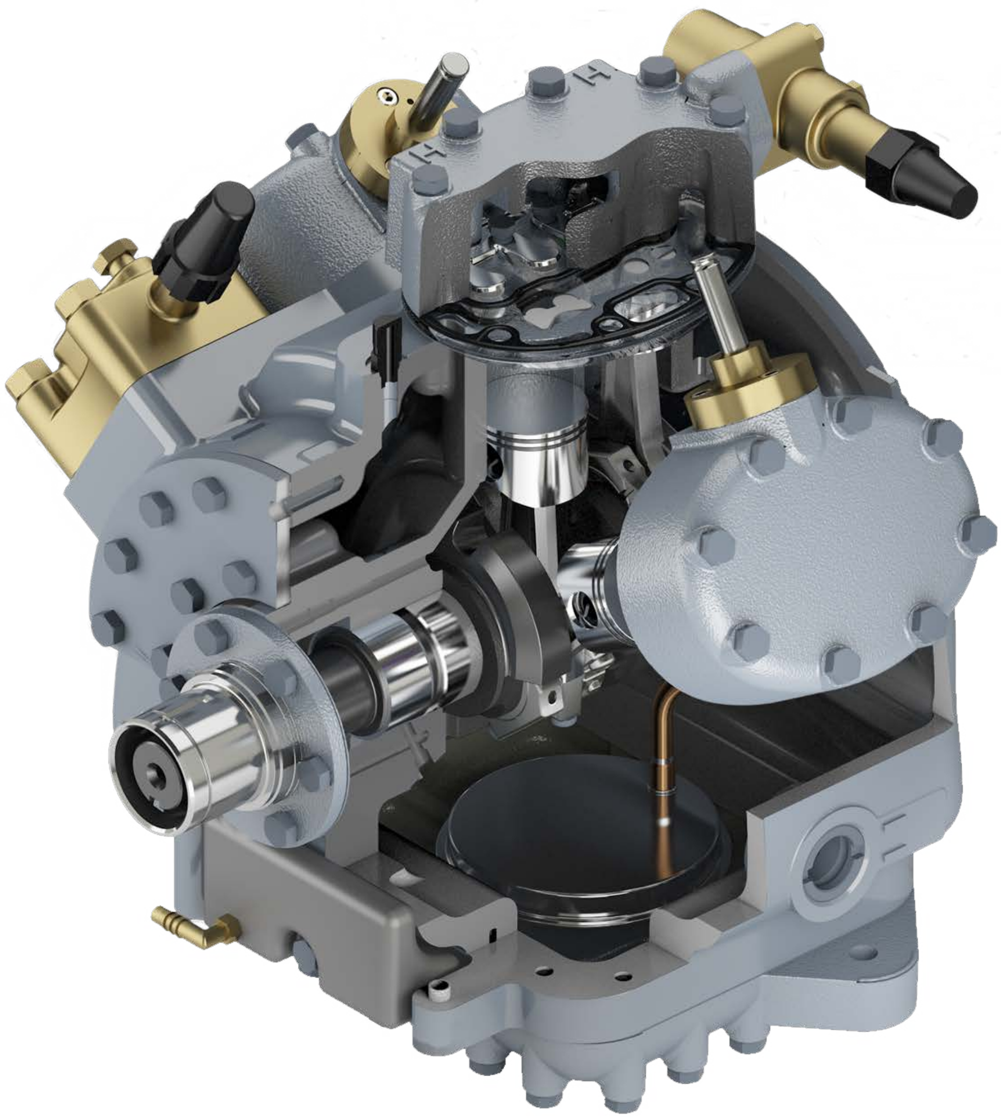


05G/05K APPLICATION GUIDE

Carlyle™

Contents

1.0 Introduction

Carlyle 05G and 05K open-drive compressors are designed for air conditioning and refrigeration applications. The compressor is approved to operate with R-134a and R-404A refrigerants. The compressors comply with the CE Mark requirements and will have the CE Mark logo added to the compressor's nameplate.

General Description

The 05G and 05K twin port compressors are of the open-drive reciprocating type. A crankshaft, connecting rods, pistons, and reed type valves accomplish vapor compression. The oil pump is driven directly from the end of the compressor crankshaft. The end of the crankshaft, which extends outside the crankcase, is adaptable to a variety of direct drive or belt-driven clutch mechanisms. A mechanical seal prevents refrigerant leakage where the rotating shaft passes through the crankcase. A shaft seal reservoir is provided to collect any oil seepage that might escape the seal.

The compressor is equipped with flanges for connecting suction and discharge service valves. Connections are also provided for pressure gages and safety cutout switches. Sight glasses installed on both sides of the crankcase provides a means for checking oil level in the compressor crankcase. A drain plug facilitates draining of oil from the crankcase and an oil fill plug enables addition of oil when necessary. A bottom plate provides access through the bottom of the crankcase for maintenance.

Compressor Features

The valving system utilizes low lift valves and high flow twin ports to reduce valve losses, maximize efficiency, and reduce valve stress.

The pistons are contoured, allowing the suction valves to mate up with the recess in the pistons, resulting in reduced clearances which increase both capacity and efficiency.

The low profile reversible oil pump is a positive displacement pump that produces a high volume of oil flow. The 05G oil pump will produce oil pressure quickly, reducing the potential for nuisance oil pressure trips.

On start-up, oil level can temporarily drop too low, causing unnecessary wear in other compressor designs due to refrigerant/oil dilution. The Carlyle oversize oil sump holds extra oil in the crankcase to prevent normal oil migration from dropping the oil level below the safe lubrication ranges.

The suction inlet screen prevents installation scale or abrasives from entering the compressor and shortening the life of the compressor.

The 05K compressor can unload $^1/_2$ of its cfm displacement. The 05G compressor has the capability to unload $^2/_3$ and $^1/_3$ of its cfm displacement through the means of electric unloading. There are two types of compressor unloader systems that will work with the 05G or 05K compressor: hot gas bypass (HGB) and suction cutoff (SCO).

The 05G compressor has a clutch hub installed over the crankshaft end for the installation of a belt-driven electromechanical clutch.

2.0 System Design Considerations

Compressor Rating Notes

Performances for most standard conditions are plotted in tabular data or rating curves. For special requests, contact Carlyle Application Engineering.

The compressor capacity and power ratings found in the compressor performance tables are based on the following conditions:

Compressor ratings are based on 1750 rpm operation, 65 F (18.3 C) return gas temperature, and 0° F (–18 C) subcooling. Refrigerant temperatures (suction and condensing) are saturation temperatures corresponding to pressures indicated at the compressor service valves. Actual gas temperatures are higher because of superheat.

Operating conditions should be controlled so that the discharge gas does not exceed 275 F (135 C) and oil temperature (in the sump) does not exceed 160 F (71 C). For HFC/POE (polyolester) applications the maximum recommended discharge temperature is 250 F (121 C).

Requirements for Proper Compressor Operation

The 05G and 05K compressor applications require good system design for proper compressor performance to ensure against compressor damage.

Refrigerant Piping

Good system piping designs will minimize the possibility of lubrication failure, flooded starts, and refrigerant flood-back problems. Refrigerant piping systems must therefore be designed to protect the compressor by:

1. Preventing excessive lubricating oil from being trapped in the system. Refrigerant piping must be sized for proper velocity, especially in suction lines, to return oil under all conditions. If capacity control is utilized, piping must be sized for full and part load conditions. With the increased use of mechanical subcooling in refrigeration conditions, the system designer must also consider the lower refrigerant mass flow that results in systems.
2. Minimizing the loss of lubricating oil from the compressor at all times.
3. Preventing liquid refrigerant from entering the compressor during operation and shutdown.

To properly cover the subject of piping design would be too lengthy to treat here, especially since many excellent guides to piping design are presently available. For complete details of good system piping practices, the Carrier System Design Manual (Part 3 Piping Design) is recommended.

Vibration Isolation

It is also recommended to design the suction line with sufficient "spring" so the suction service valve can be moved aside for access to the suction strainer. Many systems have been designed with compressors mounted to the base. In this case, it is important that the compressors be properly torqued to the base or the compressor may produce a "rattle" or transmit excessive vibration to the base.

For a more complete review of the system vibration and piping recommendations, see Carlyle OEM Bulletin #118.

Refrigerant Migration and Flood-Back

Liquid refrigerant, or even excessive amounts of entrained liquid particles in the suction gas, must be kept out of the compressor by proper system design and compressor control. Under running conditions, the presence of liquid refrigerant in the compressor tends to break down the oil film on the cylinder walls, resulting in increased wear to the cylinder walls and piston rings, and possible compressor damage.

Furthermore, excessive liquid in the cylinders causes hydraulic compression, which can create cylinder pressures as high as 1500 psi (103 bar). This hydraulic loading can cause suction and discharge valve and gasket failures to occur while also subjecting the connecting rod, piston, and main bearings to excessive loading. Although laboratory testing of 05G and 05K compressors has shown that they can withstand substantial flooded starts and flood-back, prolonged excessive flooding will eventually cause any compressor to fail.

Therefore, special care should be taken to ensure that liquid refrigerant is kept out of the compressor especially in systems where large quantities of refrigerants are often used. During compressor operation, the expansion valve must be properly adjusted to prevent liquid from entering the compressor.

During compressor shutdown, gravity, thermal action and refrigerant absorption will result in a refrigerant and oil mixture in the compressor crankcase. Gravity flow can be prevented by the use of recommended loops in the piping, liquid line solenoid valve (LLSV), and a discharge check valve.

Clean and Dry System

Clean and dry systems are essential for long compressor and motor life, and satisfactory operation. This cannot be over-emphasized. It is even more critical with the introduction of new HFC refrigerants and POE lubricants. The new POE lubricants are excellent cleaning agents that will deposit system contaminants into the system or compressor filters and screens, causing excessive pressure drop or clogging, if the system is not kept clean.

Liquid line refrigerant filter driers maintain low moisture content, and in the event of a motor burnout, prevent contamination of the evaporator and other parts of the refrigeration system. These filter driers should be compatible with the new HFC refrigerants and POE oils if used.

Prevent Excessive Discharge Temperatures

The actual discharge gas temperature at the compressor discharge service valve must not exceed 275 F (135 C). For HFC/POE applications the maximum recommended discharge temperature is 250 F (121 C).

For a given refrigerant, this discharge temperature depends upon the compression ratio as well as the temperature of the superheated suction gas. Since an increase in either the compression ratio or suction gas temperature causes the discharge temperature to increase, both must be kept within allowable limits.

3.0 Lubrication System

Compressor Lubrication

All refrigeration compressors must have adequate lubrication to ensure trouble-free operation and a long life. When starting up any new system, some oil will be lost to coat the inside of the piping, some oil will be lodged in low velocity areas of the system, and some will be kept in circulation. This loss must be made up by adding oil to the system after the initial start-up. Very low compressor oil levels can cause complete loss of lubrication and may result in an immediate compressor failure if not protected against.

The loss of oil can also be caused by flooded starts or refrigerant migrating into the oil during an off period and pulling the oil out of its sump during the sudden pressure drop of a start-up.

While it has always been apparent that very low oil levels can cause compressor damage, it has also become apparent that excessive oil charges can shorten the compressor's life. Oil levels above the “Max” mark on the compressor sight glass can cause elevated crankcase and oil temperatures, increased power consumption, and possible valve plate gasket failures.

The oil level should be observed in the sight glass immediately after the compressor shutdown, while it is still warm. The level observed when the compressor is not running for a long period may be a mixture of oil and refrigerant which would not be a true indication of the oil level when the compressor is running.

If the oil level in the sight glass of an 05G compressor is less than the “MIN” mark on the sight glass, this indicates a low oil level. If the oil level is above the “MAX” mark on the sight glass, this indicates a high oil level. Therefore, the oil level should be between the MIN - MAX marks when the compressor is running. See Fig. 1.

