



OPERATING & INSTRUCTION MANUAL VERTICAL AMMONIA COMPRESSOR

BARE UNITS

AW-23

AA-23

BELT DRIVEN UNITS

AA-23V

AW-23V

 **CORPORATION**

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Manufacturing Industrial Refrigeration Equipment Since 1912

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INTRODUCTION

Howe Corporation

Howe Corporation has been a manufacturer of industrial refrigeration equipment since 1912. From the first patent for an industry changing "safety head" discharge valve, to a pioneering design in force-feed lubrication and a landmark multi-cylinder compressor configuration. Howe has always been committed to improving the status quo.

Important Safety Information

The information found in this manual is intended for use by individuals possessing adequate backgrounds of electrical, refrigeration and mechanical experience. Any attempt to repair or make alterations to this equipment may result in personal injury or property damage. The manufacturer or seller cannot be responsible for the interpretation of this information, nor can it assume any liability in connection with its use.

Safety Symbols & What They Mean

Please read and understand this manual Prior to installing or operating this equipment. You must be completely familiar with the start-up, operation and service of this equipment **BEFORE** you attempt to start, operate or adjust this piece of equipment.

INTRODUCTION

These safety symbols will alert you to any special precautions throughout this manual.

***** DANGER *****

BEWARE OF HAZARDS WHICH CAN RESULT IN PERSONAL INJURY

***** DANGER *****

***** WARNING*****

**"DO IT RIGHT" OR RISK SEVERE PERSONAL INJURY.
FOLLOW INSTRUCTIONS.**

***** WARNING*****

***** CAUTION *****

BE CAREFUL NOT TO HURT YOURSELF OR TO DAMAGE THE EQUIPMENT.

FOLLOW INSTRUCTIONS.

***** CAUTION *****

***** CAUTION *****

Only service personnel experienced in refrigeration and qualified to work with high voltage electrical equipment should be allowed to install or service this equipment.

***** CAUTION *****

RECEIVING INSPECTION

Immediately upon receipt of any equipment, it should be thoroughly inspected for damage occurring in transit. If any damage occurs, it should be reported immediately to the transportation company so that an authorized agent can examine the unit, determine the extent of the damage, and take the necessary steps to rectify the situation. If any cartons, boxes or crates appear to be damaged, the freight bill should also be noted : "Received, subject to concealed damage" and Carrier agent notified.

All equipment that we send out is in new first class condition and it is the carriers responsibility to deliver it in the same condition. However, if the equipment is damaged the local Howe representative or the home office should be notified of any claim.

INSTALLATION INSTRUCTIONS

LOCATION

The compressor should be installed in a dry, well lighted room with sufficient space around the unit for inspection and service.

Ample ventilation is necessary for trouble free operation. The heat given off by both the motor and compressor must be removed from the air in the mechanical room, otherwise the motor may overheat and bearing temperatures may become excessive. Natural ventilation may be sufficient where there are two or more windows and a large enough room for frequent air changes. If this is not the case then forced ventilation is necessary, ventilating fan motors can be controlled by a room thermostat located in the mechanical room. The importance of adequate cooling cannot be overemphasized. Motors which will occasionally operate at more than the nameplate rating will definitely have a shorter life if it is not sufficiently cooled.

Space for flywheel and crankshaft removal should be provided. See individual compressor drawings for dimensions.

FOUNDATIONS

Compressors mounted on a concrete floor with a “house keeping” pad approximately 6" high. The concrete foundation mixture should be made in accordance with good concrete practice.

Whatever type of foundation is used, the compressor unit **MUST** be level.

DRAINS

It is important that the unit be located near a floor drain. Since a considerable amount of water must be carried away when draining units with water-cooled condensers (for repair of seasonal shut downs) a floor drain is especially important.

INSTALLATION INSTRUCTIONS

"V" BELT DRIVEN COMPRESSOR MODELS AA-23V & AW-23V

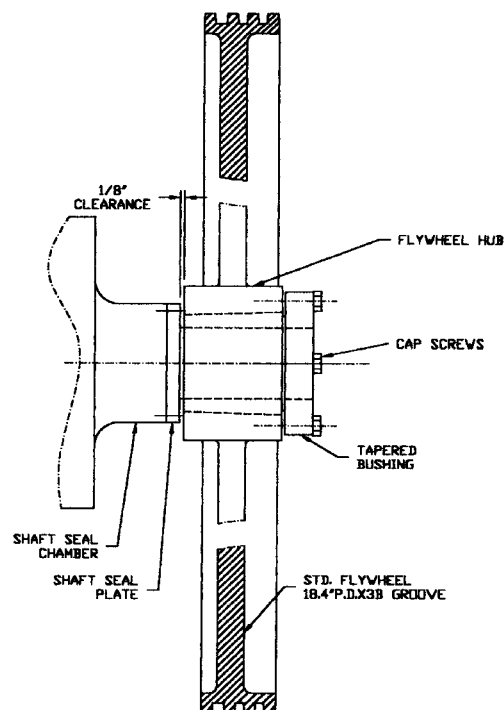
"V" belt driven compressor models may be shipped without the flywheels mounted to prevent crank shaft damage. Remove the five (5) bolts attaching the belt guard to base and lift belt guard off and place aside. Place flywheel on compressor shaft according to diagram below. Flywheel alignment can be checked by placing a straight edge on the outside edge of the pulley and flywheel. All four points of the flywheel and motor pulley must be in contact with the straight edge.

Standard flywheel is 18.4" P.D. x 3B groove with a tapered bushing. Install as shown in attached diagram. Position the flywheel hub so that it clears the seal plate by a minimum of 1/8". Be sure that flywheel and motor pulley lines up with a straight edge.

IMPORTANT: *DO NOT* use grease, oil or lubricant on the bore of the hub or the outside taper of the bushing or on the bolt threads. Tighten the bolts evenly. *DO NOT OVERTIGHTEN.*

The drive motor is mounted directly on a slide rail. This slide rail allows movement of the motor toward (counter clockwise) or away (clockwise) from the compressor by loosening the four lock nuts and turning one adjustment screw on the motor rail. Flywheel realignment should be performed each time the motor is moved or belts are tightened. Replace the belt guard.

Flywheel Mounting Diagram



INSTALLATION INSTRUCTIONS

COMPRESSOR SPECIFICATIONS:

Type:	2-cylinder vertical, 3" bore x 3" stroke
Maximum Speed:	470 rpm
Minimum Speed:	250 rpm
Displacement:	11.53 cfm at 470 rpm
Crankshaft:	Ductile Iron
Connecting Rods:	Ductile Iron, fitted with wrist pin bushing and steel backed, babbitt lined inserts.
Pistons:	Cast iron, trunk type with one compression ring and two oil rings.
Suction Valves:	Plate Type (ring) in piston head.
Discharge Valves:	Spring loaded, safety head design.
Shaft Seal:	Mechanical shaft seal, bellows type, with carbon seal face.
Bearings:	Precision main bearing, babbitt lined.
Flywheel:	18.4" P.D. x 3B groove with tapered bushing.
Gas Connections:	Suction 1", Discharge 3/4"

APPLICATION

The 3 x 3 compressor is available in two versions: Air Cooled - Model AA-23 & Water Cooled -Model AW-23

