JET KOOL

Jet Kool Installation & Operation Manual

1.0 Jet Kool System

1.1 Description

Jet Kool is the latest development of a safe and efficient means to perform oil cooling on Bitzer screw compressors utilizing system refrigerant. Liquid refrigerant is supplied by the condenser liquid return line through a primary receiver to the inlet side of a plate heat exchanger, designed for oil cooler duty. The return line from the plate heat exchanger is connected to the jet pipe nozzle connection, located in the discharge line of the refrigeration system. The purpose of the jet pipe is to create a lower pressure in the Jet Pipe than in the discharge line entering the Jet Pipe, providing a positive flow of refrigerant vapor back to the condenser. The jet pipe provides an adequate pressure differential to operate the oil system and overcome the normal refrigerant pressure drops found in the discharge line, refrigerant condenser and liquid return line. Jet Kool does not affect compressor performance or capacity, since the refrigerant used for oil cooling purposes does not influence the suction side of the system or the mass flow pumped by the compressor.

Refrigerant oil from the oil separator passes through the plate heat exchanger to the compressor oil circuit. Oil heat is transferred in the plate heat exchanger to the system refrigerant and sent to the condenser. The oil, refrigerant and compressor loads make up the total heat of rejection in the screw compressor.

Compressor discharge temperatures are monitored by the ESC 201 at each compressor discharge or on the common header for some parallel systems. Based on system demand the ESC 201 provides a 0–24 VDC signal to a refrigerant control device, located in the liquid refrigerant line, feeding the plate heat exchanger. This refrigerant control device provides the proper amount of liquid refrigerant to the plate heat exchanger inlet, maintaining the precise oil temperature to furnish a safe compressor discharge temperature.

The proper control of compressor discharge temperature is essential to a safe operation of the compressor. Discharge temperature must be maintained at 50°F above condensing temperature to prevent liquid form condensing in the discharge line or oil separator. If gas is condensed into a liquid prematurely in the discharge system, liquid will be returned in the compressor oil system, causing compressor-bearing damage. The Jet Kool oil cooling system should be set to control the discharge temperature at 180°F.

2.0 Jet Kool Components

2.1 Listed below are the Jet Kool kit components provided with Jet Kool.

A. Jet Pipe
B. Plate Heat Exchanger
C. Liquid Flow Control Valve
D. 1 ¾"-12 x 1 3/8" O.D.S. Fitting (4)
E. 1 3/8" Rotolock Valve
F. Primary Receiver and Bracket
G. Liquid Check Valve

2.2 Listed below are additional components required, not supplied with Jet Kool.

I. Liquid Sight Glass (Additional sight glass optional in pipe P4)
J. Isolation Ball Valves (3 required)
K. Access Fittings (5)
L. Discharge Ball Valves

3.0 Jet Kool Piping Specifications

3.1 Minimum Condenser Height

The below listed pipe specifications are in accordance with **Jet Kool Flow Diagram** (section 21.0) of this manual. The vertical height distance from the bottom of the condenser liquid outlet to the plate heat exchanger refrigerant inlet must be a **minimum of 6 FT*.***

3.2 Primary Jet Cool Condenser Line (P1)

All pipes, valves and fittings exiting the jet pipe must remain the same size as the jet pipe outlet diameter or a combination of multiple pipes, valves, and fittings totaling the equivalent cross sectional area of the jet pipe outlet.

3.3 Split Condenser Line (P2)

If split condenser is required, the split valve outlet cross sectional areas must total the cross sectional area of the jet pipe outlet. The full condenser side discharge pipe exiting the split valve must not be smaller than the total cross sectional area of the jet pipe outlet.

Example: If the Jet Pipe outlet is 2 1/8" in diameter, both discharge lines after the split valve must be a minimum of 2 1/8" in diameter.

3.4 Oil Cooler Liquid Line (P3)

Liquid line from the primary receiver feeding the plate heat exchanger refrigerant inlet must have a shut-off valve (Rotolock or Ball), sight glass, low-pressure drop liquid check valve (supplied), access fitting and refrigerant flow control in this sequence. These components must be sized in accordance with table 1.1.

