Bulletin SM1531-001/US

Pump/Motor Division

Effective: May 2006

700 Series
Low Speed
High Torque
Service Procedure

⚠ WARNING

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Hydraulic Pump/Motor Division
Greeneville, TN 37745 USA

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Introduction

The 700 series Low Speed High Torque (LSHT) hydraulic motor is designed to provide long life while operating with low radial side loads. Refer to catalog radial load limits. However, should maintenance be required, the instructions below should be used for disassembly, replacement of parts, cleaning and assembly.

Read the trouble shooting information to eliminate non-hydraulic causes and hydraulic system problems. The check list identifies hydraulic system and possible motor component problems. Read all disassembly and assembly sections carefully. Pay special attention to the notes, cautions and warnings.

The component part names and item numbers assigned on the exploded assembly views corresponds with names and item numbers (in parentheses) used in the disassembly and assembly procedures. Refer to the exploded assembly view page as you follow the procedures for ease in identifying and locating components.

Service part number charts display exploded view item numbers and part numbers.

Obtain service parts from the Original Equipment Manufacturer or your local Parker Distributor.

We welcome suggestions to make this manual clearer or more complete. If you are stuck, please contact our customer service department. Don't second guess the manual. Following this safe and productive procedure results in restoring the reliable, long-life operation engineered into the motor.

Important Notes:

Prior to any motor disassembly, plug the open ports and case drain. Clean all dirt from the outside of the motor.

Prior to assembly lightly oil all seals, the rollers and the threaded bolt ends.

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Troubleshooting Guide

NOTE Before troubleshooting any system problem, check service literature published by the equipment and/or component manufacturers. Follow their instructions, if given, for checking any component other than the motor unit.

Preparation

Make your troubleshooting easier by preparing as follows:

- work in a clean, well-lighted place
- have proper tools and materials nearby
- have an adequate supply of clean, petroleum-based solvent
- prior to any motor disassembly, plug the open ports and case drain
- clean all dirt from outside the motor
- prior to assembly, lightly oil all seals, rollers, rolls and the threaded bolt ends

⚠ WARNING Since solvents are flammable, be extremely careful when using any solvent. Even a small explosion could cause injury or death.

⚠ WARNING Wear eye protection and be sure to comply with OSHA and other maximum air pressure requirements.

Preliminary Checks

Hydraulic systems are often trouble-free. Hence, the problem an operator complains of could be caused by something other than the hydraulic components.

Thus, once you have determined that a problem exists, start with the easy-to-check items, such as:

- Parts damaged from impact that were not properly repaired, or that should have been replaced
- Improper replacement parts used in previous servicing
- Mechanical linkage problems such as binding, broken or loose parts, or slipping belts

Hydraulic Components

If the motor has low speed or torque, look at the check list on the next page first. Since these motors maintain volumetric and torque efficiencies during their usual life, the problem is usually elsewhere in the hydraulic system.

However, there are hydraulic system problems which can drastically reduce the long life designed into these motors. Three key areas to check are:

- Temperature: Do not exceed 180˚F.
- Fluid: Viscosity at the maximum temperature must exceed 50 ssu.
- Filtration: A Beta 25 ratio of at least 2.

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Troubleshooting Checklist

Trouble	Cause	Remedy
Oil Leakage	1. Hose fittings loose, worn or damaged.	Check & replace damaged "O" Rings. Torque to manufacturer's specifications.
	2. Motor section seal rings (7) deteriorated by excess heat.	Replace oil seal rings. Correct heat problem.
	3. Tie bolt loose	If bolts are loose because of excessive pressures as indicated by most or all being loose, replace bolts & advise customer to correct the pressure regulation.
	4. Broken tie bolts.	Replace bolts.
	5. Internal shaft seal worn or damaged.	Replace seal.
	6. Worn shaft and internal seal.	Replace shaft and seal.
Significant loss of speed under load	1. Lack of sufficient oil supply.	(a) Check for faulty relief valve and adjust/replace as required. (b) Check for/repair worn pump. (c) Check for and use correct oil for temperature of operation. Check reservoir fluid level.
	2. High internal motor leakage.	Replace worn IGR™ set.
	3. Excessive heat.	Locate excessive heat source (usually a restriction or lack of an oil cooler) and correct.
Low mechanical efficiency or undue high pressure required to operate motor	1. Line blockage.	Locate blockage source and repair or replace.
	2. Internal interference.	Disassemble motor, identify and remedy cause.
	3. Excessive binding or loading in system external to motor.	Locate source and eliminate cause.
Lack of pressure	1. Low flow output of pump.	Repair or replace worn pump.
	2. Relief valve set incorrectly or not closing completely.	Reset relief, look for contamination or replace.

⚠ CAUTION Seals in the system will shrink, harden or crack if fluid temperatures exceed 180˚F (82.2˚C), resulting in loss of ability to seal.

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Tools and Materials Required for Servicing

- Clean, petroleum-based solvent
- Emery paper
- Vice with soft jaws
- Air-pressure source
- Screwdriver
- Tape
- Breaker bar or impact wrench
- Torque wrench 50 ft. lbs.
- Socket, 1/2"
- Allen wrench, 1/4"
- Adjustable crescent wrench or hose fitting wrenches

⚠ CAUTION	Mixing greases that have different bases can be detrimental to bearing life.

