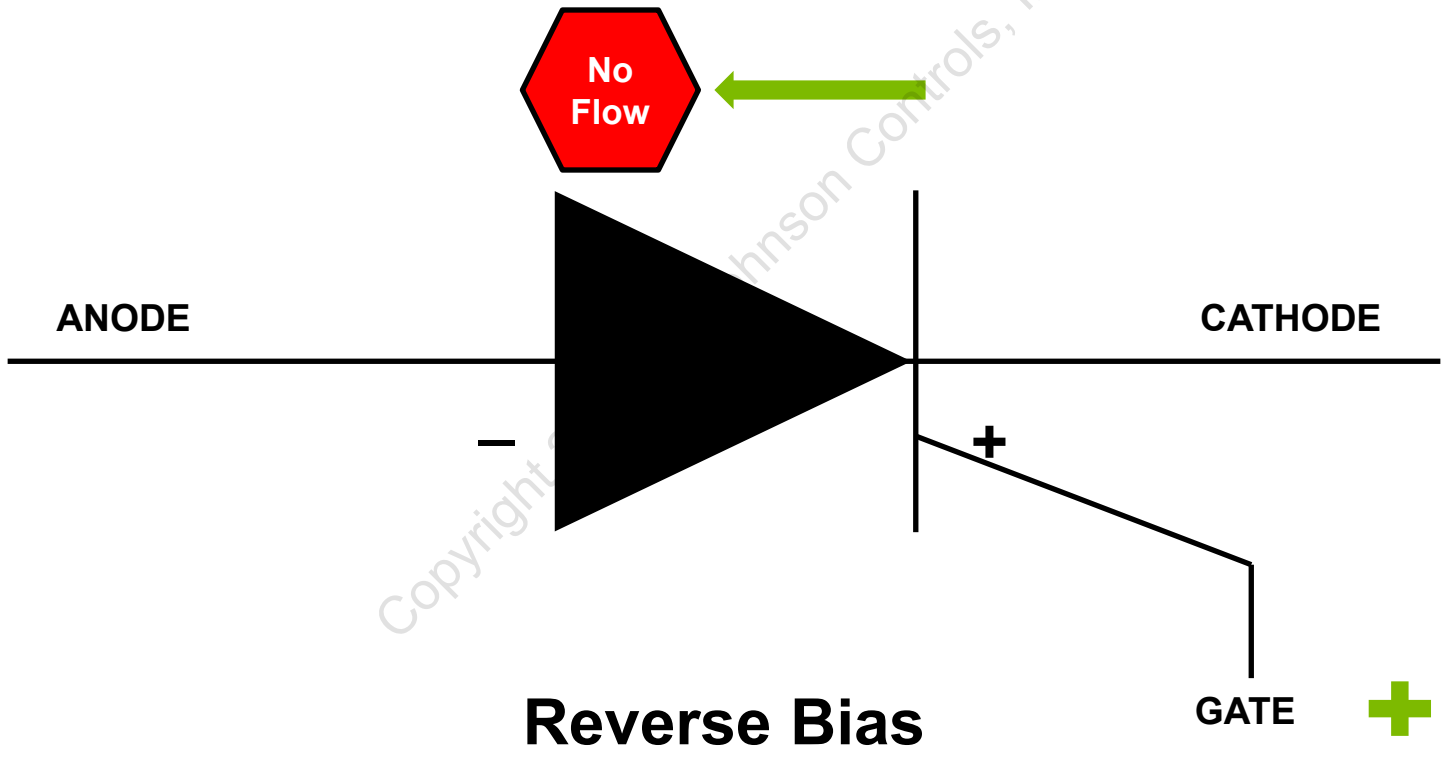
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Silicon Controlled Rectifier (SCR)



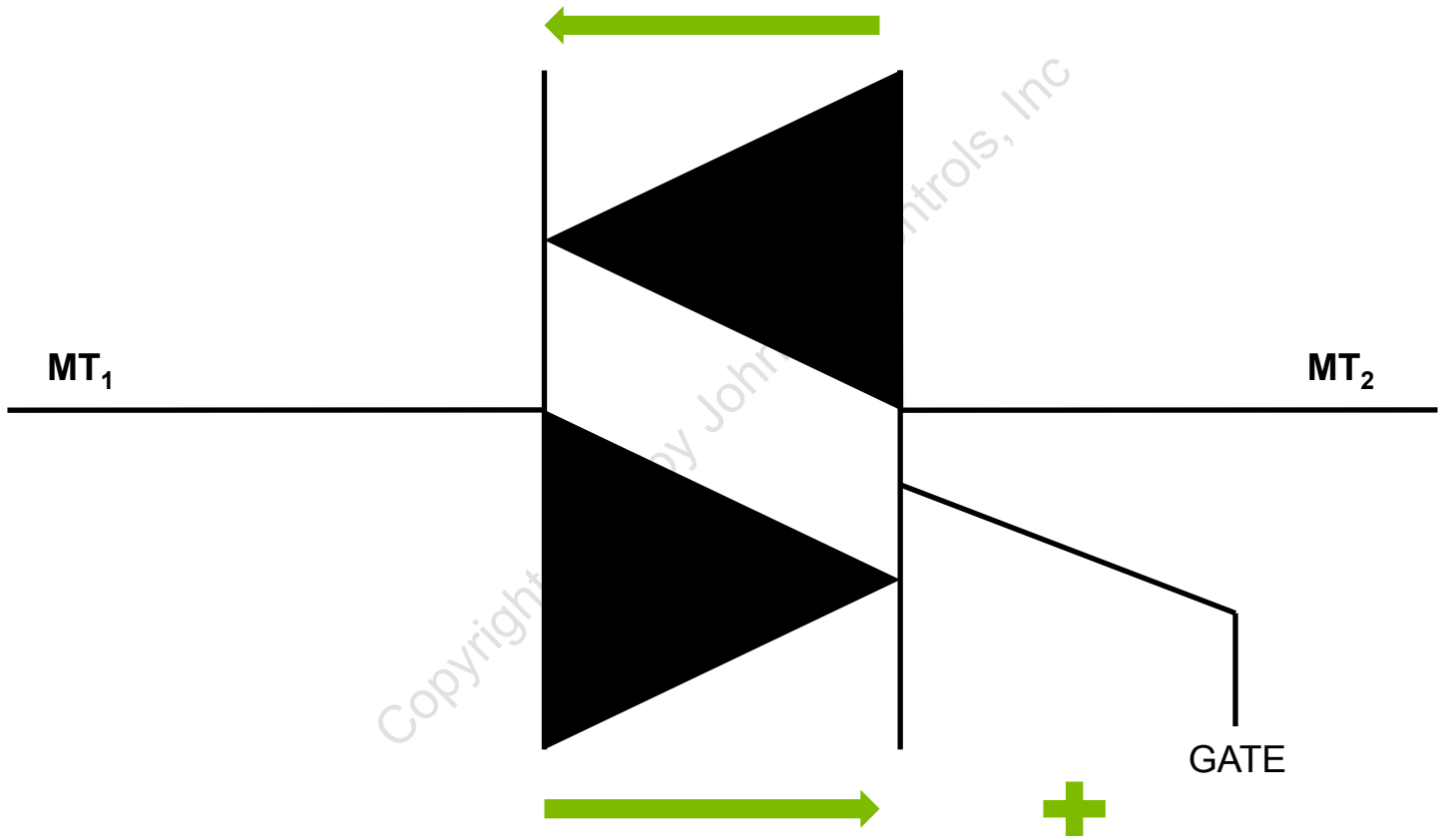
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Silicon Controlled Rectifier (SCR) (Contd.)



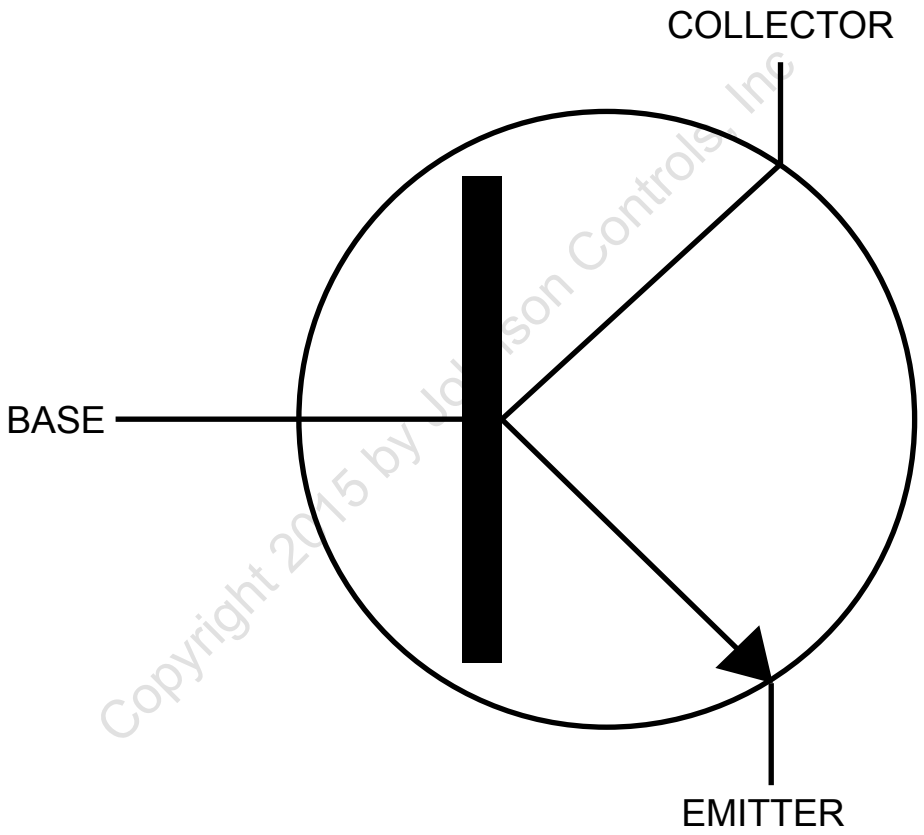
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Triac



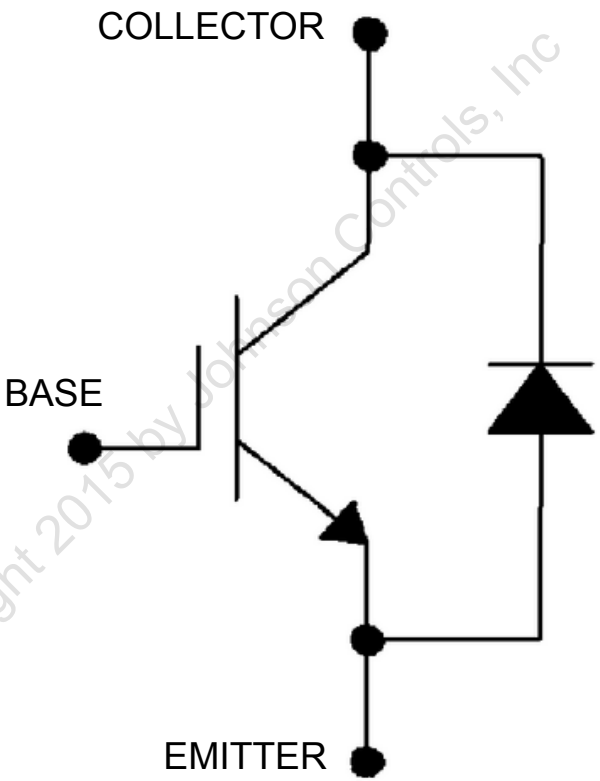
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Bipolar Transistor



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Insulated Gate Bipolar Transistor (IGBT)

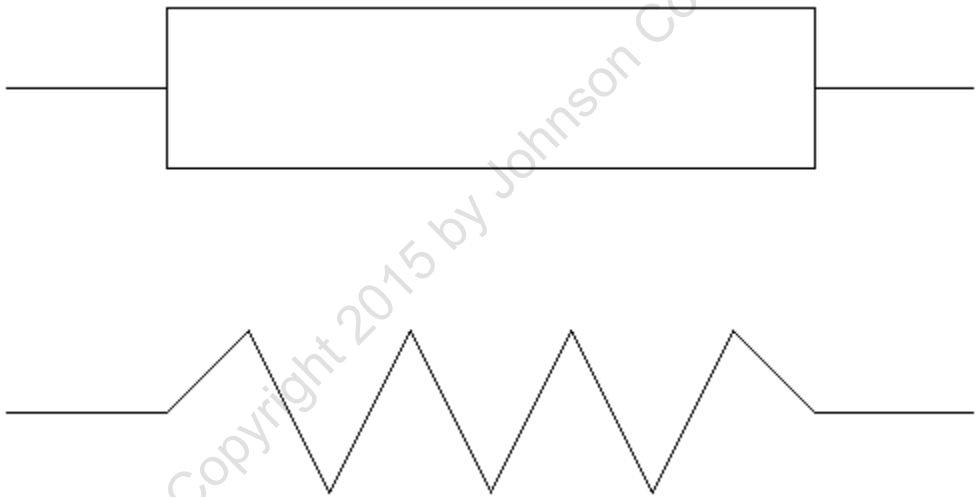


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The Resistor

In electronics, resistors are used to reduce voltage applied to a circuit.

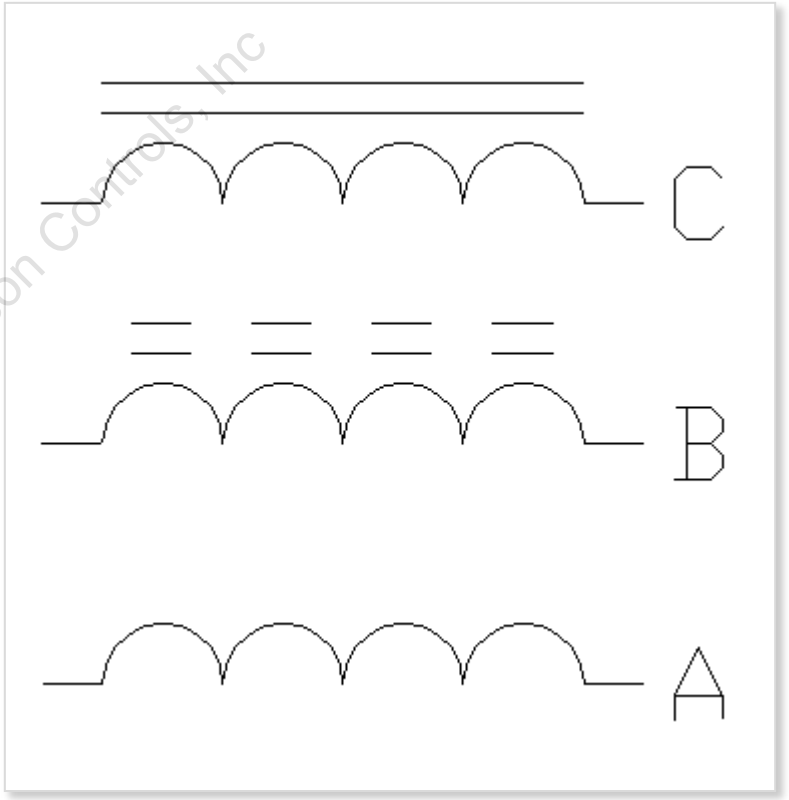
Standard unit of measurement is ohm.



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Inductor

Inductance is the property of a circuit by which energy is stored in the form of an electromagnetic field.

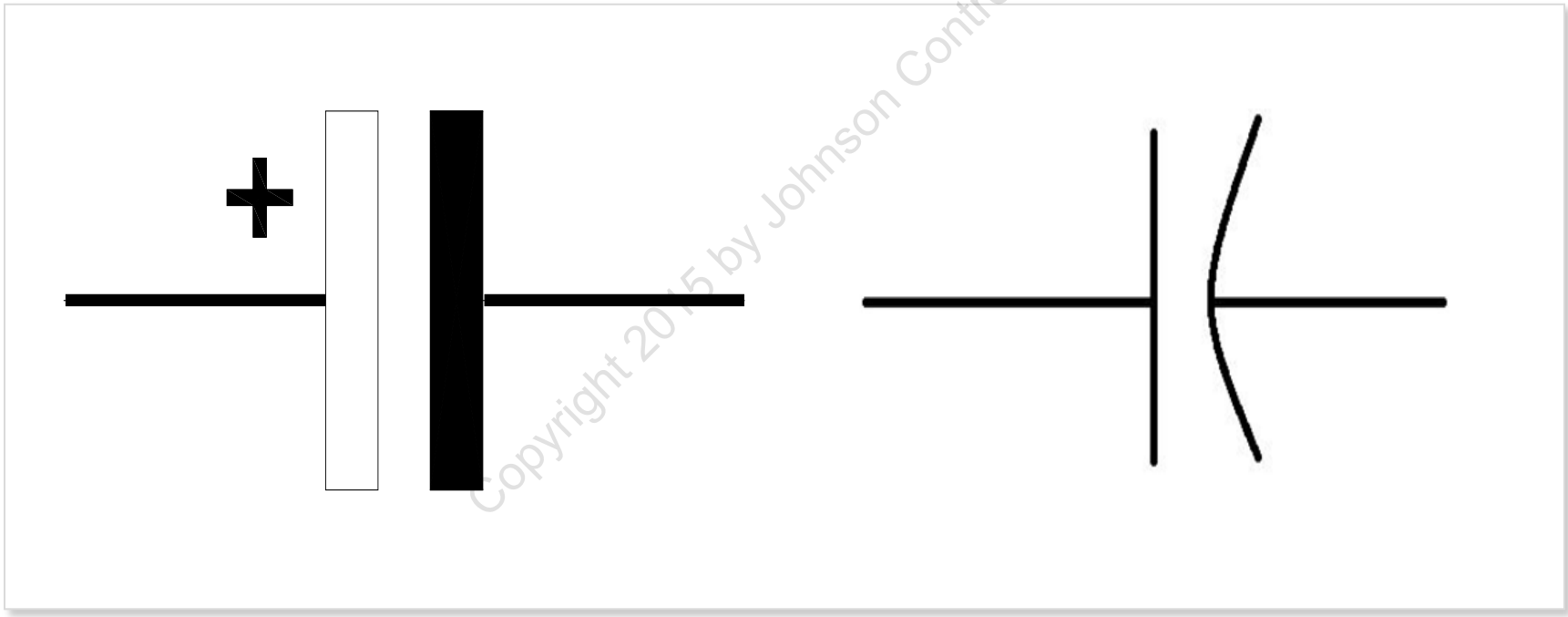


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Capacitor

The capacitor is similar to a battery, both store energy.

A Capacitor has two electrical connections connected to two plates separated by a dielectric.



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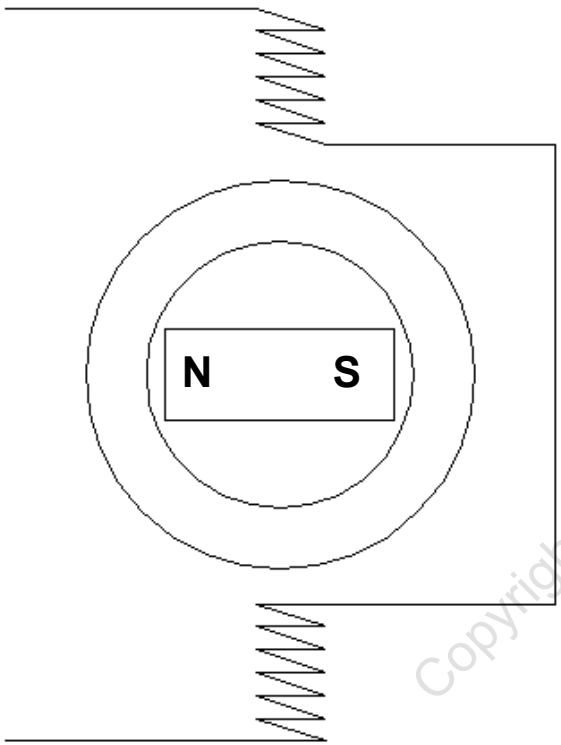
Variable Speed Drive

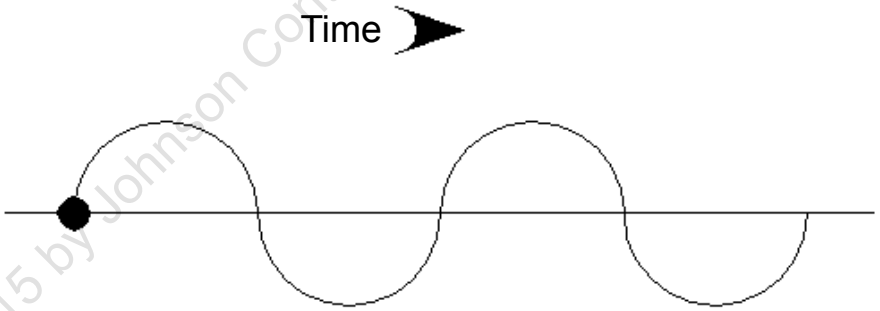
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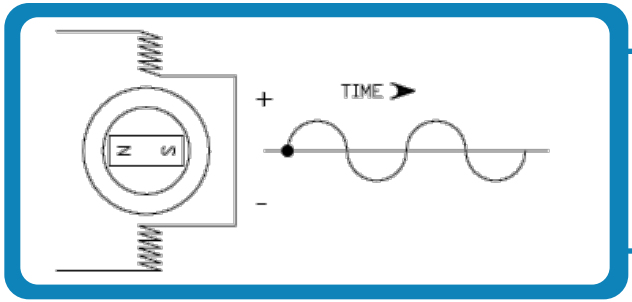
Single-phase Sine Wave Progression



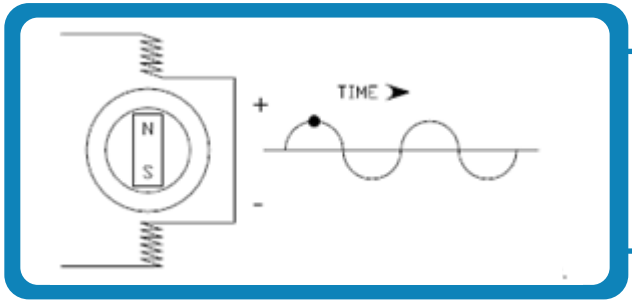


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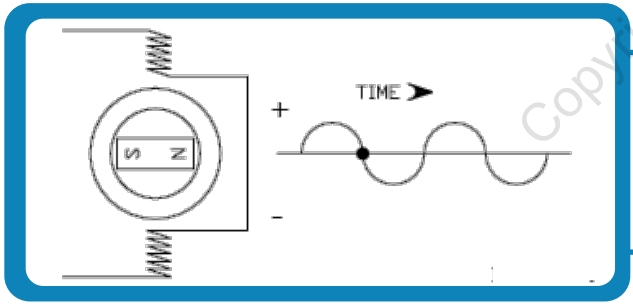
Single-phase Sine Wave



At 0ms (milliseconds), north and south poles of the armature are equidistant from both stator coils.



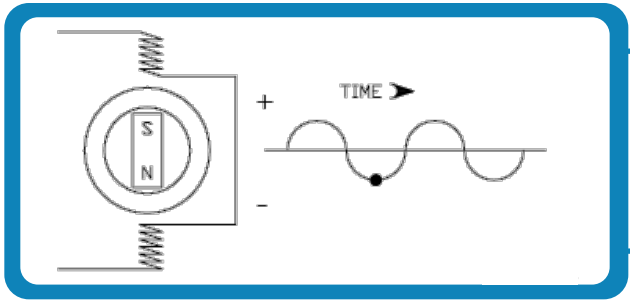
At 4ms, north and south poles of the armature are as close as possible to both stator coils.



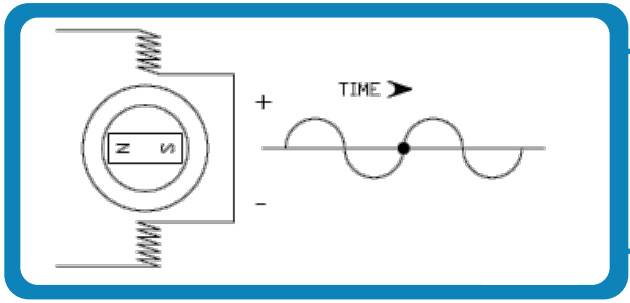
At 8ms, north and south poles of the armature are again equidistant from both stator coils.

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Single-phase Sine Wave



At 12ms, north and south poles of the armature are again as close as possible to both stator coils.

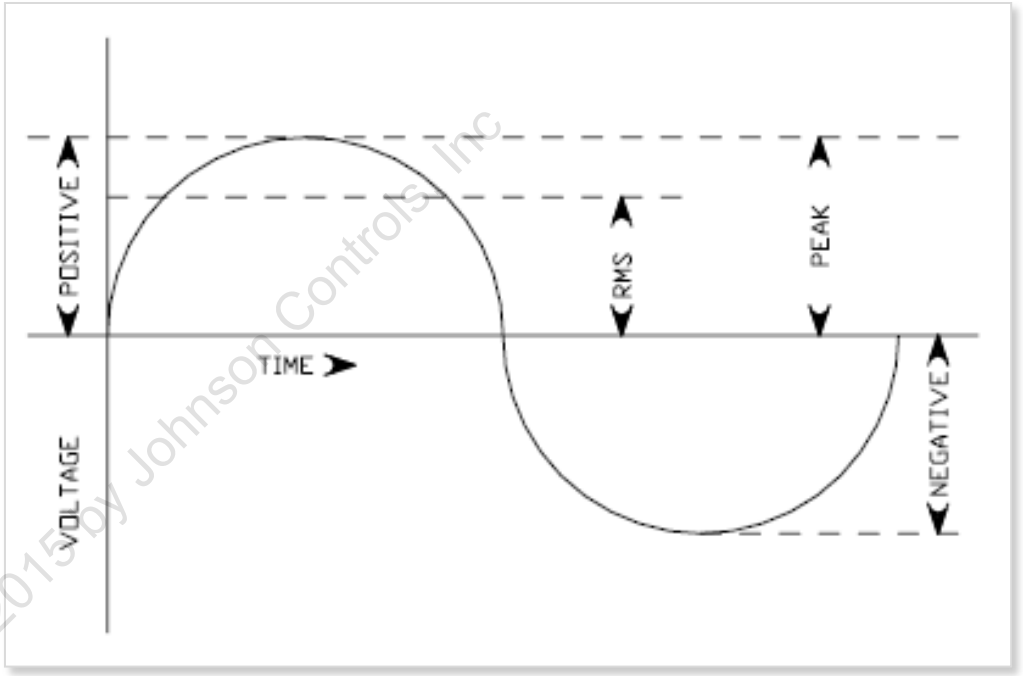


At 16ms (1/60th of a second), north and south poles of the armature are equidistant from both stator coils, and the cycle starts again.

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Effective AC Voltage

- Calculate the peak voltage for 460 V
- Calculate the RMS for 650 V



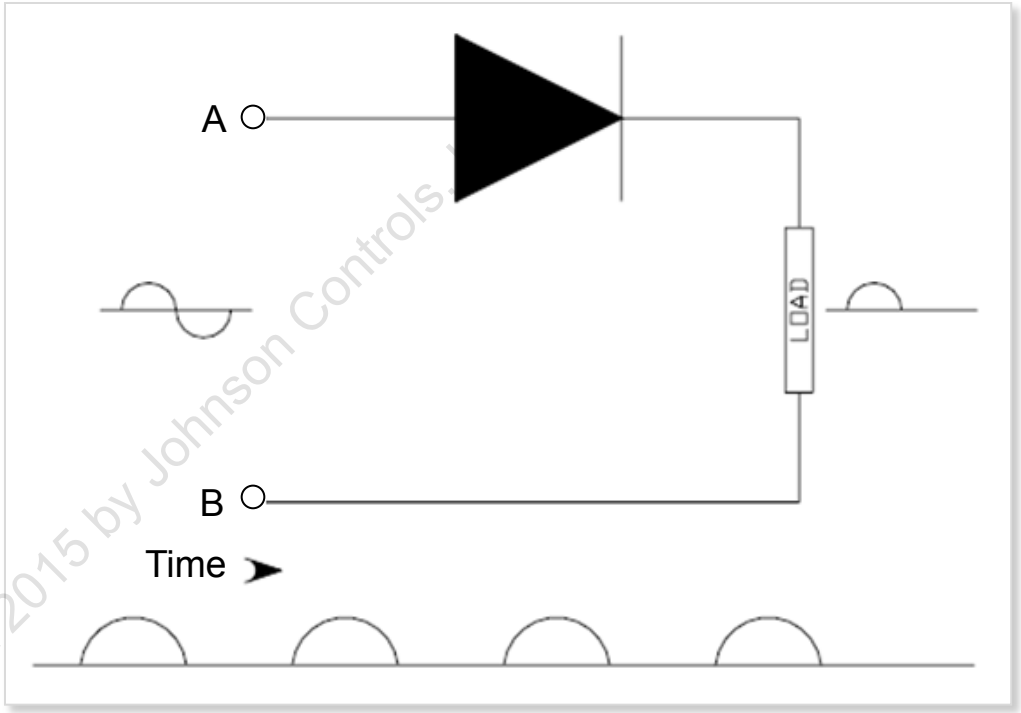
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Actual useful voltage available is RMS.

- RMS = Peak Voltage x 0.707
- Peak Voltage = RMS x 1.414

Single-phase Half-wave Rectification

Load is any device that draws current from a power source.



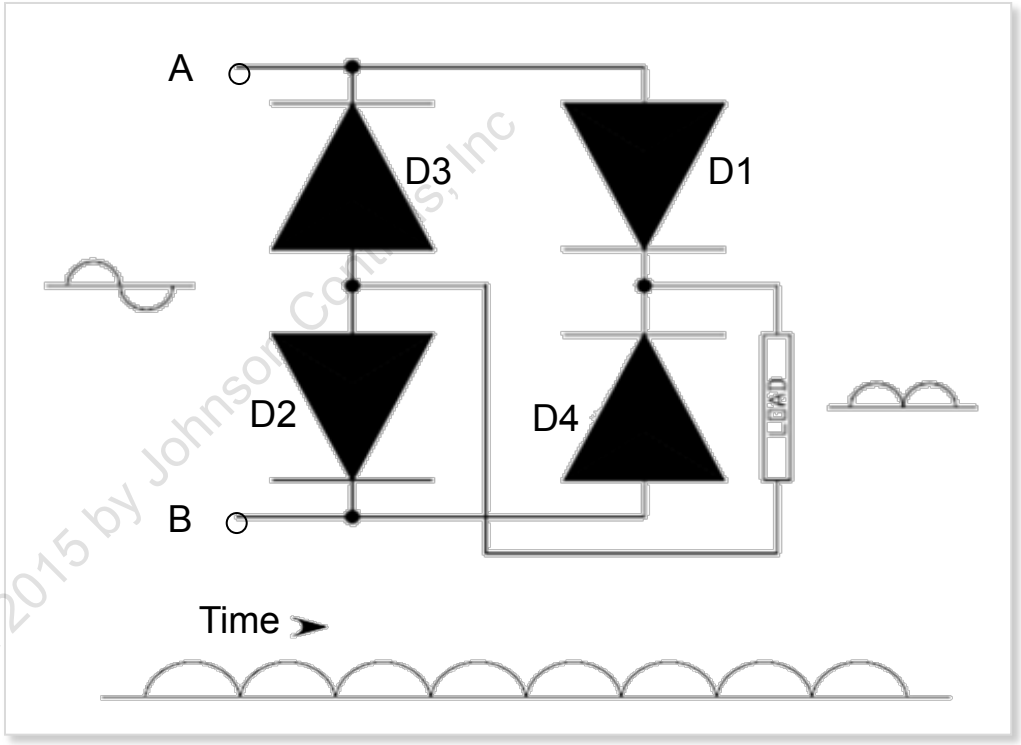
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- First half cycle: A is positive, B is negative, and the diode is forward-biased and conducts
- Next half cycle: A is negative, B is positive, and the diode is reverse-biased and does not conduct

Single-phase Full-wave Rectification

Advantages of AC:

- Cheaper infrastructure
- Transmission over Distance requires fewer generating stations



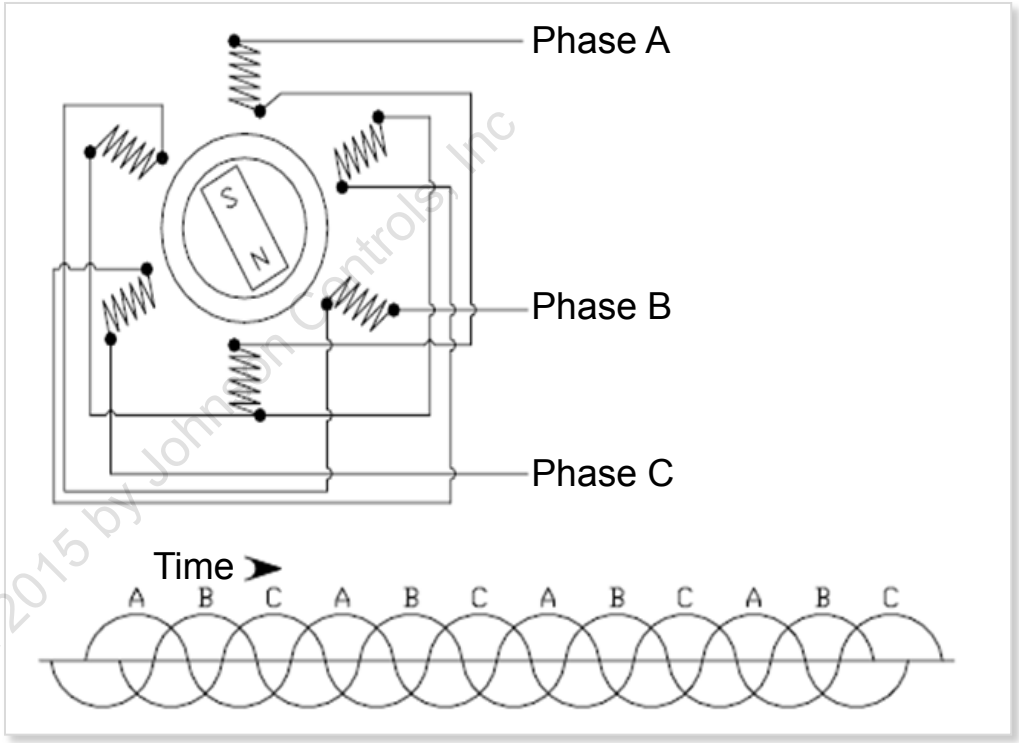
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- First half cycle: A is positive, B is negative; diodes D1 and D2 are forward-biased and conduct
- Next half cycle: A is negative, B is positive; diodes D3 and D4 are forward-biased and conduct
- Note that polarity at the load remains the same

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Three-phase Power Generation

The power plant simultaneously produces three different phases of AC power. The three phases are offset by 120 electrical degrees from each other.



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Addition of two more pair of coils to the generator, 120 electrical degrees apart, allows three-phase power generation.

Variable Speed Drive

- Basic Electronics
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- **VSD Operation**
  - **VSD Major Components**
  - V to F Ratio
  - PWM Wave Form
  - Harmonic Filter
- VSD Troubleshooting

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VSD Fundamentals

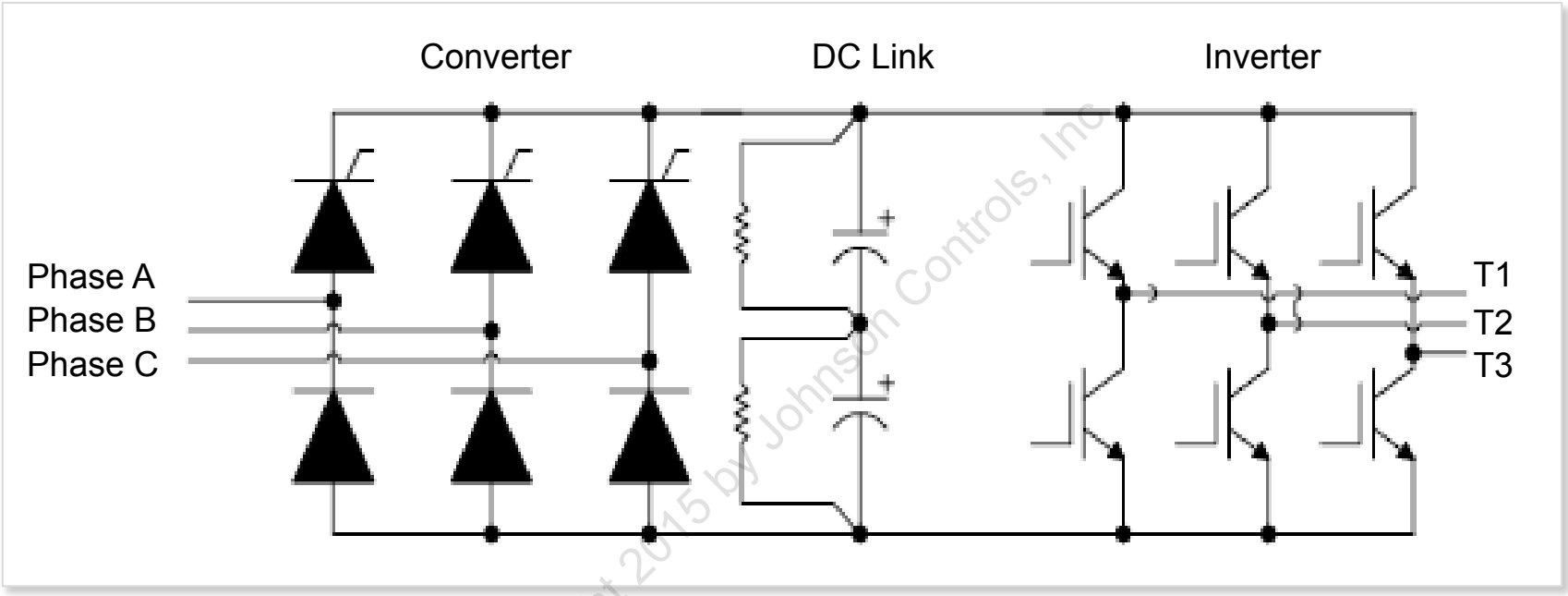


VSD Goal:

Using three-phase, single frequency AC power, create an output that is variable in voltage and frequency to manage the speed of a synchronous AC motor.

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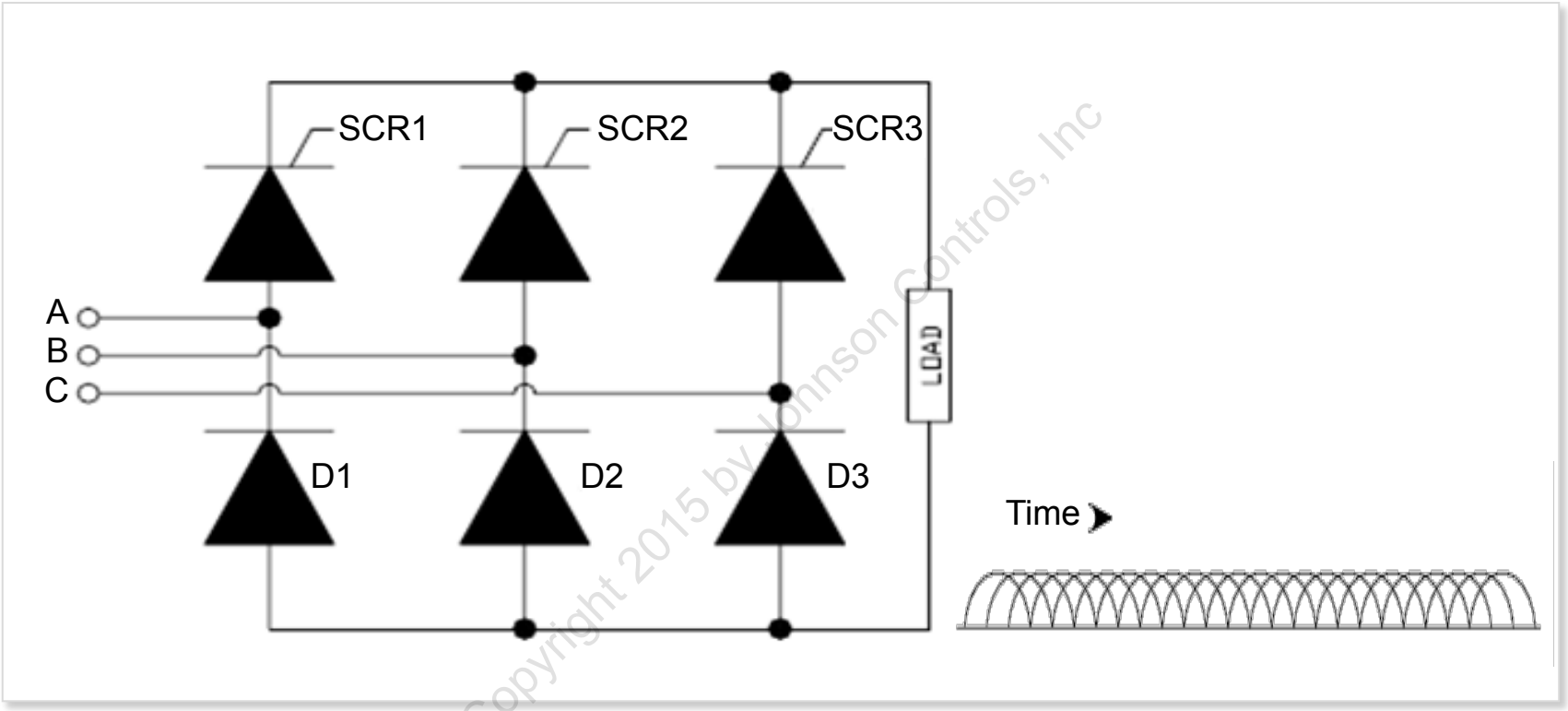
VSD Major Components



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- AC to DC semi-converter
- DC link filter
- DC to AC inverter

Three-phase Full-wave Rectification

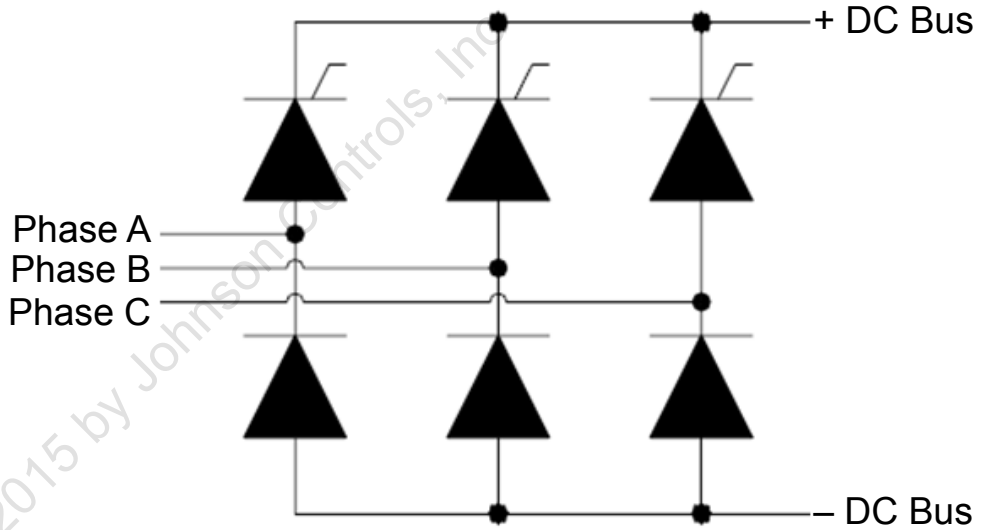


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- Bridge circuit has two halves; SCRs rectify positive half cycle, and Diodes rectify negative
- First half cycle: Sine wave of phase A, SCR1 & D1 are conducting

AC to DC Semi-converter

SCR/Diode modules are mounted on liquid-cooled heatsink.
Pre-charge results from slowly turning on SCRs to initially charge DC Bus.

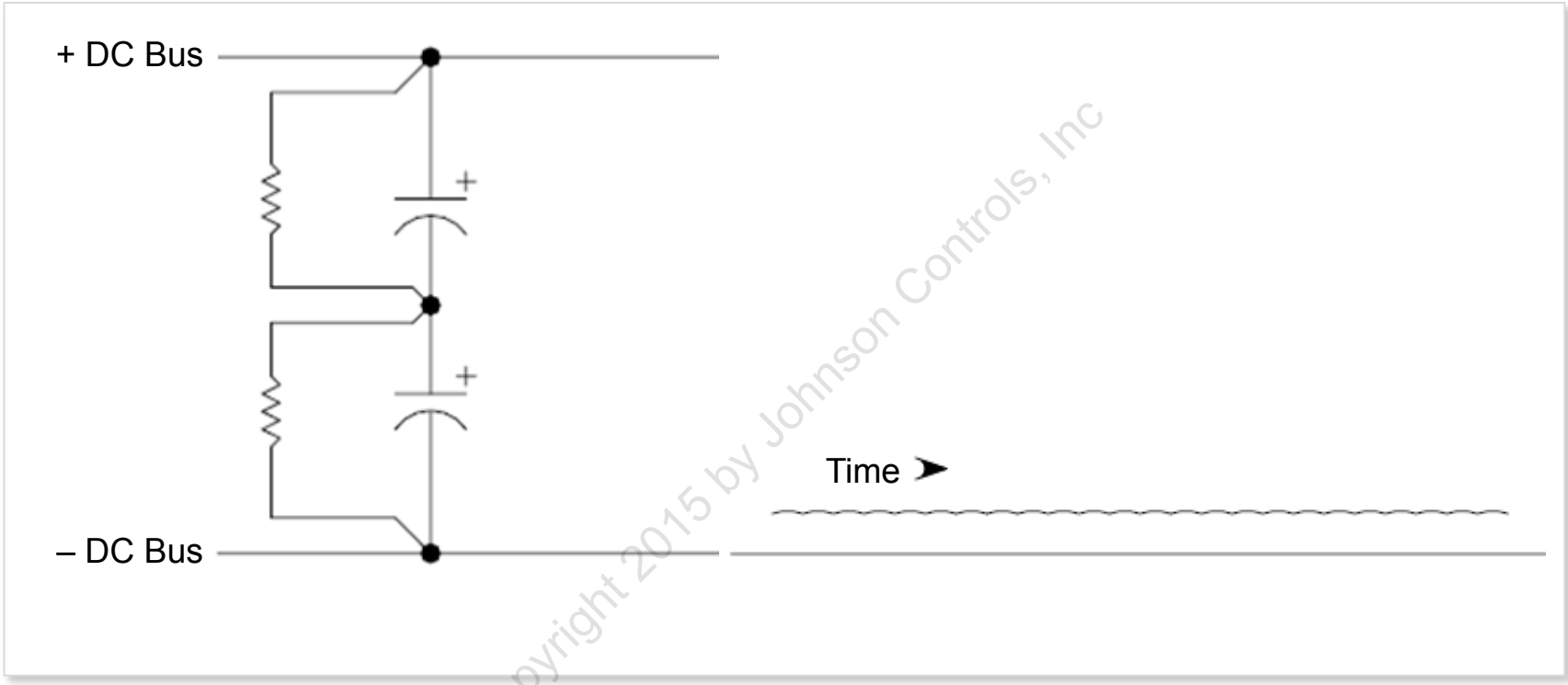


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AC to DC Semi-converter:

- Uses three SCRs and three diodes
- Permits pre-charge of DC Link Filter capacitors
- Provides fast disconnect from an AC line

DC Link Filter



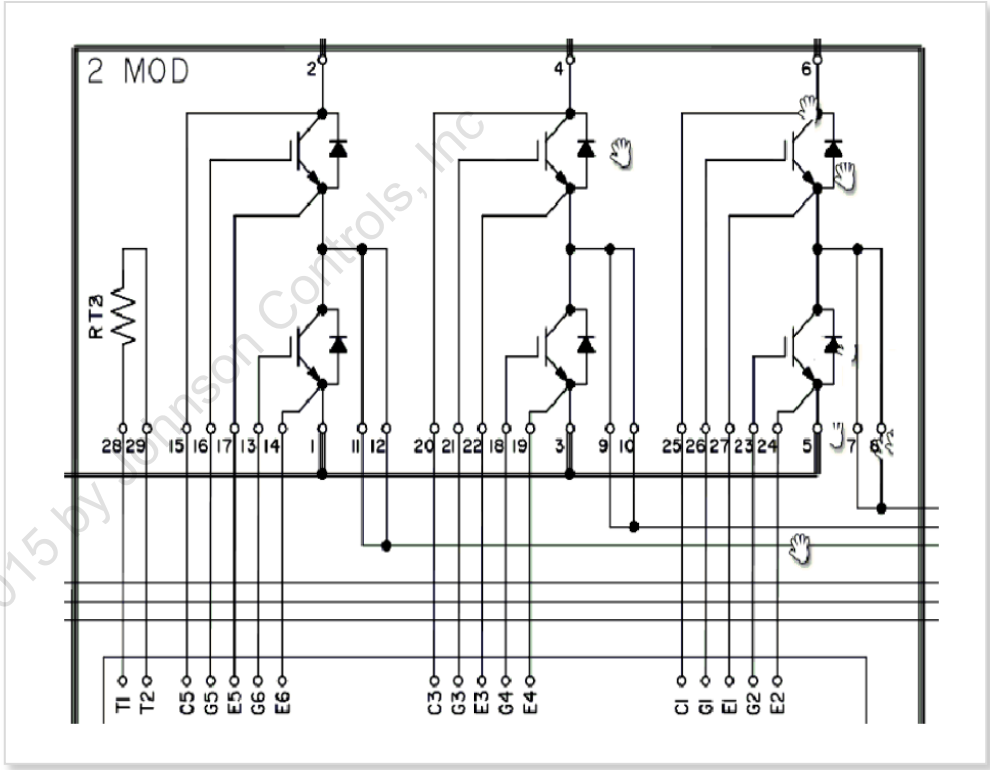
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DC Link Filter:

- Consists of a bank of electrolytic filter capacitors
- Capacitors smooth the (filter) ripple voltage resulting from the AC to DC rectification
- Provides energy reservoir for DC to AC inverter

Pulse Width Modulator (PWM)

PWM regulates the output voltage by varying width (not height) of pulses. DC Bus voltage is applied in varying widths to achieve current (approximates sine wave).

