4530
Floor Stand Reactors
Operating Instruction Manual



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PREFACE

Scope

These instructions describe the installation, operation and maintenance of Series 4530 Floor Stand Reactors offered in one and two liter sizes. They cover the basic steps to be followed installing these reactors and describe the function of all standard components. They are intended to be used in conjunction with several related instruction sheets listed in the following section. This information describes several components which are common to most pressure reaction equipment and includes safety precautions and other related information applicable to all reaction laboratories. The users should study all of these instructions carefully before starting to use these vessels so that they will fully understand the capabilities and limitations of the equipment.

Related Instructions

The following publications are also included to further your understanding of this instrument and its component parts:

No.	Description
201M	Limited Warranty
230M	Safety Precautions to be observed when operating Pressure Reaction Equipment
231M	Operating Instructions for Safety Rupture Discs
234M	Operating and Maintenance Instructions for Magnetic Drives
323M	Operating Instructions for Pressure Relief Valves
548M	Operating Instructions for 4848 Reactor Controllers
575M	Operating Instructions for 4848B Reactor Controllers
F0042	Health & Safety Assurance Certification

Safety Information

To avoid electrical shock, always:

1. Use a properly grounded electrical outlet of correct voltage and current handling capability.
2. Ensure that the equipment is connected to electrical service according to local national electrical codes. Failure to properly connect may create a fire or shock hazard.
3. For continued protection against possible hazard, replace fuses with same type and rating of fuse.
4. Disconnect from the power supply before maintenance or servicing.

To avoid personal injury:

1. Do not use in the presence of flammable or combustible materials; fire or explosion may result. This device contains components which may ignite such material.
2. Refer servicing to qualified personnel.

General Specifications

Electrical Ratings

Controller ratings are found in the Operating Instructions for the controller supplied with your reactor and on the controller data plate.

Before connecting a controller to an electrical outlet, the user must be certain that the electrical outlet has an earth ground connection and that the line, load and other characteristics of the installation do not exceed the following limits:

Voltage: Fluctuations in the line voltage should not exceed 10% of the rated nominal voltage shown on the data plate.

Frequency: Controllers can be operated from either a 50 or 60 Hertz power supply without affecting their operation or calibration.

Current: The total current drawn should not exceed the rating shown on the data plate on the controller by more than 10 percent.

Thermocouple: Unless otherwise specified, all Series 4848 Controllers operate with a Type J (iron-constantan) thermocouple. The total resistance of the thermocouple and the lead wires should not exceed 20 ohms. If the resistance of the thermocouple circuit is higher, it will reduce the sensitivity of the control system.

Explanation of Symbols

II	On position, full power heater switch
I	On position, half power heater switch
O	Off Position
~	Alternating Current (AC)
	This **CAUTION** symbol may be present on the Product Instrumentation and literature. If present on the product, the user must consult the appropriate part of the accompanying product literature for more information.
	This **CAUTION** symbol indicates that the surface may be hot.
	**Protective Earth (PE) terminal**. Provided for connection of the Protective Earth (green or green/yellow) supply system conductor.

Environmental Conditions

This instrument is intended to be used indoors.

Operating: 5 ºC to 35 ºC; maximum relative humidity of 80% non-condensing. Installation Category II (over voltage) in accordance with IEC 664.
Pollution degree 2 in accordance with IEC 664.

Altitude Limit: 0 to 6000 feet above sea level.

Storage: -25 °C and 65 °C; 10% to 85% relative humidity.

Provisions for Lifting and Carrying

The 4530 Floor Stand Reactors and its components are very heavy. Before moving ensure all cables are disconnected. Use proper and safe lifting techniques when installing or moving the 4530 Reactor and/ or its components.



Caution!
Do not use in hazardous atmospheres.

Intended Usage

This system has been designed for use as a high pressure reactor system. It has been designed, built, and tested to strict physical and electrical standards. However, it is the user's responsibility to install and operate it in conformance with local pressure and electrical codes.

If this equipment is used in a manner beyond its intended usage, the protection provided by the equipment may be impaired.

Cleaning & Maintenance

Periodic cleaning may be performed on the exterior surfaces of the instrument with a lightly dampened cloth containing mild soap solution. All power should be disconnected when cleaning the instrument.

There are no user serviceable parts inside the product other than what is specifically called out and discussed in this manual. Advanced troubleshooting instructions beyond the scope of this manual can be obtained by calling Company in order to determine which part(s) may be replaced or serviced.



Ensure that any hot surfaces have had adequate time to cool before cleaning or maintaining the reactor and/or its components.

User's Responsibility

All Reactors and pressure vessels are designed and manufactured with great care to assure safe operation when used within their prescribed temperature and pressure limits. But . . . the basic responsibility for safety when using this equipment rests entirely with the user; who must:

1. **Select a reactor or pressure vessel** which has the capability, pressure rating, corrosion resistance and design features that are suitable for its intended use. Engineers will be glad to discuss available equipment and material options with prospective users, but the final responsibility for selecting a reactor or pressure vessel that will perform to the user's satisfaction in any particular reaction or test must rest with the user .

   In exercising the responsibility for the selection of pressure equipment, the prospective user is often faced with a choice between over- or under-designed equipment. The hazards introduced by under-designed pressure vessels are readily apparent, but the penalties that must be paid for over-designed apparatus are often overlooked.

   Recognizing these criteria, reactors and pressure vessels are offered in several different styles, each designed for convenient use in daily operation within certain temperature and pressure limits, using gaskets, closures and other elements carefully selected for safe operation within the limits specified for that design. But in order to preserve the validity of these designs, all temperature and pressure limits must be observed, and no attempt should be made to increase these limits by making alterations or by substituting components which are not recommended by Company.

2. **Install and operate** the equipment within a suitable barricade, if required, with appropriate safety accessories and in full compliance with local safety codes and rules.

   All standard pressure vessels are provided with either a suitable relief device or a means to attach one (typically in the form of a plugged opening). When a pressure vessel is delivered without a pressure venting device, it is the customer's responsibility to provide pressure relief in order to protect the operator and the equipment from destructive high pressures. If you need more information or need help in selecting a proper relief device, please contact Company.

3. E**stablish training procedures** to ensure that any person handling the equipment knows how to use it properly.

4. **Maintain the equipment** in good condition and establish procedures for periodic testing to be sure the vessel remains structurally sound.

Unpack Carefully

Unpack the equipment carefully and check all the parts against the packing list. If shipping damage is discovered, report it immediately to the delivering carriers. The vessel, motor, heater, and temperature controller may be packed separately for convenience in shipping, but these parts are easily reassembled. Examine the components closely for any loose parts or shipping damage and be sure to check all layers of packing materials thoroughly so as not to overlook any parts which might otherwise be discarded.

INSTALLATION

Pressure and Temperature Limits

The working pressure and temperature at which any reactor or pressure vessel can be used will depend upon the design of the vessel and the materials used in its construction. Since all materials lose strength at elevated temperatures, any pressure rating must be stated in terms of the temperature at which it applies. The standard material of construction for Company is Type 316 Stainless Steel.

Limits for vessels made of other materials and for other operating temperatures can be obtained from Customer Service. No attempt should be made to increase these limits by making alterations or by substituting components that are not recommended by the Company. It must also be understood that lower pressure and temperature limits may be required for modified reactors and for vessels made of special alloys.

Limits for vessels will be determined by the physical characteristics of the vessel material and will be prescribed on an individual basis.

The maximum working pressure and temperature for any vessel is governed by the design of the vessel and the strength of the material from which it is constructed. There is also a close relationship between working pressure and temperature since the strength of any material will normally fall off as the temperature is increased. Temperature and pressure limits are also affected by the physical properties and temperature limits of the gaskets and seals used in the vessel, and by any valves, gages or other fittings attached to the vessel. Obviously, the safe operating pressure of any system can be no higher than that of its lowest rated component.

All reactors show the maximum safe operating pressure and temperature imprinted on the cylinder.

The standard material of construction for Company is Type 316 Stainless Steel. The working pressure and temperature in these one and two liter reactors must not exceed the following maximum limits:

Pressure Vessel and Temperature Limits

Vessel Material	Maximum Pressure	Maximum Temperature
T316SS	1900 psig	350 °C PTFE Flat Gasket
T316SS	1900 psig	275 °C FFKM O-ring
T316SS	1900 psig	220 °C FKM O-ring

ASSEMBLE THE REACTOR

These reactors require at least 10 square feet of workspace in a well-ventilated area with convenient access to an electric outlet, running water and a drain. This unit needs to be placed at least 10 inches away from walls or flammable materials.

1. Set the Temperature Controller near the reactor, leaving a space of at least six inches between the controller and the base of the reactor so that the controller will not be unduly affected by radiant heat. Connect the reactor to the controller using information contained in its Instruction Manual No. 548M or follow the steps below.

Labeled connections are provided on the rear panel of the controller.



Cooling Only:

The **Cooling** output connector is to be used only with Company cooling solenoid valve assemblies supplied with the appropriate cooling power cord.



Heating Only:

The **Heating** output connector is to be used only with Company heater assemblies supplied with the appropriate heater power cord.



Motor:
Secure the clamp on motor cord to the controller with the provided screw next to the motor socket for safety purposes.

The **Motor** output connector is to be used only with Company motor assemblies supplied with the appropriate motor power cord.

2A. **Vessels on movable cart.**
The motor is contained in the overarm assembly attached to the cart. The overarm assembly pivots to the rear to allow the vessel to be placed in the heater. The overarm is then aligned atop the vessel. Pull up on the release knob to allow the upper drive shaft to be connected to the magnetic stirrer.

2B. **Vessels on stationary stand.**



Bolt the stand to the floor using the holes in the base plate.

