



Technical Bulletin (TB-0043-04)

R407A and R407F Low Temp Applications

January 2016

This document serves as a guideline when using refrigerants R407A and R407F in low temperature application with BITZER ECOLINE semi-hermetic reciprocating compressors.

Topics covered:

1. Overview
2. CIC Application notes
3. R407A application limits
4. R407F application limits
5. CIC selection
6. Head fan kit selection
7. Using a discharge temperature sensor

1. Overview

Due to the phase-out regulations on R22, systems are being retrofitted to alternative refrigerants. R407A and R407F have become popular choices due to the similar volumetric refrigeration capacities and refrigerant mass flow rates compared to R22. One advantage of these gases is that the discharge gas temperature when running R407A and R407F (in a low temperature application) can be approximately 60°F and 40°F lower, respectively, compared to R22. However, the discharge temps are still considerably higher than when using R404A (see Fig. 1).

Because of this, some additional cooling is required to ensure that the compressor and oil remain within their thermal limits. R407A can often be applied in a low temp application with the use of a head fan only for additional cooling. However, due to the higher discharge temperatures associated with R407F, further cooling such as liquid injection may be required in addition to a head fan.

It should be noted that the use of liquid injection requires “robbing” the compressor of mass flow; thus, will reduce the overall capacity and efficiency of the system.

2. CIC Application Notes

CIC Operation with Capacity control

1. CRII system is required
2. SST > -40°F
3. Max. 1 bank of unloading allowed

Additional Cooling with CE1, CE2 and CE3 series

1. There is no connection port for CIC
2. Follow application envelope guidelines for proper cooling
3. The Varicool suction screen is no longer required

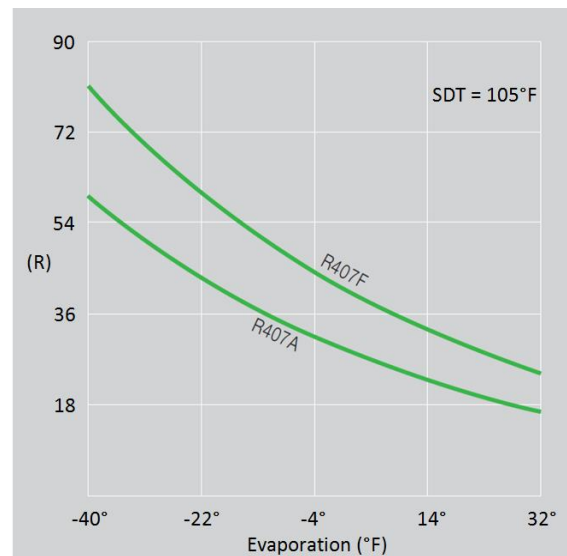


Fig. 1 Comparison of R407A and R407F discharge gas temperatures relative to R404A (R)

(R) = Difference in Degrees Fahrenheit

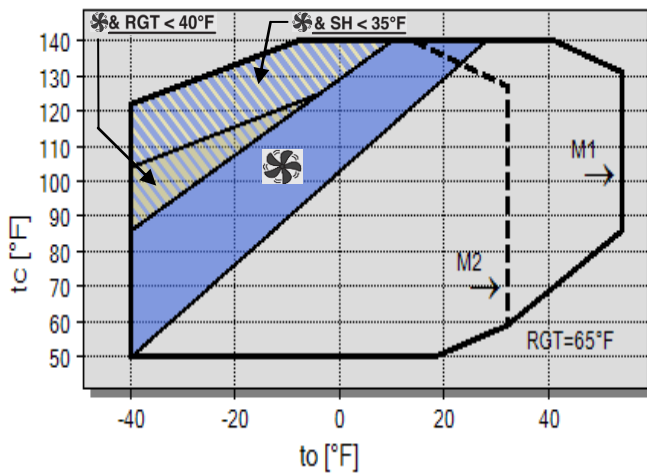
3. R407A Application Limits

The use of R407A in low temperature applications does not always require desuperheating by liquid injection. Depending on the operating parameters, controlled return gas temperature, a head fan, or a combination of both will be required. If neither of these methods can be applied then liquid injection is another option.

