
**Emerson Commercial & Residential Solutions**

# Semi-Hermetic Compressor Overview

Online Training

*Note: you will be muted upon entry. Please 'raise hand' to be unmuted or type in chat box for any questions.*

*Session is being recorded.*

EMERSON

# COVID-19 Emerson Update

As we continue to observe the collective coronavirus response effort around the world, I want to assure you that Emerson is very focused on the safety of our employees, customers, suppliers, and communities and we have joined the effort to use social distancing and, where feasible, work from home strategies to help the collective global effort to break the cycle of infection.

Emerson's goods and services directly support critical infrastructure industries and are considered essential in areas such as power generation, refrigeration, food safety, HVAC, pharmaceuticals, refineries for fuels, chemicals, food and beverage, and production technologies used in medical equipment, transportation, and so on. As we all work collectively together in the fight against the virus, please know that it is a primary mission in these times to keep our key facilities open and provide the critical products and services so that the essentials of daily life remain available to our families and communities.


Emerson has taken significant safeguards in our manufacturing facilities to provide social distancing and enhanced cleaning to operate safely and we are working with all government authorities to make sure they support our mission of remaining open and providing critical solutions in these times.

EMERSON

# Introduction

## Zaki Abedeen, P. Eng.

**Sales Manager for Emerson Commercial & Residential Solutions**

Zaki currently manages the GTA and Northern Ontario distribution channels for Emerson, working with distribution partners and local HVAC contractors directly for training, technical support and sales promotions.

He has over 14 years of experience working for refrigeration OEMs (CIMCO Refrigeration, Sunwell Technologies), process & building automation (Emerson Automation Solutions) and HVAC/R manufacturers (Copeland, White-Rodgers).

EMERSON

# Emerson Wholesaler Account Leadership

**Greg Butt**
Executive Director, Channel
Tel: 416-526-2858
Greg.Butt@emerson.com

## WESTERN CANADA

**Ray Winger**
Partner Champion – BC
Tel: 604-404-3115
Raymond.Winger@Emerson.com

**Kal Zgheir**
Partner Champion – AB
Tel: 403-589-8392
Kal.Zgheir@Emerson.com

**Cal Gogal**
Partner Champion – MB, SK
Tel: 204-918-2118
Cal.Gogal@Emerson.com

## ONTARIO

**Ken Wright**
Partner Champion
Tel: 519-502-9936
Kenneth.Wright@Emerson.com

**Zaki Abedeen**
Partner Champion
Tel: 416-948-2466
Zaki.Abedeen@Emerson.com

**Victor Vera**
Partner Champion
Tel: 613-791-6590
Victor.Vera@Emerson.com

## QUEBEC & MARITIMES

**Claude Dompierre**
Partner Champion
Tel: 514-386-0639
Claude.Dompierre@Emerson.com

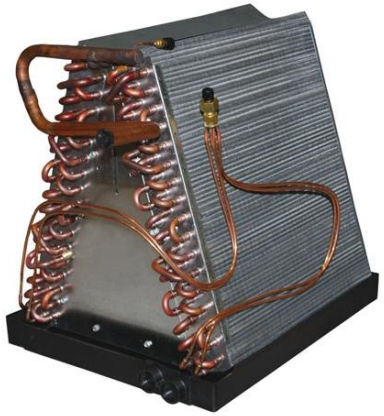
EMERSON

# What Are 4 Main Components In Refrigeration?


Compressors



Condensers



Evaporators

Metering Devices

EMERSON

# Compressor Types

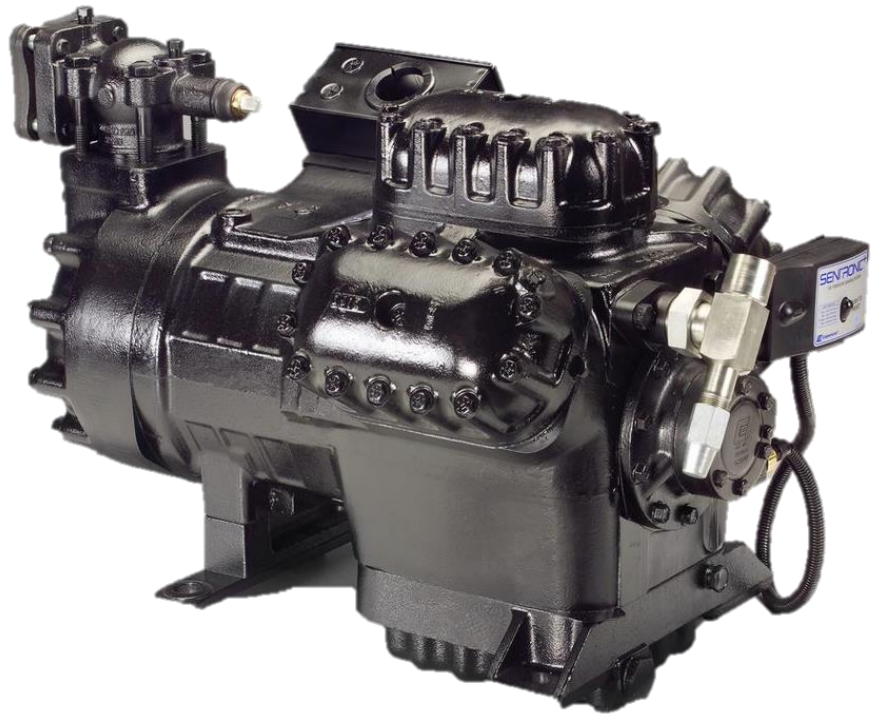
# Compressor Types

Semi-Hermetic

Hermetic Reciprocating


Scroll

# Semi Hermetic
# Copelametic Compressors




EMERSON

# Training & Development

## Introduction

## Overview

Copeland has two semi-hermetic product lines: the Copelametic and Discus compressors. This module will focus on the Copelametic compressors.

Copelametic compressors have the following features:

**Accessible Construction:**

- Field Repair Possible
- Valve Plates/Oil Pumps

**Four Pole Motors:**

- Less valve losses
- Ample port area
- Lower gas velocity

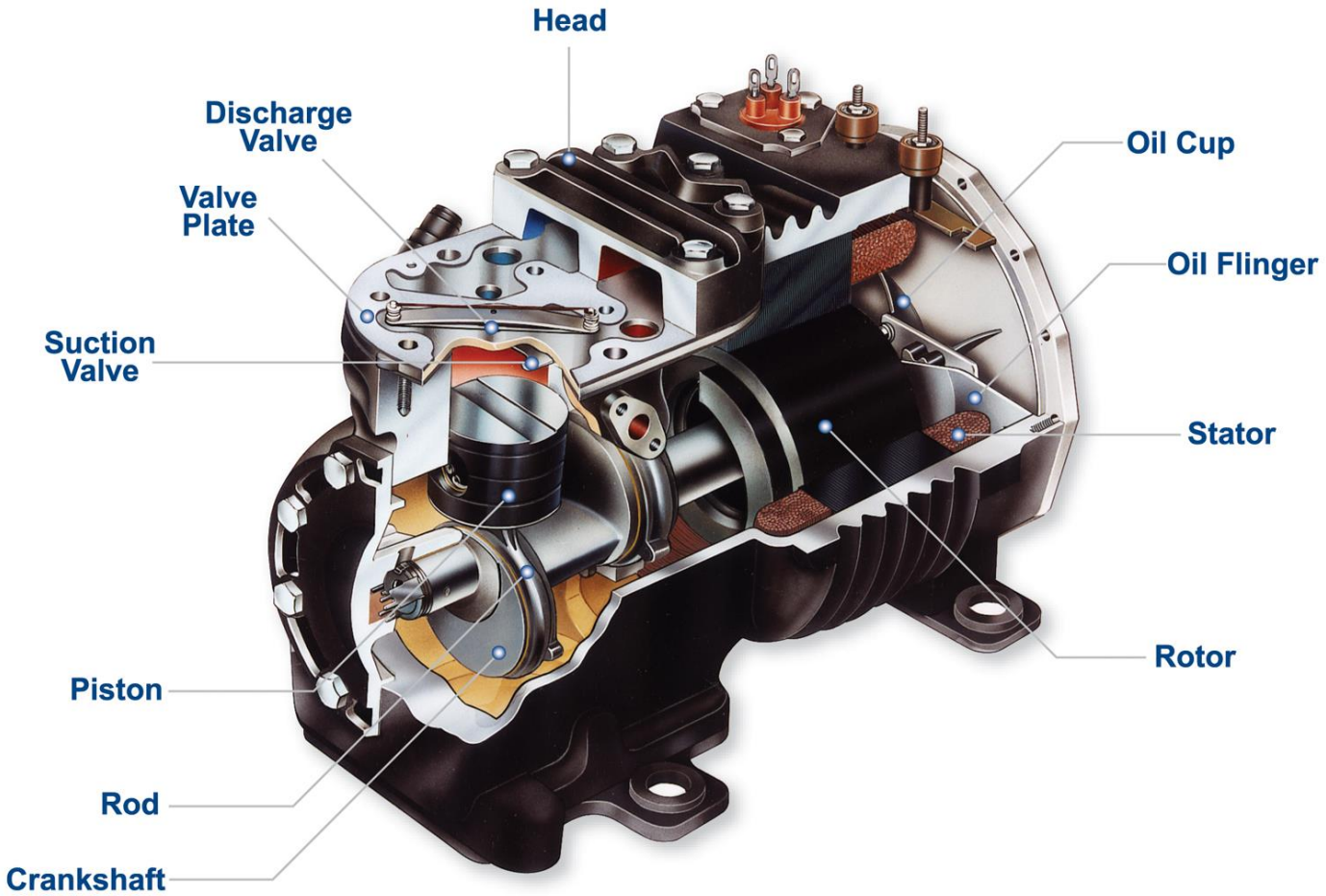
**Cast Iron Body:**

- Direct motor mounted
- Excellent heat rejection
- No internal suspension/tubes

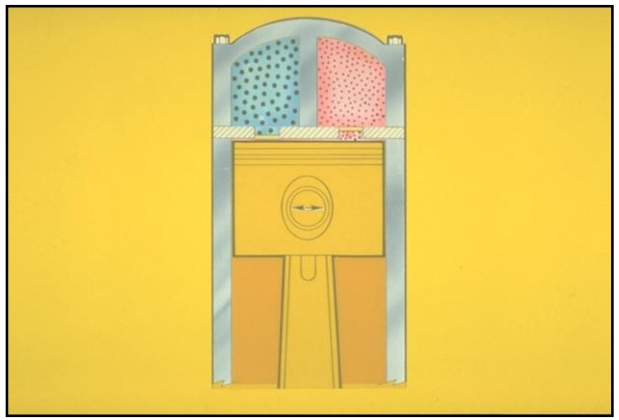
**Positive Displacement Oil Pumps:**

- Pressurized feed
- Large flow volume

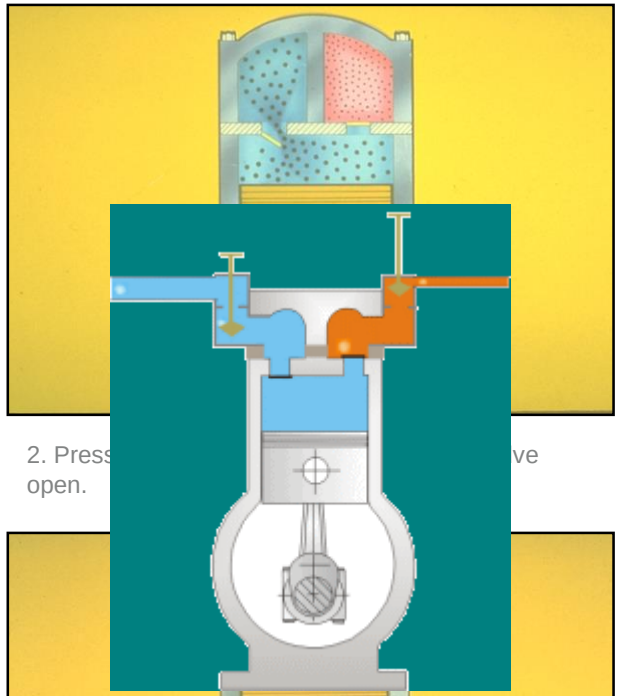
## Basic Components



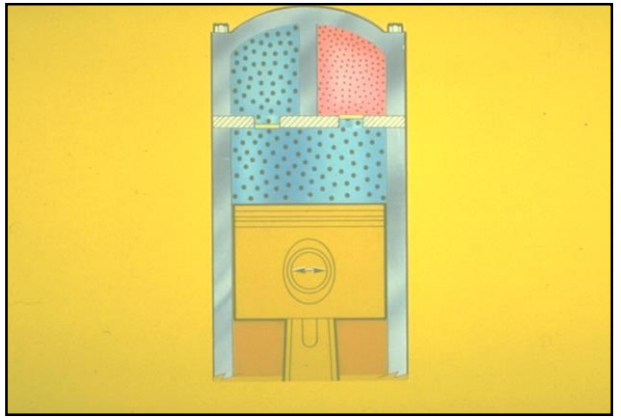
## How It Works



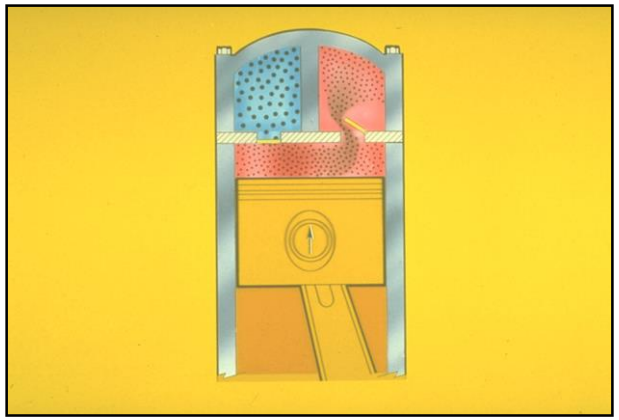
1. Start of cycle.



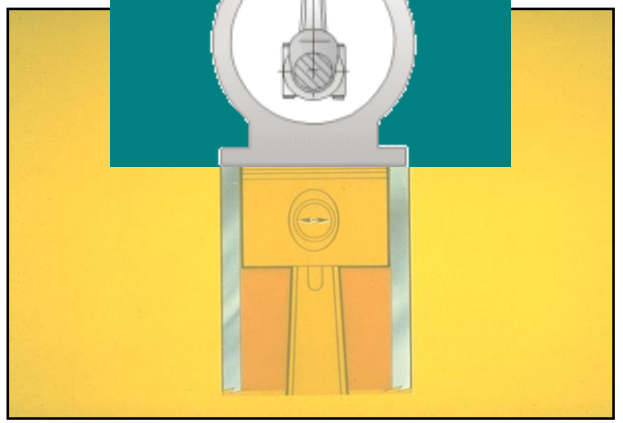
2. Press … ve open.



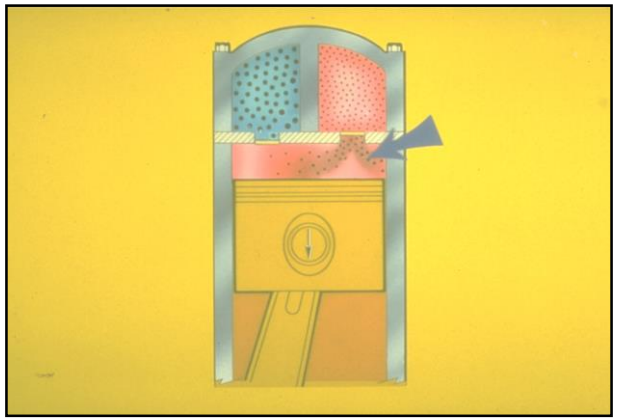
3. When pressure inside the cylinder equals pressure in the low side of the head, the suction valve will close.



4. As piston travels upward, pressure inside the cylinder increases beyond the pressure of the high side of the head.



5. Pressure equalizes and discharge reed closes. Small volume of high pressure gas remains in valve plate port and clearance between piston and valve plate.



6. High pressure gas must re-expand to low pressure before suction reed can open. This “volumetric expansion loss” limits the compressor’s efficiency.

# Training & Development

## Introduction

## Copelametic Product Family

Copelametic compressors are designed for CFC, HFC, and HCFC refrigerants with capacity ranging from fractional horsepower as low as 1/4HP and large capacity models of up to 40HP. Product family of Copelametic compressors can be identified on the first two characters of the compressor model.

| Product Family | Application |
|---|---|
| 4R, 6R, 9R | Air Conditioning |
| H, K, E, 3A, 3R, L, N | Refrigeration<br>(High, medium, and low temperature) |
| H, K, E, 3A, 3R, L, N,<br>MR, 9R, 4R, 6R | Refrigeration<br>(High, medium, & low temperature) |