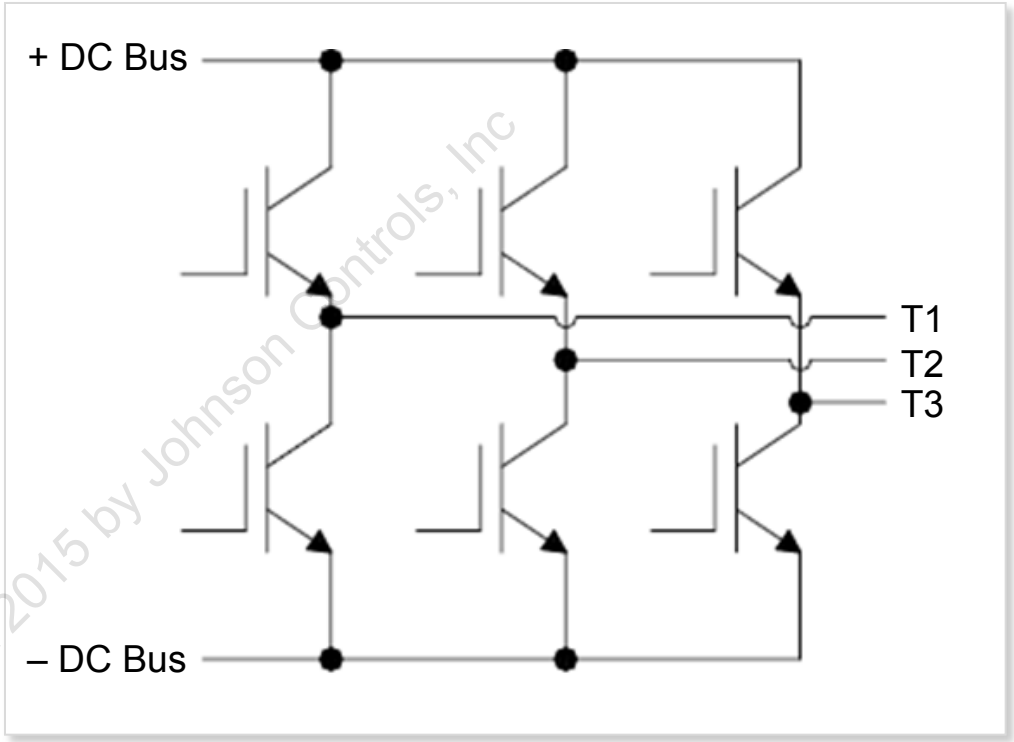


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Variable voltage and frequency created by IGBTs switches the DC Bus On and off. Longer the IGBT remains On, higher will be the output voltage.

DC to AC Inverter

DC to AC inverters produce Alternating Current power from energy stored in filters



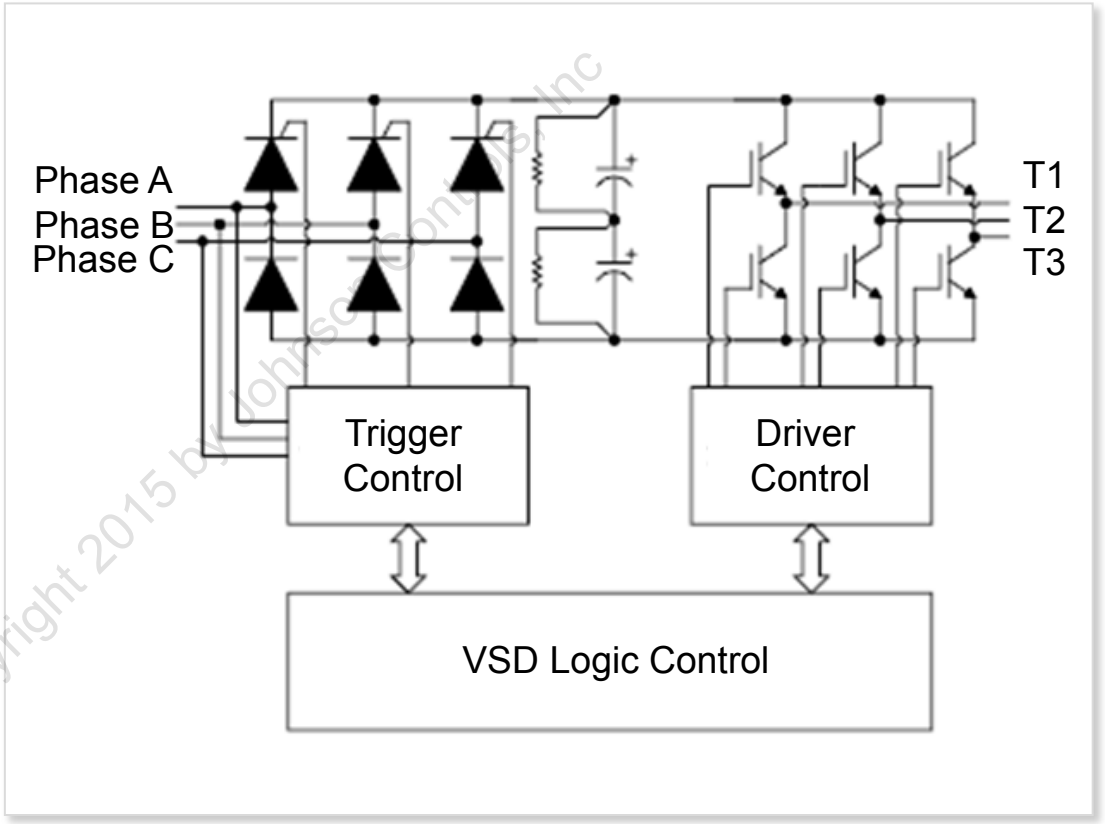
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DC to AC Inverter:

- Converts DC voltage back to AC at proper magnitude and frequency
- Consists of IGBTs connected to DC Bus to switch Positive/Negative DC Bus voltage to motor outputs, creating PWM

VSD Logic Board

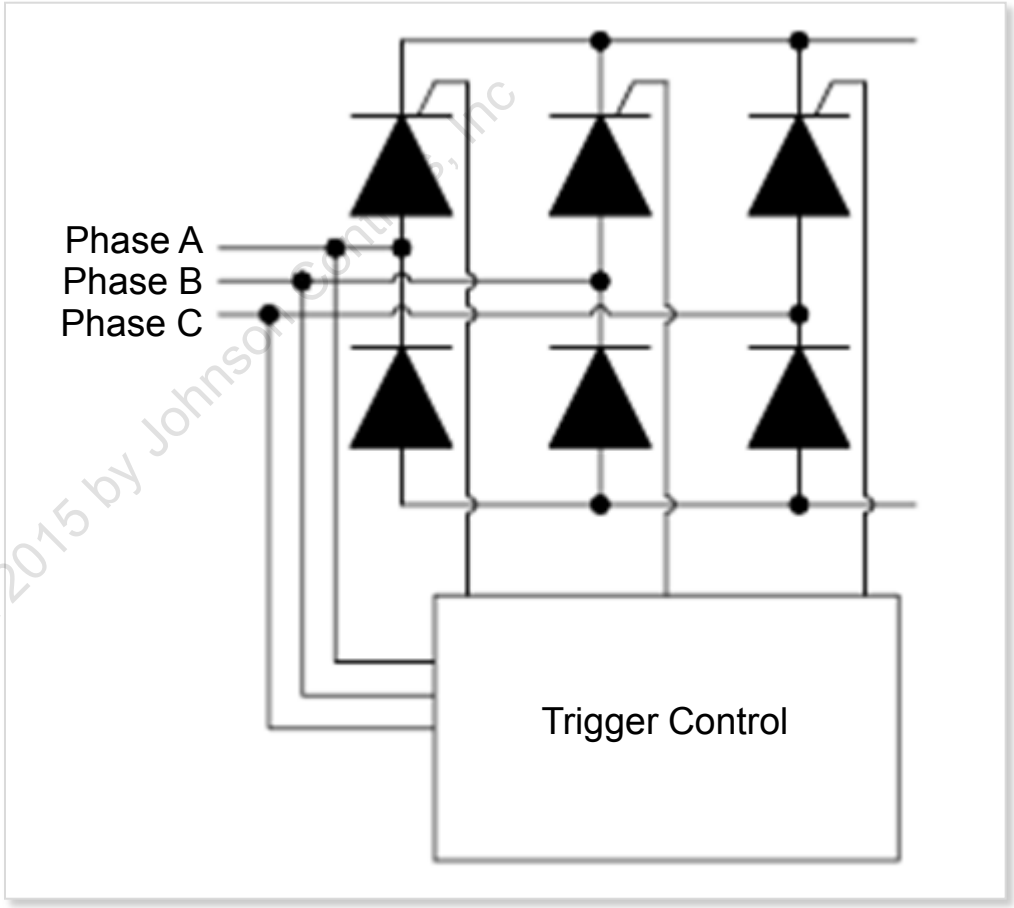
- Controls VSD functions and operations
- Operates inverter section
- Controls pre-charge of the DC link filter



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SCR Trigger Control

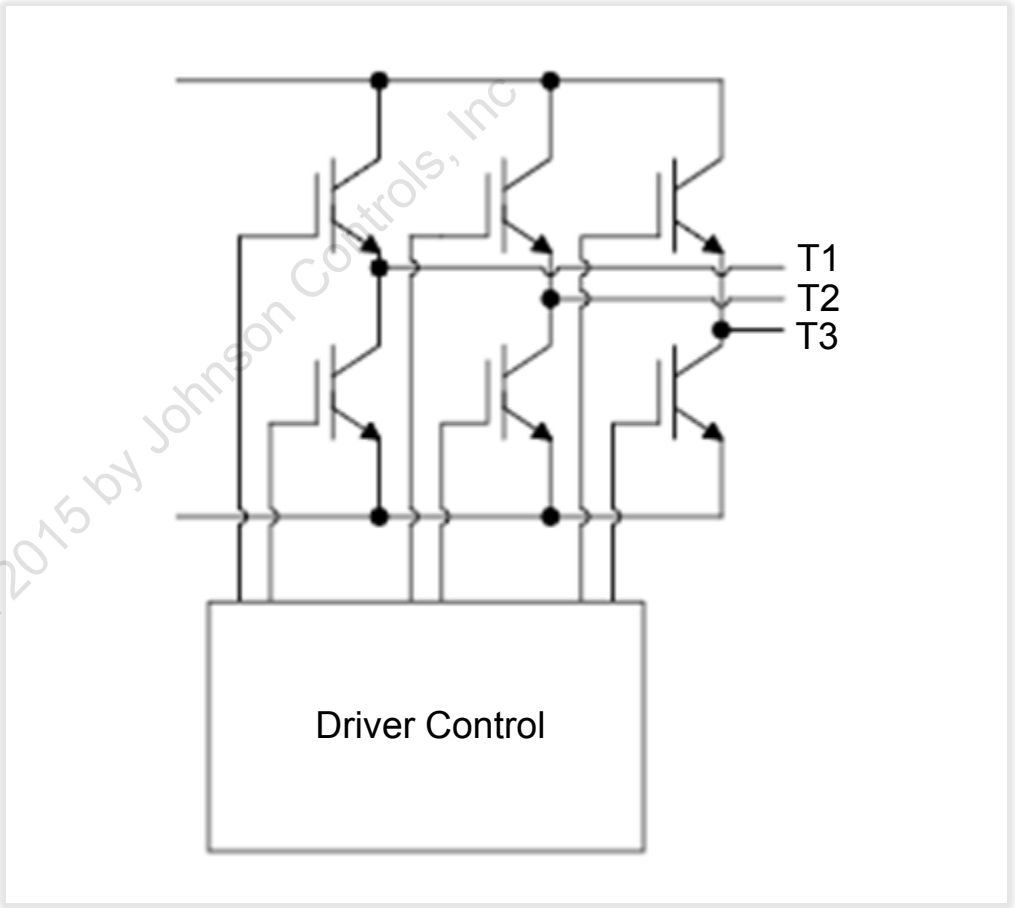
- Controls gates (firing) of SCR/Diode Rectifier Assembly
- Monitors three-phase input voltage to detect the loss of incoming phase and power



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Gate Driver Control

- Provides on and off gating pulses to the IGBTs
- Changes the DC link voltage to variable voltage and frequency, to control the motor speed and power



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Synchronous RPM Formula

$$\text{Synchronous RPM} = \frac{120 \times \text{Frequency}}{\text{Number of Poles}}$$

$$1800 \text{ RPM} = \frac{120 \times 60}{4}$$

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The speed of rotation is determined by number of poles in the motor and frequency of supplied power.



Calculate the synchronous RPM for a two-pole motor running at 23 Hz.

Voltage to Frequency Ratio

$$C = \frac{V}{f}$$

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Reduced VSD frequency will increase the strength of the magnetic field, causing unstable running and high temperatures.

To compensate, VSD varies motor voltage as well as frequency to maintain ratio.



Calculate the V/f ratio for a 460 V, 60 Hz motor.
Calculate the voltage and frequency to achieve 10% motor speed.

Variable Speed Drive

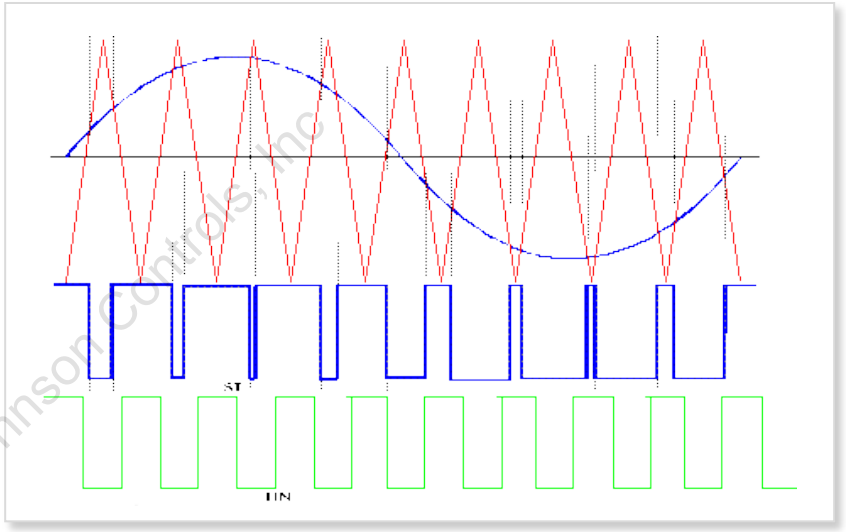
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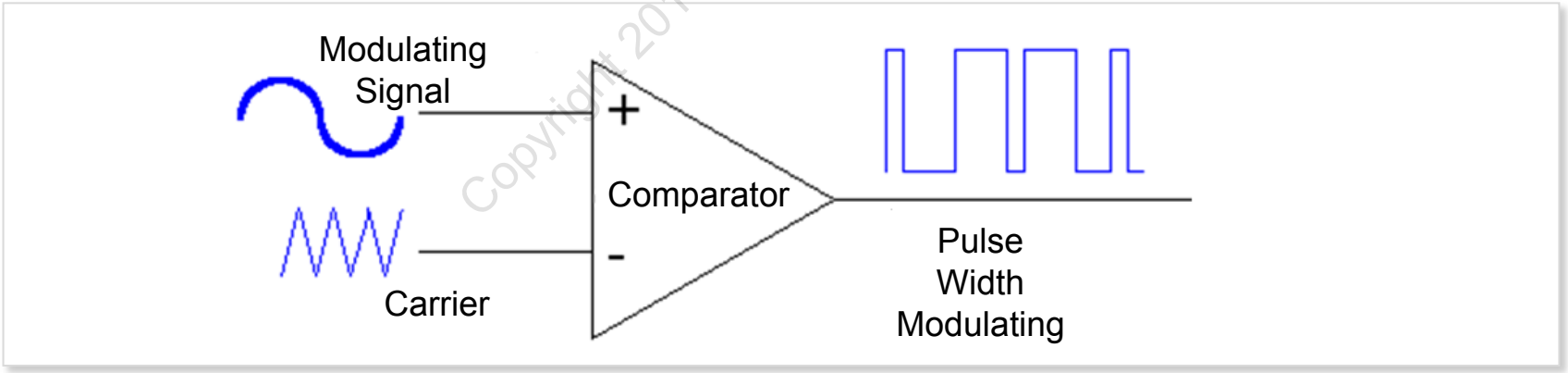
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PWM Signal

PWM signal uses the IGBT trigger signal to switch On/Off. This creates a new alternating signal from the DC voltage with higher or lower frequency.

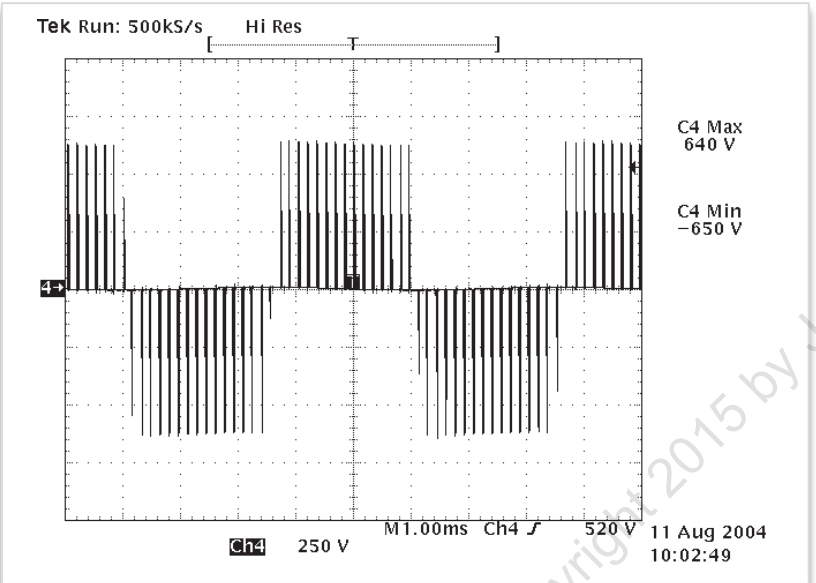




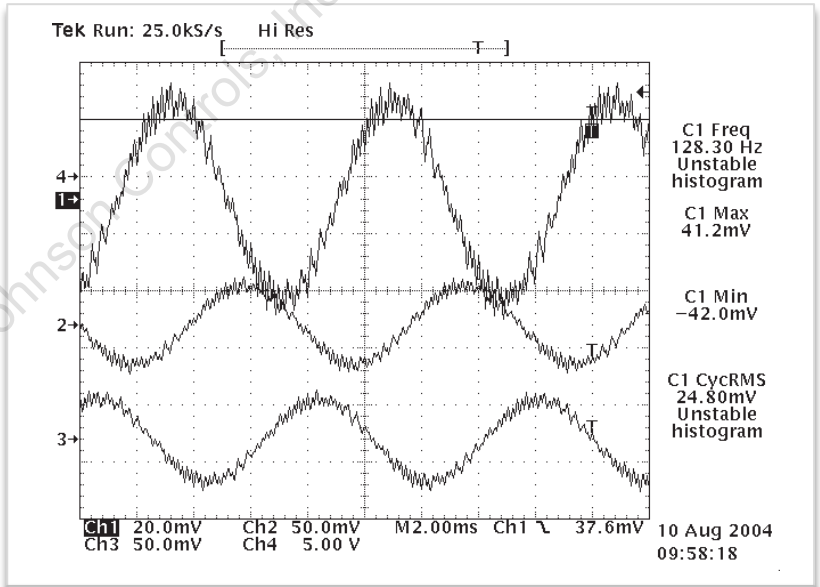
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PWM Wave Form

What is the wave form output of a VSD?



PWM voltage wave form



PWM current wave form

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Harmonic Filter Components

Components

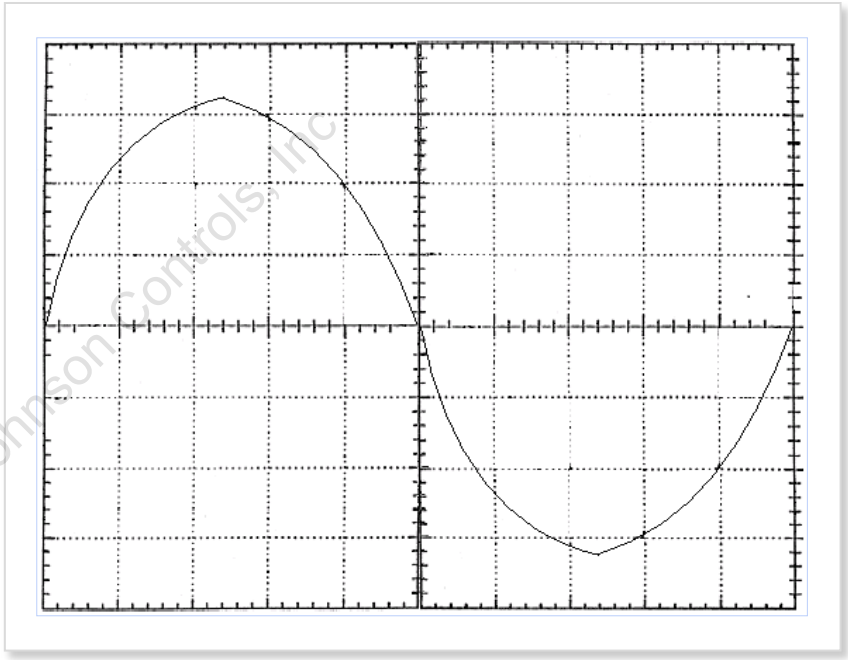
- Filter Pre-Charge Resistors and Contactors
- Three-phase Filter Inductor
- Filter Trap
- Electronic Current Sensors
- Line Isolator Board
- Bus Isolator Board
- Main Filter Assembly
- Filter Logic Board

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Harmonic Filter: Perfect AC Waveform

Features

- Cleans up the input current waveform drawn by the VSD from the AC line
- Corrects the system power factor to nearly unity (1.0 or 100%)
- Reduces the possibility of causing electrical interference with other sensitive electronic equipment connected to the same power line
- All drives create harmonic distortion as they are non-linear loads



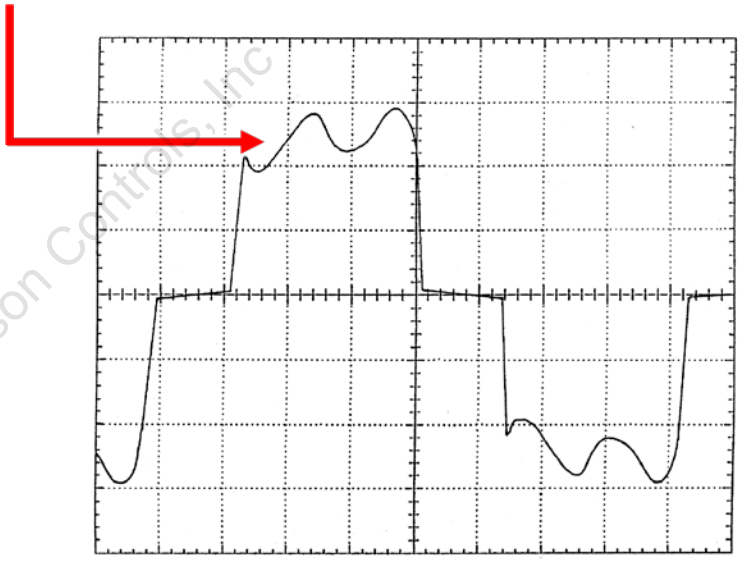
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VSD Input without a Harmonic Filter

Features

- The two **toes** within the half phase are the other 2 phases charging their capacitors

Current Waveform

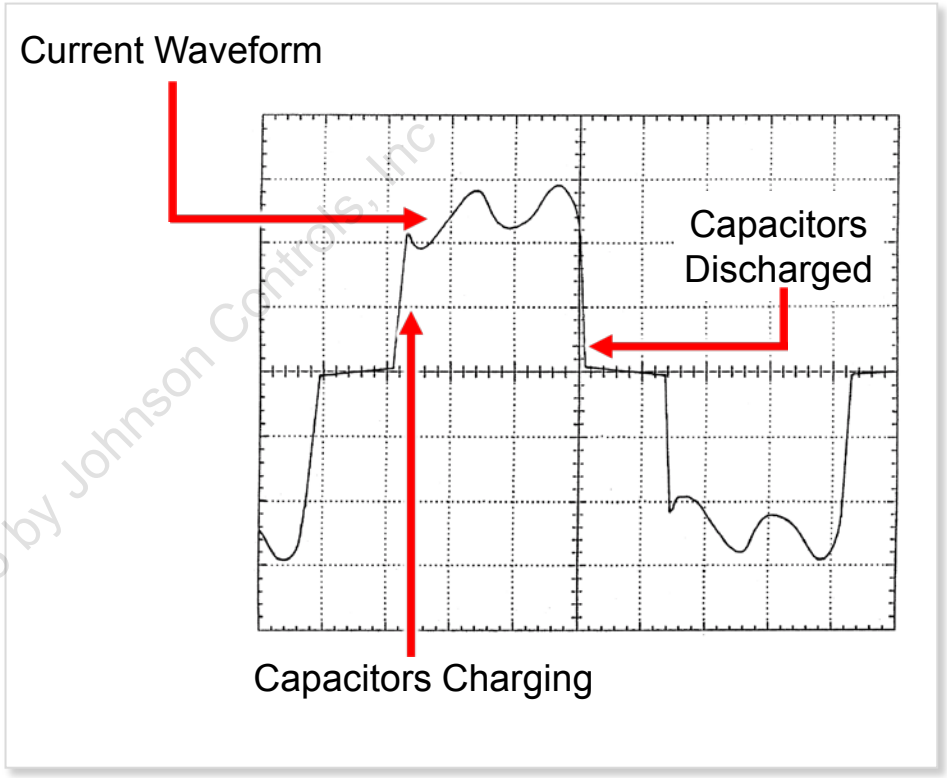


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VSD Input without a Harmonic Filter (Contd.)

Features

- The two **toes** within the half phase are the other 2 phases charging their capacitors

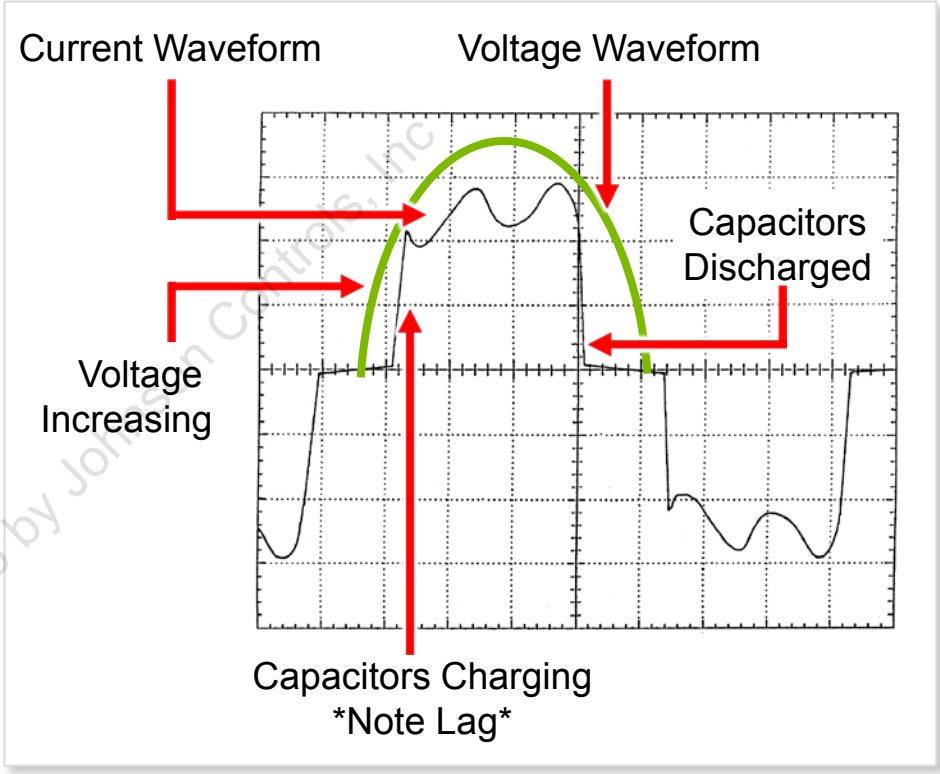


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VSD Input without a Harmonic Filter (Contd.)

Features

- The two **toes** within the half phase are the other 2 phases charging their capacitors
- Harmonics are multiples of the line frequency that create currents flowing in both directions on the line

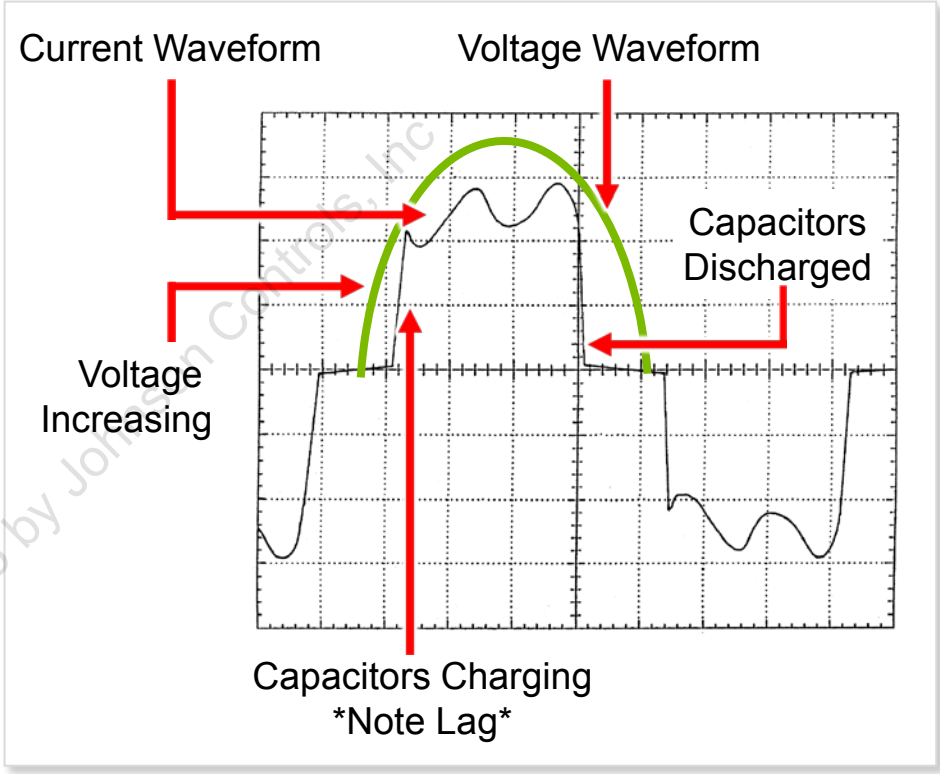


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VSD Input without a Harmonic Filter (Contd.)

Features

- The two **toes** within the half phase are the other 2 phases charging their capacitors
- Harmonics are multiples of the line frequency that create currents flowing in both directions on the line
- Filter works at 15k to 20k cycles per second

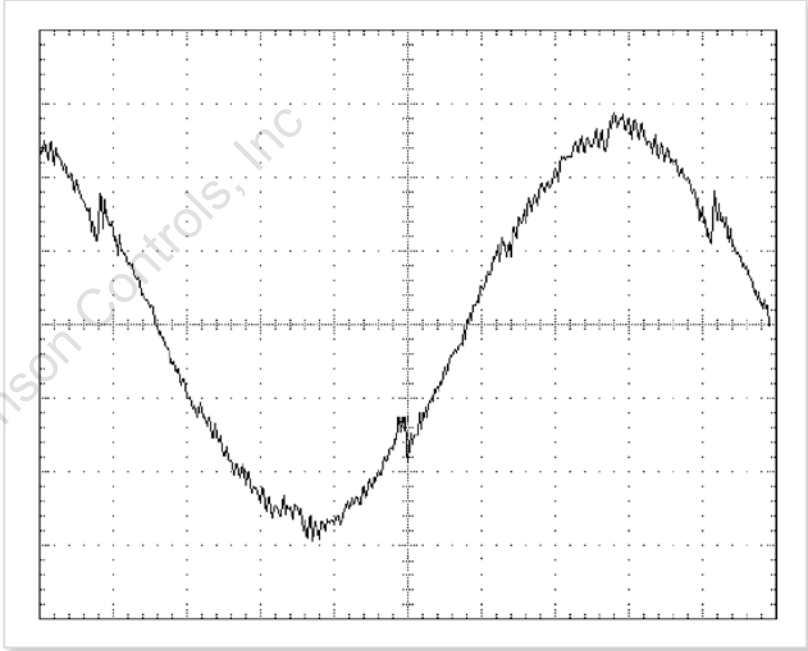


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VSD Input with a Harmonic Filter (Contd.)

Features

- The frequency of correction is dependent on the VSD frame size. (15-KHZ or 20-KHZ)
- The filter logic compares the actual current wave form with the perfect sine wave
- It then makes a correction by adding the appropriate counter-active voltage to the line at the frequency of the filter

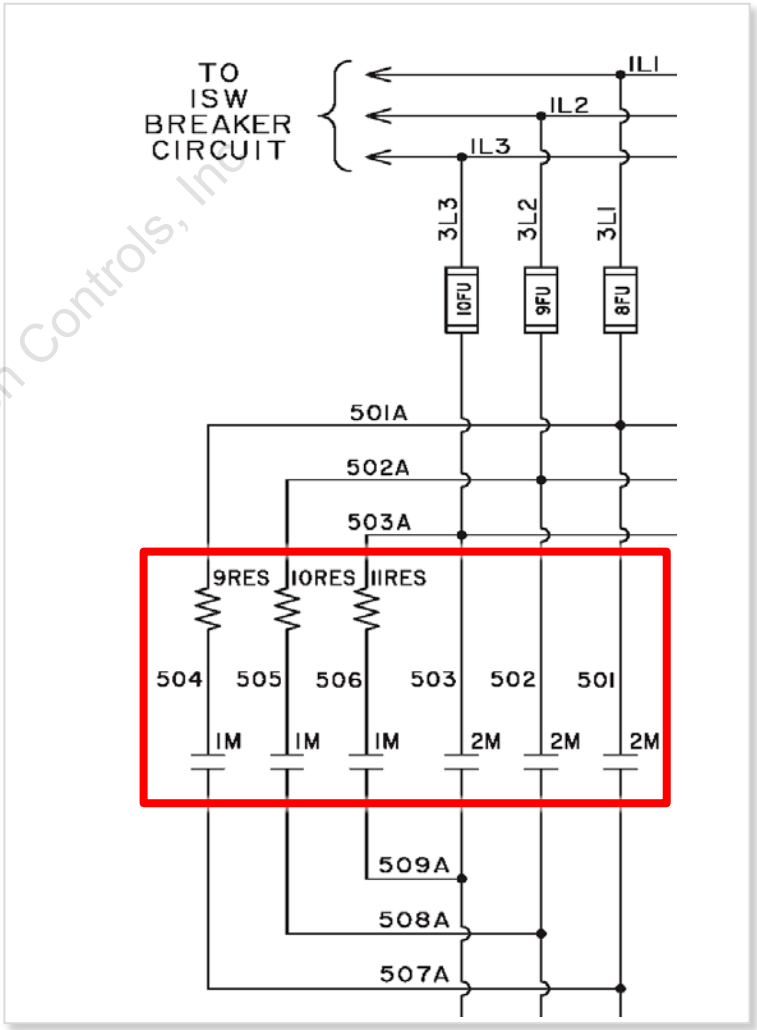


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Harmonic Filter Pre-Charge Circuit

Function

- Slowly charges the DC link filter capacitors
- Provides a means of disconnecting the filter power components from the power mains
- When the VSD is commanded to run:
  - Pre-charge resistors are switched into the circuit via contactor 1M for a fixed 5 second period
  - After pre-charge period, supply contactor 2M is pulled in and pre-charge contactor 1M drops out



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Summary

You should now possess a fundamental understanding of VSD theory, architecture, and functionality besides learning about the interconnection and functionality of the VSD components.

You learned to:

- Generate AC power
- Explain the differences between RMS and Peak voltage
- Convert AC to DC
- Convert DC to PWM
- Define basic motor principles

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VSD Troubleshooting



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Objective

After completing this lesson, you will be able to:

- List the features and benefits of a Variable Speed Drive (VSD)
- Explain the difference between the single circuit and dual circuit VSDs
- Describe the harmonic filter in the single circuit VSD
- Describe the interface between the control board and the VSD logic board
- Describe the major components of the harmonic filter
- Troubleshoot a VSD



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Shared Features and Technologies





YCAV



YCIV



YVAA



YVWA

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VSD Troubleshooting



YCAV/YCIV/YVAA/YVWA Troubleshooting Guide for Liquid Cooled Variable Speed Drives

Service Instructions Form 201.21-**M1**.pdf

Section "Troubleshooting"

See also:

Service Instructions Form 201.21-**M2**.pdf


YORK BY JOHNSON CONTROLS | LIQUID COOLED VARIABLE SPEED DRIVE

SERVICE INSTRUCTIONS | Supersedes: 201.21-M1 (812) | Form 201.21-M1 (413)

YCAV / YCIV TROUBLESHOOTING GUIDE FOR LIQUID COOLED VARIABLE SPEED DRIVES

60 / 50 HZ (P/N 371-04178-XXX)

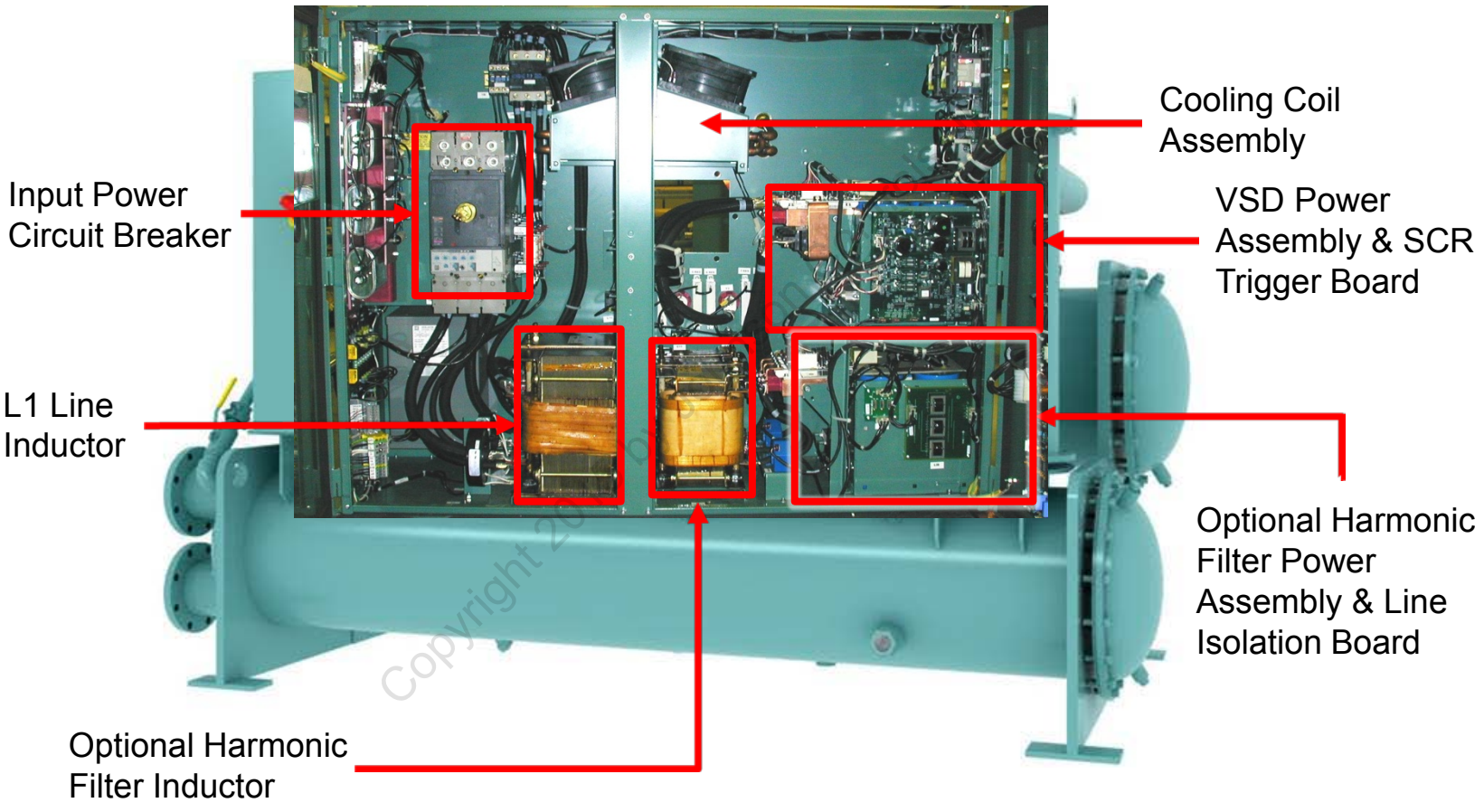
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- **VSD Operation**
  - **VSD Cooling**
- Control board and VSD logic board interaction
- Components of harmonic filter
- Troubleshoot VSD

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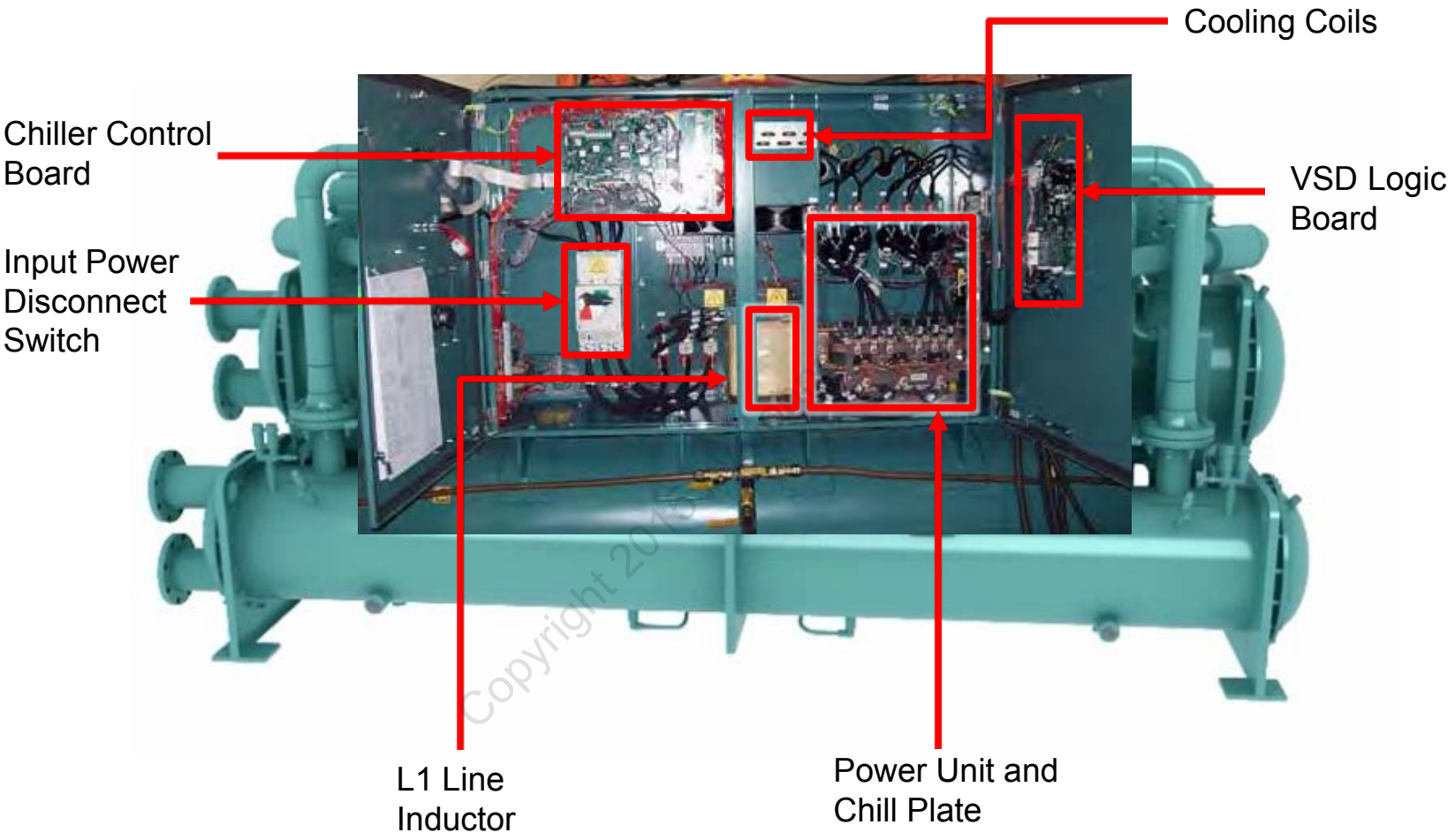
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Single Circuit VSD Components



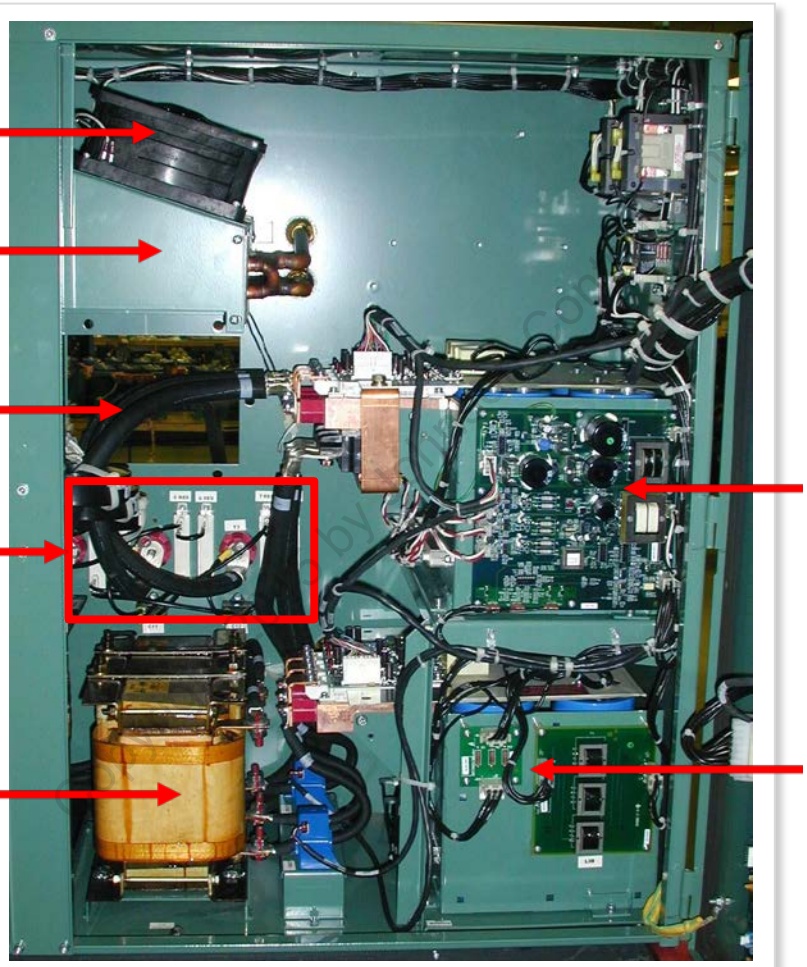
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Dual Circuit VSD Components

