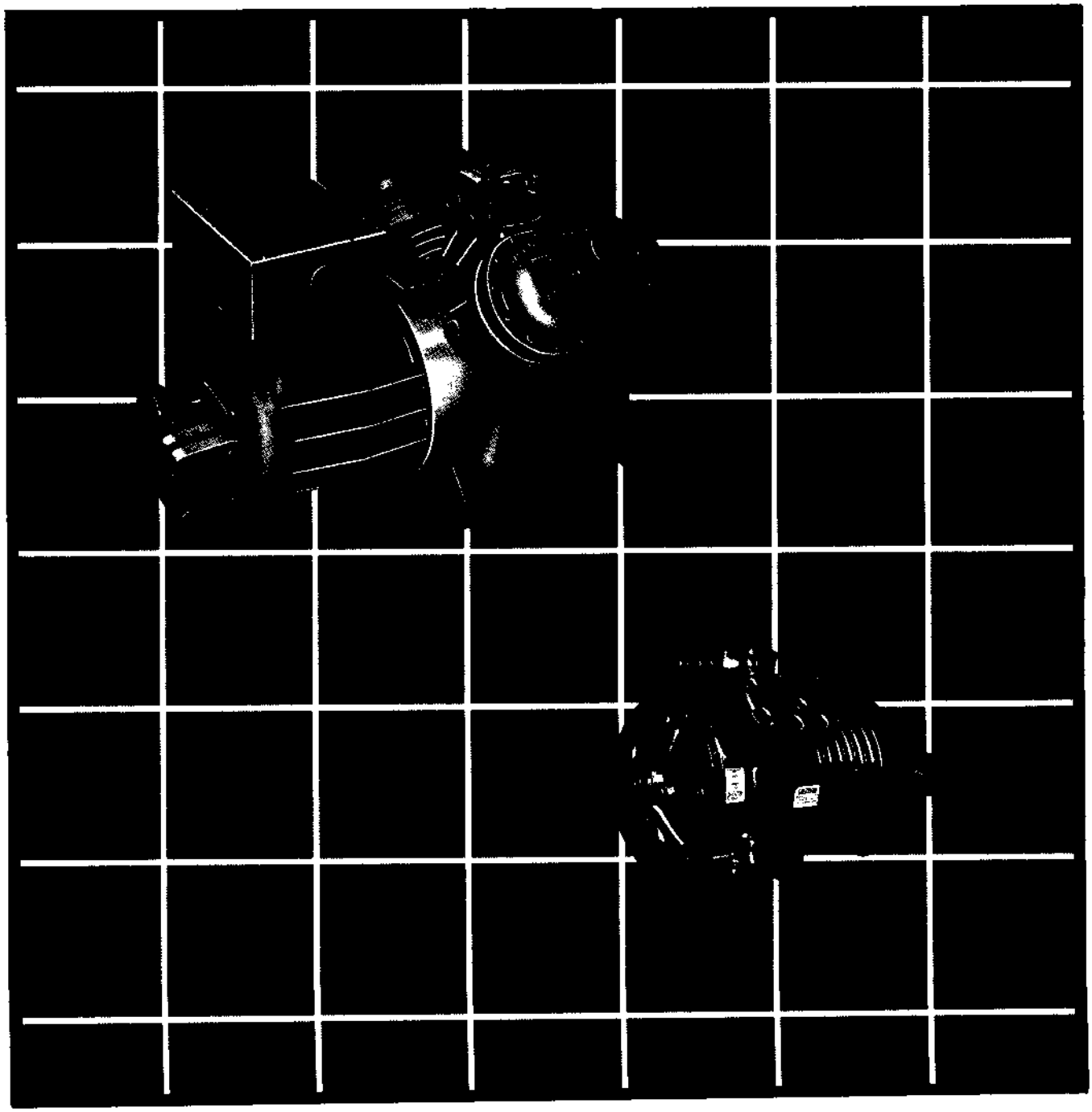
Form No. 4232F

Reciprocating Compressors Installation Instructions

D/B-Metic, Big-4, D-Line, and Belt Drive



DURHAM-BUSH®
COMPRESSORS
Products That Perform...By People Who Care®

INTRODUCTION

Dunham-Bush compressors are shipped from the factory absolutely clean and thoroughly dried. This will be of little value if the system piping has not been thoroughly cleaned and dried as well. Cleanliness is a must to insure a long and trouble-free life for all types of compressors.

Some of the major causes of contaminants are caused by lack of care and mishandling during storage, and assembly of the tubing and components. Filings, chips, flux, scale, dust and dirt can all be found in units that have been carelessly assembled and handled.

INDEX

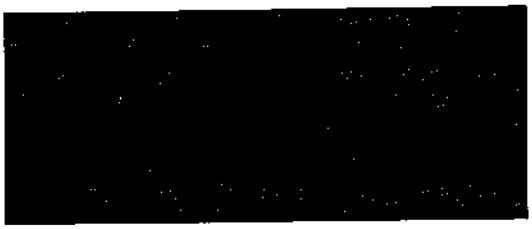
DUNHAM-BUSH RESERVES THE RIGHT TO MAKE CHANGES IN SPECIFICATIONS AND DESIGN WITHOUT NOTICE.

REFERENCES

A long, trouble-free life for Dunham-Bush compressors and units can be insured if they are properly applied, installed and maintained. It is unfortunate that we cannot list here all the forms for units which incorporate reciprocating compressors in their manufacture, therefore, we have listed only those which directly concern the compressors. Please consult the latest revision of the proper forms for further information.

DESCRIPTION	FORM NO.
Belt Drive Compressors & Condensing Units	4003
Belt Drive Compressor Parts Selection List	4004
Multi-Drive Compressors & Condensing Units	4020
Multi-Drive Parts Selection List	4022
Multi-Drive Installation & Operation Manual	4121
Multi-Drive Service & Maintenance Manual	4122
D/B-Metic Compressor & Condensing Units	4030
D/B-Metic & D-Line Compressor Replacement Parts Catalog	4032
D/B-Metic Installation, Operation & Maintenance Instructions	4130
Big-4 Compressor, Compressor-Receiver & Condensing Units	4055
Big-4 Compressor Parts Selection List	4056
Big-4 Installation, Operation and Maintenance Manual	4155

FOLLOWING INFORMATION IS SUPPLIED FOR GUIDANCE ONLY. INSTALLATION OF REFRIGERATION COMPRESSORS MUST ONLY BE MADE BY QUALIFIED SERVICE PERSONNEL IN CONFORMANCE WITH ALL APPLICABLE REGULATIONS.



