4550
Floor Stand Reactors
Operating Instruction Manual





PREFACE 3

Scope 3
Related Instructions 3
Intended Usage 3
Safety Information 3
General Specifications 3
Explanation of Symbols 4
Environmental Conditions 4
Unpack Carefully 4
Provisions for Lifting and Carrying 4
Cleaning & Maintenance 4
User's Responsibility 5

Fixed Head or Removable Head Design 6

Fixed Head or Removable Head Vessel Design 6
Flat PTFE Gasket or Self Sealing O-ring Closure 6

INSTALLATION 7

Pressure and Temperature Limits 7
Assemble the Reactor 8

IDENTIFY THE VALVES 10

Gas Inlet Valve 10
Gas Release Valve 10
Liquid Sampling Valve 10

OTHER VESSEL HEAD FITTINGS 11

Safety Rupture Disc 11
Type J Thermocouple 11
Pressure Gage 11
Gage and Valve Adapters 11

ACCESSORIES 12

Internal Cooling Coils 12
Variable Speed Electric Motor 12
Air Motor 12
Liners 12
Spare Parts Kit 12
Pneumatic Lift for Fixed Head Vessels 13

HOW TO USE THE VESSEL 14

Fixed Head Vessels 14
- To open the Vessel 14
- Before Closing the Vessel 14
- To Close the Vessel 14

Removable Head Vessels 14
- To Open the Vessel 14
- Before Closing the Vessel 14
- To Close the Vessel 14
- Sealing Vessels with PTFE Gaskets 14
- Gas Connections 14
- Pressurizing the Vessel 15
- Do Not Overfill the Vessel 15
- Releasing Pressure 15
- Withdrawing Liquid Samples 15
- Initial Operating Test 15

MAINTENANCE 16

General Maintenance Notes 16
Periodic Pressure Tests 17

PARTS LISTS 18

Reaction Vessel Parts List 18
Overarm Parts List 21
Cooling Coil Parts List 22
Heaters Parts List 23

DRAWINGS 24

4553 - 1 Gallon Fixed Head Stand Assembly 24
4554 - 2 Gallon Fixed Head Stand Assembly 26

PREFACE

Scope

These instructions describe the installation, operation and maintenance of Series 4550 Floor Stand Reactors offered in two sizes, 1 and 2 Gallon (3.75 and 7.5 liter). They cover the basic steps to be followed when 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 on the previous page. This information describes several components that 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*
FX004	*Health & Safety Assurance Certification*

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.

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 Reactor Controllers operate with a Type J (iron-constantan) thermocouple. The total resistance of the thermocouple and the lead wires should not exceed 100 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.



Caution!
Do not use in hazardous atmospheres.

Operating: 15 °C to 35 °C; 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 2000 meters above sea level.

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

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.

Provisions for Lifting and Carrying

The 4550 Floor Stand Reactor and its components are very heavy. Before moving ensure all cables are disconnected. Use proper and safe lifting techniques when installing or moving the 4550 Reactor and/ or its components.

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. **Establish 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.

Fixed Head or Removable Head Design

Series 4550 Series Reactors are furnished with two structural options in addition to the size, pressure range, stirrer motor, controller and similar options. These are:

Fixed Head or Removable Head Vessel Design

In the fixed head design, the head of the vessel may remain fixed in the reactor support stand. All attachments to the head, gas and liquid feed and discharge lines, cooling water, vapor take-off and condenser, thermocouple, and any electrical leads can remain permanently in place. The reactor is opened by removing the cover clamp sections and lowering the cylinder away from the head.

In the removable vessel design, the entire vessel must be removed from the support stand for charging, product recovery, and cleaning.

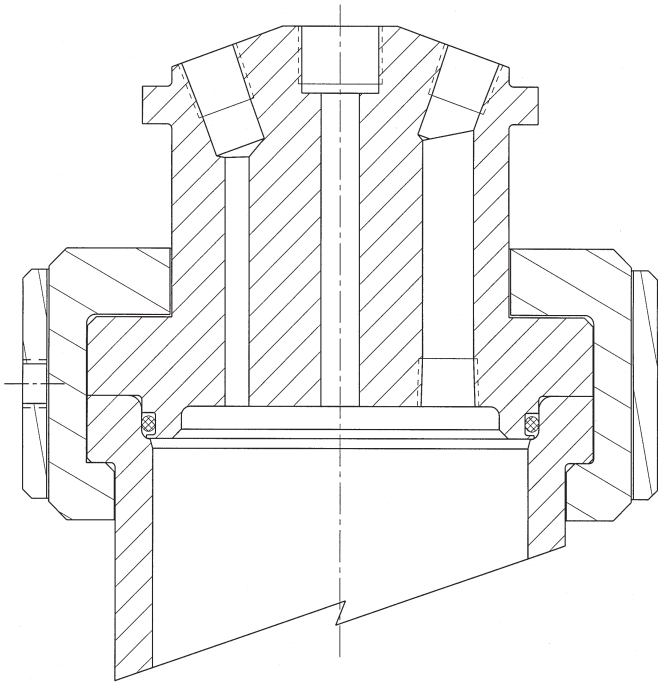
There is no difference in the pressure or temperature limits or basic operating instructions based upon the fixed head or movable vessel options. There are differences in the design of the stand components which adapt the vessels to the support system.

Flat PTFE Gasket or Self Sealing O-ring Closure

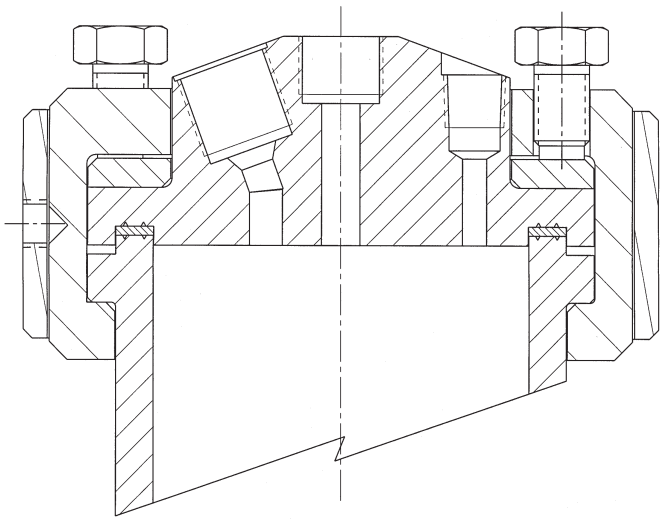
The flat gasket is held in a recess in the vessel head and a machine pilot on the cylinder closes the recess to completely contain the gasket. The split ring closure used with this gasket has six cap screws which must be tightened to develop the loading on the gasket.

The self sealing design features an O-ring retained in a groove on the vessel head. This design is self sealing and the split ring used with this sealing system does not require nor have the cap screws used with the flat gasket.

Maximum temperatures of a given system are dependant upon the material of construction and type of seal. Other accessories may limit operating temperature. The flat PTFE gasket can be used to operating temperatures as high as 350 °C. The flat flexible graphite gasket can be used to operating temperatures as high as 500 °C. The maximum temperature of the vessels equipped with O-ring seals depends upon the material used for the O-ring. The most common material is a fluoroelastomer (FKM) which has a 225 °C maximum operating temperature limit.