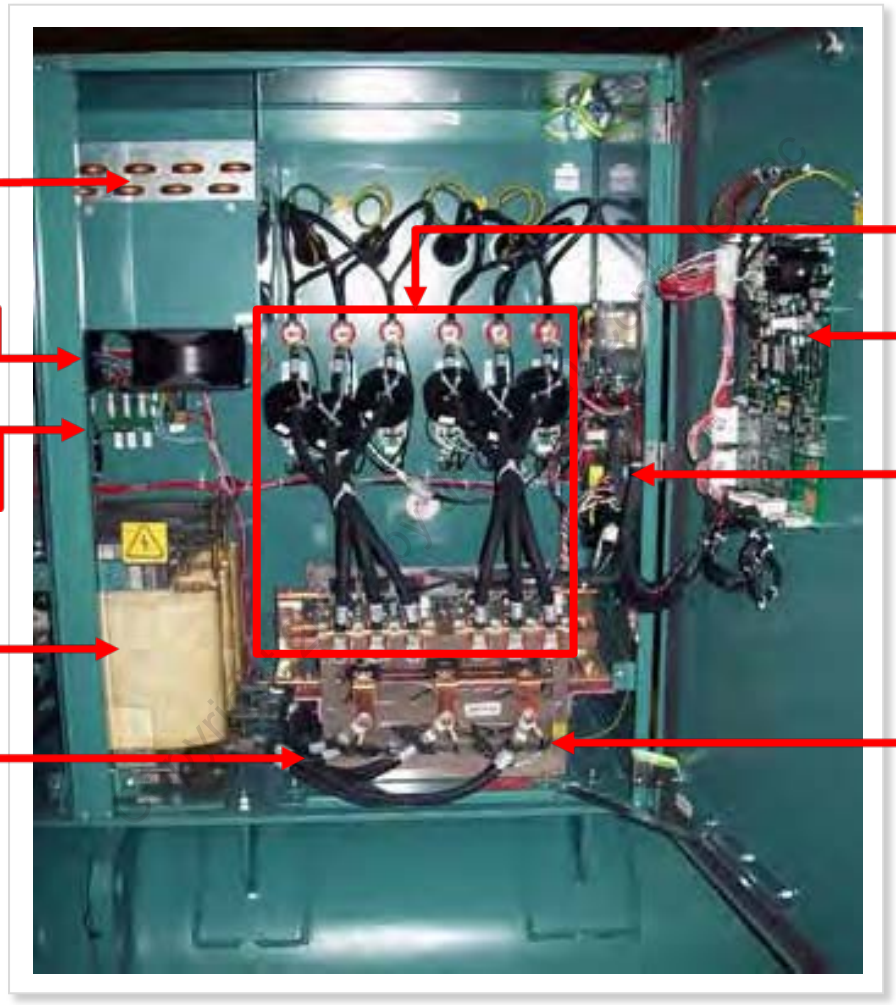


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Single Circuit VSD Power Components



Dual Circuit VSD Components



VSD Acceleration and Deceleration Rates

- The output frequency from the VSD to the motor(s) is increased from 0 Hz to the operating frequency during start-up
- When a compressor stops, it often backspins as the pressure differential equalizes between discharge and suction

Acceleration Rate	Deceleration Rate
■ 0 to 50 Hz is 10 Hz per second ■ 50 to 203 Hz is 30.4 Hz per second	■ 203 to 100 Hz is 30.4 Hz per second ■ 100 to 0 Hz is 10 Hz per second

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All Chiller Models

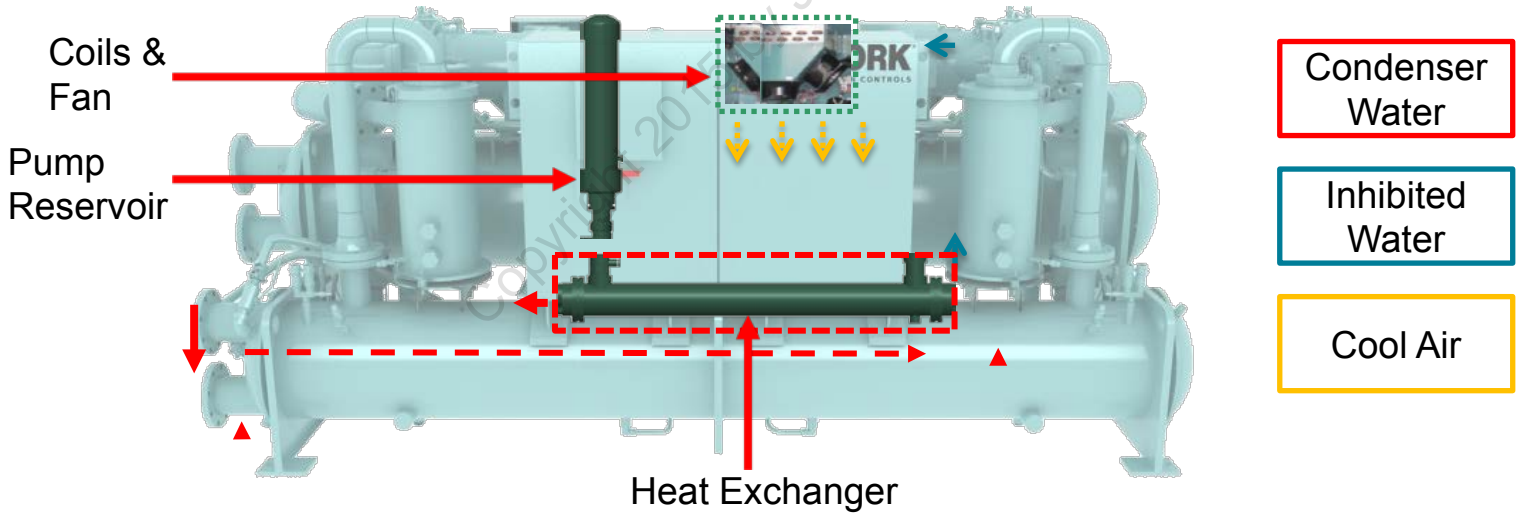
- **VSD Operation**
  - **VSD Cooling**
- Control board and VSD logic board interaction
- Components of harmonic filter
- Troubleshoot VSD

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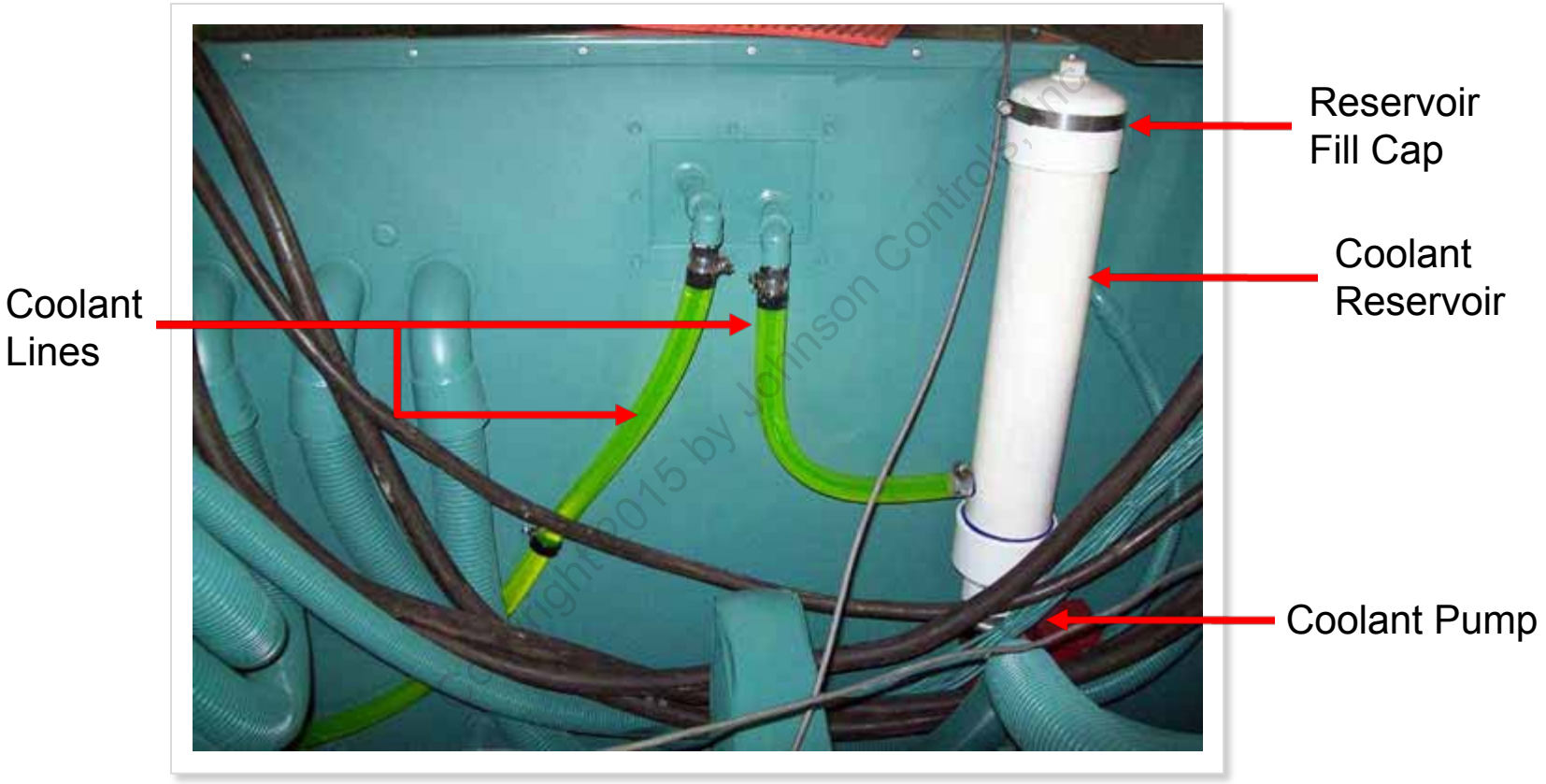
VSD Cooling System

- Coolant loop provides cooling for VSD components by pumping through:
  - Chillplates to cool IGBTs and SCR/diode modules
  - Cooling coil where circulator fans move air in cabinet to cool electronic circuit boards.
- VSD heat exchanger removes heat picked up from the VSD system.



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VSD Cooling System (Contd.)



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Cabinet Cooling Fans and Coil

- Cabinet cooling fans and coil cool the electronics in the control panel.



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Fan Pump Control Relay

- The pump / fan control relay starts & stops:
  - Coolant circulating pump
  - Internal cabinet fans
- Commanded by VSD logic board.



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Inhibited Water Pump

- Single-phase 120 VAC motor
- Circulates inhibited water through:
  - External shell and tube heat exchanger
  - Internal cabinet cooling coil
  - Water-cooled heatsink



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VSD Fan and Coolant Pump for VSD Temperature Control: For Single Circuit Units

VSD fan and coolant pump will run if:	VSD fan and coolant pump will stop if:
■ IGBT Baseplate Temp is > cutout – 10° F	■ IGBT Baseplate Temp is < cutout – 10° F
■ Pre-charge Enable 1 from the chiller logic board is On	■ Converter heatsink Temp is < cutout – 10° F
■ Converter heatsink Temp is > cutout – 10° F	■ Pre-charge Enable 1 from the chiller logic board is Off
■ VSD Internal Ambient Temp > cutout – 8° F	■ VSD Internal Ambient Temp < cutout – 8° F
■ Compressor is running	■ No compressors are running
■ Service Mode Fan/Pump Run is enabled	■ Service Mode Fan/Pump is disabled

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VSD Fan and Coolant Pump for VSD Temperature Control: For Dual Circuit Units

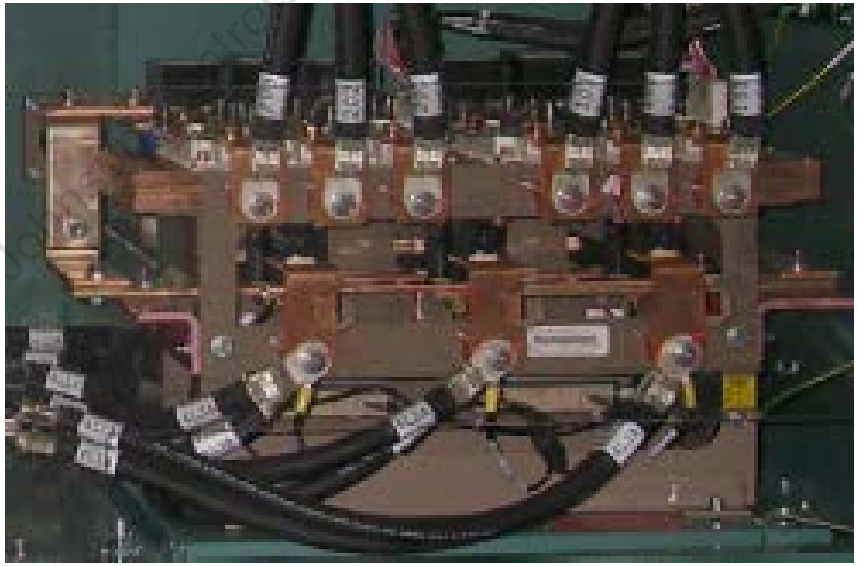
VSD fan and coolant pump will run if:	VSD fan and coolant pump will stop if:
■ IGBT Baseplate Temp is > cutout – 10° F	■ Compressor 1 IGBT Baseplate Temp is < cutout – 15° F
■ Pre-charge Enable 1 from the chiller logic board is On	■ Compressor 2 IGBT Baseplate Temp is < cutout –15° F
■ Pre-charge Enable 2 from the chiller logic board is On	■ Pre-charge Enable 1 from the chiller logic board is Off
■ VSD Internal Ambient Temp > cutout – 10° F	■ Pre-charge Enable 2 from the chiller logic board is Off
■ Any compressor is running	■ VSD Internal Ambient Temp < cutout – 15° F
■ Service Mode Fan/Pump Run is enabled	■ No compressors are running
	■ Service Mode Fan/Pump is disabled

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Inhibited Water-cooled Heatsinks

- "Chill Plate" Heatsinks cool IGBT modules and input rectifier modules







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VSD Cooling – YCAV and YCIV



VSD Cooling loop glycol circulated to:





- Condenser coil
- Bottom section



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VSD Cooling – YVAA

VSD Cooling loop glycol circulated to:



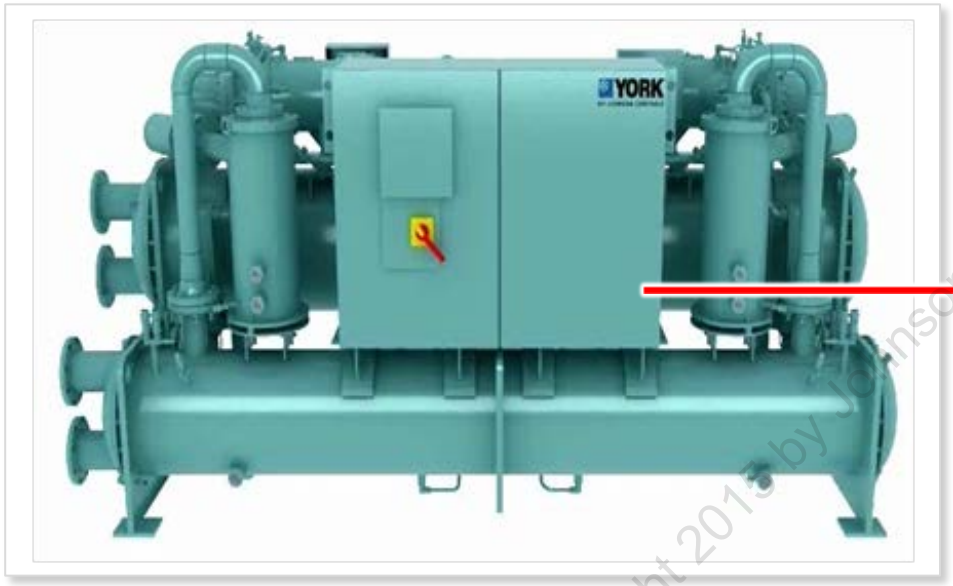


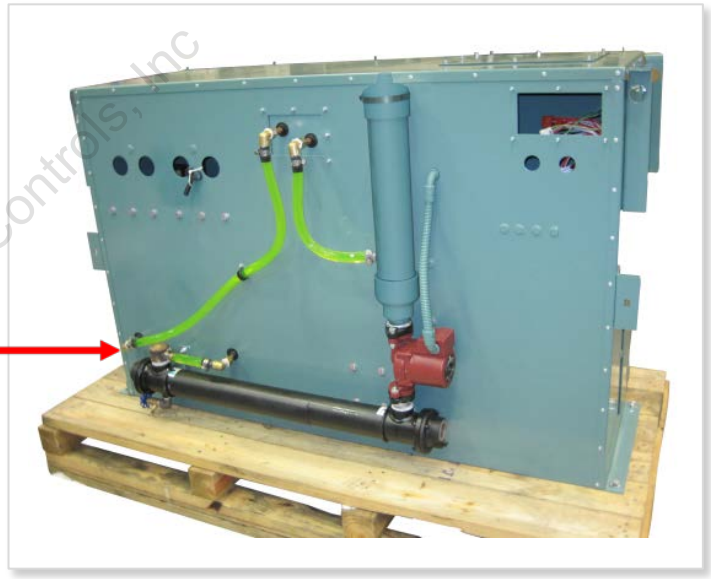
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- Separate Microchannel coil
- One coil for each circuit
- Air flow from the fan assembly for cooling

VSD Cooling – YVWA

VSD Cooling loop inhibited water circulated to:





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- Separate Heat Exchanger on rear of VSD
- Piped to condenser water

VSD Cooling – All



VSD Cooling loop glycol circulated to:



- Condenser coil
- Bottom section



- Separate Microchannel coil
- One coil for each circuit
- Air flow from the fans for cooling



- Separate Heat Exchanger on rear of VSD
- Piped to condenser water

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Using Glycol Coolant

- 9-15 inches from the top of the fill tube.
- Fill to required level before starting coolant pump.
- Re-install cap before stopping coolant pump to prevent fill tube overflow.
- Change system coolant:
  - Every 5 years



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- Never run the coolant pump without coolant.
- Always fill the system with approved coolant.
- Substituting coolant or adding water will result in cooling loop, performance loss, and chiller shutdown.

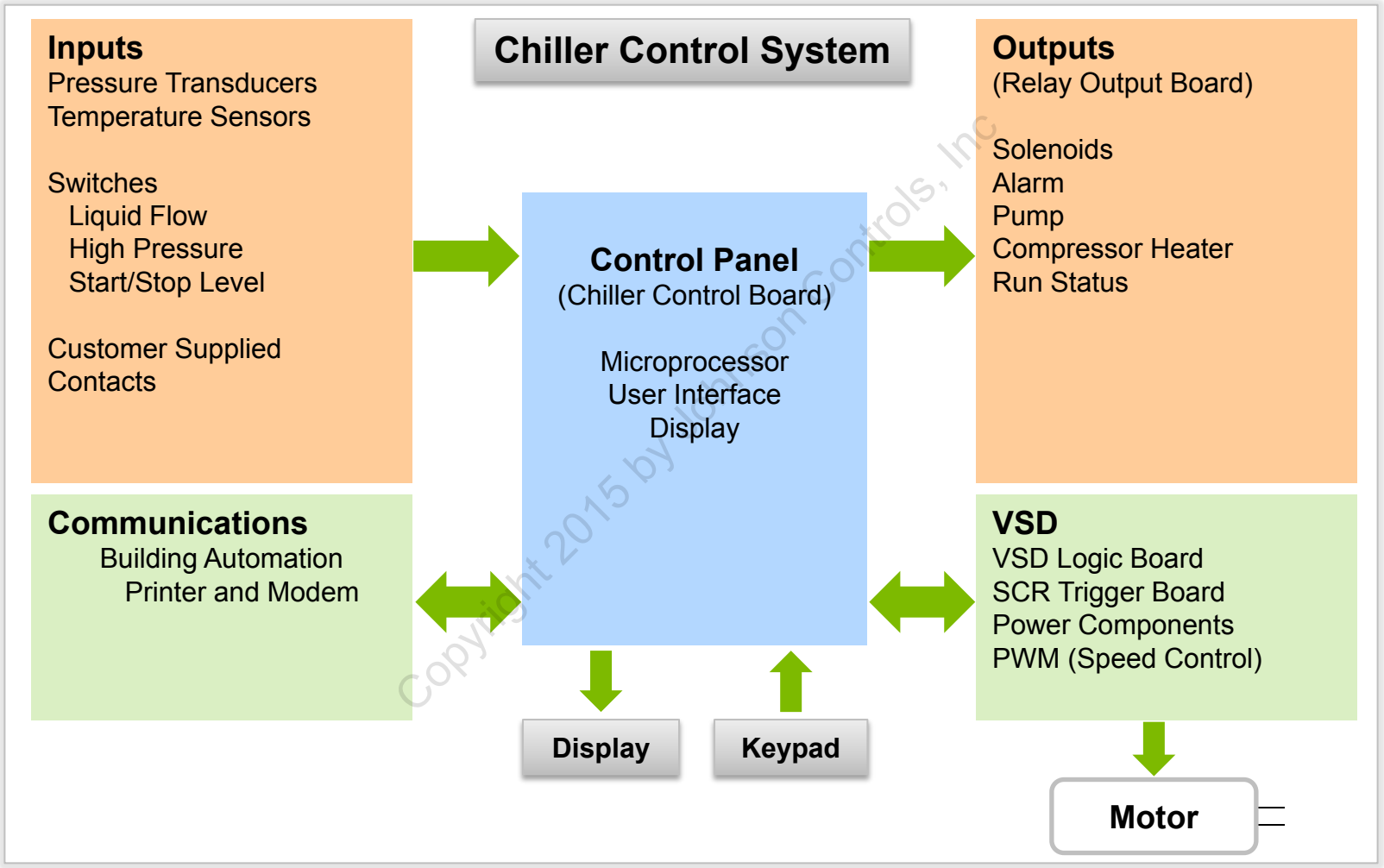
All Chiller Models

- VSD Operation
  - VSD Cooling
- **Control board and VSD logic board interaction**
- Components of harmonic filter
- Troubleshoot VSD

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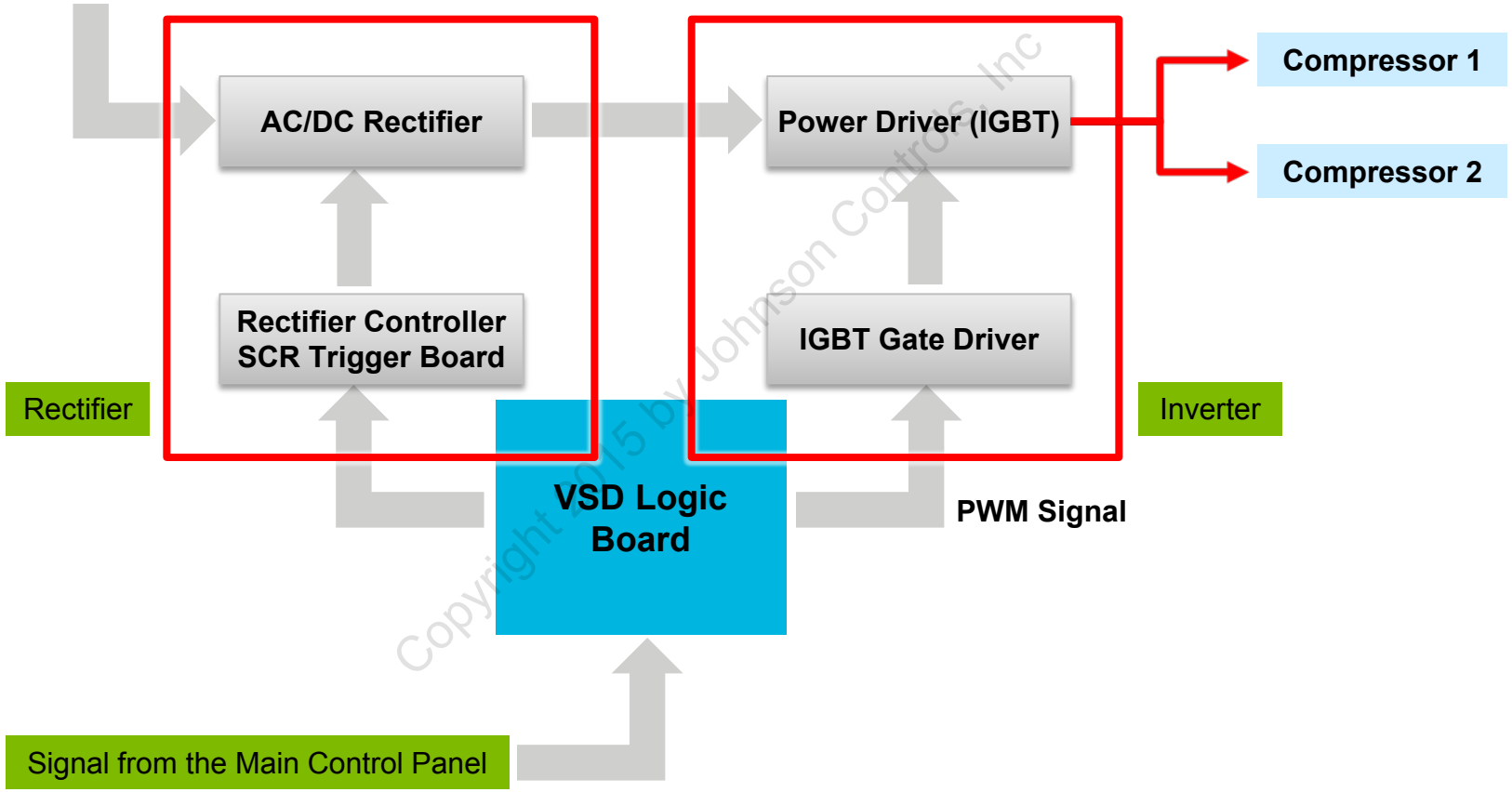
VSD Control System



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VSD Logic

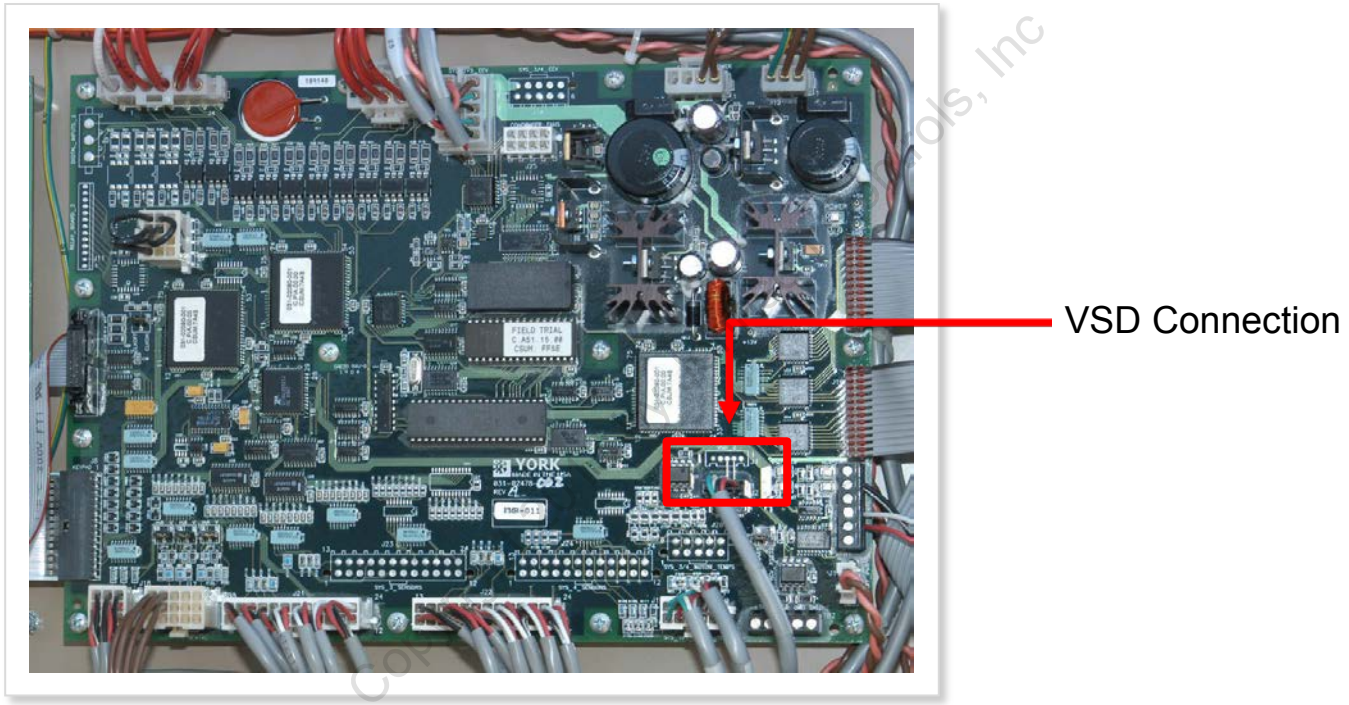
Three-phase Power Line



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Control Board

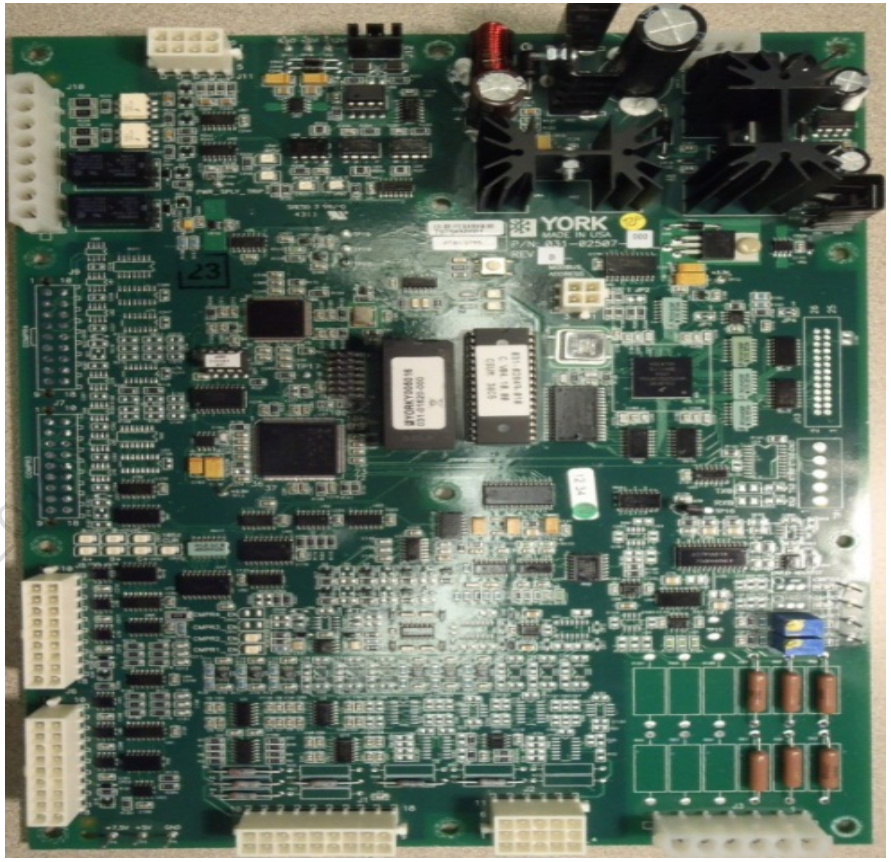
- VSD connection to VSD logic board



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VSD Logic Board

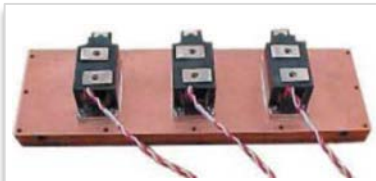
- Communicates serially with the control board via J2
- Uses a Modbus-ASCII network protocol
- Controls the VSD functions via RS-485 optocoupled data link



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VSD Logic Flow

Three-phase Power



AC/DC Rectifier



DC Link



Equalizer Resistor



IGBT/IGBT Gate Driver

Trigger SCR



SCR Trigger Board

Signal to the Rectifier Controller Board



Dual Circuit VSD Logic Board



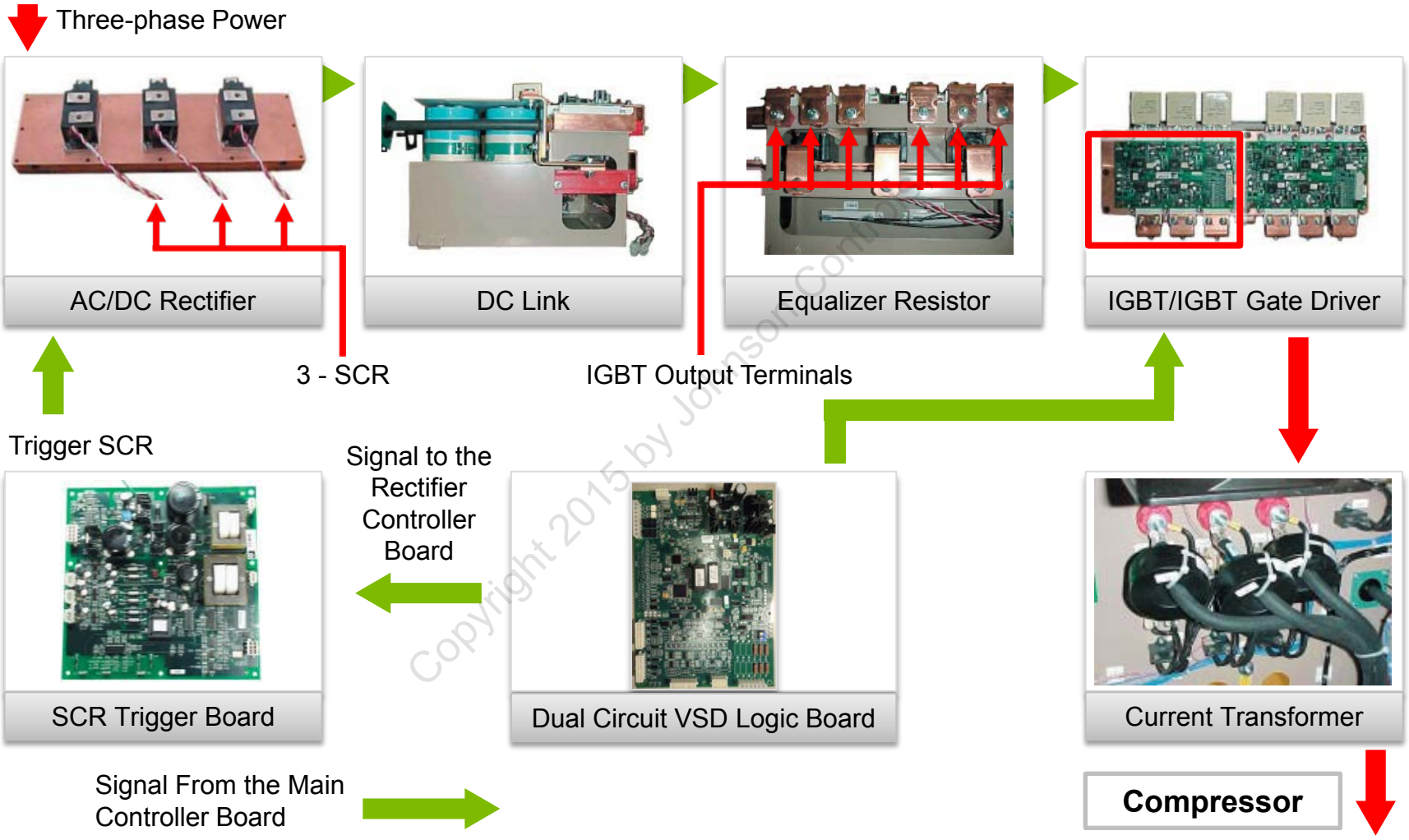
Current Transformer

Signal From the Main Controller Board

Compressor

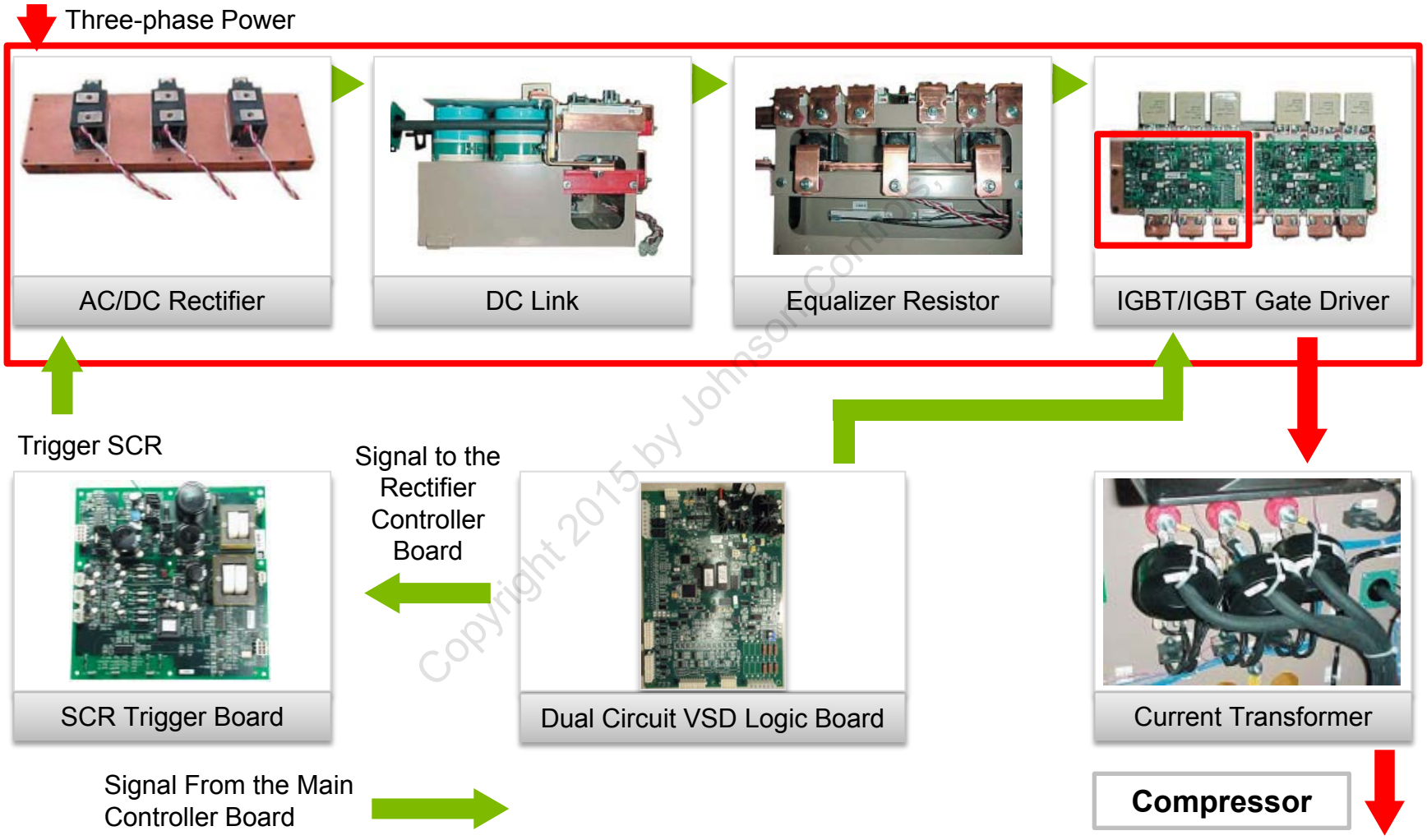
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VSD Logic Flow (Contd.)



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VSD Logic Flow (Contd.)



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All Chiller Models

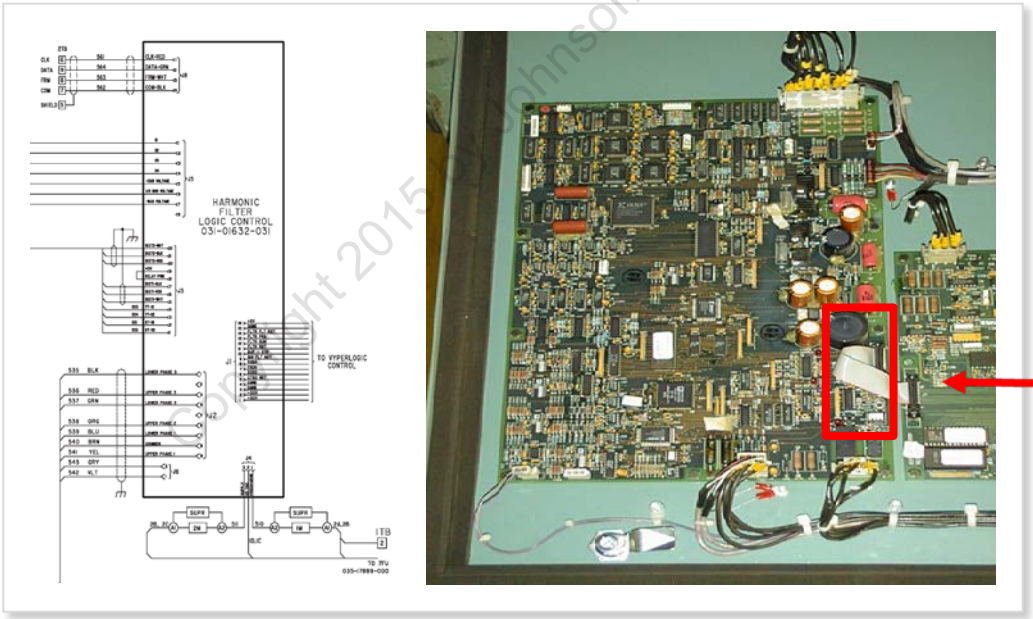
- VSD Operation
  - VSD Cooling
- Control board and the VSD logic board interaction
- **Components of the harmonic filter**
- Troubleshoot the VSD

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Harmonic Filter Logic Board

- Monitors the three-phase AC voltage, current, and the harmonic filter DC bus current
- Generates the appropriate IGBT gate driver pulses
- Produces the harmonic currents necessary to correct the waveform
- Interfaces with the VSD logic board



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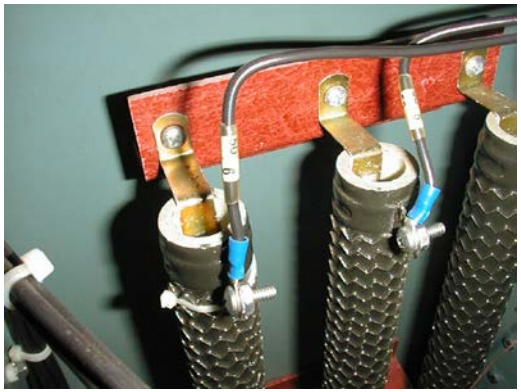
Harmonic Filter Pre-Charge Contactor and Resistors

Harmonic Filter Pre-Charge Contactor



Harmonic Filter Pre-Charge Resistors

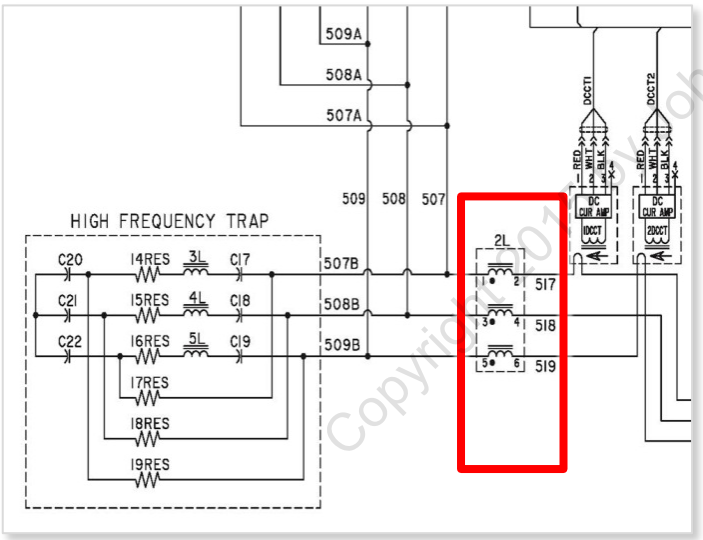


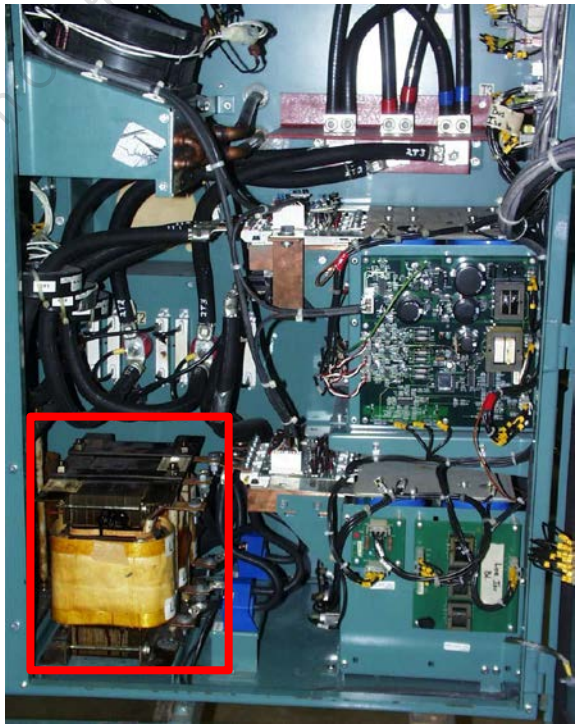


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Three-phase Harmonic Filter Inductor

- Provides some impedance for the filter to work against
- Limits the rate of change of current at the input to the filter to a reasonable level

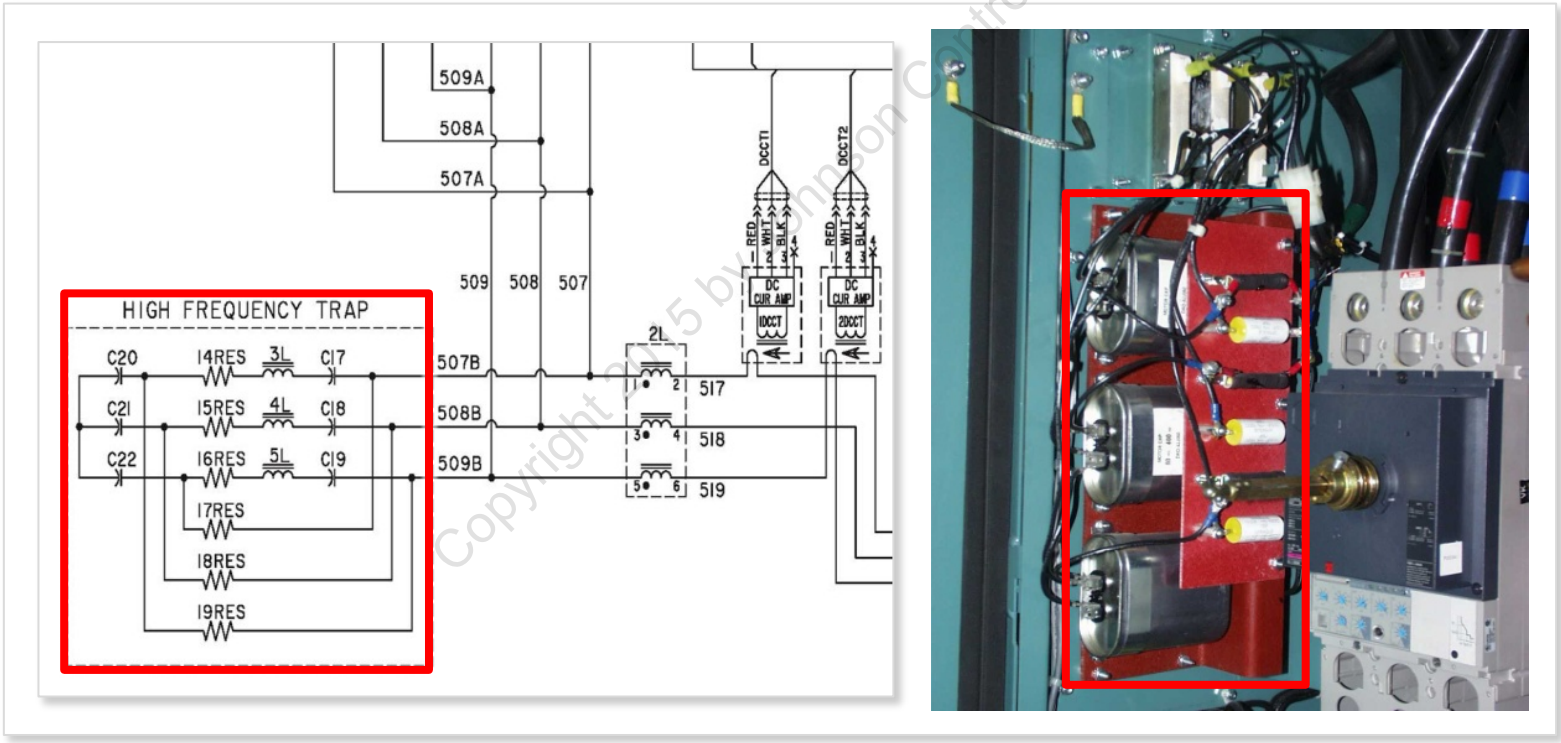




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Harmonic Filter Trap Assembly