Loosen the panel screw holding the vessel retainer to the front midplate. Open the vessel retainer to allow the placement of the vessel assembly. If fixed head style, position the head in the slot located in the front midplate. If removable head style, place vessel assembly such that the split ring rests on midplate bracket. After installing the vessel, close the vessel retainer and retighten the panel screw. Pull up on the release knob located at the top of the belt guard. This knob is attached to the upper drive shaft and the universal coupling. Lifting the knob will allow the alignment of the universal coupling and the drive adapter attached to the magnetic drive. Turn the knob to align the slot in the drive adapter with the universal coupling.

3. Connect the power cord from the heater into the heater socket on the rear panel of the controller.

4. Plug the motor power cord into the motor socket on the rear of the controller.



Secure the clamp on the motor cord with the provided screw next to the motor socket for safety purposes.

5. Note the voltage requirement on the controller identification label on the back panel, and then plug the power cord into an appropriate outlet. Power for these reactors should be drawn from a 3-slot, grounded outlet capable of carrying up to the full current rating of the system.

6. Connect the thermocouple extension wire to both the thermocouple and to the controller in the "Primary Temp Input" position on the rear panel. Insert the thermocouple into thermowell.

7. Connect leads from accessory packages such as tachometer, pressure transducer and high temp cut-off to the designated positions on the back panel of the 4848 Controller.

8. Connect cooling water to internal cooling coil if installed.

9. Connect cooling water to the magnetic stirrer. See manual no. 234M.

10. Connect tubing to the rupture disc outlet and run to a safely vented area. See manual no. 231M.

11. Using the switch on the Temperature Controller, turn on the motor for a short run to check the stirrer drive system.

IDENTIFY THE VALVES

Gas Inlet Valve

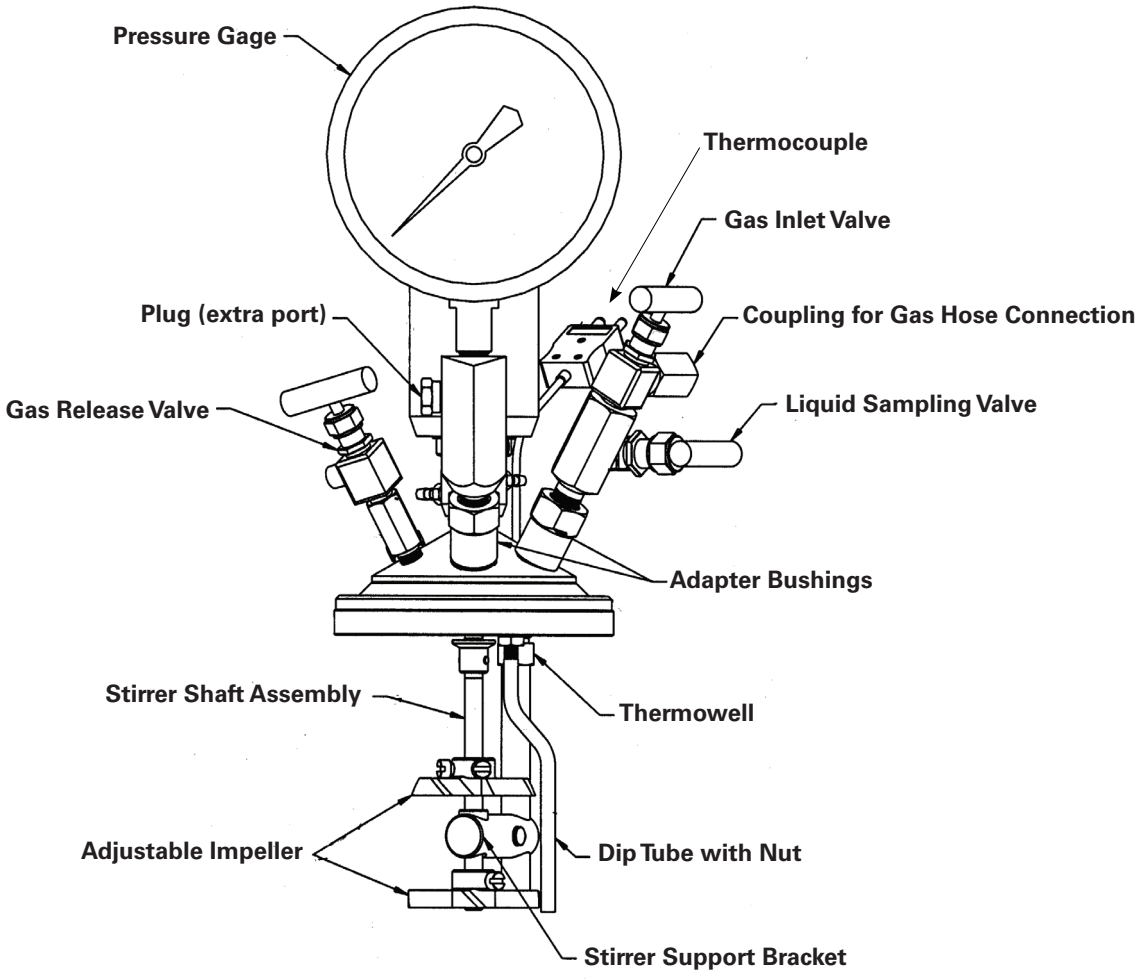
The gas inlet valve is easily identified when the bomb is open by noting that it is connected to a dip tube that extends to a point near the bottom of the bomb cylinder. This is an angle valve with an attached fitting which provides a socket for attaching the A495HC pressure hose furnished with the reactor.

Gas Release Valve

The gas release valve is connected to an opening that will not have any fitting installed on the underside of the head. Gas released from this valve will be drawn from the top of the reactor. The gas release port does include a 1/8th NPT thread on the underside of the head where an additional dip tube or catalyst addition device may be added. If one of these additions is made to this port then an additional valve must be added to the gage adapter to be used as a gas release valve.

Liquid Sampling Valve

The liquid sampling valve is attached to the same fitting as the gas inlet valve and connected to the same dip tube. With this arrangement, incoming gas is always introduced below the surface of the liquid and the operator is provided with a means for clearing the dip tube to be sure that any sample taken during a run will be representative of the charge. This can be done by opening the gas valve momentarily to force any liquid in the dip tube back into the reactor before withdrawing a sample from the sampling valve.



OTHER VESSEL HEAD FITTINGS

Safety Rupture Disc

There is a safety rupture disc attached to the head that is intended to rupture and release the pressure before it reaches a dangerous level. A metal tag wired to the safety head identifies the burst pressure at room temperature for that particular disc. A similar tag is furnished with each replacement disc. This tag must remain with the apparatus at all times so that both present and future operators will be aware of the disc rating. Users should read the discussion of rupture discs given in the Instruction Sheet No. 231M for a complete description of the characteristics of rupture discs and the precautions to be observed when operating pressure equipment protected by this type of safety device.

A typical pre-bulged disc can be used to 90% of the rating on the tag. For additional protection, the user should install an adequate and safe venting system for removing any toxic, flammable or volatile material which would be released if the rupture disc should burst. A connector for attaching 3/8" OD tubing to the discharge port of the rupture disc is provided for this purpose.

Type J Thermocouple

A Type J thermocouple in a 1/8" dia. stainless steel sheath is furnished with the reactor. Insert this thermocouple into the head thermowell and connect it to the thermocouple socket on the rear panel of the temperature controller using the A470E2 extension wire furnished with the reactor.

Pressure Gage

The pressure gage furnished with this reactor has a T316 Stainless Steel Bourdon tube. Gages are furnished in a variety of ranges to meet individual needs. Typically, the gage and the rupture disc are furnished as matched ranges. For applications where a gage is selected with a range under 1000 psi, a relief valve is added and set to protect the gage. A 1000 psi rupture disc is installed as the fail-safe vessel protection.

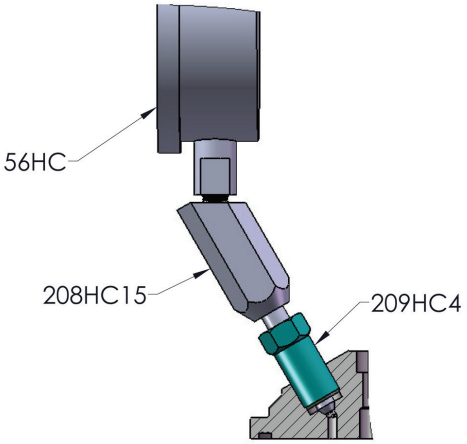
For highly corrosive applications where the vapor phase might corrode the stainless Bourdon tube, offers isolator assemblies in a variety of materials. These isolators with their internal piston isolate the vapors from the gage.

The gage adapter includes a ¼" NPT side port with a plug installed. This position may be used for a variety of fittings such as a needle valve, pressure transducer or relief valve.

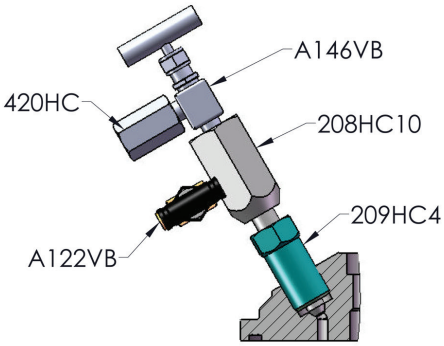
Gage and Valve Adapters

The pressure gage and the combined gas inlet and sampling valves are attached to the head with an adapter which allows these fittings to be drawn up tightly when facing in any direction. To attach these fittings to the head, screw the gage or valves firmly into the adapter, then run the 209HC4 bushing onto the threaded stem as far as it will go. Screw this assembly into the head until the nose of the adapter is seated; then back it off until the valve or gage is facing in the desired direction. Now hold the fitting firmly in place and close the joint by tightening the 209HC4 bushing. This connection can be made and broken repeatedly without destroying the sealing faces. A light coating of thread lubricant, such as No. 424HC2 High Temperature Anti-Seize Lube, applied to the threads and to the nose of the adapter will help to obtain a tight joint.

