

AE21-1222 R1

February 1984
Reformatted October 2010

External Capacity Control Valves for 9R and 9D Motor Compressors

On refrigeration and air conditioning applications where the refrigeration load may vary over a wide range, some means of compressor capacity control is necessary for satisfactory system performance. Compressor capacity modulation can reduce power consumption, provide continuous dehumidification, reduce compressor cycling, and decrease the starting load.

For Copeland® three cylinder compressors, a solenoid operated external bypass valve is available for high temperature applications. The capacity control assembly can be factory installed on production compressors, or is available in kit form for field installation.

The capacity control mechanism operates to unload one cylinder of the three, giving a capacity reduction of approximately 35% with a power reduction of approximately 20% from a fully loaded operating condition.

The Flow Controls valve is of cast bronze construction, with a flanged access plate. The basic operation of the valve is shown in **Figure 1** and **Figure 2**.

Application

Copelametic® compressors with external capacity control have a bypass valve so arranged that the unloaded

cylinder is isolated from the discharge pressure created by the loaded cylinders. The bypass valve connects the discharge ports of the unloaded cylinder to the compressor suction chamber. Since the piston and cylinder do no work other than pumping vapor through the bypass circuit, and handle only suction vapor, the problem of cylinder overheating while unloaded is practically eliminated. At the same time, the power consumption of the compressor motor is greatly reduced because of the reduction in work performed. The reduced power consumption and better temperature characteristics of this type of unloading are major advantages over external hot gas bypass unloading where all cylinders of the compressor are working against condensing pressure.

Because of the decreased volume of suction vapor returning to the compressor from the system and available for motor cooling, the operating range of unloaded compressors must be restricted. In general, Copeland® compressors with external capacity control are recommended only for high temperature applications, and the evaporating temperature should be limited to a minimum of 25° F. when operating unloaded.

Because of the danger of overheating the compressor motor, compressors with unloaders are not recommended on low temperature systems, and if compressor cycling

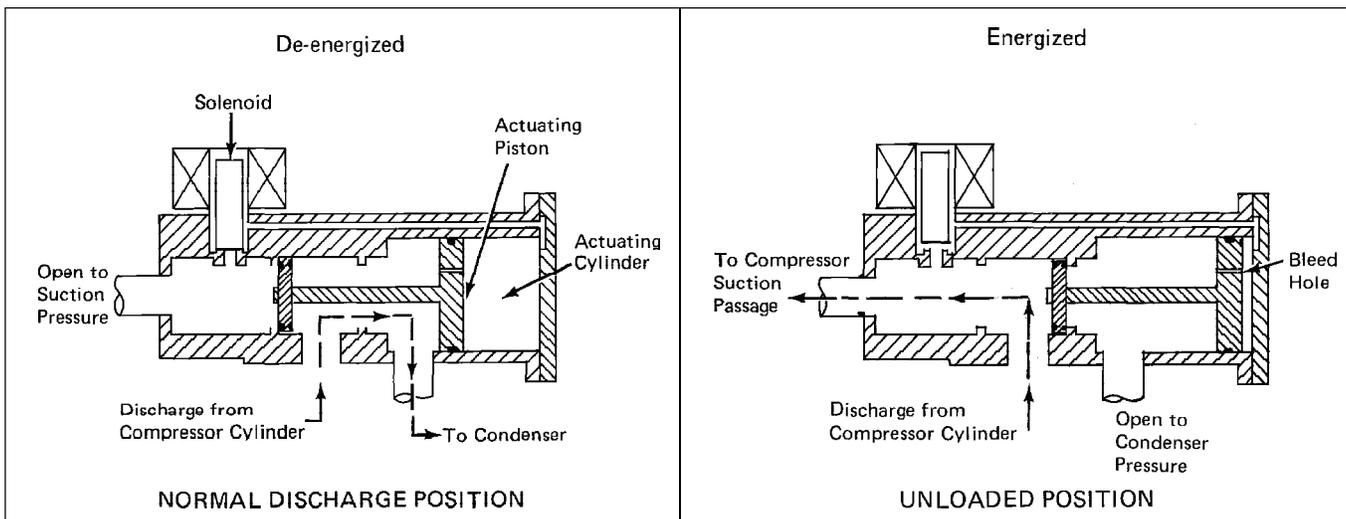


Figure 1

Capacity Control Valve

Figure 2

is not acceptable, a hot gas bypass system should be employed as a means of capacity reduction.