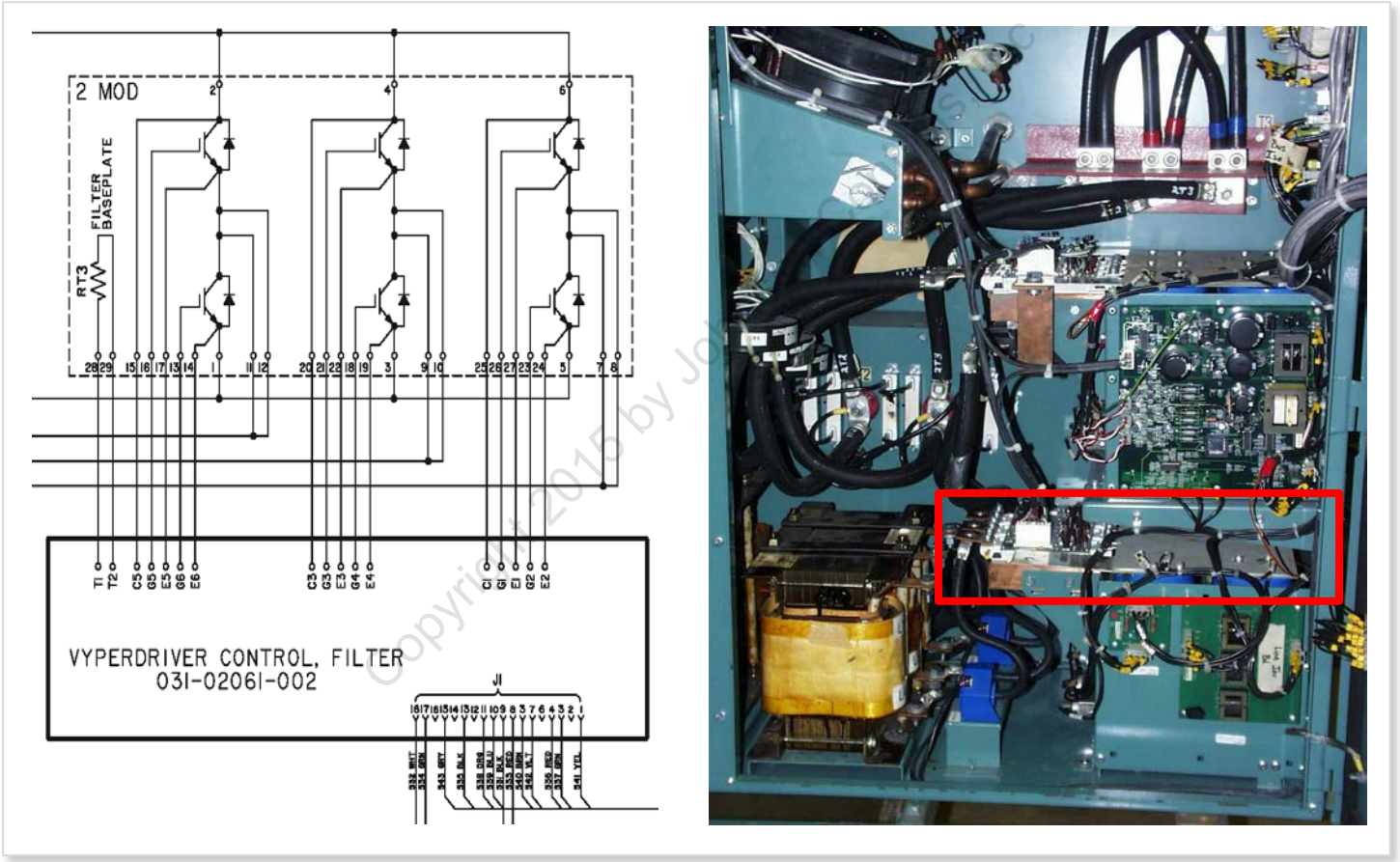
- Composed of a series of capacitors, inductors, and resistors
- Blocks currents at the switching frequency of the filter from getting onto the power mains



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Harmonic Filter Power Assembly

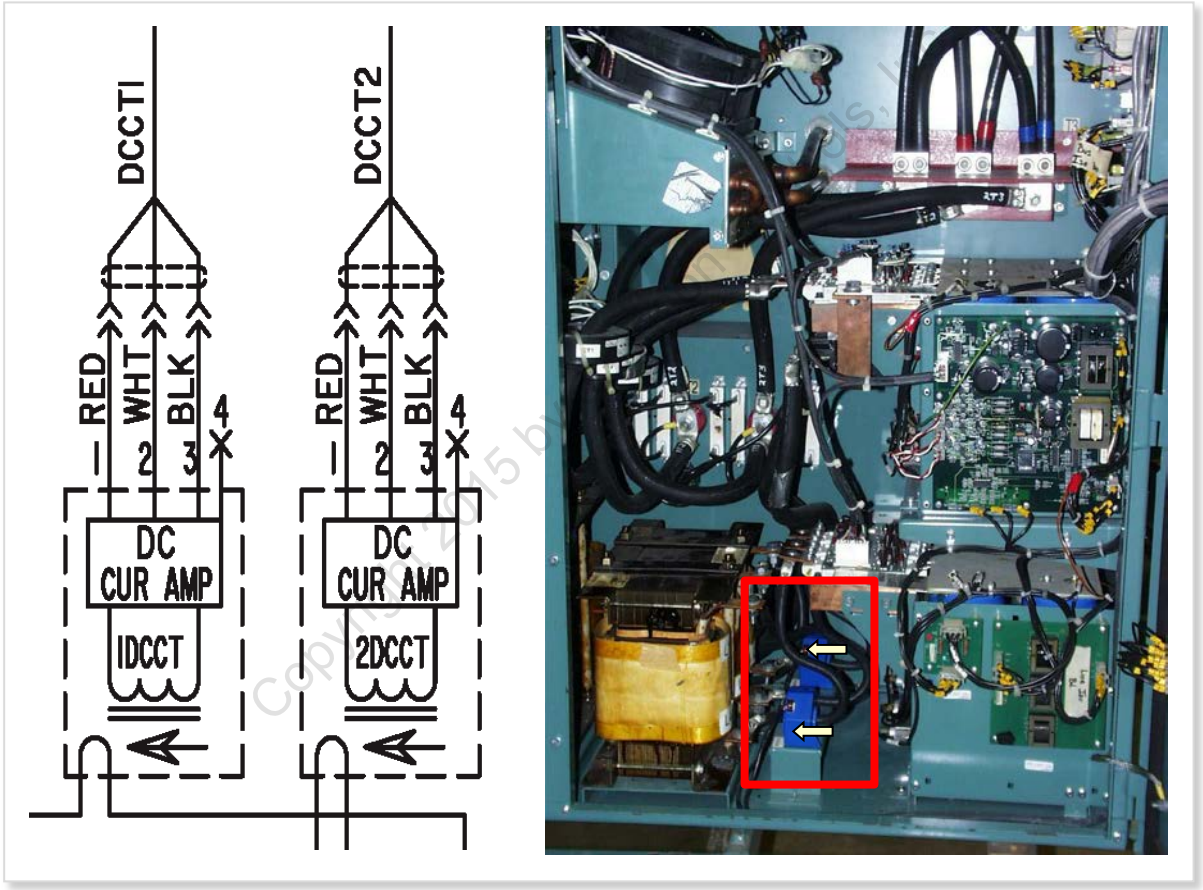
- Generates the harmonic currents required by the VSD's AC-to-DC converter



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Harmonic Filter Electronic Current Sensors

- Includes DC Current Transformers (DCCTs)

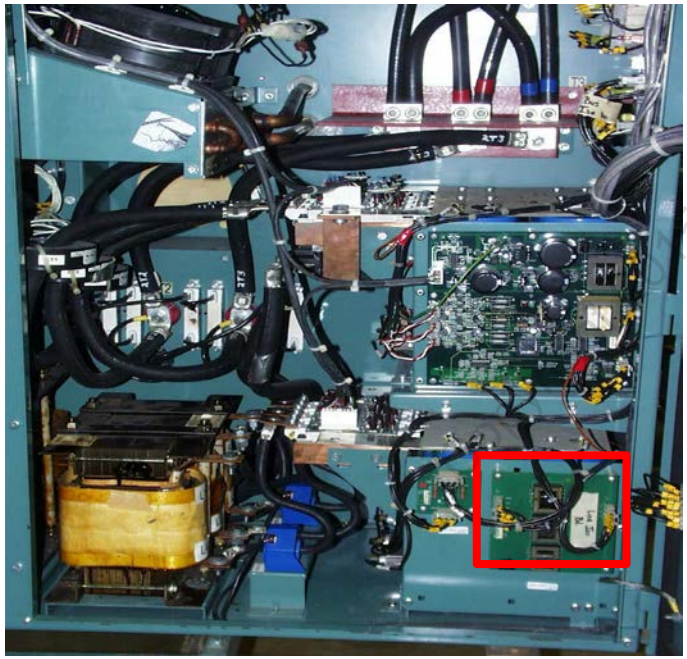


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Isolator Boards

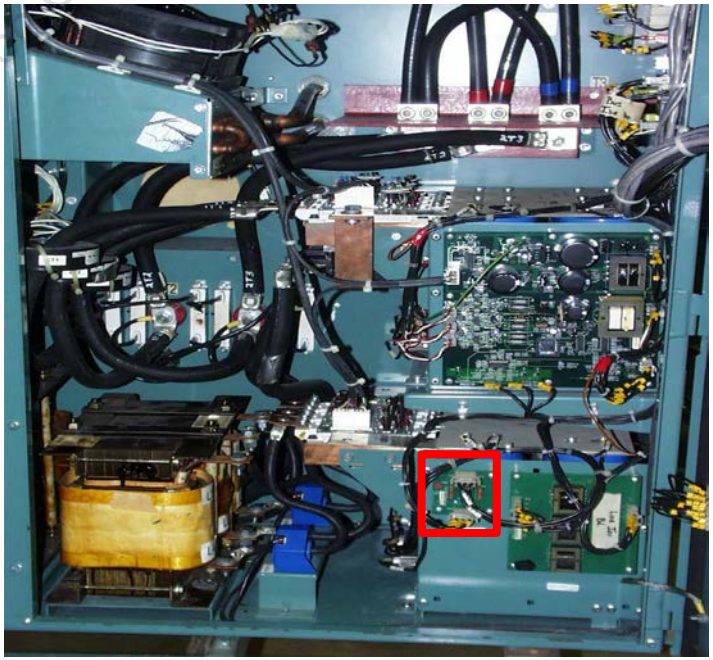
Harmonic Filter Line Isolator Board

Conditions the AC line voltage down to a safe level for the harmonic filter logic board to monitor the AC line voltage



Harmonic Filter Bus Isolator Board

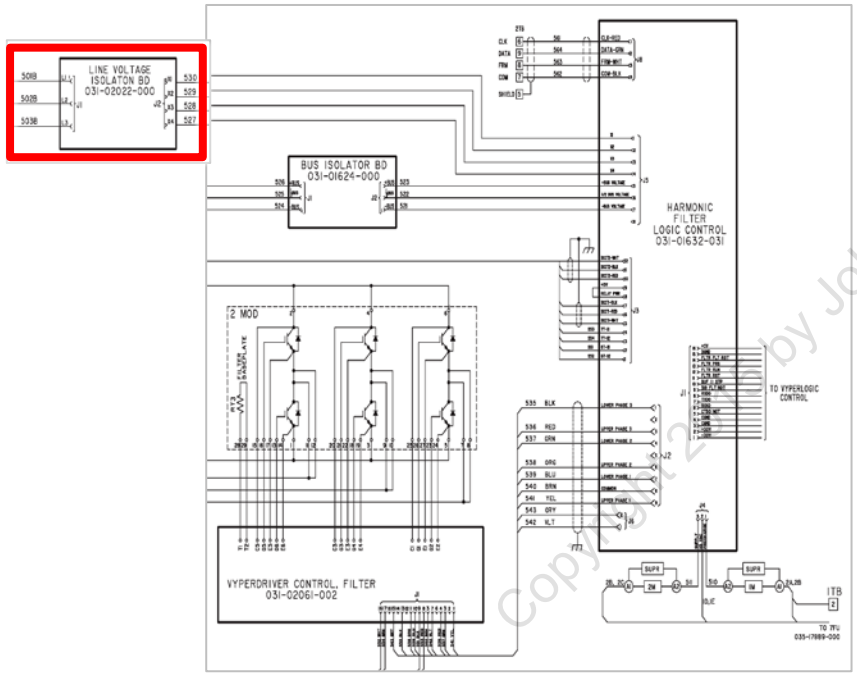
Conditions the filter DC bus voltage down to a safe level for the harmonic filter logic board to monitor the filter DC bus voltage



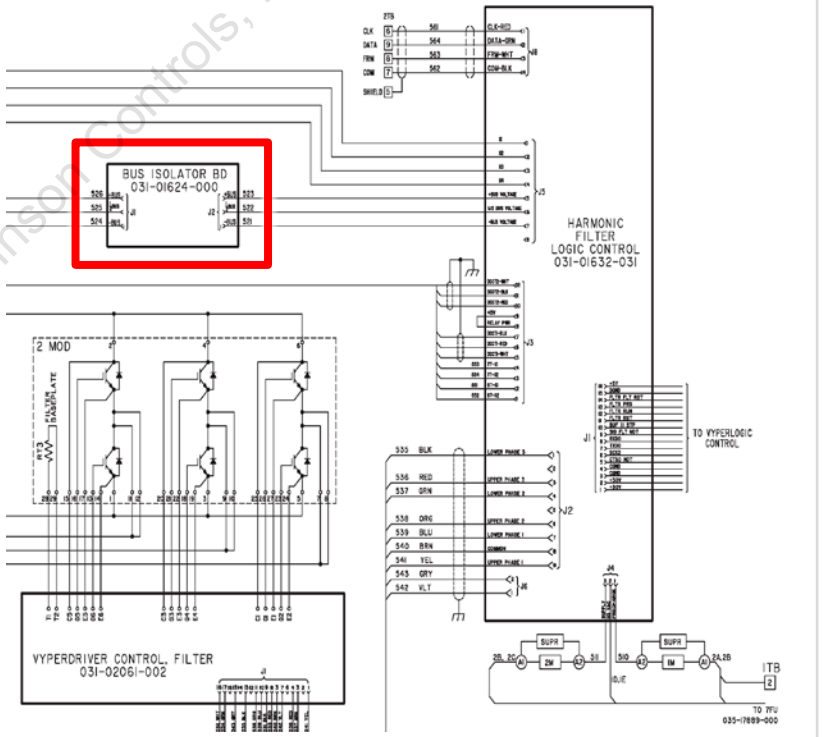
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Isolator Boards (Contd.)

Harmonic Filter Line Isolator Board



Harmonic Filter Bus Isolator Board



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All Chiller Models

- VSD Operation
  - VSD Cooling
- Control board and VSD logic board interaction
- Components of harmonic filter
- **Troubleshoot VSD**

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Safety Equipment

Assemble the appropriate safety equipment including:

- Padlock
- Multi-lock hasp
- “Danger: Do not operate” tag
- Safety glasses



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- DC voltage on the VSD DC Bus takes five minutes to bleed off after AC power is removed. Check the DC Bus voltage using a Voltmeter before working on the system.
- Personnel not familiar with AC drives and proper electrical safety procedures should not work on this chiller.

Turning Off the Circuit Breaker

Turn-off the control panel circuit breaker disconnect switch.



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Lock-out/Tag-out

1. Turn-off the service disconnect switch
2. Use the appropriate Lock-out/Tag-out procedures
3. Wait for at least five minutes after disconnecting power
4. Open the control panel cabinet



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Checking VOM

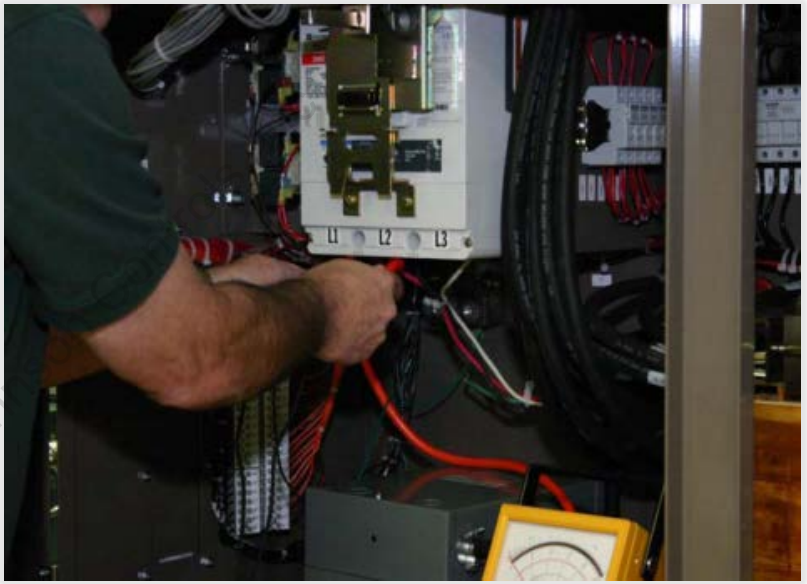
1. Verify if VOM is operational
2. Do not assume that it is functional



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Verifying Absence of Voltage

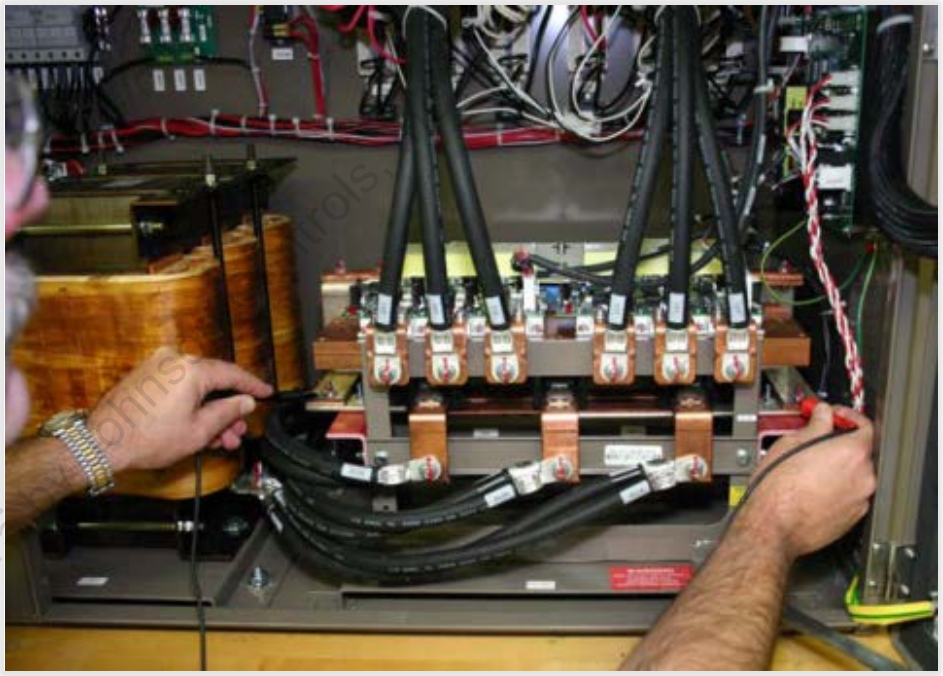
1. Do not assume that voltages are no longer present
2. Use VOM to verify that no voltage exists on any of the 3-phases downstream of the circuit breaker/disconnect



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Verifying DC Bus

Measure across the Positive (+) and Negative (-) DC Bus to verify full discharge.

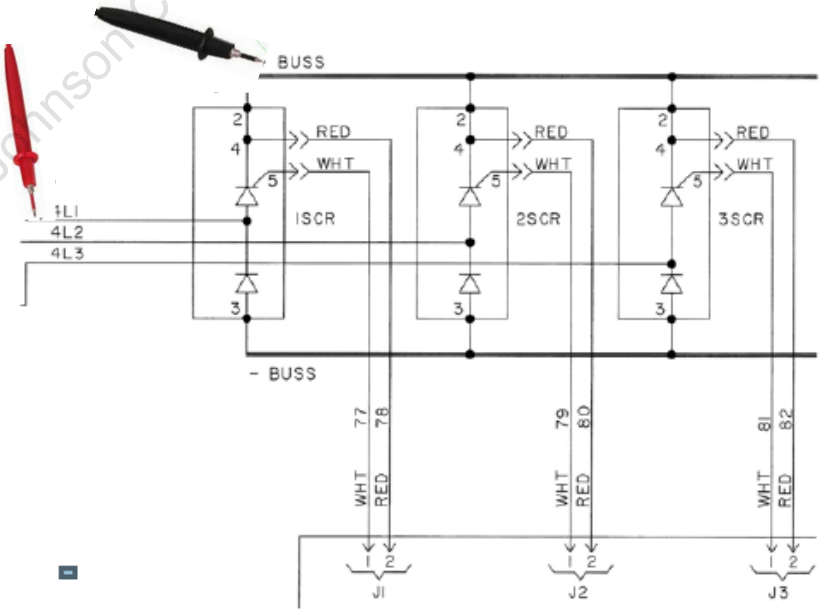


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Checking SCR Resistance in Semi-converter Modules

1. Use an analog VOM on Rx1 scale and place the VOM's Positive (+) probe on 4L1
2. Place the Negative (-) probe on the Positive (+) DC Bus. The reading should be high resistance

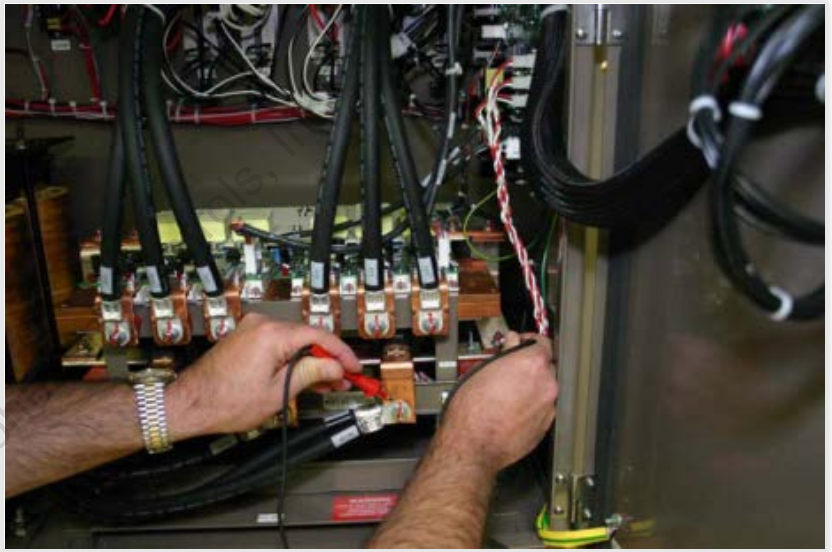




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Checking SCR Resistance in Semi-converter Modules (Contd.)

1. Use an analog VOM on Rx1 scale and place the VOM's Negative (-) probe on 4L1
2. Place the Positive (+) probe on the Positive (+) DC Bus. The reading should be high resistance
3. Repeat this process for 4L2 and 4L3

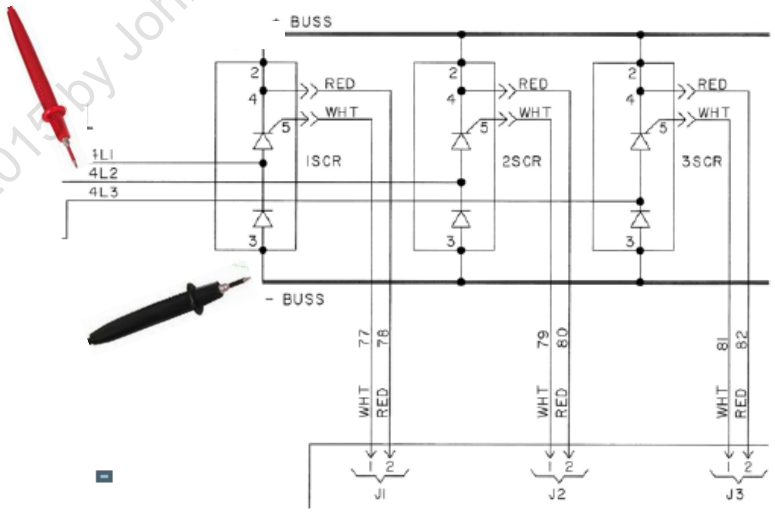


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Checking the Diode Resistance in Semi-converter Modules

1. Use an analog VOM on Rx1 scale and place the VOM's Positive (+) probe on 4L1
2. Place the Negative (-) probe on the Negative (-) DC Bus. The reading should be high resistance
3. Repeat this process for 4L2 and 4L3

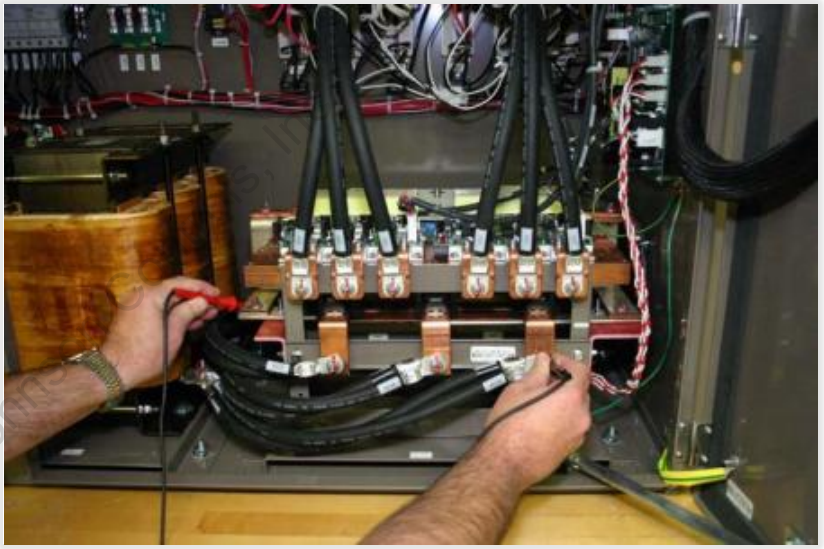




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Checking the Diode Resistance in Semi-converter Modules (Contd.)

4. Use an analog VOM on Rx1 scale and place the VOM's Negative (-) probe on 4L1
5. Place the Positive (+) probe on the Negative (-) DC Bus. The reading should be low resistance
6. Repeat this process for 4L2 and 4L3

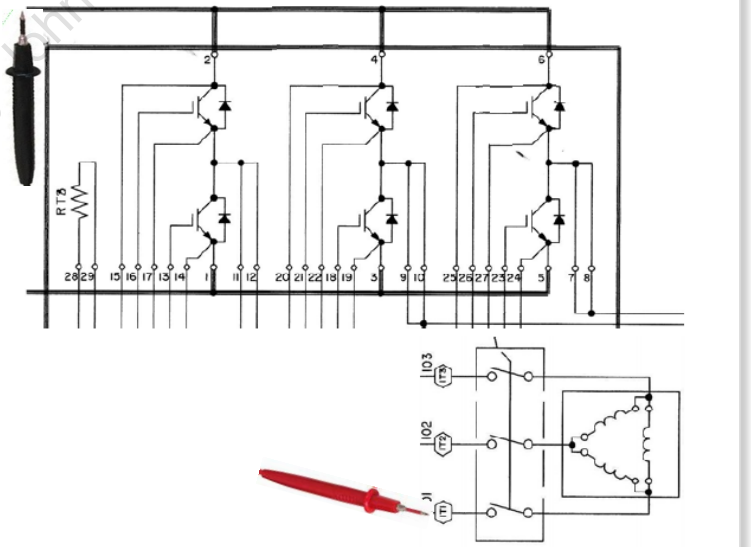


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Checking Resistance in Upper IGBT

1. Using an analog VOM on Rx1 scale, place the VOM's Positive (+) probe on the motor output terminal 1T1
2. Place the Negative (-) probe on the Positive (+) DC Bus. The reading should be low resistance
3. Repeat this process for 1T2 and 1T3

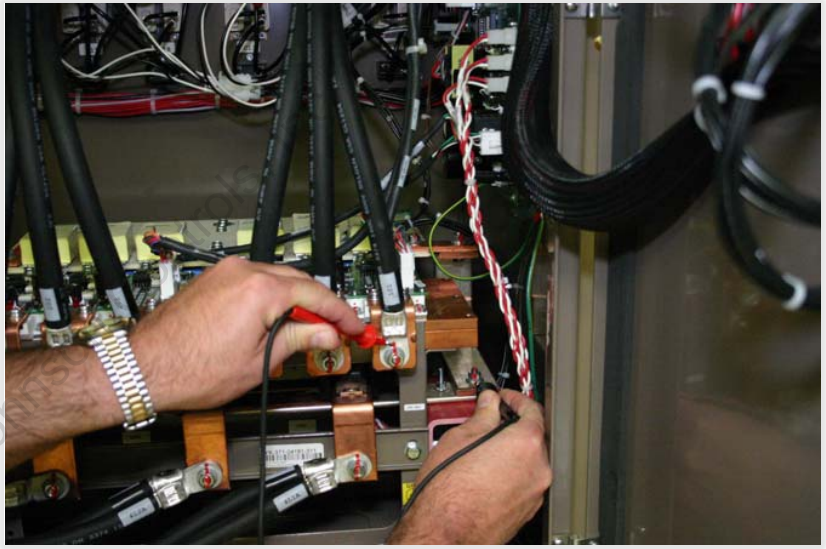




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Checking Resistance in Upper IGBT (Contd.)

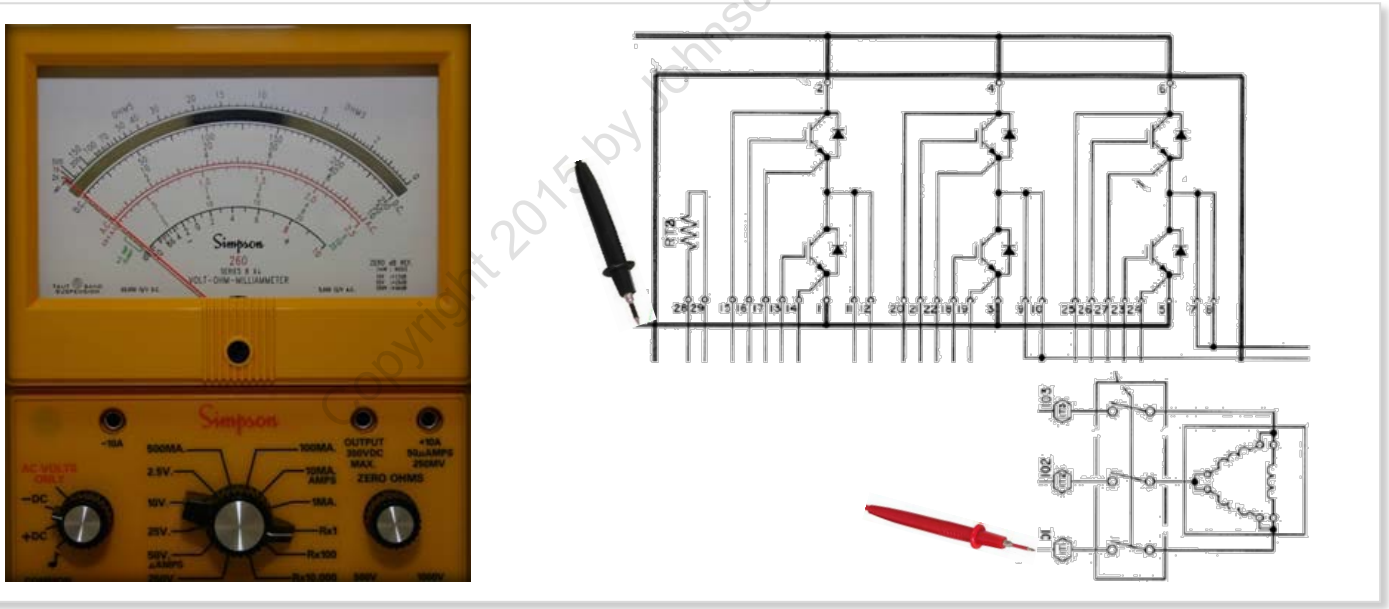
4. Use an analog VOM on Rx1 scale and place the VOM's Negative (-) probe on the motor output terminal 1T1
5. Place the Positive (+) probe on the Positive (+) DC Bus. The reading should be high resistance
6. Repeat this process for 1T2 and 1T3



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Checking Resistance in Lower IGBT

1. Use an analog VOM on Rx1 scale and place the VOM's Positive (+) probe on the motor output terminal 1T1
2. Place the Negative (-) probe on the Negative (-) DC Bus. The reading should be high resistance
3. Repeat this process 1T2 and 1T3



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Checking Resistance in Lower IGBT (Contd.)

4. Use an analog VOM on Rx1 scale and place the VOM's Negative (-) probe on the motor output terminal 1T1
5. Place the Positive (+) probe on the Negative (-) DC Bus. The reading should be low resistance
6. Repeat this process for 1T2 and 1T3

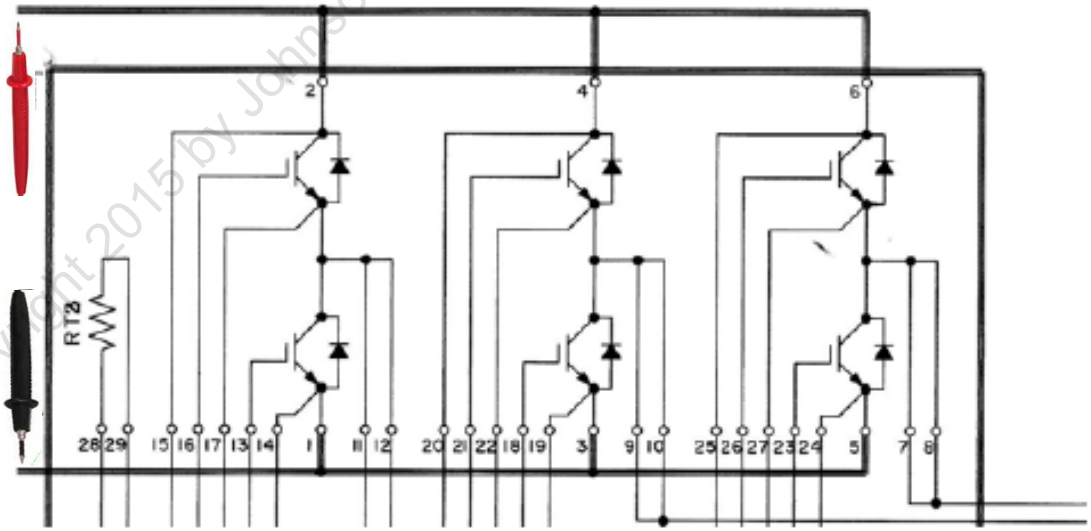


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Checking Resistance in DC Bus

1. Use an analog VOM on Rx100 scale and place the VOM's Positive (+) probe on the Positive (+) DC Bus
2. Place the Negative (-) probe on the Negative (-) DC Bus. The reading should be approximately 4000 Ohms after about one minute

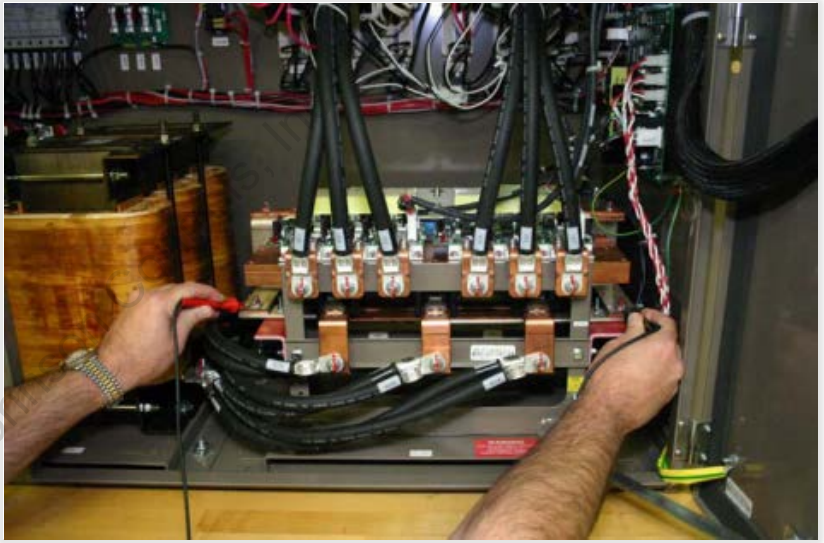




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Checking Resistance in DC Bus (Contd.)

3. Use an analog VOM on Rx100 scale and place the VOM's Positive (+) probe on the Negative (-) DC Bus
4. Place the Negative (-) probe on the Positive (+) DC Bus. The reading should be low resistance



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Exercise

VSD Troubleshooting

For each trouble scenario on the next slide:

- Identify up to four possible causes
- Prioritize the possible causes
- Describe a troubleshooting methodology to eliminate each possible cause
- Group A: VSD communications failure
- Group B: VSD CT plug (hardware) fault
- Group C: High VSD internal ambient temperature (software) fault
- Group D: DC Bus voltage imbalance (software) fault

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VSD Manuals



Open
IOM (201.21-M1)

SECTION

Troubleshooting Unit Shutdowns

Open
IOM (201.21-M2)

SECTION

FORM 201.21-M1

Open
IOM (201.30-M1)

SECTION

Maintenance: Troubleshooting Guide



YORK BY JOHNSON CONTROLS

WATER-COOLED SCREW LIQUID CHILLERS

SERVICE MANUAL | Supersedes: 201.30-M1 (612) | Form 201.30-M1 (912)

MODEL YVWA
Dual Compressor
Style A
50 Hz and 60 Hz
200 - 300 Tons
703 - 1055 kW

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Exercise: Identification and Prioritization of Causes

Identify and prioritize the causes and describe a troubleshooting methodology.

- Group A: VSD communications failure
- Group B: VSD CT plug (hardware) fault
- Group C: High VSD internal ambient temperature (software) fault
- Group D: DC Bus voltage imbalance (software) fault

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Duration: 10 minutes

VSD Troubleshooting Scenarios

Scenario 1	Low DC Bus Voltage (Software) Fault
Scenario 2	DC Bus Voltage Imbalance (Software) Fault
Scenario 3	High DC Bus Voltage (Hardware) Fault
Scenario 4	High Motor Current (Hardware) Fault
Scenario 5	Motor Current Overload (Software) Fault
Scenario 6	IGBT Gate Drive (Hardware) Fault
Scenario 7	High VSD Internal Ambient Temperature (Software) Fault
Scenario 8	Single Phase Input (Hardware) Fault
Scenario 9	Power Supply (Hardware) Fault
Scenario 10	VSD Run Relay (Software) Fault
Scenario 11	VSD Logic Board (Software) Fault
Scenario 12	VSD CT Plug (Hardware) Fault

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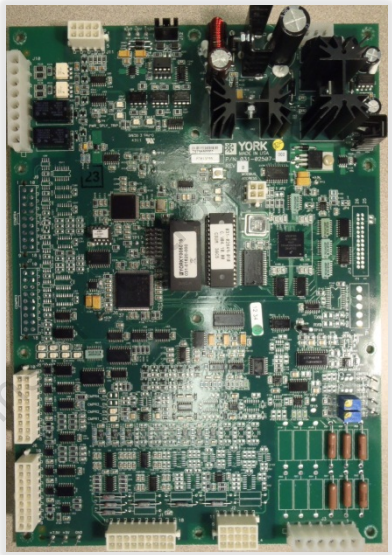
High Baseplate Temperature

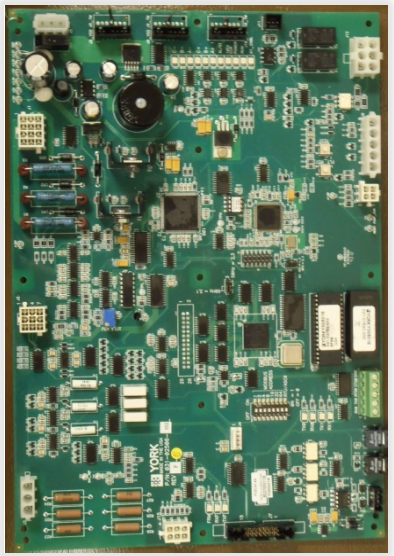
Possible Causes

1. Low coolant level
2. Defective coolant pump/VSD board
3. Defective sensor

What to do?

1. Add coolant if the coolant is low
2. Replace the defective coolant pump/VSD board
3. Check the defective sensor





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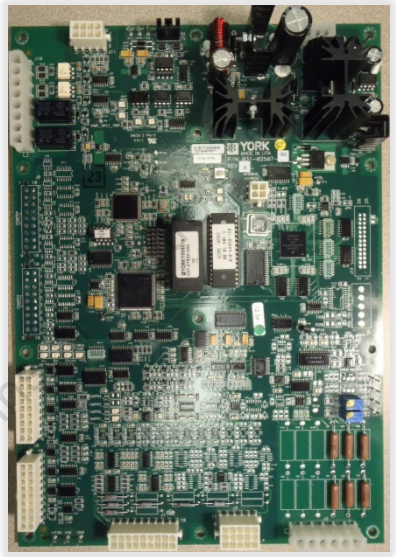
Low DC Bus Voltage

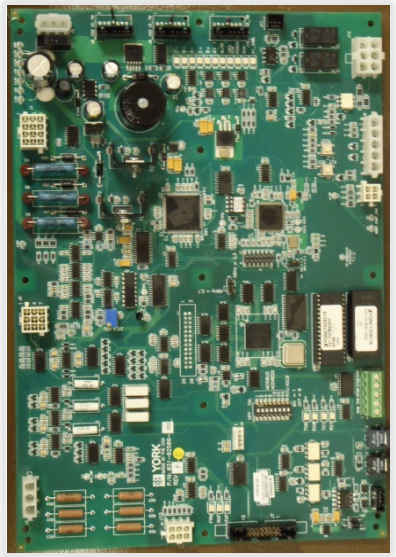
Possible Causes

1. Live voltage sag
2. Defective SCR or trigger board

What to do?

1. Evaluate indicators of power feed at the time of event
2. Check the VSD





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Line Fuse Blows

Possible Causes

1. Defective VSD assembly

What to do?

1. Replace the VSD components diagnosed to be the cause
2. Replace all three line fuses



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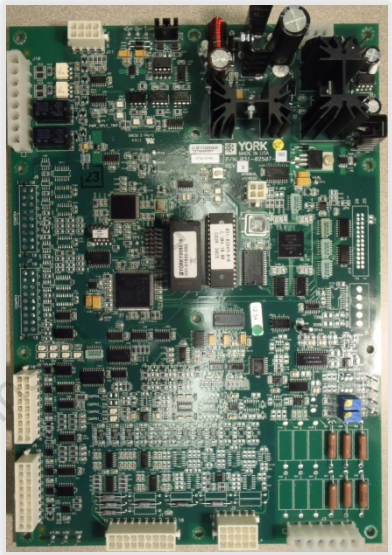
VSD Logic Board Failure

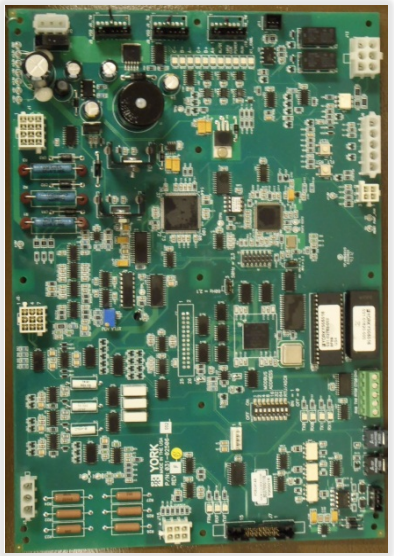
Possible Causes

1. Power supply problem
2. Software problem

What to do?

1. Replace the logic board
2. Write down the programmed RLA for each compressor
3. Follow the drive discharge procedure
4. Remove the existing logic board from the VSD





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Key Takeaways – VSD Operation & Troubleshooting

- The VSD accepts a fixed supply voltage and frequency as an input, and provides an output of variable voltage and frequency to the motor
- The VSD provides much higher efficiency at part-load or off-design conditions as compared to a fixed speed screw chiller
- The chiller control board is the controller and the master decision maker in the control panel
- The VSD logic board converts the speed and run commands from the chiller control board into the necessary voltage and frequency commands to operate the inverter section of the VSD
- The inhibited water cooled heatsink, called a chillplate, provides cooling for the IGBT modules and the input rectifier modules in the VSD

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Installation Commissioning



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Objective

After completing this lesson, you will be able to:

- Evaluate the typical screw chiller installation for conformance with the Installation and Operation Manual (IOM) requirements.
- Expand a standard commissioning checklist to include specific requirements for each York screw chiller.

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Discussion



Have you been involved with:

- Installation and startup of a new or replacement chiller?
- Seasonal re-start?
- Re-start after long-term storage?

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Installation Similarities and Differences





YCAV



YCIV



YVAA



YVWA

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Chiller Installation Sections

- **YVAA Installation**
  - Site Verification
    - Location Requirements & Clearances
  - Unit Rigging
  - Vibration Isolators
- YVWA Installation
  - Site Verification
    - Location Requirements & Clearances
  - Unit Rigging
  - Vibration Isolators
  - Shipment
  - Assembly
- All Chillers
  - Liquid Piping
  - Electrical Connections

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YVAA: Site Verification



Open
IOM (201.28-NM1.1)

SECTION 4

Installation



YORK BY JOHNSON CONTROLS

AIR-COOLED SCREW LIQUID CHILLERS

INSTALLATION, OPERATION & MAINTENANCE | Supersedes: Nothing | FORM 201.28-NM1 (1010)

035-?????-???

AIR-COOLED SCREW LIQUID CHILLERS
WITH VARIABLE SPEED DRIVE
STYLE A
MODELS
YVAA0153-0278 50 & 60 HZ
2 COMPRESSOR
(525-950 KW)

HFC-134A

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YVAA – Site Verification: Location Requirements



- Adequate air supply
- Minimal sun exposure
- Avoid flues and airborne chemicals
- Protected access
- Ground level: Concrete slab
  - Not secured to building foundation
- Roof: Adequate structural strength



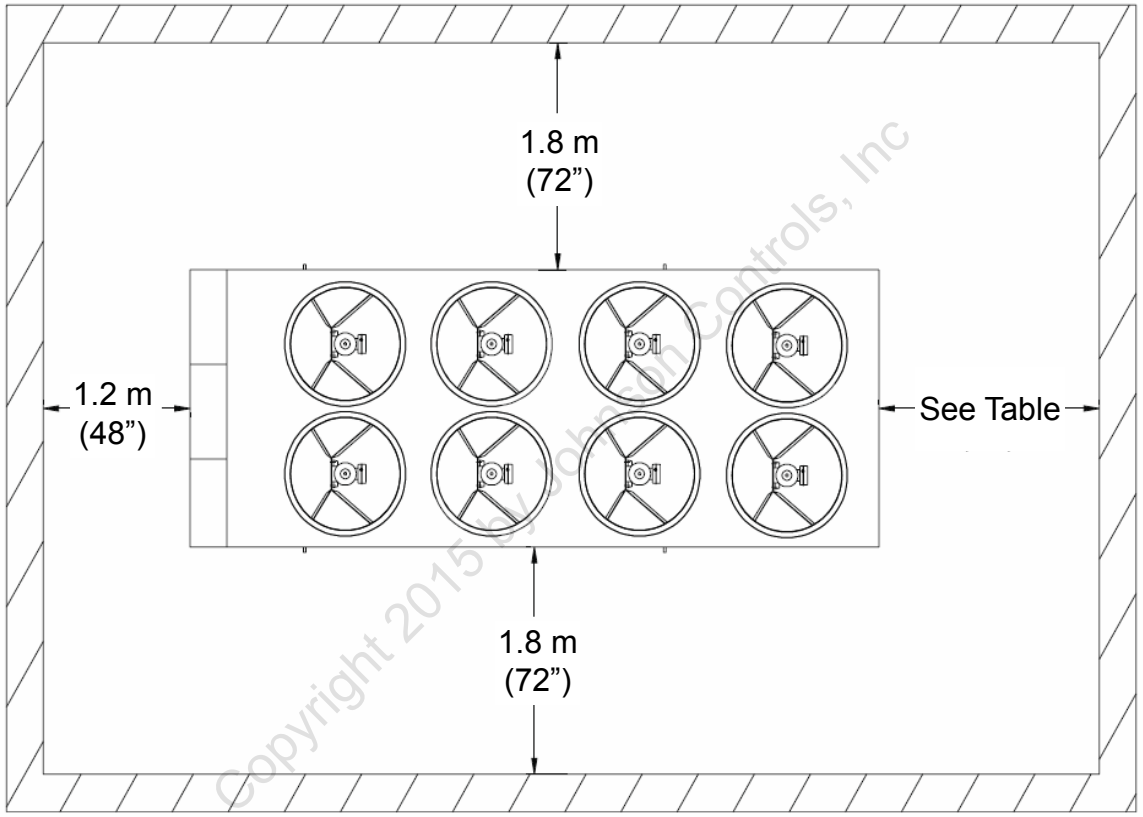
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Never lift using a forklift or by the top rails. Use only the lifting holes provided.

