

# INSTRUCTION AND REPAIR MANUAL

## SERIES 390

# 6

The 390 Series is a superior commercial Multi-Stage Vertical In-Line Centrifugal Pump. These stainless steel stackable pumps are ideal for high pressure applications which require a minimum amount of floor space. Pumping applications include: Boiler Feed, Condensate Return, Deaeration, Water Booster Applications, Jockey Pump for Fire Protection, Irrigation, Carwash, Chemical Feed System, Pressure Injection and Washdown Systems.

OPERATIONAL LIMITS	Models 391-396A	Model 397
Max. Operating Pressure:	360 psi (25 bar)	175 psi (12 bar)
Max. Operating Temp.:	250°F (120°C)	250°F (120°C)

### ATTENTION: SAFETY WARNINGS:

Read and understand all warnings before installation or servicing pump.

### ELECTRICAL SAFETY:

#### **Warning:** Electrical Shock Hazard

All electrical connections are to be made by a qualified electrician in accordance with all codes and ordinances. Failure to follow these instructions could result in serious personal injury, death or property damage.

#### **Warning:** Electrical Overload Hazard

Insure all motors have properly sized overload protection. Failure to follow these instructions could result in serious personal injury, death or property damage.

#### **Warning:** Sudden Start-Up Hazard

Disconnect and lockout power source before servicing. Failure to follow these instructions could result in serious personal injury, death or property damage.

### HIGH TEMPERATURE SAFETY:

#### **Warning:** Hot Surface Hazard

If pumping hot water, insure guards or proper insulation is installed to protect against skin contact to hot piping or pump components. Failure to follow these instructions could result in serious personal injury, death or property damage.

#### **Warning:** Spraying Water Hazard

When servicing pump replace all gaskets and seals. Do not re-use old gaskets or seals. Failure to follow these instructions could result in serious personal injury, death or property damage.

### HIGH PRESSURE SAFETY:

#### **Warning:** High Pressure Hazard

The pump is rated at a maximum of 360 psi (340 psi at 250°F) for models 391-396A and 175 psi for model 397. Do not exceed this pressure. Install properly sized pressure relief valves in system. Failure to follow these instructions could result in serious personal injury, death or property damage.

#### **Warning:** Expansion Hazard

Water expands when heated. Install properly sized thermal expansion tanks and relief valves. Failure to follow these instructions could result in serious personal injury, death or property damage.

### ELECTRICAL CONNECTIONS:

#### **Warning:** Electrical Shock Hazard

All electrical connections are to be made by a qualified electrician in accordance with all codes and ordinances. Failure to follow these instructions could result in serious personal injury, death or property damage.

#### **Warning:** Electrical Overload Hazard

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#### **Warning:** Hot Surface Hazard

If pumping hot water, insure guards or proper insulation is installed to protect against skin contact to hot piping or pump components. Failure to follow these instructions could result in serious personal injury, death or property damage.

#### **Warning:** Spraying Water Hazard

When servicing pump, replace all gaskets and seals. Do not re-use old gaskets or seals. Failure to follow these instructions could result in serious personal injury, death or property damage.

**INSTALLATION:**

Before placing a model 390 Series Multi-Stage Vertical In-Line Pump in operation, we suggest that you investigate the following points that will help to insure that you will have a "Satisfied" pump.

