Torqmotor™
Service Procedure

Effective: April 2015

TF, TG, TH and TL Series
Low Speed, High Torque
Hydraulic Torqmotors™
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WARNING

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Definitions

NOTE: A NOTE provides key information to make a procedure easier or quicker to complete.

CAUTION: A CAUTION refers to procedure that must be followed to avoid damaging the Torqmotor™ or other system components.

WARNING: A WARNING REFERS TO PROCEDURE THAT MUST BE FOLLOWED FOR THE SAFETY OF THE EQUIPMENT OPERATOR AND THE PERSON INSPECTING OR REPAIRING THE TORQMOTOR™.

Disclaimer

This Service Manual has been prepared by Parker Hannifin for reference and use by mechanics who have been trained to repair and service hydraulic motors and systems on commercial and non-commercial equipment applications. Parker Hannifin has exercised reasonable care and diligence to present accurate, clear and complete information and instructions regarding the techniques and tools required for maintaining, repairing and servicing the complete line of Parker TF, TG, TH and TL Torqmotor™ Units. However, despite the care and effort taken in preparing this general Service Manual, Parker makes no warranties that (a) the Service Manual or any explanations, illustrations, information, techniques or tools described herein are either accurate, complete or correct as applied to a specific Torqmotor™ unit, or (b) any repairs or service of a particular Torqmotor™ unit will result in a properly functioning Torqmotor™ unit.

If inspection or testing reveals evidence of abnormal wear or damage to the Torqmotor™ unit or if you encounter circumstances not covered in the Manual, STOP – CONSULT THE EQUIPMENT MANUFACTURER’S SERVICE MANUAL AND WARRANTY. DO NOT TRY TO REPAIR OR SERVICE A TORQMOTOR™ UNIT WHICH HAS BEEN DAMAGED OR INCLUDES ANY PART THAT SHOWS EXCESSIVE WEAR UNLESS THE DAMAGED AND WORN PARTS ARE REPLACED WITH ORIGINAL PARKER REPLACEMENT AND SERVICE PARTS AND THE UNIT IS RESTORED TO PARKER SPECIFICATIONS FOR THE TORQMOTOR™ UNIT.

It is the responsibility of the mechanic performing the maintenance, repairs or service on a particular Torqmotor™ unit to (a) inspect the unit for abnormal wear and damage, (b) choose a repair procedure which will not endanger his/her safety, the safety of others, the equipment, or the safe operation of the Torqmotor™, and (c) fully inspect and test the Torqmotor™ unit and the hydraulic system to insure that the repair or service of the Torqmotor™ unit has been properly performed and that the Torqmotor™ and hydraulic system will function properly.
**Torqmotor™ Design Features**

**Torqmotor™ TF Series features include:**
- Heavy-duty thrust and roller bearings for up to twice side-load capacity to the previous motor.
- Roller vanes to reduce friction and internal leakage, and to maintain efficiency.
- A patented orbiting commutation system for less wear and longer life.
- A patented 60:40 arrangement of internal and external spline members to transmit more torque with less weight.
- A unique high-pressure shaft seal that eliminates the need for case drains, check valves and extra plumbing.
- A unique manifold designed to improve operating efficiency.
- Up to 1000 lbs. (453.6 kg) end-thrust capacity in either direction.
- A design that is less sensitive to contamination than competitive motors.
- Up to 36 horsepower output.
- Greater durability because of superior lubrication and minimum drive spline wear.
- Superior low speed performance.
- Zero leak commutation valve provides greater, more consistent volumetric efficiency.

**Torqmotor™ TG/TH/TL Series features include:**
- Roller vanes to reduce friction and internal leakage and to maintain efficiency.
- A patented orbiting commutation system for less wear and longer life.
- A patented 60:40 arrangement of internal and external spline members to transmit more torque with less weight.
- A unique high-pressure shaft seal that eliminates the need for case drains, check valves and extra plumbing.
- A manifold designed to improve operating efficiency.
- Heavy-duty thrust and roller bearings for up to twice the side-load capacity to the previous motor.
- Up to 1000 lbs. (453.6 kg) end-thrust capacity in either direction.
- A design that is less sensitive to contamination than competitive motors.
- Up to 49 horsepower output.
- Greater durability because of superior lubrication and minimum drive spline wear.
- Zero leak commutation valve provides greater, more consistent volumetric efficiency.
Introduction

This service manual has one purpose: to guide you in maintaining, troubleshooting, and servicing the TF, TG, TH and TL Torqmotor™ (low-speed, high-torque hydraulic motor).