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Item No.	Qty	Part Number	Description
1	8	See Following Page	Bolts
2	1	M110C-6	4 Dowel End Cover (standard)
	1	M110C-23	Encoder End Cover, 4 Dowel End Cover BSPP
3	6	1046	O-Rings
4	1	See Following Page	IGR™ Set, Rear
5	2	1660	Clip, 2 Pieces
6	1	See Following Page	Shaft, Internal
7	2	SM015995	Commutator Plate
8	4	1021	Check Ball
9	1	See Following Page	Center Block
10	4	25060-09	Bolt, 5/16-18x1.00, G8
11	1	See Following Page	Shaft, Output
12	1	PA-2984-1	1.25" Shaft "A" Flange (with seals)
	1	PA-2984-2	1.25" Shaft "B" Flange (with seals)
13	1	1060-34	O-Ring Flange, 2-034
14	2	040230-0565	Dowel
15	8	See Following Page	Bolt
16	1	See Following Page	Front Bearing Housing
17	1	See Following Page	IGR™ Set, Front
18	2	036300	7/8-14 SAE Plug
19	1	1826	Spring, Two Speed Valve Return Spring
20	1	1825 or 2792	Valve - 1825 Open Center 2792 Closed Center
21	4	1320	Check Balls-Solenoid Block
22	5	032841	O-Rings-Solenoid Block
23	1	1823	Solenoid Block (Aluminum)
24	1	481006	Solenoid-With Manual Override
	1	2891	Solenoid-Without Manual Override
25	2	021442	Bolt, 5/16-24 x 1.875"
26	1	2271	1.25" Dia. Shaft Thrust Washer
27	1	2270	1.25" Dia. Shaft Thrust Bearing
28	1	2150	1.25" Dia. Shaft Seal, High Pressure
29	1	1435	1.25" Dia. Shaft Seal, Dust, 1.312"
30	1	1323	1" Dia. Shaft Thrust Washer
31	1	1585	1" Dia. Shaft Thrust Bearing (pressed into flange)
32	1	2175	1" Dia. Shaft Seal, High Pressure, 1.063"
33	1	1325	1" Dia. Shaft Seal, Dust, 1.062"

Motor Disp.	Item 6 Shaft	Item 17 IGR™ Set	Item 4 IGR™ Set	Item 1 Hex Bolt	Item 15 12 Point Flange Head Screw
	Standard (encoder)				
12.9/25.8	2865-258 (2249)	SM012907005A2	SM012907008A1	021363	021457
10.6/21.2	2865-212 (2249)	SM010607005A2	SM010607008A1	021428	021456
8.8/17.6	2865-176 (2249)	SM008807005A2	SM008807008A1	021356	021455
7.1/14.2	2865-142 (2249)	SM007107005A2	SM007107008A1	021306	021454
5.4/10.8	2865-108 (2249)	SM005407005A2	SM005407008A1	021382	021453
3.6/7.2	2865-072 (2249)	SM003607005A2	SM003607008A1	021437	021452

Item 16 Bearing Housing

SL012004A1
(1/4-19 BSPP)

SL012003A1
(7/16-20 O-Ring)

Item 9 Center Block

SM012002A1
(7/8-14 O-Ring, Pilot Act.)

SM012001A1
(7/8-14 O-Ring Solenoid)

SM012003A1
(BSPP Pilot Act.)

SM012004A1
(BSPP Solenoid)

PA-2817
(Manifold, Pilot Act.)

Item 11 Shaft, Output

1" Dia. Shafts
SL019012, 1" Key
SL019020, 6B Spline
SL019013, 25mm Key
SL019017, 7/8" 13T Spline

1.25" Dia. Shafts
SL019014 ,1.25" Key
SL019015, 1.25" Taper
SL019016, 1.25" 14T Spline
SL019018, 32mm Key

1" Output Shafts

Seal Kit - Complete: SK000202

Includes: P/N	Qty	Description
1046	6	Body O-Rings
1060-34	1	Flange O-Ring, Item 13
1325	1	Dust Seal
2175	1	1.063" High Pressure Seal
032844	5	Solenoid Block O-Rings
1585	1	Thrust Bearing (presses in flange)

1.25" Output Shafts

Seal Kit - Complete: SK000203

Include: P/N	Qty	Description
1046	6	Body O-Rings
1060-34	1	Flange O-Ring, Item 13
1435	1	Dust Seal
2150	1	1.311" High Pressure Seal
032844	5	Solenoid Block O-Rings

Change for All 700 Series motors with 1" diameter shafts and date codes through 091-96 (3/31/96)

Change: New seal kit and outputs for 700 Series, 1" diameter shaft motors

Summary: Starting 092-96 (4/1/96) all 700 Series motors will use the 1.25" diameter type "A" and "B" flange and the same seal kit regardless of shaft diameter size.