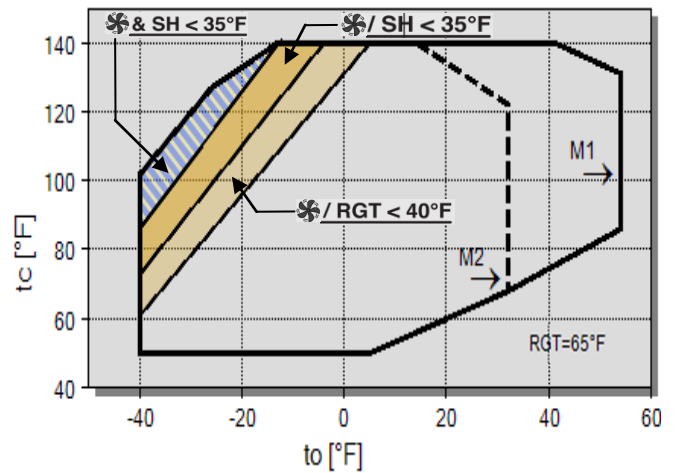
R407A CE1-CE4 Series

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CE1-CE3

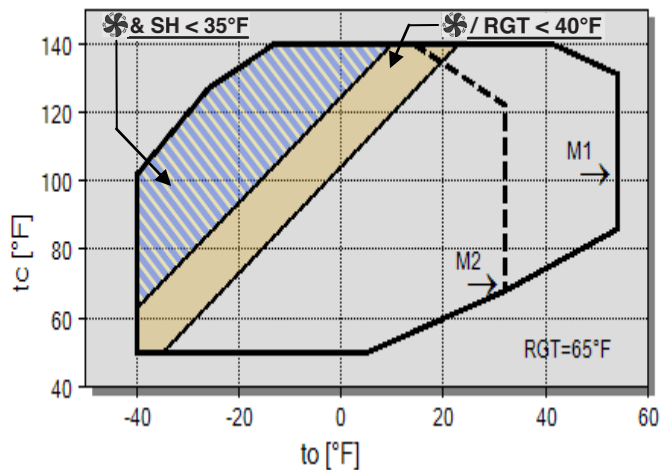


CE4



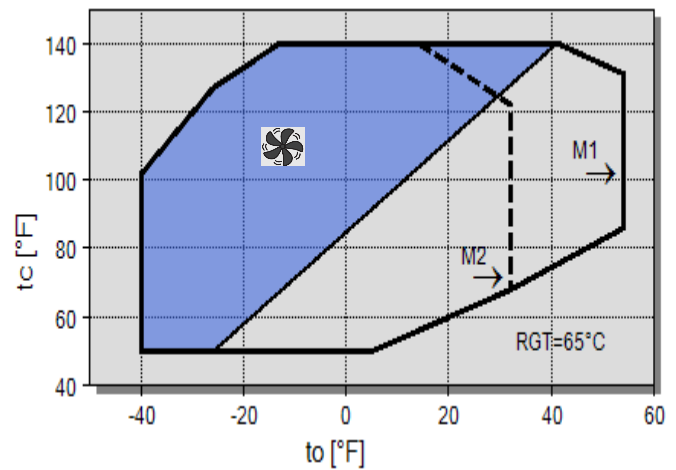
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CE3-CE4



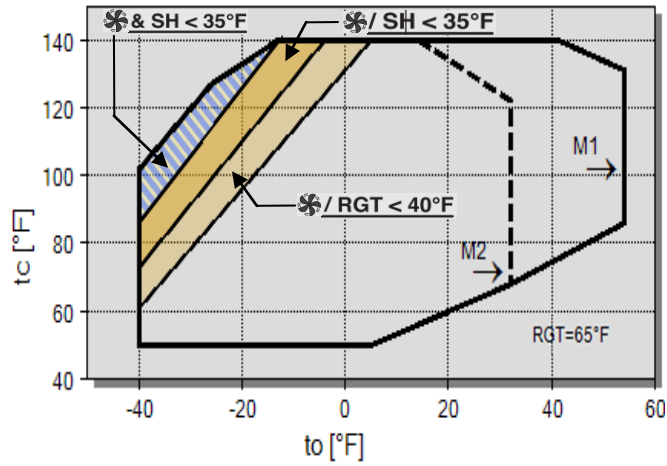
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CE3-CE4