# Training & Development

## Introduction

## Compressor Images

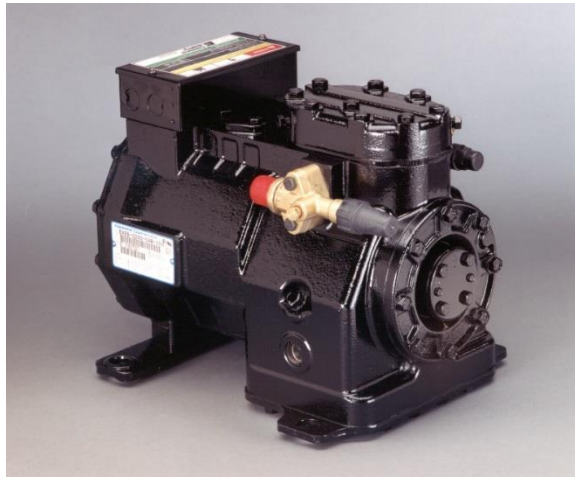
Copelametic H-line*

HAK2-0050
Approx Range = ¼ - ½  HP

Copelametic K-line

KAKB-021E
Approx Range = ½ - 1 ½ HP

Copelametic E-line



EADB-0200
Approx Range = ½ - 2 HP

Copelametic L-line

LAHA-032E
Approx Range = 3 ¼ HP

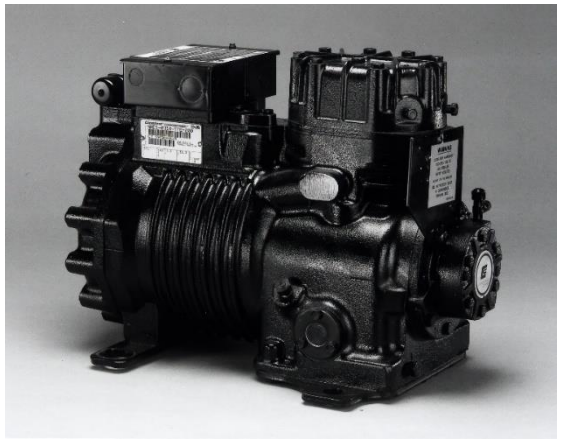
*Obsolete

# Training & Development

## Introduction

## Compressor Images

Copelametic N-line



NRD1-0310
Approx Range = 3 ¼ - 4 HP

Copelametic MR*

MRF2
Approx Range = ½ HP

Copelametic 3A/R-line

3ABA-031E
Approx Range = 3 HP

Copelametic 9R

9RA1
Approx Range = 5-15 HP

*Obsolete

# Training & Development

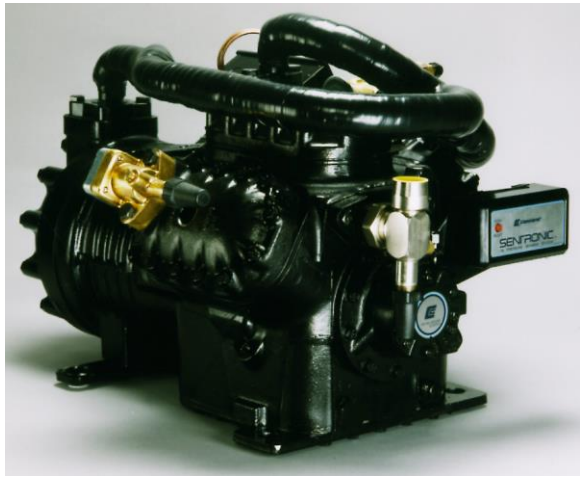
## Introduction

## Compressor Images

Copelametic 9T*

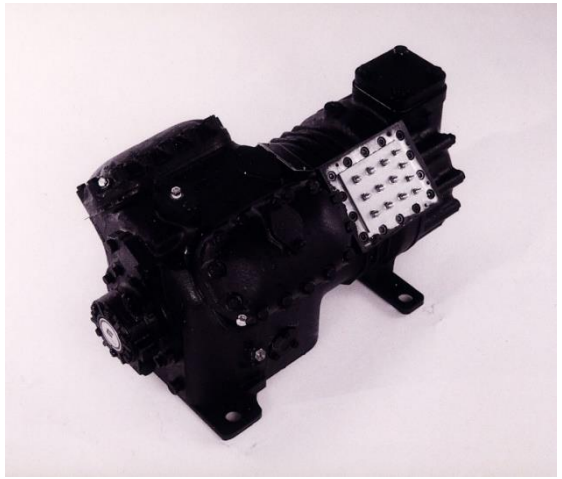
9T
Approx Range = 5 – 10 HP

Copelametic 6T*




6T
Approx Range = 20 HP

Copelametic 4R



4R
Approx Range = 10 – 30 HP

Copelametic 6R

6RJ
Approx Range = 20 – 40 HP

*Not Manufacturing in North America

# Product Features

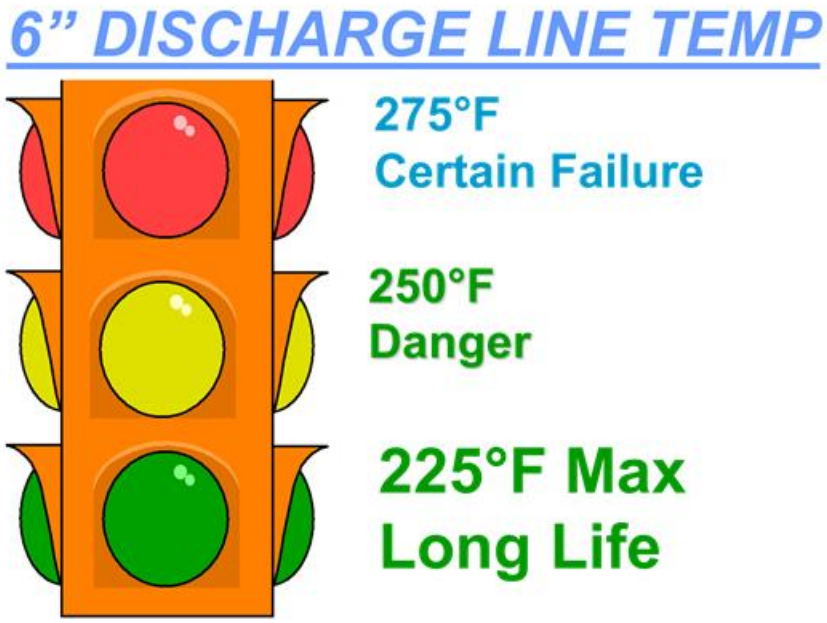
# Training & Development

## Product Features

## Cooling Requirements

Copelametic compressors require adequate cooling to prevent overheating of the compressor that may lead to motor failure. Each Copelametic products have unique cooling requirements.

The heat developed by the compressor should be transferred either through air, water, or refrigerant. The method of cooling depends on the construction of the compressor and may require additional accessories to accomplish it.



# Training & Development

## Product Features

## Air-cooled Copelametic

Can be identified by “A” on the 2nd character of the model name. The motor heat is removed by passing air across the compressor. In terms of construction, an air-cooled Copelametic has its suction service valve on the left side of the compressor.

Air-cooled require constant airflow across the compressor body for proper cooling. This can be provided by mounting the compressor at the fan discharge stream on a condensing unit. When applied with a remote condenser, an auxiliary fan is required to supply the constant airflow. Examples of Copelametic with Air-cooled design is the H, K, E, 3, and L.

K**A**LB-015E-CAV-800 is air-cooled

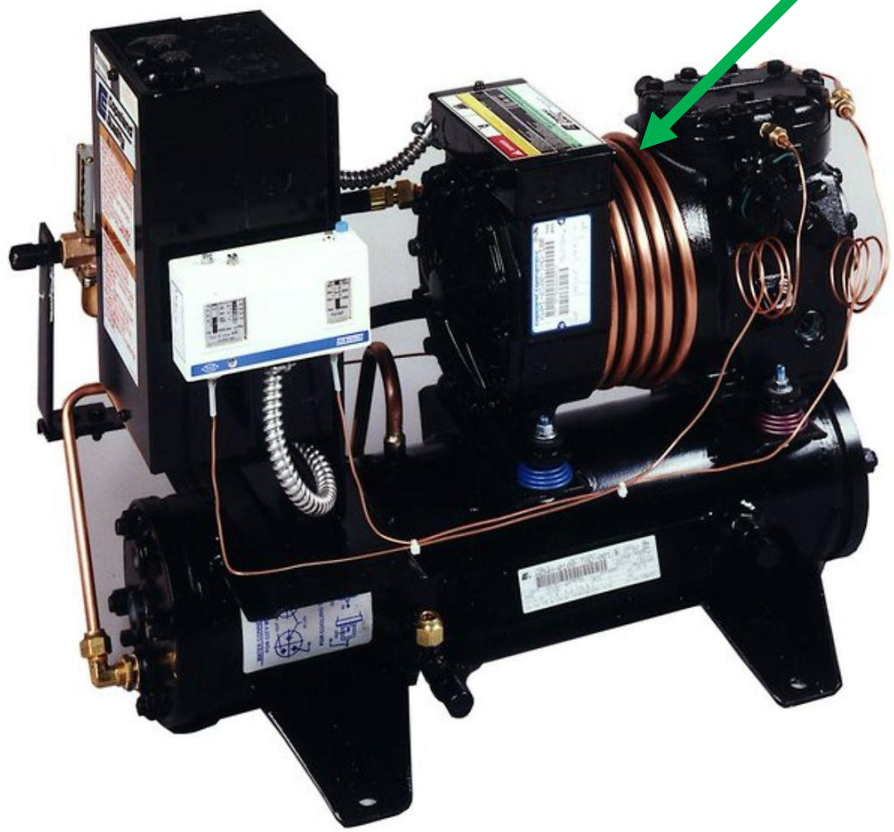
# Training & Development

## Product Features

## Water-cooled Copelametic

Can be identified by “W” on the 2nd character of the model name. Copper tube wraps around the compressor body to absorb the heat from the compressor motor. This is only available on smaller Copelametic compressor for application on water-cooled condensing units due to the absence of condenser fan that will provide the constant airflow. If water is circulated through the coil wrapped around the compressor, adequate cooling will be provided. Compressor designed for air-cooled can be converted to water-cooled.

Copper tube wrapped around the body of a small Copelametic compressor

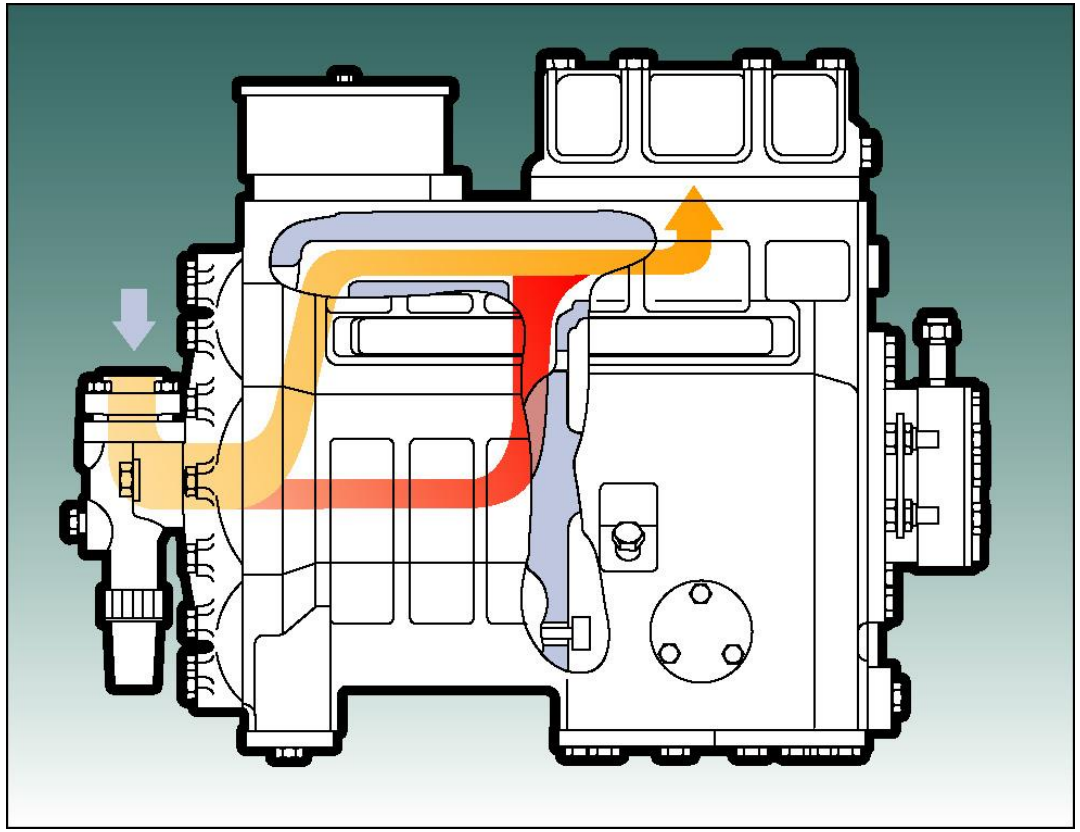


# Training & Development
## Product Features

## Refrigerant-cooled Copelametic

Can be identified by “R” on the 2nd character of the model name. The Copelametic compressor was designed so that the refrigerant suction pass through the motor of the compressor to cool the compressor. The compressor will adequately cooled by the refrigerant at evaporating temperatures above 0°F. If operated at evaporating temperatures below 0°F in which the mass flow of the refrigerant is too low, the cooling will not be enough and an auxiliary cooling is required. Copelametic compressor designed with refrigerant cooled are E, M, N, 3R, 4R, 6R, and 9R.

E**R**FA-031E-TAC-800 is refrigerant-cooled



The suction of the 3R compressor is located at the motor side to force the suction refrigerant to pass through the hot compressor motor to absorb the heat.

# Polling Question 1

Q: What are the two types of semi-hermetic compressors that are manufactured by Copeland?

1) Air-cooled
2) Water-cooled
3) Reciprocating
4) Copelametic and Discus

# Polling Question 1

Q: What are the two types of semi-hermetic compressors that are manufactured by Copeland?