Description	Not Available After 3/31/96 (1" Dia. Parts)	Replace With (1.25" Dia. Parts)
"A" Flange (including seats)	PA-2983-1	PA-2984-1
"B" Flange (including seats)	PA-2983-2	PA-2984-2
1" Keyed Shaft	2970-0	SL019000
1" 6B Spline Shaft	2970-1	SL019011
25mm Keyed Shaft	2970-2	SL019002
78" 13T Spline Shaft	2970-6	SL019006

SK000202	Seal Kit for 1" type shafts prior to 092-96 (4/1/96)
SK000203	Seal kit for all other type 700 series
2270	Thrust bearing (required when converting from 2970-X)
2271	Thrust washer (required when converting from 2970-X)

NOTE: Replacement shafts for any fo the above mentioned motors manufactured on or before 091-6 (3/31/96) must be ordered with a 1.25" type flange. The 1" diameter type flanges wll no longer be available. Also, the 1.25" diameter type thrust bearing 2270 and thrust washer 2271 must be ordered to complete the change over.

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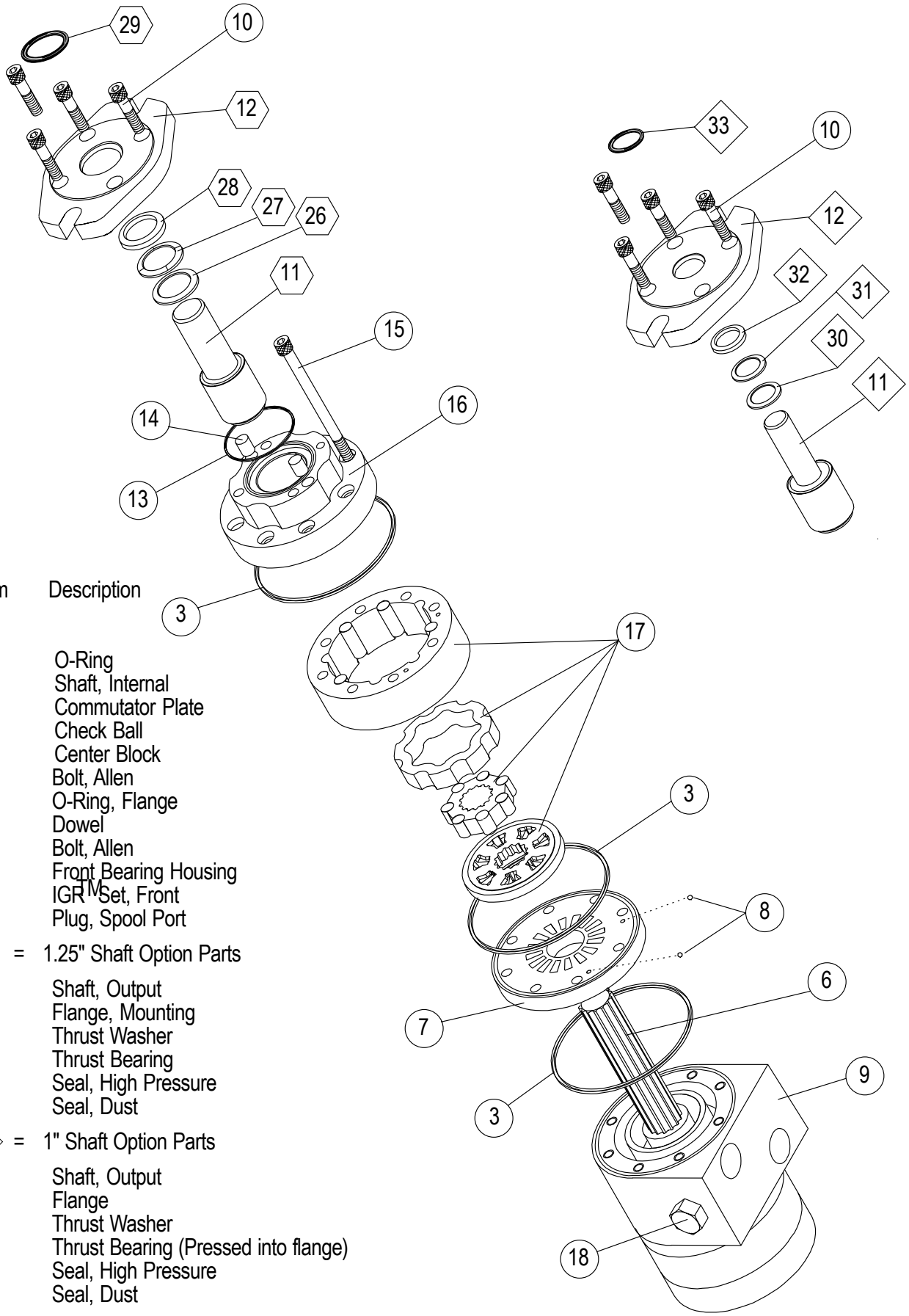

Item No.	Description
3	O-Ring
6	Shaft, Internal
7	Commutator Plate
8	Check Ball
9	Center Block
10	Bolt, Allen
13	O-Ring, Flange
14	Dowel
15	Bolt, Allen
16	Front Bearing Housing
17	IGR™ Set, Front
18	Plug, Spool Port
⬡ =	1.25" Shaft Option Parts
11	Shaft, Output
12	Flange, Mounting
26	Thrust Washer
27	Thrust Bearing
28	Seal, High Pressure
29	Seal, Dust
◇ =	1" Shaft Option Parts
11	Shaft, Output
12	Flange
30	Thrust Washer
31	Thrust Bearing (Pressed into flange)
32	Seal, High Pressure
33	Seal, Dust