Fixed Head with O-ring



Moveable Head with Flat Gasket

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 working pressure and temperature in these one and two gallon 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	300 °C FFKM O-ring
T316SS	1900 psig	225 °C FKM O-ring

Assemble the Reactor

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

1. Set the stand in the workspace.

2A. **Removable Vessels.**

First pivot the overarm assembly to the back of the support stand.

The pressure vessel has been shipped as a complete assembly; it may be easiest on the initial setup to place the entire pressure vessel assembly into the heater. Note: The complete assembly does not need to be removed from the heater during opening and closing operations. It is designed so that the cylinder can remain in the heater while the head and split rings are attached or removed.

Once the vessel assembly is in place rotate the magnetic stirrer by hand to make sure that it turns freely. Then move the overarm back into position above the vessel. The knob on the top of the overarm will raise the upper shaft with coupling for attachment to the adapter on the top of the magnetic stirrer. Push down and rotate the upper shaft to bring these components into alignment.

Occasionally the motor housing and overarm assembly may vibrate out of the standard position. If the upper shaft is not in alignment with the center of the top of the magnetic stirrer it will be necessary to loosen the bolt which attaches the motor housing to the support stand. Remove the motor housing panel; there is a single bolt that runs through the lower housing support and the top shelf of the floor stand. Once the bolt is loosened, rotate the housing the required amount, connect the upper shaft to the magnetic stirrer and then tighten the motor housing bolt.

2B. **Fixed Head Reactor.**



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

Loosen the panel screw of the vessel retainer mounted on the midplate of the support stand and open the retainer bracket.

The pressure vessel has been shipped as a complete assembly. It is necessary to loosen the split ring bolts and remove the split ring. Lift the head assembly out of the cylinder and slide it into the midplate of the stand. Close the retainer bracket. The cylinder should be placed in the cylinder lift bracket.

Rotate the magnetic stirrer by hand to make sure that it turns freely.

Connect an air line to the 1/4" quick disconnect fitting at the base of the support stand. This pneumatic lift package will raise or lower the cylinder. It may also be used for the heater. The lever on the side panel of the support frame controls the lift motion.

The pneumatic package includes a pressure regulator with gage located inside of the support stand housing. It can be accessed by removing the back panel of the support stand. The regulator has been preset to 50 psi. The regulator can be adjusted by lifting up on the cap. Rotate clockwise to increase pressure, counter-clockwise to decrease the amount of pressure sent to the pneumatic lift cylinder. Press the cap back down after setting the pressure.

The flow control valves have been preset for optimum performance. Both the speed and lifting capacity of the pneumatic lift package can be adjusted with the flow control valves located on the input and output ports of the pneumatic cylinder.

3. Set the Reactor 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 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.

   Note: *Do not make connections to a Variac, Powerstat or the like to attempt to control the heating output. The heavy inductive load on the primary side of such devices can destroy the internal solid state relay located in the 4848 Controller.*

   Motor Only:

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

4. Connect the heater cord from the heater into the heater socket on the rear panel of the Series 4848 Reactor Controller.

5. Plug the motor 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.

6. Connect the thermocouple and extension wire to both the thermocouple and to the controller in the "Primary Temp Input" position on the rear panel. Insert the thermocouple in the 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 the magnetic drive. See Instruction Manual No. 234M.

9. Connect tubing to the rupture disc outlet and run to a safely vented area. See Instruction Manual 231M.

10. Note the voltage and amperage requirement stamped on the controller data plate, and then plug the power cord into an appropriate outlet. Power for these reactors should be drawn from a grounded outlet capable of carrying up to the full current rating of the reactor.

11. If an electric stirrer motor is supplied, turn the speed control knob fully counterclockwise on the Reactor Controller, turn on the motor switch and slightly increase the speed for a short run to check the stirrer drive system but do not turn on the heater, put heater toggle switch in center position (OFF). There must always be a vessel in the heater when it is turned on, and the vessel and heater sizes must match. If the heater is operated without proper size vessel in contact with the mantle, the mantle may overheat and fail.

IDENTIFY THE VALVES

Gas Inlet Valve

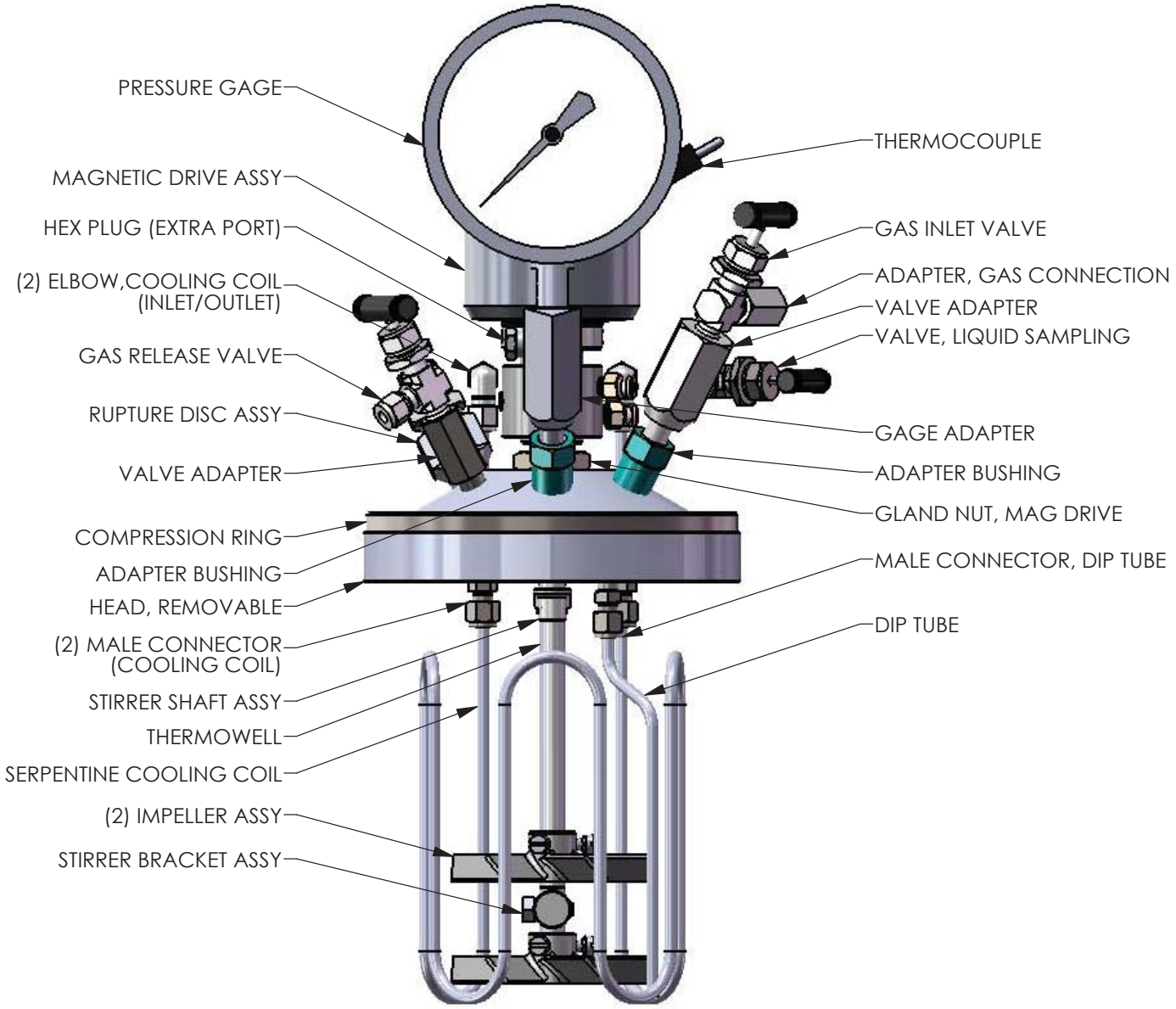
The gas inlet valve is easily identified when the bomb is open by noting that it is connected to a dip tube that extends to a point near the bottom of the bomb cylinder. This is an angle valve with an attached fitting which provides a socket for attaching the A495HC pressure hose furnished with the reactor.