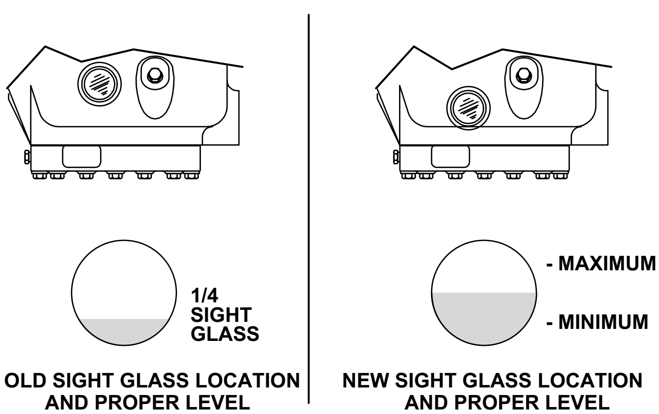


Fig. 1 — Oil Level in Sight Glass

Oil Pump

Force-feed lubrication of the compressor is accomplished by an oil pump (see Fig. 2) driven directly from the compressor crankshaft. Refrigeration oil is drawn from the compressor crankcase through the oil filter screen and pick up tube to the oil pump located in the bearing head assembly. The crankshaft is drilled to enable the pump to supply oil to the main bearings, connecting rod bearings, and the shaft seal.

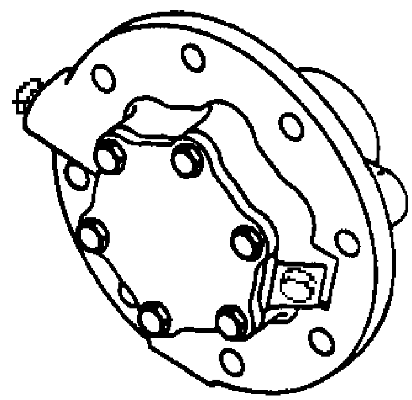


Fig. 2 — Oil Pump

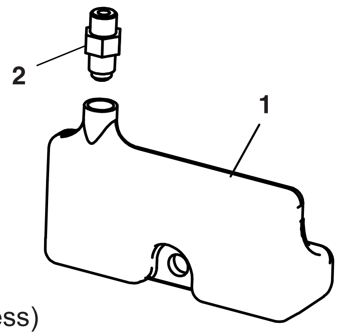
The oil flows to the pump end main bearings, connecting rod bearings and seal end main bearings, where the oil path is divided into two directions. The largest quantity flows to the oil relief valve, which regulates oil pressure at 15 to 18 psi (1.02 to 1.22 bar) above suction pressure. When the oil pressure reaches 15 to 18 psi (1.02 to 1.22 bar) above suction pressure, the relief valve spring is moved forward allowing oil to return to the crankcase. The remaining oil flows through an orifice and into the shaft seal cavity to provide shaft seal lubrication and cooling. This oil is then returned to the crankcase through an overflow passage.

Shaft Seal

The shaft seal works with an oil barrier, which prevents leakage of the refrigerant. The oil forms a thin sealing film and also contributes to cooling the shaft seal. Oil passing through the shaft seal cavity will be captured in the shaft seal reservoir.

Shaft Seal Reservoir

The shaft seal oil reservoir has been fitted to the crankcase. See Fig. 3. The coreless access valve taps into the crankshaft seal cavity where any oil that escapes the crankshaft seal will form. The coreless access valve then drains that compressor oil that escapes the crankshaft seal into the shaft seal reservoir.



1. Shaft Seal Reservoir
2. Access Valve (Coreless)

Fig. 3 — Shaft Seal Reservoir

Recommended Oils

Proper use and storage of polyolester (POE) type oil used with HFC refrigerants is critical. This type of oil is extremely hygroscopic, meaning that if allowed to become exposed to the atmosphere, it can collect moisture that leads to the formation of acids that will damage refrigeration components. Some refrigeration assemblies such as o-ring assemblies, compressor shaft seals and most solenoid valves require that refrigerant oil be applied to some of the parts during the assembly process. When this is needed, always use alkylated benzene oil (Zerol 150) even for R-134a systems. All refrigerant oils must be stored in a sealed, airtight container. See Table 1 for an approved oil list.

The oils below are suitable for use with evaporator temperatures above –40 F (–40 C).

Table 1 — Approved Oil for Air Conditioning Use (Bus and Rail)

REFRIGERANT	OIL
R-404A	Castrol Icematic: SW-68C
	Mobil Arctic: EAL 68
	ICI: Emkarate: RL68H
R-134a	Castrol Icematic: SW-68C
	Mobil Arctic: EAL 68
	ICI: Emkarate: RL68H

4.0 Capacity Control

The 6-cylinder 05G compressor can be applied with 2 banks of unloading. The 4-cylinder 05K compressor can be applied with 1 bank of unloading.

There are two types of compressor unloader systems; the first one is the hot gas bypass and the second is the suction cutoff. They are easily distinguished from each other by observing the bottom side of the compressor cylinder head; it is either blank (hot gas bypass) or has a cover plate (suction cutoff).

Design for Proper Oil Return to Compressor

When the 05G compressor is unloaded, the compressor and system capacity are reduced by $^1/_3$, or $^2/_3$ of full load capacity. For the 05K compressor, the compressor and system capacity are reduced by $^1/_2$ full load capacity. These capacity reductions result in the same large percent reduction in refrigerant flow rates through the system piping. Oil that is entrained and carried with refrigerant requires a certain gas velocity to properly return it back to the compressor and as this refrigerant flow drops, this may not be possible. This is especially true of the sizing of the suction line where oil return is most critical.

All system piping, but especially the suction line, must consider both full load and part load capacities and refrigerant velocities when being sized. For complete details of good system piping practices, the Carrier System Design Manual (Part 3 - Piping Design) or the ASHRAE Manual (Systems Volume) is recommended.

To protect the compressor against possible oil return problems, all 05G air conditioning duty compressors applied with capacity control must utilize oil safety switch protection.

Unloader Differential Setting

The unloader differential setting is the suction pressure difference at which the controller loads and unloads the particular cylinder bank. A differential setting that is too low could cause the unloader mechanism to short cycle. For example, when an 05G compressor unloads, the suction pressure rises because the compressor capacity has decreased by one-third. If the differential setting is too close, this rise in suction pressure may be enough to load the compressor back up. For this reason, Carlyle recommends a minimum differential setting of 6 to 10 psi. The final setting should be evaluated for the final application because many variables are involved:

- Compressor speed operating range
- Medium or high temperature application
- Unloading 2 or 4 cylinders (1/3 and 2/3 load reduction)
- Refrigerant R-404A or R-134a

Part Load Performance Factors

To estimate part load performance of an 05G compressor, a 0.67 or 0.33 multiplier should be applied to the compressor's capacity rating for 4 and 2 cylinder compressor operation, respectively. For 05K compressors, use a multiplier of 0.5. Apply a multiplier of 0.67 and 0.35 for the compressor's HP rating for 4 and 2 cylinder operation, respectively. These factors can be applied to the full load published Carlyle capacity and HP data for all refrigerants and conditions. The system designer should ensure the conditions are within the safe operating range of the compressor.

Location of Capacity Control Head Assembly

The capacity control head assembly cannot be installed and will not function on the center cylinder head of the 05G compressor.

Capacity control heads can be installed on either side bank of the 05G compressor. The 05G compressor can be configured with 1 or 2 unloader cylinder heads. Unloading both cylinder banks simultaneously is not recommended.

The 05K compressor can only be configured with one unloader head.

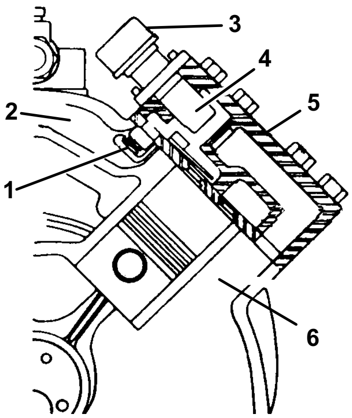
Pressure Differential (ΔP) Required to Load the Compressor

A minimum ΔP between the discharge and suction pressure is required to compress the unloader valve spring to load up the cylinder bank. While this differential pressure is low, it should be evaluated for certain low head pressure applications such as R-134a air conditioning applications. The discharge pressure must be 50 psig higher than the suction pressure for the unloader assembly to load up.

Hot Gas Bypass Unloader

The compressor is equipped with an unloader for capacity control. This consists of a self-contained, cylinder head bypass arrangement (see Fig. 4) which is electronically controlled by the temperature controller.

The capacity controlled cylinder is easily identified by the solenoid which extends from the side of the cylinder head. When the solenoid energizes, the cylinder unloads allowing discharge gas to circulate as shown in Fig. 5. The unloaded cylinder operates with little or no pressure differential, consuming very little power. A de-energized solenoid reloads the cylinder as shown in Fig. 5.



1. Discharge Check Valve
2. Discharge Manifold
3. Solenoid Valve
4. Piston Bypass Control Valve
5. Cylinder Head
6. Suction Manifold

Fig. 4 — Compressor Unloader - Hot Gas Bypass

Major Working Parts

- Solenoid and valve system
- Spring loaded piston type bypass control valve
- Spring loaded discharge check valve

Unloaded Operation

Pressure from the discharge manifold (Fig. 5, item 15) passes through the strainer (9) and bleed orifice (8) to the back of the piston bypass valve (7). Unless bled away, this pressure would tend to close the piston (6) against the piston spring (5) pressure.

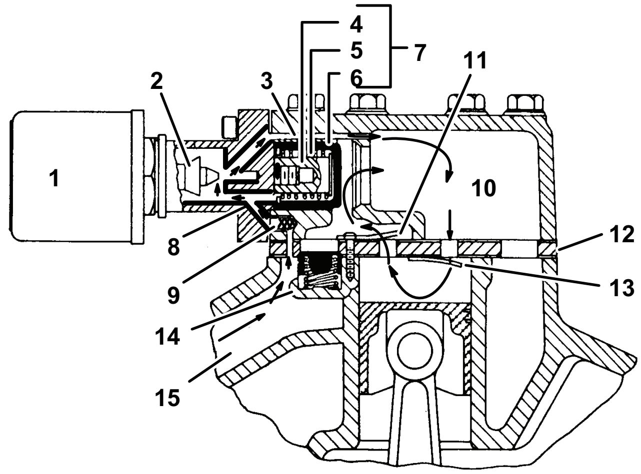
With the solenoid valve (1) energized the solenoid valve stem (2) will open the gas bypass port (3).

Refrigerant pressure will be bled to the suction manifold (10) through the opened gas bypass port. A reduction in pressure on the piston bypass valve will take place because the rate of bleed through the gas bypass port is greater than the rate of bleed through the bleed orifice (8).

When the pressure behind the piston has been reduced sufficiently, the valve spring will force the piston bypass valve back, opening the gas bypass from the discharge manifold to the suction manifold.

Discharge pressure in the discharge manifold will close the discharge piston check valve assembly (14) isolating the compressor discharge manifold from the individual cylinder bank manifold.

The unloaded cylinder bank will continue to operate fully unloaded until the solenoid valve control device is de-energized and the gas bypass port is closed.



1. Solenoid Valve
2. Valve Stem
3. Gas Bypass Port
4. Spring Guide
5. Spring
6. Piston
7. Piston Bypass Valve
8. Bleed Orifice
9. Strainer
10. Suction Manifold
11. Discharge Valve
12. Discharge Plate
13. Suction Valve
14. Discharge Piston Check Valve
15. Discharge Manifold

Fig. 5 — Compressor Cylinder Head Unloader - Hot Gas Bypass

Loaded Operation

Discharge pressure bleeds from the discharge manifold (Fig. 5, item 15) through the strainer (9) and bleed orifice (8) to the solenoid valve stem (2) chamber and the back of the piston bypass valve (7).

With the solenoid valve (1) de-energized the solenoid valve stem will close the gas bypass port (3).

Refrigerant pressure will overcome the bypass valve spring (5) tension and force the piston (6) forward, closing the gas bypass from the discharge manifold to the suction manifold (10).

Cylinder discharge pressure will force open the discharge piston check valve assembly (14). Refrigerant gas will pass into the compressor discharge manifold.

The loaded cylinder bank will continue to operate fully loaded until the solenoid valve control device is energized and the gas bypass port is opened.

Suction Cutoff Unloader

The compressor is equipped with unloaders for capacity control. This consists of a self-contained, suction cut-off arrangement which is electronically controlled by the temperature controller.

