EMERSON Climate Technologies

Application Engineering

Copeland brand products

BULLETIN

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Application Guidelines for Refrigeration Copeland Discus™ Compressors with R-410A

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Safety Instructions

Copeland Scroll™ compressors are manufactured according to the latest U.S. and European Safety Standards. Particular emphasis has been placed on the user's safety. Safey icons are explained below and safety instructions applicable to the products in this bulletin are grouped on page 3. These instructions should be retained throughout the lifetime of the compressor. **You are strongly advised to follow these safety instructions.**

Safety Icon Explanation

DANGER	DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.
WARNING	WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION	CAUTION, used with the safety alert symbol, indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE	NOTICE is used to address practices not related to personal injury.
CAUTION	CAUTION, without the safety alert symbol, is used to address practices not related to personal injury.

Instructions Pertaining to Risk of Electrical Shock, Fire, or Injury to Persons

WARNING	**ELECTRICAL SHOCK HAZARD** • Disconnect and lock out power before servicing. • Discharge all capacitors before servicing. • Use compressor with grounded system only. • Molded electrical plug must be used when required. • Refer to original equipment wiring diagrams. • Electrical connections must be made by qualified electrical personnel. • Failure to follow these warnings could result in serious personal injury.
WARNING	**PRESSURIZED SYSTEM HAZARD** • System contains refrigerant and oil under pressure. • Remove refrigerant from both the high and low compressor side before removing compressor. • Use appropriate back up wrenches on rotalock fittings when servicing. • Never install a system and leave it unattended when it has no charge, a holding charge, or with the service valves closed without electrically locking out the system. • Use only approved refrigerants and refrigeration oils. • Personal safety equipment must be used. • Failure to follow these warnings could result in serious personal injury.
WARNING	**BURN HAZARD** • Do not touch the compressor until it has cooled down. • Ensure that materials and wiring do not touch high temperature areas of the compressor. • Use caution when brazing system components. • Personal safety equipment must be used. • Failure to follow these warnings could result in serious personal injury or property damage.
CAUTION	**COMPRESSOR HANDLING** • Use the appropriate lifting devices to move compressors. • Personal safety equipment must be used. • Failure to follow these warnings could result in personal injury or property damage.

Safety Statements

- Refrigerant compressors must be employed only for their intended use.
- Only qualified and authorized HVAC or refrigeration personnel are permitted to install, commission and maintain this equipment.
- Electrical connections must be made by qualified electrical personnel.
- All valid standards and codes for installing, servicing, and maintaining electrical and refrigeration equipment must be observed.

Introduction

The refrigeration Copeland Discus™ compressor product offering has expanded to include the higher pressure refrigerant R-410A. These new models include low temperature and medium/high temperature models with capacity of 29,000 to 45,000 Btu/hr at -25/105°F ARI condition and 85,000 to 130,000 Btu/hr at 20/120° ARI condition using 60 Hz electrical power. Only three-cylinder Discus compressors have been released at this time. This bulletin covers the application parameters recommended for operating these compressors properly.

Nomenclature

The high pressure refrigerant Discus™ compressor has a model designation as follows, with the second digit shown as a '**P**': 3**P**A3R85KL-TFD-C00. The model numbers include the nominal capacity for R-410A at ARI conditions (20/120°F for medium temperature and -25/105°F for low temperature).

3 P A 3 R 85K L – TFD - C00
1 2 3 4 5 6 7 8 9

1. **3** = Number of Cylinders
2. **P** = High Pressure Refrigerant Discus (R-410A)
3. **A** = Bore Size
4. **3** = Fixed Capacity Control; **D** = Discus Digital
5. **R** = Medium Temperature; **F** = Low Temperature
6. **85K** = Nominal capacity (Btu/hr) at ARI Condition, where '**K**' is for 1,000 multiplier and '**M**' is for 10,000 multiplier
7. **L** = Less Oil; **E** = Polyolester Oil
8. **TFD** = Electrical Code (460V -3Ø-60Hz)
9. **C00** = Build of Material

T**able 1** at the end of this bulletin shows the nominal capacity (Btu/hr) for each model with R-410A refrigerant at ARI conditions. For additional performance data, refer to the Online Product Information at **www.emersonclimate.com** or through Emerson Climate Technologies' Product Selection Software, PSS.

CoreSense Protection

CoreSense Protection will be provided on all R-410A Copeland Discus compressors. CoreSense Protection is noted by a '**C**' in the build of materials, e.g. 3PA3R85KL-TFD-**C**00. The Coresense Protection module for Discus compressors combines oil and motor protection into one module, as well as offering optional protection against high discharge temperature and communication compatibility with MODBUS communication devices. Display LEDs clearly indicate the operational status of the compressor and whether or not there are any active compressor warnings, trips, or lockouts.