1) Air-cooled
2) Water-cooled
3) Reciprocating
**4) Copelametic and Discus**

# Semi Hermetic
# Discus Compressor


EMERSON

# Training & Development

## Introduction

## Overview

This module will focus on the Discus compressors.  This family consists  of refrigerant-cooled single-stage compressors, models 2D, 3D, 4D,  6D and 8D with 2, 3, 4, 6 and 8 cylinders respectively. Discus compressors have the following features:

**Accessible Construction:**

- Field Repair Possible
- Valve Plates/Oil Pumps

**Four Pole Motors:**

- Less valve losses
- Ample port area
- Lower gas velocity

**Cast Iron Body:**

- Direct motor mounted
- Excellent heat rejection
- No internal suspension/tubes

**Positive Displacement Oil Pumps:**

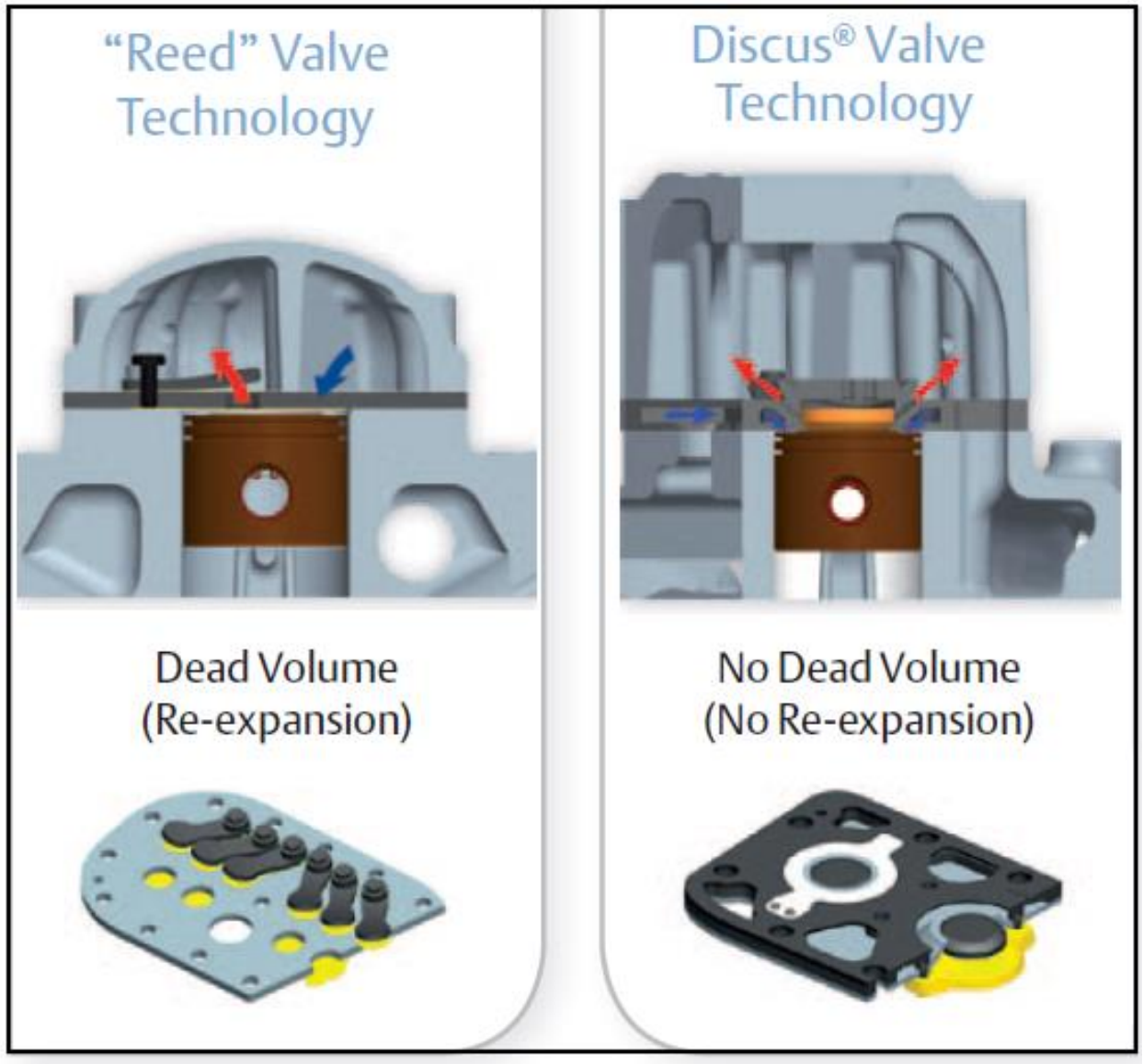
- Pressurized feed
- Large flow volume

# Training & Development

## Introduction

### Overview

- A traditional Reed (Copelametic) compressor will not allow all of the discharge gas to exit, leading to re-expansion volume.
- But in the Copeland Discus compressor, re-expansion is virtually zero, providing the highest possible efficiency.
- The complete cylinder head is under discharge pressure.



## Basic Components

# Training & Development

## Introduction

## Discus Product Family

Discus compressors were developed to provide higher capacities and **improved efficiencies (EER)** for a given displacement (CFH) or motor size (HP). The Discus concept was to minimize the re-expansion volume that us present in valve plates using conventional reed valves.

| Product Family | Approved Refrigerants | Application |
|---|---|---|
| 2D, 3D, 4D, 6D, 8D | 22, 134a, 404A, 407A, 407C, 407F, 507 | Air Conditioning |
| 2D, 3D, 4D, 6D | 134a | Refrigeration (High temperature) |
| 2D, 3D, 4D, 6D | 22, 134a, 404A, 407A, 407C, 407F, 507, 448A, 449A | Refrigeration (Medium temperature) |
| 2D, 3D, 4D, 6D | 22, 404A, 407A, 407C, 407F, 507, 448A, 449A | Refrigeration (Low temperature) |

Discus compressors are available in two, three, four, six and eight cylinder models ranging from 3 HP to 60 HP.

# Training & Development

## Definition of EER

## What is EER?

- EER stands for ENERGY EFFICIENCY RATIO.
- **The Energy Efficiency Ratio (EER) of an HVAC cooling device is the ratio of output cooling energy (in BTU) to input electrical energy (in watts) at a given operating point**. EER is normally calculated with a 95 °F outside temperature and an inside (return air) temperature of 80 °F and 50% relative humidity.
- Similarly, The Seasonal Energy Efficiency Ratio (SEER) rating of a unit looks at an air conditioner a bit more granularly i.e calculating the cooling capacity during a typical cooling-season (rather than all-time) divided by the total electric input during the same period.

# Training & Development

## Introduction

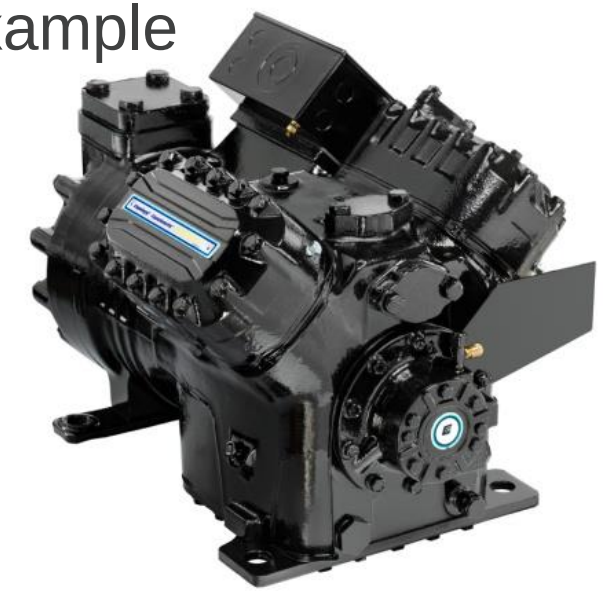
## Discus Product Family

### New Generation Discus III (4D & 6D Models Only)

- Equivalent Capacities & Efficiencies As Discus II
- Same Mounting and Line Connections As Discus II
- Deep Sump Models Eliminated
- Oil Cooler Models Eliminated

### Current Discus Example

4DH3R22ML-TSK-800
Or Digital Model
4DHDR22ML-TSK-800



### New Discus III Example

4DHNR22ML-TSK-A00
Or Digital Model
4DHXR22ML-TSK-A00

# Training & Development

## Introduction

## Compressor Images

Discus 2D

Approx Range = 3 – 7.5 HP

Discus 3D


Approx Range = 5 – 15 HP

Discus 4D

Approx Range = 10 – 30 HP

# Training & Development

## Introduction

## Compressor Images

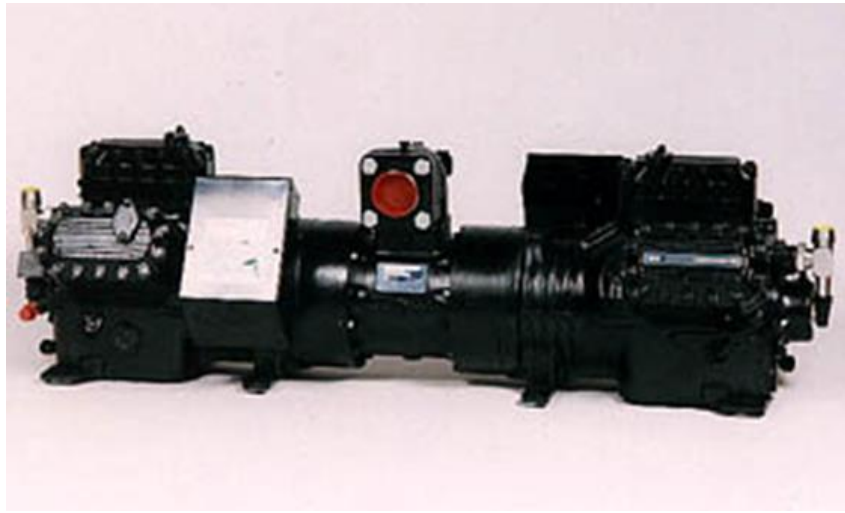
Discus 6D

Approx Range = 20 – 40 HP

Discus 8D

Approx Range = 50 – 60 HP

Discus Tandem 66D



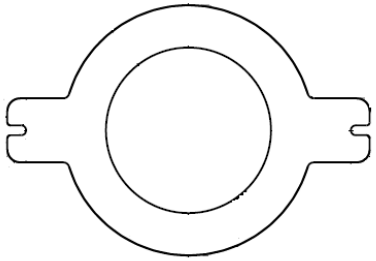
Approx Range = 20 – 80 HP

# Product Features

# Training & Development
## Product Features

## Construction – Valve Plates

- Floating Reed (also known as Laser Reed)
  - 4DA3-101E-TSK-800
  - A "-" in the 5th character identifies a floating reed compressor
  - Suction reed not riveted