Material in this manual is organized so you can work on the Torqmotor™ and get results without wasting time or being confused. To get these results, you should read this entire manual before you begin any work on the Torqmotor™.

This manual also contains troubleshooting information and checklist. If you must service the Torqmotor™, the checklist will help you to determine where the problem may be.

The three-column format of the Disassembly and Inspection, and Assembly sections will make it easier for you to conduct major work on the Torqmotor™. Column 1 gives a brief key for each procedure. Column 2 explains in detail the procedure you should follow. Column 3 illustrates this procedure with photographs. Read all material carefully and pay special attention to the notes, cautions, and warnings.

A page with the Torqmotor™ exploded assembly view is provided several places in this manual. The component part names and item numbers assigned on this exploded assembly view correspond with names and item numbers (in parentheses) used in the disassembly and assembly procedures set forth in this manual. Service part list charts are also provided in this manual with the part names and exploded view item numbers cross referenced to Parker service part numbers.

Service parts are available through the Original Equipment Manufacturer or Parker approved TF, TG, TH and TL Torqmotor™ Distributors.

As you gain experience in servicing the Torqmotor™, you may find that some information in this manual could be clearer or more complete. If so, let us know about it. Do not try to second guess the manual. If you are stuck, contact us. Servicing the Torqmotor™ should be a safe and productive procedure, in order for the unit to deliver the reliable, long-life operation engineered into it.
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 Torqmotor™ 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.

WARNING: SINCE SOLVENTS 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 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; and
- improper replacement parts used in previous servicing
- mechanical linkage problems such as binding, broken, or loose parts or slipping belts

Hydraulic Components
If you think the problem is caused by a hydraulic component, start by checking the easy-to-reach items.

Check all hoses and lines for cracks, hardening, or other signs of wear. Reroute any usable hoses that are kinked, severely bent, or that rest against hot engine parts. Look for leaks, especially at couplings and fittings. Replace any hoses or lines that don’t meet system flow and pressure ratings.

Next, go to the reservoir and filter or filters. Check fluid level and look for air bubbles. Check the filter(s). A filter with a maximum 40 micron filtration is recommended for the Torqmotor™ system.

Visually check other components to see if they are loosely mounted, show signs of leaks, or other damage or wear.

Excessive heat in a hydraulic system can create problems that can easily be overlooked. Every system has its limitation for the maximum amount of temperature. After the temperature is attained and passed, the following can occur:

- oil seal leaks
- loss of efficiency such as speed and torque
- pump loss of efficiency
- pump failure
- hoses become hard and brittle
- hose failure

A normal temperature range means an efficient hydraulic system. Consult the manuals published by equipment and/or component manufacturers for maximum allowable temperature and hydraulic tests that may be necessary to run on the performance of the hydraulic components. The Torqmotor™ is not recommended for hydraulic systems with maximum temperatures above 200°F (93.3°C).
## Troubleshooting Checklist

<table>
<thead>
<tr>
<th>Trouble</th>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Oil Leakage</strong></td>
<td>1. Hose fittings loose, worn or damaged.</td>
<td>Check &amp; replace damaged fittings or “O” Rings. Torque to manufacturers specifications.</td>
</tr>
<tr>
<td></td>
<td>2. Oil seal rings (4) deteriorated by excess heat.</td>
<td>Replace oil seal rings by disassembling Torqmotor™ unit.</td>
</tr>
<tr>
<td></td>
<td>3. Special bolt (1, 1A, 1B or 1C) loose or its sealing area deteriorated by corrosion.</td>
<td>(a) Loosen then tighten single bolt to torque specification. (b) Replace bolt.</td>
</tr>
<tr>
<td></td>
<td>4. Internal shaft seal (16) worn or damaged.</td>
<td>Replace seal. Disassembly of Torqmotor™ unit necessary.</td>
</tr>
<tr>
<td></td>
<td>5. Worn coupling shaft (12) and internal seal (16).</td>
<td>Replace coupling shaft and seal by disassembling Torqmotor™ unit.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Trouble</th>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Significant loss of speed under load</strong></td>
<td>1. Lack of sufficient oil supply</td>
<td>(a) Check for faulty relief valve and adjust or replace as required. (b) Check for and repair worn pump. (c) Check for and use correct oil for temperature of operation.</td>
</tr>
<tr>
<td></td>
<td>2. High internal motor leakage</td>
<td>Replace worn rotor set by disassembling Torqmotor™ unit.</td>
</tr>
<tr>
<td></td>
<td>3. Severely worn or damaged internal splines.</td>
<td>Replace rotor set, drive link and coupling shaft by disassembling Torqmotor™ unit.</td>
</tr>
<tr>
<td></td>
<td>4. Excessive heat.</td>
<td>Locate excessive heat source (usually a restriction) in the system and correct the condition.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Trouble</th>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low mechanical efficiency or undue high pressure required to operate Torqmotor™ unit</strong></td>
<td>1. Line blockage</td>
<td>Locate blockage source and repair or replace.</td>
</tr>
<tr>
<td></td>
<td>2. Internal interference</td>
<td>Disassemble Torqmotor™ unit, identify and remedy cause and repair, replacing parts as necessary.</td>
</tr>
<tr>
<td></td>
<td>3. Lack of pumping pressure</td>
<td>Check for and repair worn pump.</td>
</tr>
<tr>
<td></td>
<td>4. Excessive binding or loading in system external to Torqmotor™ unit.</td>
<td>Locate source and eliminate cause.</td>
</tr>
</tbody>
</table>