Piping Connections

All refrigeration piping practices must be in accordance with local, state and federal codes. To insure trouble-free operation, the following conditions should be observed.

1. *Do not* connect this carefully dehydrated compressor to tubing and evaporator which have not been dehydrated, or to an old system which may be dirty or moist and has not been thoroughly cleaned and dried out.
2. When brazing or soldering, valves are to be disassembled, or wrapped in wet cloth to prevent damage by heat. To prevent formation of copper oxide on the inside of the copper tubing, nitrogen or inert gas must be passed through the piping continuously while soldering joints.
3. If tubing or pipes are cut from open stock they should be thoroughly cleaned and deburred before they are fitted.
4. Never leave a dehydrated compressor or filter drier core exposed to the atmosphere as they will absorb moisture. Keep compressors capped and cores in unopened containers until ready for use.
5. Use proper silver solder alloys only. When soldering suction and liquid lines, whose fittings and tubing are both copper, a 15% silver alloy is recommended. For all discharge lines, and any place where copper is soldered to brass or steel, a 35% silver alloy should be used.
6. Flux should be used on all joints and should be applied only to the male portion.
7. Moisture in a refrigeration system is one of the main causes of trouble, particularly to the compressor, because acids form which attack the motor insulation, valves and valve plates.

   This contamination can be explained by two entirely different types of oil decomposition. The first type, reaction of the oil with oxygen in the noncondensables, usually is the first to take place. Even though the system is dry, at high head temperature with noncondensables present, oil breakdown products will start building up on the valve plate and particularly on the seat of the discharge valve. In time, this can lead to wire drawing (forcing of the gas through a small leak in the discharge valve creating very high temperatures), and initiate a second type of oil breakdown which involves the oil reacting directly with the refrigerant to form hydrochloric acid, hydrofluoric acid, carbon and water. This becomes a vicious cycle, snowballing until the system has a serious wet acidic condition, oil deterioration, and eventually a motor burnout.

   Extreme precautions are taken at the factory to insure that the motor compressor is clean and properly dehydrated. Equal care should be taken at the time of installation to be sure that the system is as clean and dry as possible. In addition, a properly sized drier should be used on all installations.
8. The use of a *moisture indicator* is also recommended because it affords a quick visible check of the moisture content of the refrigerant. Indicators are avaible with a sight glass that contains a porous filter paper impregnated with a chemical which will change color according to the moisture content.
9. Suction lines have a great impact on the ability of a unit to run trouble-free. Improperly piped, they can cause slugging, oil dilution and lubrication failure which results in the breakdown of the compressor.

Electrical Connections

The supply power, voltage, frequency, and phase must coincide with the compressor nameplate. All wiring should be carefully checked against the manufacturer's diagrams. Field wiring must be connected in accordance with the National Electrical Code, and other local codes that may apply.

Be sure that:

1. Wires are sized to handle the connected load.
2. Fuses are properly sized for compressors.
3. Magnetic starters, contactors, and motor protection devices are approved by Dunham-Bush for semi-hermetic compressors.
4. Semi-hermetic compressor power and sensor terminal retaining and lug nuts are torqued to specifications. Follow procedures outlined in instructions on the inside instructions on the inside of the terminal cover.

NOTE: All compressors, except belt drive, operate in either direction so it is not necessary to "phase it in".

After the system has been completely piped the following steps should be followed:

1. Check all threaded connections for tightness.
2. Shut off the suction and discharge service valves on the compressor.
3. Charge the system with refrigerant to 80 - 100 psig and leak check. The use of an electronic type leak detector is highly recommended because of its greater sensitivity to small leaks.
4. If a leak is found, depressurize the system, repair the leak then repeat step 3.

Note: If a refrigerant leak is suspected around the semi-hermetic compressor electrical power and sensor terminals, relieve all pressure before touching or disturbing anything inside the terminal box.

If no leak is found, evacuate the system by using a vacuum pump.

A small, portable vacuum pump should be used to evacuate the system (evaporator coil, drier, lines, etc.) after the condensing unit has been installed in the system.

Do not use the compressor as a vacuum pump.

Use a vacuum pump that is built for refrigeration evacuation. There are many excellent vacuum pumps on the market.

If the system is properly evacuated, the non-condensables are eliminated before the system is ever started.

A good vacuum pump which can pull down to the 50 to 100 micron range and has an electronic gauge is desirable and is highly recommended for this procedure. To properly evacuate a system and insure maximum dehydration and/or removal of non-condensables, connect the vacuum pump to the compressor suction and discharge back-seat ports and open all valves in the system, such as the liquid line solenoid and the service valves. Do not use too small a connecting line between the system and the pump as it will restrict flow and result in a pressure drop (minimum line size $^5/_8$" to the pump – $^3/_8$" to the valves).

To use the vacuum pump most efficiently a triple evacuation method should be used. This involves pulling a vacuum on the system to a predetermined level, and holding it for a minimum period of one hour with the vacuum pump running. If the system is small, a packaged unit of 100 tons or less, it should be evacuated to 300 microns. If the system is large, a packaged unit over 100 tons or a built-up system, it should be evacuated to 1500 microns (readings should be taken at the equalizing port on the expansion valve most distant from the compressor. A small 'Schrader type' tee should be used for coupling the gauge to the system). The vacuum should then be broken with a dry refrigerant if it is a small system or nitrogen if it is a large one. A second vacuum should then be pulled to the same levels, held for the same period of time and then broken in the same manner. A third vacuum should then be pulled. The small systems should be evacuated to 300 microns and the large systems to 500 microns. The vacuum pump should then be shut down and the vacuum held for ten (10) minutes. The level of vacuum should not rise beyond 500 microns for the small systems or 2000 microns for the large ones.