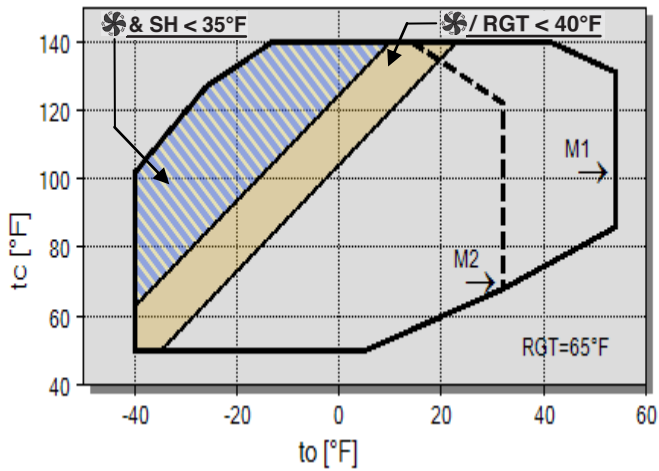


R407A BE5 Series

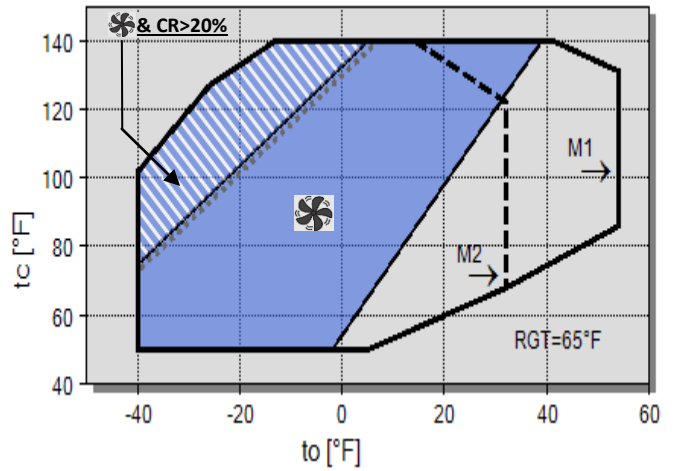
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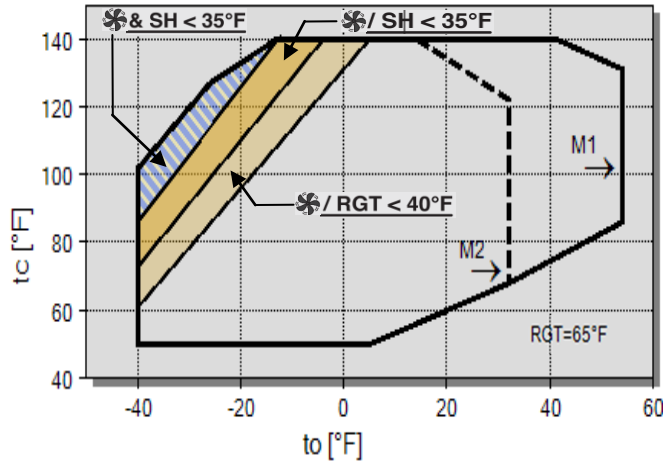


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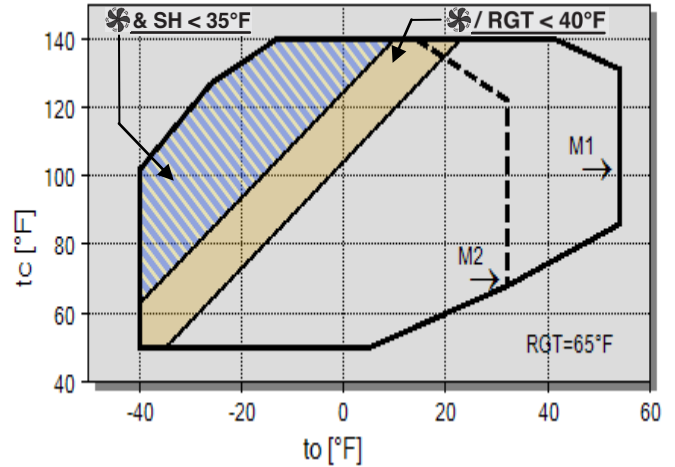


R407A BE6 Series

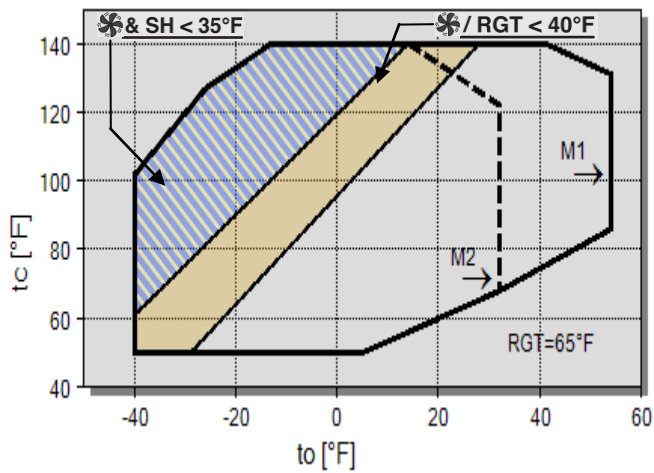
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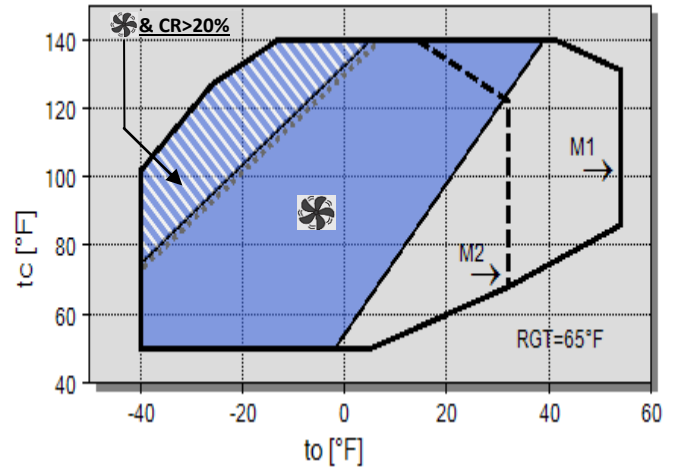
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33% -65% Capacity Control