**CAUTION:** If the hydraulic system fluid becomes overheated [in excess of 200°F (93.3°C)], seals in the system can shrink, harden or crack, thus losing their sealing ability.
Tools and Materials Required for Servicing

- Clean, petroleum-based solvent
- Emery paper
- Vise with soft jaws
- Air pressure source
- Arbor press
- Screw driver
- Masking tape
- Breaker bar
- Torque wrench-ft. lbs. (N m)
- Sockets: 1/2 or 9/16 inch thin wall, 1 inch
- Allen Sockets: 3/16, 3/8 inch
- Adjustable crescent wrench or hose fitting wrenches
- SAE 10W40 SE or SF oil
- Special bearing mandrel for TH Torqmotors (consult factory)
- Special bearing mandrel for TF, TG & TJ Torqmotors (SEE FIGURE 1)
- Feeler gage .005 inch (.13 mm)
- TH Torqmotors require blind hole bearing puller for a 1.575 inch dia. (40.0 mm) and 2.130 inch dia. (54.1 mm) bearings.
- TF, TG & TL Torqmotors require blind hole bearing puller for 1.400 inch dia. (35.6 mm) and 2.130 inch dia. (54.1 mm) bearings.
- Clean corrosion resistant grease. Part #406018 is included in each seal kit. Recommended grease is Parker Specification #045236 or Mobil Mobilith SHC® 460

NOTE: The available service seal kits include the recommended grease as a grease pack #406018

CAUTION: Mixing greases that have different bases can be detrimental to bearing life.
### CONVERSIONS

<table>
<thead>
<tr>
<th>INCHES</th>
<th>mm</th>
<th>INCHES</th>
<th>mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>.020</td>
<td>.51</td>
<td>1.060</td>
<td>26.92</td>
</tr>
<tr>
<td>.021</td>
<td>.53</td>
<td>1.295</td>
<td>32.89</td>
</tr>
<tr>
<td>.029</td>
<td>.74</td>
<td>1.297</td>
<td>32.94</td>
</tr>
<tr>
<td>.030</td>
<td>.76</td>
<td>1.396</td>
<td>35.46</td>
</tr>
<tr>
<td>.111</td>
<td>2.81</td>
<td>1.398</td>
<td>35.51</td>
</tr>
<tr>
<td>.119</td>
<td>3.02</td>
<td>1.620</td>
<td>41.15</td>
</tr>
<tr>
<td>.152</td>
<td>3.86</td>
<td>1.622</td>
<td>41.20</td>
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<td>.160</td>
<td>4.06</td>
<td>1.983</td>
<td>50.37</td>
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<td>.296</td>
<td>7.52</td>
<td>1.985</td>
<td>50.42</td>
</tr>
<tr>
<td>.304</td>
<td>7.72</td>
<td>2.120</td>
<td>53.85</td>
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<tr>
<td>.460</td>
<td>11.68</td>
<td>2.122</td>
<td>53.90</td>
</tr>
<tr>
<td>.470</td>
<td>11.94</td>
<td>2.233</td>
<td>56.72</td>
</tr>
<tr>
<td>.500</td>
<td>12.70</td>
<td>2.235</td>
<td>56.77</td>
</tr>
<tr>
<td>.585</td>
<td>14.86</td>
<td>2.483</td>
<td>63.07</td>
</tr>
<tr>
<td>.595</td>
<td>15.11</td>
<td>2.485</td>
<td>63.12</td>
</tr>
<tr>
<td>.660</td>
<td>16.76</td>
<td>2.500</td>
<td>63.5</td>
</tr>
<tr>
<td>.675</td>
<td>17.15</td>
<td>2.88</td>
<td>73.2</td>
</tr>
<tr>
<td>1.058</td>
<td>26.87</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Torque Chart