1. Check for proper initial venting to assure pump is not running dry. See that all air vapor is vented from pump before starting. An air pocket at the mechanical seal may cause the seal to run dry, overheat and possibly be fractured by thermal shock when liquid reaches the seal. (Solution: Loosen or remove vent plug prior to start up and confirm that water is coming out of the vent. Replace/tighten plug before starting pump.)
2. Be sure there is adequate by-pass flow at shut-off. Insufficient flow can result in rapid temperature rise in the pump that can lead to flashing and potential seal damage and failure. (Solution: Install properly sized orifice by pass from the pump discharge)
3. Clean water is highly desirable. Dirty water with suspended solids can collect on the casing "O" rings causing a build up that can interfere with normal movement during rise and fall of pressure and temperature. This solids build up can result in leakage at the "O" rings when the pump is not running. (Solution: Strainers and filters can clean water in closed loop systems.)
4. Sufficient NPSH must be available. If available NPSH is below required NPSH, at any point during operation, cavitation will result and may lead to premature first stage impeller/diffuser failure. Vibration in the impeller, due to cavitation, can lead to fatigue failure of welds and extensive pump damage. Always supply a "safety factor" NPSH of 2 feet over required. (Solution: Lower pump, reduce inlet piping friction losses, lower water temperature or reduce maximum flow of pump)
5. Use modulating valves on discharge during continuous operation. Quick closing valves can cause shock loading that may result in pump damage. (Solution: Remove quick closing valves from discharge side of piping and replace with modulating valve.)
6. Motor bearing re-lubrication. Due to the high temperature and vertical installation, motor bearing lubrication is highly important. Re-lubricate bearings (on motors with lubrication points) after 1000 hours operating time and be sure that the grease vent plug is open for at least one hour after resuming pump operation. (Solution: Run timers or posted lubrication schedules can assist in maintaining proper lubrication intervals.)
7. Check for reverse operation. Failure of a check valve at the discharge may result in reverse rotation of the pump during shut down. This might lead to excessive shaft stress and possible shaft failure when the motor restarts during reverse rotation. (Solution: Observe pump during shut off, confirm check valves are in place and functioning)
8. Proper coupling adjustment. The correct setting of the coupling is at 1/2 the total internal vertical movement of the shaft. Setting the correct height assures proper adjustment for the entire impeller and diffuser stack, the tungsten carbide sleeve bushings and the mechanical seal. (Solution: Read instructions prior to start up).
9. Coupling bolt tightness. Tighten the coupling bolts to the prescribed torque settings to prevent shaft slippage during operation. (Solution: Use torque wrench when tightening coupling bolts).
10. Check for pipe strain. Pipe strain might deform the casing resulting in "O" ring leakage. (Solution: Install flexible piping connectors on at least one side of pump).

Each of these points can play a major role in the life of a 390 pump in boiler feed service.

**INSTALLATION:****READ AND UNDERSTAND ALL SAFETY WARNINGS AT THE BEGINNING OF THE MANUAL BEFORE BEGINNING INSTALLATION OR ANY REPAIR WORK.**

The Aurora Series 390 pump should be installed in an area where sufficient room is available for inspection and repair. We recommend that shut off valves be installed on both the suction and the discharge side of the pump to facilitate repair/replacement of the pump. Suction side valve must be of the gate, butterfly or ball type design to prevent excess pressure drop. The pump should not be located near any sound sensitive area and special precautions may be required to avoid sound and/or vibration transmission. Consult a vibration/sound specialist if applicable. Insure the pump is bolted down securely to a flat and level foundation.

Insure that proper hydronic accessories such as pressure relief valves, thermal expansion tanks and flow/pressure control devices are installed in the system. Consult the responsible party for your system to insure these devices are installed and of the proper size.

To prevent excessive temperature rise a minimum flow must be allowed through the pump. Refer to the pump curves for the minimum flow for each pump model. Install a bypass if the pump has any possibility of operating below minimum flow.

Insure that at least 5 diameters of straight pipe is present between the suction flange and the first pipe fitting. This allows a smooth and quiet entrance of the pumped liquid into the pump.

Avoid all situations where pipe strain may be transferred to the pump casing. Expansion fittings, pipe hangers and (recommended) flexible piping located close to the pump may be required. **Never** force the piping to match the pump suction and discharge flanges. Re-cut piping to avoid this situation. When tightening the suction and discharge flanges be sure to tighten each of the bolts equally to allow the flange faces to match squarely and the gaskets to seal correctly. **Never** allow a cantilever load to develop across the flange face (possible when bolting against fix raised face flanges) or the flanges may crack.

All electrical connections are to be completed by a qualified electrician. Insure properly sized overload protection is installed.

**START UP:**

The pump must be filled with water and vented of air before start up or the mechanical seal will not be lubricated and will fail. Loosen vent plug on pump casing to insure all air is vented from casing and the casing is filled with water. After venting pump of all air, close vent plug. Jog motor to confirm motor rotation.

**OPERATING:**

Insure the system is filled with water and vented prior to pump start up. The pump rotation is clockwise when viewed from the back of the motor. Do not run the pump dry or the mechanical seal will be destroyed.

**MAINTENANCE AND SERVICE TO THE PUMP:**

The 390 pump requires no regular service except for motor bearing lubrication.