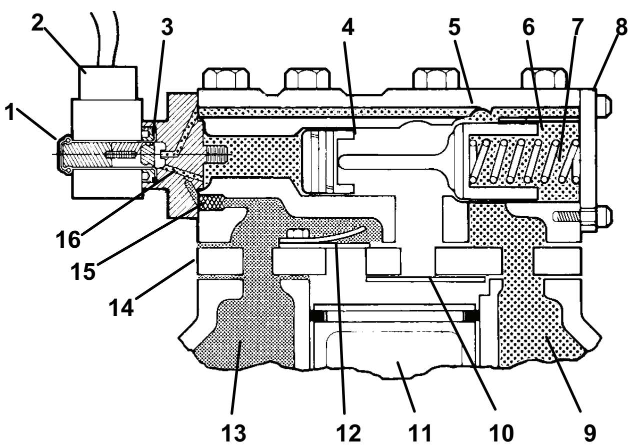
The capacity controlled cylinders are easily identified by the solenoid which extends from the side of the cylinder head. When the solenoid energizes, cylinders unload, preventing suction gas from being drawn into the cylinder (see Fig. 6). The unloaded cylinders operate with little or no pressure differential, consuming very little power. A de-energized solenoid reloads the cylinders as shown in Fig. 7.

Major Working Parts

- Solenoid and valve system
- Unloader piston assembly
- Spring and cover plate

Unloaded Operation

When the unloader valve solenoid energizes, the capacity control valve port opens (item 3, Fig. 6). This allows the discharge gas behind the unloader piston assembly (item 4) to vent back to the suction side. The unloader valve spring (item 7) at this point, can move the unloader valve body to the left, blocking the unloader suction port. The cylinder bank is now isolated from the compressor suction manifold to unload these two cylinders. No refrigerant is allowed into the cylinders and no compression takes place.



SUCTION PRESSURE

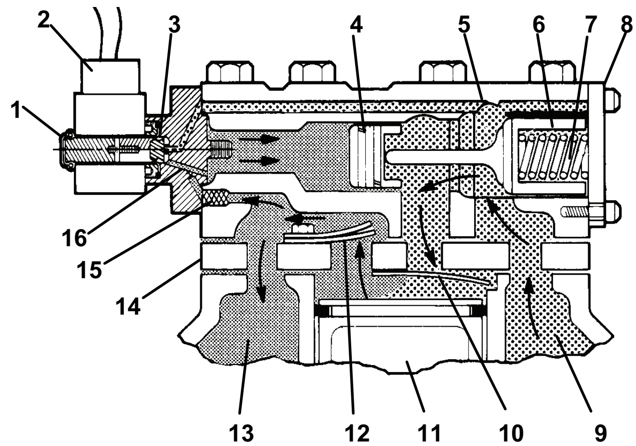
DISCHARGE PRESSURE

1. Solenoid Valve
2. Coil
3. Capacity Control Valve (Open)
4. Unloader Piston
5. Cylinder Head
6. Valve Body
7. Valve Spring
8. Cover Plate
9. Suction Manifold
10. Suction Valve
11. Piston
12. Discharge Valve
13. Discharge Manifold
14. Valve Plate
15. Discharge Gas to Unloader
16. Capacity Control Port Passage

Fig. 6 — Compressor Cylinder Head Unloader - Suction Cut-Off

Loaded Operation

When the unloader valve solenoid de-energizes, the capacity control valve port closes (item 3, Fig. 7). This allows discharge pressure to build up behind the unloader piston assembly. The high pressure will compress the unloader valve spring, opening the unloader suction port. Suction gas can now be drawn into the cylinders, running the bank fully loaded.



SUCTION PRESSURE

DISCHARGE PRESSURE

1. Solenoid Valve
2. Coil
3. Capacity Control Valve (Closed)
4. Unloader Piston
5. Unloader Head
6. Valve Body
7. Valve Spring
8. Cover Plate
9. Suction Manifold
10. Suction Valve
11. Piston
12. Discharge Valve
13. Discharge Manifold
14. Valve Plate
15. Discharge Gas to Unloader
16. Capacity Control Port Passage

Fig. 7 — Compressor Cylinder Head Loaded - Suction Cut-Off

5.0 Compressor Operating Parameters

Compressor Outline Drawings (Fig. 8-11)

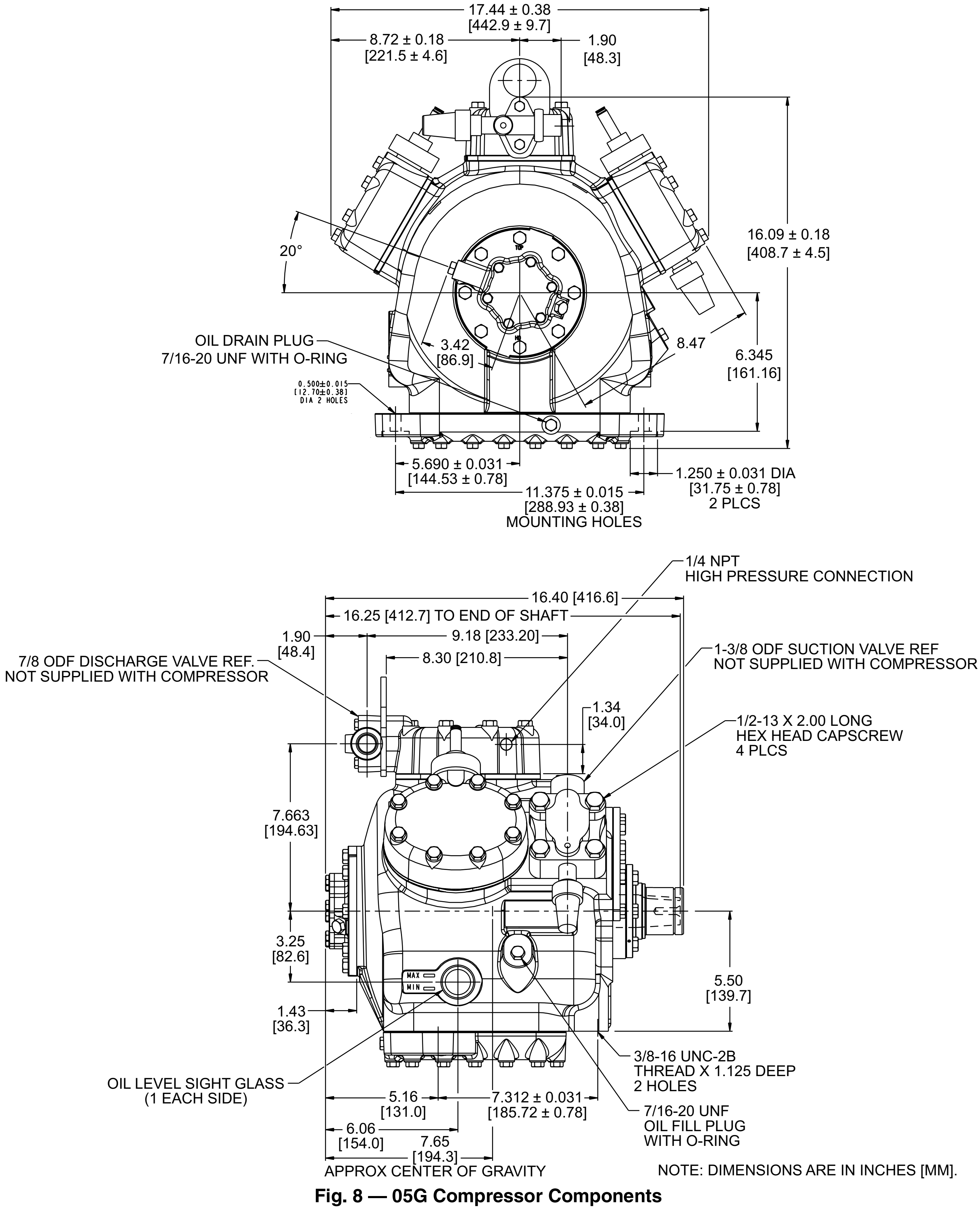
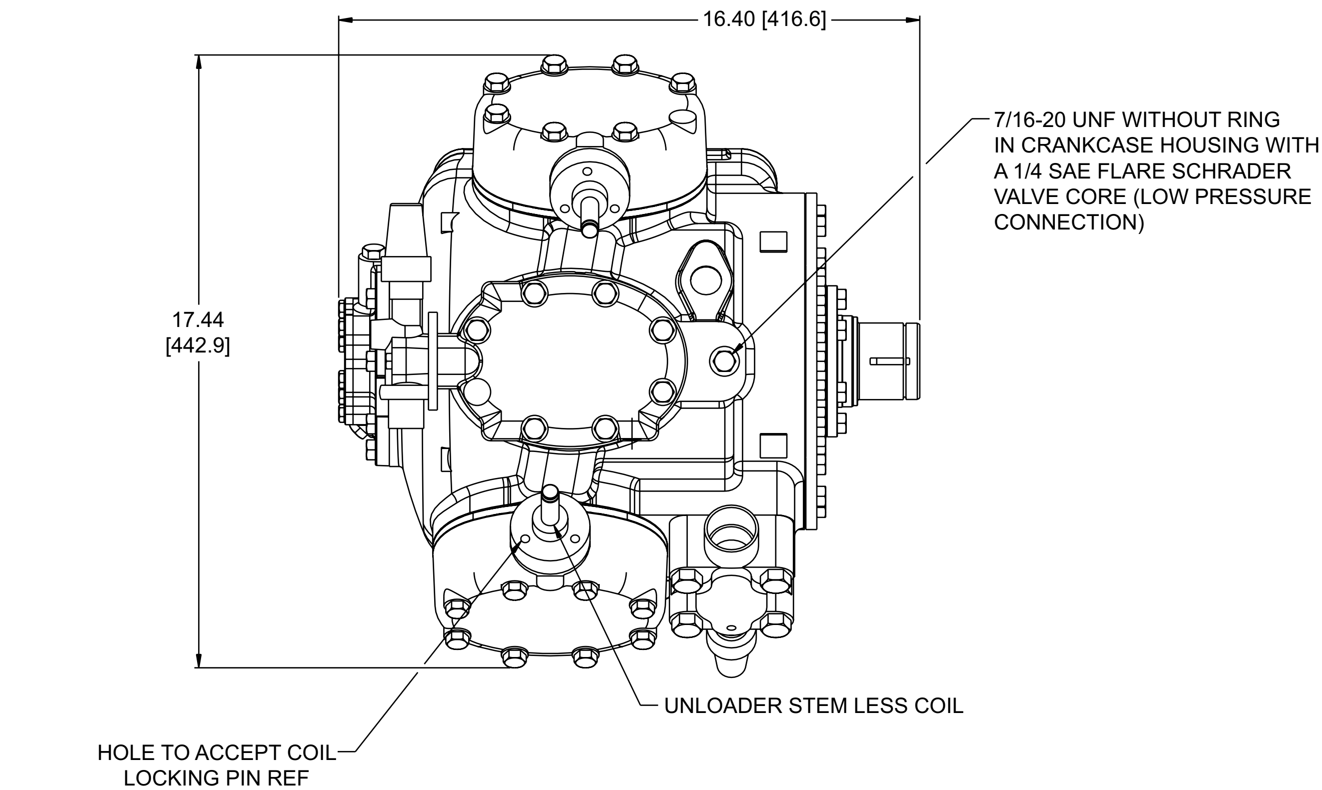
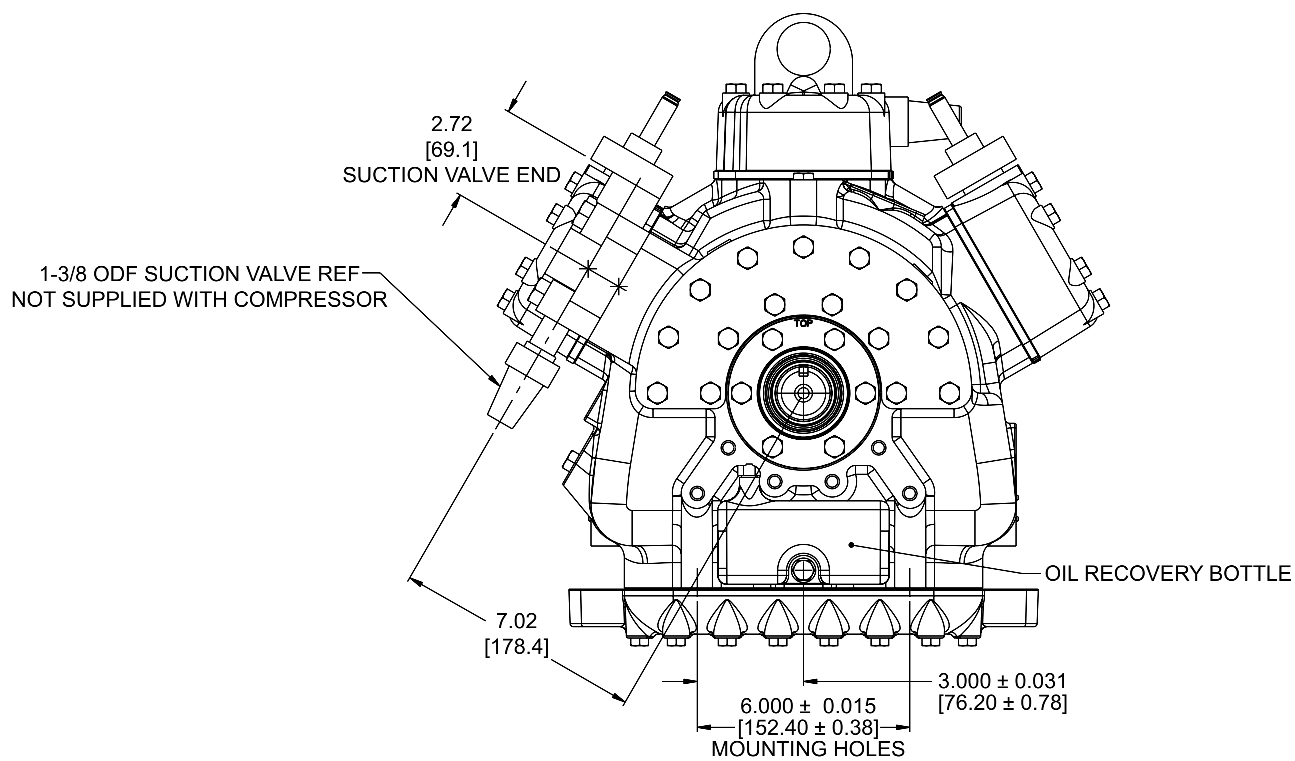