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 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.

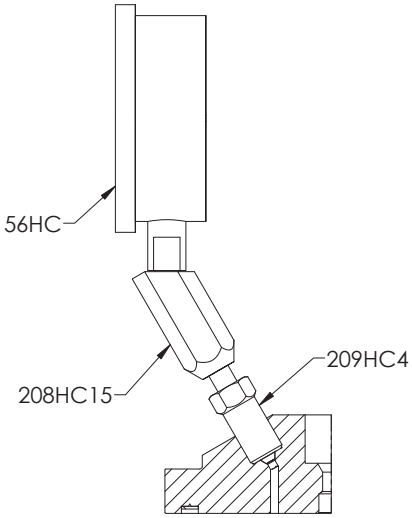
For highly corrosive applications where the vapor phase might corrode the stainless Bourdon tube, offers isolator assemblies in a variety of materials. These isolators with their internal piston isolate the vapors from the gage.

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.

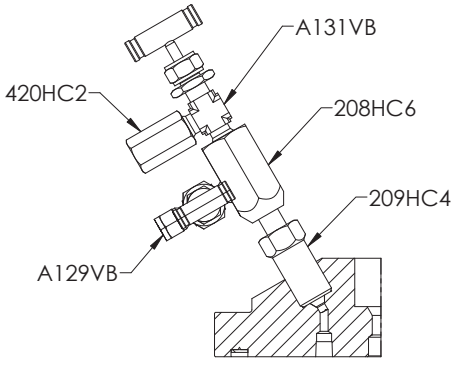
Gage and Valve Adapters

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.

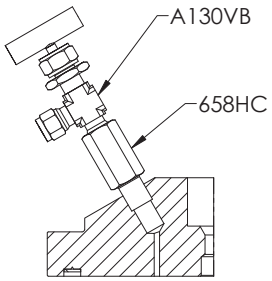
Note: *Do not use PTFE tape on the straight thread connections of the coned adapters and mating bushings. PTFE tape should only be used on the (NPT) threads such as the needle valves or gage connection.*



PRESSURE GAGE



INLET SAMPLING VALVE



GAS RELEASE VALVE

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 Reactor 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 Company 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

Fits ID	Cylinder Size	Glass Liner	PTFE Liner
6 inches	1 Gallon	894HC	894HC4HA
6 inches	2 Gallon	894HC2	894HC5HA

Spare Parts Kit

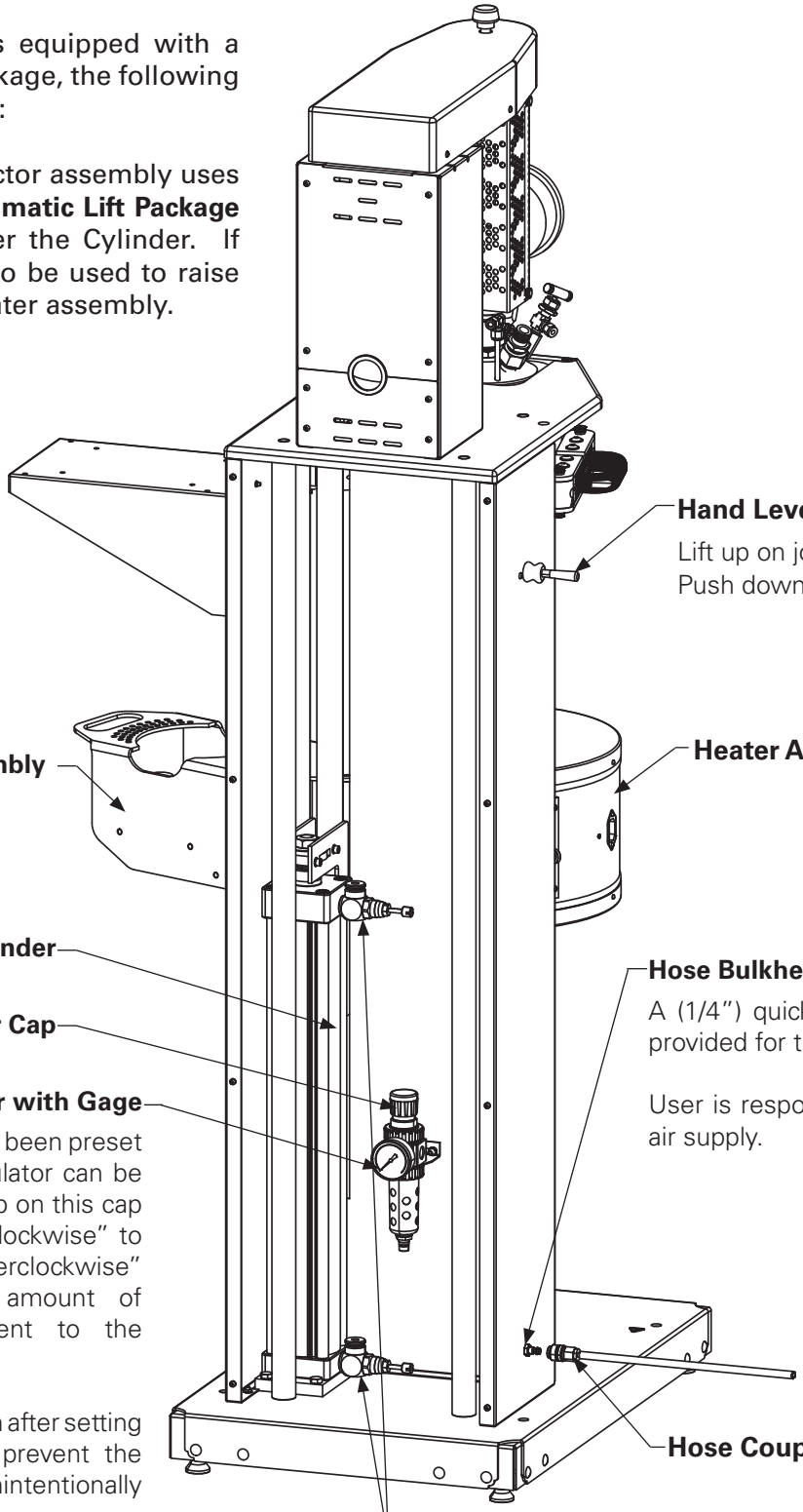
Company can furnish spare parts kits for these reactors which will provide a reserve supply of parts and tools sufficient to handle most normal replacements and emergency repairs during a year of heavy usage.