10% -32% Capacity Control

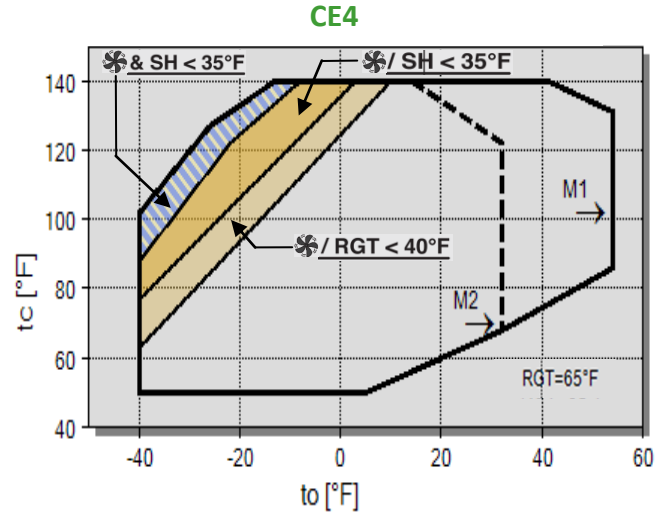
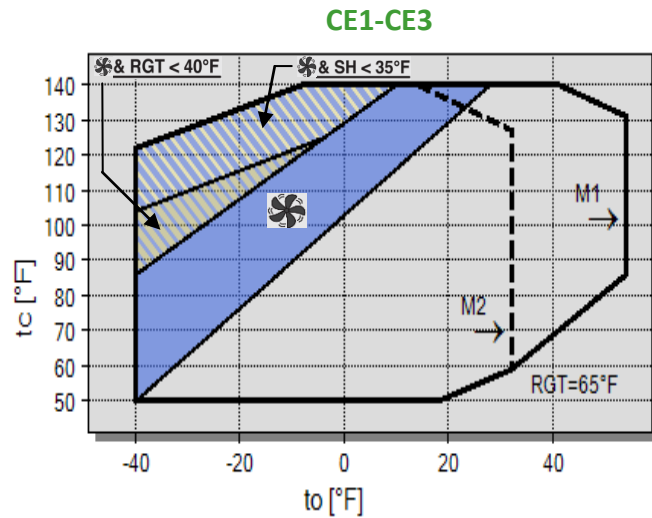


4. R407F Application Limits

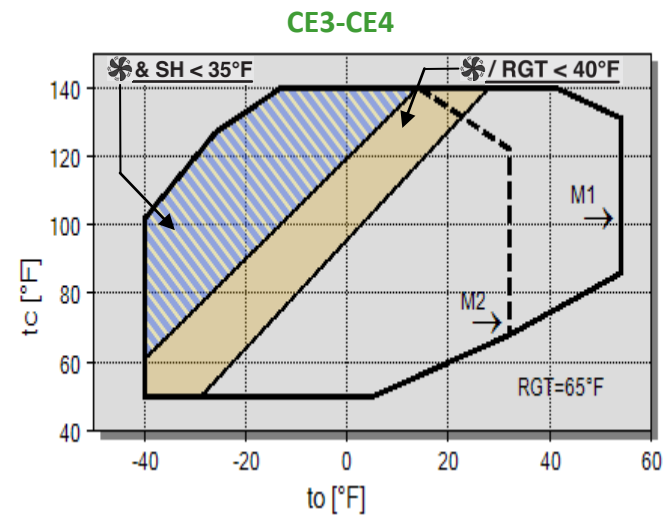
R407F generally results in higher discharge gas temperatures than R407A. The maximum discharge temperature measured internally at the discharge valve should not exceed 280°F. It is necessary to cool the return gas to ensure the proper performance and reliability of the compressor.