Fig. 8 — 05G Compressor Components





NOTE: DIMENSIONS ARE IN INCHES [MM].

Fig. 8 — 05G Compressor Components (cont)

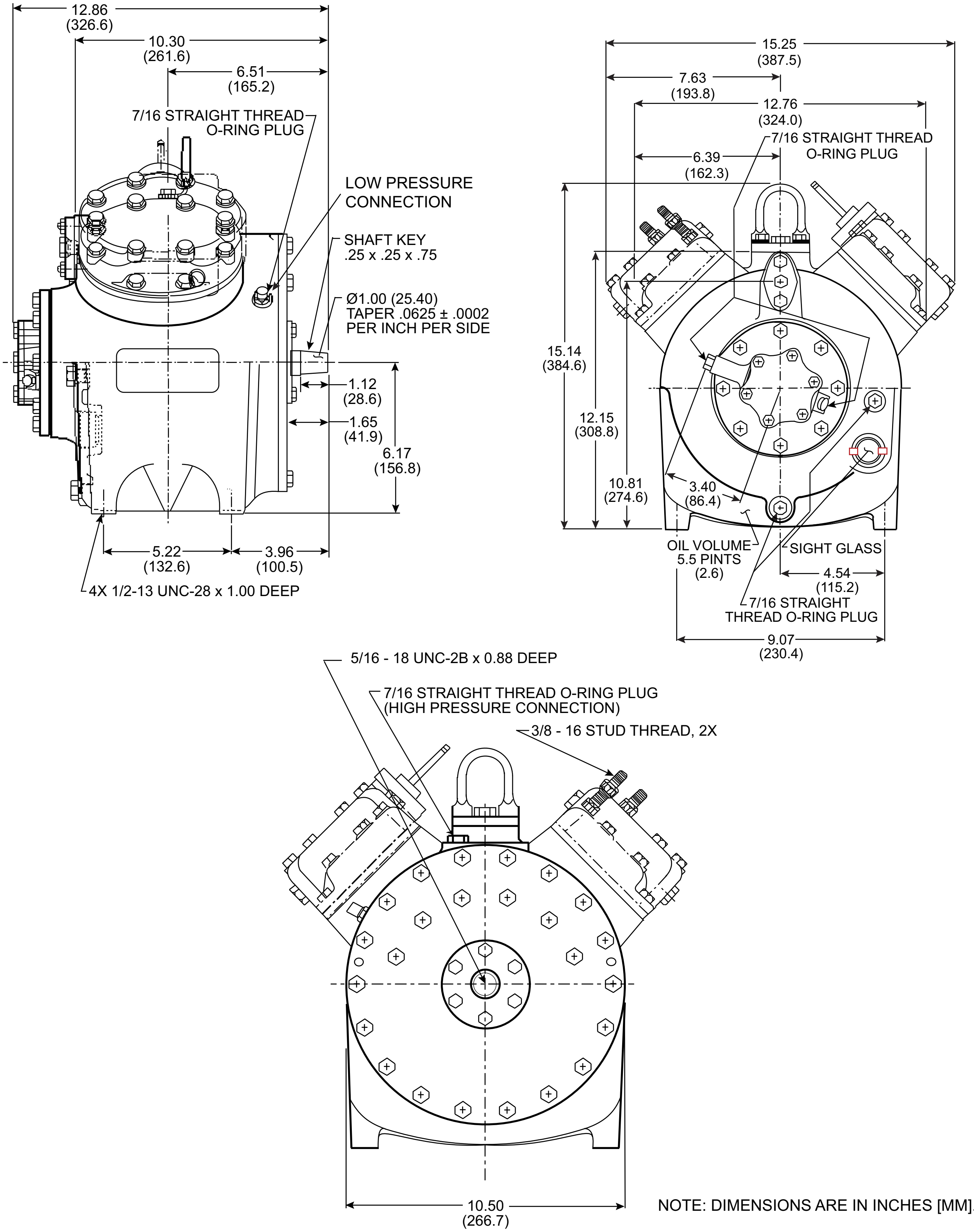


Fig. 9 — 05K Compressor Components

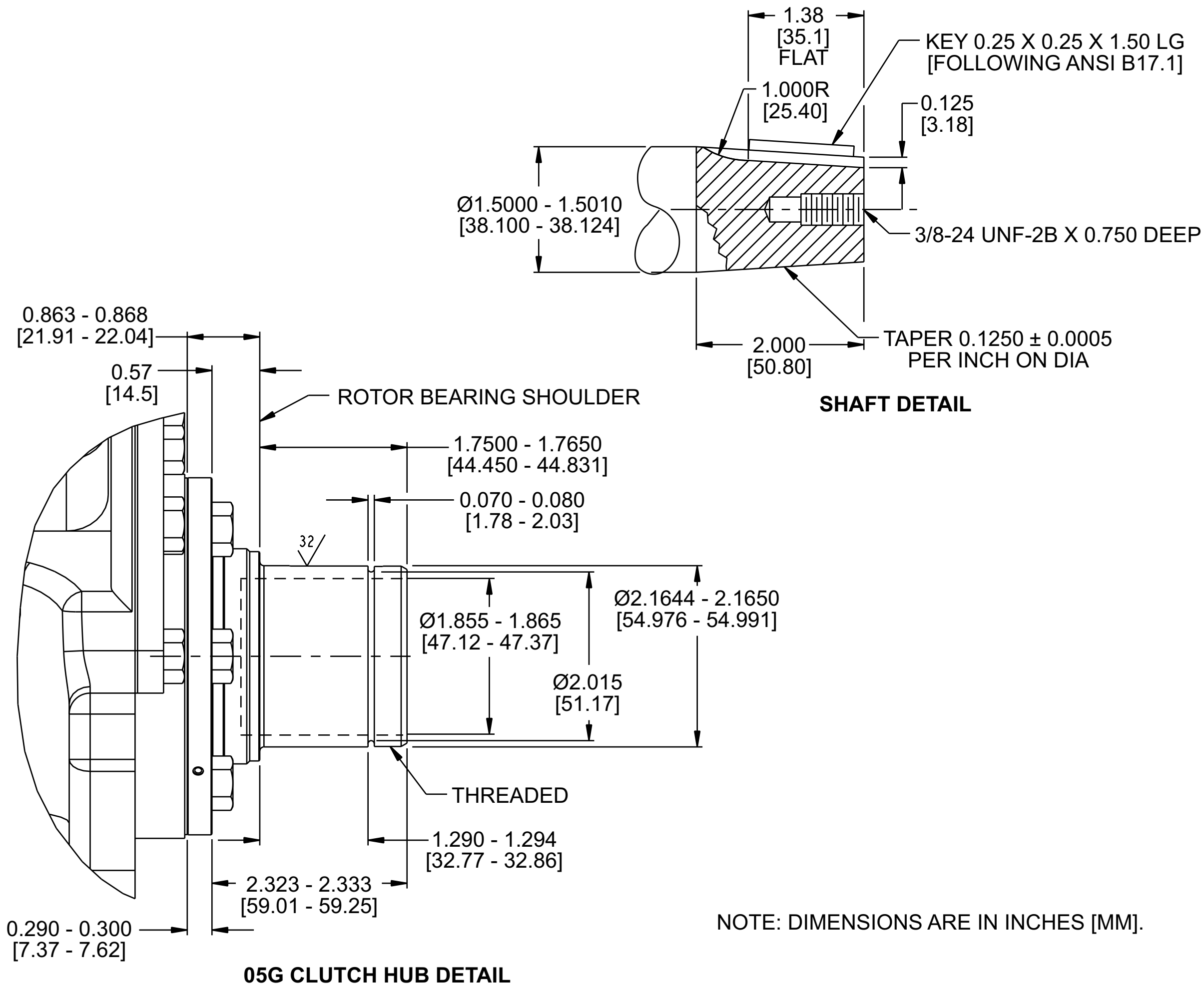


Fig. 10 — 05G Compressor Shaft and Clutch Hub Details

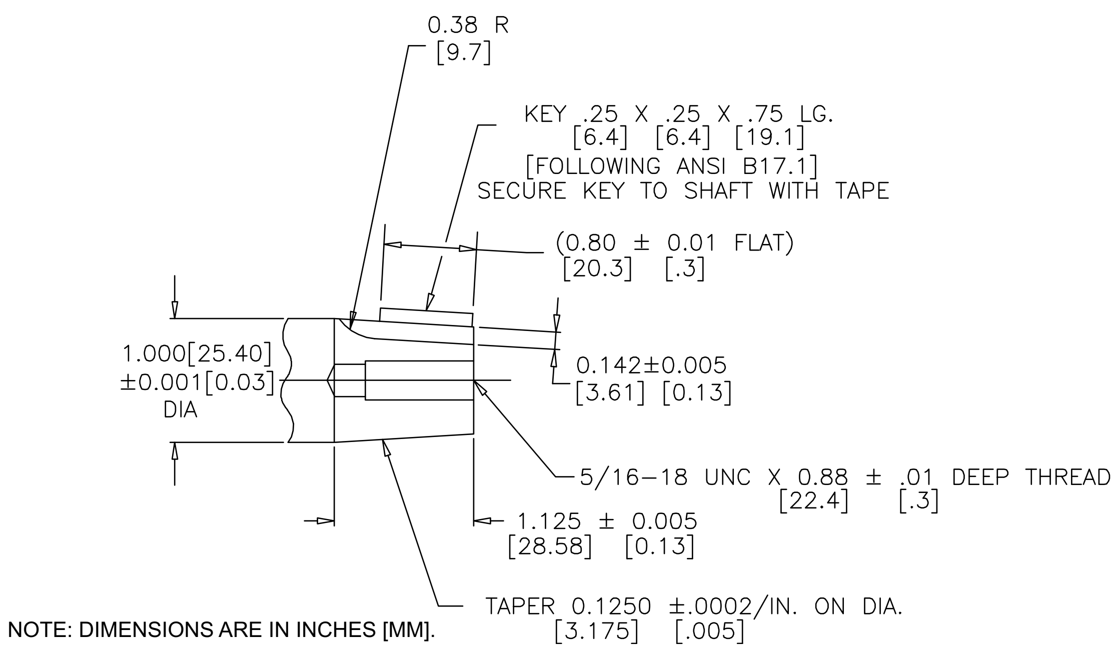


Fig. 11 — 05K 24CFM Shaft Details

Application Parameters

Operating conditions should be controlled so that during continuous operation the maximum discharge gas temperature does not exceed 275 F (135 C) and the oil temperature in the sump does not exceed 160 F (71.1 C) at any time. The minimum continuous operating suction pressure is 0 psig. Maintaining the operation of the 05G compressor within the Operating Envelope is necessary to ensure safe and reliable compressor operation. See Tables 2-7 for parameters and performance ratings. See Fig. 12 and 13 for speed corrections for capacity and HP. See Fig. 14-17 for compressor operating envelope.