YVAA – Site Verification: Clearances





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CAUTION

- No obstructions above the unit.
- Only one adjacent wall may be higher than the unit.
- Adjacent units should be 3 meters (10 feet) apart.

YVAA – Site Verification: Clearances (Contd.)

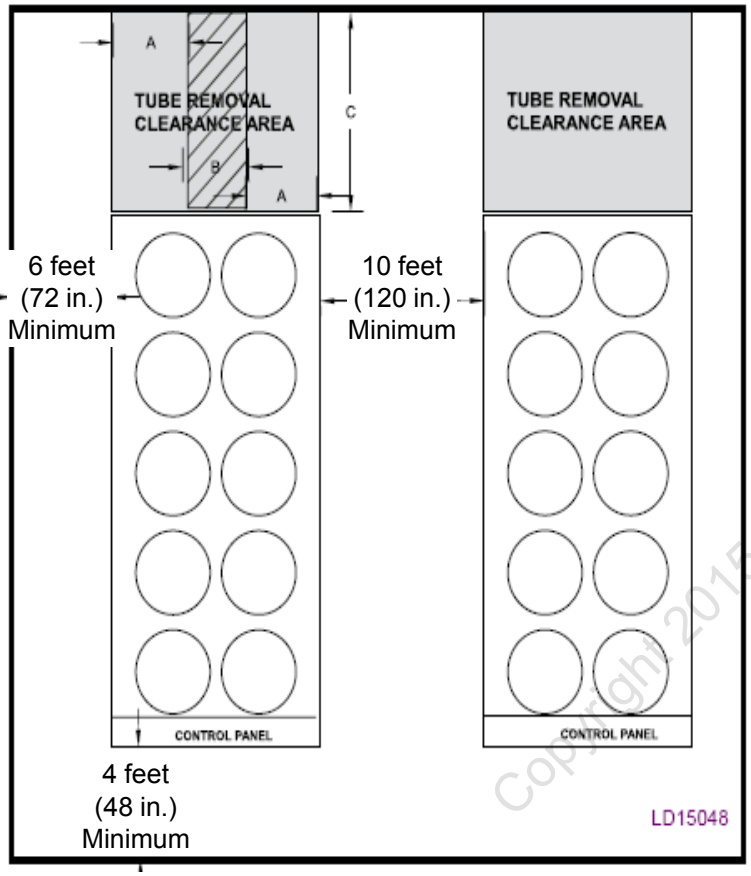


Figure 5

Model YVAA			Tube Removal Clearance Dimensions					
			A		B		C	
FRAME	EVAP	COND	IN.	MM	IN.	MM	IN.	MM
015	3	B	26	663	36	914	132	3353
016	5	B	26	663	36	914	132	3353
017	8	C	26	663	36	914	156	3962
018	3	A	26	663	36	914	144	3658
019	5	A	26	663	36	914	144	3658
019	8	B	26	663	36	914	132	3353
020	0	C	26	663	36	914	156	3962
021	3	A	26	663	36	914	144	3658
021	5	C	26	663	36	914	156	3962
021	8	C	26	663	36	914	156	3962
023	3	B	26	663	36	914	132	3353
024	5	C	26	663	36	914	156	3962
024	8	C	26	663	36	914	156	3962
026	3	B	26	663	36	914	132	3353
027	5	E	26	663	36	914	192	4877
027	8	E	26	663	36	914	192	4877

Table 1

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Poor Location



- Construction debris. No air flow to one side of the coil and re-circulation of air.



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Poor Location (Contd.)



- No air flow to either side of the coil and re-circulation of air.



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Poor Location (Contd.)



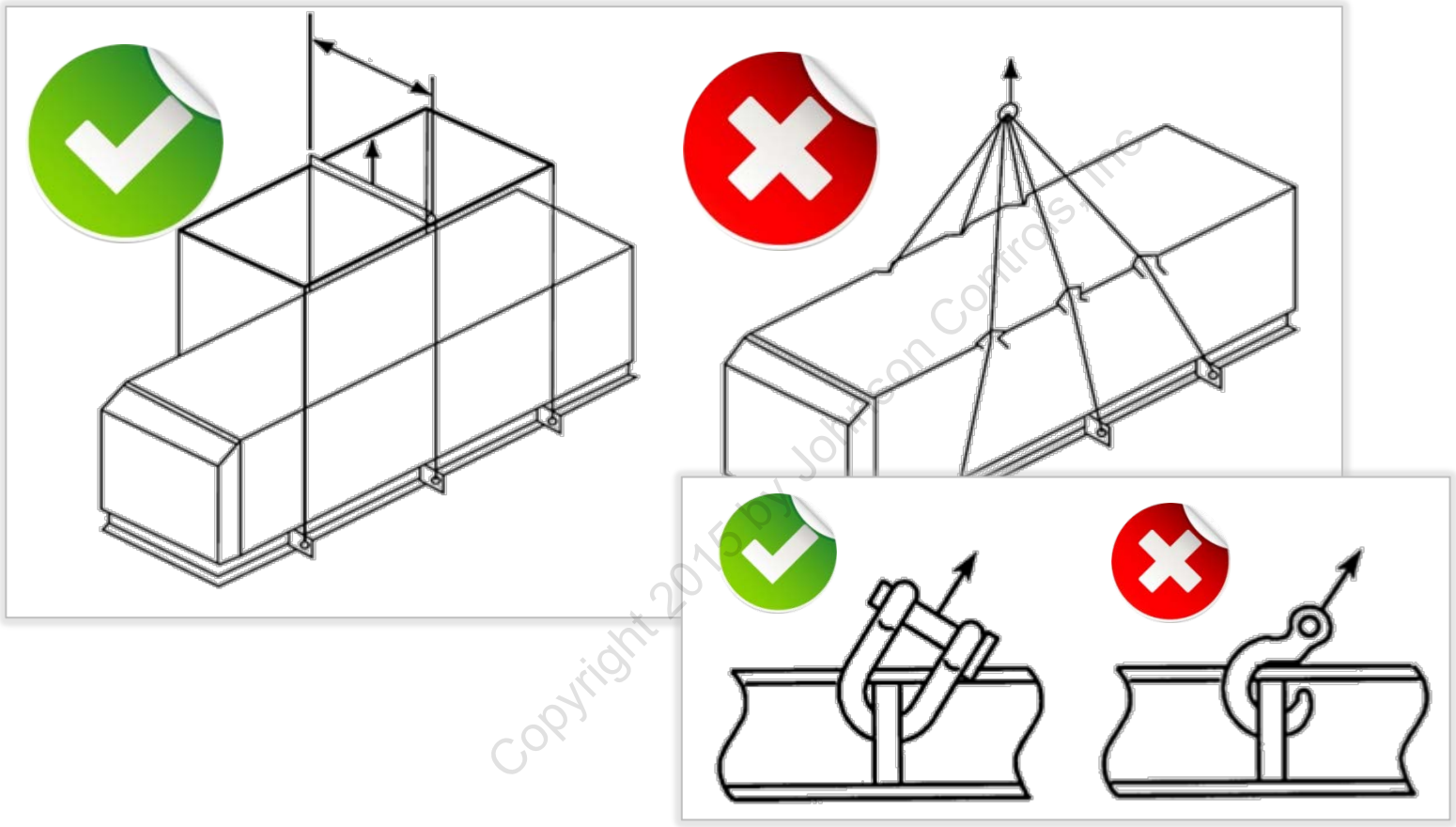
- Discharged air from one chiller acts as inlet air to another due to recirculation.



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YVAA – Unit Rigging





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To avoid unit damage, use spreader bar and attach harness to unit lifting lugs using shackles or safety hooks.

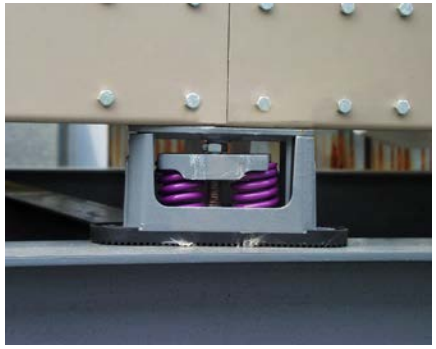
YVAA – Unit Rigging (Contd.)



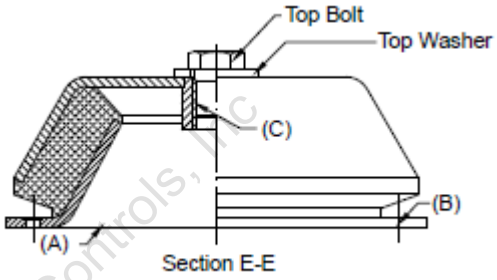
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YVAA – Vibration Isolators: Options



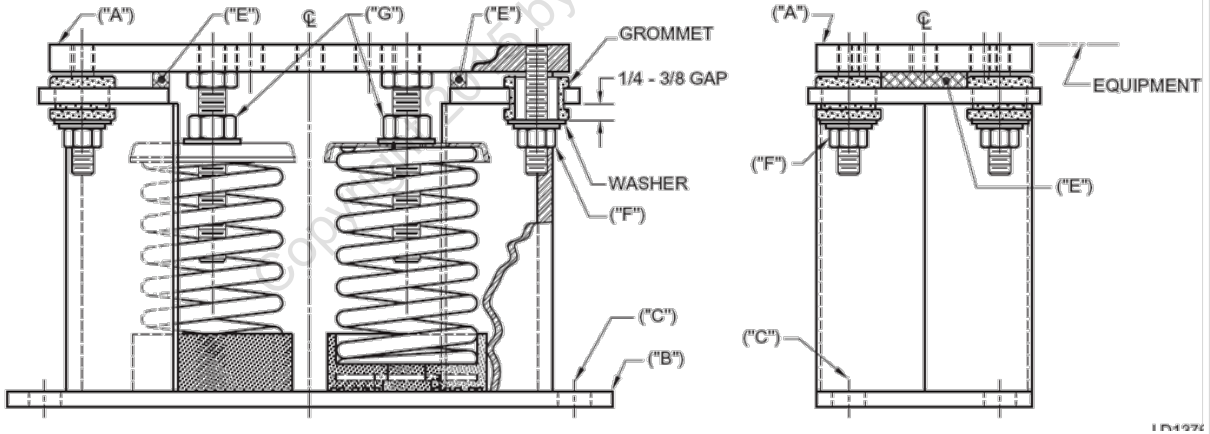


One inch spring isolators



Elastomeric isolators

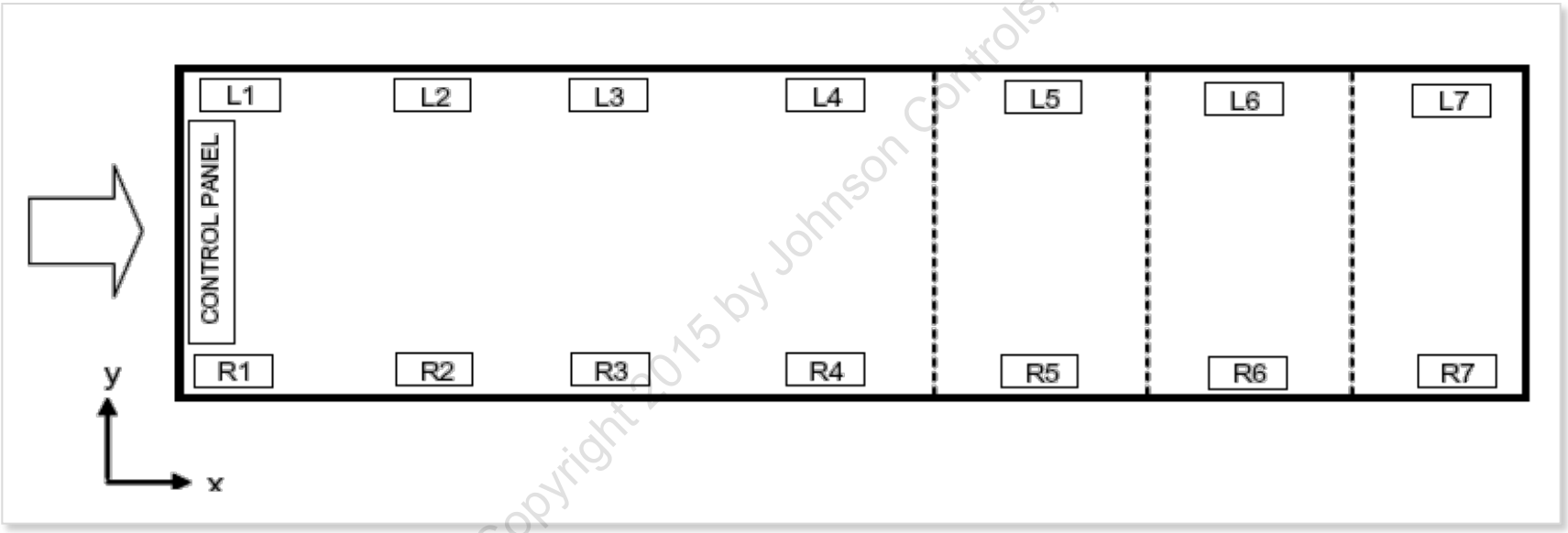
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Two inch spring isolators

YVAA – Vibration Isolators: Locations (Contd.)





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Verify the correct isolator placement and adjustment before start up.

Chiller Installation Sections

- YVAA Installation
  - Site Verification
    - Location Requirements & Clearances
  - Unit Rigging
  - Vibration Isolators
- **YVWA Installation**
  - Site Verification
    - Location Requirements & Clearances
  - Unit Rigging
  - Vibration Isolators
  - Shipment
  - Assembly
- All Chillers
  - Liquid Piping
  - Electrical Connections

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YVWA – Installation Challenges



- How will a water cooled chiller installation differ from an air cooled?
- Do you think a dual-circuit Style A chiller installation is different from a single circuit Style B chiller installation?

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YWVA Installation



Open
IOM (201.30-ICOM2)

SECTION

3. Installation

Open
Checklist (201.30-CL1)

CHECKLIST

A. General:

Open
Checklist (201.30-CL2)

CHECKLIST

Start-Up

YORK BY JOHNSON CONTROLS

WATER-COOLED SCREW LIQUID CHILLERS		
INSTALLATION, OPERATION, AND MAINTENANCE	Supersedes: 201.30-ICOM2 (512)	Form 201.30-ICOM2 (113)

MODEL YVWA
Dual Compressor
Style A
50 Hz and 60 Hz
200 - 300 Tons
703 - 1055 kW

Supersedes: 201.30-CL1 (312) Form 201.30-CL1 (912)

YORK BY JOHNSON CONTROLS — **MODEL – YVWA**

INSTALLATION CHECKLIST AND REQUEST FOR AUTHORIZED START-UP TECHNICIAN

CUSTOMER: _____ JOB NAME: _____
ADDRESS: _____ LOCATION: _____
PHONE: _____ CUSTOMER ORDER NO: _____
JCI TEL NO: _____ JCI ORDER NO: _____ JCI CONTRACT NO: _____

CHILLER MODEL NO: _____ UNIT SERIAL NO: _____
The work (as checked below) is in process and will be completed by: ____ / ____ / ____ (Month / Day / Year)

The following work must be completed in accordance with installation instructions:

A. YORK CHILLER

1. Unit checked for shipping damage ☐
   NOTE: Any damage MUST be reported to Johnson Controls immediately for inspection.
   Initials: _____
   Company Name: _____
   Date: _____
2. Unit assembled (if shipped dismantled) and refrigerant piping installed ☐
3. Vibration isolator mounted so that the unit is level and isolators are equally deflected ☐
4. If applicable, monitoring alarm is installed, functional, and operational ready for service ☐

B. WATER PIPING

1. Condenser water piping installed between condenser, pumps and cooling tower. ☐

C. REFRIGERANT RELIEF PIPING (When Required)

1. Refrigerant relief piping installed from unit to atmosphere (per local building code) ☐

D. ELECTRICAL WIRING

1. Variable Speed Drive (VSD):
   a. Main power supply available. ☐
   b. Wiring completed from main power supply up to VSD. NOTE: DO NOT cut to length or connect to drive without JCI supervision. ☐
2. External control wiring completed according to the wiring diagram shipped with the unit. ☐
3. Power available, wiring completed, and rotation checked to the following drives and motors:
   a. Chilled water pump(s) ☐
   b. Condenser water pump(s) ☐
   c. Cooling tower fan ☐
   NOTE: DO NOT check compressor motor.
4. Megohm tester available for checking motor

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YVWA – Site Verification: Location Requirements

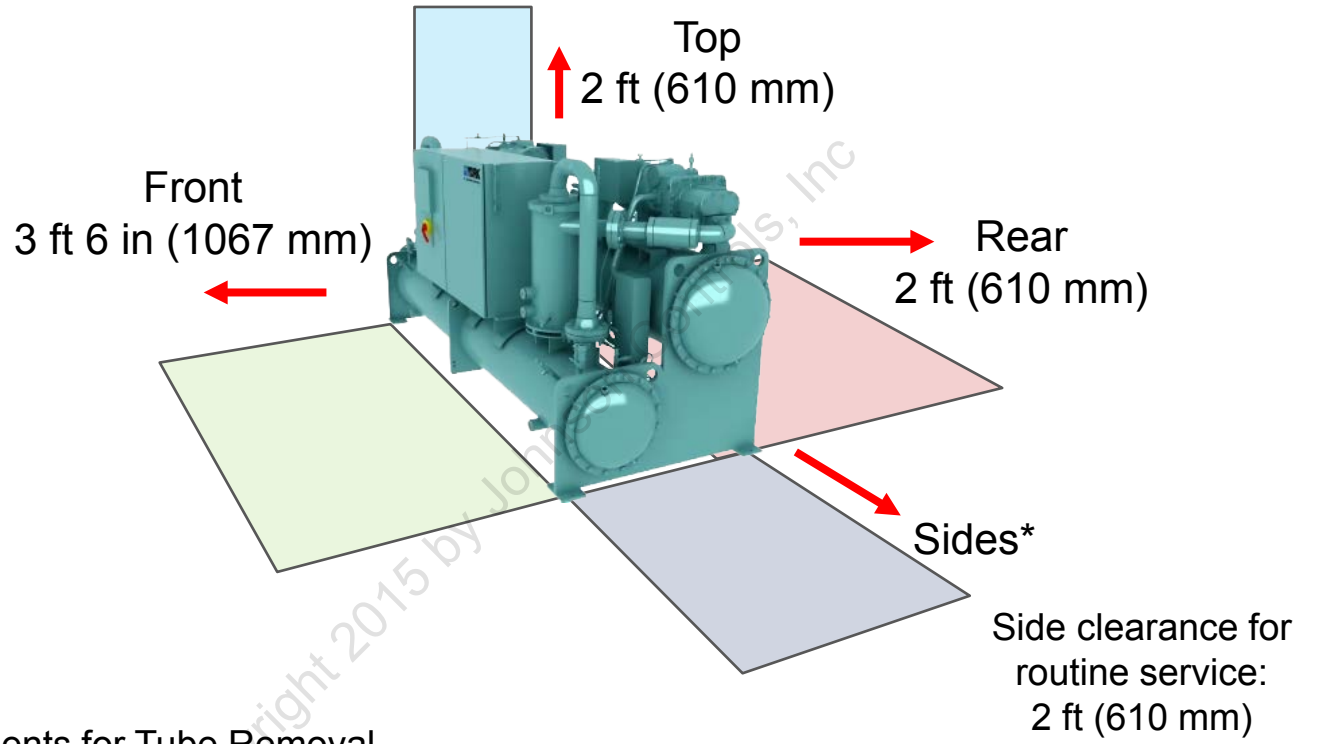


Verify the following during chiller installation:

- Located indoors; temperature range from 40 ℉ to 122 ℉ (4.4 ℃ to 50 ℃)
- Site is floor, mounting pad or foundation; level within 1/4” (6.4 mm)
- Construction supports total system operating weight
- Dew point temperature in equipment room must remain below entering condenser liquid temperature

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YVWA – Site Verification: Clearances



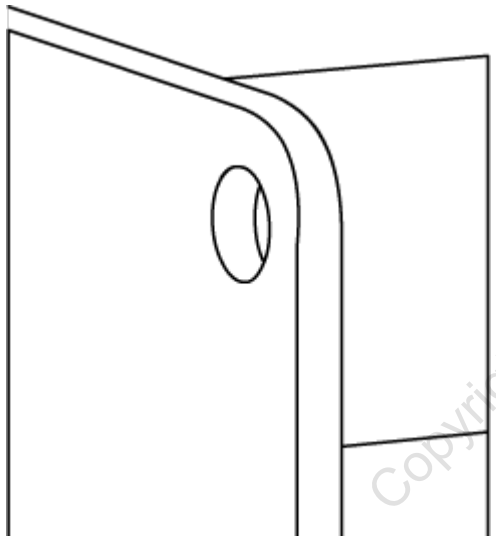
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*Clearance Requirements for Tube Removal

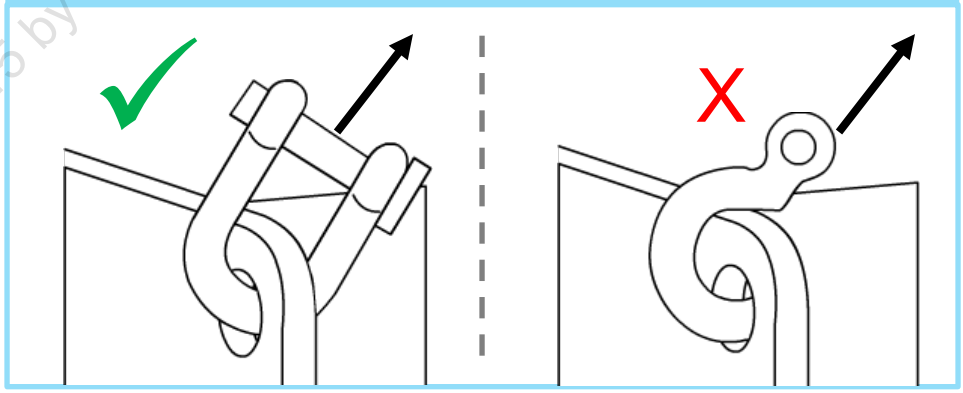
Shell Code	Tube Removal Space		Add Marine Water Boxes	
	Ft-in	mm	Ft-in	mm
M	12-1	3683	2-2	660
N	14-1	4293	2-2	660

YVWA – Unit Rigging

- Lift the unit by the end sheets at the points provided by using cables.



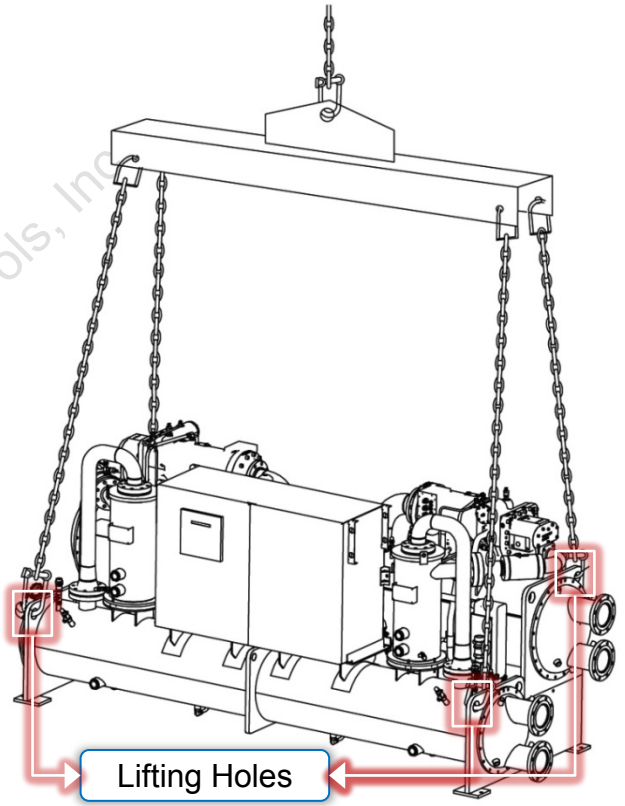
- Attach shackles or safety hooks to lifting eyes.
- Never lift the unit using a forklift truck.



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YVWA – Unit Rigging (Contd.)

- Use four lifting holes to lift the unit.
- Lift unit vertically.
- Keep the unit level.



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CAUTION

- Never lift unit with slings around compressor/motor assembly
- Never lift unit by eyebolts in compressor/motor assembly
- Do not turn unit on its side for rigging
- Do not rig with driveline in a vertical orientation.

YVWA – Rigging the Compressor

- Portable cranes must be of adequate capacity
- Position crane to prevent tipping or slipping while lifting
- Chains for lifting must be of adequate strength

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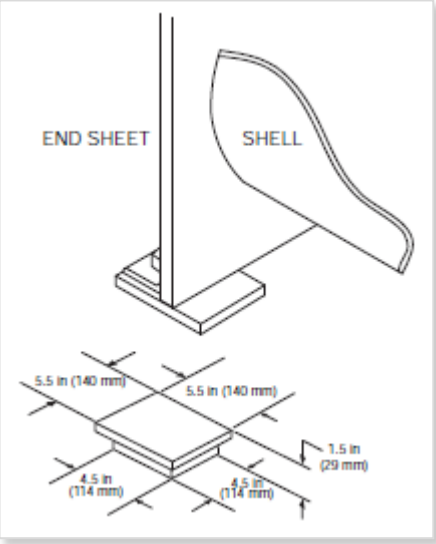
Compressor Weights

Compressor Code	Compressor Weight
CTS/WTS51	1383 lbs. (630 Kg)
CTS/WTS45	1150 lbs. (520 Kg)
CTS/WTS36	1135 lbs. (515 Kg)

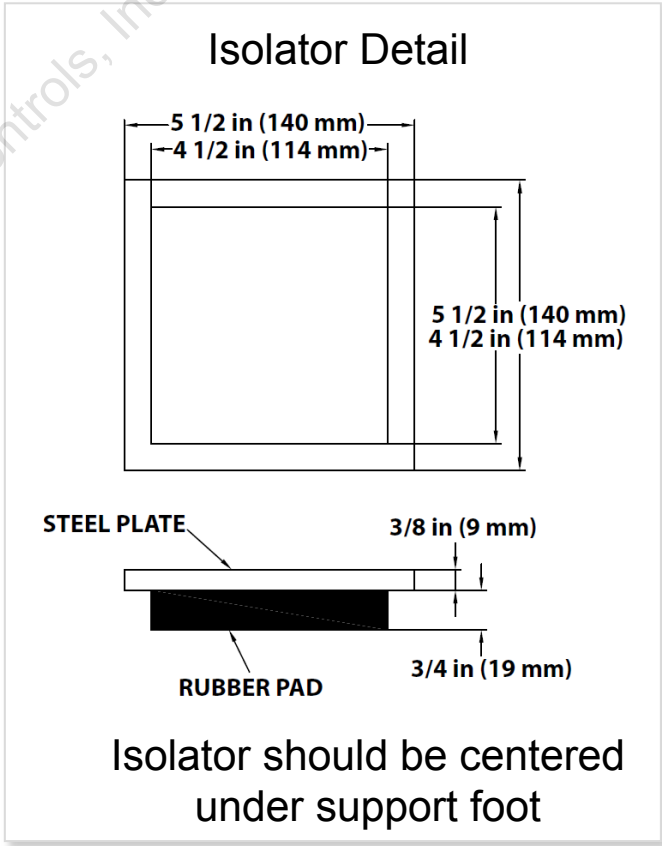


YVWA – Vibration Isolators: Elastomeric Pads

- Locate pads according to drawing



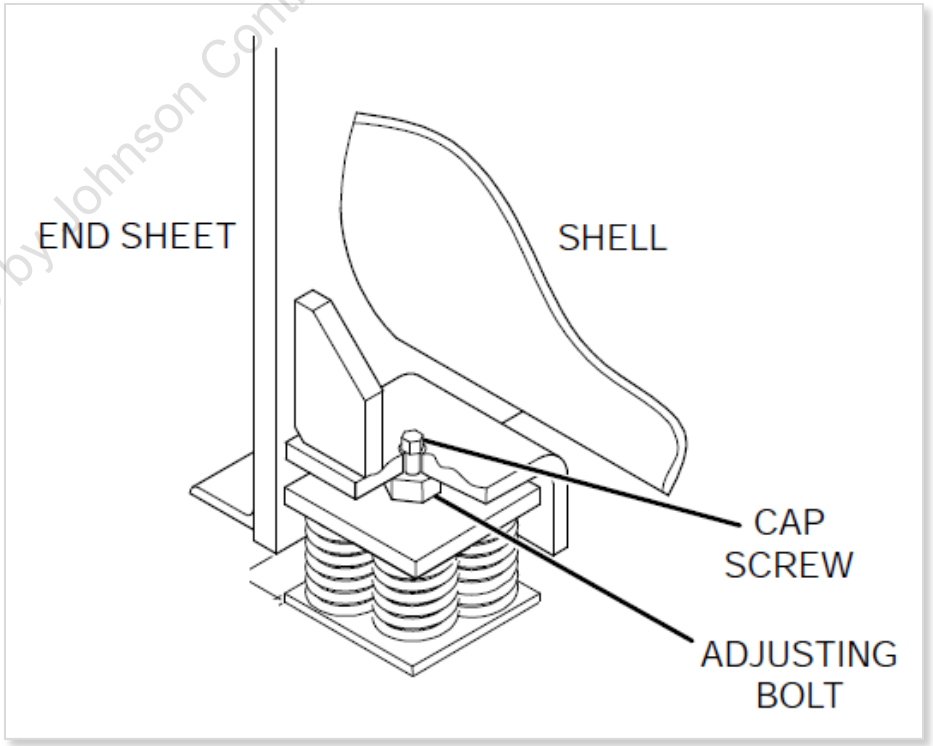
- Ensure that pads are even with edges of mounting feet.
- Level chiller longitudinally and transversely.



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YVWA – Vibration Isolators: Spring Isolators

- Rotate leveling bolts until unit end sheets are clear of floor
- Check unit level
- Wedge and shim under each corner to support unit while:
  - Piping connections are made
  - Pipe hangers adjusted and tightened
  - Connections checked for alignment and tightness
- Fill unit with water and check for leaks.
- Adjust leveling bolts and then remove shims.



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Shipment Options



- **Form 1**
  (Complete assembly and refrigerant charged)
- **Form 2**
  (Complete assembly without refrigerant)
- **Form 7**
  (Disassembled into packages)









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YVWA – Assembling a New Chiller

Share some of the challenges you may have encountered while assembling a chiller during:

- A new installation
- Re-installation due to repairs

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YVWA – Shipment Options



	Form 1	Form 2	Form 7*
Shipped Complete	✓	✓	✗
Refrigerant Charge	✓	✗	✗
Misc. Items			
Isolation Pads and Spring Isolators	✓	✓	✓
VSD Inhibitor	✓	✓	✓
Piping and Wiring	✓	✓	✓
Water Temperature Controls	✓	✓	✓

* Form 7 is shipped in split assemblies without refrigerant.

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Ensure that the refrigerant is on-site when the unit is ready to be charged.

YWVA Installation – Form 7

Open
IOM (201.30-ICOM2)

SECTION
3: Form 7 Reassembly

YORK BY JOHNSON CONTROLS	WATER-COOLED SCREW LIQUID CHILLERS	
INSTALLATION, OPERATION, AND MAINTENANCE	Supersedes: 201.30-ICOM2 (512)	Form 201.30-ICOM2 (113)

MODEL YVWA
Dual Compressor
Style A
50 Hz and 60 Hz
200 - 300 Tons
703 - 1055 kW

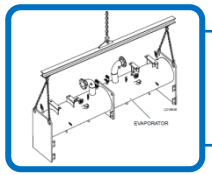


R-134a

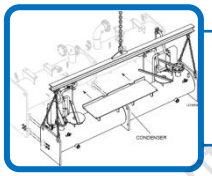
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YVWA – Chiller Assembly

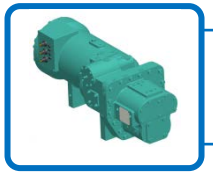
Form 7: The unit is assembled, tested, and inspected before disassembly for shipment.



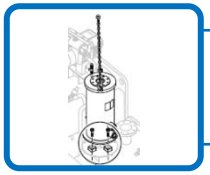
Evaporator



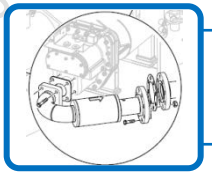
Condenser



Two drivelines (compressor/motor assembly)



Two oil separators



Two muffler kits



Variable Speed Drive (VSD) with Control Panel

- Discharge piping kits
- Loose piping and wiring harnesses
- Miscellaneous items
- Refrigerant

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Chiller Installation Sections

- YVAA Installation
  - Site Verification
    - Location Requirements & Clearances
  - Unit Rigging
  - Vibration Isolators
- YVWA Installation
  - Site Verification
    - Location Requirements & Clearances
  - Unit Rigging
  - Vibration Isolators
  - Shipment
  - Assembly
- **All Chillers**
  - Liquid Piping
  - Electrical Connections

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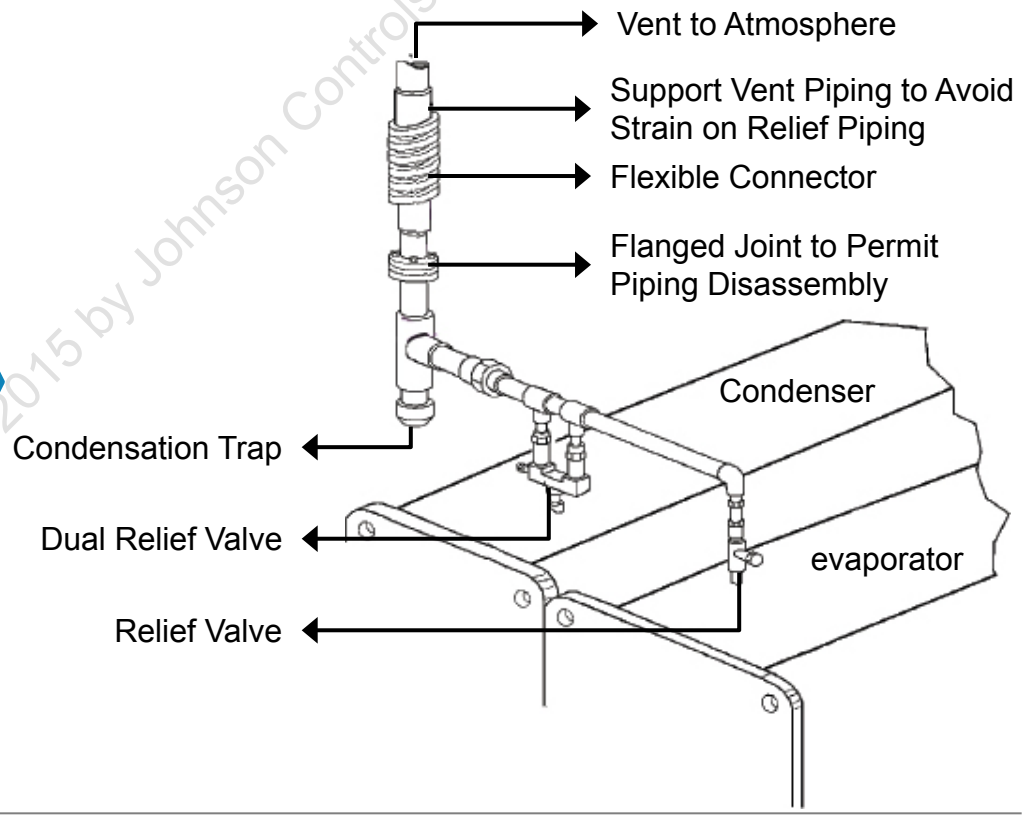
YVWA – Refrigerant Relief Piping

- Install refrigerant relief vent piping on all units.
- Do not mix valves on a common pipe.
- Ensure that outlets of relief valves or relief valve vent pipes remain clear of obstructions at all times.

Open
IOM (201.30-ICOM2)

SECTION
3: Installation

Sub-Section
Refrigerant Relief Valve



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Piping Checks



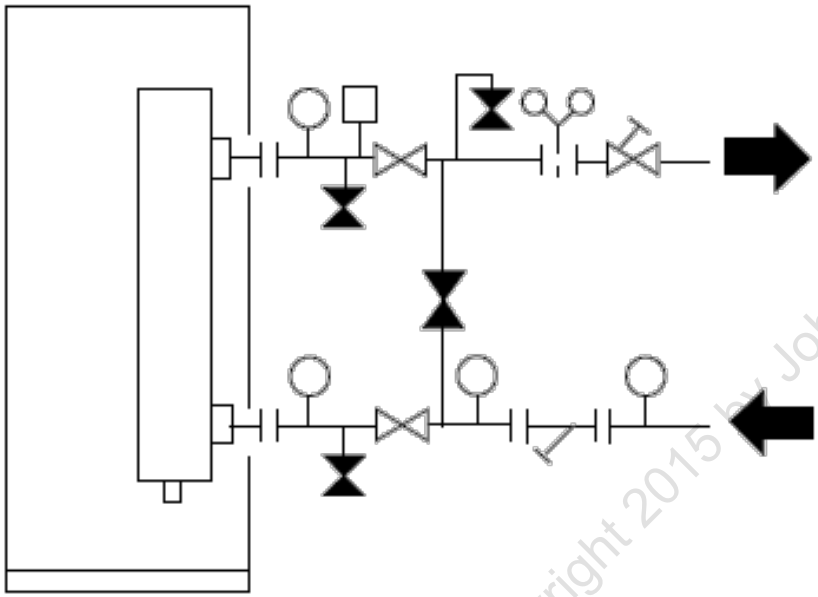
- ✓ Makeup and fill lines installed to cooling tower and chilled water system.
- ✓ Check all pipes for strain.
- ✓ Test water piping for leaks.
- ✓ Vent trapped air in water systems.
- ✓ Ensure that chilled and condenser water flow meets unit design requirements.

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YVAA – Chilled Liquid Piping



- Chilled water pipe connections and the required equipment



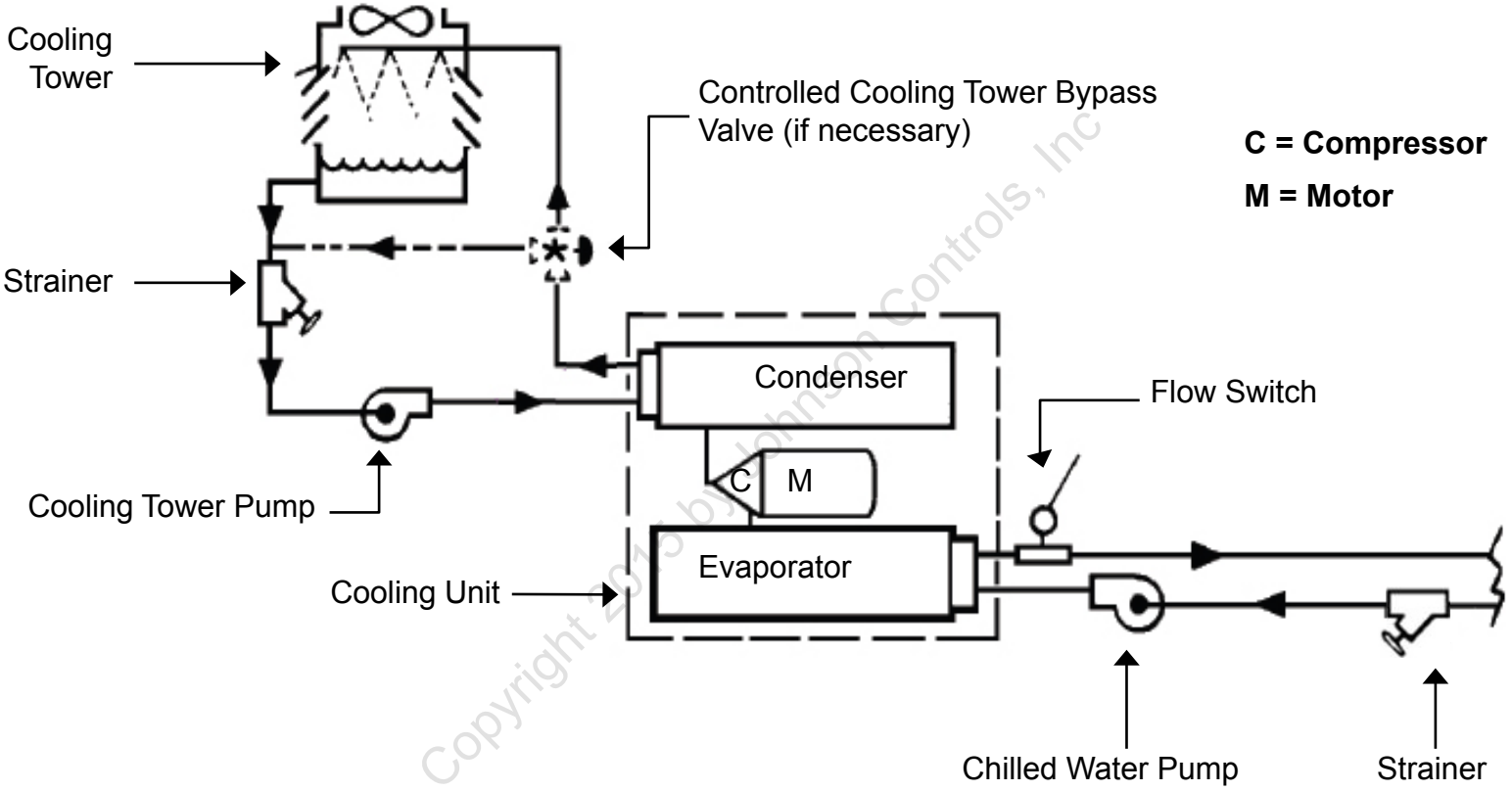
- Isolating valve – Normally open
- Isolating valve – Normally closed
- Flow regulating valve
- Flow measurement device
- Strainer
- Pressure tapping
- Flow switch
- Flanged connection
- Pipework

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CAUTION

- The maximum flow rate and pressure drop must not be exceeded
- Liquid must enter the evaporator at the inlet connection.
- A flow switch must be installed in the customer piping at the outlet

YVWA – Chilled Liquid & Condensor Piping



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CAUTION

- The maximum flow rate and pressure drop must not be exceeded
- Liquid must enter the evaporator at the inlet connection.
- A flow switch must be installed in the customer piping at the outlet

Checking Water Piping: Flow Switches

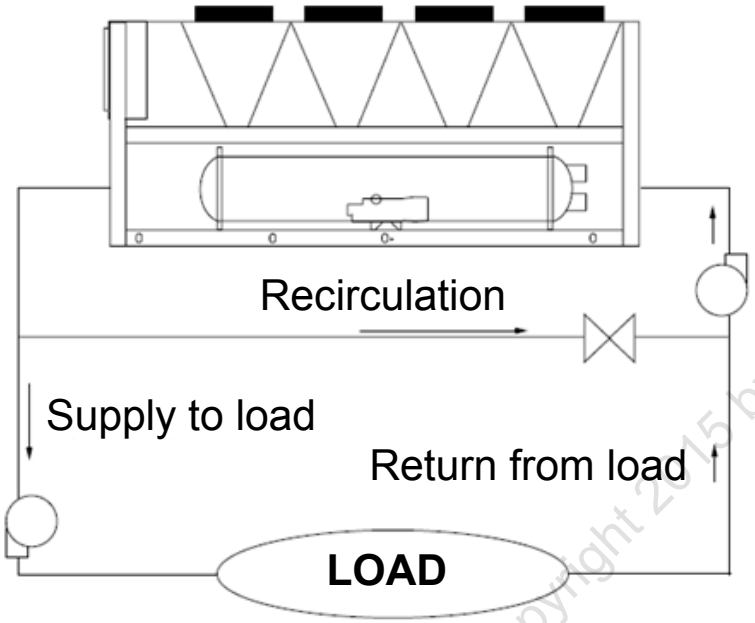
Recommendations

- Flow switch installed in customer piping at outlet of evaporator and condenser.
- Straight run of piping of at least five pipe diameters either side of flow switch.
- Flow switch wired to control panel using shielded cable.
- Flow switches must have gold plated contacts for low current operation.

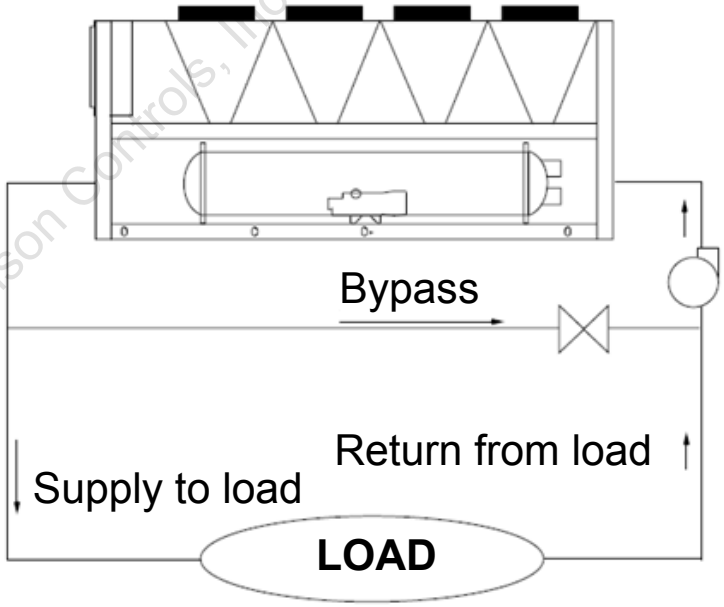
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YVAA – Piping Design Layouts





Flow Rate Less than Allowed

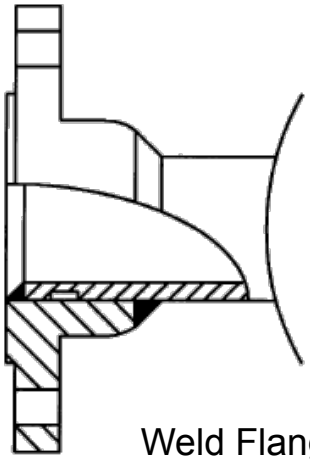


Return Water Temp Out-of-Range

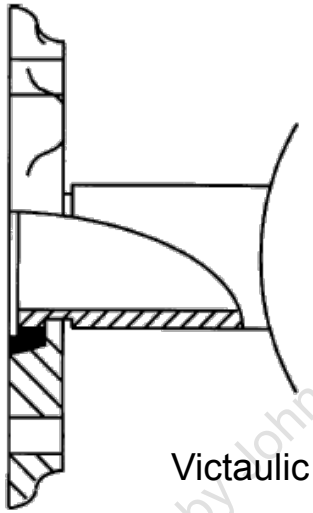
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Evaporator & Condensor Connections



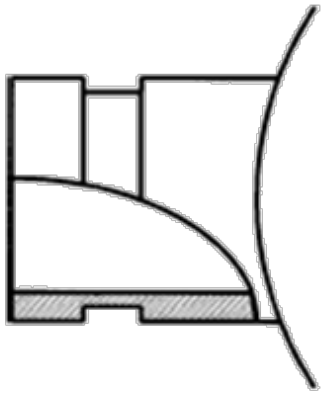


Weld Flange



Victaulic Adapter

FLANGE ATTACHMENTS



VICTAULIC GROOVE

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Disconnect GROUND from the chiller before welding any part to prevent damage to electronic circuit boards.

Checking Water Piping:
Condenser and Chilled Liquid



Ensure that:

- Liquid enters the waterbox at the inlet connection.
- Liquid pump discharges directly into the unit.
- Tubes are protected by a strainer fit as close as possible to liquid inlet.
- Piping can be easily removed to enable cleaning and inspection of exchanger nozzles.
- Flow rates and pressure drops for evaporator and condenser do not exceed the maximum.
- Chiller not exposed to flushing velocities or debris released during flushing.