R407F CE1-CE4 Series

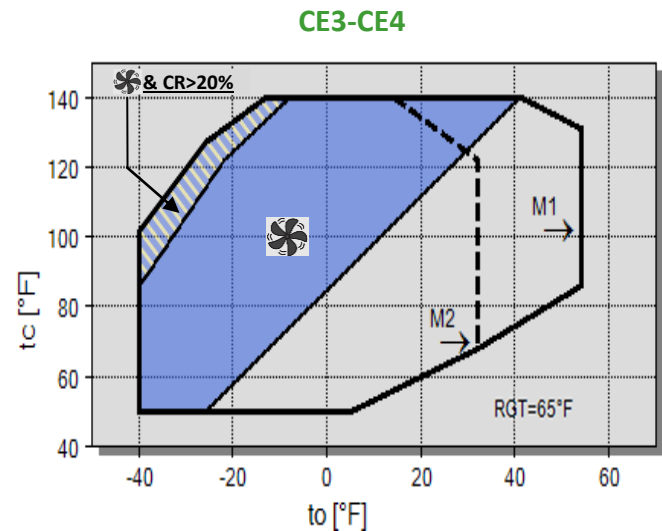
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50% -99% Capacity Control



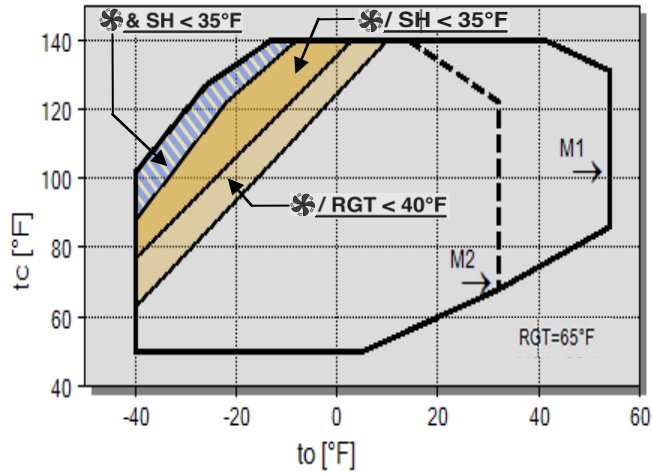
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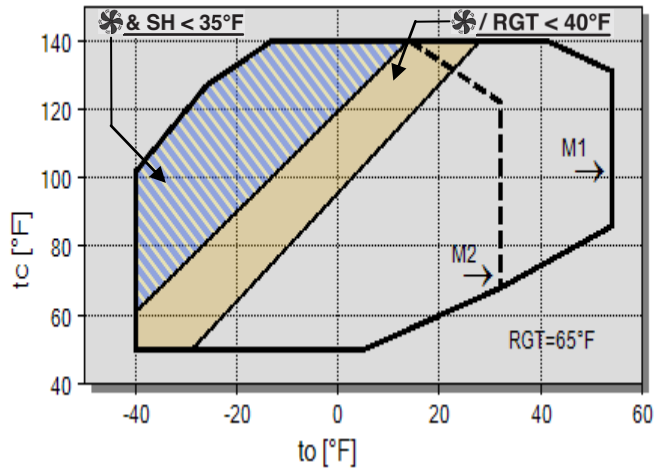
R407F BE5 Series

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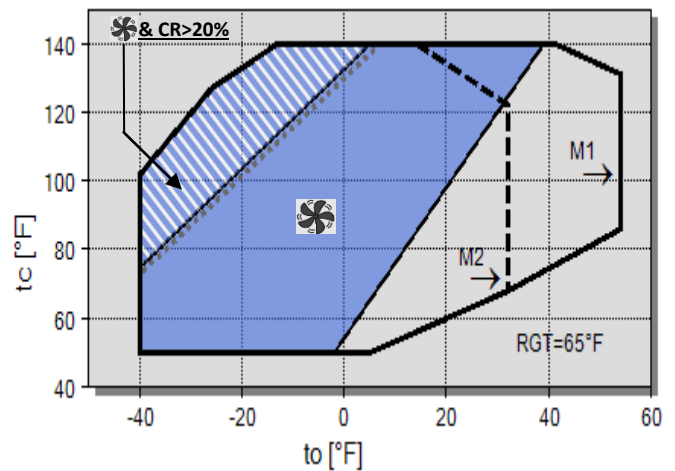
BE5 Series