<table>
<thead>
<tr>
<th>Part Name</th>
<th>Item Number</th>
<th>Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>bolt 3/8</td>
<td>24 UNF 2A 1, 1A, 1B or 1C</td>
<td>45-55 ft. lbs. (60-76 N m)</td>
</tr>
<tr>
<td>bolt 5/8</td>
<td>18 UNF 2A 12D</td>
<td>140-180 ft. lbs. (190-244 N m)</td>
</tr>
<tr>
<td>nut 1-20 UNEF 2B</td>
<td>12B (TF, TG, TL)</td>
<td>300-400 ft. lbs. (407-542 N m)</td>
</tr>
<tr>
<td>nut 1-1/8 18 UNEF 2B</td>
<td>12B (TG, TH)</td>
<td>300-400 ft. lbs. (407-542 N m)</td>
</tr>
</tbody>
</table>

- TL press internal bearing .576 below face
- TH press internal bearing .120 below face

(Fabricate if considered necessary)

Figure 1 – TF & TG (see note)
**Torqmotor™ Exploded View**

**Typical Assembly**

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Special Bolts (5, 6, or 7)</td>
</tr>
<tr>
<td>1a.</td>
<td>Special Bolts (7)</td>
</tr>
<tr>
<td>1b.</td>
<td>Special Bolts (7)</td>
</tr>
<tr>
<td>1c.</td>
<td>Special Bolts (7)</td>
</tr>
<tr>
<td>2.</td>
<td>End Cover</td>
</tr>
<tr>
<td>3.</td>
<td>Seal Ring-Commutator</td>
</tr>
<tr>
<td>4.</td>
<td>Seal Ring (5)</td>
</tr>
<tr>
<td>5.</td>
<td>Commutator</td>
</tr>
<tr>
<td>6.</td>
<td>Commutator Ring</td>
</tr>
<tr>
<td>7.</td>
<td>Manifold</td>
</tr>
<tr>
<td>8.</td>
<td>Rotor Set</td>
</tr>
<tr>
<td>8a.</td>
<td>Rotor</td>
</tr>
<tr>
<td>8b.</td>
<td>Stator or Stator Half</td>
</tr>
<tr>
<td>8c.</td>
<td>Vane (7)</td>
</tr>
<tr>
<td>8d.</td>
<td>Stator Half</td>
</tr>
<tr>
<td>8e.</td>
<td>Vane (7)</td>
</tr>
<tr>
<td>9.</td>
<td>Wear Plate</td>
</tr>
<tr>
<td>10.</td>
<td>Drive Link</td>
</tr>
<tr>
<td>11.</td>
<td>Thrust Bearing</td>
</tr>
<tr>
<td>12.</td>
<td>Coupling Shaft</td>
</tr>
<tr>
<td>12a.</td>
<td>Key</td>
</tr>
<tr>
<td>12b.</td>
<td>Nut</td>
</tr>
<tr>
<td>12c.</td>
<td>Washer</td>
</tr>
<tr>
<td>12d.</td>
<td>Bolt</td>
</tr>
<tr>
<td>12e.</td>
<td>Lockwasher</td>
</tr>
<tr>
<td>12f.</td>
<td>Retaining Ring</td>
</tr>
<tr>
<td>13.</td>
<td>Bearing, Inner</td>
</tr>
<tr>
<td>14.</td>
<td>Thrust Washer</td>
</tr>
<tr>
<td>15.</td>
<td>Thrust Bearing</td>
</tr>
<tr>
<td>16.</td>
<td>Seal</td>
</tr>
<tr>
<td>17.</td>
<td>Backup Ring</td>
</tr>
<tr>
<td>18.</td>
<td>Housing</td>
</tr>
<tr>
<td>18a.</td>
<td>O-Ring (2)</td>
</tr>
<tr>
<td>19.</td>
<td>Bearing, Outer</td>
</tr>
<tr>
<td>20.</td>
<td>Dirt &amp; Water Seal</td>
</tr>
<tr>
<td>21.</td>
<td>Plug (2)</td>
</tr>
<tr>
<td>22.</td>
<td>O-Ring (2)</td>
</tr>
<tr>
<td>23.</td>
<td>Spring</td>
</tr>
<tr>
<td>24.</td>
<td>Valve (Shuttle or Relief)</td>
</tr>
<tr>
<td>25.</td>
<td>Backup Washer</td>
</tr>
</tbody>
</table>