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.

Pneumatic Lift for Fixed Head Vessels

For those models equipped with a pneumatic lift package, the following instructions apply:

This pressure reactor assembly uses an **A2760HC Pneumatic Lift Package** to raise and lower the Cylinder. If needed, It can also be used to raise and lower the Heater assembly.



Hand Lever Valve Assembly "Joystick"

Lift up on joystick to go "**UP**" or
Push down on joystick to go "**DOWN**".

Cylinder Lift Assembly

Heater Assembly

Pneumatic Lift Cylinder

Pressure Regulator Cap

Pressure Regulator with Gage

The air pressure has been preset to 50 psi. The regulator can be adjusted by lifting up on this cap and then turning "clockwise" to increase or "counterclockwise" to decrease the amount of pressure being sent to the pneumatic cylinder.

Press cap back down after setting pressure, this will prevent the cap from being unintentionally turned.

Hose Bulkhead Flow Control Connector

A (1/4") quick disconnect fitting has been provided for the air line connection.

User is responsible for connecting to their air supply.

Hose Coupler

Flow Control Valves

The flow control valves have been preset for optimum performance. Both the speed and lifting capacity of the Pneumatic lift package can be adjusted with the flow control valves located on the input and output ports of the pneumatic cylinder.

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 available from Company 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 4352 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.

MAINTENANCE

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 High Temperature 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 compression bolts 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.

Periodic Pressure Tests

Each cylinder used in a Company stirred reactor is tested under hydrostatic pressure to the higher of 1.43 times the rated working pressure at room temperature or 1.30 times the rated working pressure corrected for temperature 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 Company 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 (FX004) signed by a responsible user.

PARTS LISTS

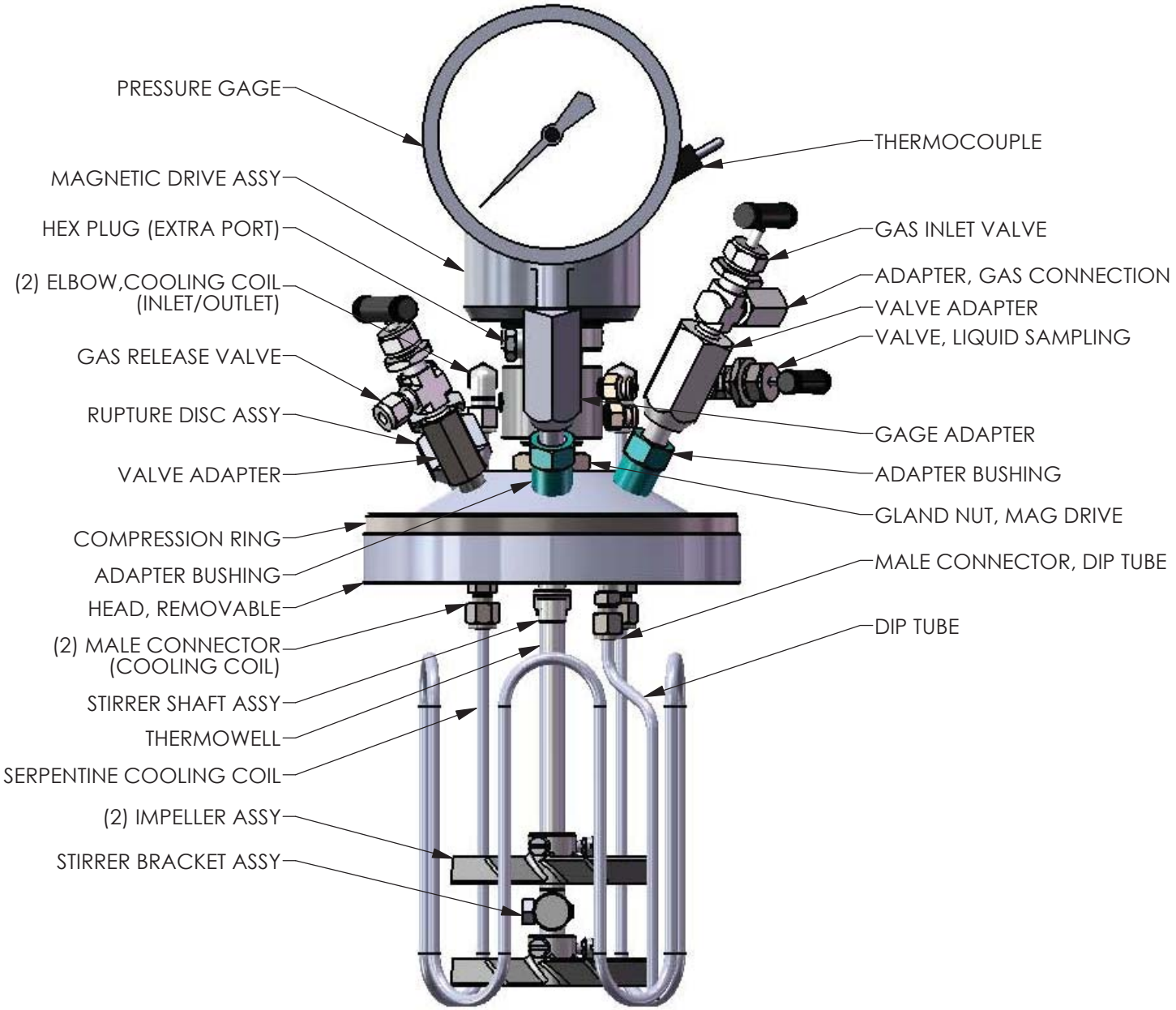
Reaction Vessel Parts List

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

* 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	CAD -	Titanium G2
CG -	Alloy B-2	CAA -	Titanium G4
CXA	Zirconium G702	CH -	Alloy C-276
CXB	Zirconium G705		



Cylinders

Part No.	Description	Code
660HC	Cylinder, 1G	FG
660HC6	Cylinder, 2G	FG
2692HC10	Cylinder, 1G	OR
2692HC20	Cylinder, 2G	OR

Heads

Part No.	Description	Code
657HC	Head	RV FG
2690HC	Head	RV OR
2271HC	Head	FH FG
2700HC	Head	FH OR

Split Rings and Accessories

Part No.	Description	Code
A754HC	Split Ring Assembly	RV FG
659HC	Compression Ring, Head	RV FG
A2265HC	Split Ring Assembly, quick close, latches	RV OS
A2265HC2	Split Ring Assembly, hinged, quick close, latches	FH OS
A2275HC3	Split Ring Assembly, hinged w/bolts, comp. ring & latches	FH FG
754HCFDE	Bolts, Split Ring, 5/8-18" 3/4 hex	
1368HC	Torque Wrench 3/8" Drive (optional)	
2701HC	Torque Adapter 3/8" Drive X 3/4" Hex (optional)	

Gages

Part No.	Description
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
56HCPG	Pressure gage, 4-1/2", 0-3000 psi