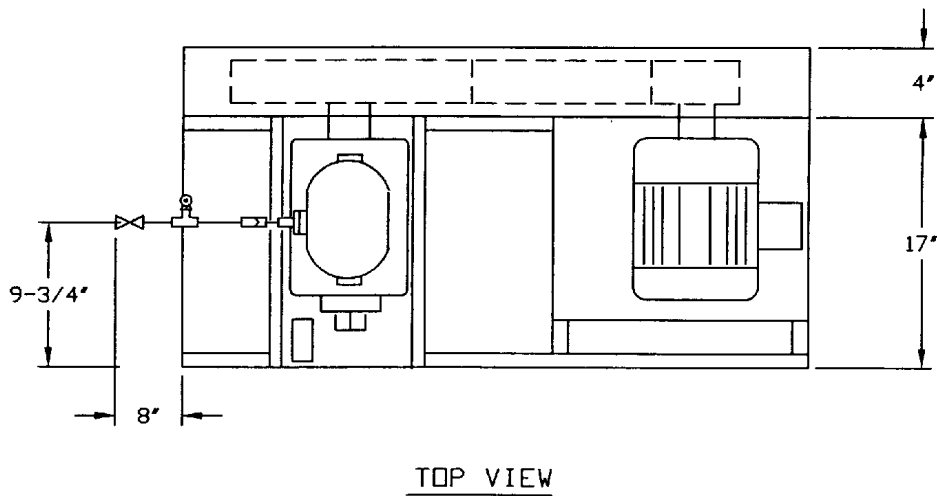
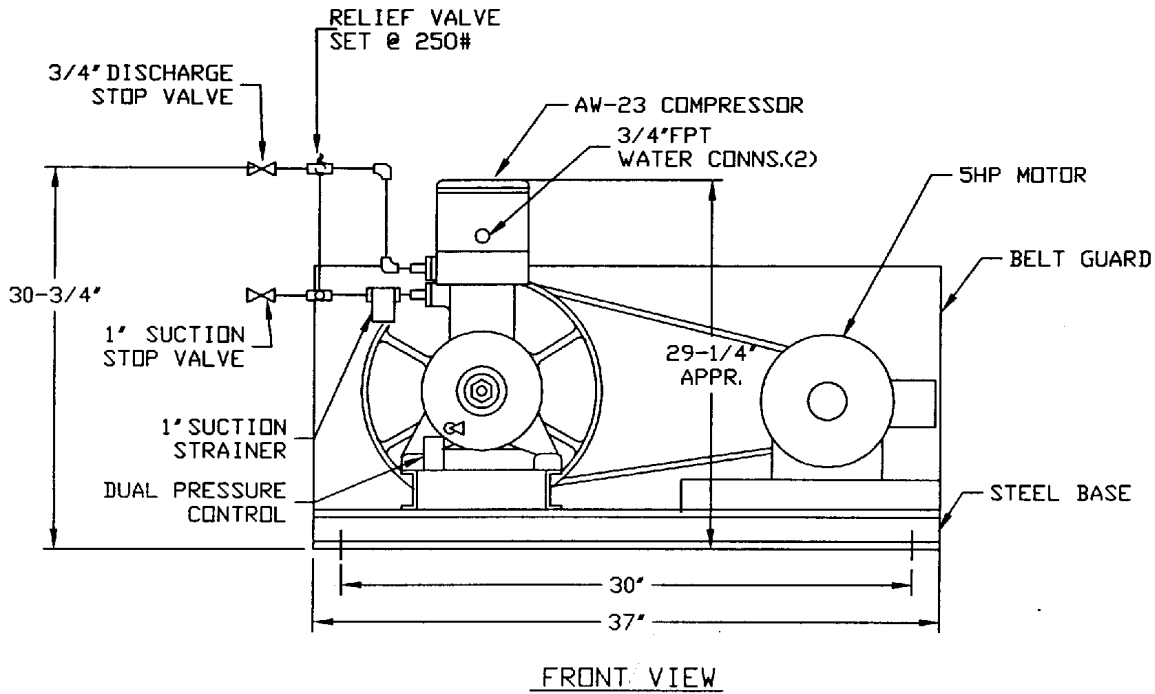
For ammonia pump-out service, either the air-cooled or the water-cooled model may be used. For gas transfer duty, the air-cooled model is normally preferred. For normal refrigeration duty such as a cold storage room, or an ice maker, use the water-cooled model only.

VALVE MANIFOLD

A fabricated manifold is available for both versions of the compressor, consisting of: 1" FPT Suction stop valve and 1" strainer, 3/4" FPT discharge stop valve and safety relief valve with relief to suction.

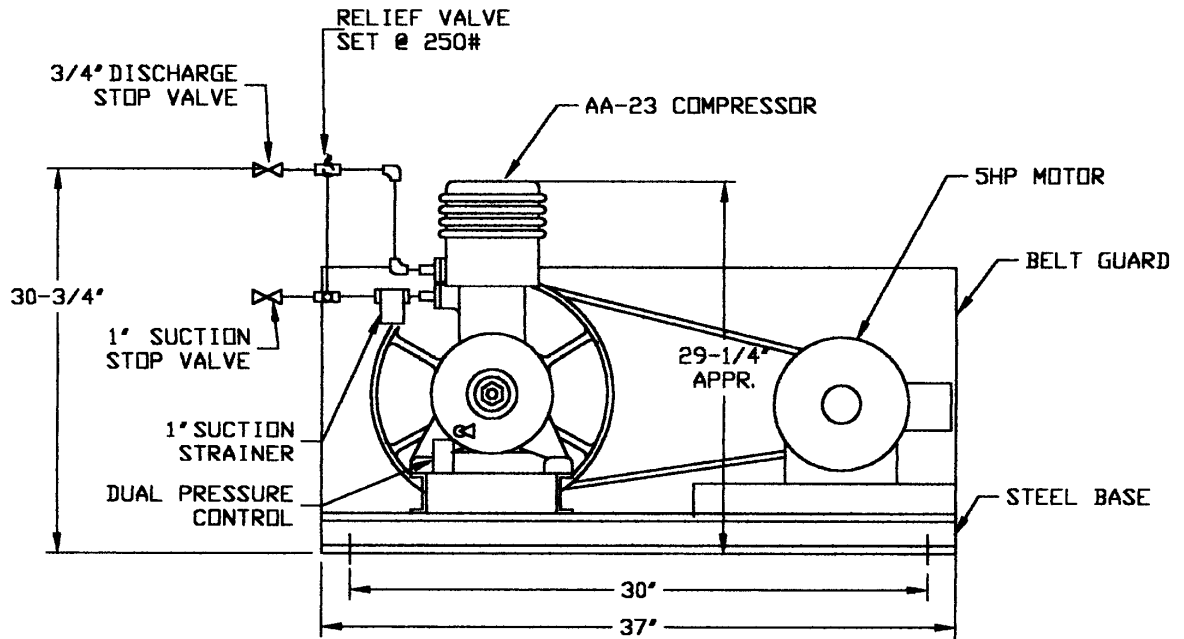
INSTALLATION INSTRUCTIONS

Dimensional Drawing AW-23

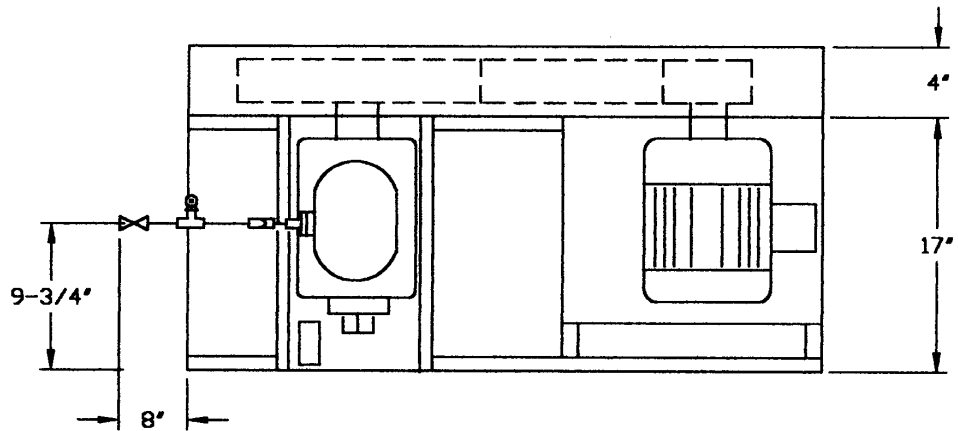


INSTALLATION INSTRUCTIONS

Dimensional Drawing AA-23



FRONT VIEW



TOP VIEW

INSTALLATION INSTRUCTIONS

Before the compressor is installed, a few simple precautions will assure trouble-free operation. Since refrigeration compressors are basically gas compressors, small amounts of liquid entering the cylinders may cause serious damage.