Discus Digital Technology

Each of the 3P R-410A Discus compressors are also available with Copeland Discus Digital™ technology. Digital capacity control is achieved by using a proven internal unloading method, blocked suction. By varying the percentage of duty cycle that the compressor is loaded and unloaded, capacity control between 10 and 100% can be achieved. During blocked suction operation, the flow of suction gas is blocked to all cylinders on a single bank; therefore there is no gas to compress and the power consumption is significantly lower. The unloader piston mechanism that controls flow of suction gas into the cylinders is driven by a high life digital solenoid valve. The digital models are indicated by a '**D**' in the 4th character of the model number, e.g. 3PA**D**R10ML-TFD. For more information on Copeland Discus Digital compressors, refer to **AE21-1355**, *Digital Capacity Control for Copeland™ and Intelligent Store Discus™ Refrigeration Compressors.*

Operating Envelope

See **Figures 1** and **2** at the end of this bulletin.

All 3PA* Discus models are approved for use with refrigerant R-410A. All models may be operated within the entire operating envelopes shown in **Figures 1** and **2**. Use of refrigerants other than R-410A voids the UL listing and warranty of these models since they could affect the motor protector setting.

Motor Protection

Conventional inherent internal line break motor protection is provided in the R-410A Discus compressor.

Refrigerant Charge

For single compressor applications, 3P* Copeland Discus compressors have a maximum recommended charge of 17.5 lbs. Some system configurations may contain higher-than-normal refrigerant charges either because of large internal coil volumes or long line sets. If such a system also contains an accumulator, then the permanent loss of oil may become critical. Accumulator manufacturers should be consulted for a pre-charge recommendation. Additional oil may need to be added to 'wet' the system prior to start up.

For racks and other applications that use multiple compressors see the section titled **Multiple Compressor Applications**.

Oil Types

All 3PA* Discus models are approved for use with polyolester oil (POE). See **Form 93-11** for a complete list of all Emerson-approved lubricants.

Oil Charges

The recommended initial oil charge for these compressors is 125 ounces and the recommended recharge is 115 ounces. The oil level of the R-410A Discus compressor should be adjusted to the mid-point of the compressor sightglass during normal operation.

Oil Management

The R-410A Discus compressors are each equipped with electronic oil pressure protection using CoreSense Protection technology. Insufficient oil pressure time for the compressor is stored and accumulated in the CoreSense module memory. Once the total time accumulated for low oil pressure (a reading less than 7-9 PSID) exceeds 120 seconds, the module will shut the compressor off and a “low oil pressure lockout” will be reported. The compressor will turn back on once the reset has been activated either manually or remotely through the communication network, or when power has been cycled to the CoreSense Protection module. For more information on CoreSense Protection for Copeland Discus compressors, refer to **AE8-1367**.

Copeland Discus with Demand Cooling™

R-410A can be used as a low temperature refrigerant in a properly designed and controlled refrigeration system. However, experience has shown that R-410A can present problems as a low temperature refrigerant because under some conditions the internal compressor discharge temperature exceeds the safe temperature limit for long term stability of the oil (similar to what is seen when using R-22 or R-407A in low temperature applications).

The Demand Cooling system uses modern electronics to provide a reliable cost-effective solution to this problem. It is required for all low temperature Discus R-410A applications with saturated suction temperatures below -10°F.

The Demand Cooling module uses the signal of a discharge head temperature sensor to monitor discharge gas temperature. If a critical temperature is reached, the module energizes a long life injection valve which meters a controlled amount of saturated refrigerant into the compressor suction cavity to cool the suction gas. This process controls the discharge temperature to a safe level. If for some reason the discharge temperature rises above a preset maximum level, the Demand Cooling module will turn the compressor off (requiring a manual reset) and actuate its alarm contact. To minimize the amount of refrigerant which must be injected, the suction gas cooling process is performed after the gas has passed around and through the motor.

Performance data for Demand Cooling compressors includes the effects of injection when it is required. The approximate conditions where injection occurs are shown in **Figure 2**. For more information on Copeland Discus Demand Cooling refer to **AE4-1287**.

NOTE! When Demand Cooling is applied, a head fan is not required. When Demand Cooling is not utilizedduring low temperature applications, a head fan is required. Part numbers for Discus head fans can be found in **Table 4**.