Internal Fittings

Thermowell

Part No.	Description
265HC4	Thermowell, 8.0", 1G
A935HC	Thermowell, 16.56", 2G

Dip Tubes

Part No.	Description
686HC	Dip Tube, 1G
686HC3	Dip Tube, 2G
A92HW	Male connector

Shafts

Part No.	Description	Code
1025HC14	Stub Shaft, Mag Drive	RV
1025HC40	Stub Shaft, Mag Drive	FH
A1030HC3	Shaft Assy w/coupling, 1G	
A1030HC4	Shaft Assy w/coupling, 2G	
1028HC	Coupling for shaft assy	
1029HC	Pin for shaft assy	
1027HC	Bushing PTFE for shaft	
1025HC3	Shaft w/bushing, 1G	
1025HC4	Shaft w/bushing, 2G	
A709HC	Impeller w/set screws	
709HCF	Set screws for impeller	

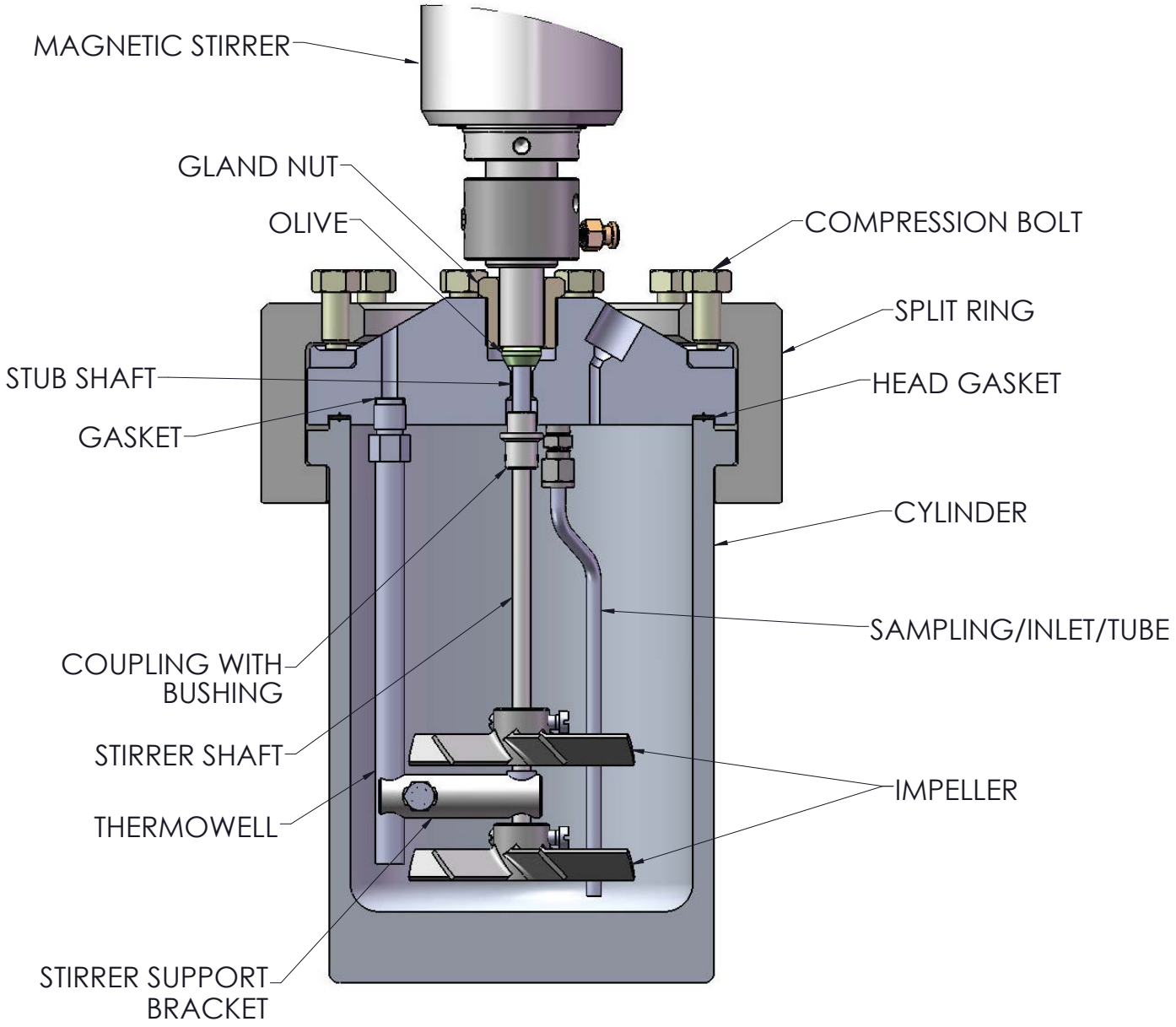
Gaskets & Seals

Part No.	Description	Code
48HC	Gasket, silver, mag drive	
48HCFG	Gasket, gold plated, mag drive	
655HC	Head Gasket, PTFE	FG
2691HCJV	O-ring, FKM	OR
2691HCJK	O-ring, FFKM	OR
663HC	Olive seal for mag drive	

External Fittings

Part No.	Description
94CAAD	Plug, 1/4" NPTM
A129VB	Valve, straight 1/4" NPTM x 1/4" (Liquid Sampling)
A130VB	Valve, angled 1/4" NPTM x 1/4"T (Gas Release)
A131VB	Valve, angled 1/4" NPTM x 1/4" NPTM (Gas Inlet)
658HC	Adapter, 1/4" NPTM x 1/4" NPTF (Gas Release)
208HC6	Valve Adapter, two 1/4" NPTF
208HC15	Gage Adapter, two 1/4" NPTF
209HC4	Bushing, gage & valve adapters

Part No.	Description
664HC3	Stirrer Plug (optional-use w/olive)
A472E6	Thermocouple, grounded, Type J 15-1/2" 1G
A472E5	Thermocouple, grounded, Type J 21-1/2" 2G
A707HC2	Safety Rupture Disc assembly w/o disc (See 231M)
A1180HC	Mag Drive Assembly (rubber coupling) (See 234M)
A1180HC4	Mag Drive Assembly (universal coupling) (See 234M)
664HC	Nut, gland, drive seal
A740HC	Cooling sleeve for Mag Drive Assembly



Overarm Parts List

Motor

Part No.	Description	Code
A388E6	Air Motor	HD
A388E2ER	Motor, 1/2 HP EXP VS 180 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	Code
A2519HC	Driven Pulley Assembly	HD
706HC2	Pulley, Driven	HD
725HC	Support Hub	HD
730HC	Ball Bearing	HD
731HC	Snap Ring Internal 2"	HD
732HC	Snap Ring External 1"	HD
2429HC	Bushing PTFE	HD

Drive Pulleys (Motor)