If the system does not meet the standards set up, it should be rechecked for small leaks, repaired and the above procedure repeated. At this point, you can be assured that virtually all of the non-condensables have been removed.

Triple evacuation works on the principle of pulling out a high percentage of the non-condensables and/or water on each pull-down. As an example, suppose 90% of the non-condensables are removed on the first pull-down. This would leave 10%, of which 90% is removed on the second pull-down, leaving only 1%, and 90% of the remainder would be removed on the third pull-down leaving only $^1/_{10}$ of 1% of the original non-condensables in the system. In addition, breaking the vacuum with dry nitrogen or dry refrigerant has a diluting effect on moisture and also prevents recondensation of the moisture which has been vaporized.

Besides being sure that the connecting line between the vacuum pump and the refrigeration system is sufficiently large enough to prevent pressure drop, there are three precautions to be kept in mind.

FIRST – An ordinary compound gauge is worthless on a good vacuum pump. The error in the gauge is greater than the amount of vacuum being measured. It is absolutely necessary to use a **true micron gauge.** There are several very good electronic gauges on the market which are rugged and have a dial on which microns can be read very similarly to the reading of an ammeter.

SECOND – Be sure the system, including the factory piping of the unit is good and tight and has been checked for the slightest leak.

A good vacuum pump will stay ahead of a small leak. It will pull air and moisture in one end and push it out the other.

THIRD – It also should be remembered that water trapped under layers of oil will stay there regardless of the vacuum pulled and will not be dislodged until the circulating refrigerant takes the oil up and releases the water.

1. All compressors are shipped with only a holding charge of refrigerant, and once connected, the system must be fully charged with the refrigerant for which it was designed. The type of refrigerant to use is specified on the nameplate of the unit. When charging a compressor you must use a clean and dry refrigerant.

2. There are several methods of charging a system and they are dependent upon size and type.

   a. The initial charge of refrigerant can be drawn into the condenser in liquid form when breaking the third vacuum. The charge should be completed as described in method C.

   b. In some instances a charging valve may be provided in the liquid line, then the unit may be charged with liquid refrigerant and "topped off" as described in method C.

   c. Open all discharge, suction and liquid line valves, and connect the charging hose to the back seating port of the suction valve. Be sure to purge the hose of all air. Move the valve off its back seat to allow refrigerant gas to enter the system. Start the compressor, continue adding refrigerant until all the bubbles have disappeared from the sight glass.

3. When charging water cooled units, be sure that water is circulating to prevent freeze up. On air cooled units with condenser flooding devices for head pressure control, additional refrigerant must be charged into the system. Consult manufacturer's data for specific additional refrigerant charge required.

4. After the unit is charged and has been running for a short period of time check the liquid line indicator for flow and moisture. Change the filter drier if moisture is indicated. Check the oil level in the compressor sight glass. (See oil level, lubrication and adding oil section of this form)

For specific instructions (i.e. pressure settings) consult the proper Installation and Operation manual for your compressor or unit.

1. Check all electrical connections including main power and unit coontrol devices. Be sure they are all tight.

2. Observe compressor oil level before start-up. The oil level should be above the center of the sight glass.

3. Check all controls including high and low pressure, oil pressure switches and safety controls. Adjust if necessary to the normal expected setting.

4. a. Water cooled units and units with chillers

    1. Be sure water is flowing in condenser and chiller.
    2. Check freezestat and controls associated with water flow for proper adjustment and operation.

   b. Air cooled units

    1. Check fans for proper rotation.
    2. Check all condenser pressure switches for proper cut-in—cut-out points.

5. Check the voltage to motor. Be certain it conforms to the tolerances in the respective I & O manual.

6. Crankcase heaters are recommended for all systems to keep liquid refrigerant out of the crankcase. Serious damage to the compressor may result if this recommendation is not followed. When starting new systems or systems which have been shut down for a prolonged period, the crankcase heaters must be energized for a minimum of 24 hours prior to start-up.

7. On low temperature units it may be necessary to throttle the suction valve during the initial "Pull-Down" of the evaporator in order to prevent over-loading the motor, particularly under low voltage or high ambient conditions. This may be accomplished by partially closing the suction service valves until the suction pressure is 15 pounds per square inch. Pressure limiting expansion valves or crankcase pressure regulating valves may be used to prevent motor over-loading during "Pull-Down" under extreme operating conditions.

8. Start the compressor and closely observe the pressure gauges, oil level and suction line temperature (superheat).

   SUCTION SUPERHEAT - It is extremely important for a reciprocating compressor to compress only dry gas therefore, the temperature of the gas entering the compressor must be monitored right from start up and through the complete operating cycle of the compressor. If the monitored temperature is less than the saturated suction temperature plus the superheat temperature required for the application, the expansion valve must be adjusted accordingly.

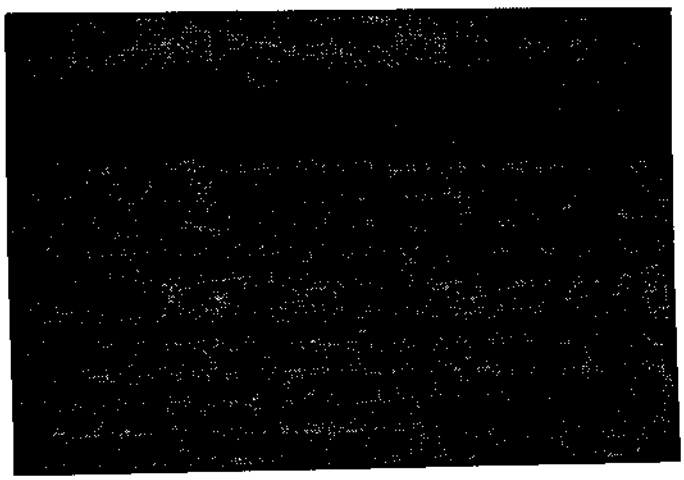
   Watch the liquid line sight glass and if flashing occurs check the temperature differential across the filter drier and the solenoid valve. If the difference is excessive, there is a restriction in the line. This problem can be resolved by changing the filters or repairing the valve. If there is flashing and the temperature difference across the filter-drier and solenoid valve is NOT excessive there is an insufficient refrigerant charge. "Top-Off" the charge until flashing disappears from the sight glass.