Discharge Temperature Protection

Another method of protecting against high discharge temperature is the use of a discharge probe. Coresense Protection has the option of adding discharge temperature protection. The probe can be installed into the head of the compressor and wired to the Coresense module. **Figure 4** shows multiple locations for installing the discharge temperature probe. Coresense Protection will open the control circuit and shut the compressor off if the probe senses too much resistance (280°F).

NOTE! When applying Demand Cooling, the optional discharge temperature probe for CoreSense Protection is not required.

Internal Pressure Relief Valve

R-410A Copeland Discus compressors are not equipped with an internal pressure relief valve. To provide safe operation, a high pressure control set no higher than 577 psig must be used in all applications (See **Table 2**.)

Crankcase Heater

If the compressor will be exposed to low ambient conditions, refrigerant migration may become an issue during the off cycle. To prevent migration during the off cycle of the compressor, a crankcase heater is

recommended. For systems that exceed the refrigerant charge limit (17.5lbs) and are without a suction accumutor a crankcase heater is recommended.

Power Supply

All 3P* Copeland Discus compressors have electrical code **'TFD'** and are rated for 460V -3Ø-60Hz. Voltage should be maintained within +/- 10% of nominal to ensure reliable operation.

Multiple Compressor Applications

3P* Copeland Discus compressors are approved for use in multiple compressor applications.

When using an OMB for oil management the system pressures may exceed the solenoid maximum operating pressure differential (MOPD) of 350psig. If the MOPD is exceeded, the solenoid may not open and the compressor could be starved of oil. This would result in a 'Low Oil Trip' fault from the CoreSense Protection module. To avoid low oil faults, a pressure reducing valve located on the oil suction line may be needed for high pressure oil systems. Another valid option would be the use of a low pressure oil system.

Accumulators

The use of a suction accumulator is very dependent on the application. A suction accumulator is recommended to prevent liquid refrigerant from returning to the compressor. When liquid refrigerant returns to the compressor, the oil can become diluted to a point that bearings are inadequately lubricated.

To determine if refrigerant is returning to the compressor, determine the superheat reading on the suction line 6 inches from the compressor. If the superheat is low, then an accumulator is recommended to ensure liquid does not return to the compressor. To prevent refrigerant floodback in systems that do not use an accumulator, it is recommended that a minimum of 20°F superheat is maintained.

Systems with scheduled defrost cycles or greater than 17.5 lbs refrigerant charge should use a suction accumulator.

Discharge Line Mufflers

Discharge line mufflers are not required for the R-410A Discus compressor. If a discharge pulsation is unacceptable then a muffler may be added to reduce vibrations and or sound.

Contaminant Control

A filter drier is required on all R-410A and POE lubricant systems to prevent solid particulate contamination, oil dielectric strength degradation, ice formation, oil hydrolysis and metal corrosion. It is recommended that a liquid line filter drier be installed. In some cases a suction line filter drier may also be necessary. It is the system designer's responsibility to make sure the filter-drier is adequately sized to accommodate the contaminants from system manufacturing processes that leave solid or liquid contaminants in the evaporator coil, condenser coil, and interconnecting tubing plus any contaminants introduced during the field installation precess. Molecular sieve and activated alumina are two filter-drier materials designed to remove moisture and mitigate acid formation. A 100% molecular sieve filter can be used for maximum moisture capacity. A more conservative mix of molecular sieve and activated alumina , such as 75% molecular sieve and 25% activated alumina, should be used for service applications.

Screens

Screens finer than 30X30 mesh (0.06mm openings) should not be used anywhere in the system. Field experience has shown that finer mesh screens used to protect thermal expansion valves, capillary tubes, or accumulators can become temporarily or permanently plugged with normal system debris and block the flow of either oil or refrigerant to the compressor.

Compressor Bolt Torque Values

The compressor bolt torque values for a R-410A Copeland Discus compressor are equivalent to those applied on a standard 3D Copeland Discus compressor. Refer to **AE4-1219**, *Torque Values for Copeland Brand Products,* for more details.

Compressor Tubing and Mounting

Compressor mounting must be selected based on application. Consideration must be given to sound reduction and tubing reliability. Some tubing geometry or "shock loops" may be required to reduce vibration transferred from the compressor to external tubing. The mounting kit required for single condensing unit applications is shown in **Table 3**. The mounting diagram in **Figure 3** shows how the mounting kits should be applied. For multiple compressor systems such as parallel racks, solid spacers are recommended.