Table 1.1

Maximum Oil Cooling Capacity (KBTU'S)		Minimum Line/Connection
R-22	R404A/507	Size
0-250		1 1/8" OD
	0-160	1 1/8" OD
250-400		1 3/8" OD
	160-250	1 3/8" OD

3.5 Oil Cooler Vapor Return Line (P4)

The refrigerant outlet from the plate heat exchanger to the jet pipe nozzle inlet must be as short as possible with the least amount of elbows keeping this pressure drop to a minimum. This line must have an isolation ball valve, (optional sight glass), and access fitting in this sequence with a 1 3/8" line size, corresponding to the Jet Pipe Nozzle Rotolock size of 1 3/8 OD.

3.6 Hot Oil Feed Line (P5)

The oil inlet to the plate heat exchanger must be sized according to table 1.2 listed below with an access fitting.

Table 1.2

Number of compressors	Oil line size OD.
1-2	1 1/8"
3-4	1 3/8"
5-6	1 5/8"

3.7 Cool Oil compressor Feed Line (P6)

The oil outlet from the plate heat exchanger must also be sized in accordance to table 1.2 with an access fitting and isolation ball valve in this sequence.

4.0 Jet Kool Component Specifications

4.1 Jet Pipe Description

Jet pipes are available in one series, “HR 66”. If the capacity range of the system exceeds the maximum pipe capacity, then more than one pipe may be required. The pipe is constructed of aluminum with flanged braze connectors. The series “HR 66” has a 2 1/8” inlet & outlet and a 1 ¾ -12 (1 3/8”) rotolock connector at the nozzle. Access fittings are provided at the outlet of the jet pipe for reading this pressure. Access fittings are also required at the pipe inlet & nozzle inlet during installation for the same purpose. Diameter of the inlet and outlet discharge line at the Jet pipe must remain the same size as the Jet pipe inlet and outlet size.

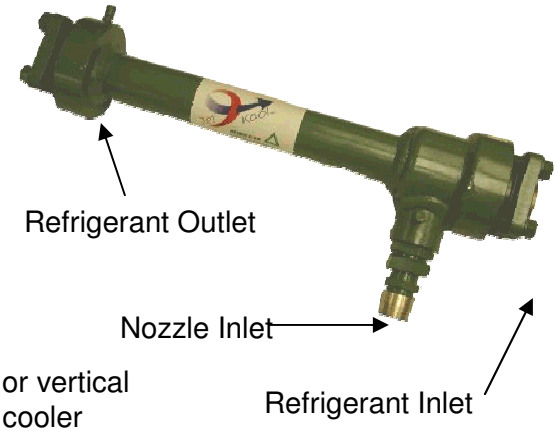
Reference (Jet Kool Flow Diagram, section 21.0)

The jet pipe is placed in the discharge line in position P1. The Jet pipe must be installed after the last heat reclaim valve or pressure differential valve and before the split condenser valve. When piping the jet pipe into the system, a few considerations should be adhered to for positive operation of the JET Kool System.

1. **Do not** reduce the pipe size from the outlet of the jet pipe to the inlet of the condenser, including the split condenser valve sizing.

2. If a ball valve is required between the jet pipe and the condenser, insure that this valve is full ported. Any reduction in line or port sizes from the outlet of the jet pipe to the inlet of the condenser will affect the performance of Jet Kool.

3. Access fittings must be installed on the Jet Pipe refrigerant inlet and the nozzle inlet. These fittings are required to check the performance of the Jet Pipe.