   To make sure that proper oil level is observed operate the compressor for 15 minutes, then stop the compressor. If it is necessary to add oil, follow the instructions under oil level, lubrication and adding oil of this form.

9. Recheck all controls to be sure they are set for operating conditions required.

OIL LEVEL

The oil level in compressors can be observed by checking the oil sight glass. To make sure that the oil is at the proper level, operate the compressor for at least 15 minutes and then stop the compressor. The oil level should fill from 1/2 to 3/4 of the sight glass with the compressor stopped.



COMPRESSORS WITH OIL PUMPS

During operation of the compressor observe the sight glass to see that the oil is being agitated. This indicates that the oil pump is functioning properly. If there is any doubt, the oil pressure can be checked by installing a gauge at the 1/4 inch pipe tapped opening in the pump cover. Differential between the oil pressure and the suction pressure should be 20 psid for D/B-Metic and 30 to 50 psid for a Big-4 and Multi-Drive compressors.

Insufficient Oil Pressure - The compressor and pump may be operated with its rotation in either direction. If there is insufficient oil pressure reverse the direction of rotation, this will cause the pump to automatically reverse. There is the possibility, however, that the pump may not reverse. If reversing does **not** produce oil pressure, remove the end bell assembly and inspect the oil strainer and the oil control check valve. If the strainer is clean and the oil control valve appears to be operating properly, replace the complete end bell assembly including the oil strainer, oil relief valve and oil pump. Be sure to order sufficient gaskets to replace these components.

[illegible], LUBRICATION AND ADDING O[illegible]

ADDING OR DRAINING OIL

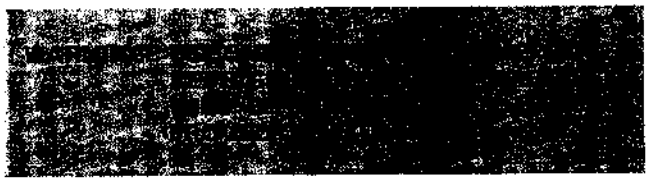
D/B-Metic Compressors - To add oil to the D/B-Metic compressor, a charging manifold must be attached to the gauge port on the suction service valve, as there is no fill and drain valve for the oil on a D/B-Metic compressor. Install a 1/4 inch copper tube to the center connection of the charging manifold and place into a container of refrigerant oil. With a positive pressure on the manifold gauge, open the hand valve momentarily. This will purge the copper tube of air, then close the liquid shut off valve on the receiver and pump the system down until the gauge reads 10 inches of vacuum. Stop the compressor and open the hand valve slowly to suck oil from the container until the proper oil level is visible in the sight glass.

Oil may be drained from a D/B-Metic compressor by removing the bottom bolt from the end bell opposite the drive end. Before draining the oil, the compressor should be isolated at the service valves and depressurized. Failure to do so will result in the oil blowing out of the compressor at a rate which cannot be controlled.

Big-4, Multi Drive Compressors - A fill and drain valve is located at the bottom of the crankcase on these compressors.

DUNHAM-BUSH RECO[illegible]			
MODELS*	[illegible]	[illegible]	
Without Oil Pumps	High, Comm., Low	+55° to -40°	150 SUS
With Oil Pumps	Comm., Low	+25° to -40°	150 SUS
With Oil Pumps	High	+55° to +20°	300 SUS
All	Low	+25° to -40°	150 SUS
All	High	+55° to +25°	300 SUS

Reference Service Bulletin SR42C



	Suniso 3GS*	Suniso 4 GS*
	WF32	WF68
	Mobilartic 155	Mobilartic 300
	Eskimo 42	Eskimo 48
	Refrig. Oil 150	Refrig. Oil 300
	Refrig. Oil 2	Refrig. Oil 1

*Used in remanufactured compressors.

[illegible] MOTOR E[illegible]

Semi-hermetic motor-compressors require specific electrical protective devices and controls. The devices and controls necessary for proper compressor protection and operation are described below.

1. **Inherent Overload Protector** (Klixon) - is mounted, in certain D/B-Metic compressors, inside the compressor terminal box and rests against the side of the motor shell where it can sense the motor temperature. This device is operated by both temperature and electric current and is adjusted to disconnect the motor in case of a dangerous overload or if the motor gets too hot, or a combination of both conditions. The overload is connected in the common line on single-phase units and to all three phases of the motor at the point of the Wye type motor. When the protector operates due to over-load or over temperature, or a combination of both, all three leads are broken simultaneously. When the protector disc cools, it automatically resets, allowing the compressor to restart.
2. **Magnetic Starter with Quick Trip Ambient Compensated Overloads** - offers excellent locked rotor protection and very good motor over-load protection. This bi-metallic overload relay senses an increase in current draw and works on an inverse time principle. That is, the higher

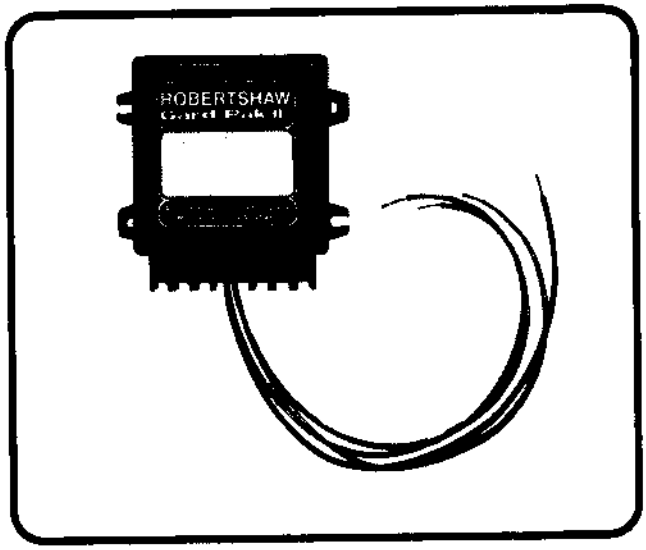
the current draw through the relay, the shorter the time period to open the circuit and conversely the lower the current draw, the longer the time period to open the circuit. Size selection of motor starters and overloads is very important. If there is any question regarding the selection, consult the factory.