SUCTION ACCUMULATORS

A suitably sized suction accumulator is recommended and should be installed particularly when the compressor is used for normal refrigeration service (such as a cold storage room) and will be operating on continuous duty. The discharge valves of the compressor are spring loaded (safety head design) and will tolerate a “ reasonable” amount of liquid, however, keep in mind these compressors are designed for pumping gas. Liquid “ slugs” can cause serious damage. It is the function of the suction accumulator to intercept liquid before it reaches the compressor.

DISCHARGE LINE OIL SEPARATOR

A demister type oil separator is available as an optional accessory. The oil separator is either a manual drain type or automatic. The automatic oil separator is fitted with an oil float valve, to automatically return oil to crankcase. A piston type discharge line check valve should always be used at the outlet of an automatic oil separator. Check valve should be installed in a horizontal line only.

REFRIGERANT PIPING

The internal cleanliness of the piping and every component in the system must be stressed to prevent dirt or slag from becoming entrained in the suction gas. Particles from a contaminated system may work through or eventually tear the suction screen and cause serious damage to the compressor.

All piping should be installed in compliance with local, state, underwriters's or other applicable Codes.

***** CAUTION *****

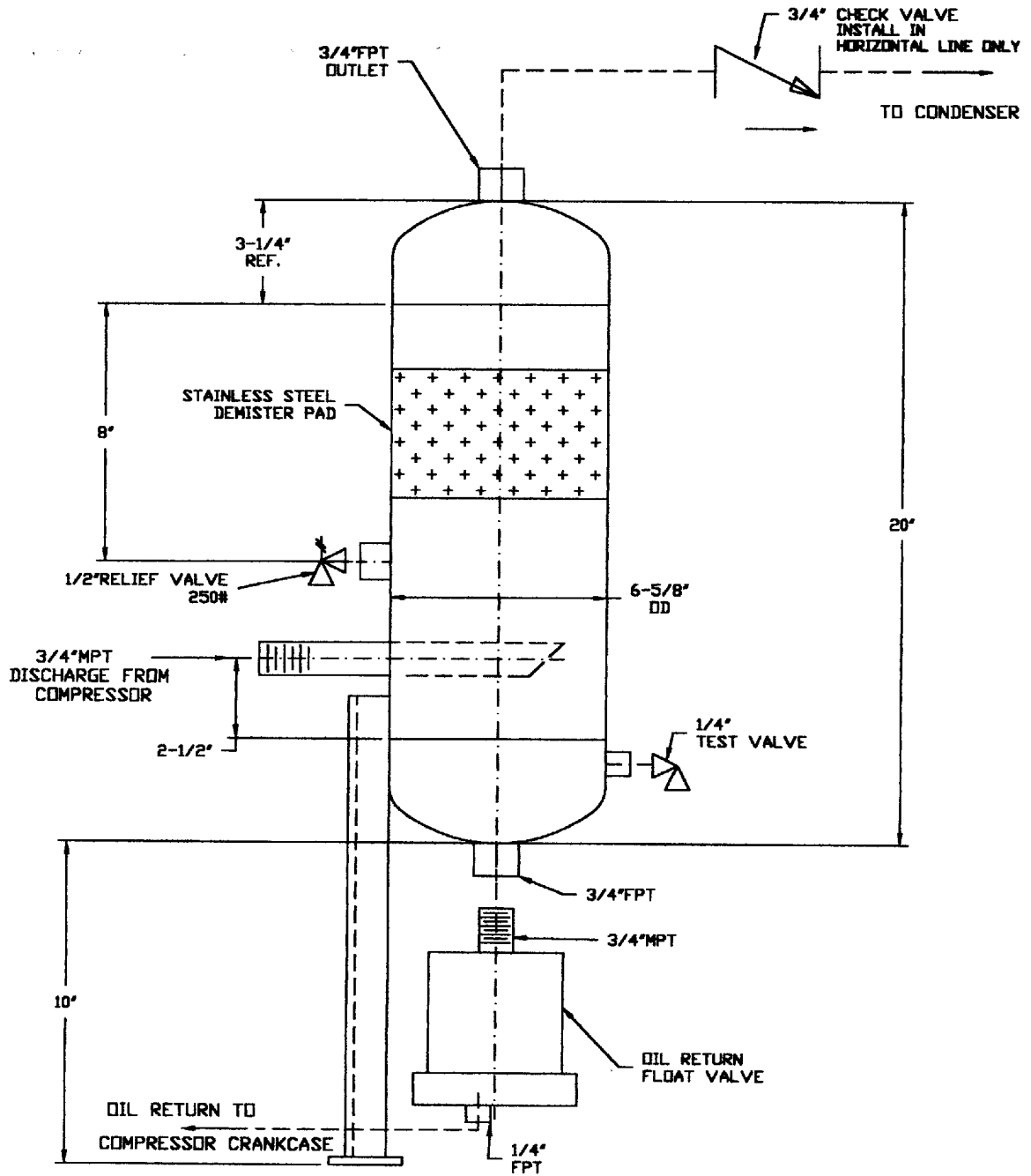
Only service personnel experienced in refrigeration equipment should be allowed to install this equipment.

***** CAUTION *****

Keep in mind that low spots in the piping will cause the accumulation of oil. For this reason, take-offs on the suction and discharge mains should be made from the top of the main, so that the take-offs will not act like a drain for the entrained oil. To augment this precaution, mains should pitch away from the compressor.

INSTALLATION INSTRUCTIONS

6" x 20" High Demister Type Oil Separator



INSTALLATION INSTRUCTIONS

REFRIGERANT PRESSURE SWITCHES

Each compressor unit is supplied with a dual (high & low) pressure switch, This control will prevent the operation of the compressor under abnormal conditions. They provide protection against malfunction in the system as well as in the compressor itself. The pressure cut-out setting of the high pressure should conform to the Refrigeration Code in the area. Usually the maximum cut-out pressure is 225 psig. The compressor relief valve is set at 250 psig. The low pressure and capacity control adjustments are made to suit each system design.

WATER COOLED COMPRESSOR, AW-23

Model AW-23 compressor is water jacketed. A ½" pipe water lines should be connected to the jacket. The lower connection is inlet so that air will be purged from the jacket as it fills with water. A hand valve should be installed in the water inlet line to control the water flow, so that the water outlet temperature is 100°F.

LUBRICATION SYSTEM

The AA-23 and AW-23 compressors are splash lubricated. Normal oil level is half way up in the glass. Add oil when level drops by 1/2". Compressor may be operated in either clockwise or counter-clockwise rotation. Direction of rotation does not affect lubrication. Specifications for ammonia compressor oil are as Texaco Capella WF-68, Sunisco 4GS.

NEVER run the compressor to charge an empty crankcase with oil. Charging an original or complete fill of oil should be accomplished with an oil charging pump. Oil additions may be made with a charging pump when the compressor is in operation, provided that the crankcase pressure is not excessive (100 psig maximum is generally specified by pump manufacturers.) Attach the oil fill line to the compressor drain valve, but do not tighten until oil has purged the air from the line. Open the compressor drain valve and fill the crankcase until the oil level is half-way up in the gauge glass. **CAUTION:** Be sure that the gauge glass valves are open.

INSTALLATION INSTRUCTIONS

PRESSURE TESTING

DO NOT use a new compressor to air pressurize a system. Pressure testing a new system may be done with dry nitrogen or air. Pressurizing an ammonia system with CO₂ **SHOULD NOT** be done, because of the possibility of precipitating ammonium carbonate, a solid which could clog strainers and other parts of the system. If air is used in a halo-carbon system, it must be introduced through a drier/filter to prevent moisture from entering the system.