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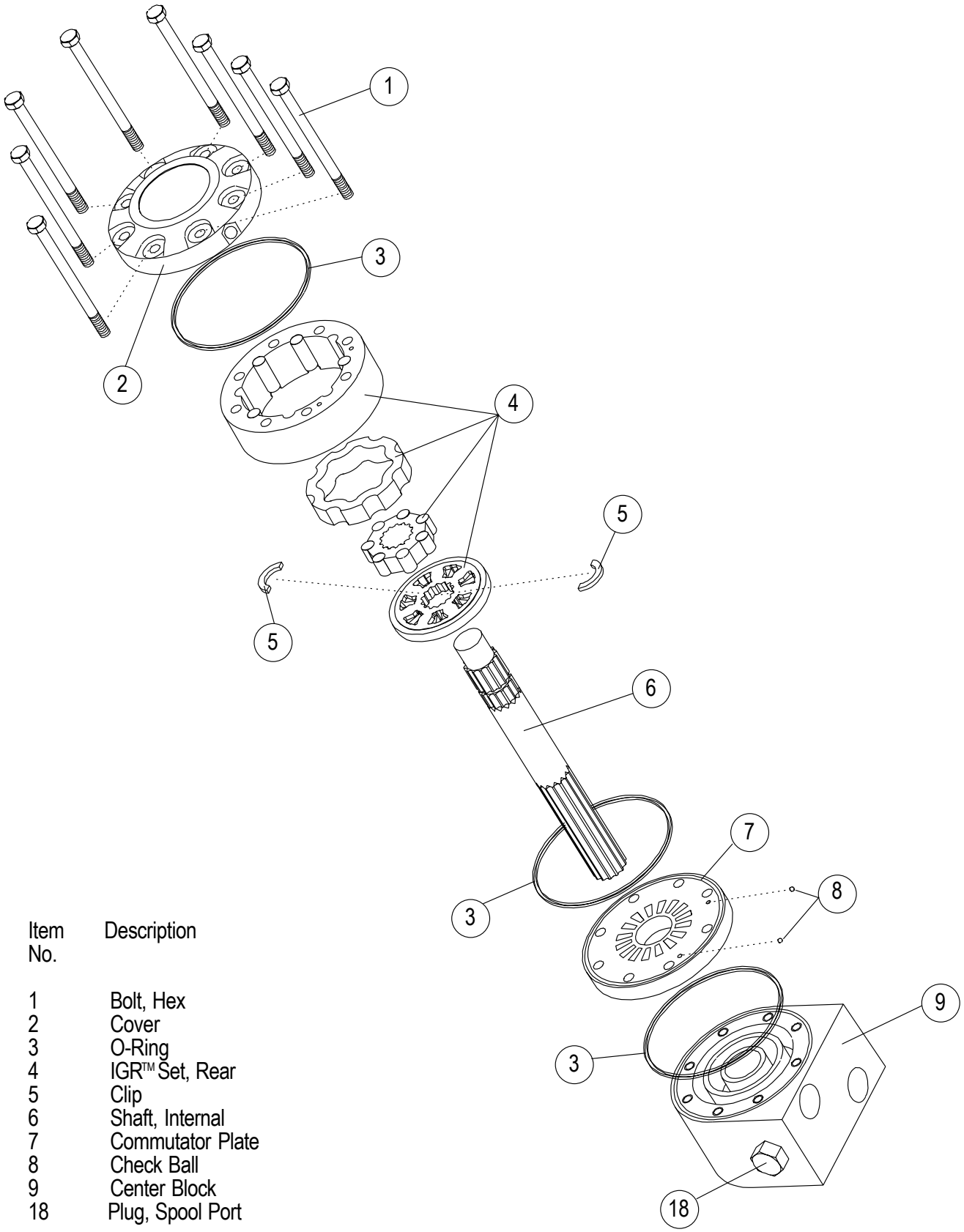

Item No.	Description
1	Bolt, Hex
2	Cover
3	O-Ring
4	IGR™ Set, Rear
5	Clip
6	Shaft, Internal
7	Commutator Plate
8	Check Ball
9	Center Block
18	Plug, Spool Port

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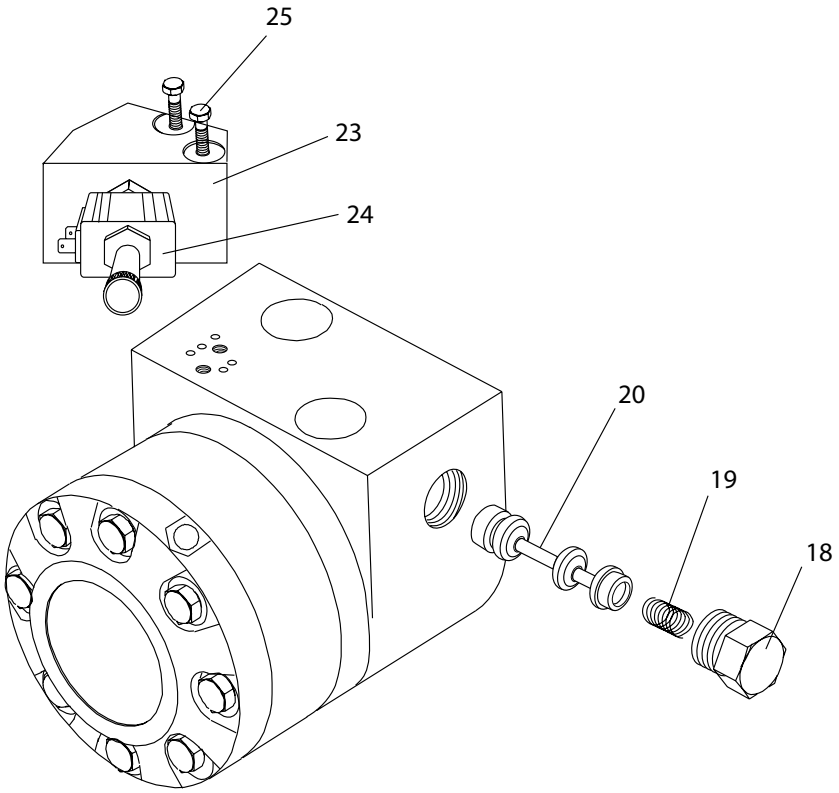