3. **Thermostats** - built into the winding of the motor, the thermostat will protect the motor against dangerous overheating. On compressor motors where this device is used, either a magnetic starter with quick trip overloads or inherent type overload protector must be used as the thermostats do not react fast enough in response to the rapid temperature rise that takes place on locked rotor condition.

4. **Solid State Motor Protection** – this form of motor protection is used on Semi-hermetic Big-4 and Multi drive compressors.

   In 1971 Dunham-Bush began incorporating a solid state motor protector on all hermetic compressors which are 25 HP or larger.

CONTROL MODULE



Through constant testing and upgrading this solid state motor protection system, the version now used is the most advanced in the refrigeration and air conditioning industry. It offers the following advantages:

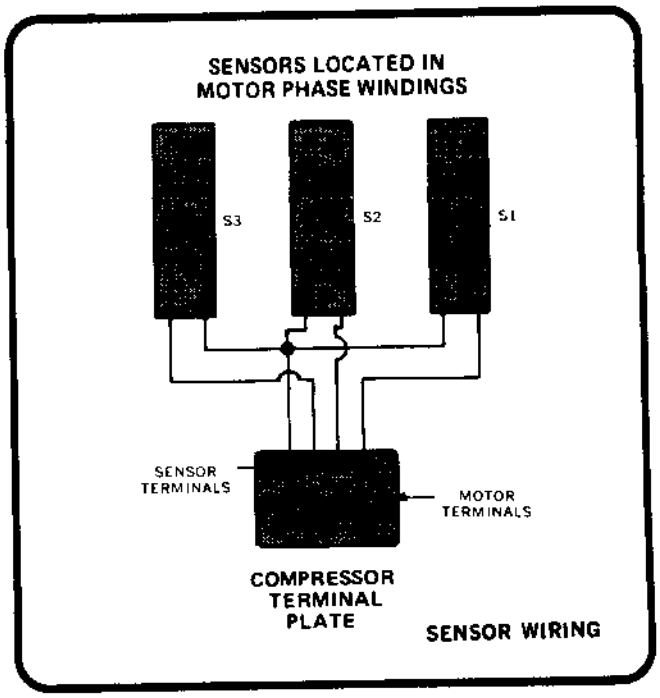
1. **Three Phase Protection** - With a sensor embedded in each phase winding.

2. **Sensor Accuracy** - Sensors are wired directly to the control module without the inaccuracy that results from additional components in sensor circuits.

3. **Control Module Location** - Mounted and wired in compressor terminal box at factory to minimize field wiring.

4. **Automatic Reset** - Allows the compressor to cycle, preventing total loss of refrigeration during crucial load periods.

5. **Integral Power Transformer** - For greater compactness and accuracy of the system.



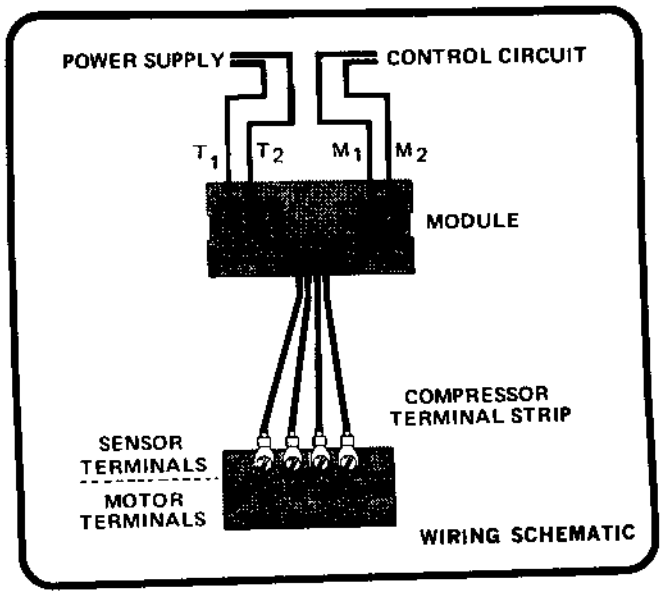
INSTALLATION:

This motor protection system is factory mounted and wired. The control module is mounted in the compressor terminal box and the sensors are embedded in the motor end-turns and their leads are wired to terminal posts on the compressor terminal plate. If desired, the control module may be removed from the terminal box and mounted remotely. Four field wiring connections must be made by the customer and they are:

1. **T1 and T2 - Module power connection** - To energize module connect these terminals to a power source of proper voltage, check voltage markings on module.

2. **M1 and M2 - Control circuit device** - The compressor control circuit is to be connected to these terminals which are wired to a 2.5 amp 120V or 1.56 amp 208/240V relay which completes the control circuit in the module.

The control module supplied with the compressor is rated at 120 volts; optional 208/240 volt modules can be supplied on request.



SOLID STATE MOTOR PROTECTION

OPERATION:

The solid state motor protection consists of two major components: sensor elements and control module.

1. **Sensors** – Three fine wire sensing elements, that are encapsulated in a plastic film, are embedded in the motor windings. When the motor temperature increases the resistance of these sensors increases. This increased resistance is sensed by the control module.

2. **Module** – The control module contains a modified solid state bridge circuit interlocked to a relay. With the module energized and the sensors at a safe temperature the relay is closed; when the temperature of the motor increases beyond a safe limit the increase in sensor resistance is sensed by the module and the relay opens, which de-energizes the control circuit shutting off the compressor. As the motor cools the process is reversed and the relay will close when the motor reaches a safe operating temperature.