Depending on motor manufacturer and motor frame size the motor bearings may be permanently lubricated (requiring no further maintenance) or they may require re-lubrication. If no lubrication fittings (zirk fittings) or plugged ports (for lubrication fittings) are present then the motor has permanently lubricated bearings. If lubrication fittings are visible or plugs are present at the lubrication points, then the bearings can be re-lubricated and it is up to the end user to install lubrication fittings as required and to follow a regular maintenance schedule of motor bearing lubrication.

In dry locations, each bearing will need lubrication at least after every

2,000 hours of running time or 3-6 months whichever is more frequent. In wet locations (exposed to dripping water, to the weather or to heavy condensation found in unheated or poorly ventilated underground locations) or when pumping fluids in excess of 180°F every 1,000 hours or every 1-1/2 to 3 months whichever is more frequent.

The amount of lubrication to add depends upon the motor manufacturer and the motor frame/bearing size. Please refer to the motor manufacturers recommendations as to the volume of grease to add and any special re-greasing instructions. Use a Polyurea NGLI grade 2 grease such as Chevron SRI#2 for re-lubrication.

A periodic inspection must be performed looking for seal leaks indicating the mechanical seal may be worn out and any unusual noise or vibration that will indicate other pump components require service/repair.

#### PUMP DISASSEMBLY AND REPAIR:

#### READ AND UNDERSTAND ALL SAFETY WARNINGS AT THE BEGINNING OF THE MANUAL BEFORE BEGINNING INSTALLATION OR ANY REPAIR WORK.

Refer to the exploded pump diagrams for item description for specific models.

There are two sections in the repair instructions below.

1. **Models 391 to 394:** Replacement of the hydraulic stack kit and mechanical seal. When impellers, diffusers or tungsten carbide bushings wear to the point where replacement is required the entire stack kit is replaced. The stack kit consists of all internal hydraulic components fully assembled and ready to install. When the mechanical seal (a wear item) has worn to the point of leaking then the seal and all gaskets need to be replaced. A mechanical seal kit contains the seal as well as all required gaskets.

**Model 395A, 396A, 397:** When impellers, diffusers or tungsten carbide bushings wear to the point where replacement is required the individual components or the entire stack kit can be replaced. Only an experienced technician should attempt to replace individual components in a stack kit as part location is critical and if parts are positioned incorrectly then major damage can occur to costly pump components. When the mechanical seal requires replacement then a cartridge seal replacement is used, the motor does not need to be removed from the pump and only a minimum of gaskets require replacement.

#### **Warning:** Sudden Start-Up Hazard

Disconnect and lockout power source before servicing. Failure to follow these instructions could result in serious personal injury, death or property damage.

#### **Warning:** Hot Surface Hazard

If pumping hot water insure guards or proper insulation is installed to protect against skin contact to hot piping or pump components. Failure to follow these instructions could result in serious personal injury, death or property damage.

#### **Warning:** High Pressure Hazard

The pump is rated at a maximum of 360 psi (340 psi at 250°F) for models 391-396A and 175 psi for model 397. Do not exceed this pressure. Install properly sized pressure relief valves in system. Failure to follow these instructions could result in serious personal injury, death or property damage.

#### **Warning:** Spraying Water Hazard

When servicing pump, replace all gaskets and seals. Do not re-use old gaskets or seals. Failure to follow these instructions could result in serious personal injury, death or property damage.

2. Replacement of drive motor. When replacing the motor, the instructions for coupling setting must be adhered to or the impellers will not be set correctly in relation to the diffusers. Failure to follow the instructions carefully will result in instant pump failure upon start up.

#### NOTE

The pump and motor can be heavy and if proper lifting equipment is not available the end user should never hesitate to pull the entire pump and motor combination from the piping system. All required work should then be performed with the pump and motor in the horizontal position. **Safety is critical** and the small amount of time spent in reconnecting the piping is always minimal in comparison to the risk of injury and damage to pump components.

#### NOTE

Refer to Table 1 on page 5 for a list of required tools.

Refer to Table 2 on page 5 for a list of tightening torques.

Refer to the exploded views on page 6 for the 391 to 394 units and page 7 for 395A, 396A, 397 units. In the written instructions the item number listed on the exploded views is placed after the item description.