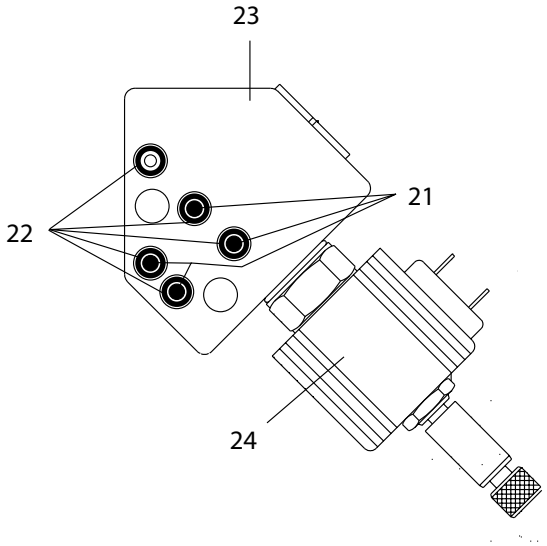

Solenoid Block
Bottom View

Item No.	Description
18	Plug, Spool Port
19	Spring, Valve
20	Valve
21	Check Ball, Solenoid Block
22	O-Ring Solenoid
23	Solenoid Block
24	Solenoid
25	Hex Bolt

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(Preparation Before Disassembly)

- Before you disassemble the motor unit of any of its components, read this entire manual. It provides important information on parts and procedures you will need to know to service the motor.
- Refer to page four for tools and other items required to service the motor and have them available.
- Thoroughly clean off all outside dirt, especially from around fittings and hose connections, before disconnecting and removing the motor. Remove rust or corrosion from coupling shaft.
- Remove coupling shaft connections and hose fittings. Immediately plug port holes and fluid lines.
- Remove the motor from system. Drain it of fluid and take it to a clean work surface.
- Clean and dry the motor before you start to disassemble the unit.
- As you disassemble the motor, clean all parts - except seals - in a clean, petroleum-based solvent and blow them dry.
- Keep parts separate to avoid nicks and burrs.
- Discard all seals and seal rings as they are removed from the motor. Replace all seals, seal rings and any damaged or worn parts with genuine Parker or OEM approved service parts.

⚠ WARNING	Since they are flammable, be extremely careful when using any solvent. Even a small explosion or fire could cause injury or death.

⚠ WARNING	Wear eye protection and be sure to comply with OSHA or other maximum air pressure requirements.

⚠ CAUTION	Never steam or high pressure wash hydraulic components. Do not force or abuse closely fitted parts.

Section I

Motor Disassembly

1. Mount the motor in a soft-jawed vise, shaft up, clamping firmly on the cover assembly. Remove manifold port rings if applicable.
2. Remove the key or castle nut if on the shaft.
3. Remove the 4 socket head cap screws (10) from the flange cover. Lift flange cover (12) by lightly tapping the flange up off the dowels with a soft hammer. Do not remove the dowel pins.
4. Remove thrust washers and shaft. (2 washers used with the 1.25" dia. shaft 1 washer used with the 1" dia. shaft).
5. Loosen and remove the 8 socket screws (15) to remove the front bearing housing (16) and the locating ring. Remove rollers and check balls. **Note:** The check balls may fall into the bolt holes or into the commutator ports. Be sure that both check balls are removed and accounted for.

⚠ CAUTION	The rollers & check balls will fall out so be ready to catch them to prevent damage and loss.

6. Separate the locating ring from the front bearing housing (16) by holding the locating ring in hand and tapping the housing with a soft nosed hammer.

⚠ CAUTION	If placed in a vise, use minimal clamping force to prevent a permanent out of round condition.

7. Remove the outer carefully to prevent rolls from falling or remove rolls with a magnet.
8. Remove rolls, inner and valve plate.
9. Remove commutator plate assembly (7) and seal (6).
10. Turn motor assembly upside down and clamp center block (9) in vise.
11. Loosen and remove the 8 5/16-24 bolts (1). Remove the cover (2), locating ring, check valve balls (quantity 2)(8), and rollers.

⚠ CAUTION	The rollers will fall out so be ready to catch them to prevent damage and loss.