When an unloading valve in an operating system is switched from the loaded to the unloaded position, or vice versa, a new system balance takes place. In air-cooled systems the suction pressure will rise and the condensing pressure will drop. In water-cooled systems the suction pressure will rise, but the condensing pressure will remain substantially the same.

The pressure or temperature control should have as wide a differential as necessary to prevent rapid cycling of the unloading valve. A wider differential will be required with the pressure control method than the temperature control method because of the thermal mass (or flywheel effect) of the cooled medium.

The capacity control valve is in the normal discharge position (loaded) when de-energized, and in the unloaded position when energized. The solenoid valve may be energized either by means of a reverse acting low pressure control or a temperature control thermostat.

The Flow Controls capacity control valve is pilot operated, and so long as the pilot solenoid valve is energized, a continuous bleed through the pilot passage from the high pressure side to the low pressure side continues. **Therefore for a pump-down control system, the Flow Controls pilot solenoid valve must be de-energized** to prevent the suction pressure from immediately building up. On systems without pumpdown control, the continued flow of refrigerant gas from the condenser back to the compressor could result in condensation in the compressor, and possible damage to the compressor on start up, and therefore it is recommended that the capacity control valve be de-energized when the compressor is not operating.

Field Service and Conversion

WARNING - DANGER:

Service replacement Copelametic® motor-compressors with provisions for external capacity control are shipped less capacity control valves, with a flange adapter covering the discharge port on top of the head.

Do not operate a service replacement unloading compressor without first installing the external unloading assembly. There is no provision internally for escape of the high pressure gas from the unloading cylinder head, and without the external unloading assembly dangerous pressures can be created which could result in possible injury to the operator.

In the event unloading operation is not desired on a cylinder bank equipped with a head designed for unloading, both the cylinder head and gasket must be replaced.

Occasionally when field replacements are required for compressors equipped with unloading valves, the exact replacement model may not be available, and compressor heads may be changed in order to utilize available stock compressors. The proper head to valve plate gasket **MUST BE USED** to insure proper operation.

The webbing in the capacity control gasket blocks off the normal discharge port. If the improper gasket is used, leakage from the discharge port can flow directly back into the suction chamber, causing compressor overheating.

9R Copelametic® Compressors

On conventional 9R compressors, the head is divided into suction and discharge chambers by a center web. For capacity control models, one cylinder in the discharge chamber is isolated by an unloading head and gasket, so that the unloading cylinder may discharge either to the discharge line for fully loaded operation, or to the suction chamber for unloaded operation.

Figure 3 and **Figure 4** illustrate the head and gasket construction.

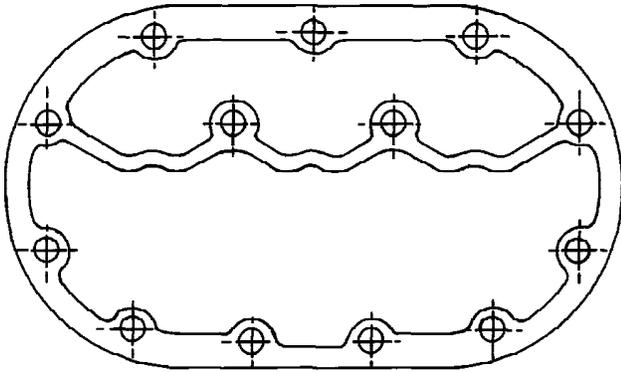


Figure 3
Typical Standard Head Gasket and Head for 9R Compressor

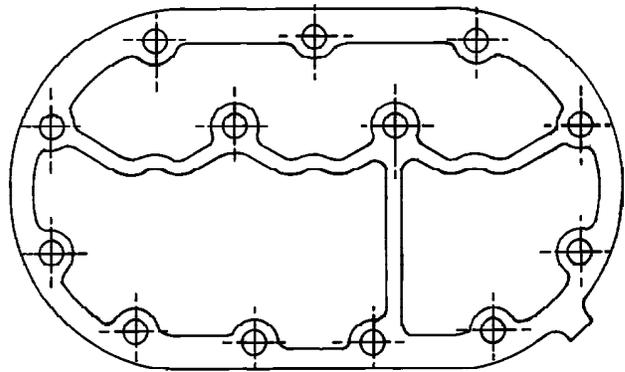


Figure 4
Typical Capacity Control Head Gasket and Head for 9R Compressor

Table A
9R Capacity Control Conversion Kits

Description	9R - 10 H.P.	9R - 15 H.P.
Head Discharge (1015, 1505)		
Conversion kits contain all necessary parts including solenoid coil		
with 24 volt coil	998-0017-07	998-0017-10
with 120 volt coil	998-0017-08	998-0017-11
with 240 volt coil	998-0017-09	998-0017-12
Body Discharge (1010, 1500)		
Conversion kits contain all necessary parts except solenoid coil.		
Solenoid coils:		
24 volt	023-0037-00	023-0037-00
120 volt	023-0037-01	023-0037-01
240 volt	023-0037-02	023-0037-02
440 volt	023-0037-03	023-0037-03