Table 2 — Compressor Parameters

MODEL	05K-24CFM	05G-41CFM
Displacement	24 cfm (40.8 cubic m/hr)	41 cfm (69.7 cubic m/hr)
No. Cylinders	4	6
Bore	50.8 mm (2.00 in.)	
Stroke	49.2 mm (1.937 in.)	54.36 mm (2.14 in.)
Comp Weight	108 lb (49 kg)	130 lb (59 kg)
SPEED (RPM) FOR OIL PUMP		
Low Profile Gear Pump	400 to 2,200 rpm	

Table 3 — R-404A and R-134a Parameters

REFRIGERANT	R-404A AND R-134A
Allowable Continuous Compressor Speed Range (rpm)	400 to 2,200 rpm
Maximum Working Pressure	Low Side: 200 psig High Side: 450 psig
Ambient Operating Temperature	25 F to 150 F (–3.9 C to 65.6 C)
Maximum Discharge Temperature, Operation	275 F (135 C)
Minimum Suction Superheat, Operation	10 F (–12.2 C)
Minimum/Maximum Sump Oil Temperature, Operation	70 F to 160 F (21.1 C to 71.1 C)
Minimum Oil Pressure (psid), Operation	15 psid
Operational Mounting Angle Degree, Physical Data	30° about shaft center line
Maximum Belt Load, Physical Data	300 lb (136.1 kg)
Belt Load Angle Degree, Physical Data	120-240°

Performance Ratings

Table 4 — 05G 41 CFM, R-134a, 65 F Return Gas Temperature, 0 F Subcooling Performance Rating

SATURATED CONDENSING TEMP (F)		SATURATED SUCTION TEMPERATURE (F)									
		5	10	15	20	25	30	35	40	45	50
80	Capacity (Btu/hr)	66,188	75,902	86,652	98,584	111,771	126,333	142,353	159,946	179,239	200,419
	Flow Rate (lb/hr)	827	953	1,094	1,250	1,424	1,618	1,833	2,071	2,335	2,628
	Power (W)	6,981	7,321	7,649	7,961	8,251	8,512	8,738	8,922	9,056	9,133
	EER (Btu/watt hr)	9.5	10.4	11.3	12.4	13.5	14.8	16.3	17.9	19.8	21.9
	Pressure Ratio	4.3	3.8	3.4	3.1	2.8	2.5	2.2	2.0	1.9	1.7
	Discharge Temp (F)	199	188.4	178.5	169.4	160.8	152.7	144.9	137.5	130.4	123.4
90	Capacity (Btu/hr)	61,233	70,342	80,462	91,616	103,997	117,672	132,721	149,248	167,374	187,270
	Flow Rate (lb/hr)	798	921	1,059	1,213	1,384	1,574	1,785	2,020	2,279	2,567
	Power (W)	7,231	7,625	8,015	8,394	8,757	9,099	9,414	9,694	9,933	10,124
	EER (Btu/watt hr)	8.5	9.2	10.0	10.9	11.9	12.9	14.1	15.4	16.8	18.5
	Pressure Ratio	5.0	4.5	4.0	3.6	3.2	2.9	2.6	2.4	2.2	2.0
	Discharge Temp (F)	209.5	198.7	188.7	179.5	170.9	162.7	154.9	147.5	140.4	133.4
100	Capacity (Btu/hr)	56,403	64,921	74,380	84,849	96,390	109,188	123,274	138,747	155,716	174,340
	Flow Rate (lb/hr)	769	889	1,025	1,175	1,342	1,529	1,737	1,967	2,223	2,506
	Power (W)	7,440	7,885	8,331	8,773	9,206	9,625	10,023	10,395	10,734	11,033
	EER (Btu/watt hr)	7.6	8.2	8.9	9.7	10.5	11.3	12.3	13.3	14.5	15.8
	Pressure Ratio	5.8	5.2	4.7	4.2	3.8	3.4	3.1	2.8	2.5	2.3
	Discharge Temp (F)	220	209	199	189.6	180.9	172.7	164.9	157.5	150.3	143.4
110	Capacity (Btu/hr)	51,709	59,646	68,454	78,207	89,004	100,889	114,023	128,450	144,273	161,636
	Flow Rate (lb/hr)	739	857	990	1,137	1,302	1,485	1,689	1,915	2,166	2,445
	Power (W)	7,609	8,102	8,601	9,102	9,600	10,091	10,568	11,027	11,459	11,861
	EER (Btu/watt hr)	6.8	7.4	8.0	8.6	9.3	10.0	10.8	11.6	12.6	13.6
	Pressure Ratio	6.8	6.0	5.4	4.9	4.4	3.9	3.6	3.2	2.9	2.7
	Discharge Temp (F)	230.5	219.4	209.1	199.7	191	182.7	174.9	167.5	160.3	153.4
120	Capacity (Btu/hr)	47,178	54,515	62,681	71,726	81,742	92,816	104,959	118,351	133,037	149,147
	Flow Rate (lb/hr)	709	825	954	1,099	1,260	1,440	1,640	1,862	2,109	2,383
	Power (W)	7,739	8,277	8,825	9,381	9,941	10,500	11,052	11,592	12,114	12,612
	EER (Btu/watt hr)	6.1	6.6	7.1	7.6	8.2	8.8	9.5	10.2	11.0	11.8
	Pressure Ratio	7.8	7.0	6.3	5.6	5.1	4.6	4.1	3.7	3.4	3.1
	Discharge Temp (F)	241.1	229.7	219.4	209.9	201.1	192.8	185	177.5	170.4	163.5
130	Capacity (Btu/hr)	42,771	49,533	57,064	65,411	74,653	84,880	96,135	108,447	122,006	136,873
	Flow Rate (lb/hr)	680	792	919	1,060	1,219	1,395	1,592	1,809	2,051	2,321
	Power (W)	7,833	8,411	9,005	9,613	10,231	10,853	11,475	12,093	12,699	13,290
	EER (Btu/watt hr)	5.5	5.9	6.3	6.8	7.3	7.8	8.4	9.0	9.6	10.3
	Pressure Ratio	9.0	8.0	7.2	6.4	5.8	5.2	4.7	4.3	3.9	3.5
	Discharge Temp (F)	251.7	240.2	229.7	220.1	211.2	202.9	195.1	187.6	180.6	173.7
140	Capacity (Btu/hr)	38,499	44,697	51,603	59,257	67,737	77,115	87,442	98,786	111,173	124,801
	Flow Rate (lb/hr)	650	760	883	1,022	1,177	1,350	1,542	1,757	1,994	2,259
	Power (W)	7,890	8,506	9,143	9,800	10,471	11,153	11,841	12,531	13,218	13,896
	EER (Btu/watt hr)	4.9	5.3	5.6	6.0	6.5	6.9	7.4	7.9	8.4	9.0
	Pressure Ratio	10.3	9.2	8.2	7.4	6.6	6.0	5.4	4.9	4.5	4.1
	Discharge Temp (F)	262.5	250.7	240.1	230.4	221.4	213.1	205.2	197.8	190.8	184
150	Capacity (Btu/hr)	34,377	40,005	46,294	53,252	60,985	69,526	78,929	89,256	100,572	112,915
	Flow Rate (lb/hr)	620	727	848	983	1,135	1,304	1,493	1,703	1,937	2,196
	Power (W)	7,912	8,563	9,240	9,941	10,663	11,401	12,151	12,910	13,672	14,432
	EER (Btu/watt hr)	4.3	4.7	5.0	5.4	5.7	6.1	6.5	6.9	7.4	7.8
	Pressure Ratio	11.7	10.4	9.3	8.4	7.5	6.8	6.2	5.6	5.1	4.6
	Discharge Temp (F)	273.3	261.4	250.6	240.7	231.7	223.3	215.5	208.1	201.1	194.4

Table 5 — 05K 24 CFM, R-134a, 65 F Return Gas Temperature, 0 F Subcooling Performance Rating

SATURATED CONDENSING TEMP (F)		SATURATED SUCTION TEMPERATURE (F)									
		5	10	15	20	25	30	35	40	45	50
80	Capacity (Btu/hr)	41,372	47,367	53,913	61,016	68,736	77,138	86,260	96,158	106,899	118,578
	Flow Rate (lb/hr)	532	611	697	791	894	1,007	1,130	1,265	1,412	1,574
	Power (W)	3,995	4,171	4,336	4,488	4,628	4,755	4,868	4,966	5,049	5,115
	EER (Btu/watt hr)	10.4	11.4	12.4	13.6	14.9	16.2	17.7	19.4	21.2	23.2
90	Capacity (Btu/hr)	38,134	43,962	50,266	57,120	64,556	72,632	81,386	90,872	101,151	112,313
	Flow Rate (lb/hr)	514	593	680	775	879	992	1,116	1,252	1,400	1,563
	Power (W)	4,183	4,402	4,608	4,801	4,980	5,146	5,298	5,436	5,557	5,663
	EER (Btu/watt hr)	9.1	10.0	10.9	11.9	13.0	14.1	15.4	16.7	18.2	19.8
100	Capacity (Btu/hr)	34,678	40,329	46,445	53,048	60,177	67,929	76,317	85,390	95,206	105,848
	Flow Rate (lb/hr)	490	571	660	756	861	975	1,100	1,236	1,385	1,548
	Power (W)	4,328	4,596	4,849	5,087	5,311	5,520	5,715	5,894	6,058	6,206
	EER (Btu/watt hr)	8.0	8.8	9.6	10.4	11.3	12.3	13.4	14.5	15.7	17.1
110	Capacity (Btu/hr)	31,004	36,479	42,394	48,755	55,621	63,024	71,045	79,704	89,054	99,173
	Flow Rate (lb/hr)	462	545	635	732	838	953	1,079	1,217	1,367	1,531
	Power (W)	4,413	4,739	5,046	5,336	5,609	5,867	6,109	6,335	6,545	6,739
	EER (Btu/watt hr)	7.0	7.7	8.4	9.1	9.9	10.7	11.6	12.6	13.6	14.7
120	Capacity (Btu/hr)	27,102	32,426	38,126	44,251	50,837	57,938	65,559	73,802	82,683	92,273
	Flow Rate (lb/hr)	427	512	604	703	811	928	1,055	1,193	1,344	1,509
	Power (W)	4,422	4,816	5,186	5,535	5,866	6,178	6,473	6,750	7,011	7,254
	EER (Btu/watt hr)	6.1	6.7	7.4	8.0	8.7	9.4	10.1	10.9	11.8	12.7
130	Capacity (Btu/hr)	22,991	28,145	33,657	39,540	45,849	52,625	59,898	67,684	76,090	85,145
	Flow Rate (lb/hr)	385	472	566	668	777	896	1,025	1,164	1,317	1,483
	Power (W)	4,334	4,807	5,251	5,670	6,066	6,440	6,794	7,130	7,446	7,744
	EER (Btu/watt hr)	5.3	5.9	6.4	7.0	7.6	8.2	8.8	9.5	10.2	11.0
140	Capacity (Btu/hr)	18,684	23,690	28,998	34,644	40,665	47,113	54,009	61,393	69,308	77,784
	Flow Rate (lb/hr)	334	425	522	626	738	858	989	1,131	1,285	1,452
	Power (W)	4,122	4,691	5,222	5,722	6,194	6,640	7,061	7,461	7,840	8,199
	EER (Btu/watt hr)	4.5	5.1	5.6	6.1	6.6	7.1	7.6	8.2	8.8	9.5
150	Capacity (Btu/hr)	14,226	19,073	24,184	29,582	35,324	41,417	47,929	54,872	62,288	70,227
	Flow Rate (lb/hr)	274	368	468	575	690	813	946	1,090	1,246	1,415
	Power (W)	3,755	4,439	5,075	5,670	6,230	6,758	7,258	7,732	8,181	8,608
	EER (Btu/watt hr)	3.8	4.3	4.8	5.2	5.7	6.1	6.6	7.1	7.6	8.2

Table 6 — 05G 41 CFM, R-404A, 65 F Return Gas Temperature, 0 F Subcooling Performance Rating