12. Remove the outer, rolls, inner and valve plate.
13. Lift shaft (6) up a short distance, push the valve plate down and remove the 2 snap ring pieces (5). NOTE: With the snap ring removed, the shaft will fall out of the motor unless you maintain a grip on it.
14. Remove the valve plate, shaft (6) commutator plate (7) and seal (3).

Seal Removal

15. Remove dust seal by tapping on the seal with a blunt instrument and hammer with the flange (12) lying on a clean, flat surface.
16. Pry lip seal out with a screwdriver. Be careful to not scratch the flange seal area. Scratching the seal area would possibly create a leak path.

Pilot Option

To change pilot operation from normally parallel to normally series or vice versa, reverse the spool direction. Also valid for solenoid shift motors.

1. Remove the plugs (18) on the center block.
2. Remove the spool (20) and spring (19).
3. Looking at the port surface, install the spool with:

   A) the "double" or "wide" land nearest the pilot port for **normally parallel** operation.

   B) the "double" or "wide" land opposite the pilot port for **normally series** operation.
4. The spring is always located on the side opposite the pilot port.

THE DISASSEMBLY OF THE MOTOR IS NOW COMPLETE.

Parts Inspection

Inspect the shaft for a smooth polish in the bearing and seal areas. If scratched, polish with fine emery paper in circumferential direction. If pitted, or if scratches are deep, replace shaft and check the rest of the motor for scratches, galling or contamination damage. Replace parts as needed.

If your motor has a thru shaft option and the seals are leaking, the entire cover must be replaced. Thru covers contain no serviceable parts.

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Section II

Motor Assembly

Replace all seals and seal rings with new ones each time you reassemble the motor unit. Lubricate all seals and seal rings with oil or clean grease before assembly.

NOTE: Individual seals and seal rings as well as complete seal kits are available. The parts should be available through most OEM parts distributors or Parker distributors. (Contact your local dealer for availability.)

NOTE: Unless otherwise indicated, do not oil or grease parts before assembly.

Wash all parts in clean petroleum-based solvents before assembly. Blow them dry with compressed air. Remove any paint chips from mating surfaces and from port an seal areas.

⚠ WARNING	Since they are flammable, be extremely careful when using any solvent. Even a small explosion or fire could result in injury or death.

⚠ WARNING	Wear eye protection and be sure to comply with OSHA or other maximum air pressure requirements.

Section II

Motor Assembly

1. Assemble the new dust seal flat edge facing into the flange (12).
2. Assemble the new shaft seal and place flat side facing out over the shaft (11) to the shoulder. Insert shaft into flange. Tap shaft end with soft hammer to seat seal.

   NOTE: With 1" diameter shafts (2970-X) thrust bearing must now be pressed into the flange with the copper side facing inward.
3. Position the center block (9) so the pilot port or solenoid ports are on your right and lock in vise.
4. Place the square cut seal (3) in center block seal gland.
5. Place commutator plate (7) on the center block (9) with the square ring groove facing up. Align the 8 bolt holes in the plate with the 8 tapped holes in the body (The holes will align in only one position).

   NOTE: Do not dislodge square ring seal (3) while positioning the commutator plate (7).
6. Insert the internal shaft through the commutator plate and center block with the spline snap ring groove up. Then place the counterbored (at the splines) valve plate on the shaft with the counterbore facing up to accept the snap ring halves (5) in the next step.
7. Put both snap ring halves (5) into the snap ring groove on the shaft (6). Hold the snap rings in place with pliers while gently tapping the shaft down, seating the snap rings into the valve plate counterbore.
8. Place the square cut seal (3) in the commutator plate (7) seal gland.
9. Place the inner counterbored side down on the splines so that the semicircular roll pockets are between the rotary valve port windows. Rotate the shaft and align one valve plate window perpendicular to the flat center block port face. Keep this valve/shaft position to enable proper timing of the motor in step 17. A properly timed motor will help smooth out low speed operation (i.e. 180˚ out of phase).
10. Place the outer over the inner and insert the rolls. The rolls should not block the ports in the valve plate. Place the check balls (8) on their seats on the commutator plate. Assembly grease can be used to keep the check balls in place during assembly.
11. Place the locating ring over the inner with the square oil return groove up and the check ball counterbores over the check balls. Align the 8 bolt holes with the commutator holes.
12. Alternate inserting long and short rollers between the outer and locating ring to match up with 4 dowels on the cover.

    NOTE: The difference between rolls and rollers is that rolls have square ends and rollers have a radius on the ends.
13. Place O-Ring (3) in cover (2) seal groove. Assembly grease can be used to hold the O-Ring in place during assembly.
14. Place the cover (2) so the port markings (IN-IN) are lined up with the corresponding ports. Also check the O-Ring (3) to verify it hasn't dropped out.

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15. Install lubricated bolts (1) and torque diagonally to 15 ft. lbs.

A) Increase torque diagonally 5 ft. lbs. on each bolt.

B) Rotate the shaft by hand through several rotations.

C) Repeat steps A & B until torque is 28 ft. lbs.

16. Turn motor right side up in the vice and install the O-Ring (3) in the center block seal gland.

17. Place the commutator plate on the center block with the square ring groove facing up. Align the 8 bolt holes with the 8 tapped holes in the center block.