50% -99% Capacity Control

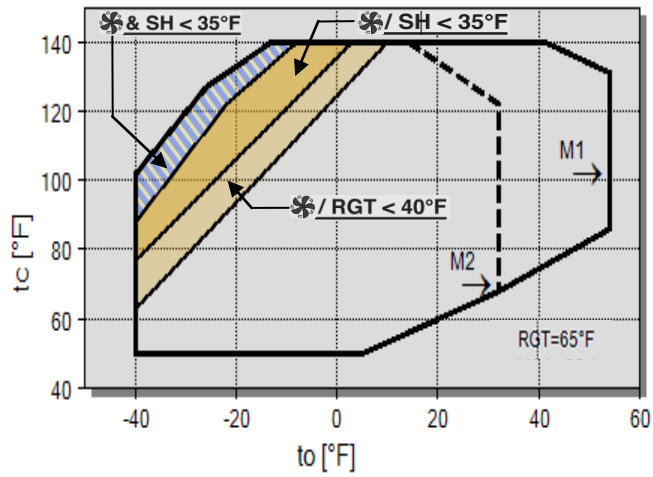


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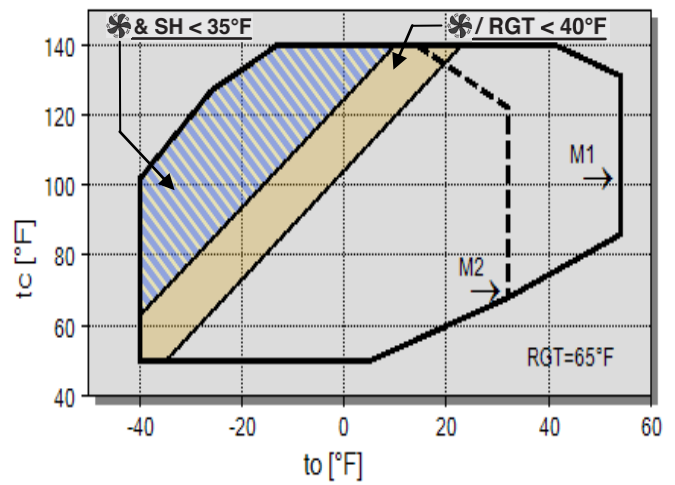


R407F BE6 Series

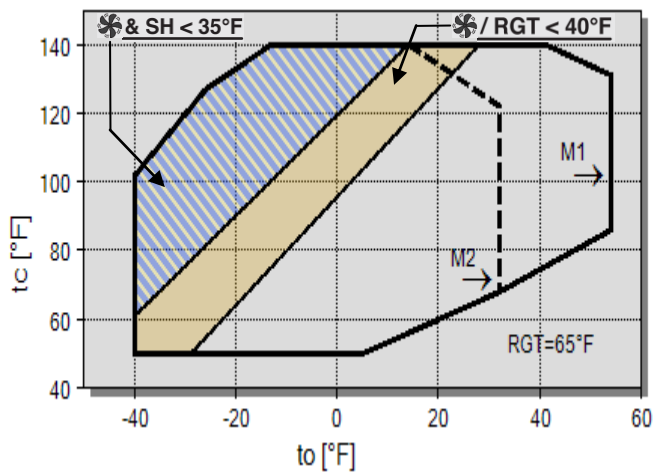
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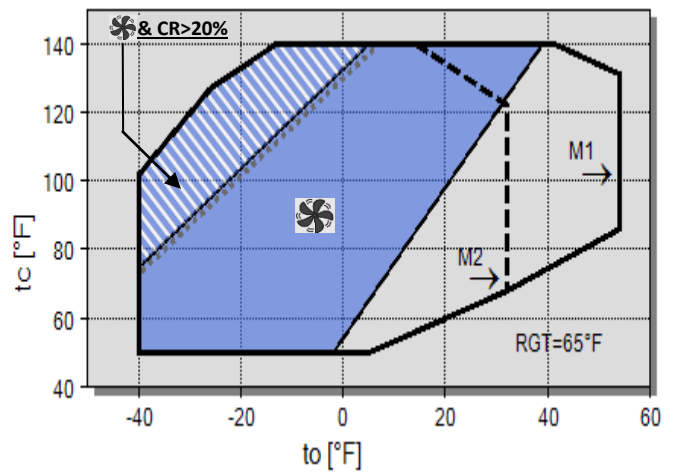
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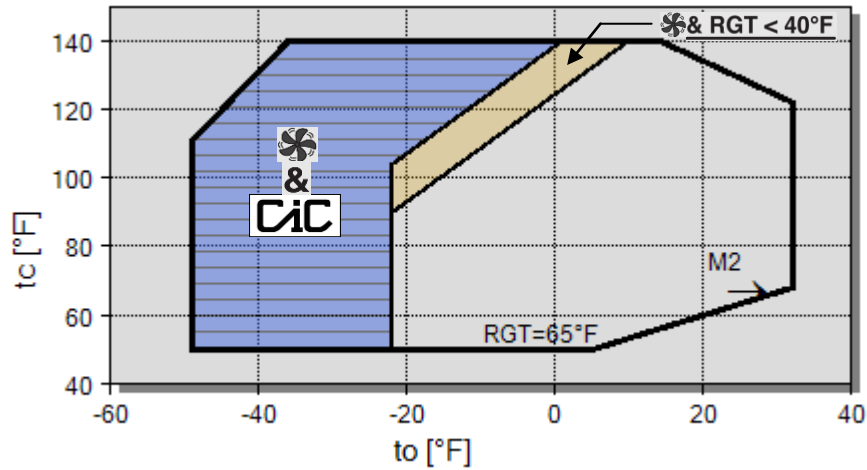
10% -32% Capacity Control