#### Section 1

#### Replacement of the hydraulic Stack kit and Mechanical Seal For Models 391 to 394:

1. Insure the electrical power is locked out, the system pressure has been lowered to 0 psig and the temperature of the unit is at a safe level.
2. Isolate the pump from the system by closing the valves that should be located on the suction and the discharge side of the pumps. Remove the vent plug from the top bracket, loosen the drain plug in the casing and allow the unit to drain.
3. Remove the coupling guard (1) from the top bracket (14) and loosen the coupling (4).
4. Remove the 4 bolts holding the motor to the top bracket (14). Using properly sized lifting equipment pull the motor from the top bracket (14).
5. Remove the coupling halves (4) and coupling pin (5).
6. Remove the 4 tie rod nuts (15S). Pull the top bracket (14) off the sleeve (24S). Careful use of a wooden block and rubber mallet may be required to break loose this connection.
7. Clean the shaft (26S) of any paint and after lubricating the shaft with soapy water pull off the mechanical seal (25S).
8. By pulling up on the shaft (a 5mm, 3/16" hole through the top of the shaft can be equipped with a hook/pin to aid disassembly) the entire stack kit can be removed from the pump. Insure the bottom stage (plate) (33S) is also out of the suction discharge casing (18S).
9. If the sleeve gaskets (23S) are to be replaced (recommended) lubricate the junction between the sleeve and the suction/discharge casing and pull the sleeve out of the casing. If required, a rubber mallet may be needed to tap the casing loose while the sleeve is held rigidly.
10. Replace sleeve gaskets (23S) as required and after lubricating the

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O-Ring place the sleeve (24S) into the suction/discharge casing (18S).

11. Place the new stack kit into the sleeve and insure the bottom stage/plate is firmly in place in the suction/discharge casing.
12. Remove the top plate (13) from the top bracket (14) and remove the stationary seat of the mechanical seal. Replace the O-Ring (12) around the vent plug. Press the top plate back into the top bracket. Replace the stationary ring of the mechanical seal.
13. Reassemble the remaining pump components in the reverse order paying special attention insure the tie rod nuts are tightened in a crosswise fashion and to the listed torque value (see table 2) . Refer to section 2 for coupling setting instructions.

### Model 395A, 396A & 397

The 395A-397 utilize a cartridge type seal and this seal can be replaced with out removing the motor or major pump disassembly. Replacing the mechanical seal is outlined in the steps 1 to 17. To replace individual hydraulic components or the entire stack kit first remove the mechanical seal as noted in steps 1 to 6 and then follow steps 18 to 24.

1. Insure the electrical power is locked out, the system pressure has been lowered to 0 psig and the temperature of the unit is at a safe level.
2. Isolate the pump from the system by closing the valves that should be located on the suction and the discharge side of the pumps. Remove the vent plug from the top bracket, loosen the drain plug in the casing and allow the unit to drain.
3. Remove the coupling guard (1) from the top bracket (11).
4. Disassemble the coupling halves (4) and the coupling pin (5).
5. Unscrew the three set screws (18) partly and the four bolts (20) completely.
6. Place a screwdriver between the seal disc (21) and the top bracket (11) and lift the cartridge seal from the shaft (30).
7. Unscrew the bolts (18) completely and remove the cartridge ring (19) and the seal disc (21) from the cartridge bushing (43).
8. Remove the stationary seat of the mechanical seal (23) from the seal disc (21). Wet the seal disc (21) with a soap solution and press in the new stationary seat.
9. Remove the rotating head of the mechanical seal (23) from the cartridge bushing (43). Clean the cartridge bushing and check for damage.
10. Wet the cartridge bushing (43) with a soap solution and place the new rotating head of the mechanical seal (23) on to the cartridge bushing (43)
11. Remove the O-rings (24, 22) from the cartridge bushing (43) and the seal disc (21) and replace them with new ones.
12. Slide the seal disc (21) on the cartridge bushing (43) followed by the cartridge ring (19) and screw down the set screws (18) partly.
13. Wet the shaft (30) with a soap solution and place the new cartridge seal assembly onto the shaft (30). Screw the four bolts (20) down to the required torque.
14. Make sure that the shaft (30) is in its bottom position, and tighten the three set screws (18).
15. Assemble coupling pin (5) and coupling halves (4) on the shaft (30). Tighten the coupling bolts and nuts (3, 2) loosely by hand.