Floating Reeds

Suction reed not riveted

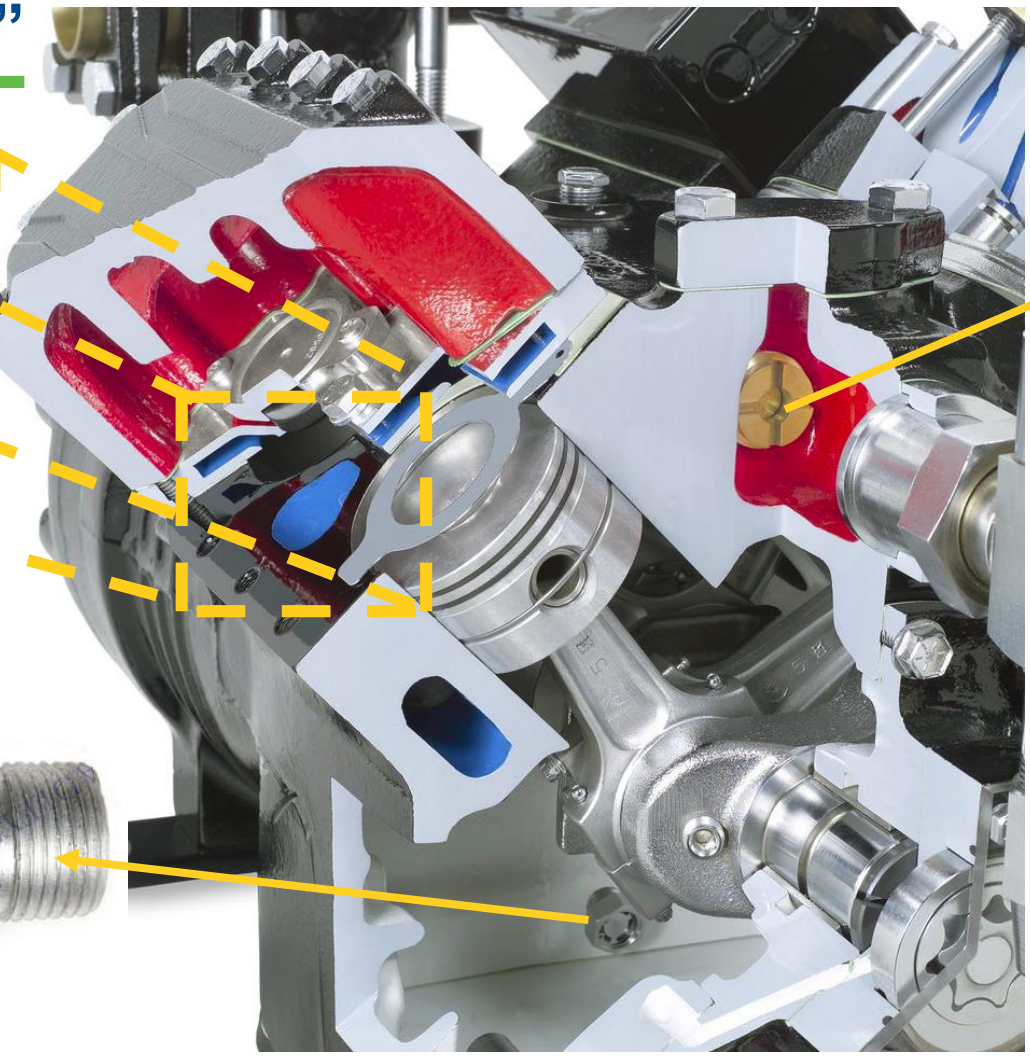
- Delta Reed Model
  - 4DA3A101E-TSK-800
  - A letter (A, S, R, F) in the 5th character identifies a Delta reed compressor
  - Suction reed riveted on valve plate

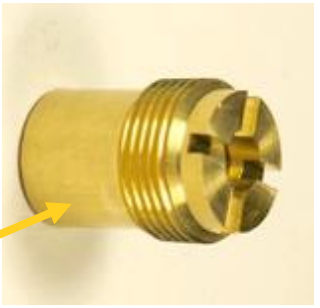
Suction reed riveted on valve plate

**The valve plate Kits for Floating reed and Delta reed models are not interchangeable**

# Training & Development
## Product Features

## Construction – “Other Valves”





- Crankcase Ventilating Valve
  - Lowers crankcase pressure thru "Venturi Effect" principle
  - Can be seen after removing the valve plate

- Internal Pressure Relief Valve
  - Protection against over-pressure
  - Located @ the discharge side right before the discharge service valve

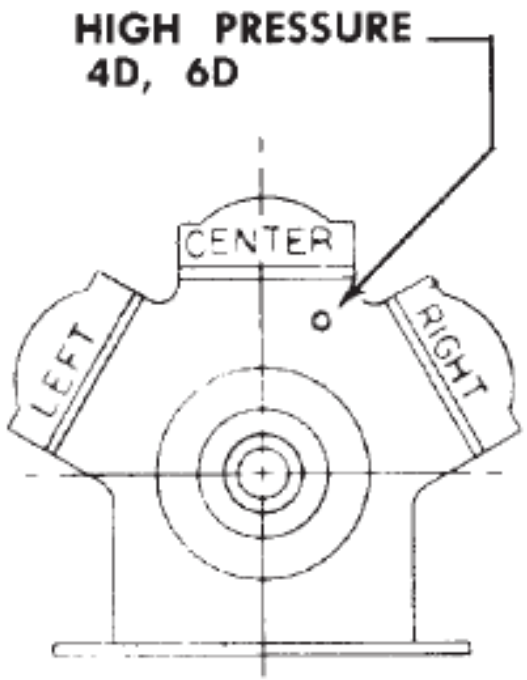
- Oil Check Valve
  - Allows oil to return to the crankcase
  - Located in-between the crankcase and motor

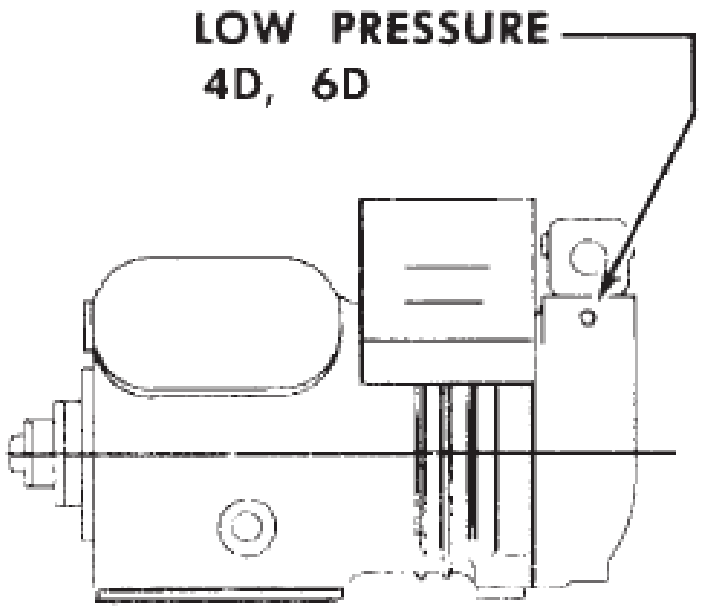
# Training & Development

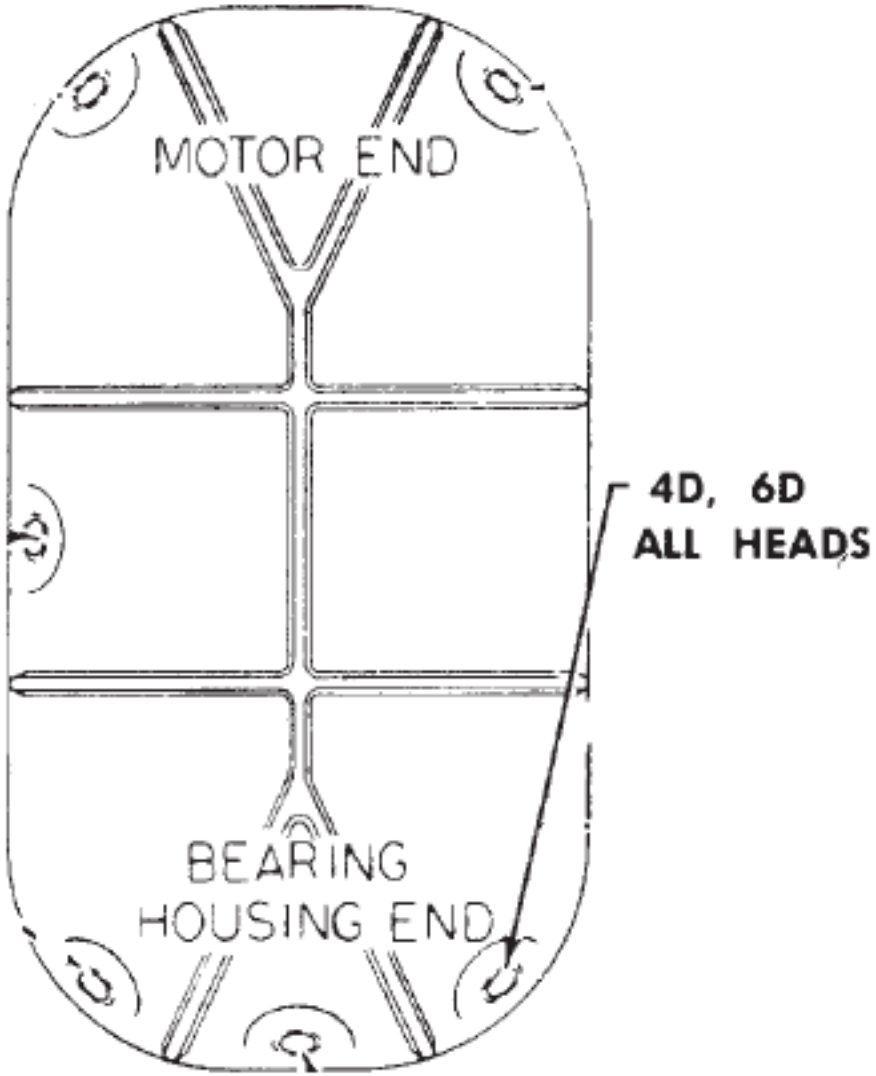
## Product Features

## Port Locations

Here is a guide on identifying the suction and discharge port of 4D & 6D Discus compressors.