SATURATED CONDENSING TEMP (F)		SATURATED SUCTION TEMPERATURE (F)						
		–30	–20	–10	0	10	20	30
80	Capacity (Btu/hr)	53,379	69,370	88,480	111,157	137,899	169,366	206,273
	Flow Rate (lb/hr)	813	1,062	1,362	1,723	2,157	2,676	3,301
	Power (W)	8,625	10,075	11,770	13,747	16,040	18,687	21,722
	EER (Btu/watt hr)	6.2	6.9	7.5	8.1	8.6	9.1	9.5
90	Capacity (Btu/hr)	49,323	64,487	82,536	103,928	129,108	158,684	193,314
	Flow Rate (lb/hr)	796	1,047	1,348	1,710	2,144	2,665	3,290
	Power (W)	8,714	10,188	11,901	13,892	16,197	18,853	21,896
	EER (Btu/watt hr)	5.7	6.3	6.9	7.5	8.0	8.4	8.8
100	Capacity (Btu/hr)	45,133	59,423	76,369	96,453	120,029	147,652	179,907
	Flow Rate (lb/hr)	777	1,029	1,331	1,695	2,130	2,651	3,276
	Power (W)	8,793	10,298	12,034	14,043	16,362	19,029	22,082
	EER (Btu/watt hr)	5.1	5.8	6.3	6.9	7.3	7.8	8.1
110	Capacity (Btu/hr)	40,799	54,183	70,016	88,715	110,616	136,211	166,025
	Flow Rate (lb/hr)	755	1,008	1,312	1,677	2,113	2,635	3,261
	Power (W)	8,856	10,400	12,166	14,198	16,535	19,216	22,281
	EER (Btu/watt hr)	4.6	5.2	5.8	6.2	6.7	7.1	7.5
120	Capacity (Btu/hr)	36,325	48,760	63,424	80,666	100,811	124,277	151,522
	Flow Rate (lb/hr)	728	984	1,290	1,656	2,093	2,616	3,244
	Power (W)	8,897	10,491	12,294	14,354	16,713	19,413	22,492
	EER (Btu/watt hr)	4.1	4.6	5.2	5.6	6.0	6.4	6.7
130	Capacity (Btu/hr)	31,690	43,106	56,506	72,210	90,459	111,686	136,196
	Flow Rate (lb/hr)	698	956	1,264	1,631	2,070	2,594	3,223
	Power (W)	8,906	10,563	12,412	14,508	16,895	19,617	22,714
	EER (Btu/watt hr)	3.6	4.1	4.6	5.0	5.4	5.7	6.0

Table 7 — 05K 24 CFM, R-404A, 65 F Return Gas Temperature, 0 F Subcooling Performance Rating

SATURATED CONDENSING TEMP (F)		SATURATED SUCTION TEMPERATURE (F)						
		–30	–20	–10	0	10	20	30
80	Capacity (Btu/hr)	32,531	43,045	59,182	82,791	115,131	157,285	210,303
	Flow Rate (lb/hr)	495	659	911	1,284	1,800	2,485	3,365
	Power (W)	4,808	5,501	6,511	7,824	9,335	10,909	12,405
	EER (Btu/watt hr)	6.8	7.8	9.1	10.6	12.3	14.4	17
90	Capacity (Btu/hr)	30,078	38,948	51,951	71,462	99,028	135,882	183,040
	Flow Rate (lb/hr)	486	632	849	1,176	1,645	2,282	3,115
	Power (W)	5,018	5,667	6,565	7,818	9,368	11,091	12,843
	EER (Btu/watt hr)	6	6.9	7.9	9.1	10.6	12.3	14.3
100	Capacity (Btu/hr)	27,194	35,583	46,173	61,921	84,889	116,418	157,675
	Flow Rate (lb/hr)	468	616	805	1,088	1,506	2,090	2,871
	Power (W)	5,143	5,885	6,689	7,833	9,350	11,148	13,090
	EER (Btu/watt hr)	5.3	6	6.9	7.9	9.1	10.4	12
110	Capacity (Btu/hr)	23,113	32,239	41,397	54,051	72,685	99,034	134,289
	Flow Rate (lb/hr)	427	600	776	1,022	1,388	1,916	2,638
	Power (W)	5,011	6,084	6,883	7,906	9,327	11,125	13,182
	EER (Btu/watt hr)	4.6	5.3	6	6.8	7.8	8.9	10.2
120	Capacity (Btu/hr)	18,003	28,210	37,049	47,426	62,266	83,707	113,111
	Flow Rate (lb/hr)	361	569	753	973	1,293	1,762	2,421
	Power (W)	4,555	6,129	7,103	8,050	9,341	11,067	13,161
	EER (Btu/watt hr)	4	4.6	5.2	5.9	6.7	7.6	8.6
130	Capacity (Btu/hr)	15,381	22,836	32,435	41,516	53,286	70,208	94,015
	Flow Rate (lb/hr)	339	506	725	938	1,219	1,631	2,225
	Power (W)	4,518	5,813	7,249	8,249	9,420	11,021	13,073
	EER (Btu/watt hr)	3.4	3.9	4.5	5	5.7	6.4	7.2