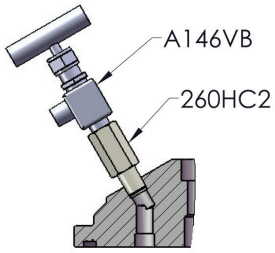
Note: *Do not use PTFE tape on the straight thread connections of the coned adapters and mating bushings. PTFE tape should only be used on the (NPT) threads such as the needle valves or gage connection.*



PRESSURE GAGE



GAS INLET/LIQUID SAMPLING VALVES



GAS RELEASE VALVE

HOW TO USE THE VESSEL

Fixed Head Vessels

First, lower the heater and push it aside before attempting to remove the split ring and cylinder. Raise the cylinder support holder to the bottom of the cylinder. Open the gas release valve to discharge any internal pressure.

To open the Vessel
Remove the split rings. For vessels with a confined, flat PTFE gasket, loosen the six bolts. For vessels with an O-ring closure, loosen the latches on each side of the split rings. The split ring halves can now be removed. The head with all attached fittings will remain in place. The cylinder can now be lowered away. Handle the cylinder carefully so as not to damage the stirring shaft and other internals.

Before Closing the Vessel
Examine the head seal carefully to be sure that it is in good condition. The seal should not have any nicks or be hardened, discolored or deformed. Examine the mating surfaces on the cylinder and head to be sure they are clean and free from burrs; then raise the cylinder up to the head.

To Close the Vessel
Put the two split ring halves around the head and cylinder flanges and fasten the latches or tighten the bolts as assembled before.

Removable Head Vessels

First, open the gas release valve to discharge any internal pressure. For vessels on a movable floor cart, lift the vessel out of the heater before attempting to remove the split ring and head. For vessels on a stationary stand, loosen the panel screw holding the vessel retainer, remove the vessel from the stand and set it on a table.

To Open the Vessel
Remove the split rings. For vessels with a confined, flat PTFE gasket, loosen the six bolts. For vessels with an O-ring closure, loosen the latches on each side of the split rings. The split ring halves can now be removed. The head with all attached fittings is free to be lifted from the cylinder. Handle the head carefully so as not to damage the stirring shaft and other internals.

Before Closing the Vessel
Examine the head seal carefully to be sure that it is in good condition. The seal should not have any nicks or be hardened, discolored or deformed. Examine the mating surfaces on the cylinder and head to be sure they are clean and free from burrs. Then carefully set head on cylinder.

To Close the Vessel
Slide the two split ring halves around the cylinder and head flanges. If equipped with a drop band, position the split ring halves such that the indentation for one of the halves is located 180 degrees away from the pressure gage. Slide the drop band over the split ring halves and tighten the set screw lightly to hold the band in place.

For vessels on a movable floor cart, place the vessel into the heater with the gage facing forward and swing the drive arm into position, connecting the rubber sleeve onto the spline coupling on the stirrer. For vessels on a stationary stand, place the vessel onto the midplate such that the drop band set screw fits into the slot on the back of the midplate.

> ***Note:*** *The following steps are common to both head configurations*

Sealing Vessels with PTFE Gaskets
If your split ring has compression bolts, tighten each of the bolts with the wrench furnished. Apply a firm but hard pull to each bolt. Or, if a torque wrench is available, apply 25ft-lbs to each bolt. Tightening should proceed in a criss-cross pattern rather than progressively around the circle. Let the vessel stand for about five minutes after the initial tightening; then tighten the bolts again. This will compensate for any tendency of the PTFE gasket to flow under the loading pressure.

Gas Connections
Gas connections are dependent on applications. For general usage, use the pressure hose furnished with the reactor. Screw the Type “A” coned pressure fitting into the adapter attached to the gas inlet valve and tighten the compression nut firmly. Do not use any thread dope on the coned fitting. The A495HC pressure hose is made of reinforced Nylon that can

be used at ambient temperature for all non-corrosive gases at pressures up to 2500 psig. For operations involving corrosive gases, this hose should be replaced with an A490HC hose which has a PTFE lining and a braided stainless steel outer covering. Both of these hoses have the same fittings. The A506HC all metal hose is also available in stainless steel and other corrosion resistant materials.

Pressurizing the Vessel

Check all valves carefully before admitting gas into the system. The liquid sampling valve must remain closed throughout the charging procedure. The gas release valve must also be closed unless the vessel is to be purged, or unless there is to be a continuous flow through the reactor during a run. Always make certain that the pressure in the gas tank is greater than the pressure in the vessel; otherwise liquid will be forced out of the vessel and into the gas tank when the inlet valve is opened. If there is any possibility that the tank pressure might not be high enough to force gas into the reactor, install a one-way check valve (optional) in the gas line to prevent any reverse flow. After the desired pressure has been reached, close the valves and disconnect the hose at the vessel end.

Alternate gas hoses with check valves are avalable from upon request.

Do Not Overfill the Vessel

Always watch the pressure gage closely when admitting gas so as not to exceed the maximum working limit. Remember that any subsequent increase in temperature will raise the pressure. Also, be sure that the amount of liquid placed in the vessel is carefully controlled. As a general rule, the liquid charge should not exceed two-thirds of the capacity of the cylinder. Too much liquid in the vessel can lead to development of dangerous pressures if sufficient space is not provided for expansion when the liquid is heated. This hazard is explained in greater detail in a warning statement included in the Safety Instruction Manual No. 230M.

Releasing Pressure

Use the gas release valve to reduce the pressure in the vessel if the reactor is accidentally overcharged when filling. Use this valve also to release any excess pressure during a run and to exhaust the vessel at the end of a run. If the discharge gases are flammable or toxic, discharge to an exhaust hood or to any other safe release point.

Withdrawing Liquid Samples

Liquid samples may be withdrawn from the sampling valve attached to the same adapter as the gas inlet valve whenever the vessel is pressurized. Always close the inlet valve before withdrawing a liquid sample and open the sampling valve cautiously because liquid will be discharged with considerable force. Be particularly careful if the temperature of the sample is above its boiling point at atmospheric pressure. If so, it will "flash" and be lost as soon as it is released from the vessel. This problem can be avoided by connecting an optional 4351 Sample Collection Vessel to the sampling valve to collect the liquid into an appropriate receiver. The addition of a small amount of gas can be used to clear the dip tube between liquid samples so that the next sample drawn through the tube will truly be representative of the mixture..

Initial Operating Test

Read all operating instructions carefully so as to be well acquainted with the correct procedures for handling the vessel and for operating the controller and other accessories. An initial operating test should be made, with only water, to check the apparatus before starting the first experimental runs. For this initial test, fill the cylinder not more than half full of water and run the temperature up to 150°C while checking the apparatus for leaks and observing the performance of the temperature controller.

ACCESSORIES

Internal Cooling Coils

Cooling coils can be installed in any of these reactors. Reactors purchased without a coil can have this feature added.

Standard cooling coils are made in serpentine configurations. A serpentine coil offers a smaller but effective cooling area and it does not interfere with the use of a liner. An optional spiral coil can be provided, which offers more surface area than a serpentine coil but it is more difficult to clean and, when installed, it prevents the use of some internals and liners. Plugs are available to seal the cooling coil opening when the coil is not used.

Variable Speed Electric Motor

Reactors are normally equipped with a DC variable speed motor supplied and controlled through the Series 4848 controller. Instructions for connecting and operating these motors are included in the controller instruction sheet No. 548M. This motor is usually installed in a drive system designed to produce stirring speeds from 0 to 600 rpm. Higher speeds (1000 or 1700 rpm) can be obtained by substituting larger diameter motor drive pulleys.

Air Motor

Variable stirring speeds from 100 to 2000 rpm can be obtained by replacing the standard motor with an A1393HC air motor. This motor operates on compressed air, which must be supplied at 40 psig minimum pressure with at least 10CFM available at that pressure. It is furnished with a speed control valve and oiler.

To operate reactors equipped with an air motor, connect the air hose to a compressed air line. Fill the oiler with SAE 10 oil and adjust the oiler to feed one drop per minute into the air stream. For long continuous runs at high speeds, the oiling rate should be increased to three drops per minute. If the motor becomes sluggish, flush it with a non-flammable solvent in a well-ventilated area. Disconnect the air line and muffler and pour a small amount of solvent into the inlet port. Rotate the shaft by hand in both directions for a few minutes; then connect the air line and run the motor until there is no further trace of solvent in the exhaust. If the muffler felts are dirty, wash them in solvent or replace them. Re-lubricate the motor with a squirt of oil into the chamber and reassemble. If it becomes necessary to disassemble the motor to replace the vanes, follow directions given in the instruction sheet published by the Gast Manufacturing Corp., Benton Harbor, Michigan.

Liners

Glass or PTFE liners can be furnished to fit most reactors. These liners slide into the cylinder. Although they will not keep corrosive vapors from reaching the surfaces of the cylinder and head, they make it much easier to add and remove liquid reactants, and they give some protection to the cylinder when working with corrosive solutions. It must be noted, however, that adding a liner will slow the heat transfer rate into the vessel, and it may be necessary to adjust the temperature control method to prevent overheating.

Liner Part Numbers

Cylinder Size	Glass Liner	PTFE Liner
1000 mL	398HC	398HCHA
2000 mL	399HC	399HCHA

Spare Parts Kit

Can furnish spare parts kits for these reactors which will provide a reserve supply of parts and tools sufficient to handle most normal replacements and emergency repairs during a year of heavy usage.

These kits contain replacement gaskets, packing, O-rings, shafts, bearings, and rupture discs. They can be ordered from any Dealer or direct from the Company. The order must specify the reactor size and indicate type of rupture disc, stirrer drive and whether it has a flat-gasket or O-ring seal. Always provide the reactor serial number (stamped on head and cylinder) to assure receipt of proper replacement parts.