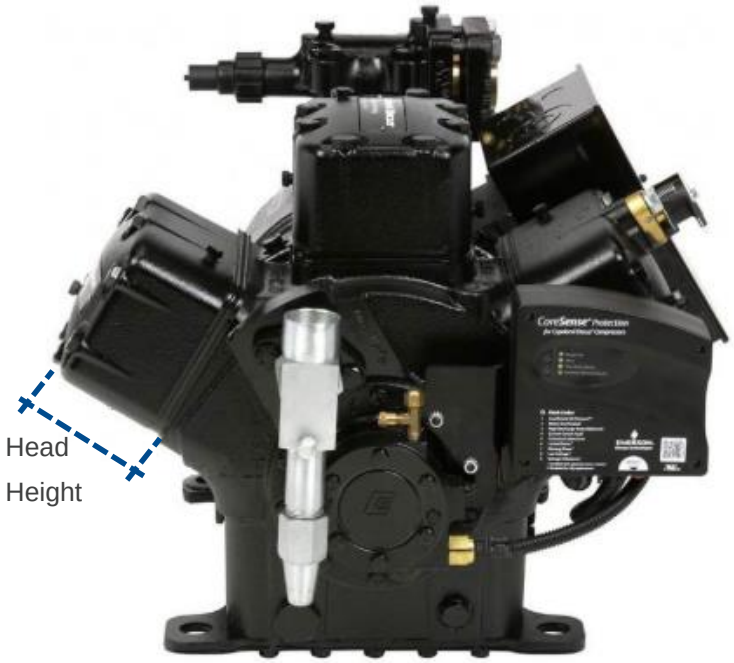



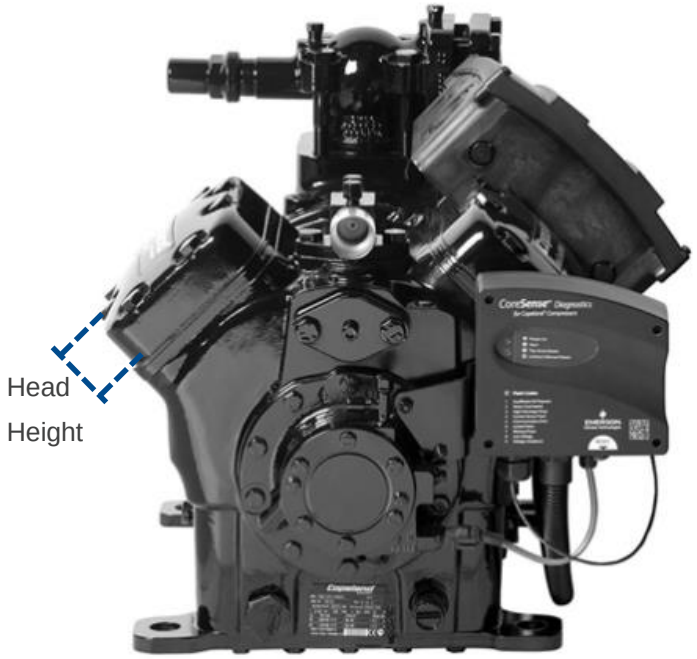
# Training & Development

## Product Features

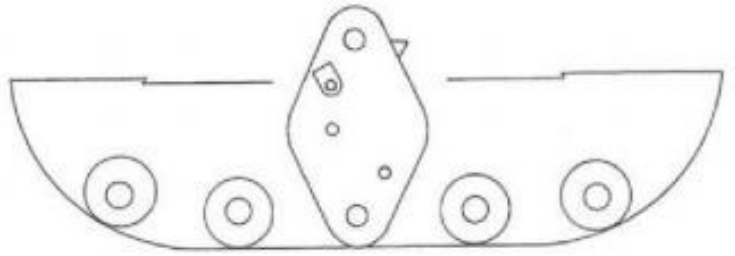
## Tall & Short Head Models



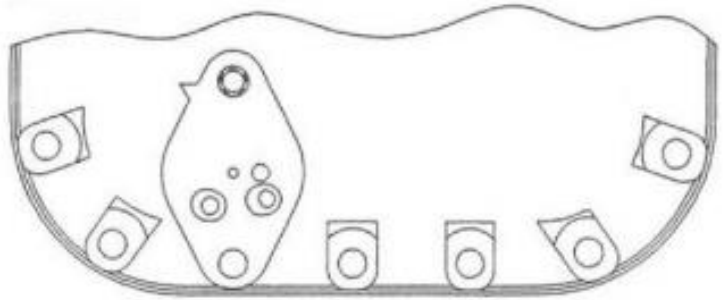

6D*3 Tall Head Model




4D*1 Short Head Model



**Mounting Pad on Short Compressor Head Internal Unloading Solenoid Valve Copelametic 4D*1 and 6D*1 Discus™ Compressors**



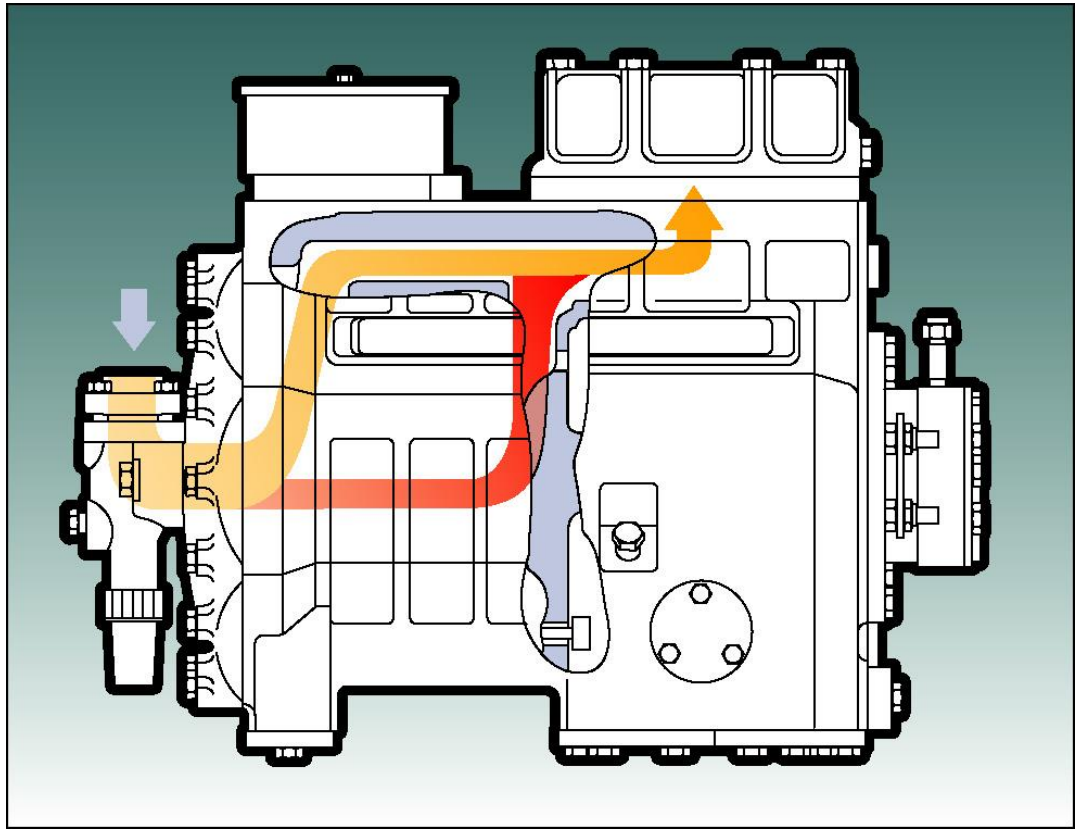
**Mounting Pad on Tall Compressor Head Internal Unloading Solenoid Valve Copelametic 4D*3 and 6D*3 Discus™ Compressors**

Short Head Model is Typically OEM, If Aftermarket replacement is Tall Head, Customer can Swap Heads

# Refrigerant-Cooled Discus

The Discus compressor was designed so that the refrigerant suction pass through the motor of the compressor to cool the compressor. The compressor will adequately cooled by the refrigerant at evaporating temperatures above 0°F.

If operated at evaporating temperatures below 0°F in which the mass flow of the refrigerant is too low, the cooling will not be enough and **an auxiliary cooling (head cooling fan) is required**.



The suction of the 3D compressor is located at the motor side to force the suction refrigerant to pass through the hot compressor motor to absorb the heat.

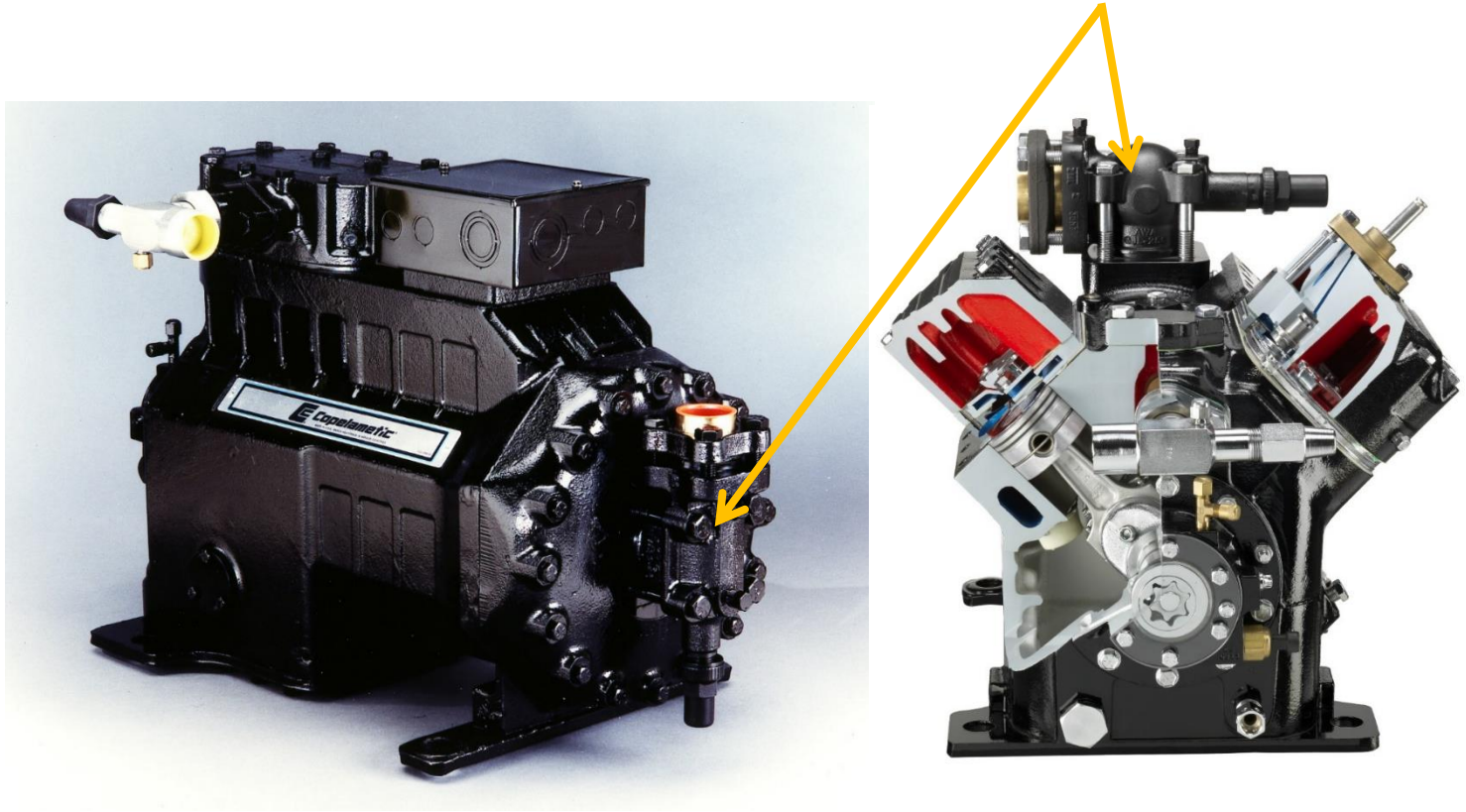
# Training & Development

## Product Features

## Cooling Requirements

Discus compressors require adequate cooling to prevent overheating of the compressor that may lead to motor failure. The heat developed by the Discus compressor should be transferred through refrigerant and may require additional accessories to accomplish it.