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Checking Piping Circuits and Venting Air



Guidelines

- Tighten nuts on liquid head flanges and torque to specification.
- Using chilled and condenser water circuits filled, operate the pumps manually and check for leaks at evaporator and condenser water heads and piping.
- Repair the leaks, if required.

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Electrical Connections

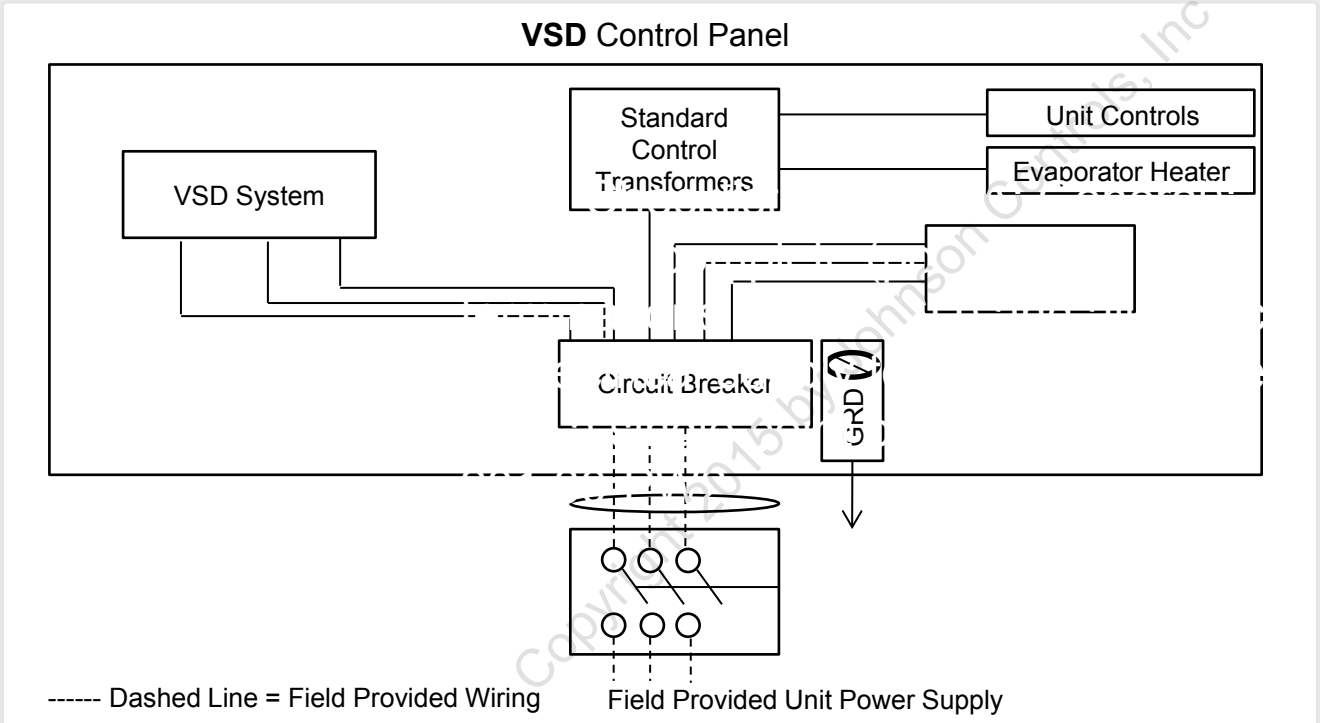


- ✓ Wiring completed from main power supply to VSD.
- ✓ Power available, wiring completed, and rotation checked for drives and motors.
- ✓ System inputs connected to their respective terminals of 1TB Terminal Block.
- ✓ External control wiring connected to respective terminals of 1TB Terminal Block.

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Electrical Supply: Single Point of Isolation

- Verify that all sources of electrical supply to the unit are taken from a single point of isolation.



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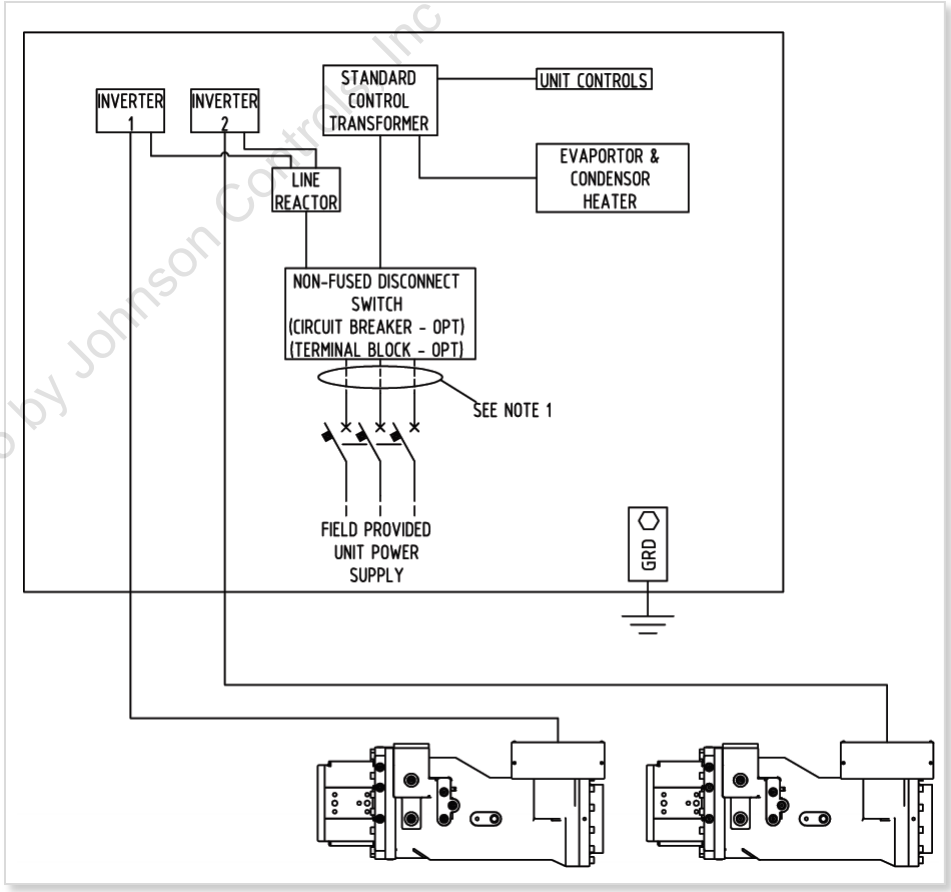
Start-up Checklist (Section A: General):

4. Wiring is complete (power feed terminations in the VSD) and all sources of electrical supply to the unit are taken from a single point of isolation per 201.30-PW2.

Wiring Diagram



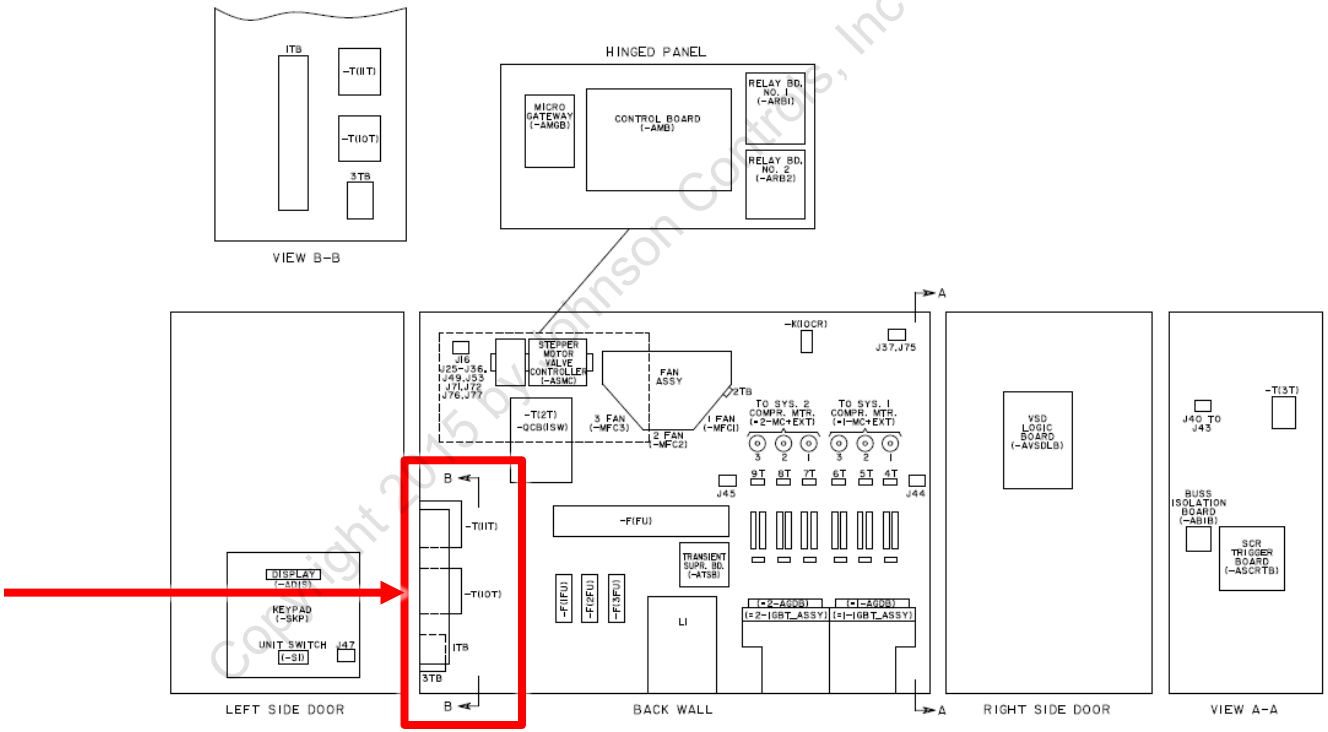
- Field-provided wiring is represented by a dashed line (---)
- Autotransformer :
  - YVAA - located in a separate box attached to bottom of control panel.
  - YVWA - located in a separate box attached ???



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Control Cable Connection

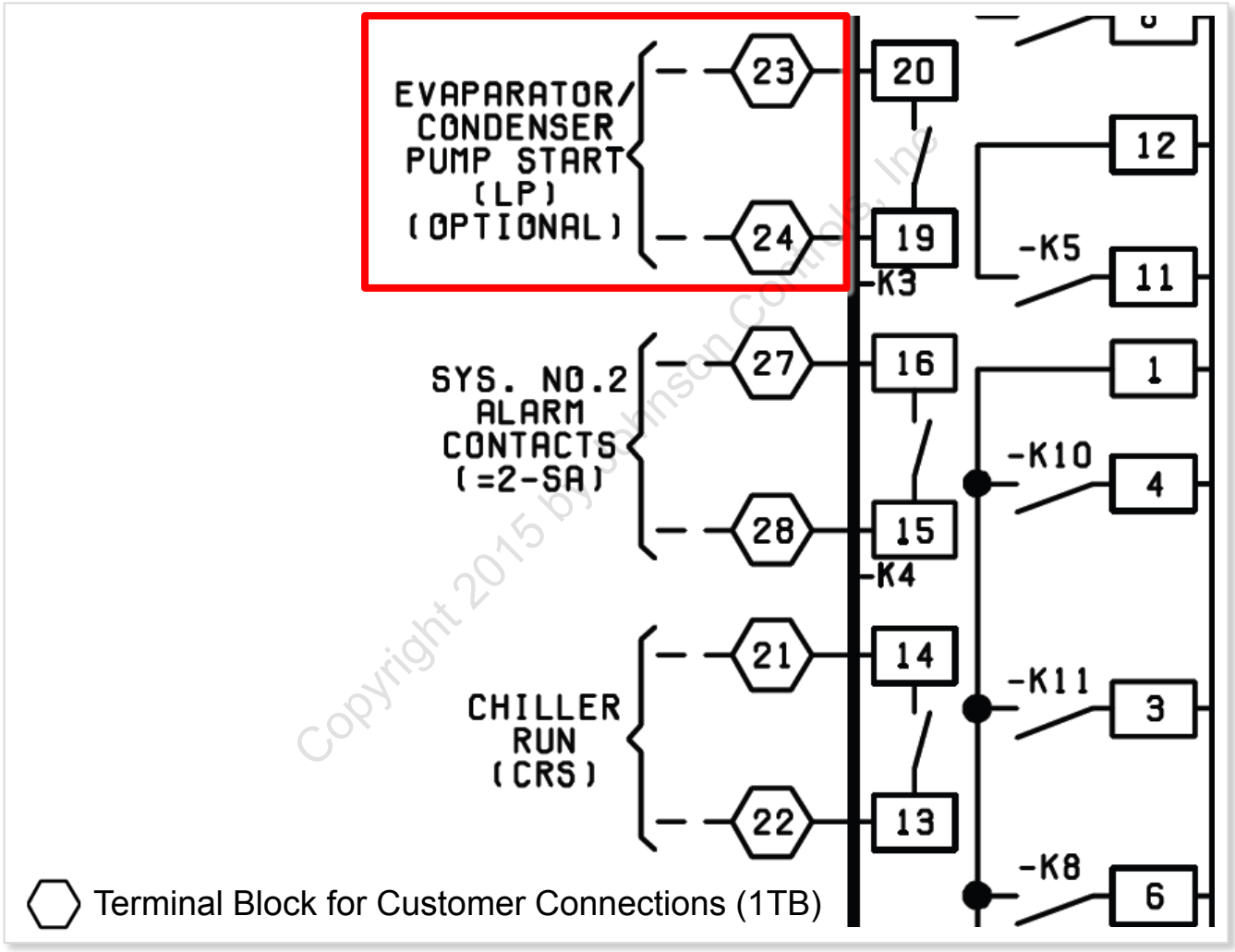
Control Connection



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Evaporator Pump Control

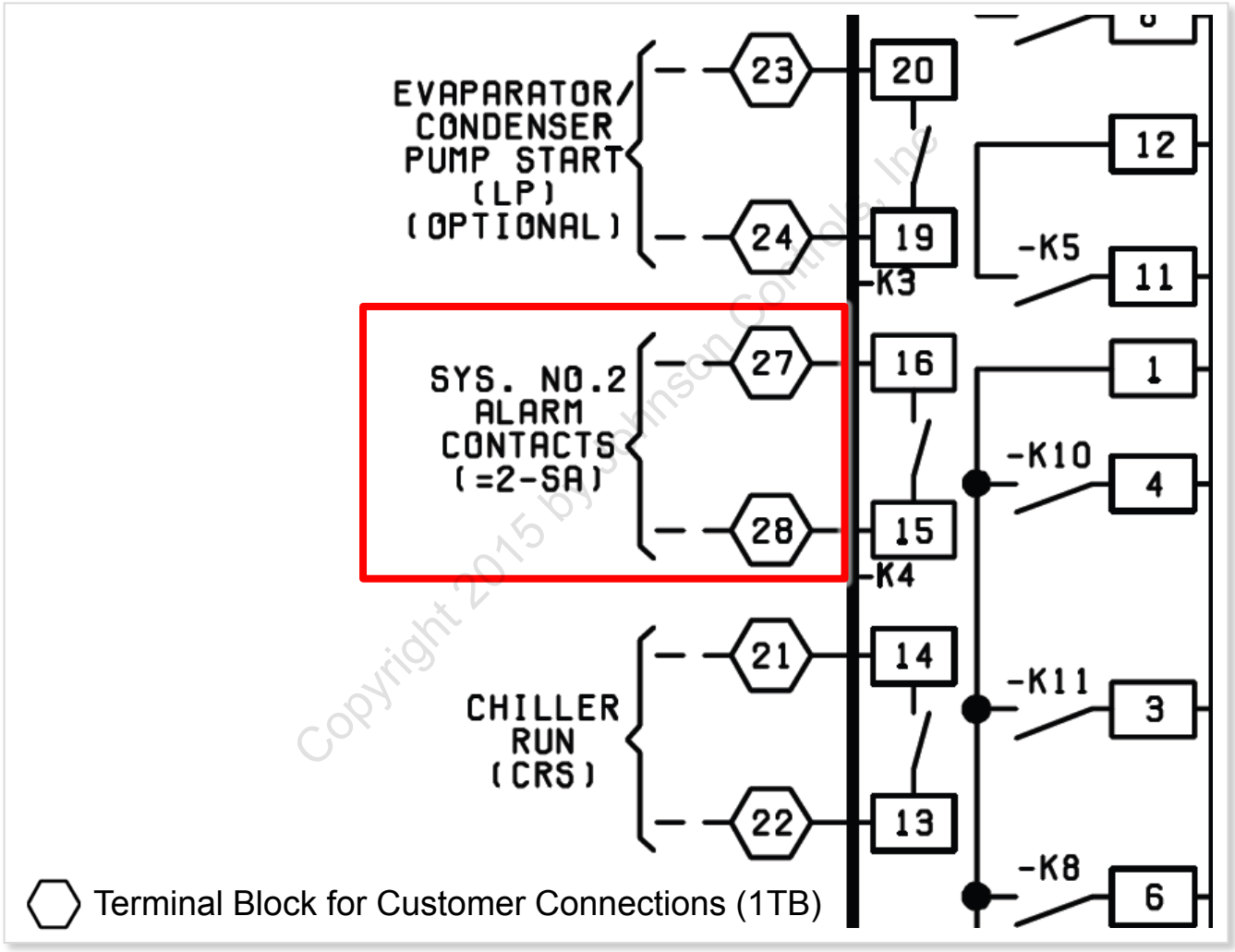




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Alarm Contacts

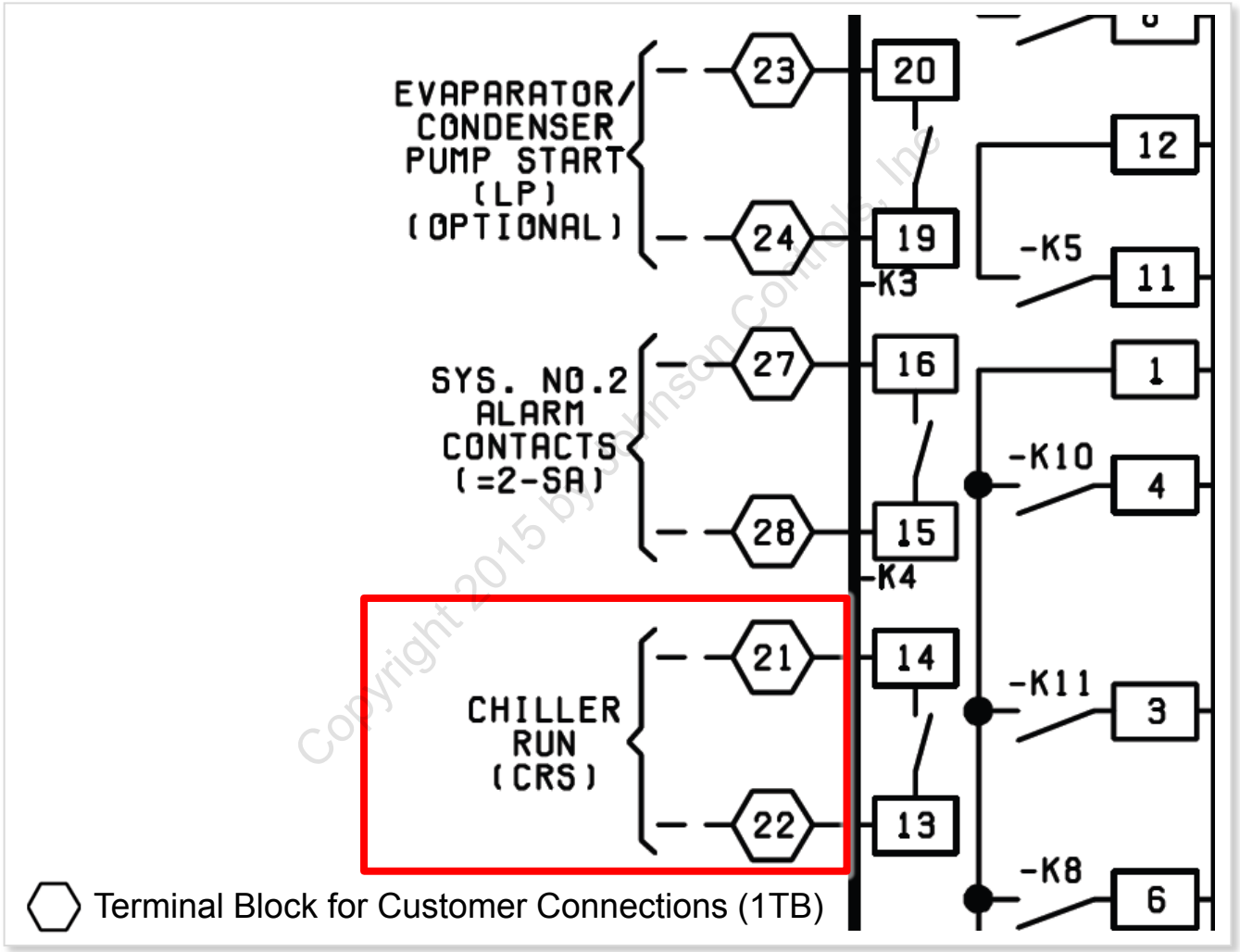




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Chiller Run Contacts

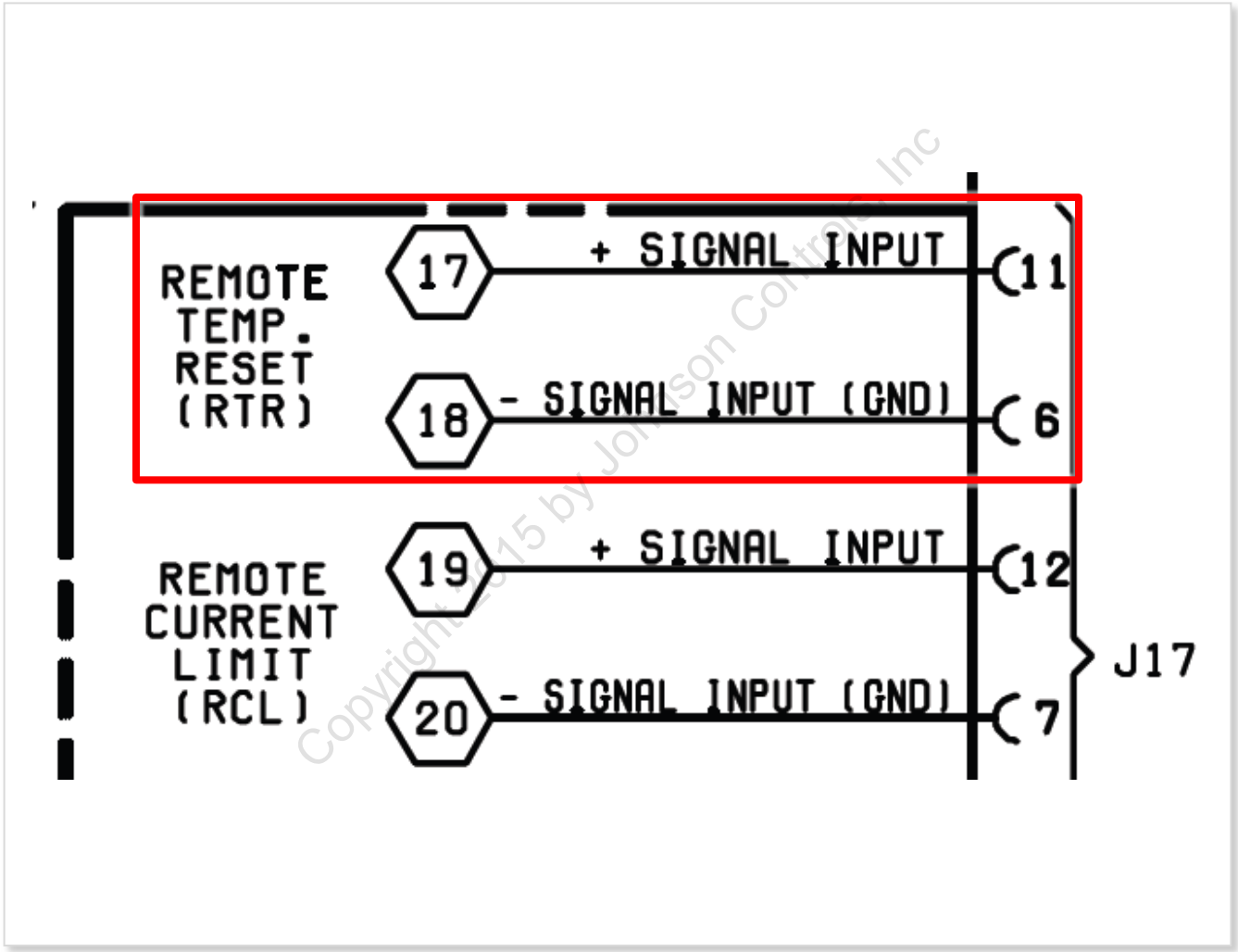




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Remote Temperature Reset Control





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Chiller Commissioning Sections

- **All Chillers:**
  - Power Off Checks
    - Preparation
    - Inspection
  - Power On Checks
    - First Time Startup
    - Loading
    - General Operation

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Activity: Commissioning the YVAA or YVWA Chiller

- Look at the YVWA image to critically think about what needs to be verified/checked while commissioning the YVWA chiller.
- Create a commissioning list for the YVWA chiller.

Share with other participants:

- Which tasks need to be completed while the YVWA's customer power to the unit is switched On/Off?
- How are sensors and components related to one another?

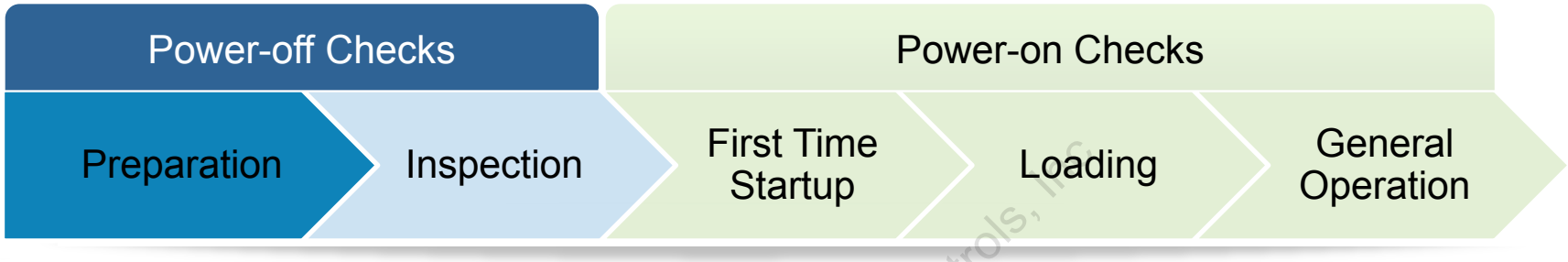
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YVWA



Duration: 20 minutes

Commissioning Process: Preparation



- All York chillers must be commissioned only by an authorized personnel.
- Proper electrical lock out and tag out procedures must be followed.



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Start-up Checklist

Open
IOM (201.30-CL2)

SECTION

A. General:

Supersedes Form 201.30-CL2 (412) — Form 201.30-CL2 (912)

YORK BY JOHNSON CONTROLS | MODEL – YVWA

START-UP CHECKLIST

CUSTOMER: _____ JOB NAME: _____
ADDRESS: _____ LOCATION: _____
PHONE: _____ CUSTOMER ORDER NO: _____
JCI TEL NO: _____ JCI ORDER NO: _____ JCI CONTRACT NO: _____

CHILLER MODEL NO: _____ UNIT SERIAL NO: _____
The work (as checked below) is in process and will be completed by: ____ / ____ / ____ (Month / Day / Year)

The following work must be completed in accordance with start-up instructions contained in the Installation, Operation, and Maintenance Manual (Form 201.30-ICOM2):

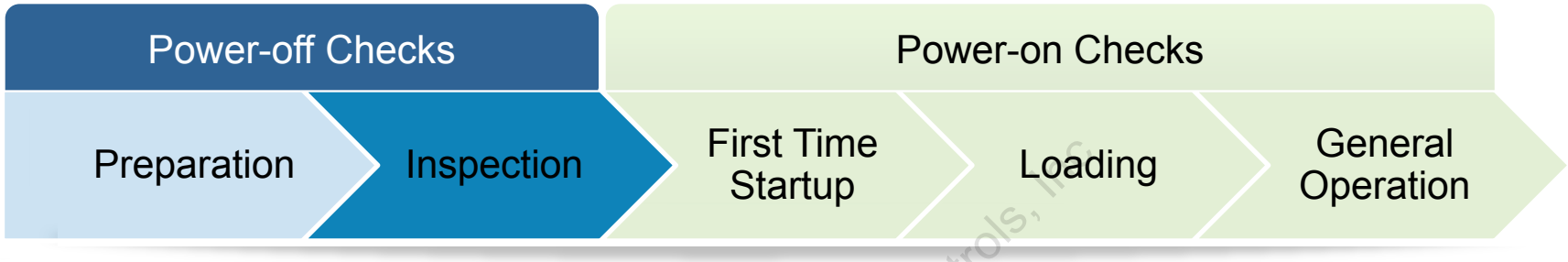
A. GENERAL:

The following basic checks should be made with the customer power to the unit switched off.

1. Review the Installation Checklist (Form 201.30-CL1). ☐
2. Inspect the unit for installation damage that may have occurred. If damage is found, take action and/or repair as appropriate. ☐
3. Water connection inlet and outlet are at proper locations, have hangers nearby that would support their weight and show no visible strain on chiller nozzles. ☐
4. Wiring is complete (power feed terminations in the VSD), and all sources of electrical supply to the unit are taken from a single point of isolation per 201.30-PW2. ☐
5. Confirm any field control wiring modifications are in accordance with Form 201.30-PW2 ☐
6. Verify the chiller is charged with refrigerant (pressures match R-134a saturation for ambient temp). ☐
7. Verify that the unit's protective ground terminal(s) are properly connected to a suitable grounding point. Ensure that all unit internal ground connections are tight. ☐
8. Verify the following isolation valves are open.
   a. Compressor 1 discharge (optional) ☐
   f. System 1 evaporator pressure transducer ☐
   g. System 1 evaporator oil return to eductor ☐
   h. System 1 oil return eductor to compressor ☐
   i. System 1 liquid injection to compressor (optional) ☐
   j. System 1 economizer pressure transducer ☐
   k. Compressor 2 discharge (optional) ☐
   l. System 1 condenser subcooler outlet (optional) ☐
   m. System 2 main oil supply inline ball valve ☐
   n. System 2 condenser pressure transducer ☐
   o. System 2 condenser gas to oil eductor ☐
   p. System 2 evaporator pressure transducer ☐
   q. System 2 evaporator oil return to eductor ☐
   r. System 2 oil return eductor to compressor ☐
   s. System 2 liquid injection to compressor (optional) ☐
   t. System 2 economizer pressure transducer ☐
9. Verify the shipping anti-freeze solution has been drained from the VSD, and replaced with the proper amount of inhibited water coolant that shipped loose with the chiller. Refer to SECTION 7 - MAINTENANCE in the 201.30-ICOM2 for filling process. ☐

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Commissioning Process: Inspection



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Inspection

Inspect the unit for installation damage.

If any damage is found, repair the chiller.

Other Checks

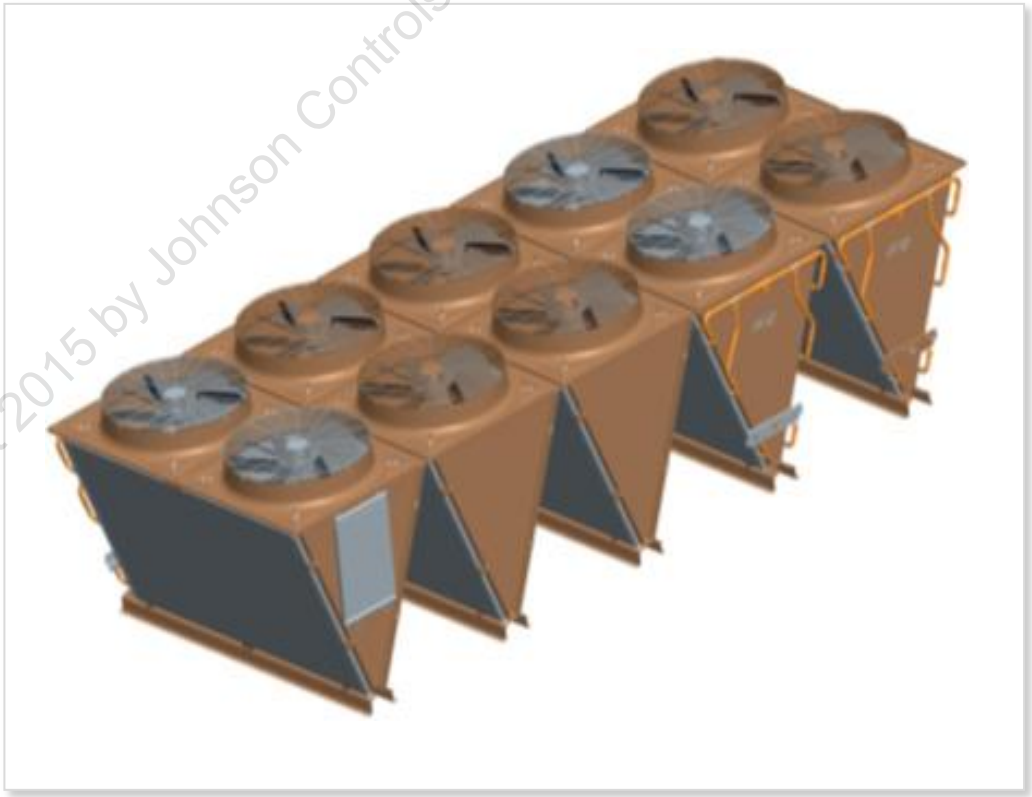
Refrigerant Charge

Service and Oil Line Valves

Compressor Oil

Condenser Fans

- Verify that all fans can rotate freely and are not damaged.



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Water System

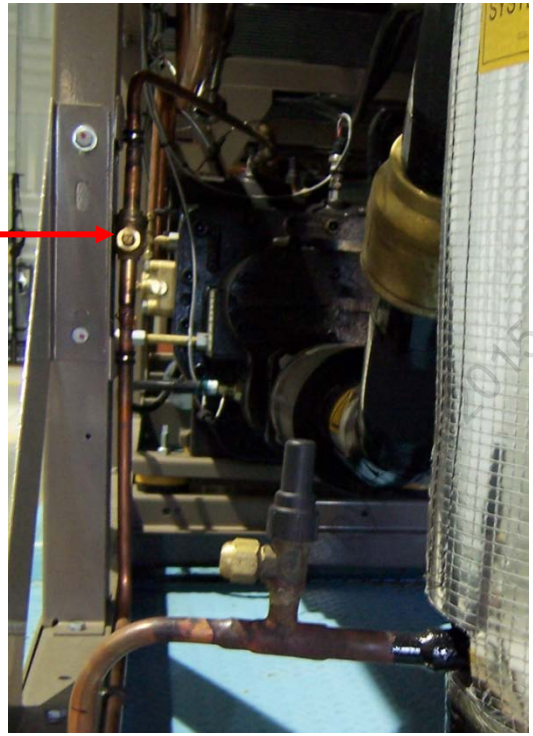
- Verify that the chilled and condenser liquid systems have been connected correctly.
- The inlet should be at the bottom connection on a two-pass shell.
- Purge air from the top of the waterbox using the plugged air vent mounted on the top of the waterbox.
- Flow rates and pressure drops must be within the specified limits. Operation outside of these limits is undesirable and can cause damage.

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Service Valves

- Open each economizer service valve.
- Fully open the liquid line service valve and the oil return line ball valve.

Oil Line
Ball Valve





Economizer



Liquid Line

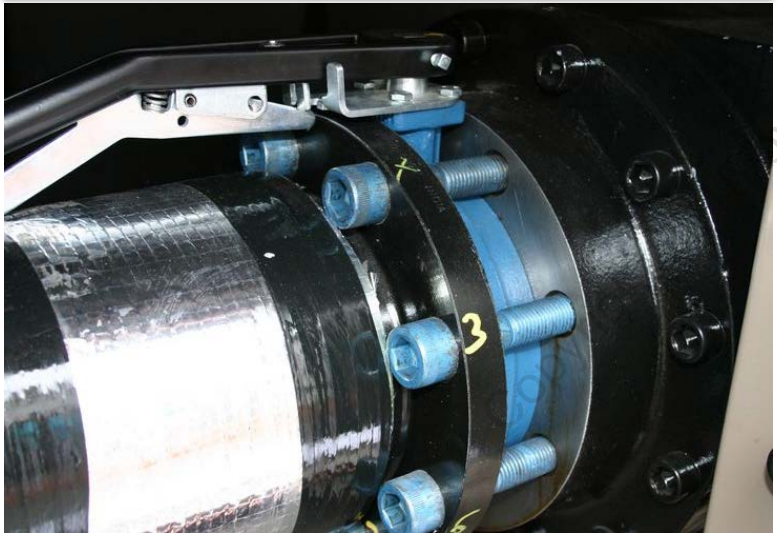
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Compressor Service Valves

- Open Suction and Discharge Valves.

Property of Johnson Controls, Inc

Compressor Suction Service Valve (Optional)



Compressor Discharge Valve (Standard)



Refrigerant Operating Charge

- Packaged units are shipped with full refrigerant operating charge.



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Do not liquid charge when there is static water in the evaporator.

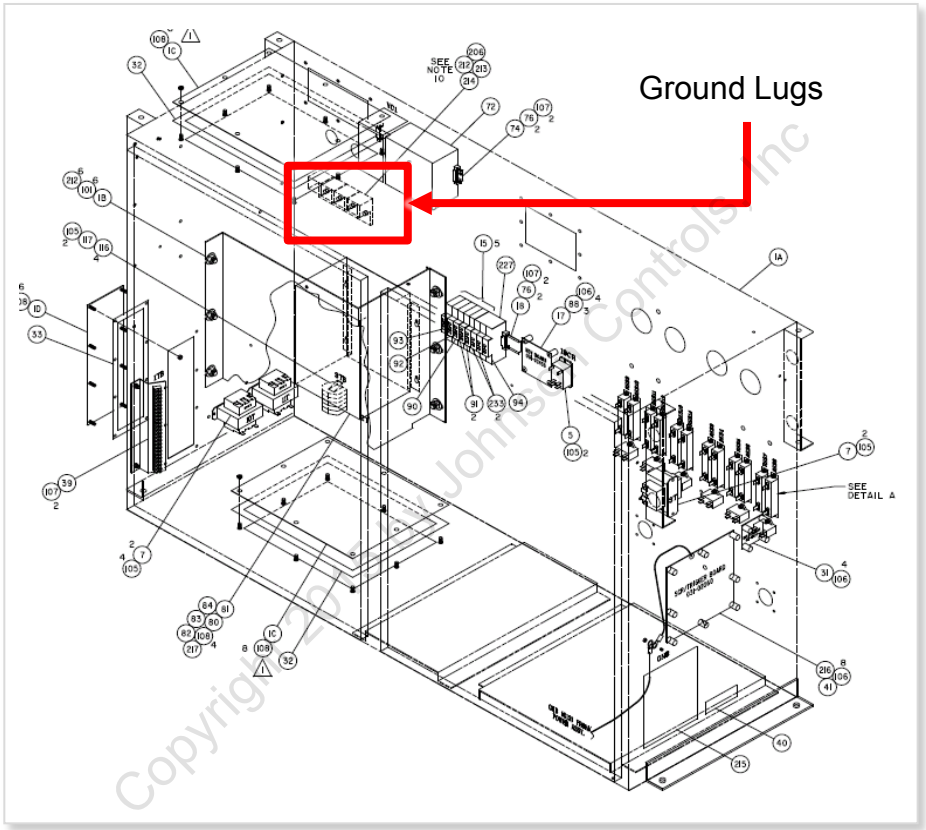
Refrigerant Charge

- Check that refrigerant pressure is present in both systems and no leaks are apparent.
- Do not evacuate or liquid charge with static water in the evaporator or condenser.
- Turn the pumps On.
- The best practice is to charge only with refrigerant vapor until the pressure in the unit is above the freezing point of water, 29 psig (200 kPa).
- Liquid charge slowly to avoid excessive thermal stress and to ensure that the refrigerant temperature does not dip below the freezing point.



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Grounding



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Start-up Checklist (Section A: General):

7. Verify that the unit's protective ground terminal(s) is properly connected to a suitable grounding point. Ensure that all unit internal ground connections are tight.

Protective Ground

Verify that the unit's protective ground terminal(s) is properly connected to a suitable grounding point.



Incoming Power Ground Lugs



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Service and Oil Line Valves

Guidelines

- Open each compressor oil, economizer and discharge ball or service valve.
- If valves are of the back seat type, open them fully (counter clock-wise). Then, close one turn of the stem to ensure that the operating pressure is fed to the pressure transducers.



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Start-up Checklist (Section A: General):

8. Verify if the isolation valves are open.

Inhibited Water Coolant

Guidelines

The following guidelines apply for the YVWA chiller:

- Verify that the shipping anti-freeze solution has been drained from the VSD.
- Replace the anti-freeze solution with the proper amount of inhibited water coolant that is shipped loose with the chiller.

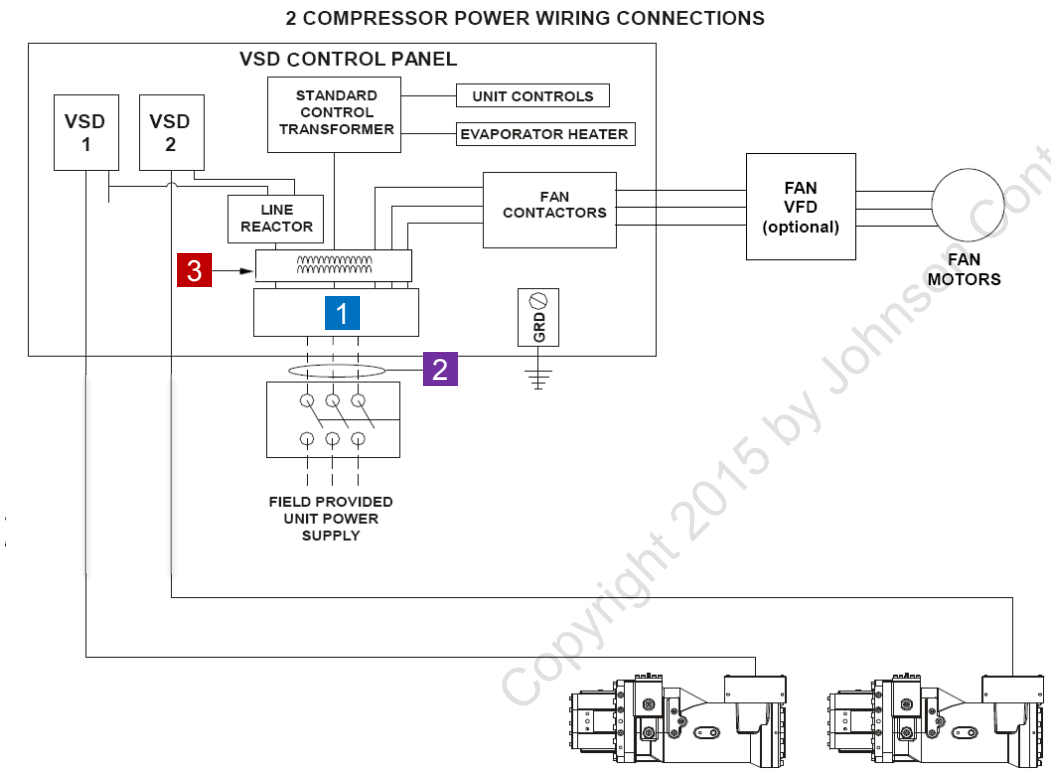
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CAUTION

The system should be filled with the approved coolant to avoid damage to the pump seals and other components.

Power Cable Connection



1	Terminal block, circuit breaker, or non-fused disconnect switch
2	The chiller can be selected for supplied voltages of 220, 230, 380, 400, 415, or 460 VAC. Other customer line voltages require an external transformer to meet this requirement
3	Recommendations are based on the national electric code using the copper conductors

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Power Connections

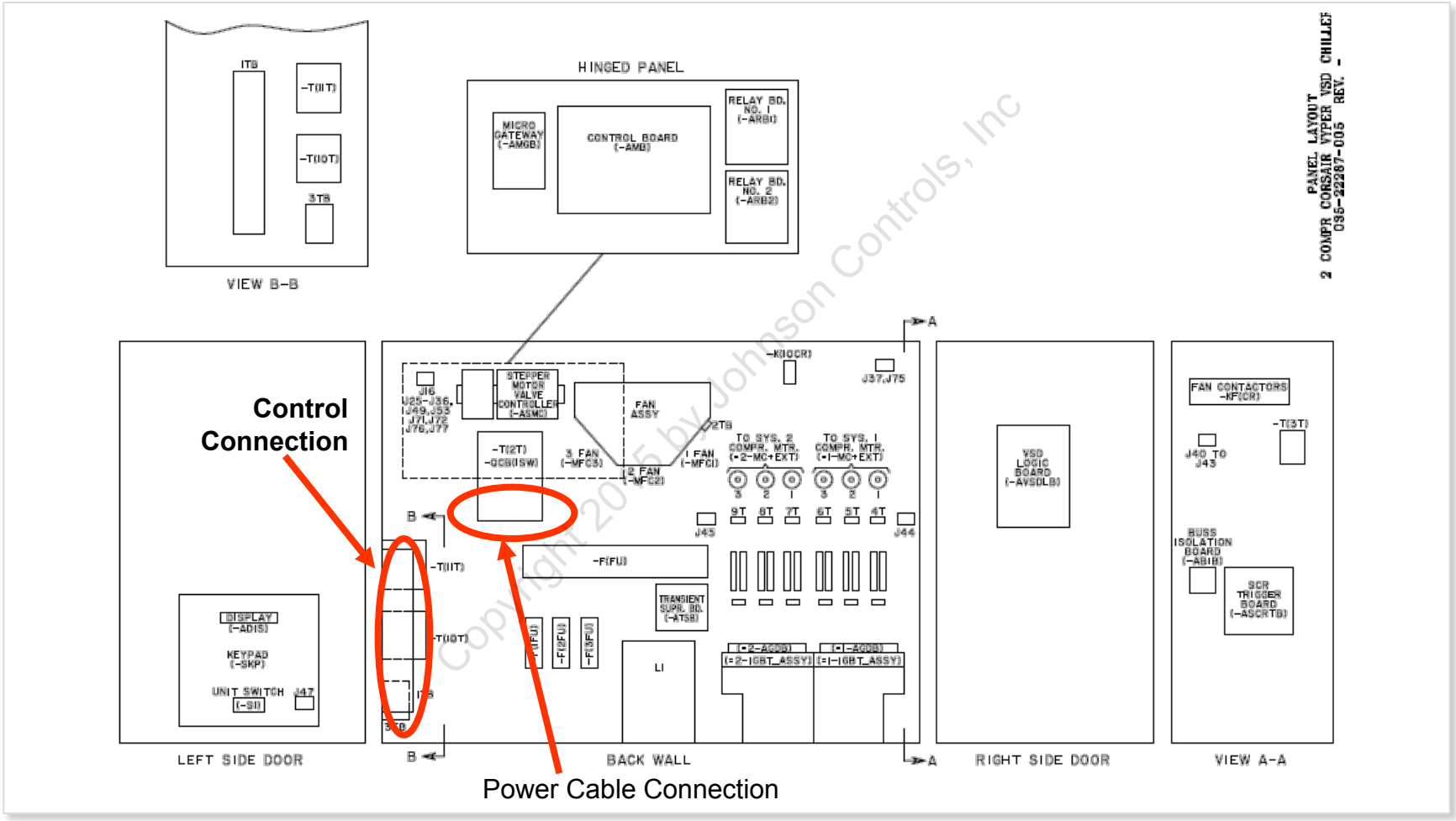
- Check that the customer power cables are connected correctly to the terminal blocks or optional circuit breaker.
- Ensure that connections of power cables within the panels to the circuit breaker or terminal blocks are tight.



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Power Cable Connection

Power Cable and Control Cable Connections



Circuit Breaker

- Ensure the correct settings for the circuit breaker.
- Set the adjustments to the setting values for your VSD model according to the Start-up Checklist, General section, point 11.