EXPLOSION PROOF OPERATION

If the local safety code requires that equipment installed in the user's laboratory must be explosion proof, there are four possible ignition hazards to be considered:

1. **The Motor**
   The standard adjustable speed motor is not explosion proof, yet these motors are not unduly hazardous if operated in a well ventilated location where care is taken to prevent the accumulation of explosive gases or vapors. To eliminate any possible spark hazard originating at the motor, Company can furnish an air motor as described previously, or the reactor can be equipped with a variable speed, explosion proof motor that is approved for use in Class 1, Groups C & D, and Class 2, Groups E, F, & G atmospheres. Explosion proof motors are furnished with a temporary power cord and plug which are not explosion proof. The user should remove this temporary wiring and replace it with an explosion proof switch and wiring which will comply with the local electrical code.

2. **The Temperature Controller**
   The Series 4848 Temperature Controllers furnished with these reactors contain switches and other elements that are not explosion proof. The minimal spark hazard associated with these units can be resolved by installing the controller in a remote location outside of the hazardous area or by enclosing it in an approved explosion proof housing. If enclosed within a positive pressure, clean air housing, the discharge from the housing must be directed into a safe area. If requested, Company will furnish the long lead wires needed to mount the controller in a remote location. If the controller is to be installed in an explosion proof housing, the user must provide the necessary housing and installation.

3. **The Heater**
   The elements in the heater could be dangerous in an explosive atmosphere if the surface temperature of the element becomes high enough to ignite flammable vapors. This hazard must be evaluated for each individual installation since major modifications are required if the heater must be isolated from the surrounding atmosphere. Users who consider this a significant hazard are urged to contact the Company for further discussion and suggestions that might be helpful.

4. **The Wiring**
   The wiring provided with the standard reactor systems does not meet the standards prescribed for explosion proof operation. Optional, intrinsically safe barriers are available.

PERIODIC PRESSURE TESTS

Each cylinder used in a stirred reactor is tested under hydrostatic pressure to 1.3 times its maximum rating before it is released from the factory. Micrometer caliper measurements are taken during this test to check the deflection of the walls under pressure. Excessive deflection or failure of the metal to resume its original dimensions after pressure is released indicates that a cylinder is potentially unsafe and it will be rejected. Similar tests should be made at regular intervals during the life of each cylinder, and particularly whenever the user suspects that the equipment has been over-stressed or damaged.

Some laboratories maintain hydraulic test facilities and make it a rule that all pressure vessels must be tested at regular intervals. Records are kept of deflections at specific test pressures so that any increase in deflection becomes a warning that the metal has lost strength. Any cylinder that fails to return to its original dimensions after application of the prescribed hydrostatic test should be discarded as unsafe for further use.

Users who do not have pressure test facilities can return any pressure vessel to the factory for hydrostatic testing and overhaul. This should be done whenever the metal shows excessive damage from corrosion or whenever an over-pressure or other unusual occurrence raises any safety questions. **To return a vessel for repair, contact Company for a return authorization number.** Apparatus returned for testing and overhaul should be shipped prepaid to Company, 211-53rd Street, Moline, Illinois 61265. An order or letter of instructions should be mailed to the same address, as no repair work will be started without specific instructions and a Health & Safety Assurance Certification form (F0042) signed by a responsible user.

GENERAL MAINTENANCE NOTES

1. Periodically inspect all electrical wiring and pressure connections for excessive corrosion. Suspect parts should be replaced by components only supplied by Company.

2. Always use appropriate wrenches on all fittings and valves. Never use pliers or pipe wrenches.

3. Head and cylinder service fixtures are available for convenience and protection of components during maintenance of your reactor.

4. To reinstall straight thread (NPS) fittings to the head, screw the gage or valves firmly into the adapter.

   Run the bushing onto the threaded stem as far as it will go. Screw this assembly into the head until the nose of the adapter is seated; then back it off until the valve or gage is facing in the desired direction (no more than one full turn). Hold the fitting firmly in place and close the joint by tightening the bushing. This connection can be made and broken repeatedly without destroying the sealing surfaces. A light coating of thread lubricant, such as ture Anti-Seize Lubricant, applied to the straight threads and to the nose of the adapter will help to obtain a tight joint.

   Note: *PTFE tape should not be used on this joint.*

5. NPT (National Pipe Taper) threads should not be disassembled any more than necessary. It will become increasingly difficult to maintain a tight seal with these tapered threads if the joint is made and broken repeatedly. Grafoil tape or PTFE tape (if temp allows) should be used on all NPT threads.

6. Do not use oil or anti-seize lubricant on threads or fittings if the vessel is to be used with oxygen.

7. If your vessel is equipped with a loose compression ring be sure that it is in place on the head before attaching any head fittings. The compression ring cannot be installed after fittings have been screwed into the head.

8. Clean all threads and gas passages thoroughly and remove all tape fragments when overhauling a vessel. An ultrasonic bath is excellent for cleaning metal parts, but do not place a thermocouple probe, pressure gage, face seals or ball bearings in an ultrasonic bath. Periodic cleaning may be performed on the exterior surfaces of the reactor stand with a lightly dampened cloth containing mild soap solution. All power should be disconnected when cleaning.

9. Routinely inspect cap screws on split ring closure for lubrication and cleanliness. These screws should not be allowed to dry because the threads will seize. Regularly apply High Temperature Anti-Seize Lubricant (No. 424HC2) before this happens.

10. To operate reactors equipped with an air motor, connect the air hose to a compressed air line. For best torque and speed control the piping to the motor should be at least 3/8" IPS or larger. Fill the oiler with SAE 10 oil and adjust the oiler feed one drop per minute into the air stream. For long continuous runs at high speeds, the oiling rate should be increased to three drops per minute. If the motor becomes sluggish, flush it with a non-flammable solvent in a well ventilated area.

    Disconnect the air line and muffler and pour a small amount of solvent into the inlet port. Rotate the shaft by hand in both directions for a few minutes; then connect the air line and run the motor until there is not further trace of solvent in the exhaust. If the muffler is dirty, replace it. Relubricate the motor with a squirt of oil into the chamber and reassemble.

11. If servicing assistance is needed, contact Company directly at the address shown on the back of these instructions.

PARTS LISTS

Reaction Vessel Parts List

Consult the itemized list for your reactor provided along with this manual. For purpose of reactor identification, the following abbreviation/codes are used:

FH -	Fixed Head	LD -	Light Duty
RV -	Removable Head	HD -	Heavy Duty
FG -	Flat Gasket	OS -	O-Ring Seal
MD -	Mag Drive	FMD -	Footless Mag Drive

* For parts made from alternate materials use the codes shown below as a suffix to the standard part number.

CM -	Alloy 400	CC -	Alloy 20Cb3
CT -	Alloy 600	CA -	Titanium G2 or G4
CG -	Alloy B-2	CH -	Alloy C-276
CX -	Zirconium		

Cylinders

Part No.	Description	Code
236HC10	Cylinder, 1000 mL	FG
236HC20	Cylinder, 2000 mL	FG
2742HC10	Cylinder, 1000 mL	OS
2742HC20	Cylinder, 2000 mL	OS

Heads

Part No.	Description	Code
1370HC20	Head	RVFG LD MD
1370HC25	Head	RVFG LD FMD
755HC50	Head	RVFG HD MD
755HC55	Head	RVFG HD FMD
2252HC20	Head	FHFG LD MD
2252HC25	Head	FHFG LD FMD
2259HC20	Head	FHFG HD MD
2259HC25	Head	FHFG HD FMD
2740HC20	Head	RVOS LD MD
2740HC25	Head	RVOS LD FMD
2748HC20	Head	FHOS LD MD
2748HC55	Head	FHOS LD FMD
2750HC20	Head	FHOS LD MD
2750HC25	Head	FHOS LD FMD
2758HC20	Head	FHOS HD MD
2758HC25	Head	FHOS HD FMD

Internal Fittings

Dip Tubes

Part No.	Description
257HC26	Dip Tube with nut, 1000 mL
257HC27	Dip Tube with nut, 2000 mL

Shafts

Part No.	Description	Code
352HC6	Stub Shaft, mag. drive	RV LD
352HC9	Stub shaft, mag. drive	FH LD
1025HC39	Upper Shaft	FH HD
1025HC14	Upper Shaft	RV HD
2141HC5	Shaft, 1000 mL	FH LD FMD
2141HC6	Shaft, 2000 mL	FH LD FMD
2141HC44	Shaft, 1000 mL	MV LD FMD
2141HC45	Shaft, 2000 mL	MV LD FMD
2135HC	Shaft, 1000 mL	FH HD FMD
2135HC2	Shaft, 2000 mL	FH HD FMD
A449HC	Shaft assembly with coupling, 1000 mL	LD
A449HC2	Shaft assembly with coupling, 2000 mL	LD
A1030HC	Shaft assembly with coupling, 1000 mL	HD
A1030HC2	Shaft assembly with coupling, 2000 mL	HD
378HC	Coupling, stirring shaft	LD
379HC	Pin, shaft, coupling	LD
1028HC	Coupling, stirrer shaft	HD
1029HC	Pin, shaft, coupling	HD
447HC	Shaft bushing, PTFE	LD
1027HC	Shaft, bushing, PTFE	HD
448HC	Shaft with 447HC bushing, 1000 mL	LD
448HC2	Shaft with 447HC bushing, 2000 mL	LD
1025HC	Shaft with 1027HC bushing, 1000 mL	HD
1025HC2	Shaft with 1027HC bushing, 2000 mL	HD
A2148HC2	Impeller with set screws, 2.28" diameter	RV LD FMD
A2148HC3	Impeller with set screws, 2" diameter	FH LD FMD
A2138HC4	Impeller, 2" diameter	HD FMD
A358HC2	Impeller with set screws, 2.28" diameter	
A358HC5	Impeller with set screws, 2" diameter	
358HC2F	Set screws for impeller	

Stirrer Support Brackets

Part No.	Description	Code
A380HC	Stirrer Support Bracket	FG
A1404HC	Stirrer Support Bracket	OS

Stirrer Support Brackets (Continued)