Speed Correction for Capacity and HP

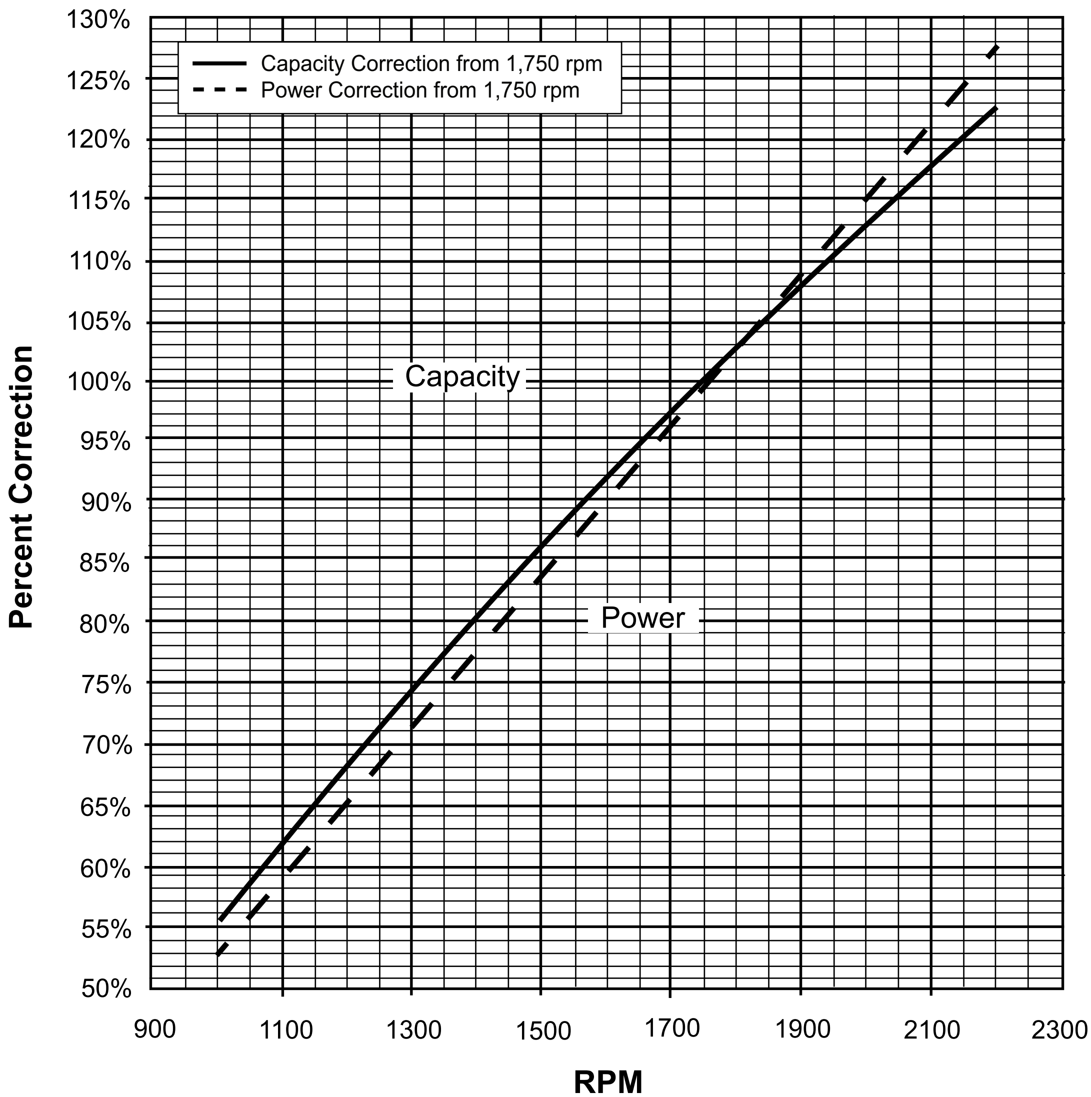


Fig. 12 — R-404A Speed Correction

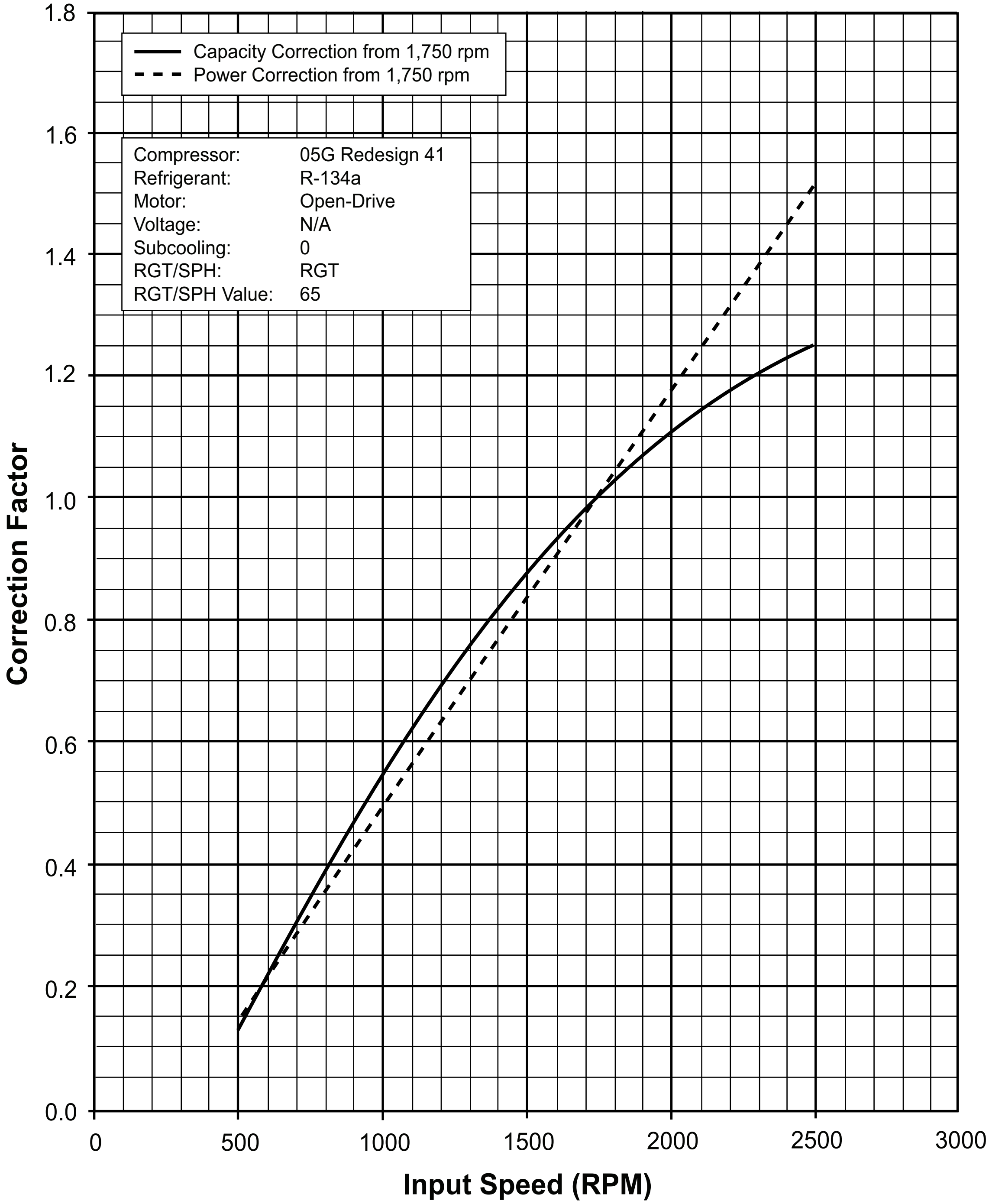


Fig. 13 — R-134a Speed Correction

Compressor Operating Envelope

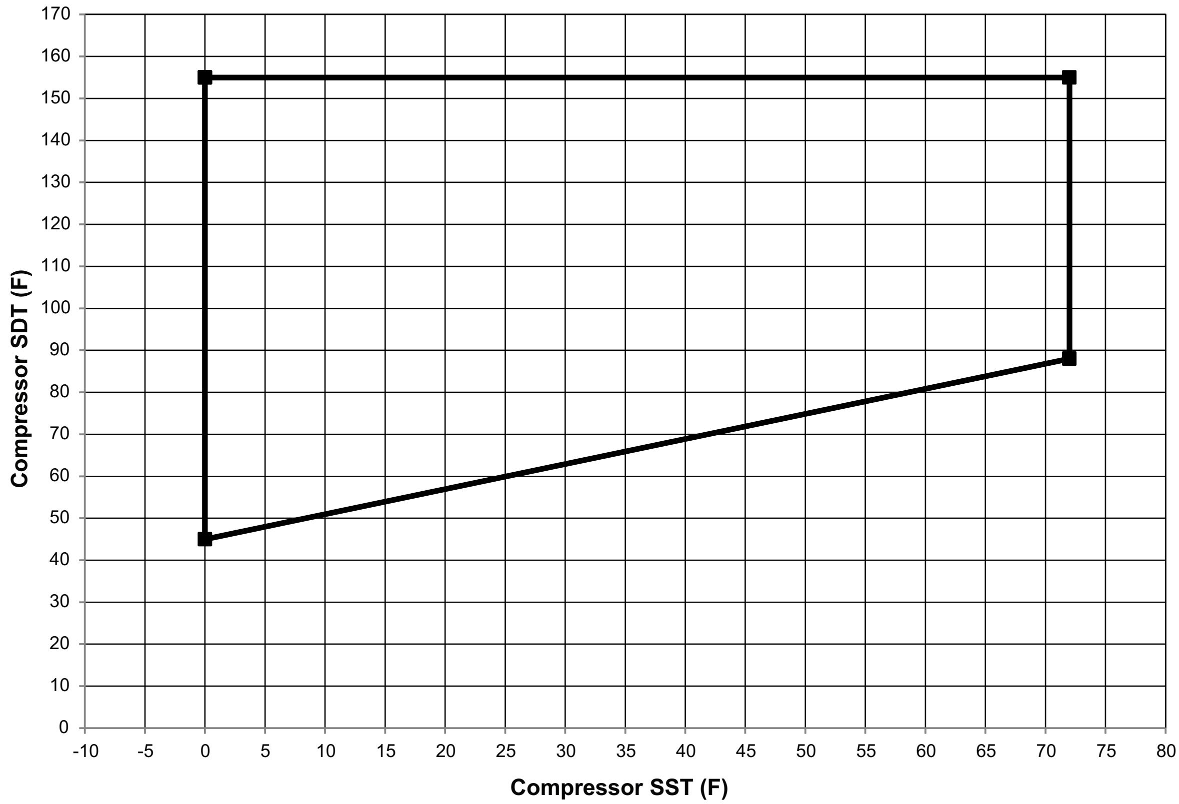


Fig. 14 — 05G/K R-134a Operating Envelope (Temperature)

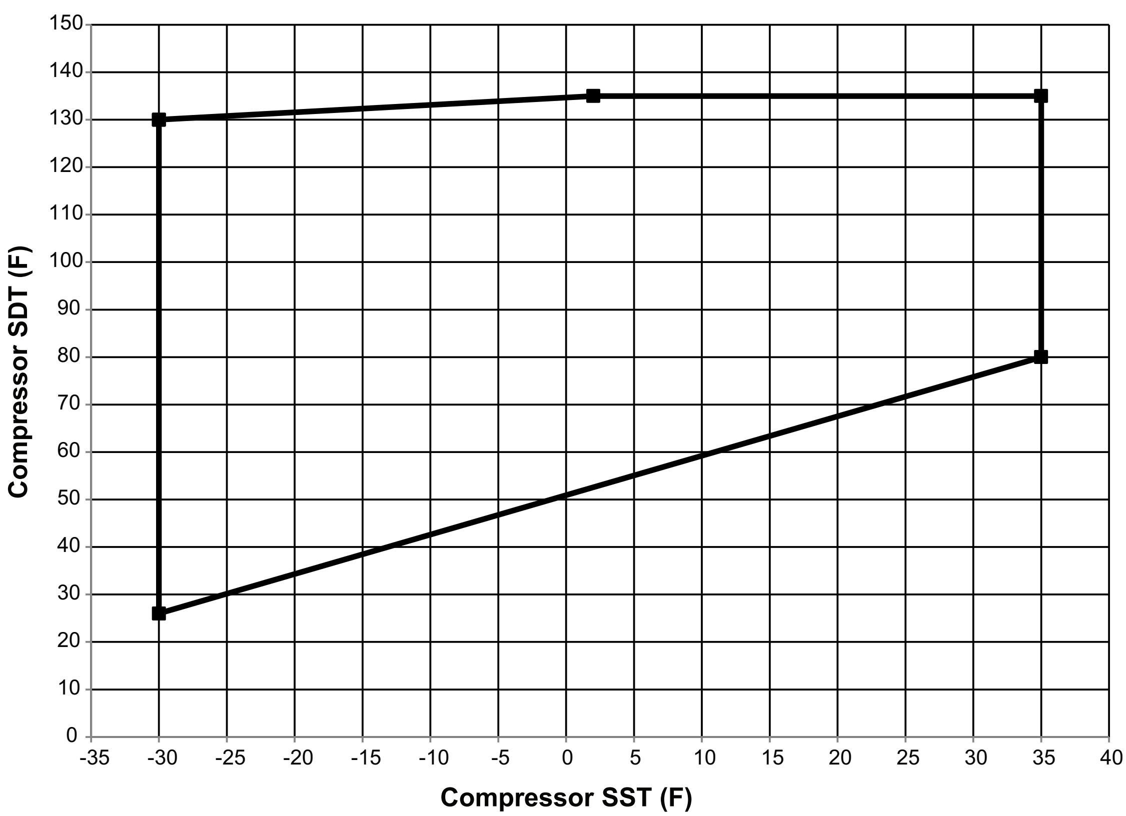


Fig. 15 — 05G/K R-404A Operating Envelope (Temperature)

LEGEND FOR FIG. 14 AND 15

SDT — Saturated Condensing Temperature
SST — Saturated Suction Temperature

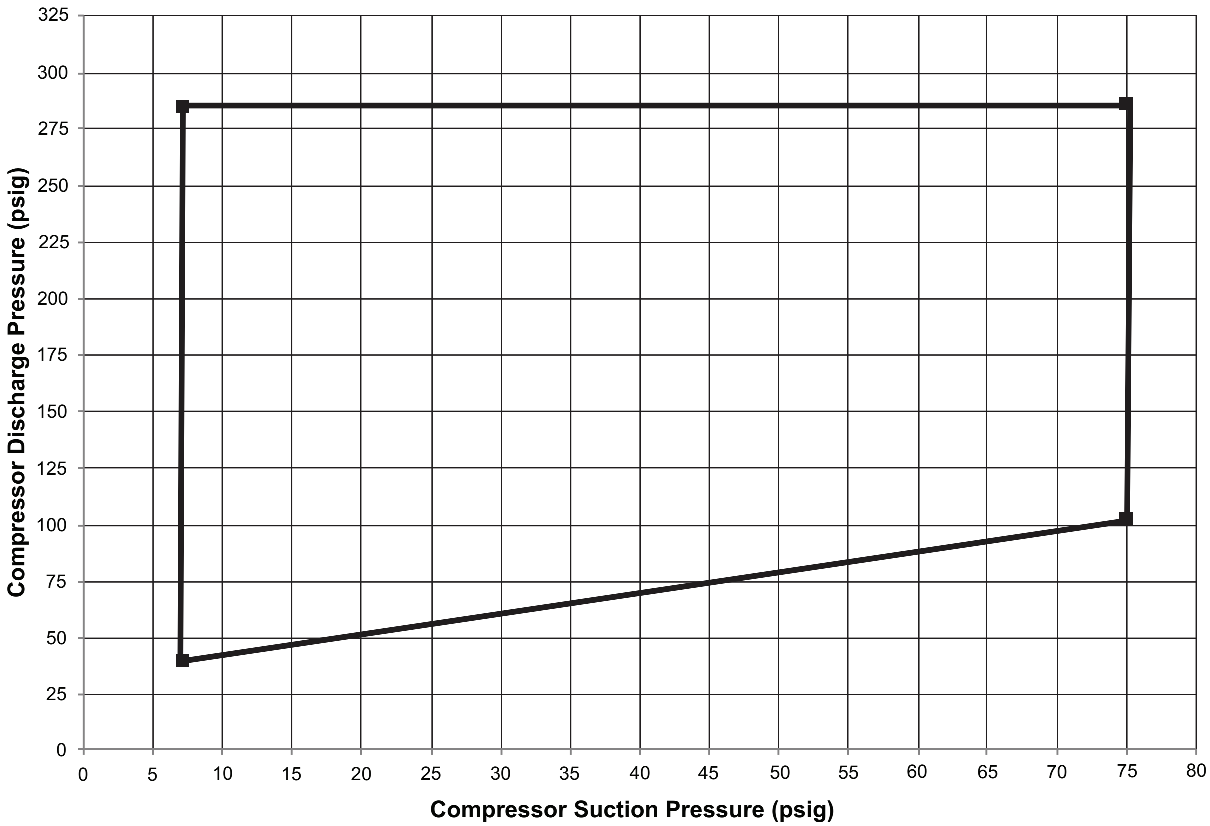


Fig. 16 — 05G/K R-134a Operating Envelope (Pressure)

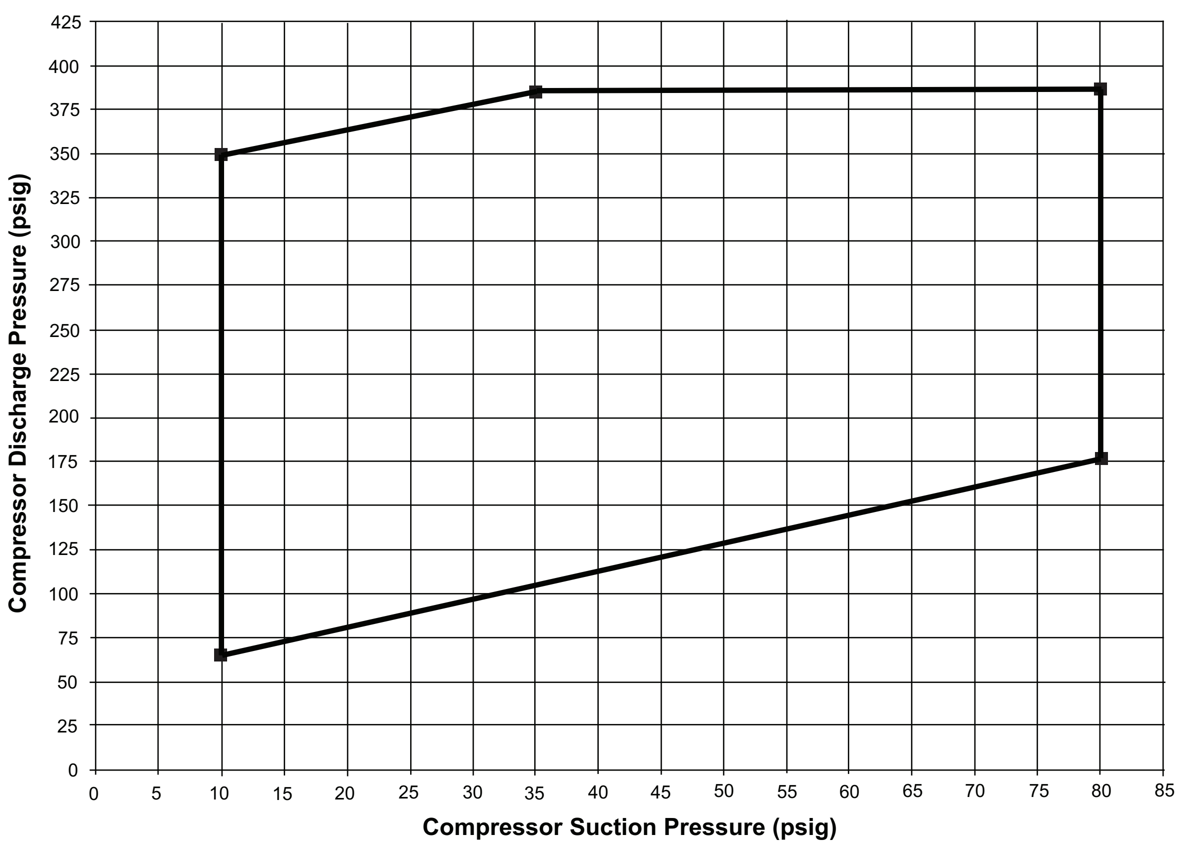


Fig. 17 — 05G/K R-404A Operating Envelope (Pressure)

6.0 Compressor Installation and Operation

Initial Inspection

1. Inspect compressor for shipping damage and file claim with shipping company if damaged or incomplete.
2. Check compressor nameplate for correct model designation.
3. Before installation, review all Carlyle compressor application literature to assure yourself that the proper compressor has been selected and is being applied in a proper manner. The required application literature is available through Carlyle.