If the test pressure exceeds the relief valve setting, the relief valve and other safety devices must be removed, and the opening plugged during the pressure test.

A soap and water solution applied all over the pressurized system will reveal major leaks. Tapping joints with a hammer will reveal leaks that may not be obvious until after the system has been in operation.

DEHYDRATION AND CHARGING

Since moisture is one of the greatest sources of trouble in a refrigeration system, dehydration is of utmost importance. Dehydration by evacuation is a commonly used method.

After recovering the leak test charge, connect a vacuum pump to the system charging valve and pump down the system to 20" Hg. At the farthest point possible from the vacuum pump, **GRADUALLY** introduce dry nitrogen into the system for ten minutes to absorb the last traces of moisture. Disconnect the nitrogen and again pump down the system to 20" Hg. Check after one hour to see that the pressure has not risen more than 3 or 4 inches. This will insure that the system is moisture-free and leak-proof.

INSTALLATION INSTRUCTIONS

SPECIAL PRECAUTIONS TO BE OBSERVED WHEN CHARGING REFRIGERATION SYSTEMS

Only technically-Qualified persons, trained and Certified in the handling of refrigerant and operation of refrigeration systems, should perform the operations described in this manual.

If a refrigeration system is being charged from refrigerant cylinders, disconnect each cylinder when empty or when system is fully charged. A gauge should be installed in the charging line to indicate the refrigerant cylinder pressure. The cylinder may be considered empty of liquid refrigerant when the gauge pressure is 25 pounds or less, and there is no frost on the cylinder. Close the refrigerant charging valve and cylinder valve before disconnecting the cylinder. Loosen the union in the refrigerant line, SLOWLY and CAREFULLY, to relieve refrigerant pressure in the charging hose.

***** WARNING *****

**Never open charging valve allowing refrigerant to vent directly to atmosphere.
Refrigerant must be reclaimed through a recovery system.**

***** WARNING *****

Always store cylinders containing refrigerant in a cool place. They should never be exposed to temperatures higher than 125°F and should be stored and secured in a manor to prevent abnormal mechanical shocks.

START UP INSTRUCTIONS

Fill oil in the crankcase, halfway up in the glass. All refrigerant and water valves should be open. The oil level should be in the middle of the gauge glass. Start all auxiliary equipment such as fans and pumps. Start the compressor.

***** CAUTION *****

Only service personnel experienced in refrigeration and qualified to work with high voltage electrical equipment should be allowed to install or service this equipment.

***** CAUTION *****

BREAK-IN PERIOD

Check the V-belt drive during initial operation and re-adjust. New belts will stretch and seat in the grooves, requiring frequent checking until their final running length is reached. Check sheave alignment each time motor is moved.

If the new compressor is installed in an existing plant, it is possible the new compressor could lower the suction pressure considerably. In such cases, there could be liquid and oil carry-over from the evaporators due to increased gas velocities. Such unusual and sudden disturbance could loosen scale and dirt, which could be sucked into the compressor. An adequate suction trap will normally catch all of this material. The system must have a suction trap.

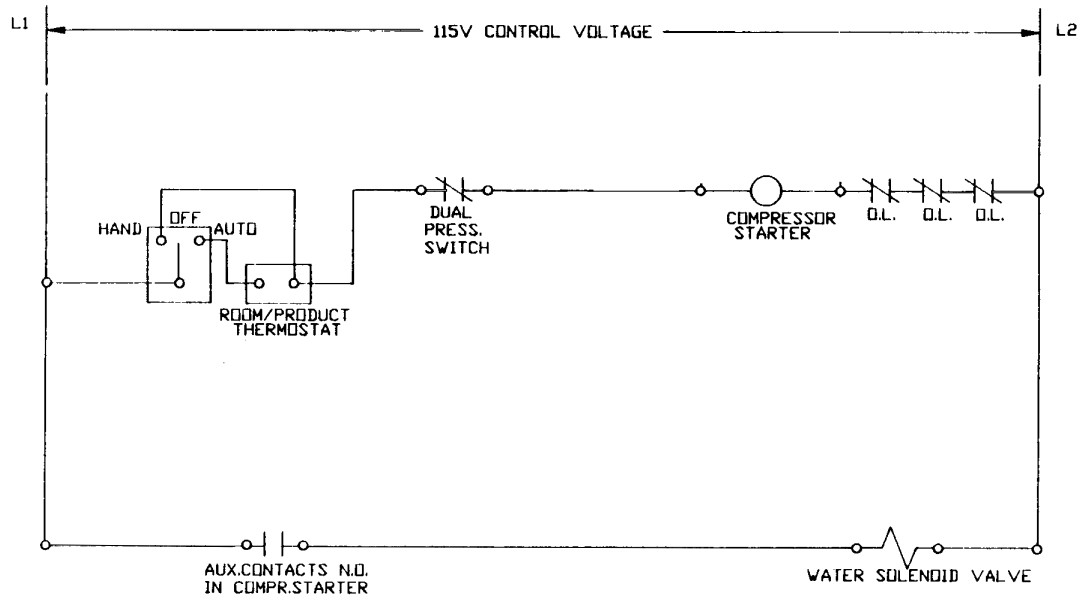
START UP INSTRUCTIONS

SYSTEM CHECKS

All switches, auxiliary equipment and controls should be checked to see that they are operating properly. In suction accumulators, make sure that the liquid level can rise to the upper limit without carrying over into the compressor. Check evaporators to see that frost formation does not become excessive. Make sure the defrost equipment works properly.

ELECTRICAL WIRING DIAGRAMS

SCHEMATIC FOR AW-23



PERIODIC MAINTENANCE

Howe compressors are designed to operate efficiently with a minimum of maintenance. The following procedures will be helpful in reducing down time.

COMPRESSOR PUMP-DOWN

To isolate the compressor for service, it is necessary to pump it down. Low pressure switches will have to be kept closed to keep the compressor from stopping before all the refrigerant is removed. This is done by holding the spring loaded arm up with a screwdriver. SLOWLY close the suction stop valve. When suction pressure drops to about 20", stop the compressor and shut the discharge stop valve. High pressure gas can be purged by carefully removing the 300 psig discharge gauge and attaching a purge line.

ADDING OIL TO COMPRESSOR

Periodic oil additions may be necessary because of the oil carried away from the compressor to the system. The oil level should be maintained in the middle of the sight glass. To add oil, connect an oil charging pump to the 1/4" drain valve, but do not tighten until oil fills the hose and purges the air. Tighten the connection, open the drain valve & pump the oil. Observe the oil level for a while to make sure it is being maintained.

REMOVING OIL FROM COMPRESSOR

To remove oil from the crankcase, make sure that there is positive pressure and open the drain valve. Since escaping refrigerant will cause the oil to foam, a large container must be provided.

SEASONAL SHUT-DOWN AND START-UP

If the system is to be shut down for several months, the refrigerant should be stored in the receiver to reduce unnecessary stress on the piping. To do this, shut off the liquid line valve at the receiver and manually open the liquid line solenoid valve. Operate the system to about 20" Hg and stop the compressor. The refrigerant in the oil should cause the pressure to rise slowly. Repeat the pump-down until a slight (about 2 psig) positive pressure is maintained throughout the system. This will prevent air from being drawn into the system in case a leak develops. Carefully check the condenser and receiver for leaks. Note that the receiver should not be more than 85% full. Open the system's master switch.

During a prolonged shut-down, inspection and service should be performed so that the system will perform efficiently when put back in service.

Before start-up, after a prolonged shut-down, make sure to inspect all water lines, wiring, evaporators, and auxiliary equipment. Start the condensing water supply. Open the compressor discharge shut-off valve. Close the system's Master switch. Open the liquid line valve. Leak test the entire system. Start the compressor.