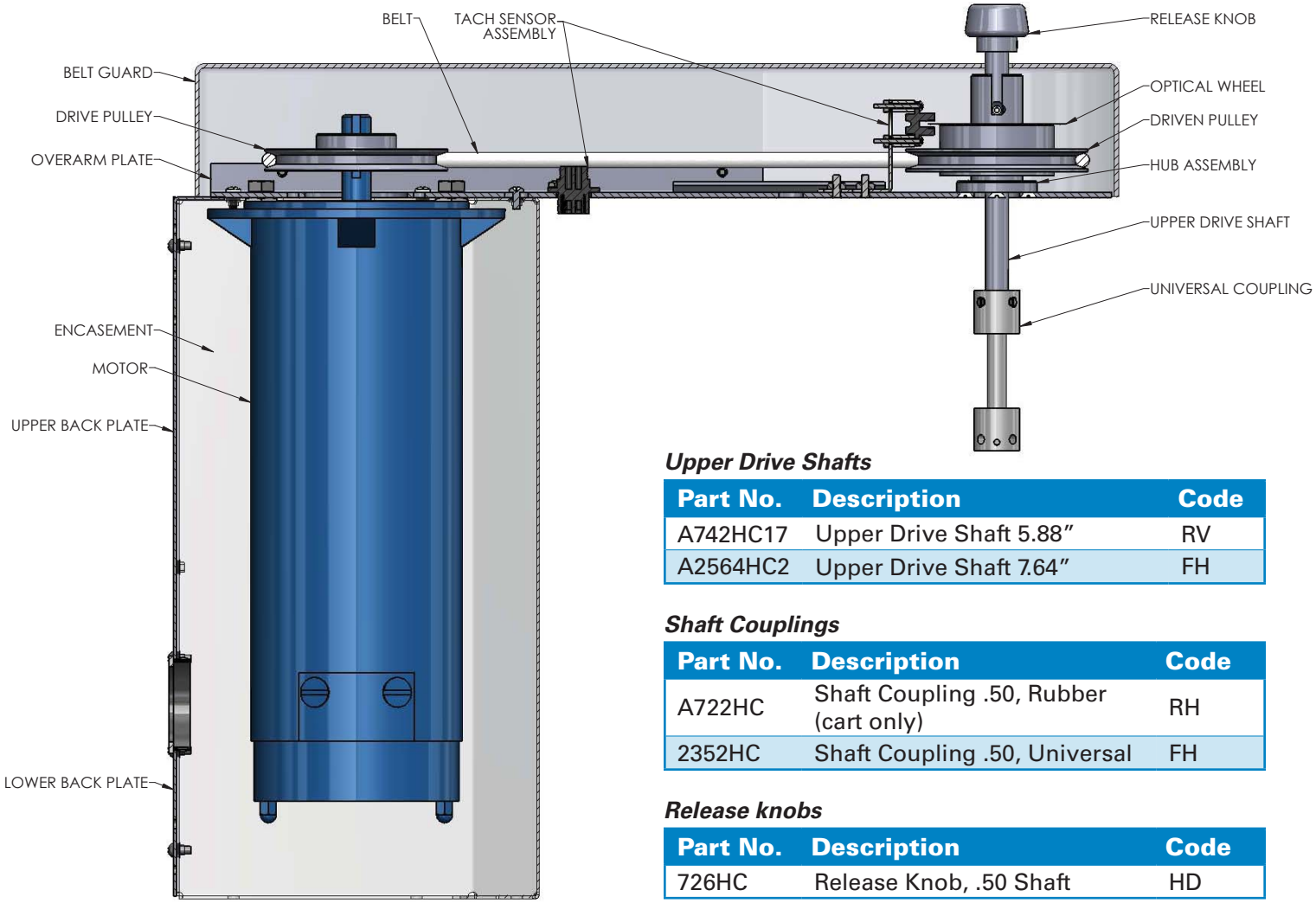
Part No.	Description	Code
695HC5	Pulley 600 RPM .62	HD
695HC3	Pulley 1000 RPM .62	HD
695HC2	Pulley 1700 RPM .62	HD

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)
A1001E2	Tach Sensor Assembly (5.5"L)



Upper Drive Shafts

Part No.	Description	Code
A742HC17	Upper Drive Shaft 5.88"	RV
A2564HC2	Upper Drive Shaft 7.64"	FH

Shaft Couplings

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

Release knobs

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

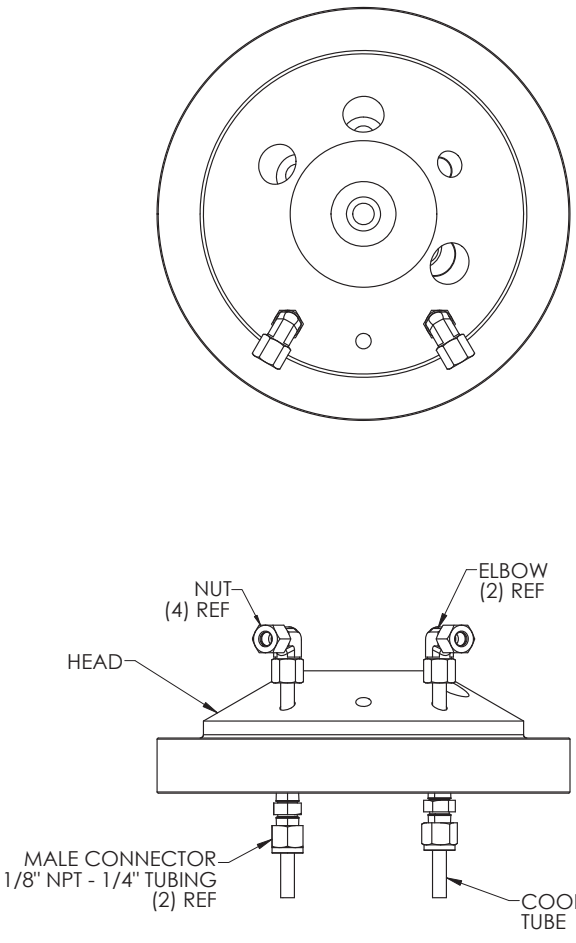
Cooling Coil Parts List

Cooling Coils

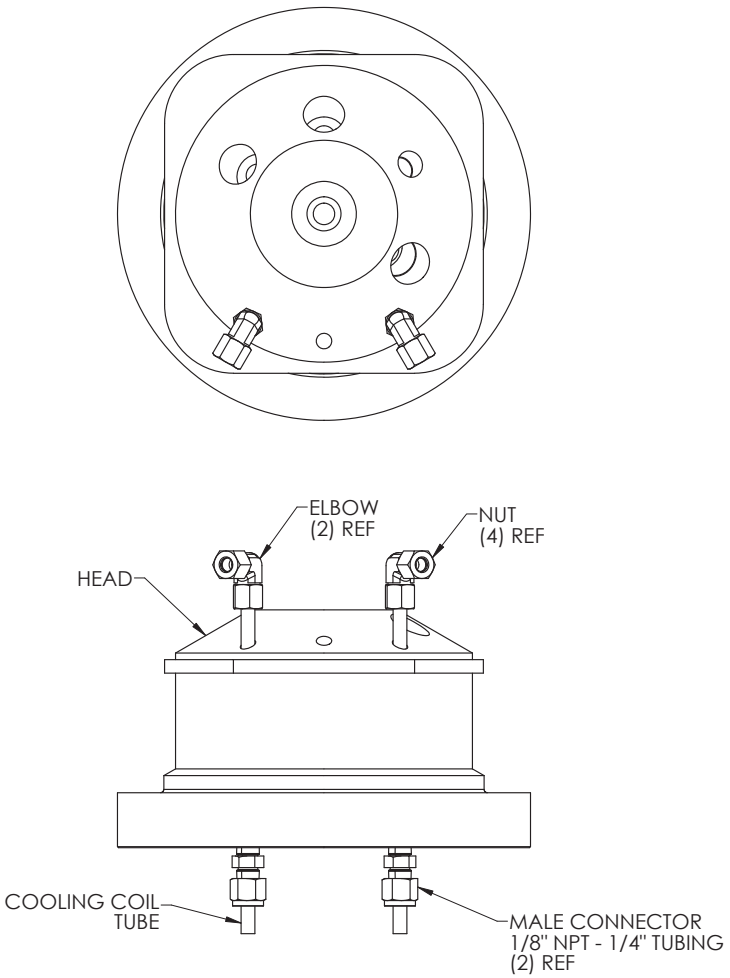
Part No.	Description	
689HC9	Cooling Coil, Serpentine 1G	RV
689HC11	Cooling Coil, Serpentine 2G	RV
689HC	Cooling Coil, Spiral 1G	RV
689HC3	Cooling Coil, Spiral 2G	RV
2267HC10	Cooling Coil, Serpentine 1G	FH
2267HC20	Cooling Coil, Serpentine 2G	FH
2267HC11	Cooling Coil, Spiral 1G	FH
2267HC21	Cooling Coil, Spiral 2G	FH