16. The pump shaft (30) and coupling (4) can move vertically approximately 3/16" (5 mm) and must be set in the middle of its total travel range to properly set the impellers and mechanical seal.

17. Refer to step 7 in section 2 for illustrations and instructions on properly setting the coupling.

### Full pump disassembly

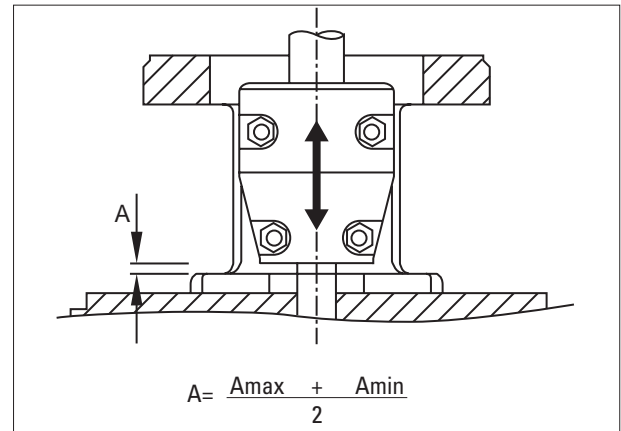
18. After removing the mechanical seal as noted above. Remove the tie rod nuts (15) and washers (16).
19. Using a rubber mallet tap on the bottom of the top bracket (11) until it can be removed. If the top plate (13) remains on the sleeve (27) remove it by tapping on its edge with a wooden block being careful not the dent the surfaces.
20. Pull out the stack kit from the sleeve casing assembly.
21. Remove the sleeve (27) from the lower casing (44) by tapping on the casing (44) with a rubber mallet while holding the sleeve (27) firmly.
22. Replace both sleeve O-rings (26).
23. If the entire stack kit is to be replaced then press in the sleeve (27) into the lower casing (44) and lower into this assembly the new stack kit. Reassemble in reverse order the remaining components referring to table 2 for tightening torques.

24. If the stack kit is to broken down into components for evaluation and review then prepare a long table as a work surface. Remove the impeller nut (41) and carefully slide each component off the shaft (30) and place these parts on the work surface **IN THE ORDER THEY WERE REMOVED**. Each model pump had different component combinations and many look similar. Identify which parts need replacement and order by referencing the part numbers in the parts list. When rebuilding the stack kit the components must be reassembled onto the shaft in the same order and direction as they were removed.

### Section 2

#### Replacement of the electric motor and coupling setting instructions.

1. Insure the electrical power is locked out, the system pressure has been lowered to 0 psig and the temperature of the unit is at a safe level.



2. Remove the 4 bolts holding the motor to the top bracket. Using properly sized lifting equipment pull the motor from the top bracket.
3. Remove the coupling halves (4) and coupling pin (5).
4. Replace coupling and/or pin as required. Insure the coupling is loose on the pump shaft so the motor shaft can slide easily into place.
5. Using properly sized lifting equipment place the motor onto the top bracket insuring the motor register holes align with the top bracket

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holes and the motor shaft slides easily into the coupling.

6. Tighten the 4 motor connecting bolts insuring the motor register is fully engaged with the top bracket register.
7. Adjusting the height of the coupling is critical to successful pump operation. The shaft and coupling can move vertically approximately 3/16" (5 mm) and must be set to the middle of its total travel range to properly set the impellers and mechanical seal.
8. Using a large flat blade screwdriver as a lever lift up the coupling by the bottom (the pump shaft will move with the coupling) to the top of its movement. Allow the coupling to lower and note the total

range of travel by the coupling. Raise the coupling one half of its total movement range and tighten the socket head coupling bolts (in a crosswise pattern) sufficiently to prevent the coupling from further movement on the motor shaft.

9. Using a torque wrench and hex bit socket tighten the coupling bolts to the required torque value. Tighten coupling bolts in crosswise pattern insuring gap between coupling halves is even. Recheck all coupling bolt torques a second time before replacing the coupling guards.

Read the installation section prior to pump start up.