PERIODIC MAINTENANCE

MAINTENANCE CHECK LIST

Make a check list that will serve as a guide in the maintenance of your system. It should be displayed near the compressor for ready reference with spaces provided to add items peculiar to its particular system.

Should the yearly inspection reveal worn parts, the following sections will keep down-time and expense at a minimum while restoring the compressor to peak efficiency. It is recommended that a reputable mechanic be contracted or a service contract obtained with a competent refrigeration company for any major work done on the compressor. "Feel" is an important consideration that only comes from experience in working with precision machinery.

DISCHARGE VALVE UNITS

Discharge valve units are of a "safety head design" which means that a heavy spring called a "safety head spring" keeps each valve unit in place. Care should be taken when removing the cylinder head because it is spring loaded. Unbolt evenly to release spring tension.

OIL CHANGE

Change oil after 24 hours of operation, after one week of operation, and every 6 months thereafter or sooner if oil is dirty.

Suction screen: Check & clean suction screen whenever oil is changed.

REPLACEMENT AND ADJUSTMENT OF PARTS

***** IMPORTANT SAFETY NOTICE *****

This information is intended for use by individuals possessing adequate background in electrical, refrigeration and mechanical experience. Any attempt to repair major equipment may result in personal injury and / or property damage. The manufacturer or seller cannot be responsible for the interpretation of this information, nor can it assume any liability in connection with its use.

***** IMPORTANT SAFETY NOTICE *****

***** CAUTION *****

Only technically qualified service personnel experienced in refrigeration, should perform the operations described in this manual.

***** CAUTION *****

***** WARNING *****

The control panel on this machine may be powered by TWO SEPARATE power sources. Disconnect BOTH SOURCES prior to servicing this piece of equipment. Failure to do this may potentially cause an electrical hazard!!

***** WARNING *****

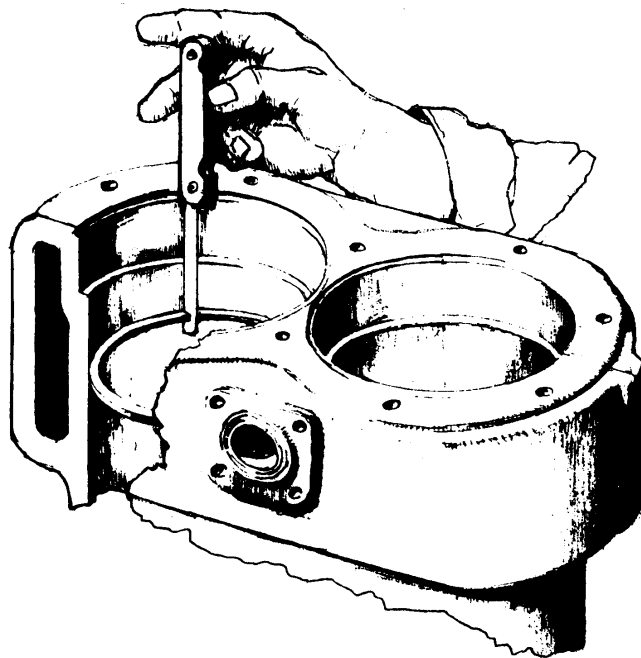
REPLACEMENT AND ADJUSTMENT OF PARTS

Piston Rings

Make certain cylinders and piston rings are wiped clean and dry; cylinder walls are smooth and free of burrs. Check cylinder bores with a micrometer to be sure the bores are straight and round. To replace the rings, spread them from the split until they can be lifted over the piston. Be careful when sliding the rings onto the piston, because they are brittle and may snap easily. Rock the piston and rings into the cylinder carefully to position the ring squarely.

Check end gap of ring with feeler gage as shown below. Gap should be a minimum of .015 inches.

Diagram for Checking Piston Ring Gap



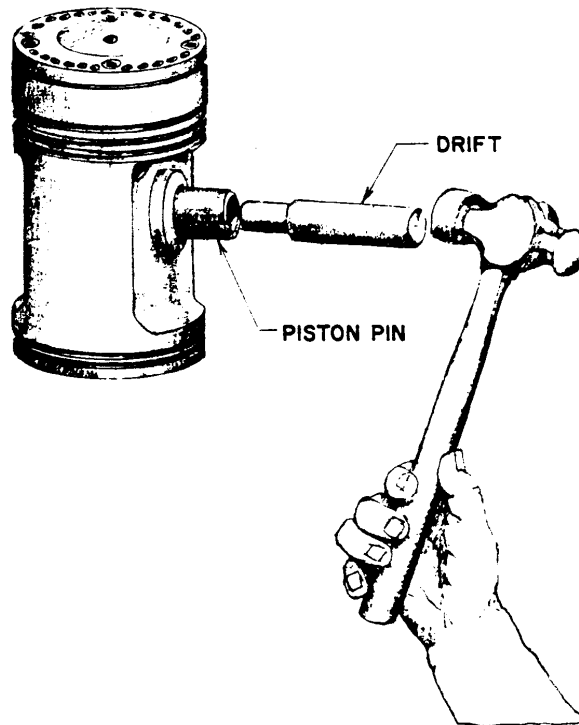
REPLACEMENT AND ADJUSTMENT OF PARTS

PISTONS AND CONNECTING RODS:

To remove piston & connecting rod assembly, first remove cylinder head and discharge valve units as described above. Connecting rod bolts are accessed through the rear bearing cover opening. Unbolt rear bearing housing and slide it off the shaft. (Support flywheel from below with a wood block so that shaft stays level when bearing housing is removed.)

Loosen and remove connecting rod nuts. Remove connecting rod cap. Push up rod & piston assembly & remove. NOTE: cap is notched, marked or numbered with the respective rod and must be reassembled in the same position. To re-install piston assembly, a tapered ring guide must be used to compress the rings as the piston is pushed into the cylinder.

Piston Pin Installation



Comp. Model No.	Drift			Piston Pin		
	A	B	C	Part No.	D= O.D.	Length
A-23 AA-23 AW-23	17/32	3/4	1	3D3	.875	2 - 7/16

*REPLACEMENT AND ADJUSTMENT OF
PARTS*

REPLACEMENT AND ADJUSTMENT OF PARTS

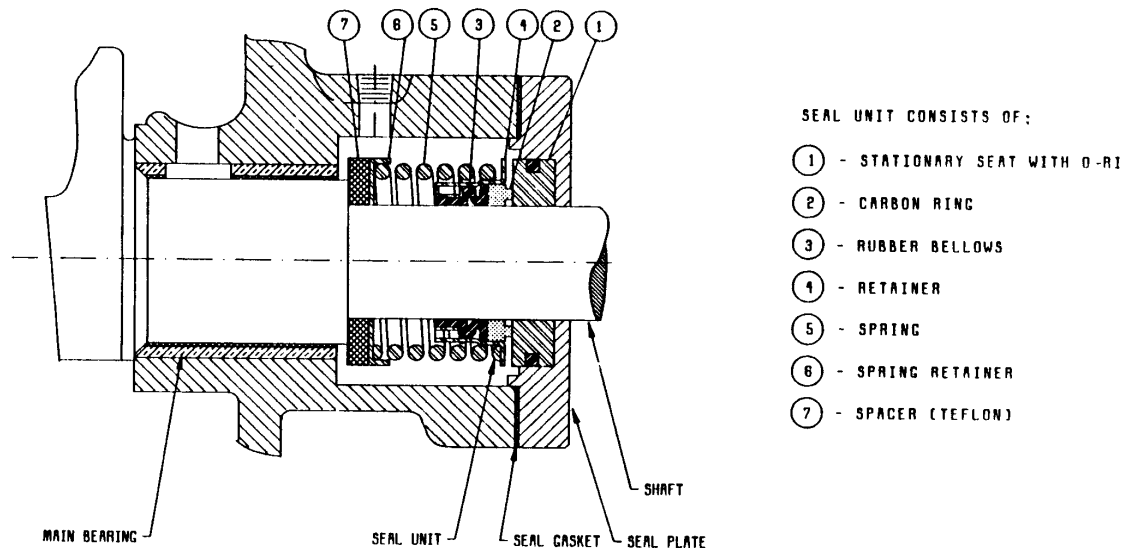
SHAFT SEAL:

To remove seal: see SEAL DIAGRAM, below. Remove flywheel. Unbolt & remove seal plate. Pull the rubber bellows & metal retainer off the shaft. Remove spring & spring retainer. Slide off & remove teflon spacer. Pry out & remove stationary seat from seal plate.