Part No.	Description	Code
380HCF	Cap screw for A380HC/ A1404HC bracket	
299HC	Bushing PTFE for A380HC/ A1404HC bracket	
299HCKF	Bushing, graphite for A380HC/ A1404HC bracket	

Thermowell

Part No.	Description
265HC7	Thermowell 1000ml
265HC12	Thermowell 2000ml

Gaskets & Seals

Part No.	Description	Code
48HC	Gasket, silver; thermowell and LD drive	
48HCFG	Gasket, gold plated; thermowell and LD drive	
315HC2	Head Gasket, PTFE	FG
2741HCJV	O-ring FKM	OS
2741HCJK	O-ring FFKM	OS

External Fittings

Part No.	Description	Code
94CAAD	Plug, 1/4" NPTM	
A122VB	Needle Valve, 1/8" NPTM (Liquid Sample)	
A146VB	Needle Valve, angled 1/8" NPTM (Gas Inlet & Gas Release)	
208HC10	Valve adapter, two 1/8" NPTF	
208HC15	Gage adapter, angled, two 1/4" NPTF	
234HC	Compression Ring	
209HC4	Bushing	
260HC2	Valve extension, 1/8" NPT (Gas Release)	
288VBAD	Male Connector, 3/8T-1/4" NPTM	
396HC3	Stirrer Plug	LD
35HC	Compression Nut, for plug	LD

External Fittings (Continued)

Part No.	Description	Code
420HC	Adapter, 1/8" NPTF to A socket (Gas Inlet)	
A472E2	Thermocouple, 1000 mL	
A472E6	Thermocouple, 2000 mL	
A888HC2	Safety Rupture Disc assembly without disc (see 231M)	
A2685HC	Cooling Sleeve assembly	LD
A740HC	Cooling Sleeve assembly	HD

Magnetic Stirrers

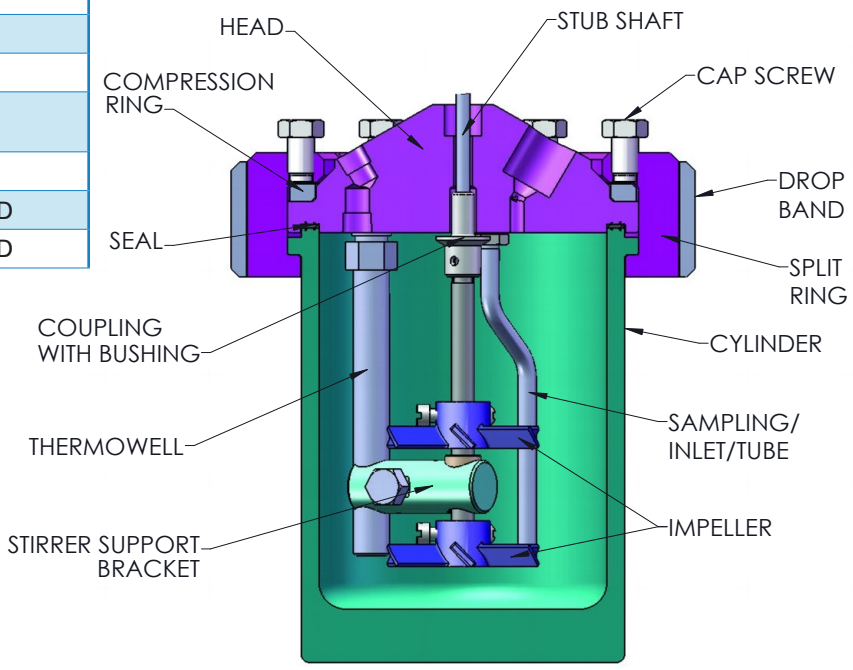
**See manual 234M for a full list of stirrers and parts.*

Split Rings and Accessories

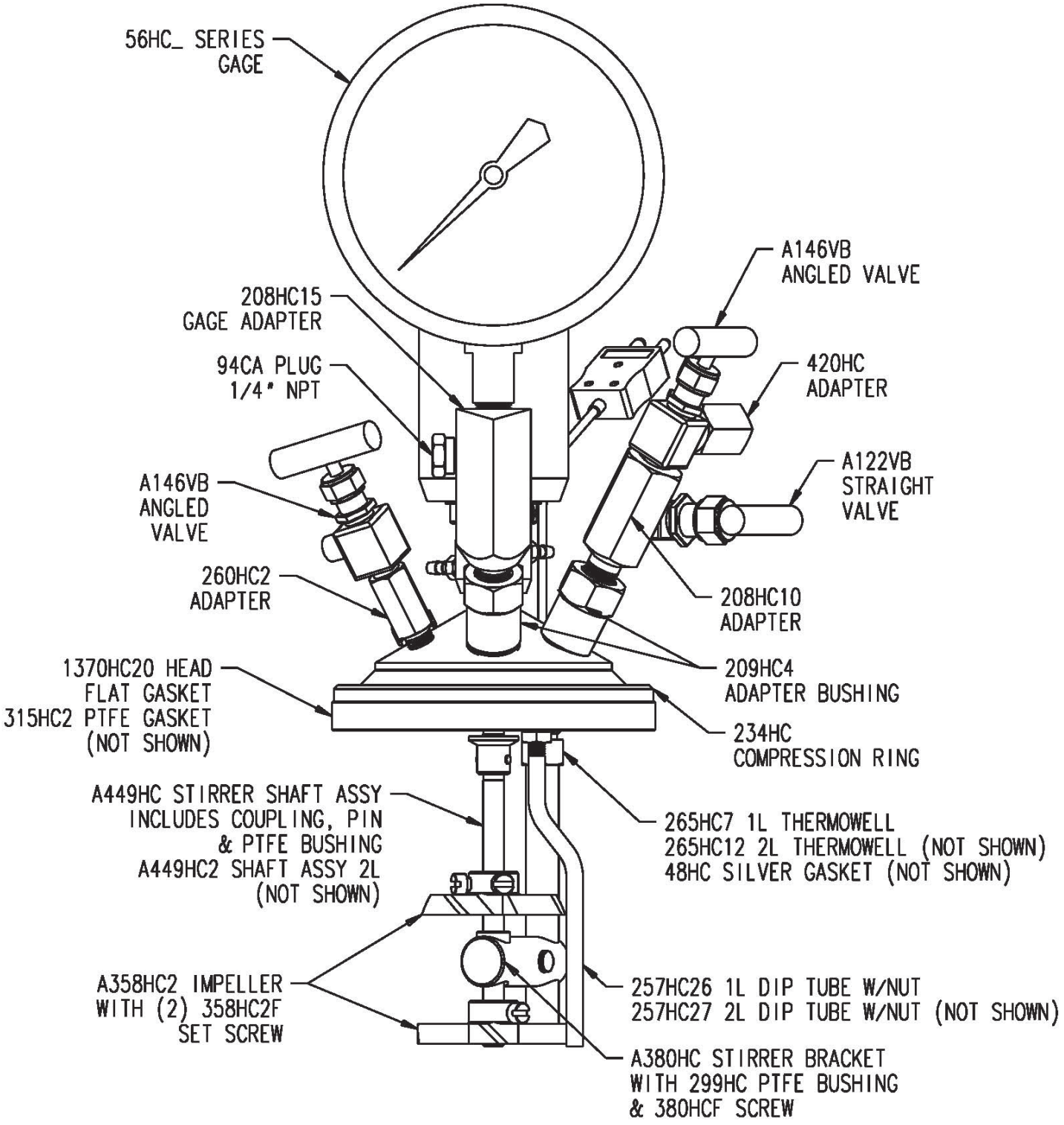
Part No.	Description	Code
A232HC	Split ring pair with cap screws	RVFG
A2255HC3	Split ring pair with cap screws, latches	FHFG
232HCFDE	Cap screw, for A232HC and A2255HC3	
2245HC	Split ring, pair	RVOS
A2243HC	Split ring, pair, with latches	FHOS
A233HC	Drop band with screw	RV