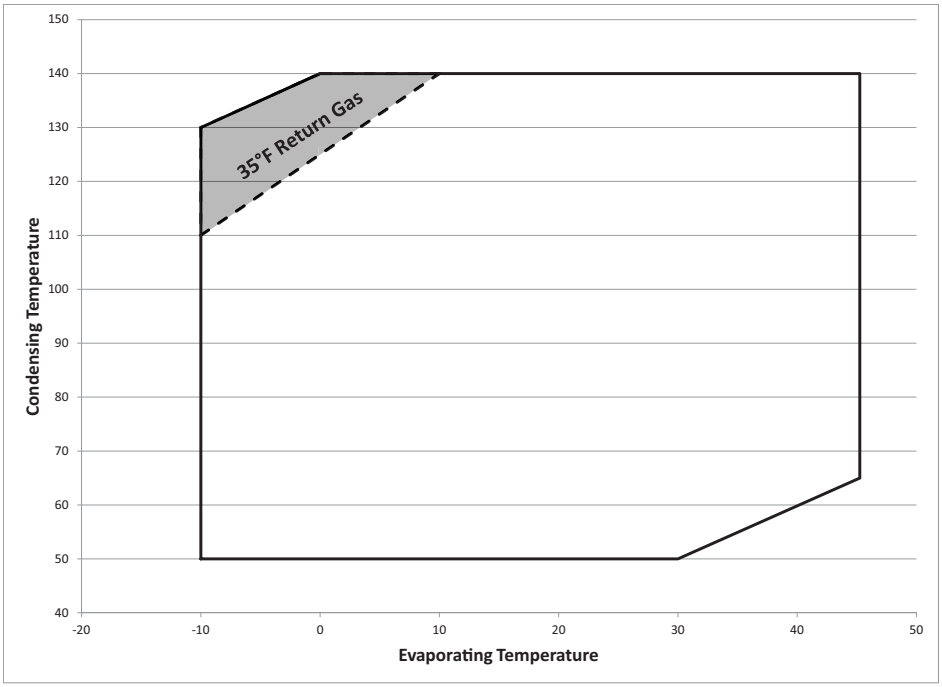


Figure 1 – Medium Temperature (3PA*R) R-410A Operating Envelope

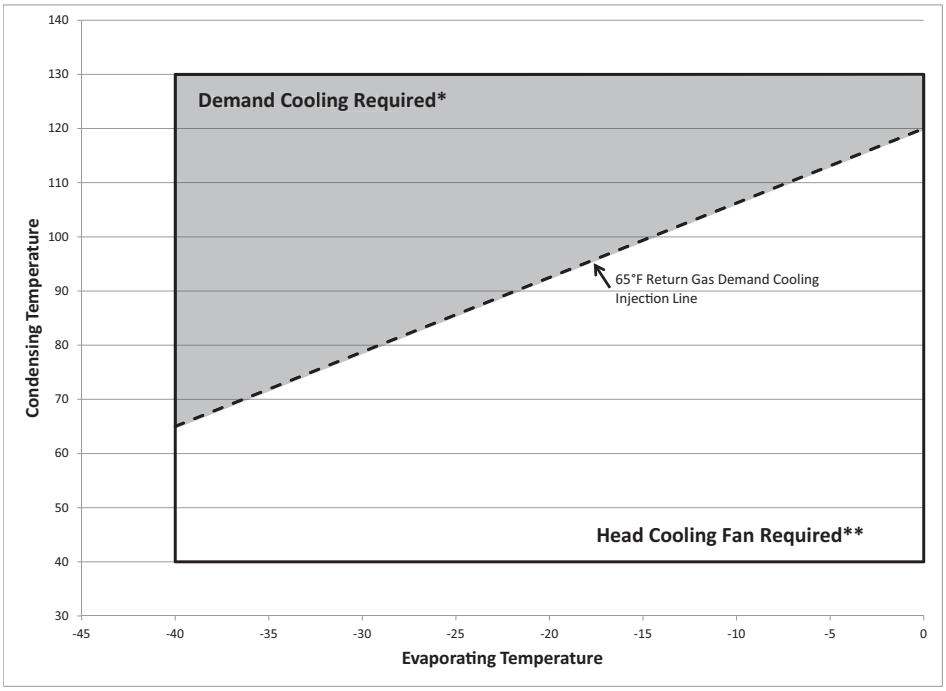
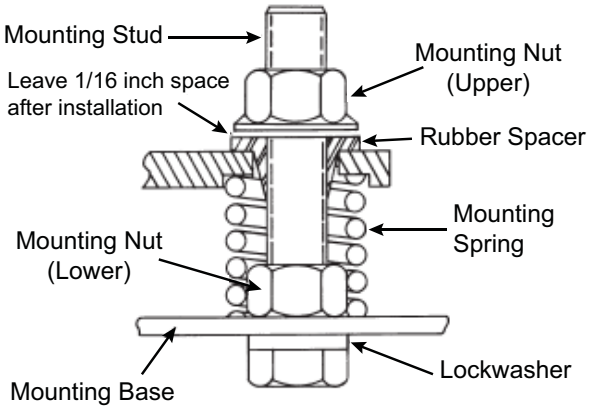


Figure 2 – Low Temperature (3PA*F) R-410A Operating Envelope

* Demand Cooling is required when using low temperature R-410A Discus models above the dotted line.