To install seal: Dull sharp edge of shaft keyway with file or emery paper. Clean the shaft surface removing any rough spots or sharp edges. Immerse rubber bellows in clean refrigeration oil for a few minutes. Cover the shaft surface with clean oil. Install the teflon spacer, spring retainer and spring. Push stationary seat into seal plate. Note the highly polished surface which is the sealing surface for the carbon ring, must face inside. Work the rubber bellows with metal retainer over the shaft & push till it clears the keyway. Place seal gasket in position. Place carbon ring in position (in metal retainer)

NOTE: CARBON RING IS FRAGILE. HANDLE WITH CARE. AVOID TOUCHING THE SEAL FACE. Using the seal plate, push the seal assembly into position. Install cap screws & tighten evenly.

Cross-Section of Shaft Seal

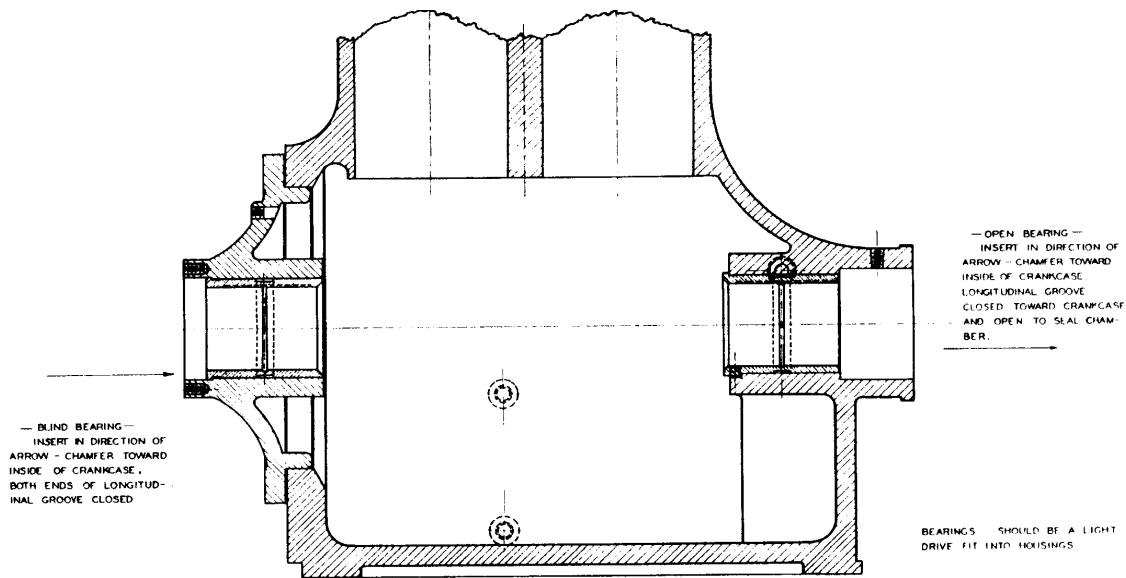


REPLACEMENT AND ADJUSTMENT OF PARTS

MAIN BEARINGS:

The compressor is fitted with babbitt lined precision bearings. Both front & rear bearings are identical. Bearings are a light drive fit into the housing. Refer to diagram below and note the positioning of the oil grooves. The chamfered end faces inside the crankcase, open end of oil groove towards outside of the crankcase, oriented as shown. Proper positioning of the oil grooves is important because it allows oil to feed into the seal chamber and to the rear of the crankshaft.

MAIN BEARINGS



NOTE

MAKE CERTAIN THAT PIPE PLUGS
IN BEARINGS EXTEND FAR ENOUGH
TO ENGAGE IN BEARING HOUSING
GROOVES.

REPLACEMENT AND ADJUSTMENT OF PARTS

SHAFT END PLAY:

Shaft end play should be checked and adjusted when the shaft seal is replaced. The correct end play is .003 to .005. To achieve this end play setting refer to instructions on DIAGRAM below

***** CAUTION *****

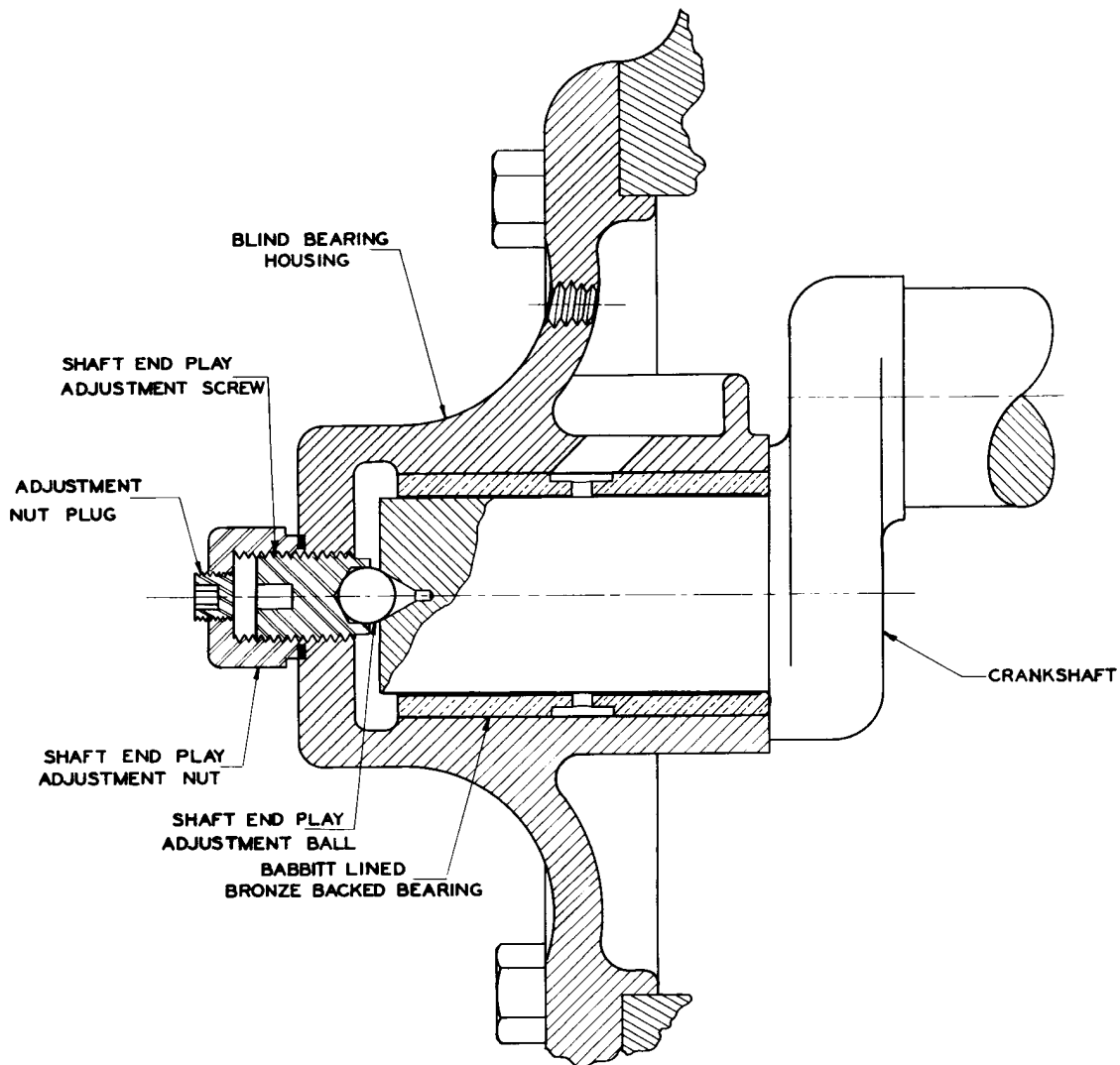
Do not force or tighten excessively.