TROUBLE SHOOTING

IN THE EVENT REPLACEMENT COMPRESSOR DOES NOT START, OR RUN PROPERLY, MAKE THE FOLLOWING CHECKS:

LINE VOLTAGE

The first check to be made when a unit will not run is the voltage at the compressor terminals (Common and Run terminals on single phase D-B Metic). Be sure the contact points on the operating and safety controls are closed. The voltage at the terminals must be within the limits stated in the respective I & O Manuals.

SINGLE PHASE D/B-METIC COMPRESSORS

Capacitors

For a quick check to determine whether a starting capacitor is still good, disconnect the capacitor lead wires and touch them for a second or two to line wires having the same approximate voltage as the voltage shown on the capacitor. Caution: Never check a 115V capacitor on a 230V line, and do not hold a starting capacitor on the line more than a few seconds. Then touch the two capacitor wires together. If they spark on several attempts, the capacitor is good. If not, the capacitor is defective and should be replaced.

Compressor Motor

The compressor motor may be checked on single phase D-B Metics by removing all wires from the compressor terminals which are marked as follows:

'S' for Start Winding.
'R' for Running Winding.
'C' for Common.

Attach a 2-wire test cord to the common and running winding terminals and plug in the test cord to the power supply. Then momentarily touch the leads of an auxiliary starting capacitor having the same microfarad rating and voltage rating as supplied with the unit, across the start and running terminals. If the motor does start, the trouble is in the electrical accessories.

EXTERNAL OVERLOAD PROTECTOR (Klixon)

If there is no voltage on the compressor terminals, it is possible that the overload protector (Klixon used on most 1½ HP thru 7½ HP D-B-Metics) has tripped or is open. The protector can be checked by bridging the protector terminals with a jumper wire, which should contain a fuse for protection. If the compressor now starts, this indicates a defective protector, or an overload condition. Do not disconnect the overload protector and leave the machine operating without any protection. A fusetron may be used temporarily in an emergency. (New fractional single and three phase compressors are presently employing starters.)

INTERNAL OVERLOAD PROTECTOR (Thermostat)

To determine if internal thermostat imbedded in stator winding is open, install jumper across the two protector terminals. If compressor runs, leave jumper and order replacement compressor. NOTE: Most 10, 15, 17½ and 20 HP D-B Metics have thermostats.

SOLID STATE MOTOR PROTECTION

Big-4 and Multi-Drive Only

Warning – The control module is sealed at the factory and its warranty is void if it is opened. Do not attempt to service the module in the field.

If the compressor will not operate in a normal manner and the motor protection system is suspected, the following checks should be made;

1. All wiring connections must be sound and correct.

2. Power supply to module must be within 10% of voltage marked on case.

3. Connect jumper wire between M1 and M2 and try running compressor. If the compressor does **not** run the motor protection system is not at fault. If the compressor runs, shut it off and proceed with the following steps to determine if the sensors or the module is faulty.

4. Disconnect the leads between the module and sensor terminals and check the resistance of sensors using a 6 volt max. ohm meter. The resistance of each sensor as measured across the common terminal marked 'C' and each sensor terminal should be between 75 ohms with the motor cool and 105 ohms with the motor hot. If a sensor is found defective, jumper the defective sensor with an 82 ohm, ½ watt wire wound resistor (D-B P/N-RES7), then consult the factory for further information.

5. If a) compressor runs with jumper wire between M1 and M2, b) resistance of sensors is within limits and c) motor is not overheating or being overloaded then module should be replaced. Modules used by other compressor manufacturers are not interchangeable with ones supplied by Dunham-Bush.

STARTING RELAY
(Voltage Type)

This is used on all single phase D-B-Metic compressors. If the relay contacts fail to open, motor will draw excessive current. It will cycle on the overload protector and may blow out the starting capacitor. This failure may be due to an open circuit in the relay coil, or to welded contact points. The latter may be determined by disconnecting the power supply and manually trying to open the contact points. Sometimes a cracked relay base will prevent the contact points from opening sufficiently.

The relay holding coil may be checked as follows: Connect a fused test cord to compressor terminals 'C' and 'S' and plug the other end of the test cord into the power supply. Due to the fact that the relay requires more than line voltage to actuate, it may still not open. But by pushing the relay actuating arm with an insulated screwdriver, the contacts should remain open, as long as the test current remains on. If not, the relay holding coil is faulty, and the relay should be replaced.

BASIC OPERATING & SAFETY PRESSURE CONTROLS

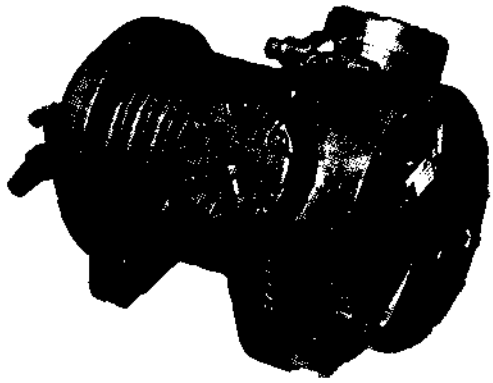
OPERATING PROTECTION: Compressors must be protected by a high pressure control and a low pressure control. Additionally, compressors with oil pumps must be protected with an oil failure control.

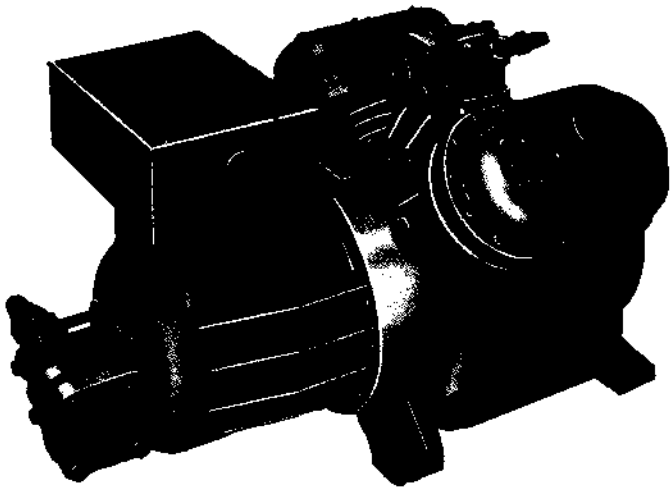
A high pressure control is used to monitor the compressor if it exceeds the preset pressure. The low pressure control is necessary to monitor the suction pressure. If it falls below the preset pressure the control must shut down the compressor. The oil failure control must be a time delay type which monitors the differential pressure across the oil pump. If the pump should fail to attain and sustain the preset oil pressure, this control must shut down the compressor.