**Table 1**

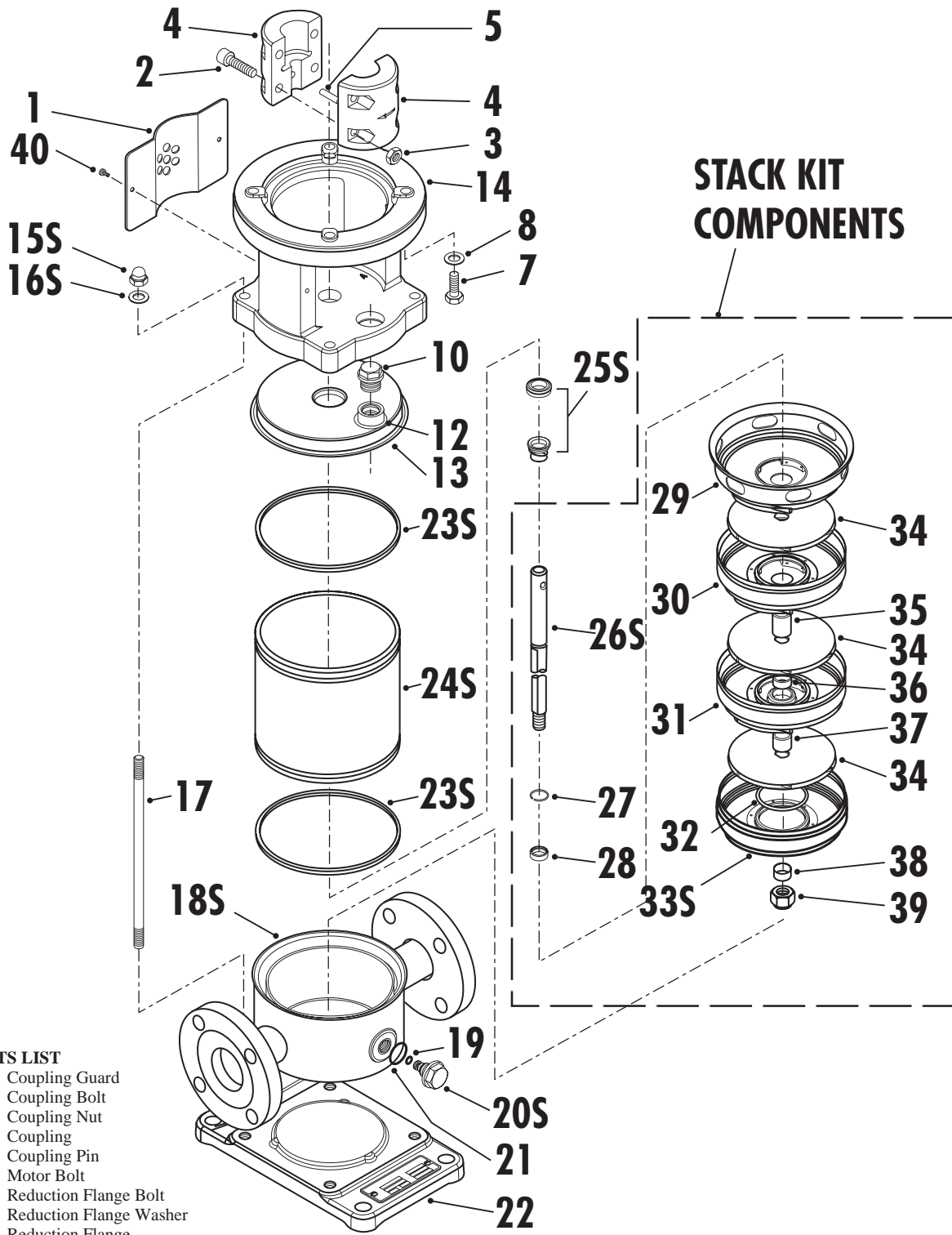
TOOL	TOOL SIZE FOR SPECIFIC MODELS			USED ON
	391 & 392	393 & 394	395A, 396A & 397	
Torque Wrench	Up to 275 in-lbs	Up to 55 ft-lbs	up to 55 ft-lbs	Tie Rods & Coupling
Hex Bit Socket (1)	6 mm	6 mm or 8 mm	6 mm or 8 mm	Coupling
Drive Socket	13 mm	17 mm	24 mm	Tie Rod Nuts
Drive Socket	7 mm	7 mm	7 mm	Coupling Guard
Adjustable Wrench	1" min	1" min	1" min	Vent & Drain Plugs
Rubber Mallet	12 oz	12 oz	12 oz	As Required
Wood Block	2 x 4 x 4	2 x 4 x 4	2 x 4 x 4	As Required
Box Wrench	9/16"	N/R	3/4"	Motor Bolts
Allen Wrench	N/R	3/8"	N/R	Motor Bolts
Flat Blade Screw Driver	12"	12"	12"	Lifting Coupling