5. CIC / Liquid Injection Limits

Depending on all operating conditions (SST, SDT, Return Gas Temp, etc), it may be desirable to install liquid injection. The limits of this application are shown below. Unloading is allowed with CIC Liquid Injection. Refer to Section 2 for additional requirements.

R407A/F CE4-BE6 Series



CIC Kit Part Numbers

(See document KT-130 for more information)

| Series | Compressor | CIC Kit 230V | CIC Kit 115V |
|--------|------------|--------------|---------------|
| CE4 | 4VE(S)-7 | 347702-18 | 347702-18-115 |
| | 4TE(S)-9 | 347702-18 | 347702-18-115 |
| | 4PE(S)-12 | 347702-18 | 347702-18-115 |
| | 4NE(S)-14 | 347702-18 | 347702-18-115 |
| BE5 | 4JE-15 | 347702-03 | 347702-03-115 |
| | 4HE-18 | 347702-03 | 347702-03-115 |
| | 4GE-23 | 347702-19 | 347702-19-115 |
| | 4FE-28 | 347702-20 | 347702-20-115 |
| BE6 | 6JE-25 | 347702-21 | 347702-21-115 |
| | 6HE-28 | 347702-21 | 347702-21-115 |
| | 6GE-34 | 347702-21 | 347702-21-115 |
| | 6FE-44 | 347702-22 | 347702-22-115 |

6. Head Fan Kit Selection

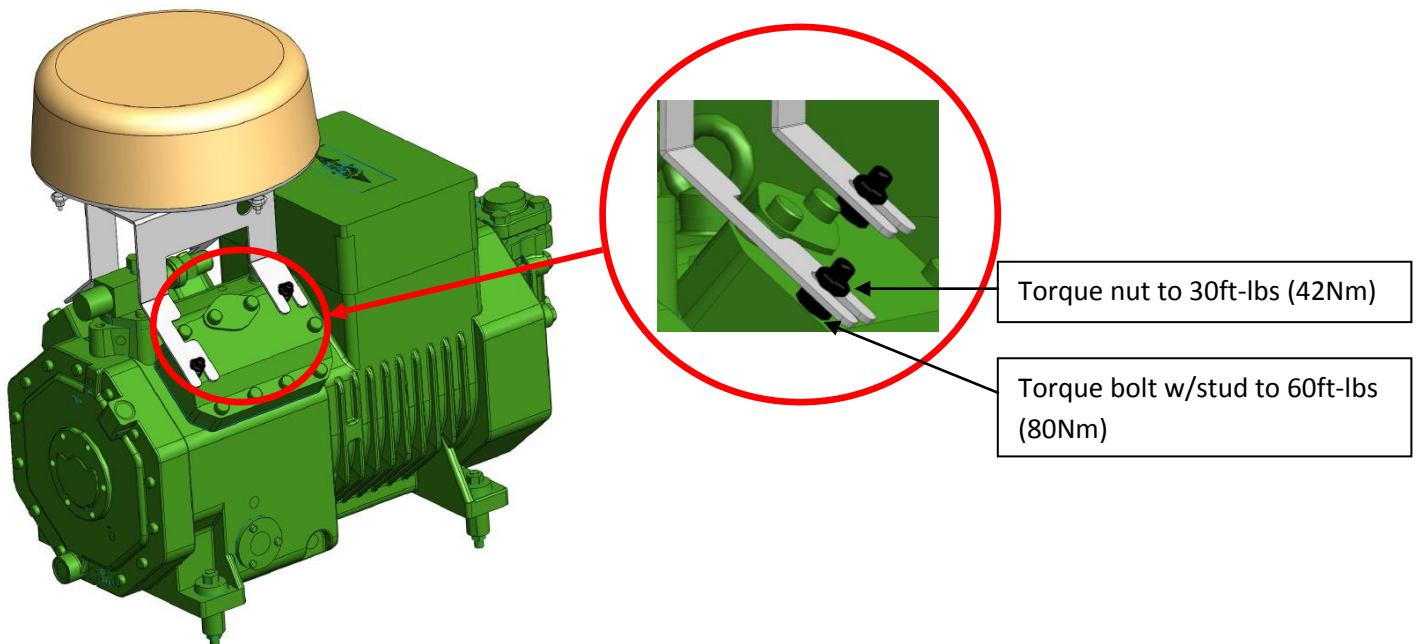
Select the part number for the head fan bracket based on the compressor model series/number and the head fan based on the voltage supply using the tables below.