Gages

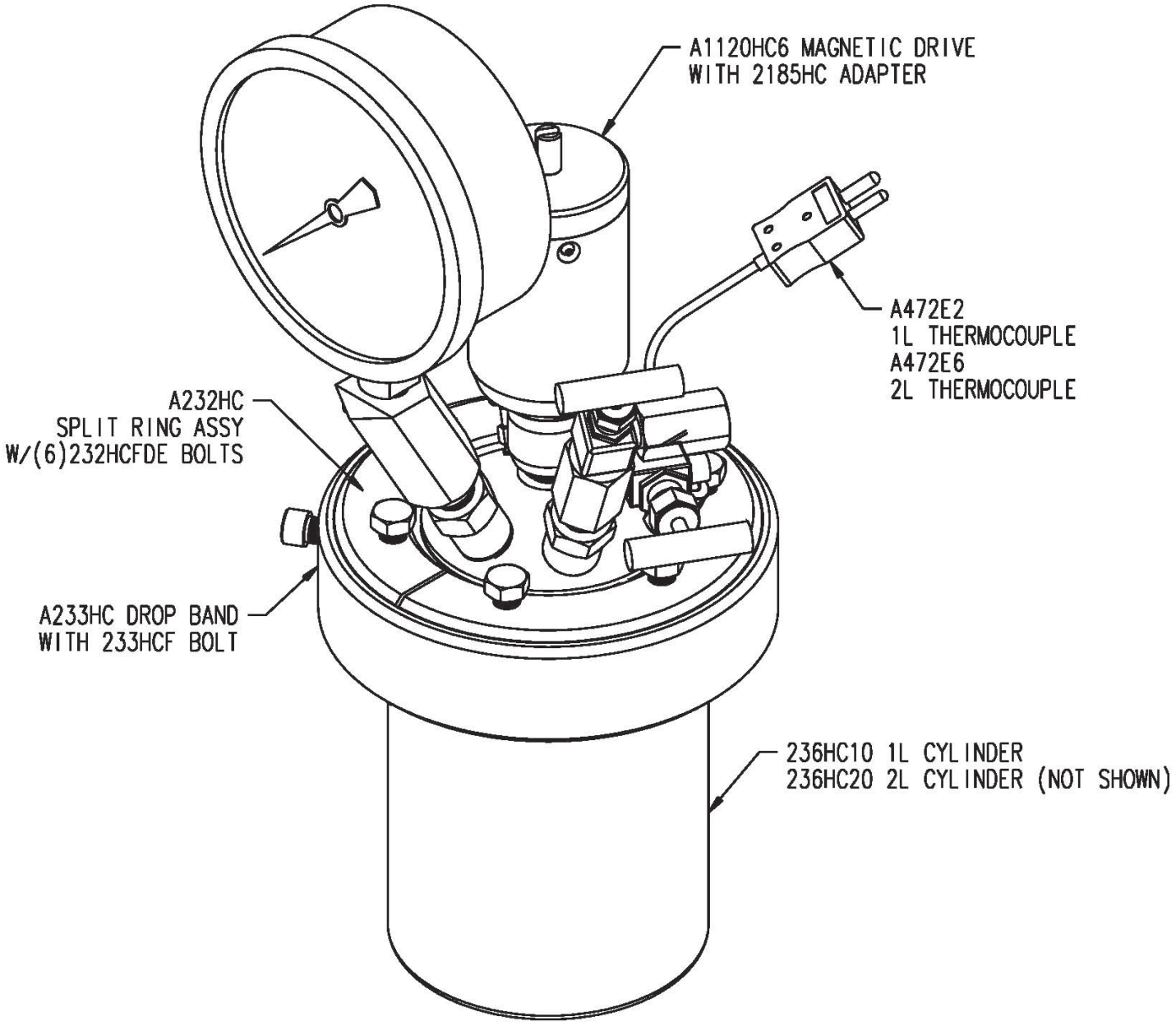
Part No.	Description
56HCPA	Pressure gage, 4-1/2", 0-100 psi
56HCPB	Pressure gage, 4-1/2", 0-200 psi
56HCPC	Pressure gage, 4-1/2", 0-600 psi
56HCPD	Pressure gage, 4-1/2", 0-1000 psi
56HCPF	Pressure gage, 4-1/2", 0-2000 psi