18. With the valve plate windows sharp edge facing the commutator plate, place the valve plate over the splines of the shaft. The plate should be positioned one tooth off the opposite end valve plate when viewing valve plate port timing with respect to the commutator plate.

19. Install an O-Ring into the groove in the commutator plate.

20. Place the inner over the splines of the shaft. Position the inner so the semi-circular roll pockets are between the rotary valve port windows.

21. Place the outer over the inner and insert the rolls into the inner pockets.

NOTE: The difference between rolls and rollers is that rolls have square ends and rollers have radius ends.

⚠ WARNING	Do not rotate the locating ring or check balls will drop into the bolt holes.

22. Place the check balls (8) on their seats on the commutator plate. Place the locating ring section onto the commutator plate with the check ball counterbored facing downward over the balls. Align the 8 bolt holes with the commutator holes. Place the rollers in position alternating long and short to match up with the 4 dowels in the front bearing housing (16).

23. Install an O-Ring (3) into the groove of the front bearing housing (16). Place the front bearing housing with O-Ring over the shaft and place onto the locating ring. Be sure to align the 4 dowels with the short dowels inside the locating ring and to align the bolt holes in the locating ring. The bolt pattern will only match one way.

24. Insert O-Ring seal (13) into the front bearing housing (16).

25. Insert shaft (11). Gently tap in with a soft hammer, rotating the shaft if necessary to align the splines.

For the 1.25" dia. shaft:
Place the thrust washer (11A) on the shaft and place the thrust bearing (11A) on top of the thrust washer. The grooves on the bearing washer must face towards the shaft seal.

For the 1" dia. shaft:
There is only one thrust washer and it can be assembled either way. The thrust bearing is pressed in the front bearing housing.

26. Install lubricated bolts (1) and torque diagonally to 15 ft. lbs.

A) Increase torque diagonally 5 ft. lbs. on each bolt.

B) Rotate the shaft by hand through several rotations.

C) Repeat steps A & B until torque is 30 ft. lbs.

27. Place the flange with 2 dowels over the shaft and onto the front bearing housing. Align the dowel pins as you install the flange. Lubricate and install the 4 socket head cap screws and torque to 25 ft. lbs.

Solenoid Assembly

1. Place 4 check balls (21) on their seats on the center block (9).

2. Place 5 O-Rings (22) in the grooves on the solenoid block (23).

3. Place solenoid valve assembly (23) on the center block. Insert bolts and torque to 15 ft. lbs.

THE MOTOR ASSEMBLY IS NOW COMPLETE EXCEPT FOR KEYS, NUTS, ETC. AT THE TIME OF INSTALLATION IF APPLICABLE. SEE FINAL CHECKS.

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Final Checks

- Pressurize the motor with 100 psi dry air or nitrogen and submerge in solvent to check for external leaks.
- Port with IN cast adjacent to the port indicates shaft rotation.
- Check operation of the motor with a test stand.

Hydraulic Fluid

- Hydraulic fluid as recommended by equipment manufacturer, with viscosity no less than 50 SSU.

⚠ CAUTION	Do not mix oil types. Any mixture or non-approved oil could deteriorate the seals. Maintain the proper fluid level in the reservoir. When changing fluid, completely drain old oil from the system. It is suggested also that you flush the system with clean oil, especially if there was a major hydraulic component failure. In addition, run the system with no load for a period of time to allow the filters to clean up the oil. Then, change the filters before returning the machine to service.

Filtration

- Recommended filtration: Beta 25 ratio of at least 2.

Oil Temperature

- Maximum operating temperature 180˚.

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Maintenance Tips

- Adjust fluid level in reservoir as necessary.
- Encourage all operators to report any malfunction or accident that may have damaged the hydraulic system or component.
- Do not attempt to weld any broken motor component. Replace the component with original equipment only.
- Do not cold straighten or bend any motor part.
- Prevent dirt or other foreign matter from entering the hydraulic system. Clean the area around the filler caps before checking oil level.
- Investigate and correct any external leak in the hydraulic system no matter how minor.
- Comply with manufacturer's specifications for cleaning or replacing the filter.

⚠ CAUTION	Do not strike or drop the motor on the shaft end. This will cause internal damage.

⚠ CAUTION	Do not weld, braze, solder or in any way alter any motor component.

⚠ CAUTION	Maximum operating pressure must not exceed recommended motor pressure capacity.

⚠ CAUTION	Always carefully inspect any system component that may have been struck or damaged during operation or in an accident. Replace any component that is damaged or that is questionable.

⚠ CAUTION	Do not force any coupling onto the motor coupling shaft as this could damage the unit internally.

Parker Hannifin Corp. extends close technical cooperation and assistance. If problems occur that you cannot solve, please contact our Parker Technical Service Representative or local Parker Distributor. See the back cover of this manual for our address, phone and fax numbers.

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3. Delivery: Unless otherwise provided on the face hereof, delivery shall be made F.O.B. Seller's plant. Regardless of the method of delivery, however, risk of loss shall pass to Buyer upon Seller's delivery to a carrier. Any delivery dates shown are approximate only and Seller shall have no liability for any delays in delivery.