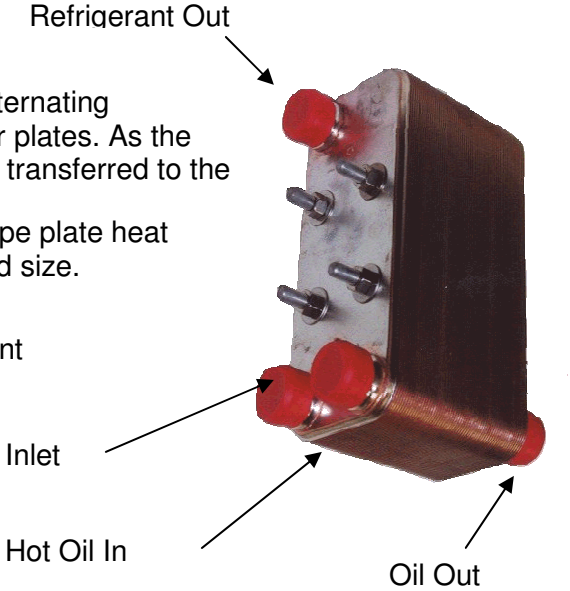


4. Placement of the Jet Pipe can be either in the horizontal or vertical positions. The pipe nozzle should be pointing toward the oil cooler refrigerant outlet to eliminate additional elbows.

4.2 Oil Cooler Plate Heat Exchanger Description

The plate heat exchanger is a brazed plate device with alternating refrigerant and oil passages separated by heat exchanger plates. As the refrigerant and oil past each other, the heat from the oil is transferred to the refrigerant. Both two pass and single pass counter flow type plate heat exchangers are utilized, depending upon the required load size.

Four mounting studs are provided for mounting the heat exchanger on the rack. Fluid connections for the refrigerant and oil are 1 ¾”-12 male Rotolock connectors.



The two pass oil coolers have the refrigerant connections vertically opposed while the oil connections are on opposite sides. The refrigerant inlet is on the lower left connector, with the refrigerant outlet on the upper left connector. The oil inlet & outlet connections are interchangeable. Single pass oil cooler connection fittings are located on the same side of the heat exchanger. These must be piped in a counter flow configuration with the refrigerant inlet on the lower left and the oil outlet on the lower right (Figure not shown). Reference (Jet Kool Flow Diagram, section 21.0)

The plate heat exchanger is piped between refrigerant side positions P3 and P4 and the oil side positions P5 & P6. The plate is to be mounted on lowest possible position of the rack frame in an area directly below the jet pipe (if this is not possible please consult the factory). This position will allow for a short refrigerant return line from the plate outlet to the jet pipe nozzle inlet (P4 piping configuration).

4.3 Liquid Flow Control Operation

Description

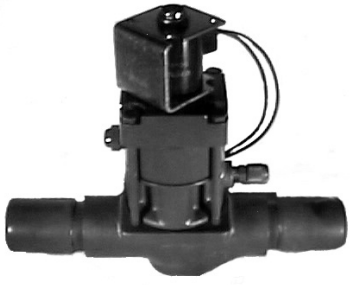
A flow control valve (JKV-100) is used to control the amount of refrigerant flow to the plate heat exchanger. The discharge temperature requirement determines the volume of refrigerant required to performing oil cooling. A 0-22 VDC signal is sent to the flow control valve from the ESC 201. The ESC 201 also monitors the discharge temperature by using either the PT 1000 sensor mounted in the compressor discharge or the rack sensor mounted on the discharge header.

ESC 201 Configuration

Proper configuration of the ESC 201 is essential to the correct Jet Kool operation. When the discharge temperature is sensed at each compressor discharge port, the **"Temperature Probe"** function in the ESC 201 must be configured as **"PT1000"** and the **"Jet Kool Temperature"** function must be assigned as **"Compressors"**. When the **"Temperature Probe"** function is configured as **"PTC"**, a single high temperature probe must be installed on the discharge header and the **"Jet Kool Temperature"** function must be assigned as **"Rack Sensor"**. The valve position and refrigerant flow are contingent upon this voltage signal. The constant control of oil temperature maintains the necessary discharge temperature setting.

Reference (Jet Kool Flow Diagram, section 21.0)

The flow control must be placed as close as possible to the plate heat exchanger refrigerant inlet and after check valve (H) in pipe P3. The valve should be properly supported and mounted in a location where physical contact and condensation will not affect the life or performance of the valve. The flow valve should be positioned in the same plane as, or above the heat exchanger refrigerant inlet to prevent a negative effect on any liquid head advantage.



4.4 JKV 100 Ana-loid Valve

The JKV 100 Ana-loid valve manufactured by Parker is used to meter refrigerant to the Jet Kool plate heat

exchanger. This valve is operated from the ESC 201 control which receives a 0 –22 VDC signal. The valve modulates from full open to 90% closed controlling the amount of refrigerant flow to the heat exchanger. JKV 100 has a ductile iron valve body with 1 3/8" copper braze fittings.