Removable Head Style Parts Lists

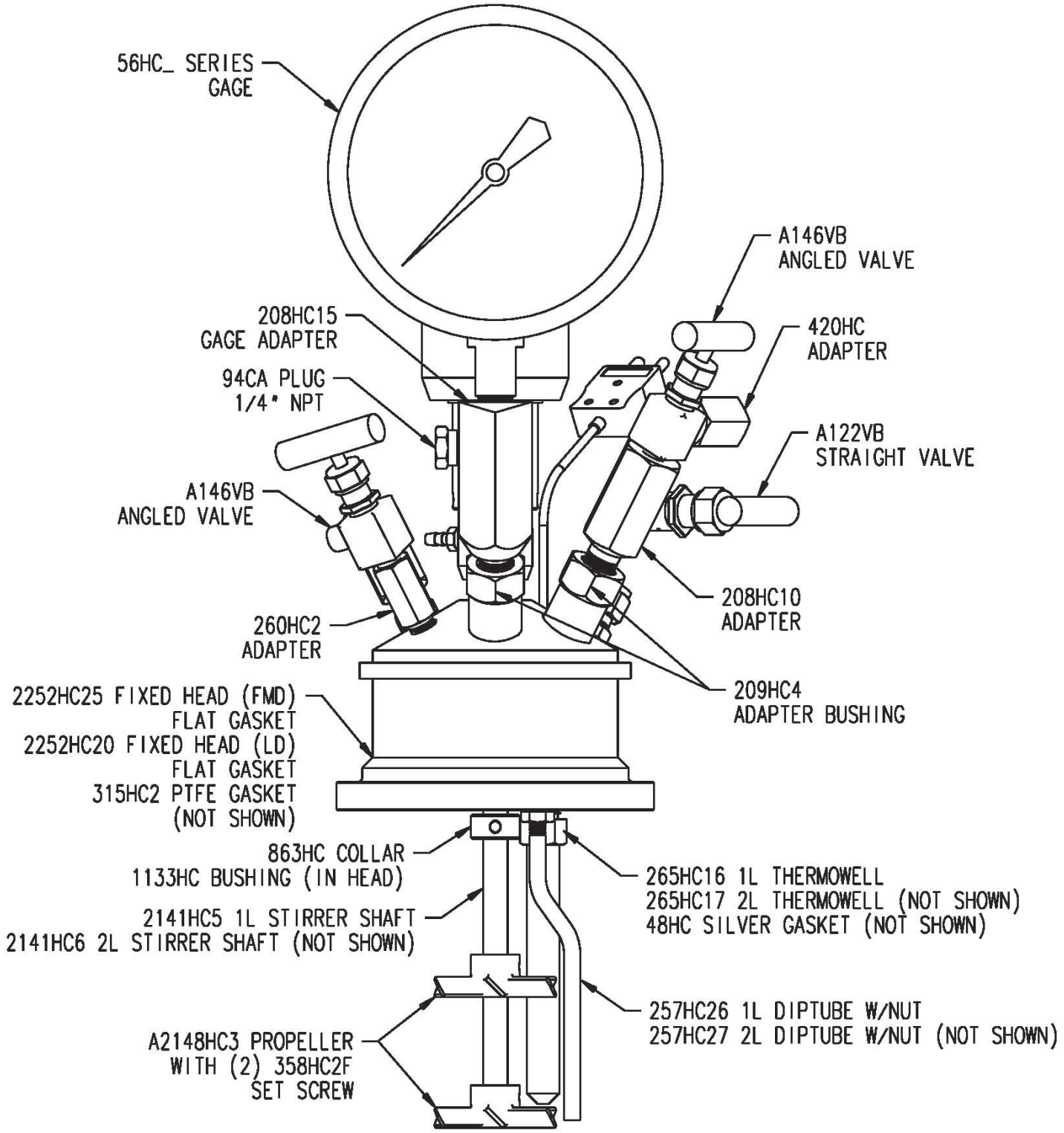


Removable Head Flat Gasket
Front View

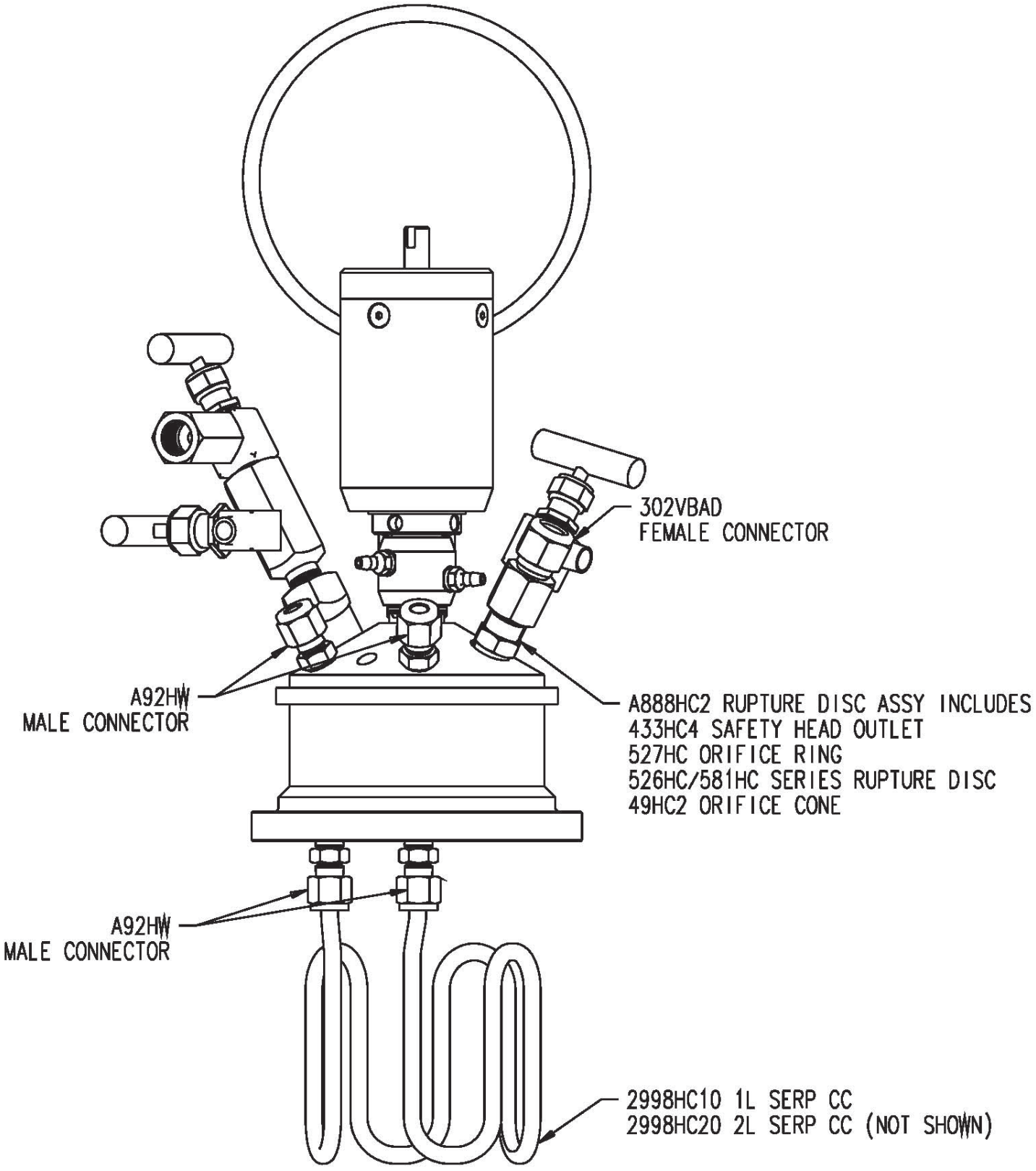


Removable Head Flat Gasket

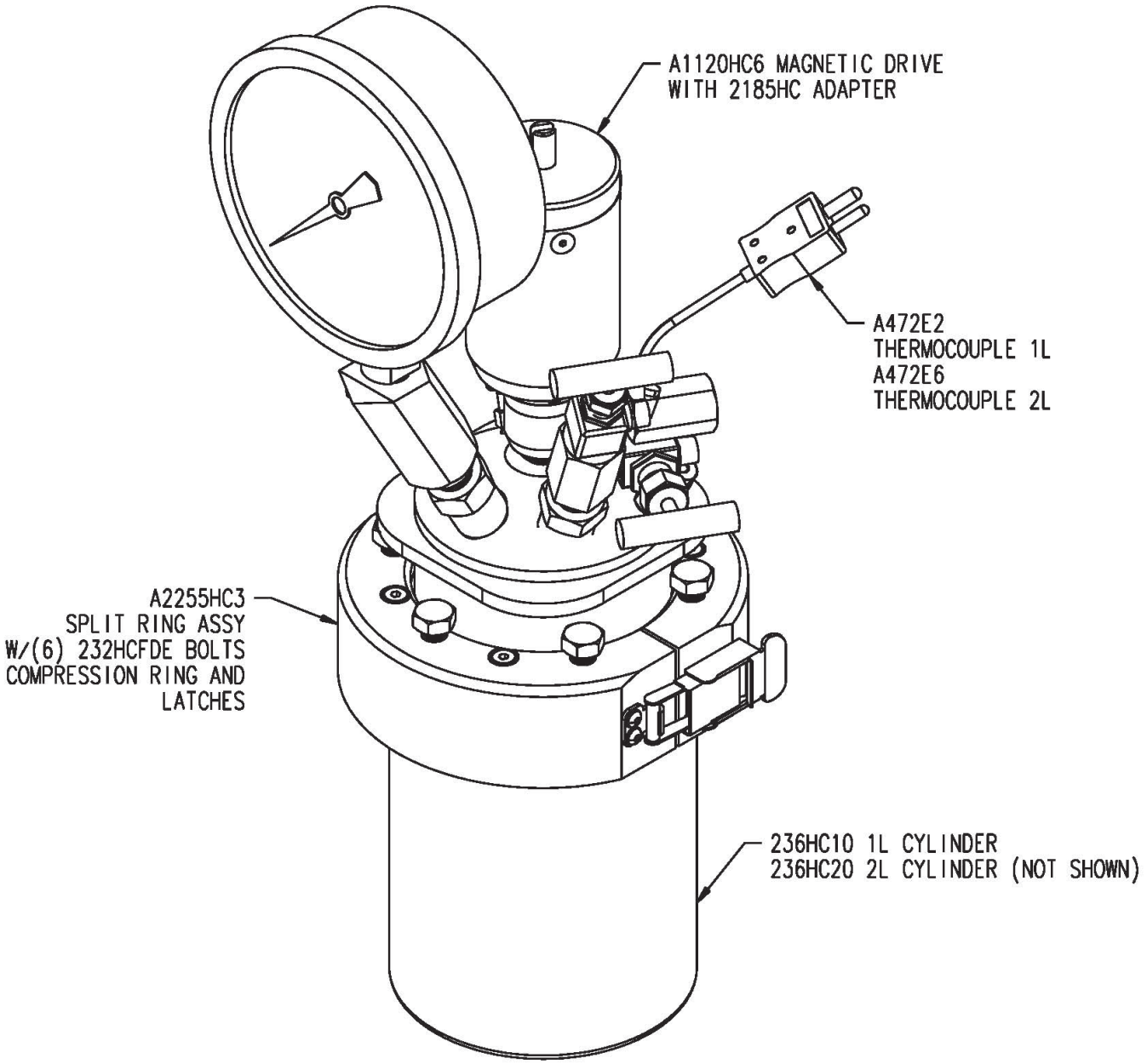
Fixed Head Style Parts Lists



Fixed Head Flat Gasket
Light Duty Footless Mag Drive
Front View



Fixed Head Flat Gasket
Back View



Fixed Head Flat Gasket

OVERARM PARTS LIST

Motor

Part No.	Description
A388E6	Air Motor
A388EES	Motor 1/4 HP VS 90 VDC
A388E2ES	Motor 1/2 HP VS 90VDC
A388EEQ	Motor 1/4 HP EXP VS 90 VDC
A388E2ET	Motor 1/2 HP VS 180 VDC
A388EER	Motor 1/4 HP EXP VS 180 VDC
A388EET	Motor 1/4 HP VS 180 VDC

Driven Pulley Assembly

Part No.	Description
A2519HC	Driven Pulley Assembly
706HC2	Pulley, Driven
725HC	Support Hub
730HC	Ball Bearing
731HC	Snap Ring Internal 2"
732HC	Snap Ring External 1"
2429HC	Bushing PTFE

Upper Drive Shafts

Part No.	Description	Code
A742HC14	Upper Drive Shaft 9.82" (cart only)	LD
A742HC7	Upper Drive Shaft 7.3" (cart only)	HD
A2564HC	Upper Drive Shaft, 1/4 hp, A1120HC	LD
A2564HC2	Upper Drive Shaft, 1/4 - 1/2 hp, A1180HC	HD

Shaft Couplings

Part No.	Description
A722HC	Shaft Coupling Rubber (cart only)
2352HC	Shaft Coupling .50, Universal

Release knobs

Part No.	Description
726HC	Release Knob, .50 Shaft

Drive Pulleys (Motor)

Part No.	Description
695HC5	Pulley 600 RPM
695HC3	Pulley 1000 RPM
695HC2	Pulley 1700 RPM

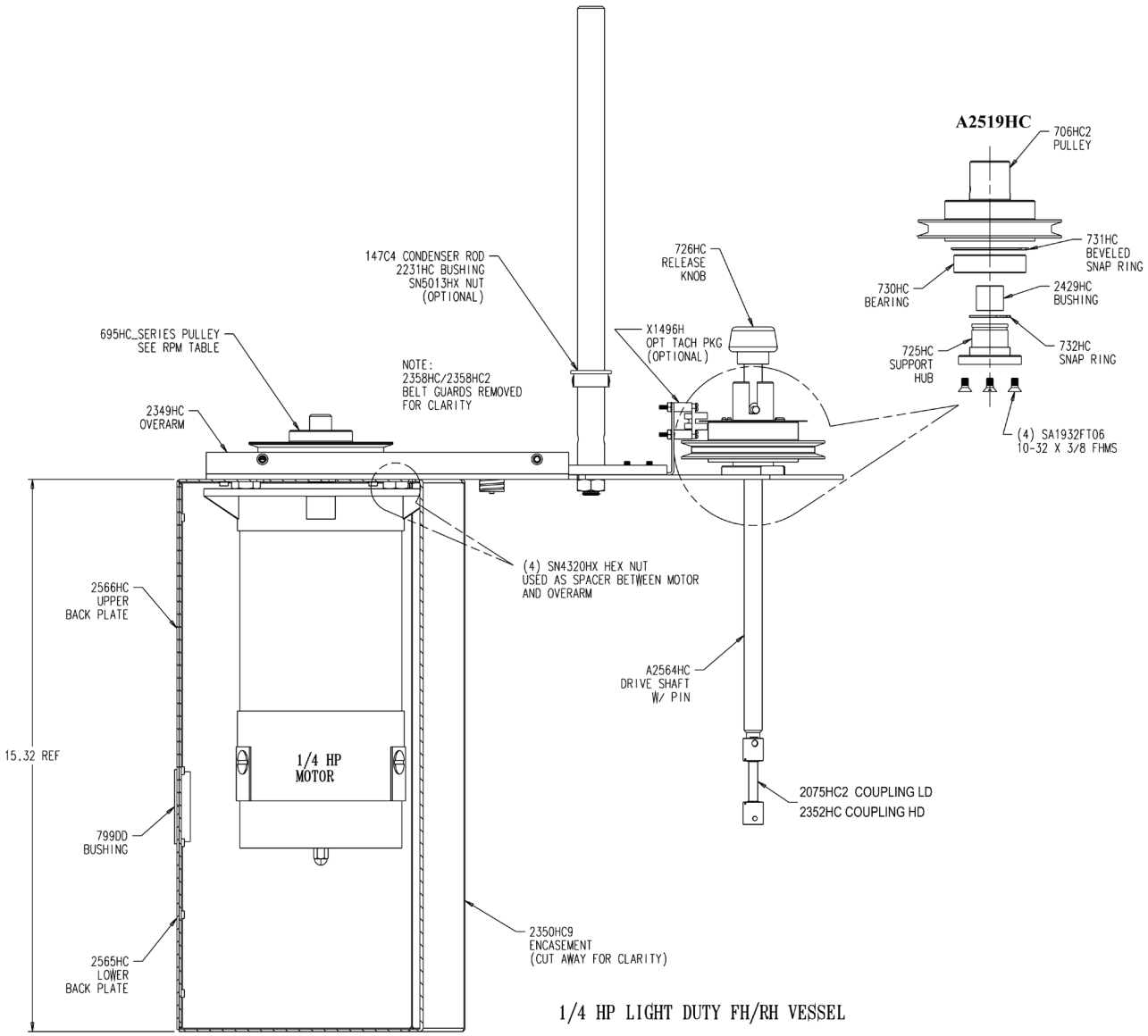
Pulley Belt Combinations (HD Drive)

HD Pulley	Cart-Belt	FH-Belt
695HC5	728HC	728HC5
695HC3	728HC	728HC5
695HC2	728HC3	728HC6