Cooling Coil Fittings

Part No.	Description	
511HC	Elbow, Tube Conn, ¼" T, Brass	
122HW	Ferrule for 511HC, Brass	
123HW	Cap Nut for 511HC, Brass	
A138CA	Male Connector	FH
217VB	Nut for A138CA ¼T	
218VB	Ferrule for A138CA ¼" T	
885HC2	Plug, ¼" T Cap & Nut, SS only	
79HW	Plug, Hex Head, 1/8" NPTM	



REMOVABLE HEAD



FIXED HEAD

Heaters Parts List

Heaters on Moveable Floor Cart

Part No.	Description
A693HC2EE	Heater Assembly, 2250W 230V 1G
A693HC3EE	Heater Assembly, 2750W 230V 2G

Heating Elements

Part No.	Description	For Use With
661HCEE	Heating Element 1500W 230V	A693HC2EE
661HC2EE	Heating Element 1000W 230V (Qty 2)	A693HC3EE
95EEE	Ring Heater 750W 240V	A693HC2EE & A693HC3EE

Heaters on Floor Stand

Part No.	Description
A2693HC10EE	Heater Assembly 2250W 230V 1G
A2693HC20EE	Heater Assembly 2700W 230V 2G

Heating Elements

Part No.	Description	For Use With
1689EEE	Heating Element 2250W 230V	A2693HC10EE
1689E2EE	Heating Element 2700W 230V	A2693HC20EE