| Table 1. Head Fan Bracket Part Numbers | | |
|--|--------------------|---------------------|
| Compressor Series | Model Number Range | Bracket Part Number |
| CE1 | 2KES – 2FES | 0705468-KIT |
| CE2 | 2EES – 2CES | 0705484-KIT |
| CE3 | 4FES – 4CES | 0705467-KIT |
| CE4 | 4VE – 4NE | 0705482-KIT* |
| BE5 | 4JE – 4FE | 0705481-KIT* |
| BE6 | 6JE – 6FE | 0705480-KIT* |

* KIT includes bolts with studs for replacing head bolts so that head fan can be mounted to the stud while the bolt can be independently torqued correctly.

| Table 2. Head Fan Part Numbers | |
|--------------------------------|----------------------|
| Voltage | Head Fan Part Number |
| 110V | 415-2100-15KIT |
| 220V | 415-2100-28KIT |
| 460V | 415-2100-46KIT |

Head Fan Kit Installation



Tightening torque for all cylinder head bolts (M10): 60ft-lbs or 80Nm

6. Installing a Discharge Gas Temperature Sensor

The use of a discharge temperature sensor as a safety device is recommended to protect the compressor from overheating and damage. This safety device is recommended when using R407F/R407A in low temperature applications, even when additional cooling is in place.

The discharge temperature sensor can only be used with the CE3, CE4, BE5 and BE6 series compressors. For CE3 compressors it will only monitor the temperature of one of the heads – a port is available on both of the heads.

BITZER offers a discharge gas temperature sensor (p/n 347023-03) that will open the SE-B INT module at 140°C (284°F).

Installation: Apply Teflon tape sealant to the threads of the sensor and install on the compressor. The sensor must not be installed further downstream (e.g. at discharge piping) due to the ability of the gas to lose heat quickly; doing so would allow unsafe temperatures in the head.

Wire the sensor according to Figure 3 below:

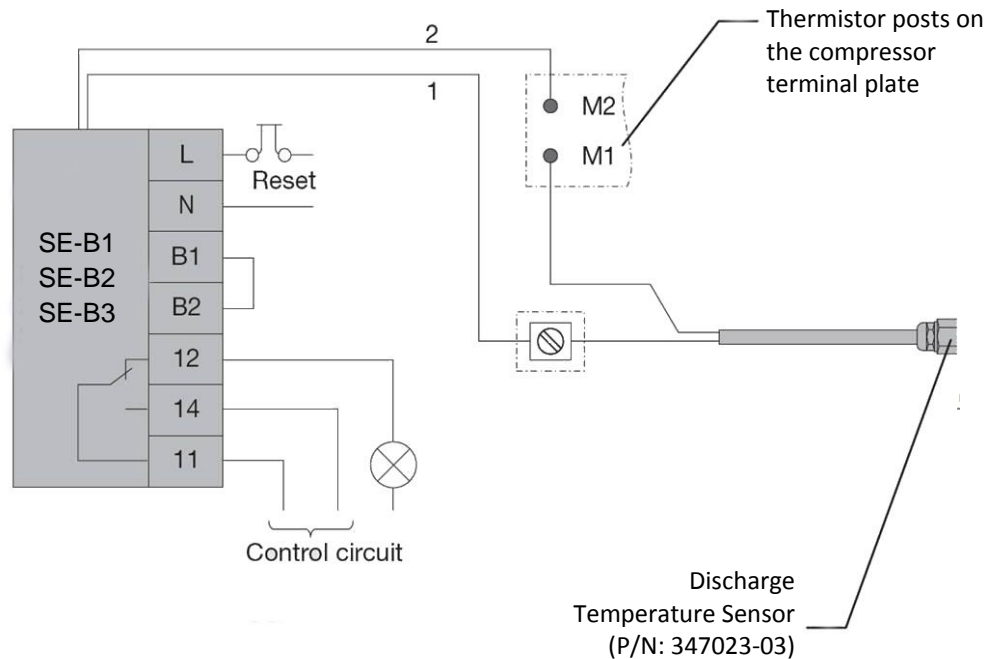


Fig. 3 Discharge temp sensor installation