**Table 2**

TIGHTENING TORQUES FOR TIE RODS			
Pump Model	391 & 392	393 & 394	395A, 396A & 397
Tightening Torque	100 in-lbs	225 in-lbs	50 ft-lbs

TIGHTENING TORQUES FOR COUPLINGS			
Coupling Material	Aluminum	Cast Iron (Small)	Cast Iron (Large)
Bolt Size	8mm	8mm	10mm
Hex Bit Socket Size	6mm	6mm	8mm
Tightening Torque	200 in-lbs	275 in-lbs	55 ft-lbs

(1) Note: Coupling size is dependent on HP.



**PARTS LIST**

- 1 Coupling Guard
- 2 Coupling Bolt
- 3 Coupling Nut
- 4 Coupling
- 5 Coupling Pin
- 6 Motor Bolt
- 7 Reduction Flange Bolt
- 8 Reduction Flange Washer
- 9 Reduction Flange
- 10 Plug
- 12 Gasket, Plug
- 13 Top Plate
- 14 Top Bracket
- 15S Tie Rod Nut
- 16S Tie Rod Washer
- 17 Tie Rod
- 18S Suction/Discharge Casing
- 19 Gasket, Drain
- 20S Plug
- 21 O-Ring, Drain
- 22 Support Base

- 23S Sleeve O-Ring
- 24S Sleeve
- 25S Mechanical Seal
- 26 Shaft
- 27 Fixing Ring
- 28 Seal Bushing
- 29 Upper Diffuser
- 30 Diffuser w/out Bushing
- 31 Diffuser with Bushing

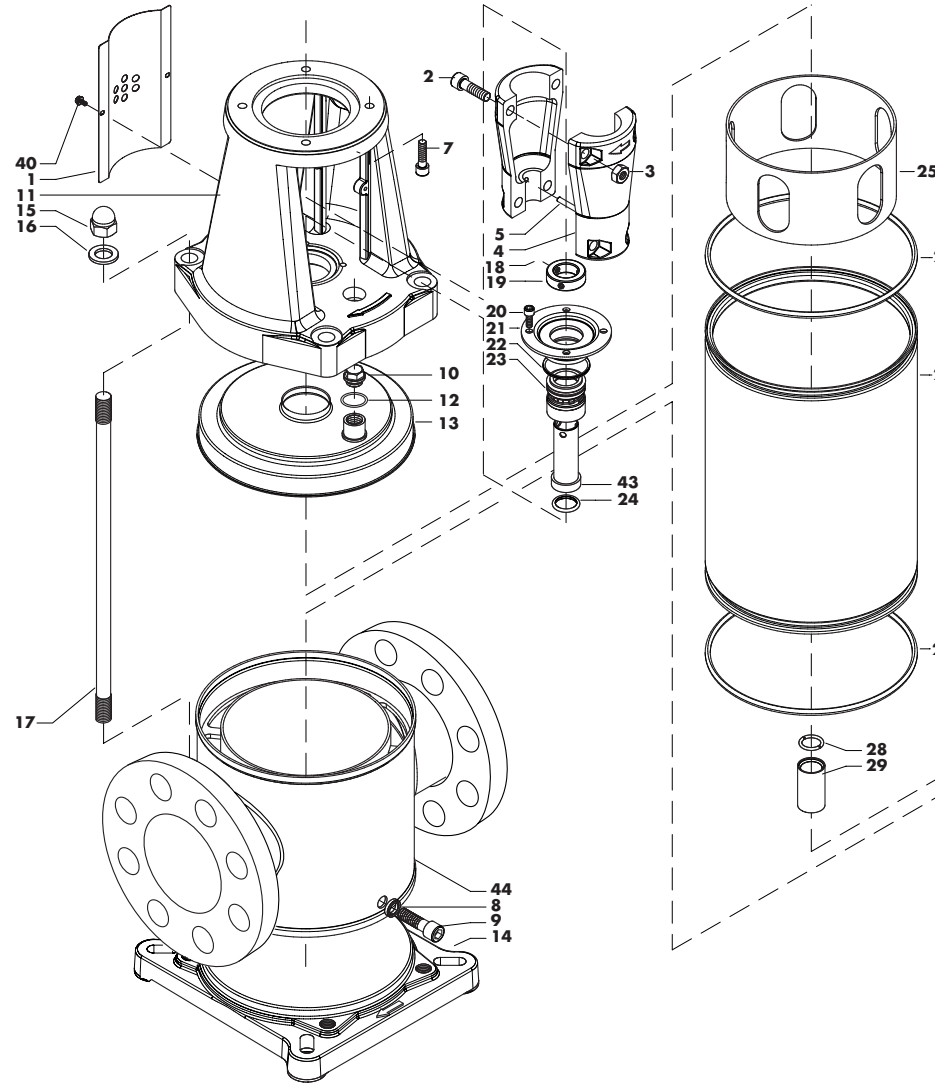
Items not shown: Motor, Pc No. 6 - Motor Bolts,  
Pc No. 9 - Reduction Flange