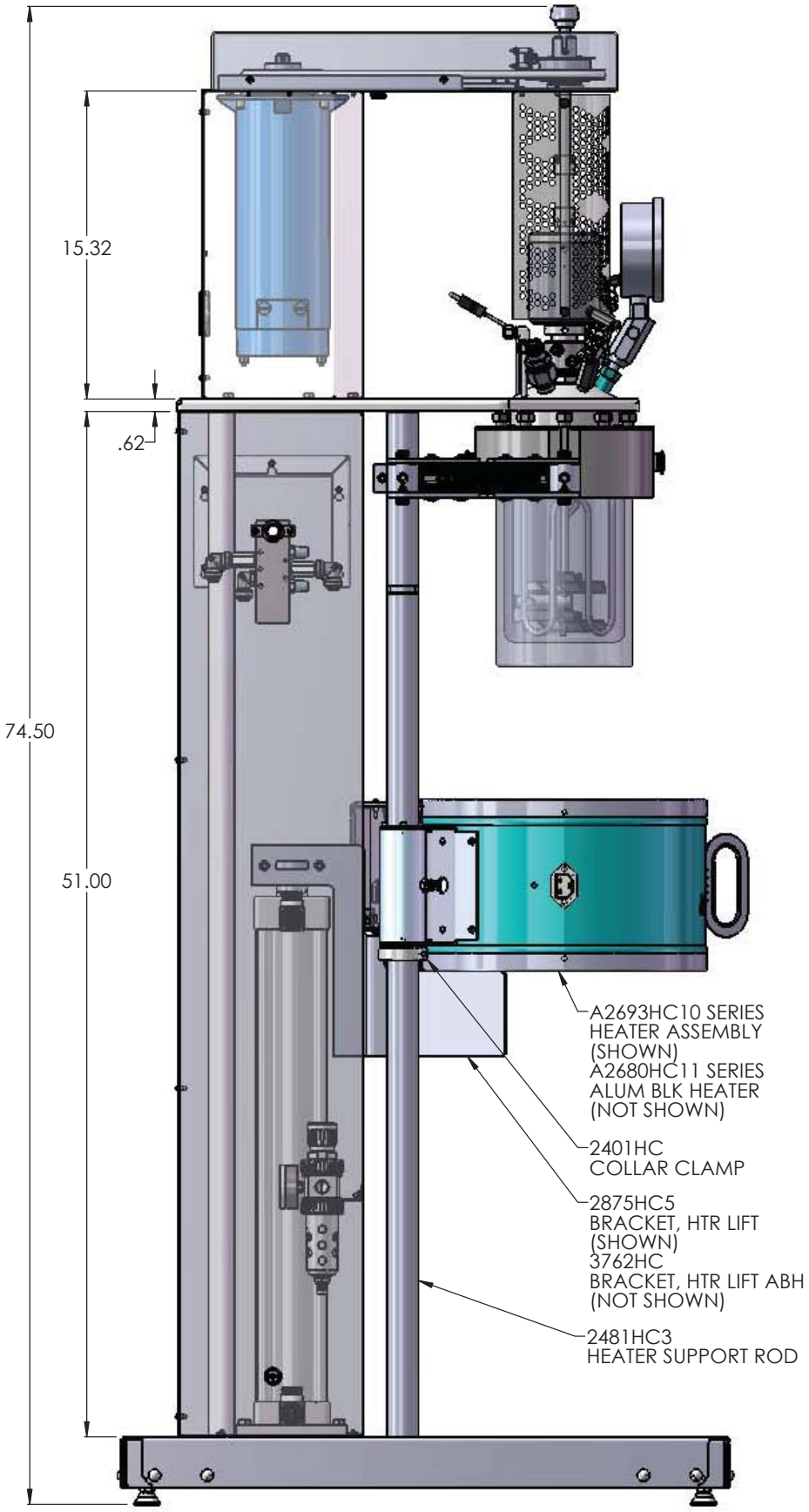


Moveable Floor Cart

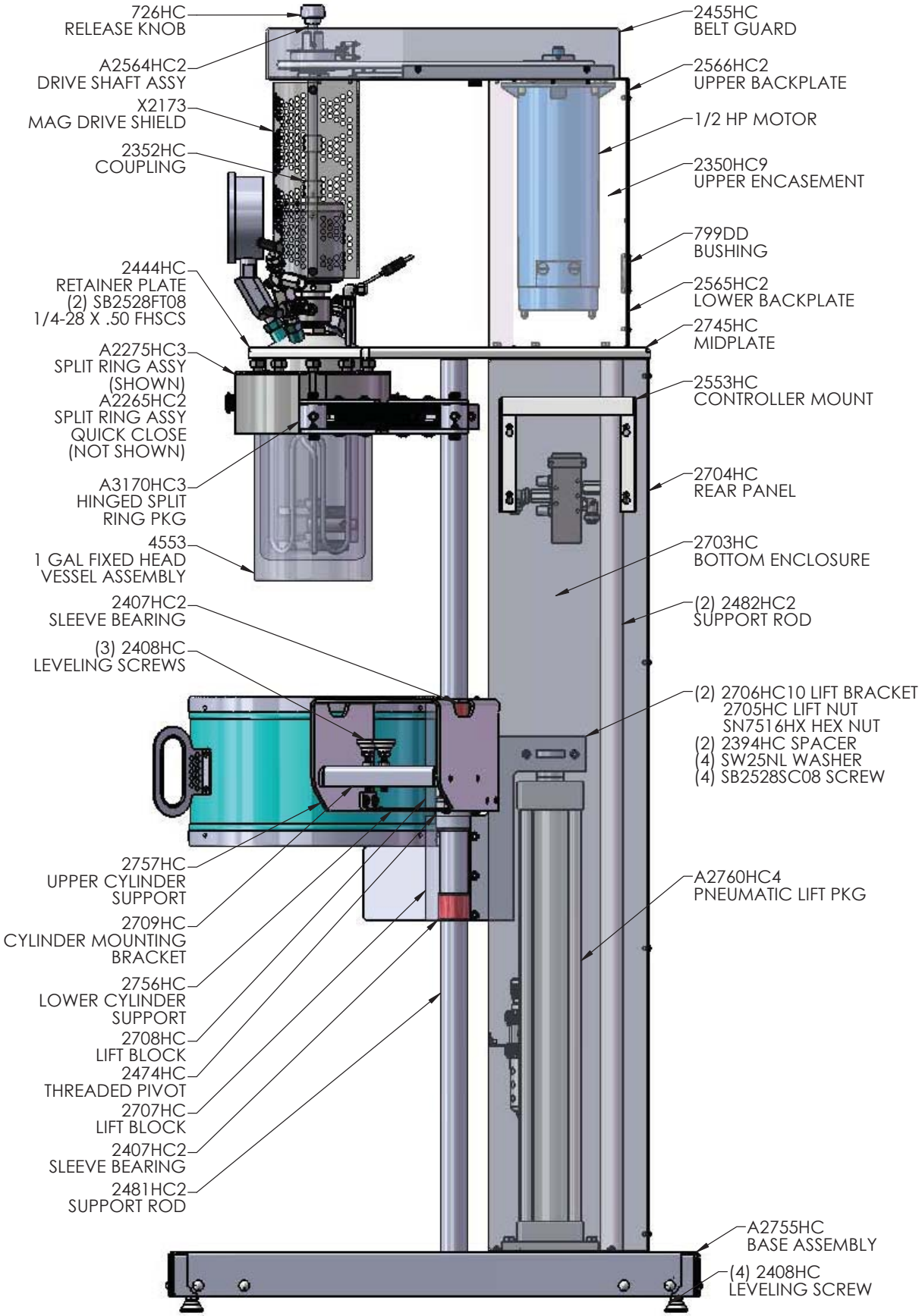


Floor Stand

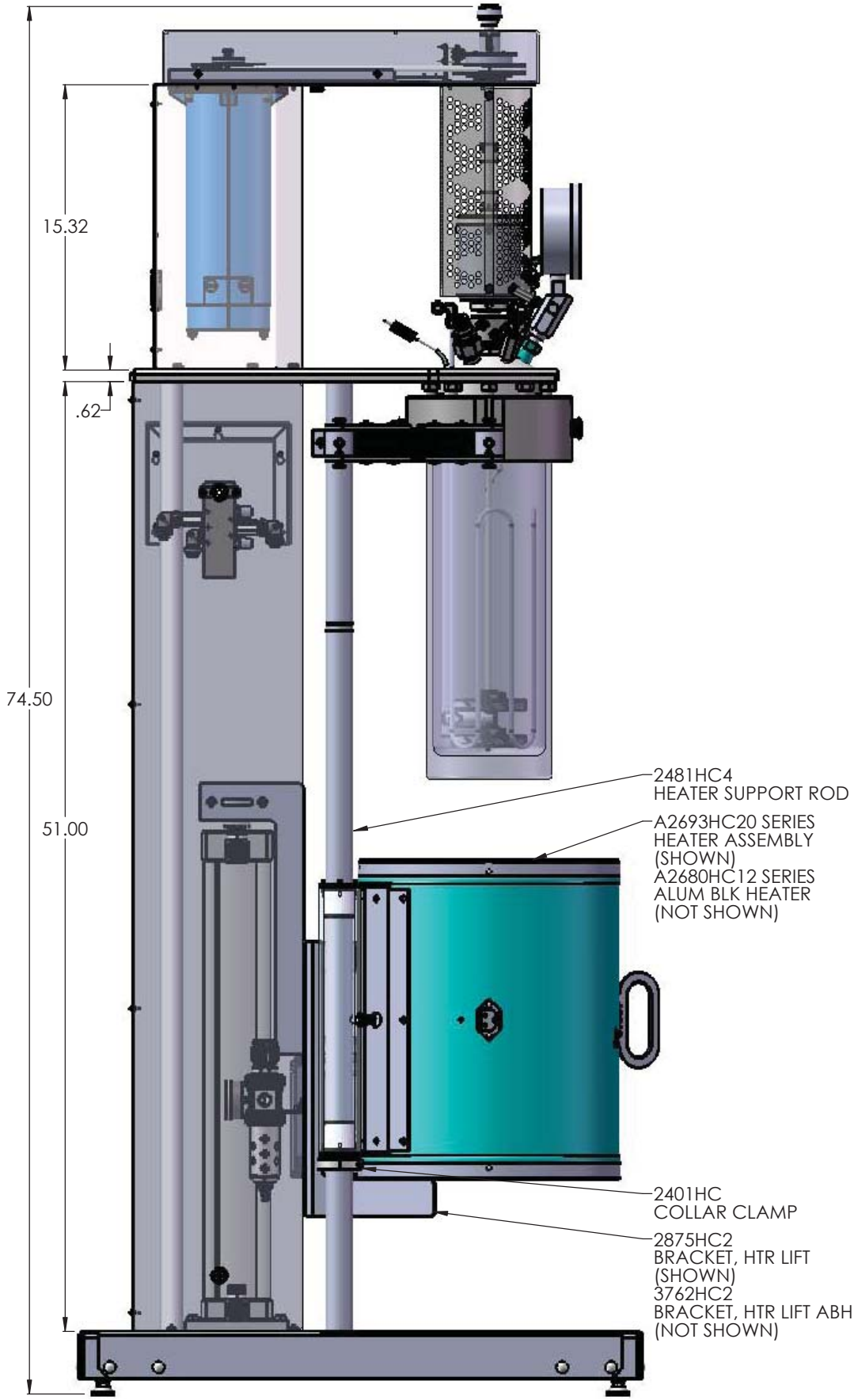
4553 - 1 Gallon Fixed Head Stand Assembly



4553 - 1 Gallon Fixed Head Stand Assembly



4554 - 2 Gallon Fixed Head Stand Assembly



4554 - 2 Gallon Fixed Head Stand Assembly