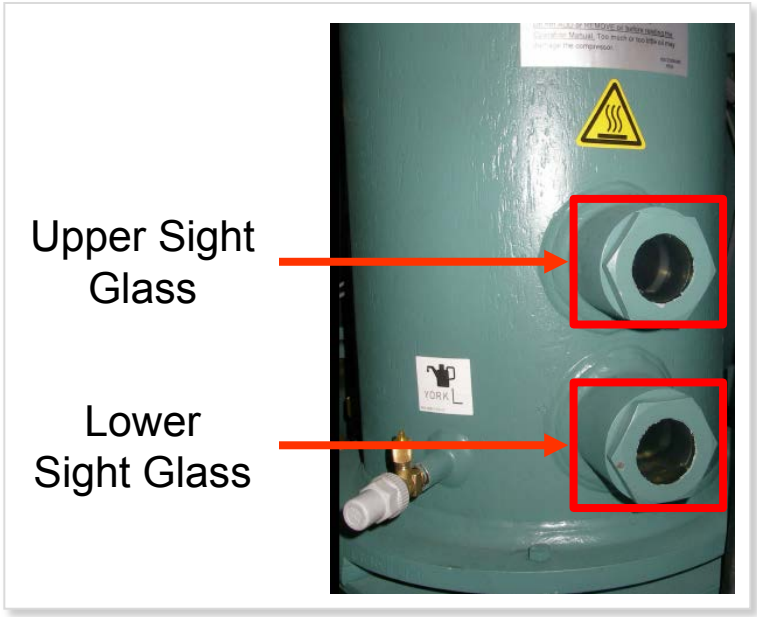


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Compressor Oil Level

- Ensure that proper amount of oil has been added to both the circuits.
- While the compressor is running at the design speed, the oil level should be visible between the bottom of the lower and the middle of the upper sight glass of the oil separator.
- Ensure that the compressor heaters have been energized at least 24 hours before starting the chiller.

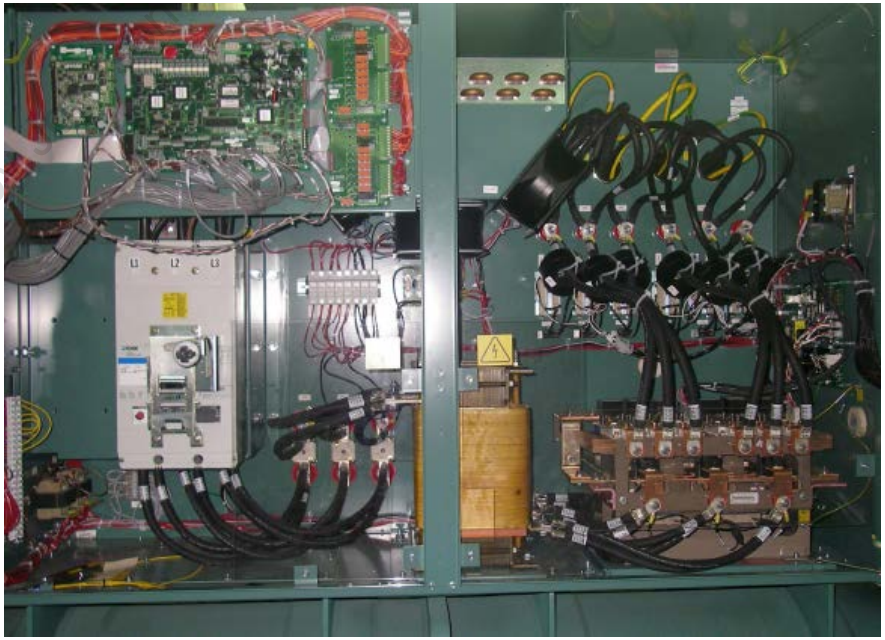
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Control Panel

- Check the panel to verify that it is free of foreign materials.
- Clean the panel, if required.

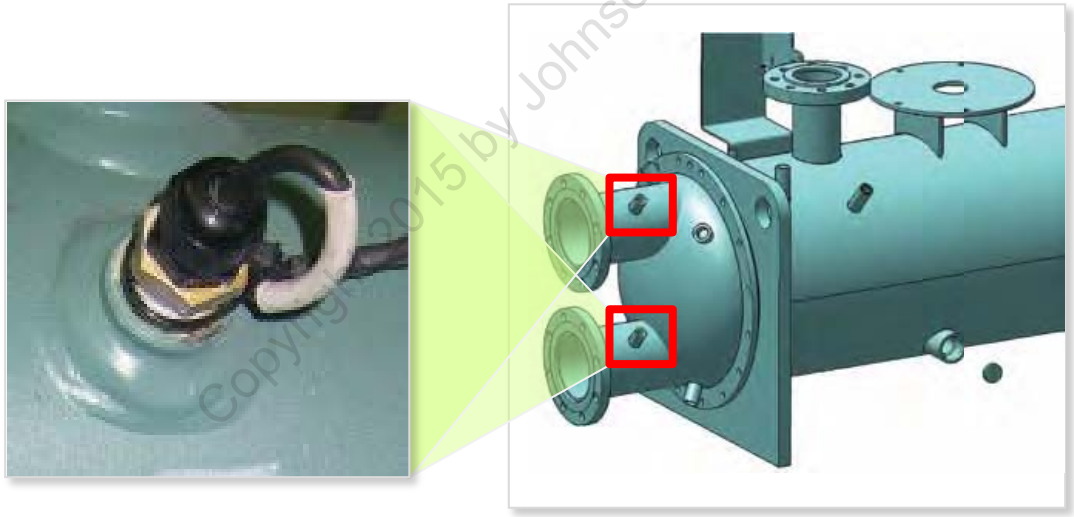
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Temperature Sensor(s)

Ensure that the leaving liquid temperature sensor is:

- Coated with the heat conductive compound
- Inserted to the bottom of the water outlet sensor well in the evaporator



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Flow Switches

Verify that water flow switches are:

- Correctly fitted in the customer's piping
- Wiring and contacts must be suitable for switching 115 VAC 5 MA. And wired into the control panel correctly.



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Lesson Summary



- Site preparation tasks include:
  - Selecting a site capable of supporting the operating weight of unit
  - Ensuring adequate clearances around the chiller
- YVWA chillers can be shipped as a single package (Form 1 and 2) or in split assembles (Form 7).
- Unit shipment must be checked on arrival; any damage reported immediately.
- During rigging, the unit should be lifted using prescribed lifting holes.
- Vibration isolators, piping and electrical connections need to be installed
- Commissioning checks:
  - Unit Damage
  - Water flow direction & volume
  - Power connections & fusing, disconnects or Circuit Breakers

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Start-up and Scheduled Service



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Objective

After completing this lesson, you will be able to:

- Expand a standard startup checklist to include specific requirements for each York screw chiller.
- Compare the periodic and preventive service requirements of the York screw chillers.

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Startup and Scheduled Service
YVAA and YVWA





YCAV



YCIV



YVAA



YVWA

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Similarities in technology make Startup nearly the same

York Screw Chiller Models

- **Startup**
  - **YVAA and YVWA Startup**
- Scheduled Service

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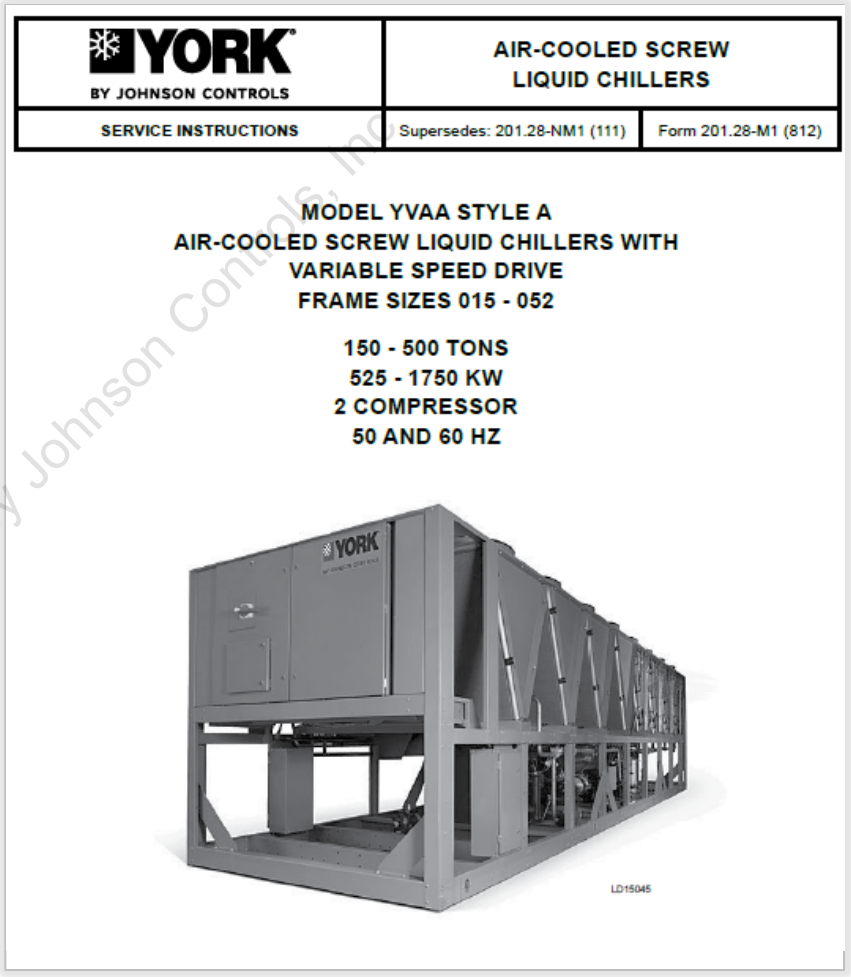
Manuals and Checklists

Open Service (201.28-M1)

SECTION
First Time startup

Open Checklist (201.28-CL2)

SECTION
Pre-Start



YORK BY JOHNSON CONTROLS

AIR-COOLED SCREW LIQUID CHILLERS

SERVICE INSTRUCTIONS | Supersedes: 201.28-NM1 (111) | Form 201.28-M1 (812)

MODEL YVAA STYLE A
AIR-COOLED SCREW LIQUID CHILLERS WITH VARIABLE SPEED DRIVE
FRAME SIZES 015 - 052

150 - 500 TONS
525 - 1750 KW
2 COMPRESSOR
50 AND 60 HZ

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Manuals and Checklists (Contd.)

Open Service (201.30-M1)

SECTION
First Time startup

Open Checklist (201.30-CL2)

SECTION
Pre-Start



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WATER-COOLED SCREW LIQUID CHILLERS

SERVICE MANUAL | Supersedes: 201.30-M1 (612) | Form 201.30-M1 (912)

MODEL YVWA
Dual Compressor
Style A
50 Hz and 60 Hz
200 - 300 Tons
703 - 1055 kW

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Start-Up Process

Power-on Checks

Operating Sequence Checks

First Time Startup → Loading → General Operation → Self → Automated

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Power-on Checks: First Time Startup

Power-on Checks | Operating Sequence Checks

First Time Startup → Loading → General Operation → S/C Shelf → Automated

- The chiller should be serviced by qualified personnel.
- Ensure that there is sufficient stable heat load to operate the unit at full capacity.



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Operational Checks

Verify if:

Chilled (and condenser) liquid system:

- Installed correctly
- Inlet and outlet connections are correct
- Correct direction of water flow through the evaporator and condenser

- Chilled and condenser water flow switches fitted correctly in piping:
  - Straight run of at least five pipe diameters either side of flow switch
  - Flow switches are correctly wired into the control panel.

Chilled and Condenser Hydronic System



Flow Switch

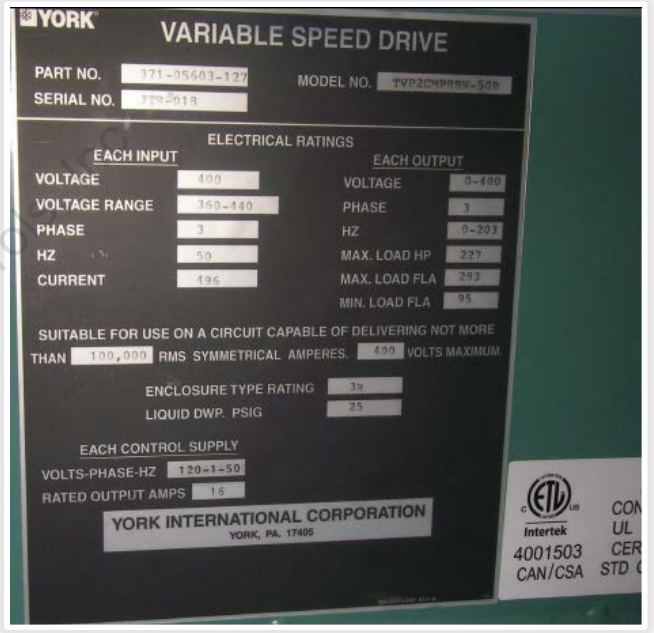


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Voltage Supply

Voltage supply:

- Must correspond to the unit requirement
- Should be within the limits as specified below:



Voltage Variations

Freq.	Rated Voltage VAC	Input Freq. Hz	Operating Voltage VAC	
			Min	Max
60 Hz	380	60	342	402
	460	60	414	508
50 Hz	380	50	342	402
	400	50	360	440
	415	50	374	456

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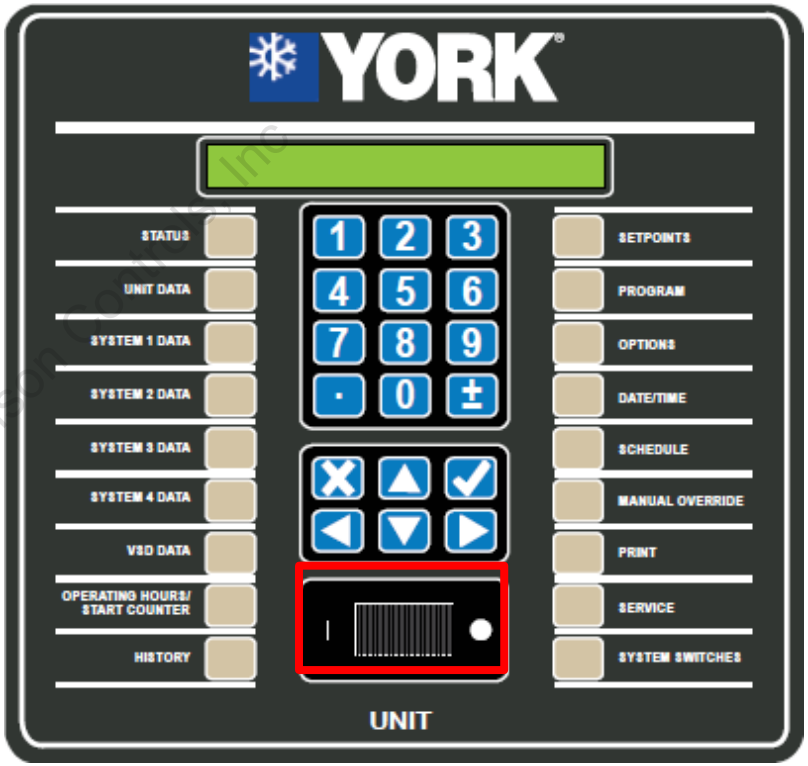


Start-Up Checklist (Section B: Start-up):

1. Verify if the voltage supply corresponds to the unit requirement, and is within the limits as specified.

Unit Switch

- The Unit switch should be Off.
- Apply 3-phase power to the chiller and turn On the optional panel circuit breaker/disconnect switch.



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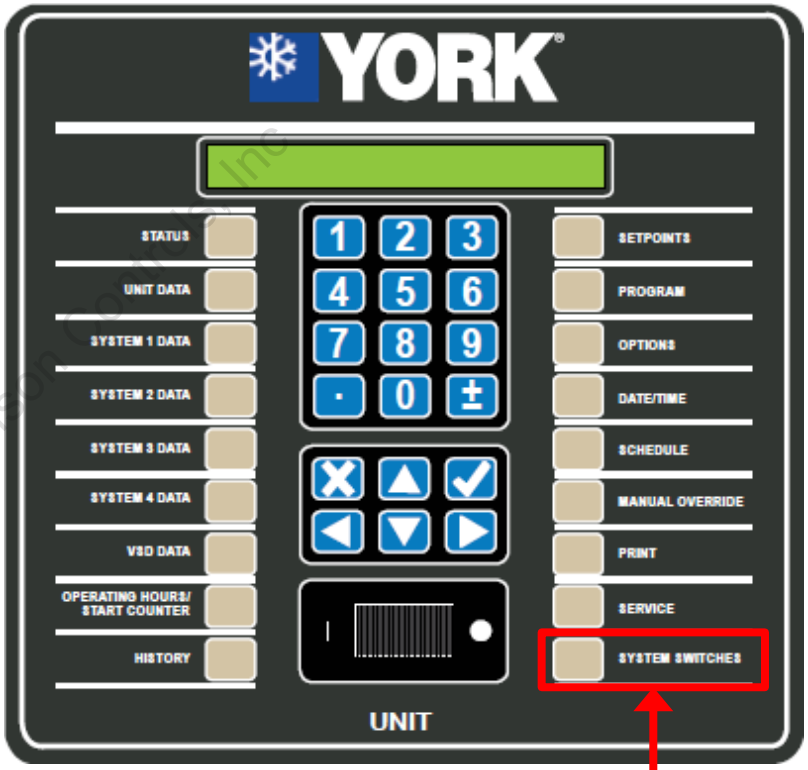


Start-Up Checklist (Section B: Start-up):

1. Make sure the Unit switch at the bottom of the keypad is in the OFF (O) position.
2. Apply 3-phase power to the chiller. Turn On the optional panel circuit breaker/disconnect switch, if supplied.

System Switches Key

- Verify if the control panel display is illuminated.
- Verify if the system switches under the **SYSTEM SWITCHES** key is Off.



System Switches Key

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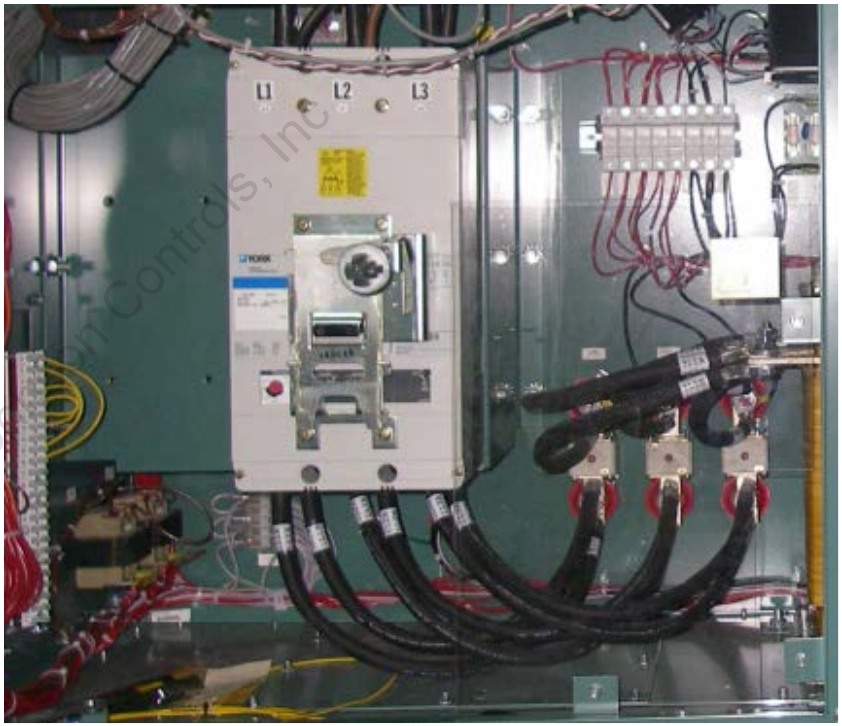


Start-Up Checklist (Section B: Start-up):

4. Verify the control panel display is illuminated. To prevent the compressors from starting, make sure that the **SYSTEM SWITCHES** key is Off for both systems.

Compressor Heaters

- Verify if both the compressor heaters are turned On.



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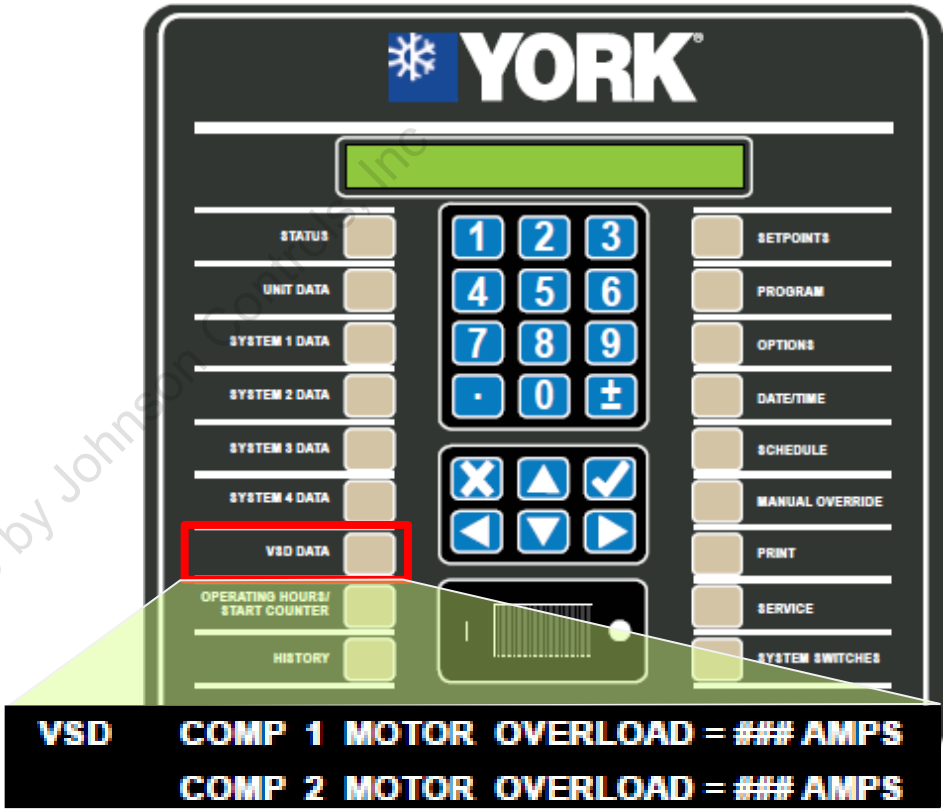
Start-Up Checklist (Section B: Start-up):

5. Use a clamp-on ammeter to make sure both the compressor heaters are turned On. Heater current draw is approximately 3A.

Compressor Overload Current Settings

Verify compressor overload current settings:

1. Navigate to:
   COMP1 MOTOR OVERLOAD = ### AMPS and
   COMP2 MOTOR OVERLOAD = ### AMPS screens.
2. Match the values on the overload setting label which is located inside the VSD cabinet.
3. If the values do not match, an adjustment is required.



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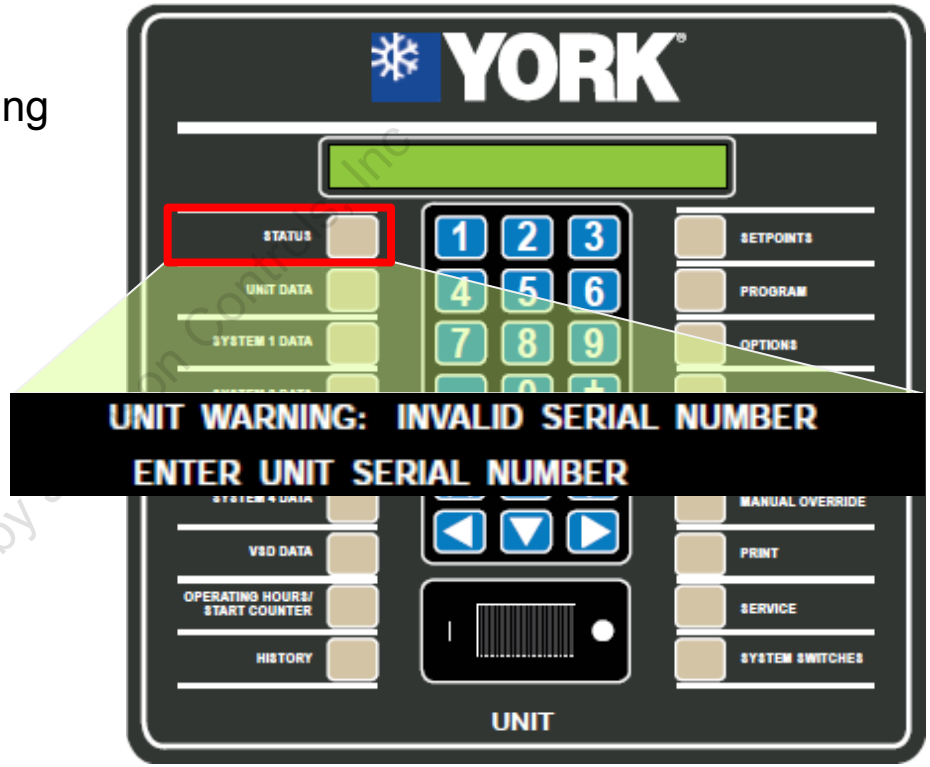
Start-Up Checklist (Section B: Start-up):

6. Confirm that the compressor overload current settings have been correctly adjusted by the factory.
7. Record the overload settings.

Status Key

Resolve Unit warning messages:

1. Press the **Status** key to view any warning messages.
2. If an invalid serial number has been entered, contact Product Technical Support to request the password to reprogram the serial number.



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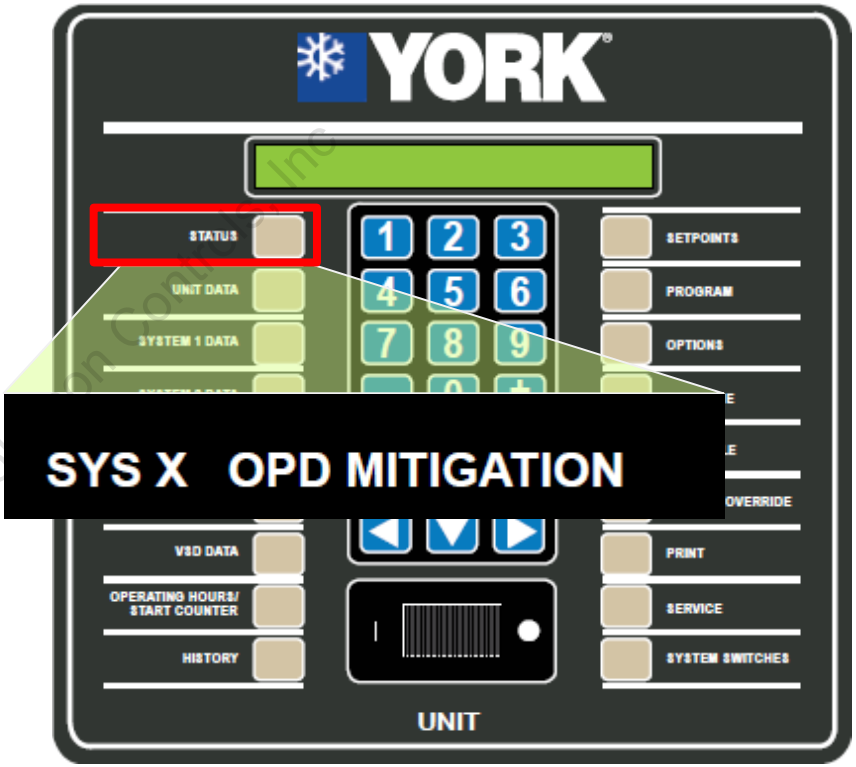


Start-Up Checklist (Section B: Start-up):
Press the STATUS key.

OPD Mitigation Mode

Resolve Unit warning messages:

- Condenser level control is repositioning the level setpoint to reduce evaporator pressure and overcome low differential pressure to maintain oil flow.

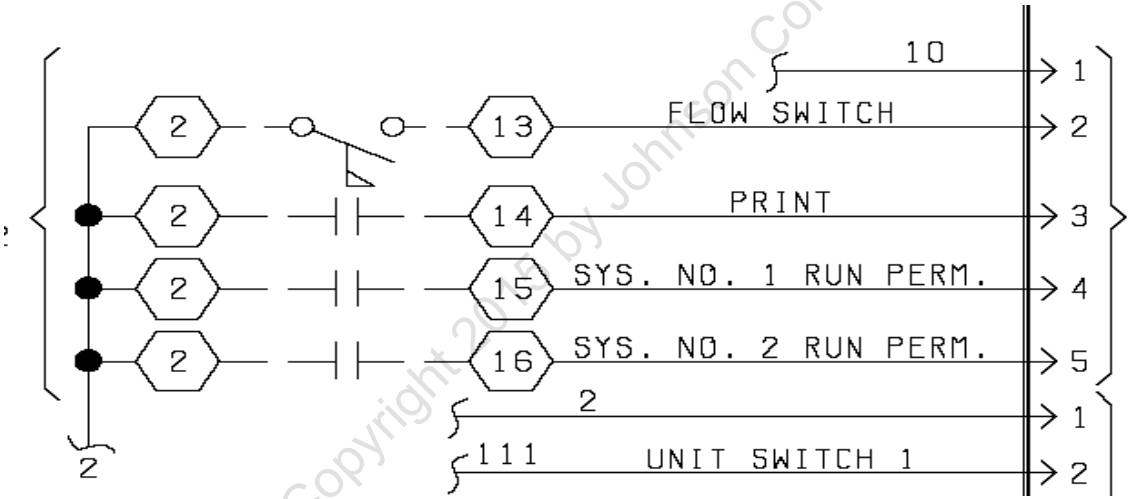


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Remote Run Interlocks

Verify if:

- The remote run interlocks are in the run position.
- A daily schedule allows the unit to run or is overridden.

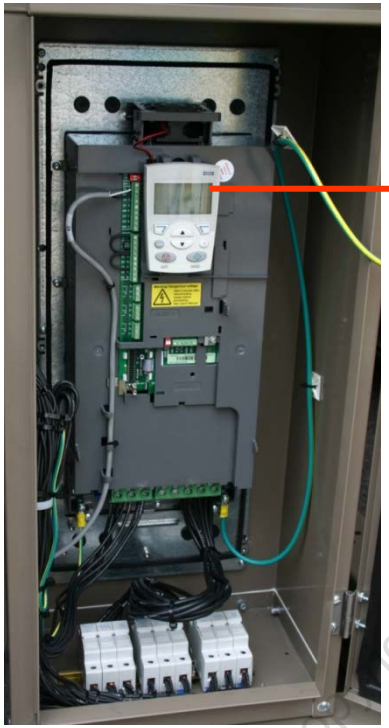


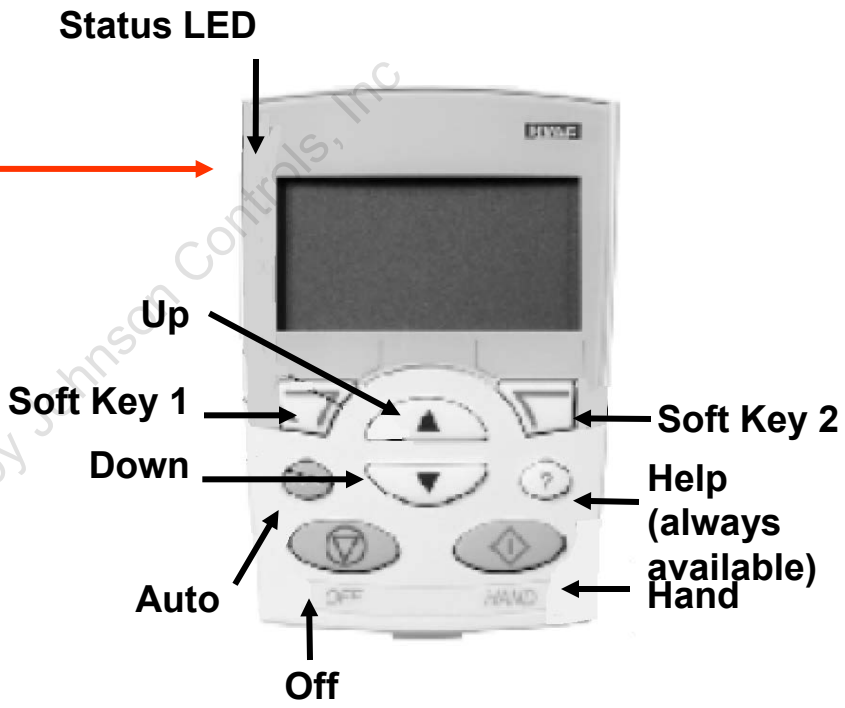
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Excessive flow and a GPM that is above its maximum value will damage the evaporator.

YVAA – Optimized Fan VSD Control





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Do not change other programming parameters in the drive or set up the system with non factory approved values.

YVAA – Condenser Fan Rotation

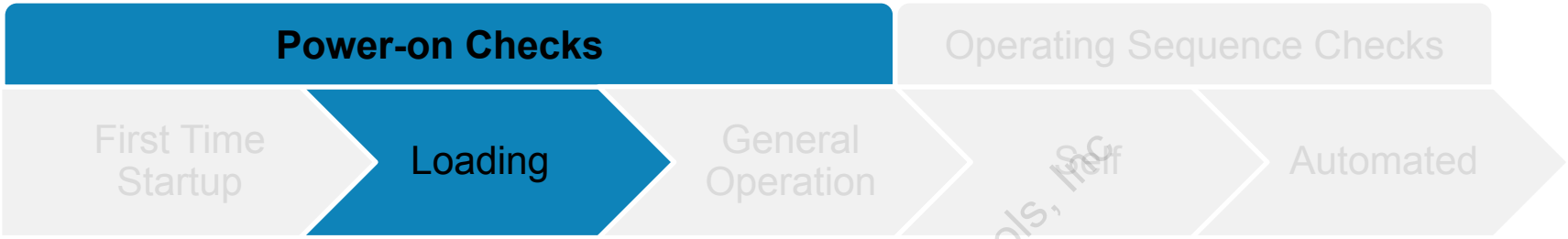
Once the compressor is running and discharge pressure rises, verify if:

- Condenser fans are rotating in the correct direction
- Operation is correct for this type of unit



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Power-on Checks: Loading



- Start each compressor system separately.
- Once a system has been started, all operations are fully automatic. After an initial period at minimum capacity, the control system will adjust the unit load depending on the chilled liquid temperature and the rate of temperature change.
- If a high heat load is present, the controller will increase the speed of the compressor(s).

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Oil Differential Pressure

When a compressor is running, verify if the oil differential pressure has developed immediately.

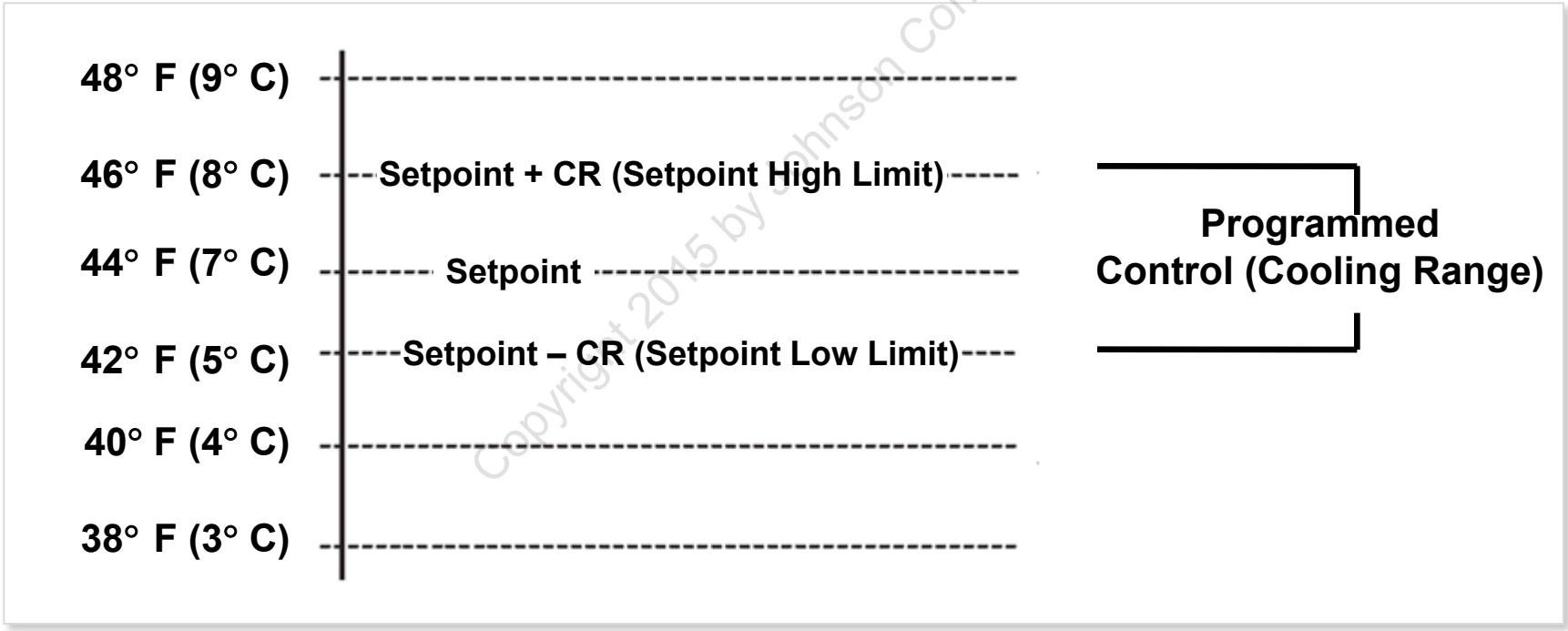


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Never restart a compressor that does not immediately develop an oil pressure.

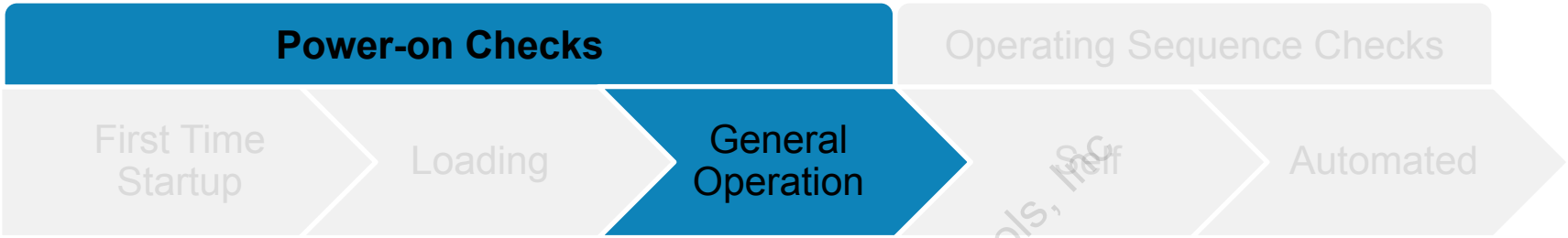
Loading

Verify if, once the unit has started and after an initial period at minimum capacity, the control system will adjust the unit loading, depending on the chilled liquid temperature and the rate of temperature change.



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Power-on Checks: General Operation



- After completion of the checks for System 1, switch Off the SYS 1, switch On the keypad, and repeat the process for System 2.
- When both systems are running correctly, stop the unit, switch all applicable switches On, and restart the unit.

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General Operation

Ensure that all checks mentioned in the Equipment Start up check sheet are completed.

When all systems run correctly, it is ready to be placed in operation:

1. Stop the unit.
2. Turn On the system switches.
3. Restart the unit.



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Operating Sequence Checks: Self

Power-on Checks | **Operating Sequence Checks**

First Time Startup | Loading | General Operation | Self | Automated

- ✓ The Unit switch is On.
- ✓ At least one system switch is On.
- ✓ All permissive inputs (Remote Cycling Contacts) are satisfied.
- ✓ No unit or system faults exist.
- ✓ No unit or system start inhibits exist.
- ✓ The daily schedule calls for the chiller to run.
- ✓ The Chilled Liquid flow switch input is satisfied (switch is closed).
- ✓ (YVWA) The Condenser Liquid flow switch is satisfied.
- ✓ LCHLT is above the setpoint high limit (LCHLT setpoint + control range).

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Operating Sequence Checks: Self (Contd.)

Refer to the table below to calculate LCHLT and setpoint high limit:

Program Value	Mode	Low Limit	High limit	Default
LCHLT Setpoint	Water Cooling	38.0°F	60.0°F	44.0°F
		3.3°C	15.6°C	6.7°C
	Glycol Cooling	8.0°F	70.0°F	44.0°F
		-13.3°C	15.6°C	6.7°C
LCHLT Control Range	Cooling	1.5°F	2.5°F	2.0°F
		0.8°C	1.4°C	1.1°C

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Compressor Control

- Optimized IPLV Chiller Capacity Control Logic controls multiple compressors at low loads.
- Compressor cycling is reduced to a minimum to satisfy the load.
- All running compressors are brought to zero speed to stop or start.
- System run initiated by VSD logic; the output frequency is increased from 0 Hz to operating frequency.
- A **Maximum Change Rate** is maintained for the VSD.

Frequency Mode	Range	Maximum Change Rate
Increasing	0-50 Hz	10 Hz/s
Increasing	50-203 Hz	30.4 Hz/s
Decreasing	203-100 Hz	30.4 Hz/s
Decreasing	100-0 Hz	10 Hz/s

- Maximum number of compressors are run at startup to reduce cycling and starting compressors while in operation.

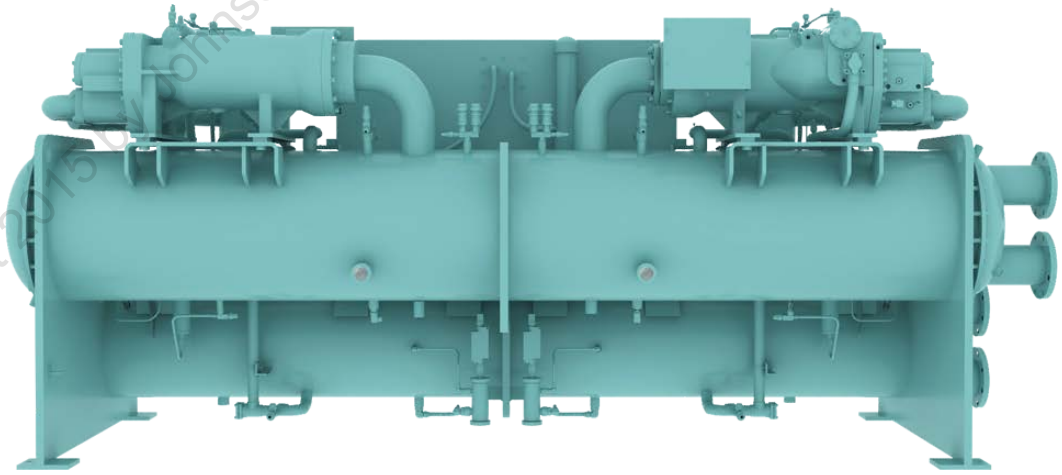
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Factors Determining Startup Compressors

Typically, the chiller starts two compressors, unless:

- The last run time or duration is less than five minutes.
- LCHLT is less than 5 °F above the setpoint high limit.
- LCHLT is decreasing faster than 3 °F per minute when chiller not running.

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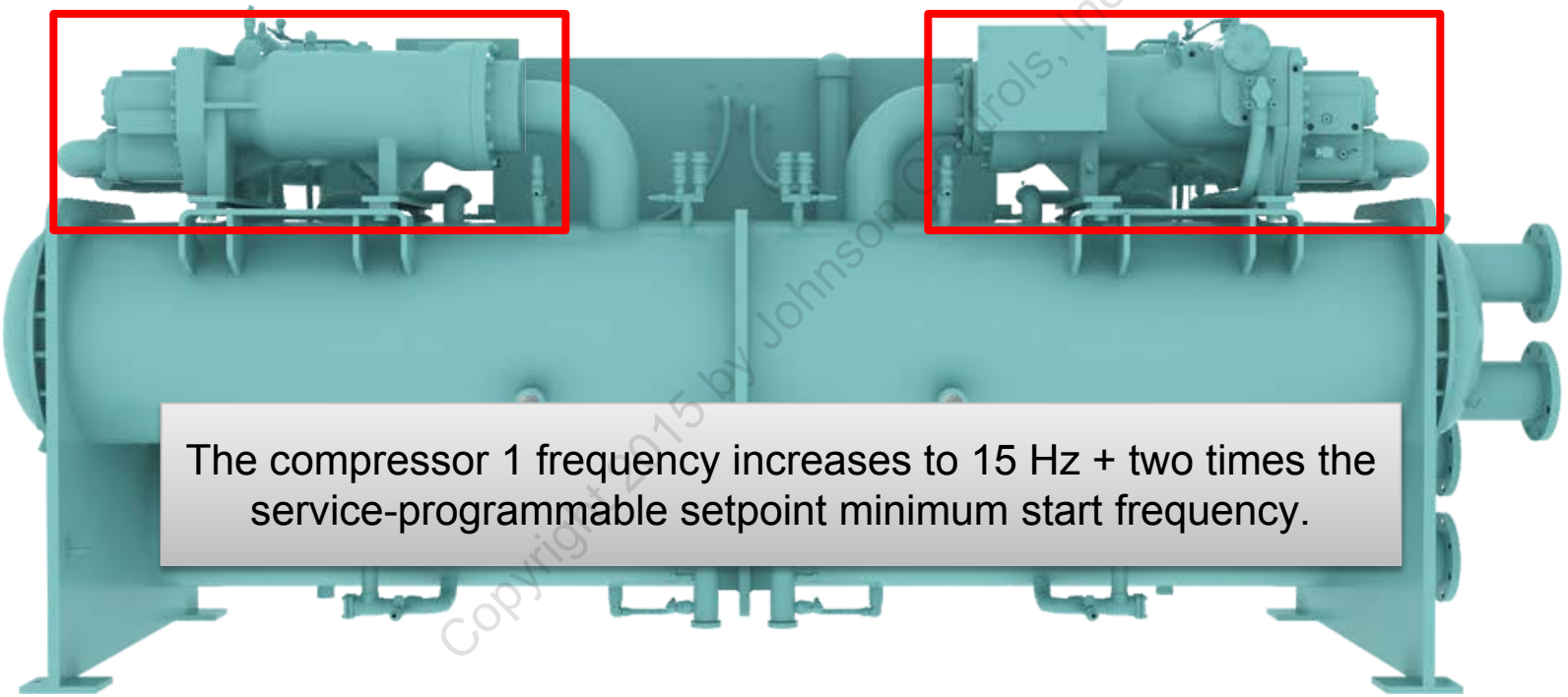




In the automatic LEAD/LAG control, the logic leads with the compressor with the lowest run time.

Factors Determining Running Compressors

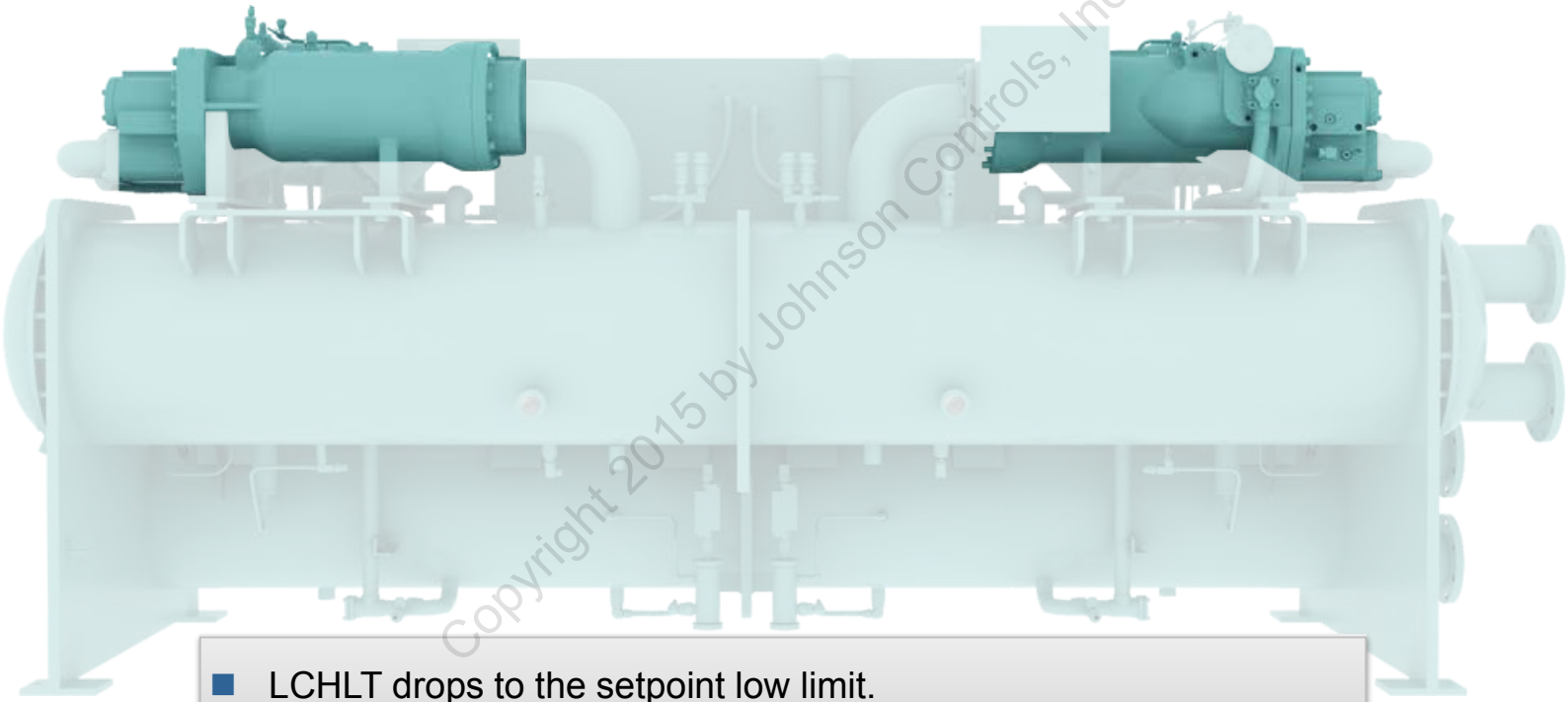
Run at 1/2 of the compressor 1 frequency



The compressor 1 frequency increases to 15 Hz + two times the service-programmable setpoint minimum start frequency.