9D Discus Compressors

Since the entire head of the Discus® compressor is exposed to discharge pressure, one cylinder must be isolated for unloading by means of a special head and gasket. There is no change in the valve plate. **Figures 5, 6, 7, and 8** illustrate the head and gasket construction.

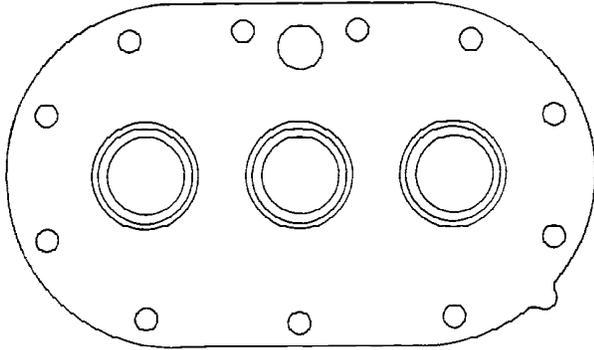


Figure 5
9D Discus Valve Plate

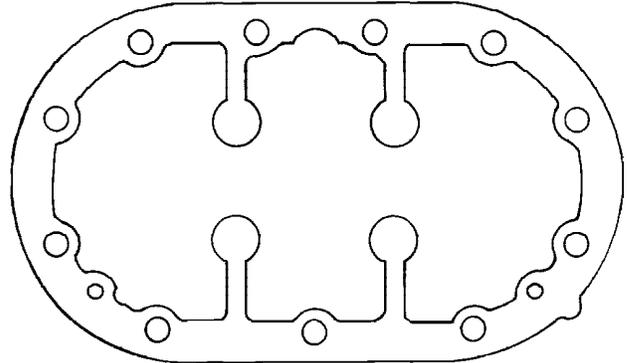


Figure 6
Standard 9D Discus Head Gasket and Head

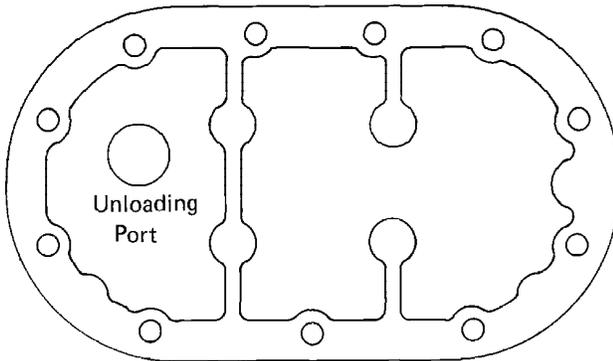


Figure 7
9D Discus Head for Capacity Control

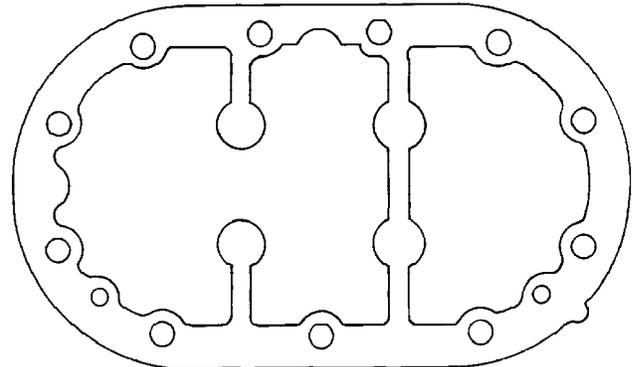


Figure 8
Head Gasket for 9D Capacity Control Models

Table B
9D Discus Capacity Control Conversion Kits

Description	9D - 10 & 15 H.P.
<p>Head Discharge</p> <p>Conversion kits contain all necessary parts including solenoid coil,</p> <p>with 24 volt coil with 120 volt coil with 240 volt coil</p>	<p>998-0017-04 998-0017-05 998-0017-06</p>