***** CAUTION *****

REPLACEMENT AND ADJUSTMENT OF PARTS

SUCTION VALVE PLATES

To replace suction plate, remove set screw on top of piston which locks the suction cage. Using a special tool which fits into the drilled ports in the cage, rotate the cage (counter-clockwise) to unscrew it. Inspect the suction seat (rails) on top of piston to ensure that new plate will seat. Position new suction plate on top of piston. Insert & tighten cage. Insert & tighten set screw. Using a center punch “lock” the set screw in position. This last step is important to prevent set screw from unscrewing while compressor is in operation.



TOLERANCE FOR AA-23 & AW-23 COMPRESSOR

PISTONS: (STD)

Diameter:	2.997 - 2.9975
Top Clearance:	.030 - .035
Diameter Clearance:	.003 - .004

WRIST PINS: (STD)

Diameter:	.8747 - .875
Bushing Clearance:	.001 - .0015

CRANKSHAFT:

Journal Diameter:	1.498 - 1.4985
Mains:	1.748 - 1.7485

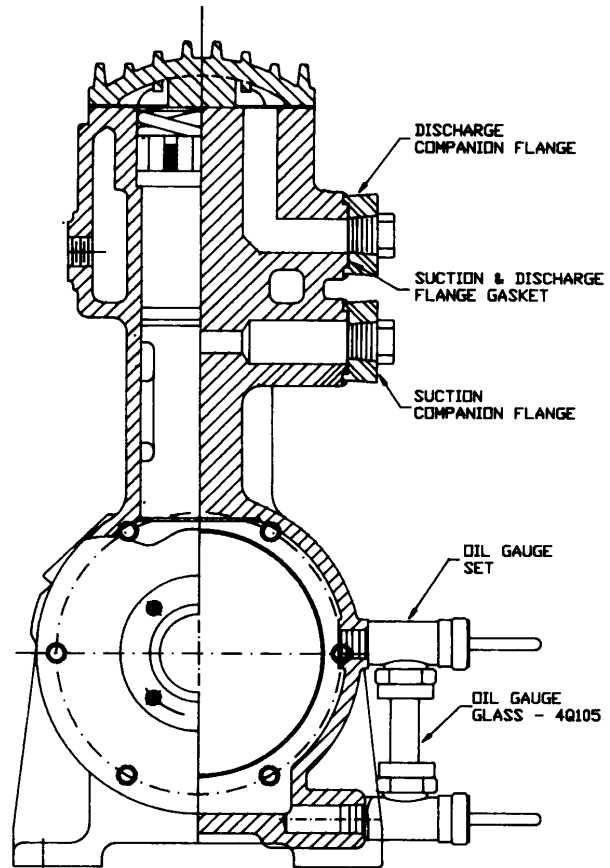
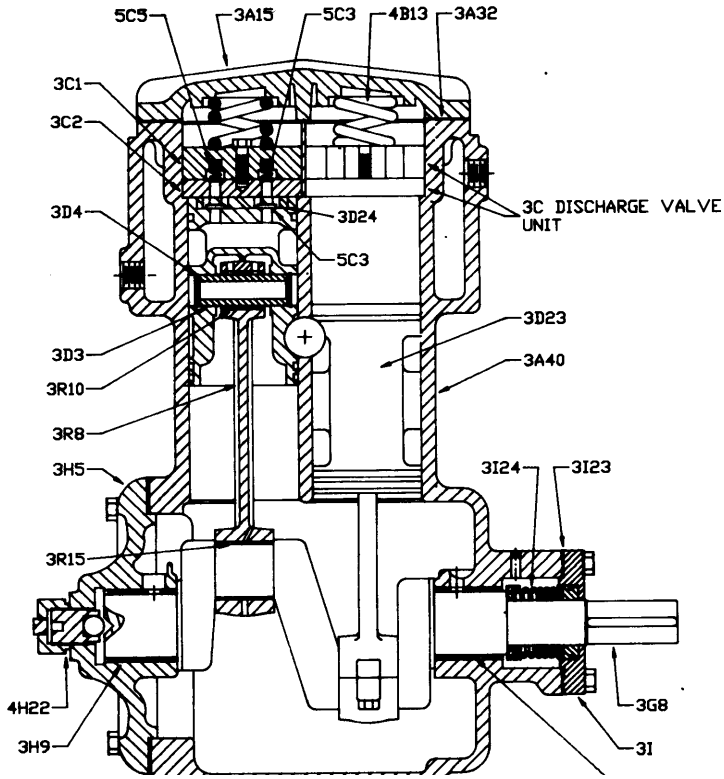
CONN. ROD INSERTS\CRANKSHAFT CLEARANCE: .0025 - .0035

END PLAY CRANKSHAFT - ADJUSTMENT: .005 (.004-.006)

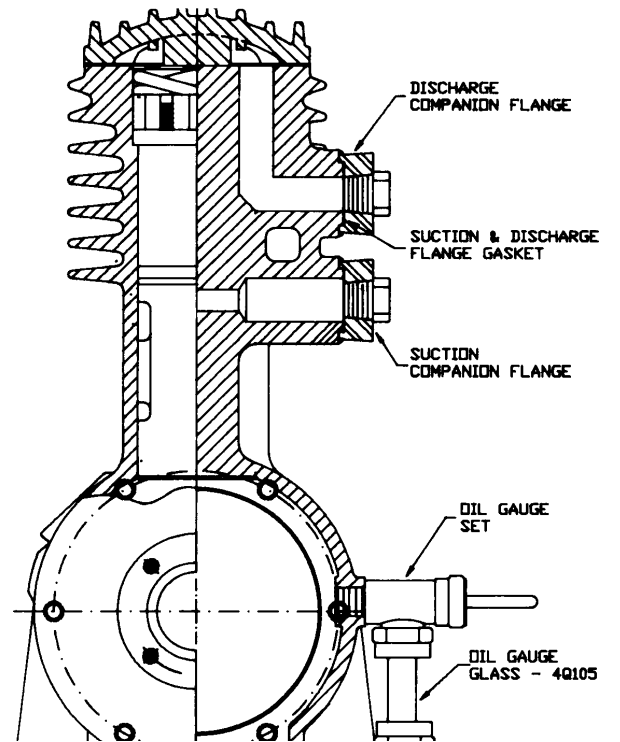
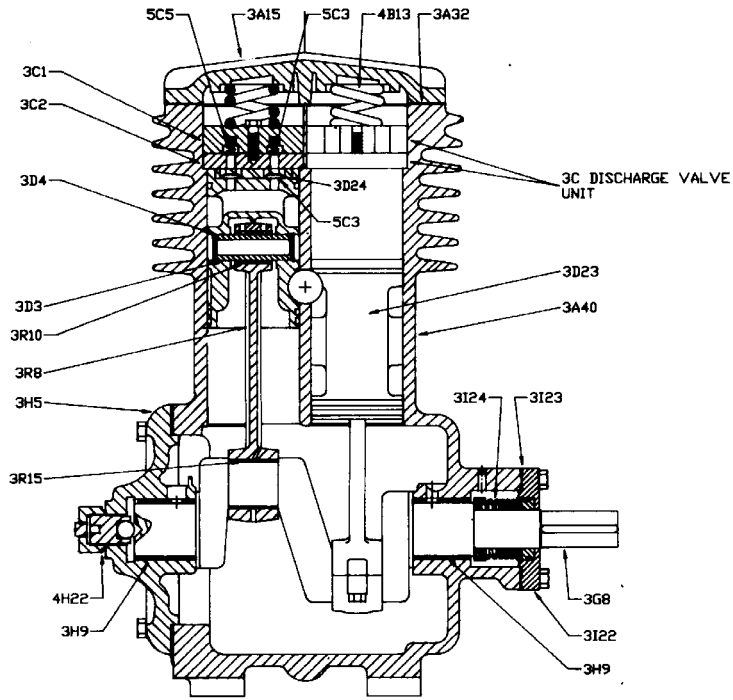
END GAP FOR PISTON RINGS: .015 - .030