Refrigerant Cooled Identification – Valve Location



**Location of the suction service valve, usually on the stator cover, allows refrigerant to enter and flow across the motor.**

## Lubrication

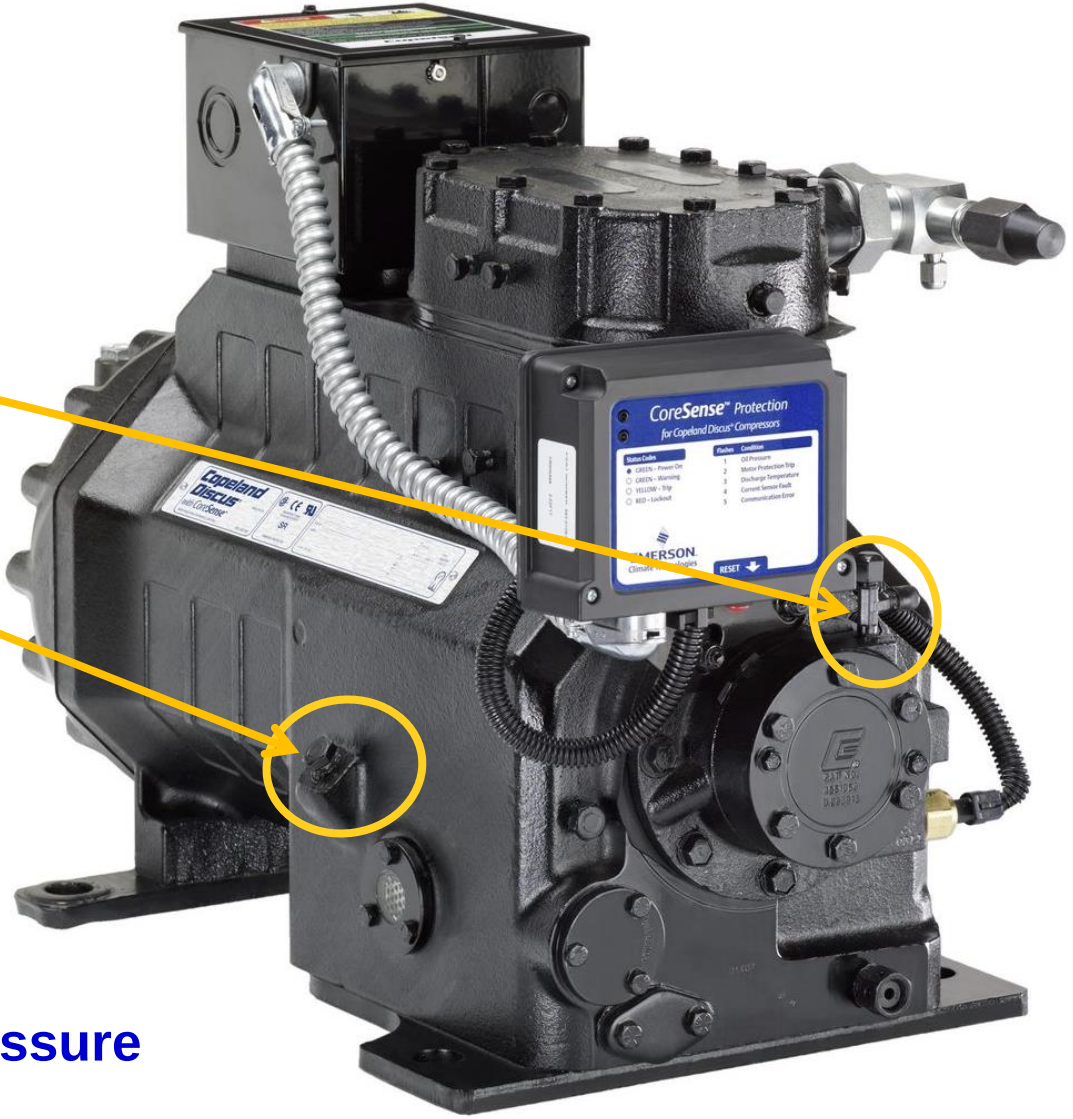
**Net Oil Pressure Difference =**

Pump Outlet Pressure

*minus*

Crankcase Pressure

**20-60 PSID – Normal**
**10 PSID – Minimum**
**60 PSID – Relief**




**Crankcase pressure is not equal to suction pressure**
**Oil pump will pump in either direction**

# Training & Development

## Introduction

## Applications

Since Copelametic & Discus compressors have a wide capacity range, they can be used for condensing units for food service equipment or transport refrigeration using the fractional or small horsepower models or for building a rack compressor using the large capacity compressors

Condensing Unit with Copelametic

Rack Compressor with Discus

# Polling Question 2

Q: If you had to replace an older Copelametic semi-hermetic compressor with an equivalent Copelametic or a Discus model, which would you choose, and why?

1) Copelametic, because you have to replace like for like.
2) Discus, since it is more efficient in design (no dead volume) and performance (higher EER).
3) Whichever model have in stock, Discus if both are in stock.
4) Whichever model have in stock, Copelametic if both are in stock.

# Polling Question 2

Q: If you had to replace an older Copelametic semi-hermetic compressor with an equivalent Copelametic or a Discus model, which would you choose, and why?

1) Copelametic, because you have to replace like for like.
2) Discus, since it is more efficient in design (no dead volume) and performance (higher EER).
**3) Whichever model I have in stock, Discus if both are in stock.**
4) Whichever model I have in stock, Copelametic if both are in stock.

# Nomenclature

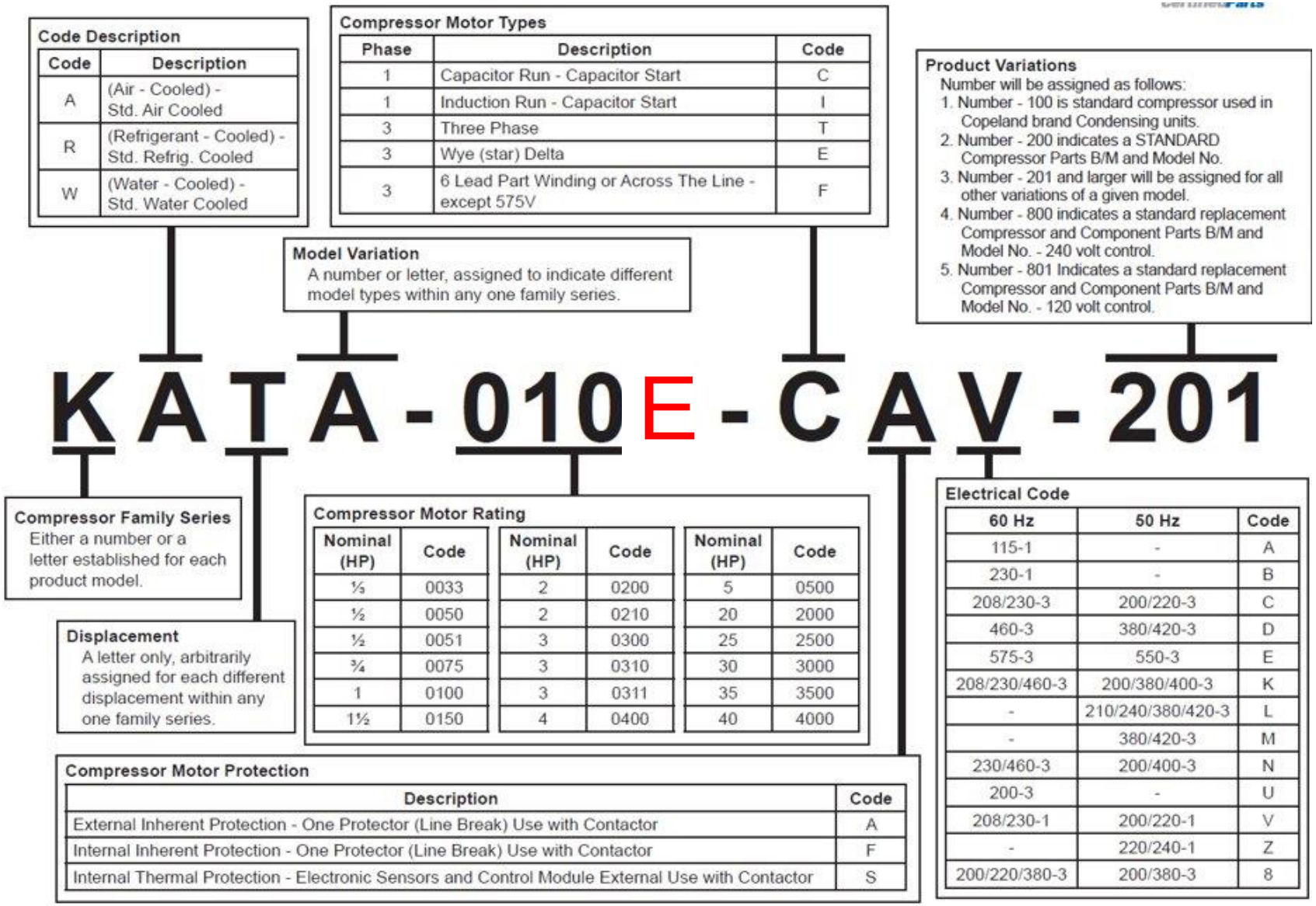
## Nomenclature

Nomenclatures give information about the Copelametic & Discus compressor models. This can be a valuable aid for a contractor when trying to select a compressor model for a new application or replacement. The following information can be obtain from the model name of the compressor if you understand the nomenclature.

- Compressor family
- Compressor cooling type
- Temperature application range
- Displacement and type of valve plate
- Nominal capacity
- Compressor Motor type and protection
- Voltage, phase, and hertz
- Bill of Material