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Factors Determining Running Compressors (Contd.)



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- LCHLT drops to the setpoint low limit.
- VSD frequency is at the service-programmable minimum VSD frequency setpoint.
- LCHLT is lowering.

Compressor Capacity Control: Determining Factors

Compressor capacity ∝ VSD speed (Range: service-programmable minimum VSD frequency setpoint (50Hz to 95 Hz, default 50 Hz) - 203 Hz) ∝ 1/LCHLT

Compressor capacity is controlled through load and unload delay timers that control the VSD speed, and hence excess cycling:

Condition	Timer
Compressor is started or stopped.	30s
Control has changed the VSD speed.	2s

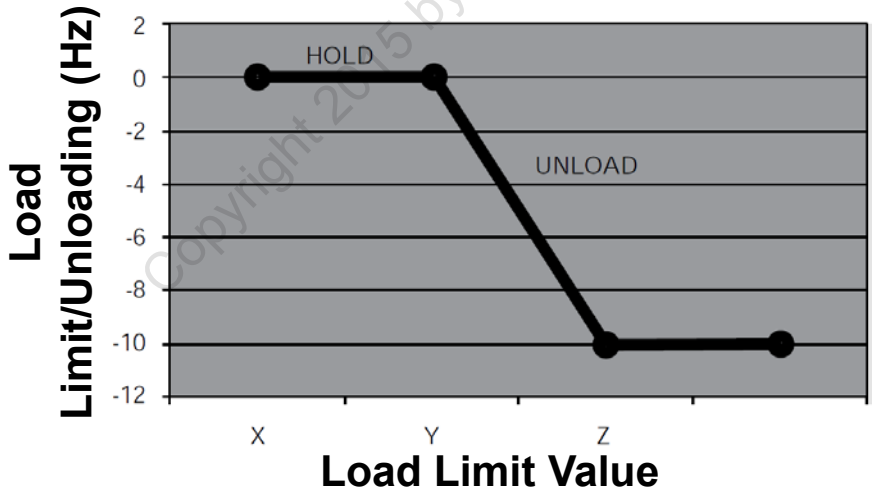
Conditions under which the unloading rate (normal loading and unloading rate being 1.0 Hz/2s) increases:

Condition	Unloading Rate (Hz/2s)
LCHLT < LCHLT setpoint – (Control Range/2)	2
LCHLT < 1°F over low LCHLT cutout	4

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Compressor Capacity Control

X Axis	At X Point	At Y	At Z
Motor Current	Active Setting - 2 %FLA	Active Setting	Active Setting + 5 %FLA
Discharge Pressure	High Cutout - 20 PSIG	High Cutout - 15 PSIG	High Cutout
Evaporator Pressure	Low Cutout + 3 PSIG	Low Cutout + 2 PSIG	Low Cutout
VSD Internal Ambient Temperature	Cutout - 3°F	Cutout - 2°F	Cutout
VSD Baseplate Temperature	8°F	4°F	Current Value

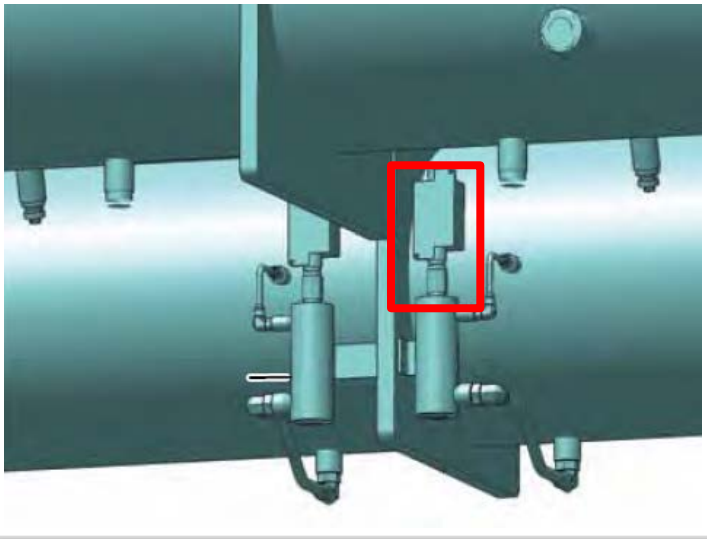


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Condenser Refrigerant Level Control: Level Sensor (YVWA)

A condenser level sensor:

- Used to control the condenser refrigerant level
- Capacitance-type sensor with 4-20mA transmitter output proportional to the refrigerant level on the probe (0% of probe coverage is 4.00 mA + 5% and full 100% coverage is 20.00 mA + 5%.)
- Is factory-calibrated, and not adjusted in the field

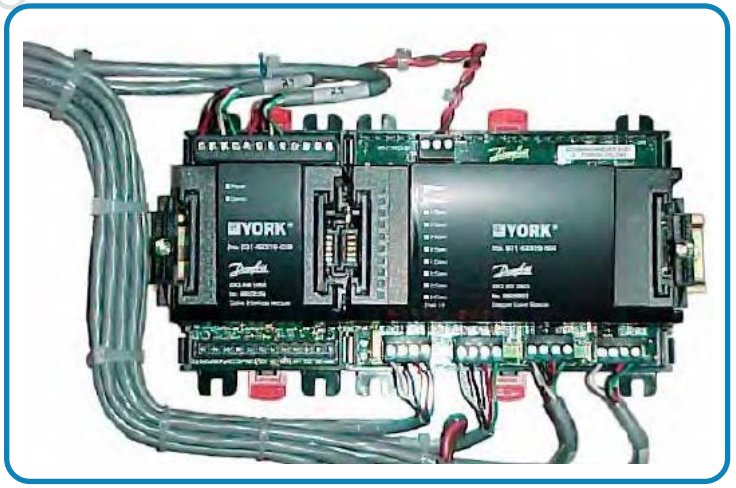


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Condenser Refrigerant Level Control: Level Controller (YVWA)

A condenser level controller is a:

- Stepper motor-operated Electronic Expansion Valve (EEV) that maintains in/out refrigerant flow into the evaporator from the condenser
- Controller that is based on the condenser liquid level sensor and a programmable level setpoint (20.0% to 80.0%, default 50.5%)
- Proportional plus Integral (PI) controller
- Controller that gives level control valve output percentage as output, which in turn gets converted to voltage (*Maximum 10.28 V*), and then the valve position



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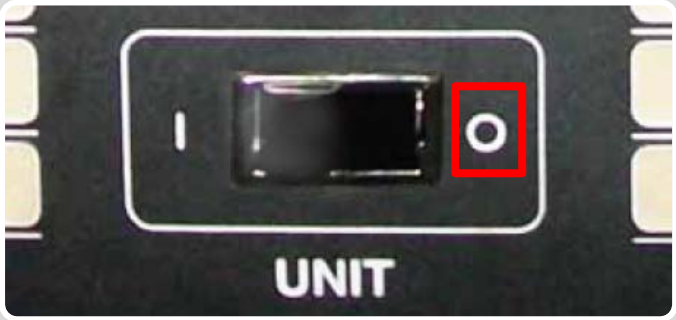
When the level is not in the range of ± 5% of the setpoint, proportional gain and integration time constants are the programmable startup values; however, when it is in range, these constants switch to fixed running values.

Condenser Refrigerant Level Control: Stopped System (YVWA)

The level control valve is set to the programmable condenser level control valve hold position (5 to 50%, default 30%).

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Stopped System

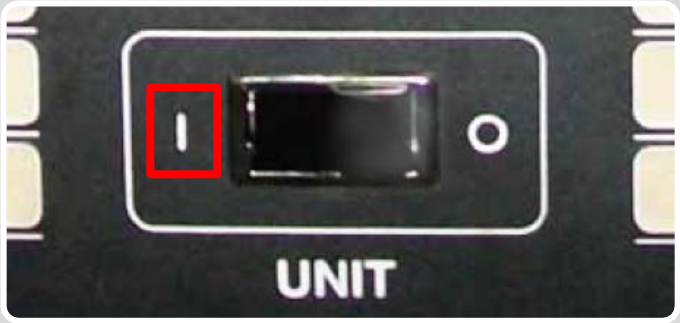


Condenser Refrigerant Level Control: Running System (YVWA)

Condition	Action
Level < Programmed level setpoint	The control valve is held at its programmed position until the programmable delay time (*0 to 10 minutes, default 5 minutes*) lapses.
Level < Programmed level setpoint after hold	The active level setpoint is set and maintained to the present condenser level.
Level > Programmed level setpoint	The active setpoint is set to the programmed level setpoint.

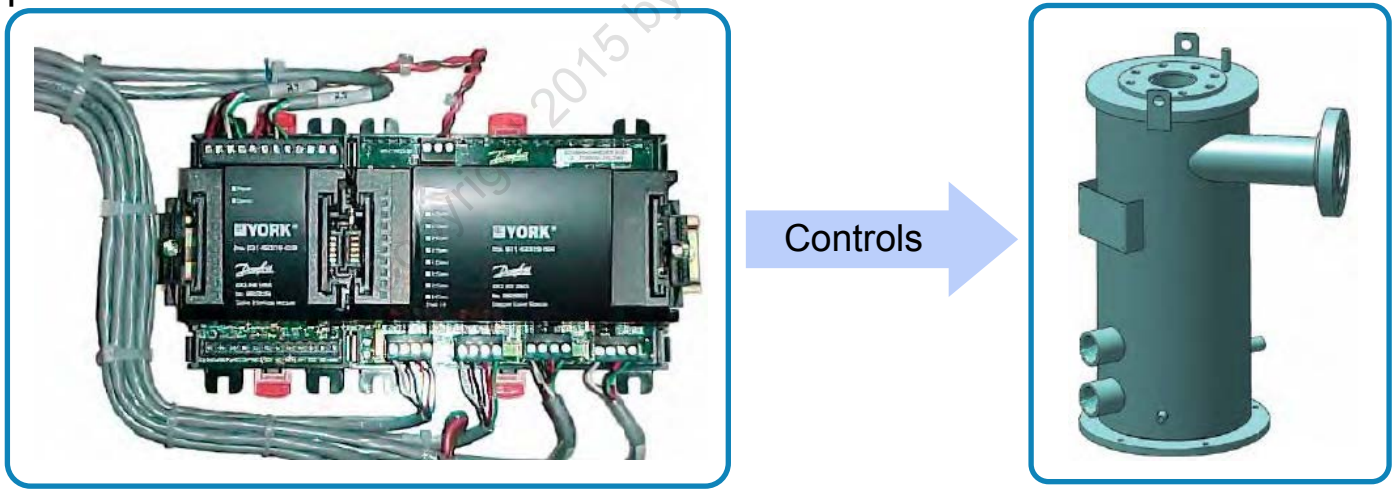
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Running System



Condenser Refrigerant Level Control vs. Oil Pressure (YVWA)

- Low condenser level control operating conditions result in discharging the pressure difference required for good oil flow.
- Active condenser level setpoint has an offset added every second control cycle :
  - Compressor run time > 5 minutes
  - Logic is controlling the condenser level to the intended setpoint
  - Differential oil pressure < service-programmable oil differential pressure control setpoint + 1



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Condenser Refrigerant Level Control vs. Oil Pressure (Contd.)

Pattern of offset increment:

Condition	Operator-programmable Level Control Increment
Evaporator pressure > Low evaporator safety shutdown pressure + 5 PSI	1 (0% to 10%, default 2%)
Evaporator pressure < Low evaporator safety shutdown pressure + 5 PSI	2 (0% to 10%, default 0.5%)

Pattern of offset decrement:

Condition	Operator-programmable Level Control Decrement
Evaporator pressure < Low evaporator pressure Cutout + 2 PSIG	2 (0% to 10%, default 0.5%)
Differential oil pressure > Oil differential pressure control setpoint + 1	1 (0% to 10%, default 2%)

Decrementing continues until the condition is met or the active setpoint is equal to the programmed normal operating level setpoint.

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Economizer Superheat Control

Economizer Superheat = Economizer Temperature – Saturated Economizer Temperature

The economizer feed valve is positioned to the operator-programmable economizer hold position (0.0 to 50.0%, default 2.0%) when the:

- System is not running; or
- VSD frequency < Operator-programmable economizer off frequency (45 Hz to 203 Hz, default 45 Hz)

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Economizer Superheat Control (Contd.)

Sequence of economizer feed valve operation:

1. VSD frequency increases to the operator-programmable Economizer On frequency (50 Hz to 204 Hz, default 50 Hz)
2. Motor temperature becomes less than operator-programmable Economizer Max Motor Temperature setpoint
3. Economizer option enables

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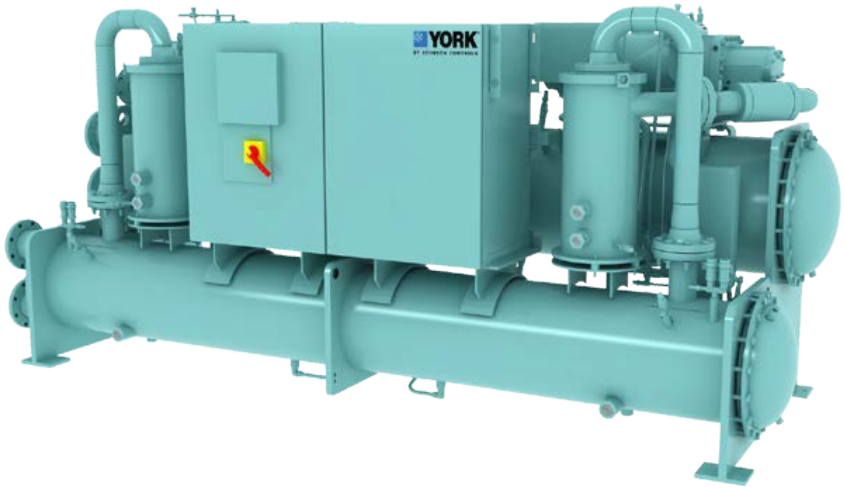
Condition	Control Action
Superheat < Operator-programmable economizer superheat setpoint	Valve is closed.
Superheat > Operator-programmable economizer superheat setpoint	Valve is opened.
VSD frequency < Operator-programmable value or Motor Temp >= Economizer Max Motor Temp setpoint	Valve is closed to the Economizer Hold position.

Operating Sequence Checks: Automated

Power-on Checks | **Operating Sequence Checks**

First Time Startup → Loading → General Operation → S/C Shelf → Automated

- ✓ Compressor control
- ✓ Condenser refrigerant level control
- ✓ Economizer superheat control
- ✓ Volume Index Step solenoid control

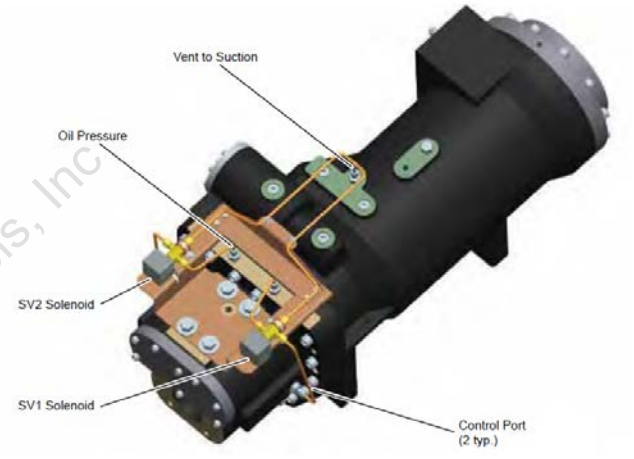


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VI Step Solenoid Control

Steps to control VI step solenoid:

1. Saturated temperature difference (saturated discharge temperature minus saturated evaporator temperature) is calculated to determine when to energize them.
2. The result is compared with the service-programmable setpoints:

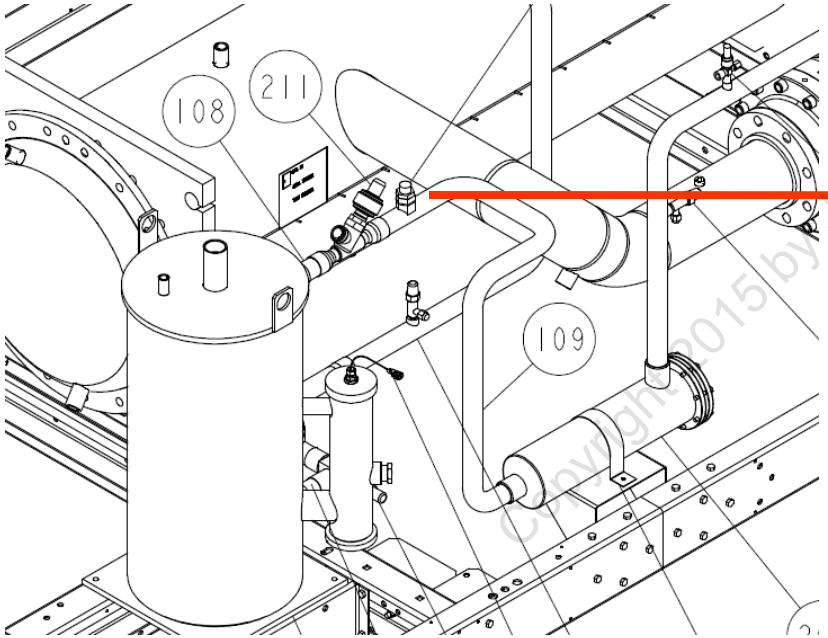


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Setup Mode Value	Low Limit	High Limit	Default
Sys 1 VI Differential Temp Setpt	60.0 °F	90.0 °F	73.0 °F
Sys 2 VI Differential Temp Setpt	60.0 °F	90.0 °F	73.0 °F
VI Dead band	2.0 °F	10.0 °F	4.0 °F
VI Differential Temp Setpt Offset	2.0 °F	40.0 °F	20.0 °F

Refrigerant Flow

Verify that when a compressor starts, a liquid refrigerant flow is present in the liquid line sight glass.





Sight Glass

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YVWA – Refrigerant Charge

- Check the refrigerant charge at steady full-compressor load only.
  - Verify flow rates through the evaporator and condenser are within range.
  - Measure evaporator approach and discharge superheat and verify that they are at design values at full load conditions.
  - Refrigerant level in the condenser should be about one inch above the sub-cooler.
- Adjust the level setpoint as necessary.
- Add refrigerant charge to the YVWA chiller until the evaporator approach and discharge superheat values are within the design values, if necessary.



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YVAA – System Charge

Verify the evaporator liquid level at steady full-compressor load only.



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BAS Interface Checks

Checks applicable to any York Screw Chiller with installed options:

✓ Remote Reset - Leaving Chilled Liquid Setpoint Reset

✓ Remote Reset - Current Limit Setpoint

Input Types: 0-10 or 2-10 VDC or 0-20 or 4-20 mA

Remote Reset checks:

- Change each remote input and verify value on control panel
- Return all remote inputs to normal operating position

✓ BAS Integration via E-Link or MicroGateway

BAS Integration

BAS Interface checks:

- Verify each mapped output
- Exercise each remote input
- Return all remote inputs to automatic operation (release overrides)

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York Screw Chiller Models

- startup
  - YVAA & YVWA startup
- **Scheduled Service**

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Scheduled Service: YVAA and YVWA



YVAA



YVWA

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Similar requirements at different intervals

Manuals

Open Service (201.28-M1)

SECTION
Maintenance

YORK BY JOHNSON CONTROLS	AIR-COOLED SCREW LIQUID CHILLERS	
SERVICE INSTRUCTIONS	Supersedes: 201.28-NM1 (111)	Form 201.28-M1 (812)

MODEL YVAA STYLE A
AIR-COOLED SCREW LIQUID CHILLERS WITH VARIABLE SPEED DRIVE
FRAME SIZES 015 - 052

150 - 500 TONS
525 - 1750 KW
2 COMPRESSOR
50 AND 60 HZ



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Manuals (Contd.)

Open
Service (201.30-M1)

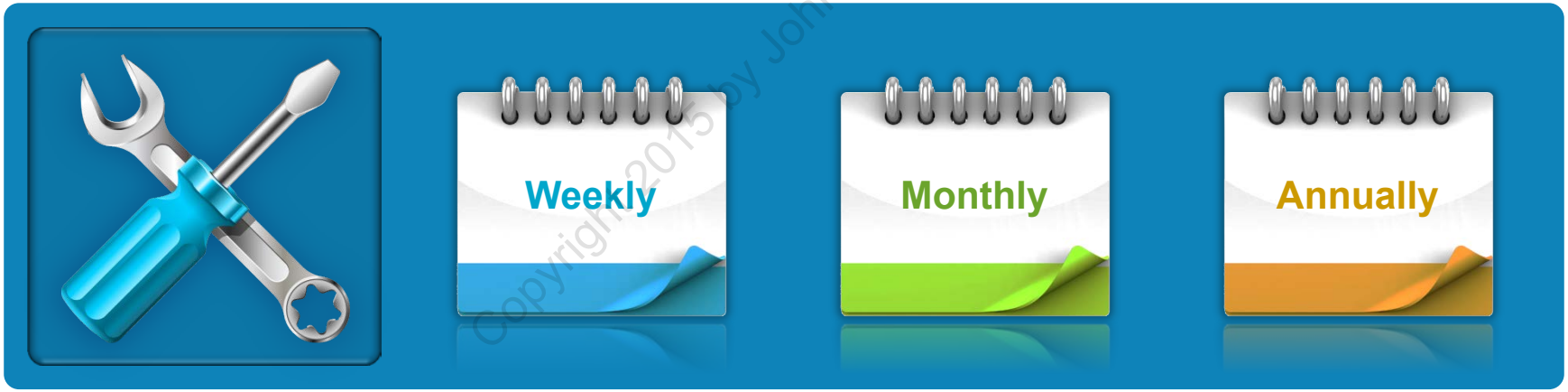
SECTION
Maintenance



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Maintenance Intervals

All York screw chillers require a periodic inspection and maintenance to ensure their uninterrupted operation. There are certain tasks that must be performed at regular intervals:



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Exercise

How do the Schedules Differ?

- Find the Scheduled Maintenance table for each of these two chillers:

YVAA Service Instructions
Form **201.28-M1.pdf**
Maintenance Requirements For YVAA Chillers

YWAA Service Instructions
Form **201.30-M1.pdf**
Operation/Inspection /Maintenance Requirements For YVWA Chillers

- Only one proceedure, "*Check refrigerant level – weekly*" is the same for both chillers.
- Study the differences in each table on the next two pages.
- Discuss your reaction to the question posed in each page header.

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Similar Procedures; Different Schedules

Why would these schedules be different?

YVAA

Procedure	Weekly	Quarterly	Semi-Annually	Annually	Every 5 Years	Every * Hours
Check Oil Level in Oil Separator Sight Glass.	X					
Record System Operating Temperatures and Pressures.	X					
Check Programmable Operating Setpoints and Safety Cutouts. Assure they are correct for the application.		X				
**Leak check the Chiller.			X			
**Sample Compressor Oil, check for Acid, and replace if necessary.				X		
**Disconnect Power Source and Lock Out. Check tightness of Power Wiring connections.				X		
VSD Glycol Change.					X	

YVWA

Procedure	Daily	Weekly	Monthly	Annually
Record operating conditions (on applicable log form)	X			
Check oil level in oil level sight glass	X			
Check programmable operating setpoints and safety cut-outs. Make sure they are correct for the application.				X
Check and repair leaks as needed[1]			X	
Check and tighten all electrical connections				X
Replace VSD coolant (after cleaning heat exchanger)				X
Perform oil analysis on compressor lube oil				X

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Different Procedures

Could these procedures apply to both chiller types? Why or why not?

	Procedure	Weekly	Quarterly	Semi-Annually	Annually	Every 5 Years	Every * Hours
YVAA	Check Liquid Line Sight Glass/ Moisture Indicator.	X					
	Check Condenser Coils for dirt / debris and clean as necessary.	X					
	Check Compressor and Evaporator Heater operation.		X				
	Check for dirt in the Panel. Check Door Gasket sealing integrity.		X				
	Check Glycol concentration on Low Temp. or other applications where freezing may be a problem.				X		

	Procedure	Daily	Weekly	Monthly	Annually
YVWA	Check oil return system operation			X	
	Check operation of motor starter			X	
	Check oil heater operation			X	
	Check 3-phase voltage and current balance			X	
	Verify condenser and evaporator liquid flows			X	
	Check the motor windings resistance				X
	Clean or back flush VSD heat exchanger tubes				X
	Perform refrigerant analysis				X
	Perform Eddy current testing and inspect tubes				X
	Clean evaporator and condenser tubes				X

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YVAA Cleaning Microchannel Coils

To clean:

1. Remove surface debris with vacuum cleaner or blow compressed air from inside out.
2. Use a soft bristle brush to brush debris off face of coil.
3. Rinse coil with tap water from inside out, running water through every passage until clean.
4. Blow or vacuum out rinse water from coils to speed drying and to prevent water pooling.



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CAUTION

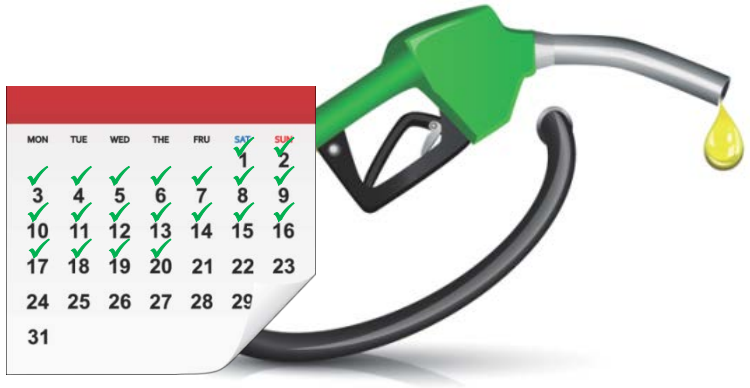
Do not:

- Use coil cleaners or any chemical as it can severely damage the coils.
- Use a pressure washer to clean the coils.
- Let the coil come to contact with any hard surface such as a hose nozzle, a metal vacuum nozzle, or any other tool.

Manage Oil Level

- Appropriate oil level in York screw chillers is critical for correct operation
- Excess oil level can accumulate in evaporator, leading to foaming and carryover of liquid refrigerant at high load conditions.
- Inadequate oil level can result in compressor damage.
- Amount of oil visible in the oil separator varies significantly with operating conditions and system transients.
- Active oil level management is critical. Maintain a daily record of oil level and operating conditions.

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Manage Oil Level (Contd.)

The decision to add or remove oil depends on the state of the chiller:

Startup



In-operation



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Manage Oil Level: Startup

Problem

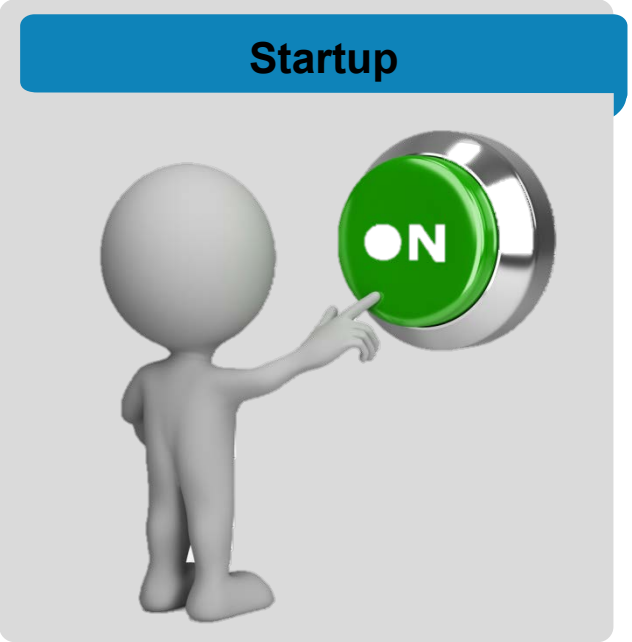
Oil level is above the upper sight glass.

Cause

Occurs when the evaporator pressure is greater than the condenser pressure causing the refrigerant in the oil separator to condense.

Solution

1. Confirm that the compressor oil heater is working and is energized (At first startup, the heater should be energized for at least 24 hours).
2. Keep unloading the chiller manually until :
   - The discharge superheat temperature reaches 18° F (10° C) or greater
   - The liquid level goes below the top of the upper sight glass
   - Foaming minimizes
3. Revert the original load control conditions.



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Manage Oil Level: In-operation

Problem

Oil level is not visible in or above the upper sight glass.

Cause

Occurs if the chiller operates in a low discharge superheat condition for long.

Solution

- Unload and hold the chiller at a capacity so that:
  - The discharge superheat temperature increases to 18° F (10° C) or greater
  - The liquid level goes below the top of the upper sight glass
  - Foaming minimizes
- Revert the original load control conditions.
- Remove oil if unloading doesn't work even after 1 hour.



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Manage Oil Level: In-operation (Contd.)

Problem

Oil level is not visible in either of the sight glasses and bearings are not properly lubricated.

Cause

- Problem with the oil return system
- Compressor operating at low load (at less than 100 Hz)

Solution

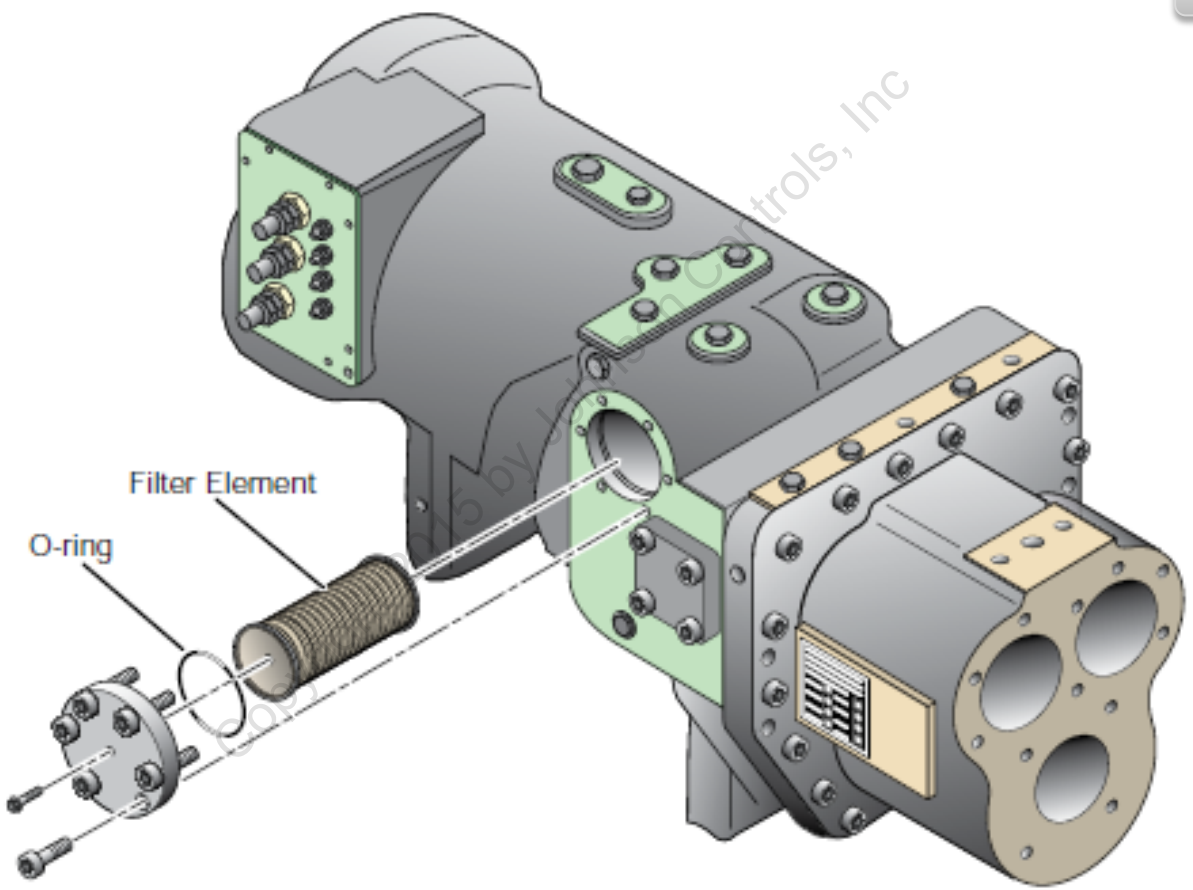
- Determine and resolve problems with the oil return system.
- Add enough oil to create a visible level.
- Start the chiller and operate at a stable load condition for 1-2 hours.
- Trim the oil charge.



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Oil Filter Assembly

Annually



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Vacuum Dehydration: An Introduction

After any prolonged maintenance activity, vacuum the chiller using a wet bulb indicator or a vacuum gauge. Some related considerations are as follows:

- Refer to the relation between ‘dew point temperature’ and ‘pressure in’ of mercury (vacuum).
- Note that the dehydration time depends on:
  - Size or volume of the system
  - Capacity and efficiency of the vacuum pump
  - Room temperature
  - Quantity of water present in the system

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Relationship Between Dew Point Temperature and Pressure

Gauge	Absolute		Dew point temperatures of water (°F)
In of HG < 1 standard atmosphere	PSIA	MM of HG	
0	14.696	760.0	212
10.24"	9.629	500.0	192
22.05"	3.865	200.0	151
25.98"	1.935	100.0	124
27.95"	0.968	50.0	101
28.94"	0.481	25.0	78
29.53"	0.192	10.0	52
29.67"	0.122	6.3	40
29.72"	0.099	5.0	35
29.842"	0.039	2.0	15
29.882"	0.019	1.0	+1
29.901"	0.010	0.5	–11
29.917"	0.002	0.1	–38
29.919"	0.001	0.05	–50
29.9206"	0.0002	0.01	–70
29.921"	0	0	0

1 standard atmosphere = 14.696 PSIA = 760 MM HG absolute pressure at 32°F = 29.921 in HG absolute at 32°F

Water freezes



PSIA = Lbs. per sq. in. gauge pressure = Pressure above atmosphere = Lbs. per sq. in. absolute pressure = Sum of gauge and atmospheric pressure

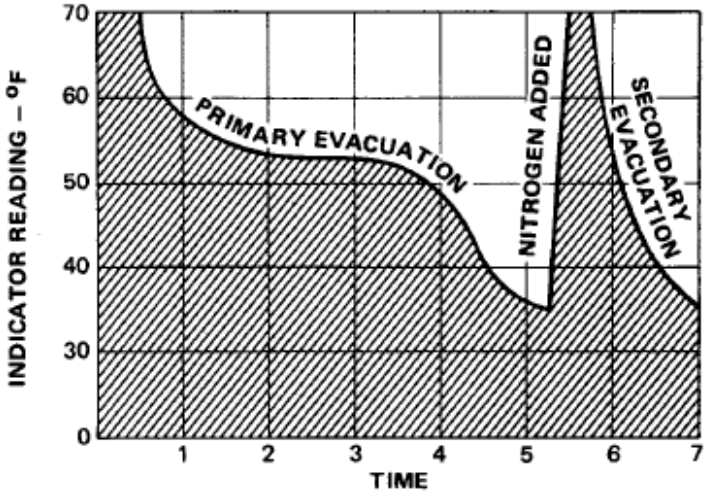
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Vacuum Dehydration: Key Points

Consider the below key points while vacuum dehydration:

- Circulate hot water (not more than 125 °F) through tubes to thoroughly dehydrate the shells
- Connect a hose between the source of hot water under pressure and the evaporator head drain connection, out the evaporator vent connection, into the condenser head drain and out the condenser vent
- Avoid leaks by bringing the temperature up slowly
- Make sure that the saturation temperature recordings follow the pattern given in the image.

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Vacuum Dehydration: Key Points (Contd.)

Other key points:

- Water temperature drops as the pressure decreases until the boiling point is reached.
- At the boiling point, most of the air is evacuated but a small amount of moisture is left; Introduce nitrogen gas to evacuate it, and then initiate the second evacuation.
- If the vacuum indicator registers a temperature of -11 °F or a pressure of .5 MM Hg, it indicates a complete evacuation and dehydration to the recommended limits.

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Perform Vacuum Testing

To perform vacuum testing after completing the pressure test:

1. Connect a high capacity vacuum pump, with indicator, to the system charging valve or shell service valve and start the pump.
2. Open wide all system valves, including the purge and gauge valves while ensuring that all valves to the atmosphere are closed.
3. Operate the vacuum pump in accordance with vacuum dehydration until a wet bulb temperature of -11 °F or a pressure of .5 MM Hg is reached.
4. Close the system charging valve and the stop valve between the vacuum indicator and the vacuum pump, then disconnect the vacuum pump leaving the vacuum indicator in place.
5. Hold the vacuum wet bulb temperature obtained in Step 3 in the system for 10 minutes.
   - The slightest rise in pressure indicates a leak or the presence of moisture, or both.
   - If a system needs to be evacuated to minimum of 500 microns, the system should be able to hold the vacuum for 10 minutes with a maximum rise of 50 microns. If the system is not able to hold a Vacuum, recheck the system for leaks.
6. If the vacuum does not hold for 10 minutes within the limits specified in Step 5, find and repair the leak.

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Lesson Summary

In this lesson, you learned that:

- Operating sequence checks are self and automated.
- Automated controls include compressor control, condenser refrigerant level control, economizer superheat control, and Volume Index step solenoid control.
- You should check the compressor and sensors to run tuning checks.
- All York Screw chillers need to be maintained on a periodic basis to ensure an uninterrupted operation.
- YCAV, YCIV, YVAA and YVWA maintenance requirements vary – follow the schedule in appropriate manual.
- Oil level checks are critical to efficient operation and compressor life.



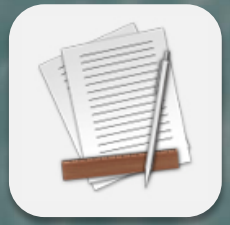
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Resources

Day 1 | Day 2 | Day 3 | Day 4



Videos



Technical Documentation



Handouts



Scratch Pad

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Videos

YVWA Animations

YCAV Refrigerant Flow

YVAA Refrigerant Flow

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YVWA Animations

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YCAV Refrigerant Flow

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YVAA Refrigerant Flow

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Technical Documentation

- 50.20-CL9
- 50.20-nm1
- 50.20-nm9
- 160.00-m4(113)
- 201.21-EG1-Engineering Guide-Model YCAV Air-Cooled Screw Compressor Liquid Chillers Style A 60 Hz
- 201.21-m1
- 201.21-nm1
- 201.21-nm3
- 201.21-rp1[1] 2 compressor
- 201.21-w1
- 201.21-w3
- 201.28-CL2
- 201.28-EG1-Engineering Guide-Model YVAA Air-Cooled Screw Compressor Chiller with VSD Style A 50 and 60 Hz
- 201.28-M1
- 201.28-nm1.1 IOM
- 201.28-rp1
- 201.30-cl1 Installation and Request for Startup
- 201.30-cl2 Startup Checklist

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Technical Documentation (Contd.)

- 201.30-EG1-Engineering Guide-YVWA
- 201.30-ICOM1.EN.UL
- 201.30-icom2(412)
- 201.30-m1 IService
- 201.30-N1
- 201.30-PW1
- 201.30-pw2
- 201.30-rp1(1113)

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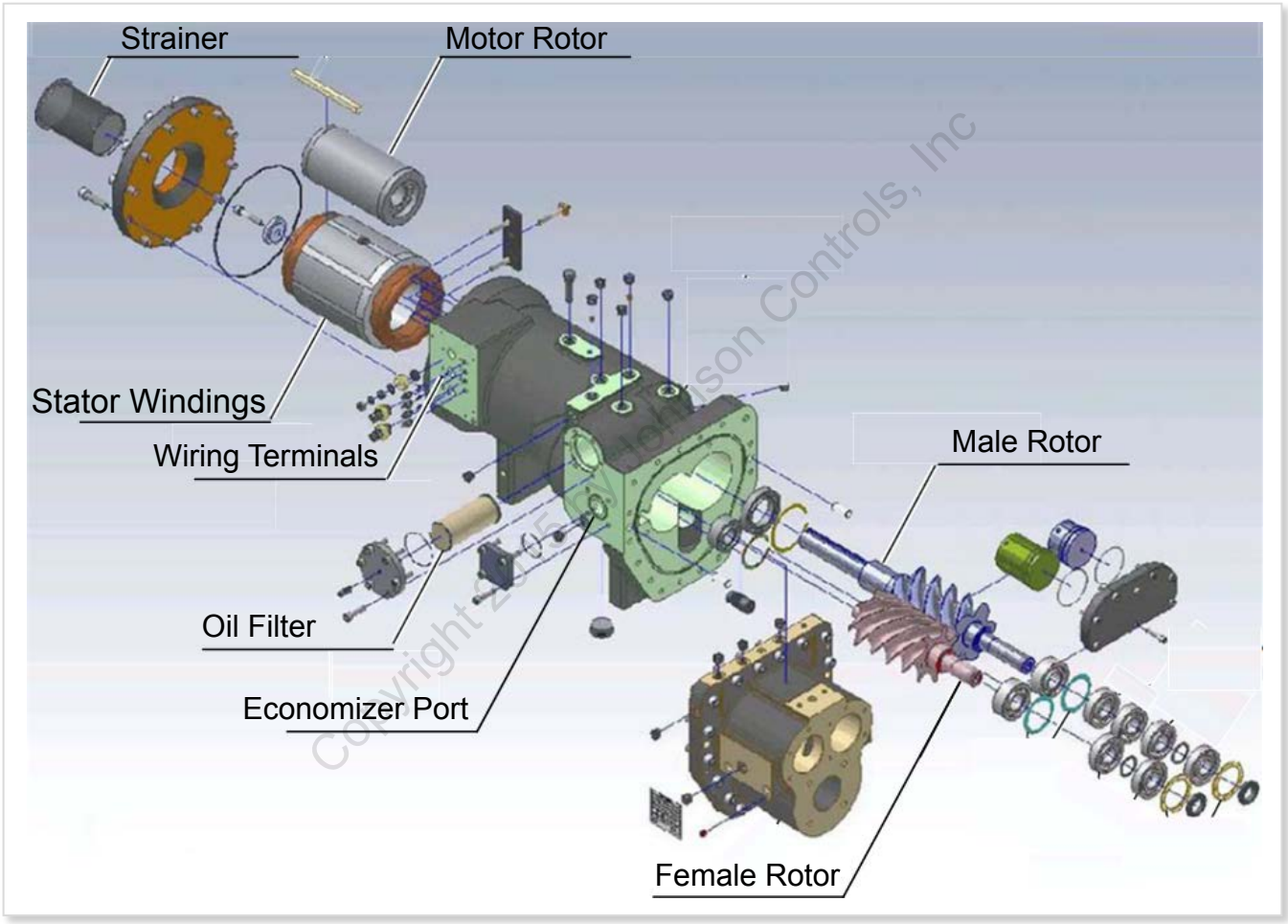
Handouts

- Component Recognition Exercise rev1
- CP130 Printer Weight Tronix
- Downloading YCIV Data Instructions
- Flash Tank Test
- pr0602
- si0219Ycav&YCIV Low SSH
- si0245
- si0246
- si0261
- si0269
- YCAV Set up lab
- YCAV Simulator Exercises
- YVAA Safety Shutdowns
- YVAA Order Form
- YVWA Example OrderSpec

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Answers

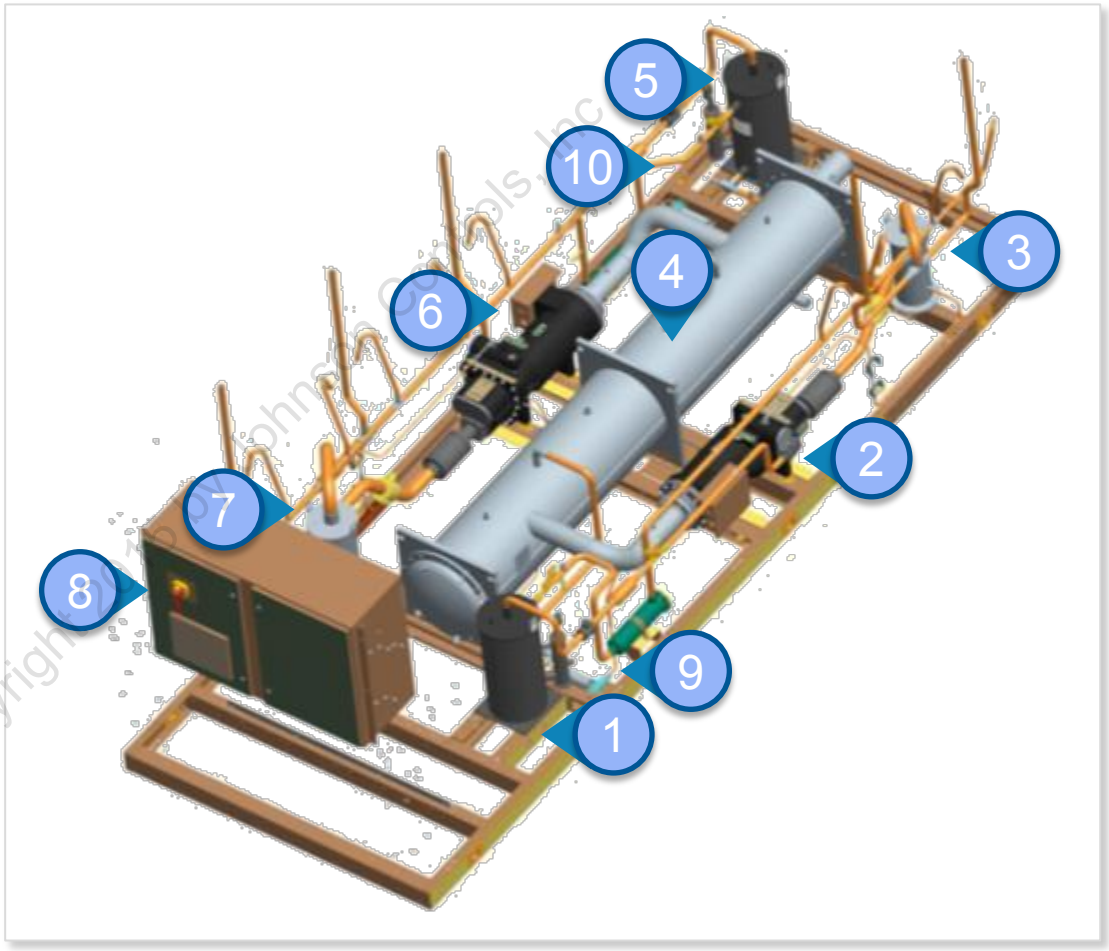




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YVAA Internal Components

1. Flash Tank
2. Compressor
3. Oil Separator
4. Evaporator
5. Flash Tank
6. Compressor
7. Oil Separator
8. Control Panel/VSD
9. Oil Eductor
10. Economizer feed line



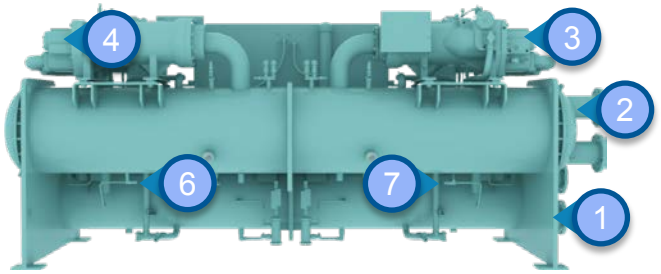
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Activity: Identify the Major Components

1. Condenser
2. Evaporator
3. Compressor
4. Compressor
5. Control Panel/VSD
6. Oil Eductor
7. Oil Eductor
8. Oil Separator
9. Economizer
10. Oil Separator



Front View



Rear View

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