Safety Instructions

⚠ WARNING

Failure to follow these instructions could result in serious injury.

1. Follow recognized safety procedures and practices.
2. Do not remove any compressor bolts or fittings until the factory-supplied holding charge has been relieved. Exhaust holding charge pressure through low-pressure connection (shown in Compressor Outline Drawings, Fig. 8-11) by removing the connection cap and depressing the internal disc.
3. Do not operate the compressor unless suction and discharge service valves are installed and opened.
4. Follow recommended safety precautions before attempting any service work on the compressor.

Initial Checks

Holding Charge

Compressor is factory supplied with a 5 to 15 psig (1.4 to 2 bar) charge of dry air. This internal pressure must be relieved before attempting to remove any compressor fitting or part. Relieve holding charge by removing the cap on the low-pressure connection fitting and depressing the internal disc. See Fig. 8 and 9 for applicable low pressure connection fitting location.

Service Valves

Remove valve pads and attach approved suction and discharge gaskets and service valves to the compressor. When brazing piping to valve, disassemble valve or wrap in a wet cloth to prevent heat damage.

Oil

1. Check to see that oil level is $^1/_3$ to $^1/_2$ of the way up on compressor sight glass before starting and after 15 to 20 minutes of operation. Compressors can be shipped with or without an oil charge based on the model type. All compressors must contain the specified oil charge prior to start-up as a condition of warranty.
2. To add oil: Relieve internal crankcase pressure, isolate crankcase, and add oil through the oil fill connection (see Compressor Outline Drawings). To remove excess oil: Reduce internal crankcase pressure to 2 psig (1.15 bar), isolate crankcase then loosen the oil drain plug allowing oil to seep out past the threads of the plug.

⚠ CAUTION

With the compressor crankcase under slight pressure, do not remove the oil drain plug as the entire oil charge could be lost. Do not reuse drained oil or oil that has been exposed to the atmosphere.

NOTE: When additional oil or a complete oil change is required, use only Carlyle approved oils.

Service Valves

⚠ CAUTION

Do not operate compressor unless suction and discharge service valves are open. Otherwise the high-pressure switch is tripped and turns the compressor off.

The suction and discharge service valves used on the compressor are equipped with mating flanges for connection to flanges on the compressor. These valves are provided with a double seat and a gauge connection, which allows servicing of the compressor and refrigerant lines (see Fig. 8).

Turning the valve stem counterclockwise (all the way out) will backseat the valve to open the suction or discharge line to the compressor and close off the gauge connection. In normal operation, the valve is backseated to allow full flow through the valve. The valve should always be backseated when connecting the service manifold gauge lines to the gauge ports.

Turning the valve stem clockwise (all the way forward) will front seat the valve to close off the suction or discharge line to isolate the compressor and open the gauge connection.

To measure suction or discharge pressure, midseat the valve by opening the valve clockwise about 2 turns. With the valve stem midway between frontseated and backseated positions, the suction or discharge line is open to both the compressor and the gauge connection.

Suction Strainer

All 05G and 05K compressors are equipped with a suction strainer located on the compressor side of the suction service valve. Do not remove or operate the compressor without the suction strainer installed.

Protective Devices

1. A discharge line check valve is recommend for preventing condensed refrigerant from migrating into the cylinder heads of an idle compressor.
2. A liquid line solenoid valve is recommend for preventing condensed refrigerant from migrating into the cylinder heads of an idle compressor.
3. Low and high pressure switches should be installed to maintain compressor operation within the operating enveloped in section Compressor Operating Envelope.
4. An oil differential switch should be installed and set to trip the compressor upon a minimum oil pump ΔP of 15 psid.

Mounting

NOTE: See Table 8 for proper torque values.

1. When lifting the compressor do not place strain on cylinder unloaders, pressure switches or miscellaneous small brass fittings. Use of heavy lifting straps is permitted around cylinder heads and the compressor crankcase itself.
2. Solid mounting is recommended for all 05G compressor installations as shown in Fig. 18. Mount the compressor using the front and rear foot supports in the compressor's base.
3. The compressor can be applied with a belt drive or direct drive system. Belt drive systems generally do not require the use of shock or spring mounts. The compressor maximum tilt angle, about the shaft center line, is 30 degrees. For belt drive installation use a spring loaded idler pulley to regulate belt tension. Do not exceed a belt tension greater than 300 lb (136 kg) (see Fig. 8 and 9). Possible damage to the compressor's bearings and shaft will occur if exceeded. Tension the belts according to the recommendations from the manufacturer. Use only V-belts of the same length and as a banded set for a multi-belt application. An electromagnetic clutch pulley (Warner Electric or Linnig) has been specifically designed to install on the clutch hub of the 05G compressor. Use only Carlyle approved clutches. Consult OEM for clutch/pulley installation details.
4. Use only pipelines which are clean and dry inside, free from rust and process oils. Connect compressor with flexible lines, hard piping will result in eventual refrigerant leak due to operating vibrations, if the compressor is installed in a mobile/transport application.

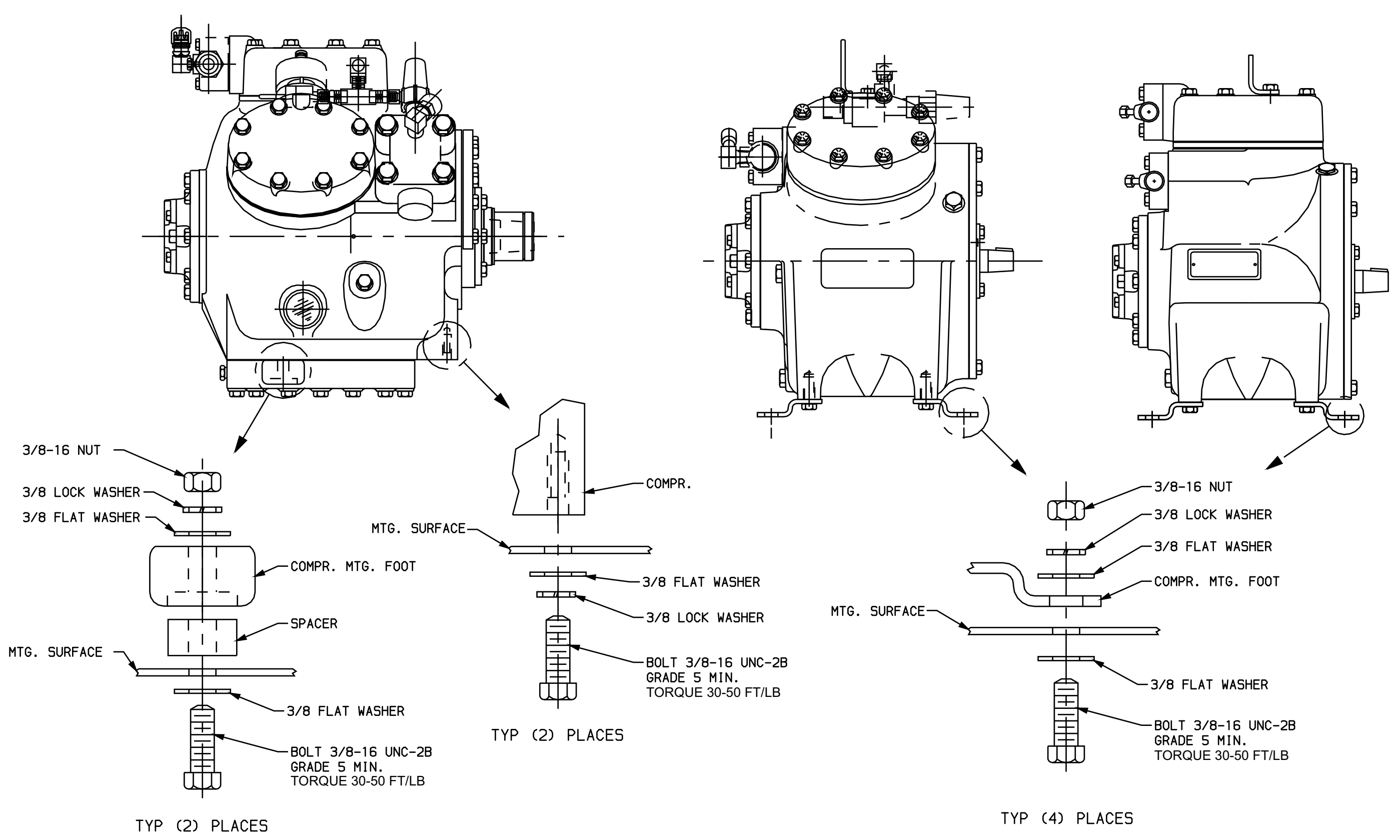


Fig. 18 — Mounting

Torque Values

Table 8 — Torque Values

SIZE DIAMETER (INCHES)	THREADS PER INCH	TORQUE RANGE		USAGE
		ft-lb	mkg	
$^{1}/_{16}$	27 (pipe)	5.5 to 7	0.8 to 1.0	Crankshaft Center Web Plug
$^{1}/_{8}$	27 (pipe)	8 to 16	1.1 to 2.2	Oil Return Check Valve, Crankcase
$^{7}/_{16}$	20	8 to 14	1.1 to 1.9	Oil Fill / Drain Plug
$^{1}/_{4}$	20 (pipe)	20 to 25	2.8 to 3.5	Pipe Plug, Gage Connection
$^{1}/_{4}$	20	8 to 12	1.1 to 1.7	Connecting Rod Cap Screw
		10 to 13	1.4 to 1.8	Connecting Rod Counter Weight
$^{1}/_{4}$	28	5.5 to 7	0.8 to 1.0	Crankshaft Setscrew
		8 to 18	1.1 to 2.5	Unloader Valve
		12 to 16	1.7 to 2.2	Discharge Valve Backer
$^{5}/_{16}$	18	16 to 20	2.2 to 2.8	Cover, Oil Pump
		20 to 30	2.8 to 4.1	Discharge Service Valve
$^{3}/_{8}$	16	8 to 15	1.1 to 2.1	Bottom Plate, Crankcase
		30 to 50	4.1 to 6.9	End Flange, Crankcase
				Shaft Seal Cover
				Pump End Bearing Head
		42 to 55	5.8 to 7.6	Cylinder Head
$^{1}/_{2}$	13	55 to 80	7.6 to 11.1	Suction Service Valve
$1^{1}/_{2}$	18 NEF	35 to 50	4.8 to 6.9	Oil Level Sight Glass

LEGEND

NEF — National Extra Fine

Carlyle™

Manufacturer reserves the right to discontinue, or change at any time, specifications or designs and prices without notice and without incurring obligations.

P.O. Box 4808 • Syracuse, New York 13221
www.carlylecompressor.com
In U.S. and Puerto Rico: 1-800-GO-CARLYLE (1-800-462-2759)
In Canada: 1-800-258-1123
In Mexico: 001-800-GO-CARLYLE (001-800-462-2759)

Lit. No. 574-071
Rev. B
(9/2021)