4. Warranty: Seller warrants that the items sold hereunder shall be free from defects in material or workmanship for a period of 18 months from date of shipment from Parker Hannifin Corporation. **THIS WARRANTY COMPROMISES THE SOLE AND ENTIRE WARRANTY PERTAINING TO ITEMS PROVIDED HEREUNDER. SELLER MAKES NO OTHER WARRANTY, GUARANTEE, OR REPRESENTATION OF ANY KIND WHATSOEVER. ALL OTHER WARRANTIES, INCLUDING BUT NOT LIMITED TO, MERCHANTABILITY AND FITNESS FOR PURPOSE, WHETHER EXPRESS, IMPLIED, OR ARISING BY OPERATION OF LAW. TRADE USAGE, OR COURSE OF DEALING ARE HEREBY DISCLAIMED.**

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6. Changes, Reschedules and Cancellations: Buyer may request to modify the designs or specification for items sold hereunder as well as the quantities and delivery dates thereof, or may request to cancel all or part of this order, however, no such requested modification or cancellation shall become part of the contract between buyer and Seller unless accepted by Seller in written amendment to this Agreement. Acceptance of any such requested modification or cancellation shall be at Seller's discretion, and shall be upon such terms and conditions as Seller may require.

7. Special Tooling: A tooling charge may be imposed for any special tooling, including without limitation, dies, fixtures, molds and patterns, acquired to manufacture items sold pursuant to this contract. Such special tooling shall be and remain Seller's property notwithstanding payment of any charges by Buyer, in no event will Buyer acquire any interest in apparatus belonging to Seller which is utilized in the manufacture of the items sold hereunder, even if such apparatus has been specially converted or adapted for such manufacture and notwithstanding any charges paid by Buyer. Unless otherwise agreed, Seller shall have the right to alter, discard or otherwise dispose of any special tooling or other property in its sole discretion at any time.

8. Buyer's property: Any designs, tools, patterns, materials, drawings. Confidential information or equipment furnished by buyer, or any other items which become Buyer's property, may be considered obsolete and may be destroyed by Seller after two (2) consecutive years have elapsed without Buyer placing an order for the items which are manufactured using such property. Seller shall not be responsible for any loss or damage to such property while it is in Seller's possession or control.

9. Taxes: Unless otherwise indicated on the face hereof, all prices and charges are exclusive of excise, sales, use, property, occupational or like taxes which may be imposed by any taxing authority upon the manufacture, sale or delivery of the items sold hereunder. If any such taxes must be paid by Seller or if Seller is liable for the collection of such tax, the amount hereof shall be in addition to amounts for the items sold. Buyer agrees to pay all such taxes or to reimburse Seller therefore upon receipt of its invoice. If Buyer claims exemption from any sales, use or other tax imposed by any taxing authority, Buyer shall save Seller harmless from and against any such tax together with any interest or penalties thereon which may be assessed if the items are held to be taxable.

10. Indemnity For Infringement of Intellectual Property Rights: Seller shall have no liability for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights except as provided in this Part 10. Seller will defend and indemnify Buyer against allegations of infringement of U.S. patents, U.S. Trademarks, copyrights, trade dress and trade secrets (hereinafter "Intellectual Property Rights). Seller will defend at its expense and will pay the cost of any settlement or damages awarded in an action brought against Buyer based on an allegation that an item sold pursuant to this contract infringes the Intellectual Property Rights of a third party. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of such allegations of infringement, and Seller having sole control over the defense of any allegations or actions including all negotiations for settlement or compromise. If an item sold hereunder is subject to a claim that it infringes the Intellectual Property Rights of a third party, Seller may, at its sole expense and option, procure for Buyer the right to continue using said item, replace or modify said item so as to make it noninfringing, or offer to accept return of said item and return the purchase price less a reasonable allowance for depreciation. Notwithstanding the foregoing, Seller shall have no liability for claims of infringement based on information provided by Buyer, or directed to items delivered hereunder for which the designs are specified in whole or part by Buyer, or infringements resulting from the modification, combination or use in a system of any item sold hereunder. The foregoing provisions of this Part 10 shall constitute Seller's sole and exclusive liability and buyer's sole and exclusive remedy for infringement of Intellectual Property Rights.

If a claim is based on information provided by Buyer or if the design for an item delivered hereunder is specified in whole or in part by Buyer, buyer shall defend and indemnify Seller for all costs, expenses of or judgments resulting from any claim that such item infringes any patent, trademark, copyright, trade dress, trade secret or any similar right.

11. Force Majeure: Seller does not assume the risk of and shall not be liable for delay or failure to perform any of Seller's obligations by reason of circumstances beyond the reasonable control of Seller (hereinafter "Events of Force Majeure"). Events of Force Majeure shall include without limitation, accidents, acts of god, strikes or labor disputes, acts, laws, rules or regulations of any government or government agency, fires, floods, delays or failures in delivery of carries or suppliers, shortages of materials and any other cause beyond Seller's control.

12. Entire Agreement/Governing Law: The terms and conditions set forth herein, together with any amendments, modifications and any different terms or conditions expressly accepted by Seller in writing, shall constitute the entire Agreement concerning the items sold, and there are no oral or other representation or agreements which pertain thereto. This Agreement shall be governed in all respects by the law of the State of Ohio. No actions arising out of the sale of the items sold hereunder or this Agreement may be brought by either party more than two (2) years after the cause of action accrues.

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