4.5 JKV 100 Ana-loid Coil

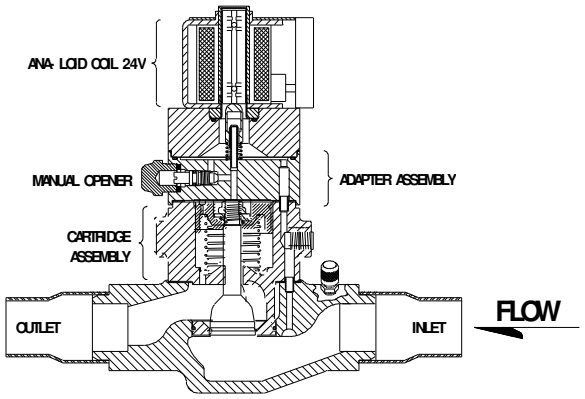
Positioning of the Ana-loid 24V coil on the valve stem is extremely important. The coil must be placed on the stem with the coil base flat against the valve housing. A screw is provided to secure the coil to the valve. This screw must be in place or the valve will not properly operate. If the screw is not in place the coil will travel up on the plunger, preventing the valve from opening and closing.

4.6 Setting Manual Oil Cooling

In the event of electronic component failure of either the JKV 100 coil or the ESC 201, the JKV 100 can be manually operated by the manual opener located on the downstream side of the valve in the adapter assembly. Remove the seal cap covering the manual opener screw on the adapter assembly.

The Ana-loid valve can be adjusted with the manual opener screw from closed to fully open with one full turn counter-clockwise. Adjustments between open and closed can control the flow through the valve to achieve the proper discharge temperature when operating in the manual mode. A discharge temperature of **150°F – 155°F** is desired while operating in the manual mode.

To set this temperature, turn the manual opener 1/3 of a turn counter-clockwise and allow the temperature to stabilize. If the temperature has not been achieved a second and third adjustment may be required.



Specifications

Ana-loid Coils Voltage	24VDC
Design Pressure	450 PSIG
Maximum Power	7 Watts

4.7 Oil Cooler Fittings

Description

Four 1 ¾" – 12 X 1 3/8" ODS rotolock adapter fittings are supplied to connect refrigerant and oil lines to the plate oil cooler. An additional fitting may be supplied to connect the primary liquid refrigerant outlet to pipe P3, if the customer prefers a ball valve in place of a rotolock valve.

4.8 Primary Receiver Shut off Valve

Description (Jet Kool Flow Diagram, section 21.0)

A steel 1 3/8” rotolock valve is supplied for mounting on the bottom of the primary receiver. This valve is used to shut off refrigerant and isolate the liquid flow control valve located in pipe P3. A ball valve can also be utilized for this application as a customer preference.

4.9 Primary Receiver

Description (Jet Kool Flow Diagram, section 21.0)

A steel receiver is provided as a refrigerant reservoir to be installed in the system condensate drain line. This receiver provides a solid column of liquid to the plate oil cooler to insure positive heat transfer. Receiver is a flow through vessel holding approximately 3 gallons of liquid. A ½” NPT port is provided in the top dome for installation of a pressure relief valve. Valve type and relief setting is dependent on system refrigerant. Relief valve is not supplied in the jet Kool Kit.

4.10 Liquid Check Valve

Description (Jet Kool Flow Diagram, section 21.0)

Check valve is a Muller model # B34237 with less than ½ lb. pressure drop. This valve insures the refrigerant flow direction cannot reverse during pressure changes or surges. The valve is a full-ported 1 3/8” with 1 3/8” ODS. inlet and outlet connections. DO NOT SUBSTITUTE COPPER SPUN BALL CHECK VALVES. These valves normally have pressure drops that exceed the system specifications.

4.11 Liquid Sight Glass

Description (Jet Kool Flow Diagram, section 21.0)

A 1 3/8” ODS liquid sight glass is required in line P3 to make sure a solid column of liquid is present at all times. An optional sight glass of the same line size as P4 may be placed in this line.