Optional Tach Parts

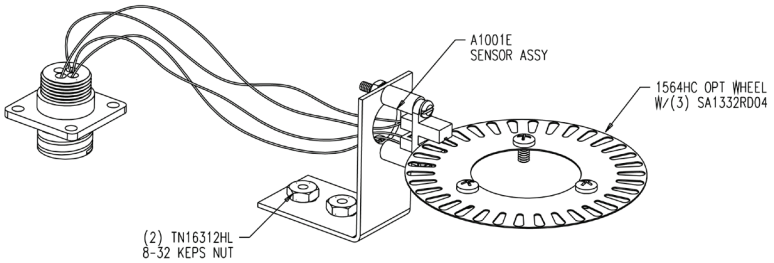
Part No.	Description
1564HC	Optical Wheel
A1001E	Tach Sensor Assembly (9.0"L)

HEAVY DUTY OVERARM ASSEMBLY



1/4 HP LIGHT DUTY FH/RH VESSEL

RPM TABLE			
RPM	PULLEY	DIA.	BELT
600 RPM	695HC5	ø1.75	728HC5
1000 RPM	695HC3	ø3.00	728HC5
1700 RPM	695HC2	ø4.00	728HC6

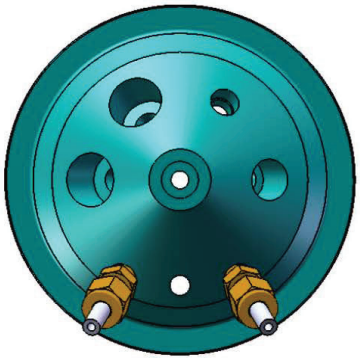


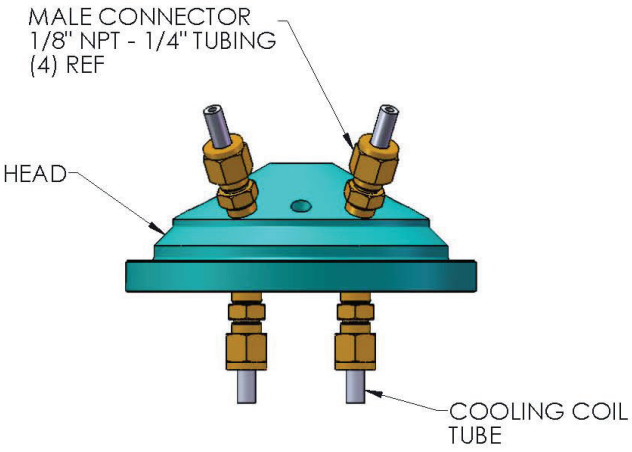
X1496H
OPT TACH PKG

COOLING COIL PARTS LIST

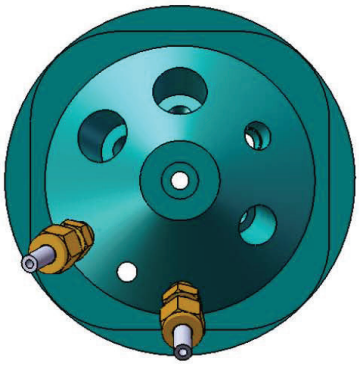
Part No.	Description
2998HC10	Cooling Coil, Serpentine 1L
2998HC20	Cooling Coil, Serpentine 2L
A92HWAD	Male Connector, T316SS*
217VBAD	Nut for tube 1/4", T316SS*
218VBAD	Ferrule for tube 1/4", T316SS*
885HC2	Plug, 1/4" T Cap & Nut

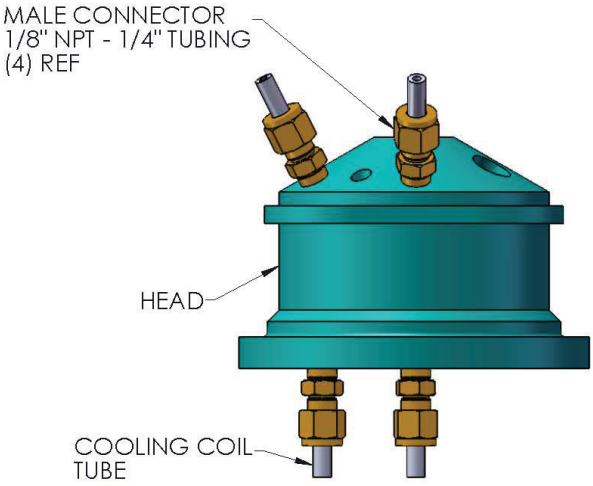
** Used in both top and bottom on the head. Change to appropriate material suffix for special alloy vessels for internal connection.*





REMOVABLE HEAD





FIXED HEAD

HEATERS PARTS LIST

Heaters on Moveable Floor Cart

Part No.	Description
A735HCEB	Heater Assembly 1500W 115V 1&2L
A735HCEE	Heater Assembly 1500W 230V 1&2L
A735HC3EB	Heater Assembly 1000W 115V 1L Bottom Drain
A735HC3EE	Heater Assembly 1000W 230V 1L Bottom Drain

Heating Elements for A735HC Series Heaters

Part No.	Description	For Use With
662HCEB	Heating Element 1350W 115V	A735HCEB
662HCEE	Heating Element 1500W 230V	A735HCEE
662HC4EB	Heating Element 1000W 115V	A735HC3EB
662HC4EE	Heating Element 1000W 230V	A735HC3EE

Heaters on Floor Stand

Part No.	Description
A2256HC12EB	Heater Assembly 1000W 115V 1L w/ thermowell
A2256HC12EE	Heater Assembly 1500W 230V 1L w/ thermowell
A2256HC22EB	Heater Assembly 1500W 115V 2L w/ thermowell
A2256HC32EE	Heater Assembly 2000W 230V 2L w/ thermowell

Heating Elements for A2256HC Series Heaters

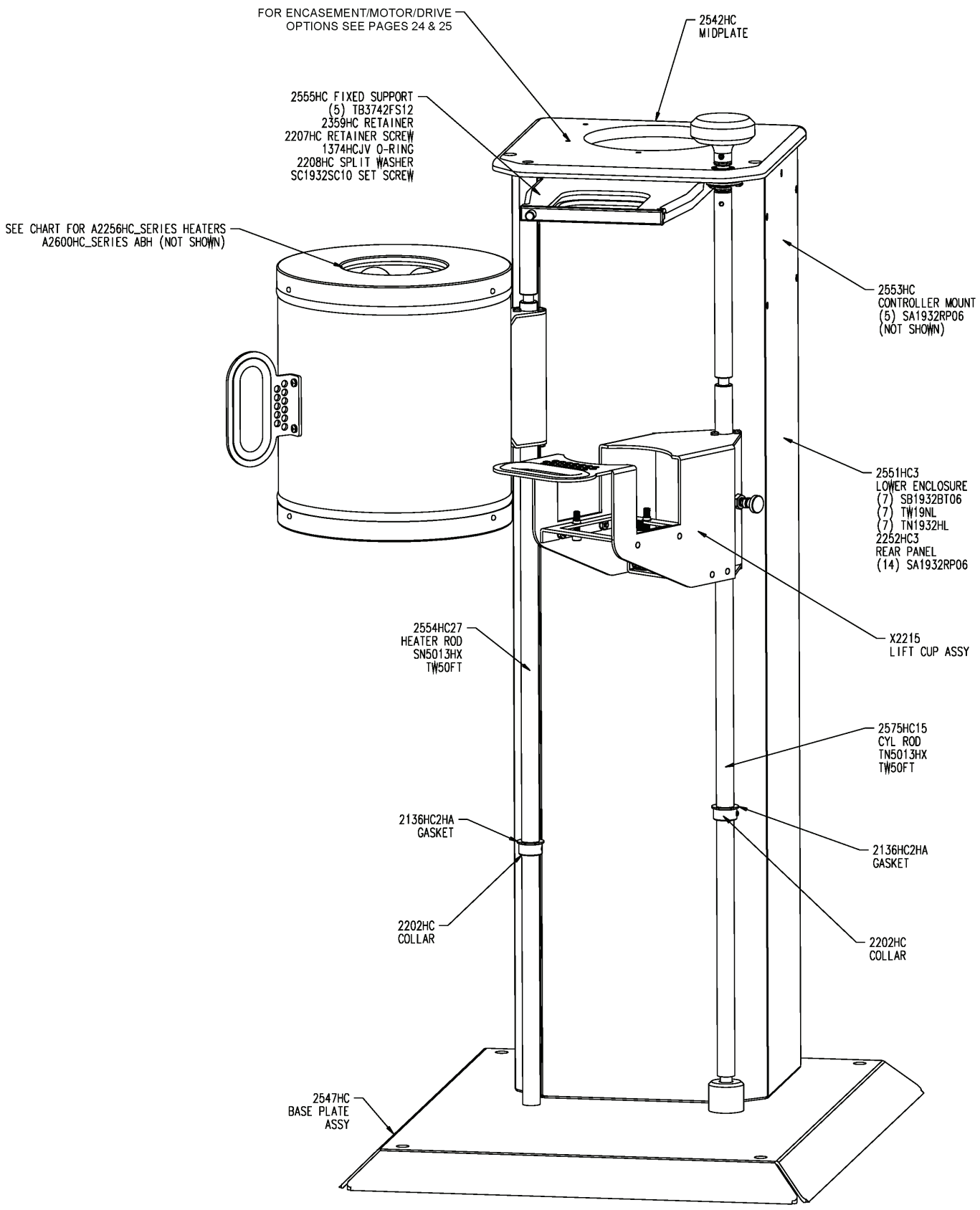
Part No.	Description	For Use With
1603EEB	Heating Element 1000W 115V	A2256HC12EB
1603E4EE	Heating Element 1500W 230V	A2256HC12EE
1603E2EB	Heating Element 1500W 115V	A2256HC22EB
1603E2EE	Heating Element 1500W 230V	A2256HC22EE
1603E3EE	Heating Element 2000W 230V	A2256HC32EE



Moveable Floor Cart



Floor Stand



Floor Stand Arrangement