- 32 Diffuser O-Ring
- 33S Bottom Stage
- 34 Impeller
- 35 Shaft Protection Bushing, Long
- 36 Shaft Protection Bushing, Short
- 37 Shaft Bushing, Tungsten
- 38 Shaft Protection Bushing, Middle
- 39 Shaft Nut
- 40 Hex Head Screw

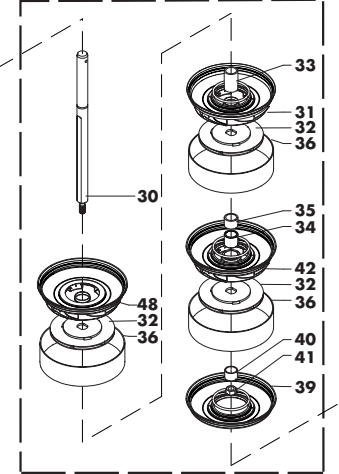
**PARTS LIST**

- 1 Coupling Guard
- 2 Coupling Bolt
- 3 Coupling Nut
- 4 Coupling
- 5 Coupling Pin
- 6 Motor Bolt
- 7 Reduction Flange Bolt
- 8 Gasket, Plug
- 9 Plug, Drain
- 10 Plug 1/4 NPT
- 11 Top Bracket
- 12 Gasket, Plug
- 13 Top Plate
- 14 Support Base
- 15 Tie-rod Nut
- 16 Tie-rod Washer
- 17 Tie-rod
- 18 Set Screw
- 19 Cartridge Ring
- 20 Bolt
- 21 Seal Disk
- 23 Mechanical Seal
- 24 O-Ring
- 25 Fixing Ring
- 26 Sleeve O-Ring
- 27 Sleeve
- 28 Ring
- 29 Bushing
- 30 Shaft
- 31 Diffuser w/o Bushing
- 32 Impeller
- 33 Shaft Protection Bushing, Long
- 34 Shaft Bushing, Tung Carb
- 35 Shaft Protection Bushing, Short
- 36 Diffuser Sleeve
- 37 Shaft Protection Bushing
- 38 Distance Ring
- 39 Bottom Plate
- 40 Spacer Bushing
- 41 Impeller Nut
- 42 Diffuser w/Bushing
- 43 Cartridge Bushing
- 44 Lower Casing
- 45 Motor Adapter
- 46 Hex Head Screw

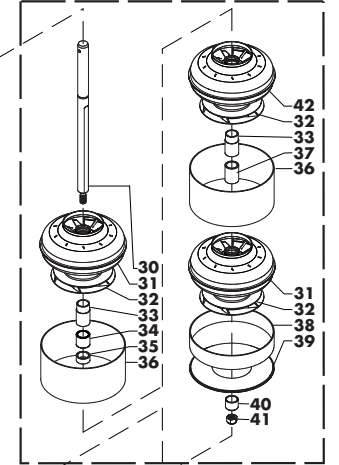
NOT SHOWN: ITEM #6 MOTOR BOLT  
ITEM #45 REDUCTION FLANGE



**395A AND 396A STACK KIT COMPONENTS**



**397 STACK KIT COMPONENTS**



**NOTE:**

Aurora Pump reserves the right to make revisions to its products and their specifications, and to this bulletin and related information without notice.



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