** A head cooling fan is required for low temperature R-410A Discus models when demand cooling is not used and operation is below the dotted line.



Mount is shown in properly adjusted position.
(Shipping retainer has been removed.)

Figure 3 – Condensing Unit Spring Mounting Kit for R-410A Discus

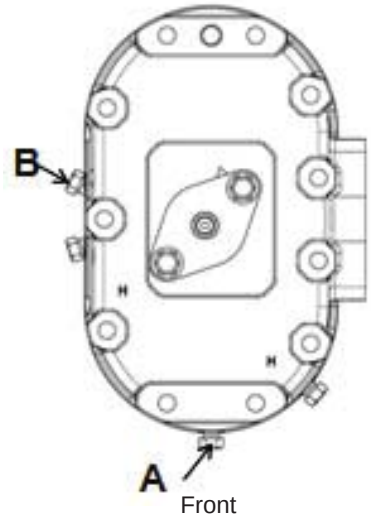


Figure 4 -
Top View of 3D Discus Cylinder Head with Possible Temperature Probe Locations

Table 1 – R-410A Copeland Discus Compressor Models

Application	Model Number	HP	Compressor Capacity (Btu/hr)
Medium Temperature 20/120/65RG/0SC °F	3PA3R85KL-TFD	10	85,000
	3PA3R10ML-TFD	10	100,000
	3PA3R12ML-TFD	15	120,000
	3PA3R13ML-TFD	15	130,000
Low Temperature -25/105/65RG/0SC °F	3PA3F29KL-TFD	7.5	29,000
	3PA3F35KL-TFD	7.5	35,000
	3PA3F41KL-TFD	10	41,000
	3PA3F45KL-TFD	10	45,000

Table 2 – Pressure Control Settings

Application	Low Pressure Cutout	High Pressure Cutout
Low Temperature (3PA*F*)	6 psig min.	508 psig max.
Medium Temperature (3PA*R*)	32 psig min.	577 psig max.

Table 3 – R-410A Discus Condensing Unit Spring Mounting Kit Part Numbers

Model Number	Mounting Kit
3PA3R85KL-TFD	527-0009-00
3PA3R10ML-TFD	527-0009-00
3PA3R12ML-TFD	527-0045-00
3PA3R13ML-TFD	527-0045-00
3PA3F29KL-TFD	527-0009-00
3PA3F35KL-TFD	527-0009-00
3PA3F41KL-TFD	527-0045-00
3PA3F45KL-TFD	527-0045-00

Table 4 – Accessory Kits for R-410A Discus

Part Description	Kit Number
CoreSense Protection Optional Discharge Temperature Probe	985-0109-50
Demand Cooling Kit, 120V, 60Hz	998-1000-13
Demand Cooling Kit, 240V, 60Hz	998-1000-24
Crankcase Heater, 120V, 100W	918-0028-00
Crankcase Heater, 240V, 100W	918-0028-01
Heater Sleeve	030-0187-00
Head Cooling Fan Assembly, 460V	998-0550-01
Head Cooling Fan Assembly, 230V	998-0550-00
Head Cooling Fan Assembly, 115V	998-0550-02
Head Cooling Fan Mounting Kit	998-0574-10
Digital Compressor Controller (3D)	943-0086-02
XC643 Digital Compressor Controller	998-0189-00
Discus Digital 24V Coil	923-0084-00
Discus Digital 120V Coil	923-0084-01
Discus Digital 240V Coil	923-0084-02
High Discharge Temperature Protection Probe	985-0109-50

Table 5 – Service Valve Part Numbers

Model Number	Discharge Service Valve	Suction Service Valve
3PA3R85KL-TFD	998-0510-02	998-0510-11
3PA3R10ML-TFD	998-0510-02	998-0510-11
3PA3R12ML-TFD	998-0510-02	998-0510-07
3PA3R13ML-TFD	998-0510-02	998-0510-07
3PA3F29KL-TFD	998-0510-02	998-0510-11
3PA3F35KL-TFD	998-0510-02	998-0510-11
3PA3F41KL-TFD	998-0510-02	998-0510-11
3PA3F45KL-TFD	998-0510-02	998-0510-11