TORQUE FOR CONN. ROD BOLTS: APPROX. 45 #

Cross Sectional Drawing of Model AW-23



Cross Sectional Drawing of Model AA-23





REPLACEMENT PARTS
FOR
VERTICAL AMMONIA COMPRESSORS

MINIMUM PARTS ORDER \$50.00 NET

CONTENTS

TABLE	DESCRIPTION
1	Parts for A-23 (obsolete), AA-23, AW-23

CORPORATION

1650 North Elston Ave • Chicago, Illinois 60622

Tel (773) 235-0200 Fax (773) 235-1530 235-0269

e-mail: howeinfo@howecorp.com

website: <http://www.howecorp.com>

* old style discontinued water cooled model.

(Number in parenthesis indicates quantity, if more than one is needed)

HOWE CORPORATION

TABLE 1: REPLACEMENT PARTS FOR MODELS A-23, AA-23, AW-23

PART DESCRIPTION	A-23* 3 x 3 S-FEED	AA-23, AW-23 3 x 3 S-FEED
CYLINDER HEAD	3A15	3A15
DISCHARGE VALVE UNIT (Includes Seats, Cages, Plates and Springs)	3A29	3C (2)
DISCHARGE VALVE SEAT	3A30	3C2 (2)
DISCHARGE VALVE CAGE	3A31 (2)	3C1 (2)
DISCHARGE VALVE PLATES	5C3 (2) -	5C3 (2) -
DISCHARGE VALVE SPRING	5C5 (2)	5C5 (2)
DISCHARGE VALVE SPRING PAD	-	-
GAUGE GLASS	4Q105	4Q105
O - RINGS	4Q120 (2)	4Q120 (2)
GAUGE GLASS VALVE (Upper)	5021	5021
GAUGE GLASS VALVE (Lower)	5022	5022
SAFETY HEAD SPRING	-	4B13 (2)
PISTON UNIT STANDARD	3D25 (2)	3D25 (2)
PISTON UNIT OVERSIZED (Includes Suction Valve Unit)	3D25OS (2)	3D25OS (2)
PISTON BODY STANDARD	3D23 (2)	3D23 (2)
PISTON BODY OVERSIZED	3D23OS (2)	3D23OS (2)
SUCTION VALVE UNIT (Includes Cage, Plates and Seat)	-	-
SUCTION VALVE CAGE	3D24 (2)	3D24 (2)
SUCTION VALVE PLATES	5C3 (2) -	5C3 (2) -
SUCTION VALVE SEAT CASTING	-	-
SOCKET HEAD CAP SCREW	-	-
WRIST PIN - STANDARD	3D3 (2)	3D3 (2)
WRIST PIN - OVERSIZE	3D3OS (2)	3D3OS (2)

* old style discontinued water cooled model.
(Number in parenthesis indicates quantity, if more than one is needed)

HOWE CORPORATION

TABLE 1: REPLACEMENT PARTS FOR MODELS A-23, AA-23, AW-23

PART DESCRIPTION	A-23* 3 x 3 S-FEED	AA-23, AW-23 3 x 3 S-FEED
PISTON PIN LOCK RINGS	3D4 (4)	3D4 (4)
CRANKSHAFT	3G8	3G8
BLIND BEARING UNIT (Includes Bearing Lining)	3H5	3H5
BLIND BEARING BODY	3H6	3H6
BLIND BEARING LINING	3H9	3H9
OPEN BEARING LINING	3H9	3H9
SHAFT END PLAY ADJUSTMENT UNIT	4H22	4H22
SHIMS (For Shaft End Play Adjustment)	-	-
SHAFT SEAL UNIT	3I24	3I24
SHAFT SEAL PLATE	3I22	3I22
VALVE STEM FOR OIL PRESSURE REGULATOR	-	-
VALVE GUIDE FOR OIL PRESSURE REGULATOR	-	-
VALVE SPRING FOR OIL PRESSURE REGULATOR	-	-
VALVE CAP FOR OIL PRESSURE REGULATOR	-	-
VALVE GASKET FOR OIL PRESSURE REGULATOR	-	-
OIL PUMP UNIT	-	-
OIL PUMP BODY	-	-
OIL PUMP DRIVING FLANGE	-	-
OIL PUMP GEAR ASSEMBLY (Reversible)	-	-
VIKING PUMP GASKET	-	-
OIL PUMP VALVE STEM	-	-
OIL PUMP VALVE PACKING GLAND	-	-
OIL PUMP VALVE PACKING GLAND WASHER	-	-
OIL PUMP VALVE PACKING	-	-
OIL FILTER VALVE HEAD	-	-

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(Number in parenthesis indicates quantity, if more than one is needed)

HOWE CORPORATION

TABLE 1: REPLACEMENT PARTS FOR MODELS A-23, AA-23, AW-23

PART DESCRIPTION	A-23* 3 x 3 S-FEED	AA-23, AW-23 3 x 3 S-FEED
OIL FILTER CARTRIDGE	-	-
OIL STRAINER UNIT	-	-
CONNECTING ROD UNIT (Includes Wrist Pin Bushing)	3R8 (2)	3R8 (2)
PISTON PIN BUSHING	3R10 (2)	3R10 (2)
CONNECTING ROD BEARING INSERTS (Includes 2 Halves)	3R15 (2)	3R15 (2)
VALVE MANIFOLD UNIT	-	-
VALVE MANIFOLD BODY	-	-
3/8" VALVE BONNET ASSEMBLY	-	-
1½" VALVE BONNET ASSEMBLY	-	-
SCALE TRAP CAP	-	-
SCALE TRAP SCREEN	-	-
RELIEF VALVE UNIT	-	-
COMPRESSION RING	3D28 (2)	3D28 (2)
COMPRESSION RING OVERSIZE *(20,40,60,80,100)	3D29* (2)	3D29* (2)
OIL RING	3D30 (4)	3D30 (4)
OIL RING-OVERSIZE *(20,40,60,80,100)	3D31* (4)	3D31* (4)
CYLINDER HEAD GASKET (One Piece)	3A32	3A32
CYLINDER HEAD GASKET (Two Piece)	-	-
VALVE BLOCK GASKET	3A11	-
BLIND BEARING GASKET	3H8	3H8
SEAL GASKET	3I23	3I23
OIL PUMP GASKET	-	-
OIL FILTER GASKET	-	-
3/8" VALVE BONNET GASKET	-	-
1½" VALVE BONNET GASKET (2" Valve for G-20)	-	-

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TABLE 1: REPLACEMENT PARTS FOR MODELS A-23, AA-23, AW-23

PART DESCRIPTION	A-23* 3 x 3 S-FEED	AA-23, AW-23 3 x 3 S-FEED
VALVE MANIFOLD SUCTION FLANGE GASKET	GK-OV-10	GK-OV-10
VALVE MANIFOLD DISCHARGE FLANGE GASKET	GK-OV-10	GK-OV-10
VALVE MANIFOLD SCALE TRAP GASKET	-	-
VALVE MANIFOLD RELIEF VALVE GASKET	-	-
RING GUIDE	3U	3U

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