CRANKCASE HEATER

Heaters are 100 Watt (D-B-Metic), 200 Watt (Big 4) and 300 Watt (Multi-Drive) cartridge type and are available in 115V and 230V. They should be energized at least 24 hours before initial start-up. The heater should be interlocked with the compressor to de-energize it when the compressor is running.

Use of a heater is mandatory with a low temperature compressor. Low temperature compressors are identified by an 'L' in the model number and operate in the 0°F to -40°F suction temperature range.





SERVICE CHART

SYMPTOM		
Compressor will not start	1. Power off	1. Check main disconnect switch.
	2. Main line open	2. Check main fuses.
	3. Incorrect wiring	3. Check wiring diagrams.
	4. Loose or dirty terminals	4. Tighten or clean terminals.
	5. Control circuit open	5. Check motor protection (Klixons, internal thermostats, solid state protection, starter heater elements), pressure & temperature controls.
Compressor hums but does not start.	1. Low voltage	1. Check at main entrance & at unit. Consult power company if voltage is low & increase wire size to the unit if voltage is normal at main and low at unit. Voltage must be within limits indicated in this manual.
	2. No power on one phase of 3 phase unit	2. Check fuses and wiring.
Compressor cycles on low pressure control	1. Refrigerant shortage	1. Check for leaks and add refrigerant.
	2. No cooling load	2. Check low pressure side of system – T-X Valve, evaporator, etc.
	3. Restriction in liquid line	3. (a) Plugged drier. If temperature drop exists across the drier remove and replace cores. (b) Liquid line hand or solenoid valves partially closed. Open valves fully. (c) Expansion valve clogged or inoperative. Check superheat setting. Check charge and thermo bulb.
	4. Restriction in suction line	4. Compressor internal suction filter or suction line filter blocked. Check pressure differential. Clean or replace.
	5. Compressor suction valve partially closed	5. Open valve fully & close one turn.
	6. Head pressure too low	6. Water cooled: Restrict water flow to condenser by adjusting the water regulating valve or cycle cooling tower fan. Air Cooled: Cycle condenser fan; consider use of low ambient controls
Compressor cycles on high pressure control:		
Water Cooled Systems	1. Main water valve closed	1. Open the water valve.
	2. Water regulating valve set high or defective	2. Reset or replace valve.
	3. Water temperature too high or insufficient water	3. Check water supply against requirements. If cooling tower is used, check the spray nozzles.
	4. Dirty or fouled condenser	4. Clean the condenser water passages.
	5. Air in condenser water system.	5. Vent to purge air from high spots and trapped areas.
Air Cooled Systems	6. Insufficient air across condenser	6. (a) Fins blocked with lint, paper, grease, dirt, etc. Clean. (b) Condenser poorly situated. Remove obstructions or relocate.
	7. Undersized condenser	7. (a) Spray with water during high ambients. (b) Replace with larger condenser. (c) Add booster water cooled condenser.
	8. Compressor discharge valve partially closed	8. Open valve fully and close one turn.
	9. Overcharge of refrigerant	9. Evacuate system while in operation until bubbles show in sight glass. Close valve and add small amount of refrigerant until sight glass just clears.
	10. High pressure control improperly set	10. Adjust the control.

The first step in any cleanup procedure, is to determine if a burnout has occurred and its severity. A thorough check of the electrical system must be made to determine the exact cause of the burnout. The replacement compressor should not be started until the cause of the failure has been accurately determined and corrected. Do NOT assume that the cause of the burnout was inherent within the compressor. A thorough check of the electrical system must be made and any defective components replaced.

If the compressor motor failed due to an electrical burnout, the extent of the contamination should be determined in order to decide what type of cleanup should be used.

A check of the oil by sight or smell will give some indication of the condition of the oil. However, the oil should be checked for acid by using an acid test kit. Acid test kits are available from several manufacturers and are the most reliable method of field testing the oil.

The two factors which determine the procedure to use when cleaning up the system are the severity of the burnout and the size of the system.

Severity of Burnout

a. Instantaneous Burnout - If the acid test of the oil shows no acid, as indicated by the manufacturer of the kit, and there is no odor of acid it can be assumed that an instantaneous burnout occurred and there is little if any contamination.

b. Mild Burnout - If the acid test of the oil shows marginal, and the oil color is normal, a mild burnout has occurred.

c. Severe Burnout - If the acid test shows heavy acid and soot or carbon are visible in the oil, a severe burnout has occurred.

METHODS OF SYSTEM CLEAN-UP

With the above factors in mind, the type of system cleanup can now be considered.

1. Liquid Line Filter Drier Changeout Method for Instantaneous Burnouts

In the case of burnouts where no contaminants are present, this method may be used. If any contaminants are present in the system this method should NOT be used.

2. Suction Line Filter Drier Method for Mild or Severe Burnouts

This method of cleanup can be used in the majority of cases. The suction line filter will protect the motor compressor from further contamination if the filter is changed at regular intervals.

INSTRUCTIONS FOR SYSTEM CLEAN-UP

The following instructions are given as guidelines only. Each system will require its own unique type of cleanup.

1. Liquid Line Filter Drier Method - For Instantaneous Burnouts

NOTE: This method is only to be used where no system contamination is found.

a. Close the compressor service valves to trap the refrigerant in the system and isolate the compressor. Evacuate and recover the refrigerant in the compressor.