4.12 Isolation Ball Valves

Description (Jet Kool Flow Diagram, section 21.0)

Ball valves are required in lines P3, P4 and P6 to isolate the plate oil cooler, if replacement is required. These ball valves will also permit servicing of the Ana-loid valve. It is strongly recommended that ball valves be placed in line P1 before and after the Jet Pipe. Along with the ball valve in line P4, the valves in line P1 will accommodate the removal of the Jet Pipe for changing the nozzle.

4.13 Access Fittings

Description (Jet Kool Flow Diagram, section 21.0)

Five ¼” access fittings with cores are required in lines P3 (2), P4, P5, and P6 to qualify and troubleshoot the system.

5.0 Troubleshooting the Jet Kool system

Troubleshooting the Jet Kool system

Problem	Possible Solution
1. System will not operate during hot gas defrost	1. If hot gas or cool gas defrost system has a master liquid line valve (pressure differential valve) it is highly possible the condenser hot gas is being circumvented and not supplying adequate hot gas to supply liquid to the primary receiver
2. System will not control the discharge system temperature	2. Refrigerant charge is low and not feeding liquid to the promary receiver, supplying a solid column of liquid to the oil cooler. **The liquid system cannot have any gas bubbles.** 2A. Check the JKV 100 liquid valve to ensure it is opening properly. Suggest the valve be manually opened if there is any doubt about the valve operation. 2B. Check to make sure the liquid line from the condenser feeding the primary receiver falls from the condenser to the receiver. The liquid return line must fall without any risers to the receiver or to the oil cooler from the outlet of the primary receiver.
3. System operated for a long time and then stopped working	3. Check for low refrigerant charge. 3A. Check system set points to make sure they have not been lowered. Jet Kool systems have been calculated on a specific set of system set points. If the mass flow has been lowered this will affect the oil cooling required and the Jet Pipe performance.

4. JKV 100 valve is not receiving an electrical signal.	4. Check master ESC201 to insure a signal is being sent from the Jet Kool terminals. 4A. Make sure ESC201 master has been configured for Jet Kool in the set-up program. 4B. Check ESC201 for the proper discharge temperature probe set-up. If each compressor's temperature is used to calculate the discharge temperature, the "Jet Kool Temperature Source" should be set to "Compressors". If a single probe is used on the compressor equipment, the "Jet Kool Temperature Source" should be set to "Rack". Also check the "Jet Kool Target Temperature" for the proper setting.
5. Jet Kool will not work in split condenser.	5. Check to see if discharge lines are the same size out of the split valve as they are out of the Jet Pipe. These lines must not be reduced out of the split valve (Jet Pipe must be a minimum of 2-1/8" OD from the Jet Pipe outlet to the condenser inlet). Both discharge lines exiting the split valve must be a minimum of 2-1/8" OD to the condenser inlets. 5A. Check the pressure drop across the condenser while in and out of spilt. Extremely high pressure drop when in split will affect the Jet Kool performance. 5B. Check the condenser split set-up to make sure it is not switching into split above the manufacturer's recommended setting. 5C. Make sure the condenser fans are operating on the same section as the split condenser, when in split.

6.0 Jet Kool Flow Diagram

A. JET PIPE
B. PLATE HEAT EXCHANGER
C. LIQUID FLOW CONTROL - ANA-LOID VALVE
D. SENSOR FOR THE ELECTRONIC TEMPERATURE CONTROL (DIGITAL TEMPERATURE DISPLAY)
E. 1 3/4"-12 X 1 3/8" O.D.S. FITTING
F. PRIMARY RECEIVER AND BRACKET
G. 1 3/8" RECEIVER BALL VALVE
H. LIQUID CHECK VALVE
I. LIQUID SIGHT GLASS
J. ISOLATION BALL VALVE (2 REQUIRED)
K. ACCESS FITTING (WITH CORE)
L. ELECTRICALLY ACTUATED FULL PORT BALL VALVE
N. PRESSURE RELIEF VALVE (425 P.S.I.) (OPTION - PIPE OUTLET TO SUCTION)

DIAGRAM 1