# Training & Development

## Nomenclature – Copelametic

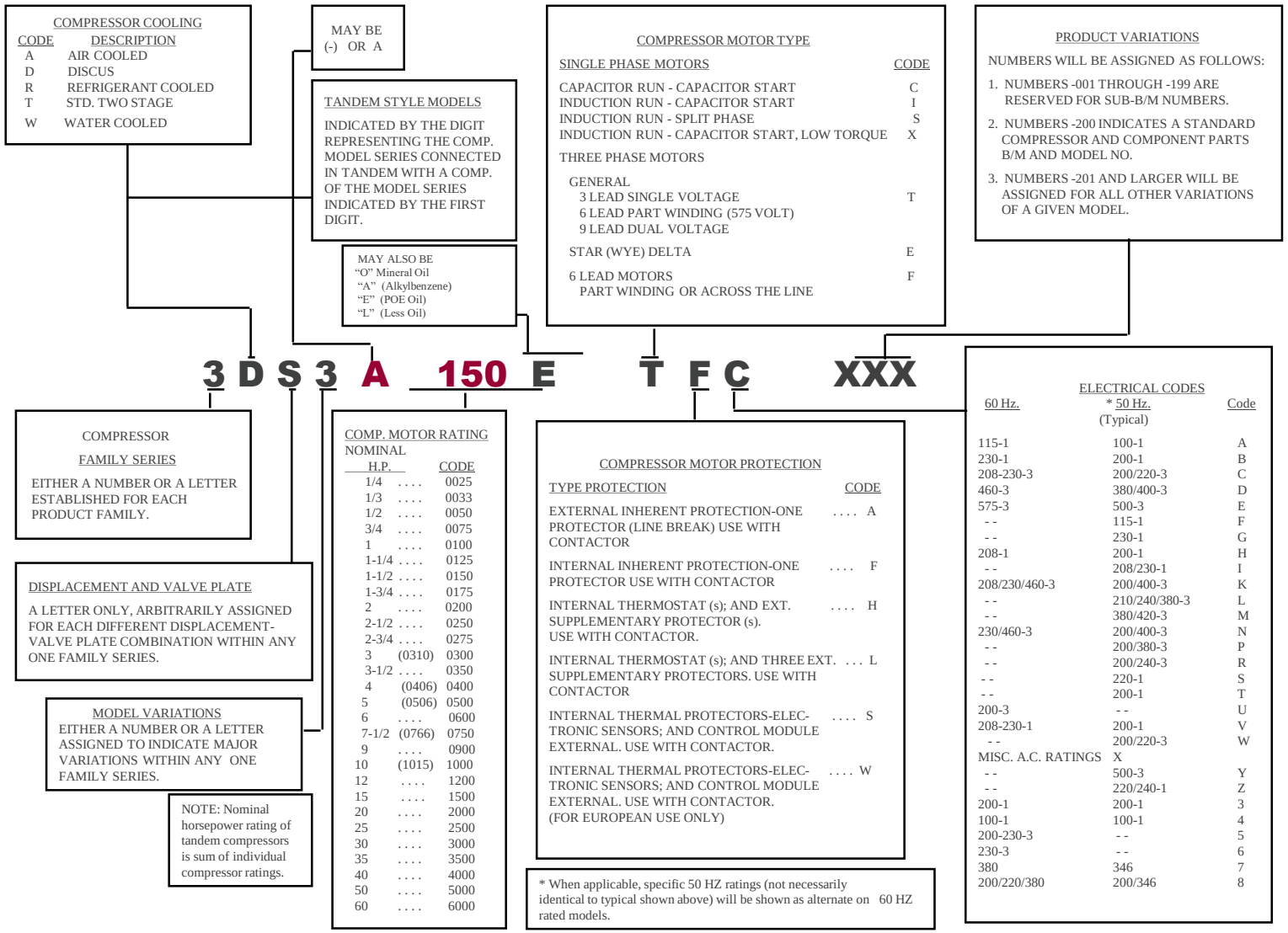



*POE Oil

# Training & Development

## Nomenclature - Discus

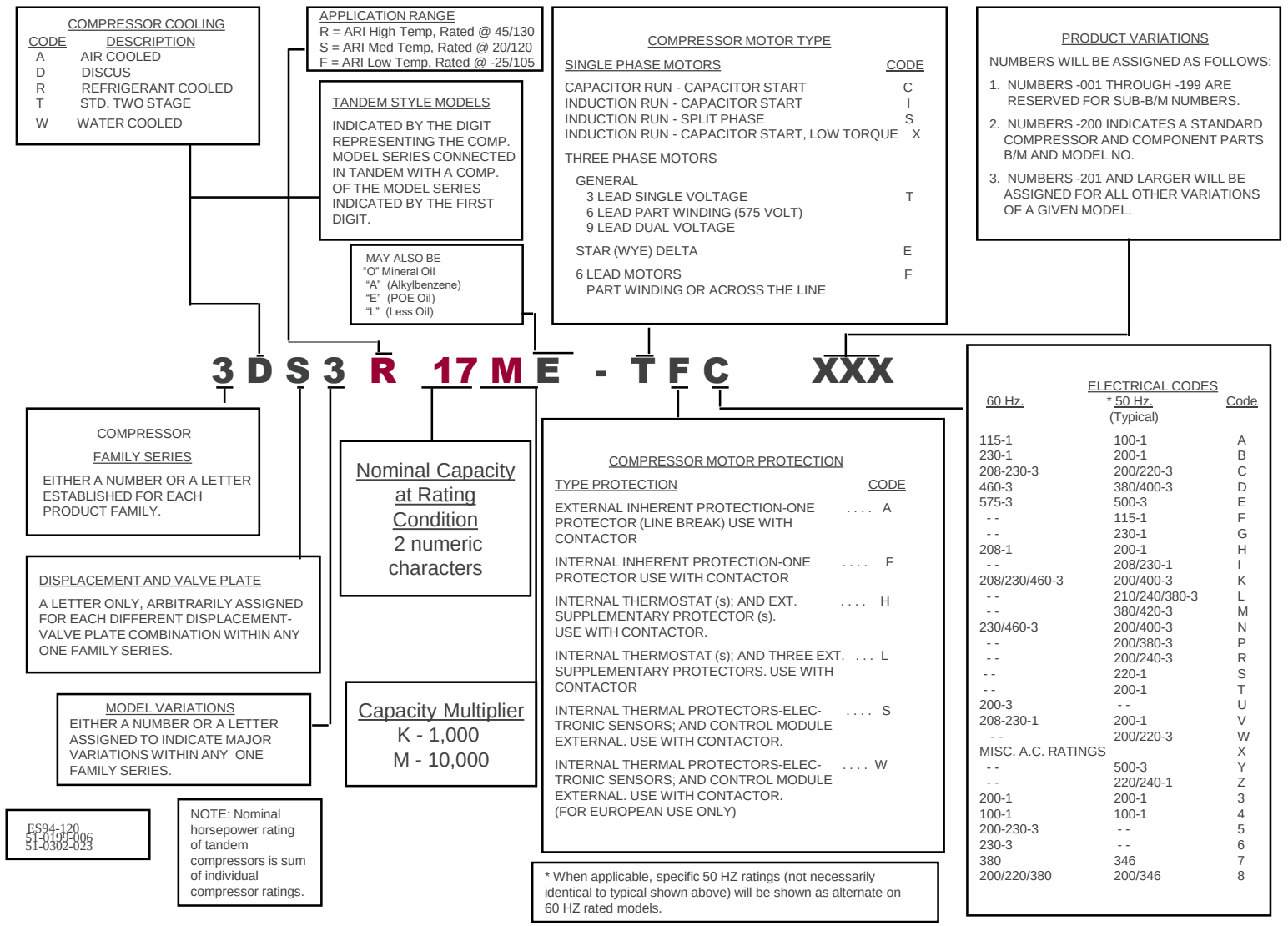
### DISCUS® COMPRESSOR MODEL NUMBER NOMENCLATURE OLD



# Training & Development

## Nomenclature - Discus

### DISCUS® COMPRESSOR MODEL NUMBER NOMENCLATURE NEW



# Training & Development

## Nomenclature

## New Nomenclature

- The new nomenclature moves away from a horsepower based convention to a capacity based one. This move enables an OEM to correctly size and pick the right compressor for an application.

- We are now using 5th character to signify the operating envelope of the compressor and the rating point for the capacity designation.

  - **R** = 45 evap/ 130 condensing (Dual Envelope - High & Medium Temp)
  - **S** = 20 evap/ 120 condensing (Medium Temp Models)
  - **F** = -25 evap/ 105 condensing (Low Temp)

| Old Nomenclature | New Nomenclature |
|---|---|
| 3DS3**A** **150**E-TFC-200<br>Delta Reed<br>15 HP | 3DS3**R** **17M**E-TFC-200<br>High/Med Temp<br>170,000 BTU/hr |
| 3DS3**A** **100E**-TFC-200<br>Delta Reed<br>10 HP | 3DS3**F** **46K**E-TFC-200<br>Low Temp<br>46,000 BTU/hr |

# Polling Question 3 - Nomenclature

Q: What is the capacity (in Btu/hr) of a discus compressor model number **4DL3F63KE-TSE-800**?

1) 57,000 Btu/hr
2) 63,000 Btu/hr
3) 78,000 Btu/hr
4) 82,000 Btu/hr

# Polling Question 3 - Nomenclature

Q: What is the capacity (in Btu/hr) of a discus compressor model number **4DL3F63KE-TSE-800**?

1) 57,000 Btu/hr
**2) 63,000 Btu/hr**
3) 78,000 Btu/hr
4) 82,000 Btu/hr

# Publication Materials

# Training & Development
## Publication Materials *Copelametic*

### Application Engineering Bulletins

4-1135 Cooling Requirements for Copelametic and Copeland Discus Compressors
4-1281 Oil Charges for Copelametic Compressors
4-1291 Using Air-Cooled Copelametic Compressors for Low Temperature HCFC-22 Applications
19-1132 Copelametic Two-Stage Compressors Application and Service Instructions

For information about the selection and performance data of the compressor, you can use the Online Product Information on this link:
https://climate.emerson.com/online-product-information/

# Training & Development
## Publication Materials *Discus*

### Application Engineering Bulletins

4-1094 Identification of Port Locations in Heads of Copelametic Compressors
4-1135 Cooling Requirements for Copelametic and Copeland Discus Compressors
4-1287 Copeland Discus™ Compressors with Demand Cooling™ System
4-1357 Upgrade Procedures for 3D Discus Digital
4-1373 Upgrade Procedures for 4D/6D Discus Digital
21-1216 Internal Capacity Control Valves for 4-6-8 Cylinder Compressors
21-1278 Moduload® Capacity Control for 3D Compressors
21-1355 Digital Capacity Control For Copeland Discus
8-1328 Copeland Digital Compressor Controller
8-1367 CoreSense™ Protection for Copeland Discus™ Compressors
8-1368 Intelligent Store Discus 2.1

For information about the selection and performance data of the compressor, you can use the Online Product Information on this link:
https://climate.emerson.com/online-product-information/

# Polling Question 4 – Valve Plate Kit

Q: You have a customer looking for the standard valve plate kit on an obsolete Discus compressor model **4DA3A101E-TSE-800.** You realize that you do not have the service part listed 998-2661-26 in stock, but you do have the standard valve plate kit for an older Discus compressor model **4DA3-101E-TSE-800** in stock, which is listed as 998-1661-26. The capacity, application and voltage are identical for both compressors. Can you use 998-1661-26 to help your customer?

1) TRUE
2) FALSE

# Polling Question 4 – Valve Plate Kit

Q: You have a customer looking for the standard valve plate kit on an obsolete Discus compressor model **4DA3A101E-TSE-800.** You realize that you do not have the service part listed 998-2661-26 in stock, but you do have the standard valve plate kit for an older Discus compressor model **4DA3-101E-TSE-800** in stock, which is listed as 998-1661-26. The capacity, application and voltage are identical for both compressors. Can you use 998-1661-26 to help your customer?

1) TRUE

**2) FALSE, because 4DA3-101E-TSE-800 is a floating reed model and 4DA3A101E-TSE-800 is a delta reed model and the valve plate kits are not interchangeable.**

# Questions

Zaki.Abedeen@Emerson.com