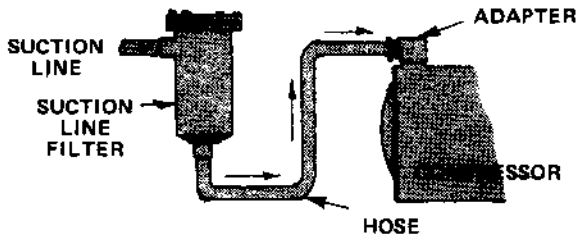
b. Install a new compressor and an oversized (usually one size larger than standard) liquid line filter drier.

c. With a good vacuum pump evacuate the compressor and the liquid line to 300 microns. Break the vacuum with refrigerant and re-evacuate. Only the compressor and the liquid line need to be evacuated.

d. Open the compressor service valves and operate the system normally.

e. Sample the oil for acid after 24 hours, two weeks and four weeks of operating time. If the samples show no acid, further follow up should not be necessary.

2. Suction Line Filter Drier Method - for Mild and Severe Burnouts



a. Close the compressor service valves to trap the refrigerant in the system and isolate the compressor.

b. Install a new compressor and a suction line filter in the suction line so that the refrigerant gas will pass through the filter before entering the compressor. If the suction filter has not been made a permanent part of the system and an adapter is available, be sure that the hose used between the suction filter and compressor is clean and purged of air and moisture. Use the largest sized suction filter available which has fittings to match the suction line.

c. With a good vacuum pump evacuate the compressor and the suction line filter in accordance with the evacuation procedure prescribed on page 2. Only the compressor and the suction filter need to be evacuated as the service valves have been closed, isolating the refrigerant in the system.

d. Open the compressor service valves, close the liquid line valve and pump down the system. Install an oversized filter drier (at least one size larger than the normal selection size) in the liquid line and remove the old filter drier if one exists.

e. Operate the system using the usual starting procedure. Check the pressure drop across the suction line filter and change the cores if it becomes excessive.

f. If the pressure drop across the suction filter drier does not become excessive, take oil samples at two to four hour intervals and test for acid. If the oil samples do show acid, change the suction filter core and the compressor oil ever four hours.

MAXIMUM RECOMMENDED PRESSURE DROP - PSI FOR SUCTION LINE FILTER-DRIERS

	3	2	8	6
	2	1½	4	3
	1	½	2	1

g. When the oil samples show no traces of acid, the cleanup can be considered complete.

h. If the suction line filter drier housing is to be removed after completion of the cleanup, replace the liquid line filter drier and install a sight glass with a moisture indicator in the liquid line.

j. Sample the oil for acid after 24 hours, two weeks and four weeks of operating time. If the samples show no acid, further followup should not be necessary.

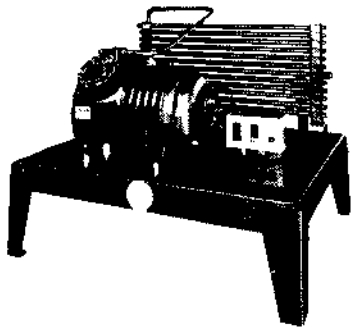
k. If acid shows in the oil sample, change the liquid line filter ever 4 hours until the oil sample shows no acid. The cleanup is not complete until the oil is clear and acid free. The sight glass with moisture indicator will indicate if the filter drier must be changed to reduce the moisture content of the system.

[redacted]

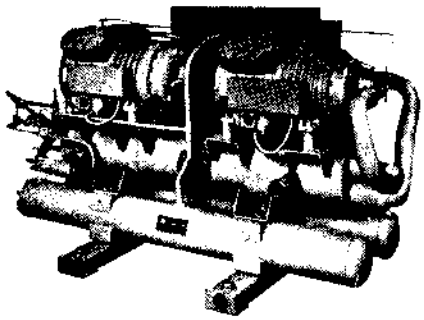
[redacted]

EQUIPMENT DESIGNED FOR USE WITH RECIPROCATING COMPRESSORS

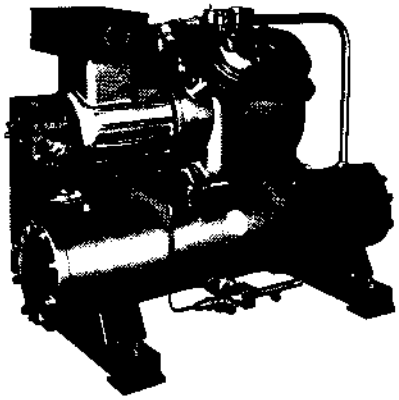
D/B METIC WATER COOLED UNITS



D/B METIC PACKAGED CHILLERS



BIG 4 UNITS



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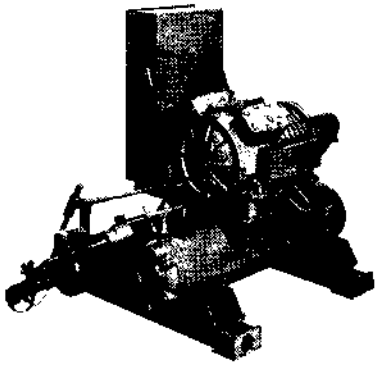
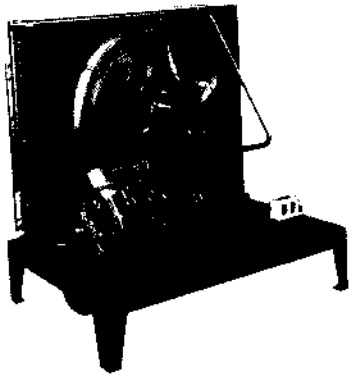
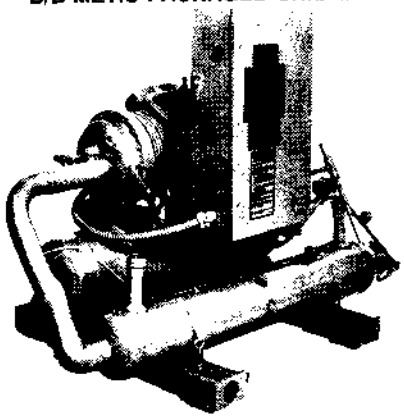


D/B METIC AIR COOLED UNITS



D/B METIC PACKAGED CHILLERS



BIG 4 COMPRESSOR UNITS