= Items not sold separately. Sold as matched sets only.
Integral Clutch Housing Exploded View

**Typical Assembly**

---

**Item No.** | **Description** | **P/N**
--- | --- | ---
39 | Torqmotor Sub-Assembly | 021479
40 | Bolt 1/2-13 (UNC-2A) (4 Req'd.) | 021479
41 | Clutch Housing | 405167
42* | Splined Gear Drive | 490102
44* | Thrust Washer (2) | 400142
45* | Thrust Bearing | 073005
46* | Disc Spring (5) | 028511
47† | Seal - Dirt and Water | 478030
48† | Snap Ring | 401623
49 | Drive Shaft 14 Tooth Spline | 093043
49 | Straight Key Shaft 1 1/4" | 093044
50† | Thrust Washer | 400141
51† | Bearing and Cone Assembly (2) | 067033
51† | Bearing Cup (2) | 400140
53† | Retaining Ring | 401623
55 | Plug | 036024
56 | Housing | ME012013A1

NOTE: Apply .06 in. (1.5 mm) Bead of Loctite #51514 Around Full Circumference of Pilot

* Items sold separately: not included in Seal Kit
† SK000039 for Clutch Assembly only
SK000092 Seal Kit for Hydraulic Motor only Item #39.

Clutch Motor applies to TF Series only (Not available in 22, 25, 29 cu in.)

SHC Oil 90 WT 45± 5CC
Chart Use Example:
TF0080AS010AAAB Torqmotor™ includes part numbers listed to the right of TF (SERIES), 0080 (DISP), AS (MOUNTING/PORTING), 01(SHAFT), 0 (ROTATION), and AAAA (OPTION) shown in the left hand column of the chart.

Caution:
The charted component service information is for the Torqmotors listed only. Refer to the original equipment manufacturer of the equipment using the Torqmotor for assembly numbers not listed below.

### Torqmotor™ Service Procedure

**FRONT PORTING**

TF, TG, TH and TL Series

Parker Hannifin Corporation
Hydraulic Pump/Motor Division
Greeneville, TN 37745 US

**EXPLODED VIEW**

<table>
<thead>
<tr>
<th>ITEM #</th>
<th>DESCRIPTION</th>
<th>ASSEMBLY</th>
<th>PLATE BEARING</th>
<th>BEARING WASHER</th>
<th>BEARING SEAL WASHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>TF</td>
<td>TF0080AS010AAAB Torqmotor™ includes part numbers listed to the right of TF (SERIES), 0080 (DISP), AS (MOUNTING/PORTING), 01(SHAFT), 0 (ROTATION), and AAAA (OPTION) shown in the left hand column of the chart.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**HOUSING GROUP**

<table>
<thead>
<tr>
<th>MOUNTING</th>
<th>DESCRIPTION</th>
<th>PORTING</th>
<th>END COVER</th>
<th>SERVICE HOUSING ASS’Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS-</td>
<td>Standard (4 Bolt)</td>
<td>7/8&quot; 0-Ring</td>
<td>ME016000</td>
<td>ME012001A1</td>
</tr>
<tr>
<td>US-</td>
<td>Wheel Mt. (4 Bolt)</td>
<td>7/8&quot; 0-Ring</td>
<td>ME016000</td>
<td>ME012002A1</td>
</tr>
<tr>
<td>AS-</td>
<td>SAE A (2 Bolt)</td>
<td>7/8&quot; 0-Ring</td>
<td>ME016000</td>
<td>ME012006A1</td>
</tr>
<tr>
<td>HS-</td>
<td>Whl. (US) w/Machined Pilot Nose</td>
<td>7/8&quot; 0-Ring</td>
<td>ME016000</td>
<td>ME012008A1</td>
</tr>
<tr>
<td>LS-</td>
<td>Whl. w/Brake Mt. (4 Bolt)</td>
<td>7/8&quot; 0-Ring</td>
<td>ME016000</td>
<td>ME012009A1</td>
</tr>
<tr>
<td>BS-</td>
<td>SAE B (2 Bolt)</td>
<td>7/8&quot; 0-Ring</td>
<td>ME016000</td>
<td>ME012019A1</td>
</tr>
<tr>
<td>GS-</td>
<td>Clutch Motor</td>
<td>7/8&quot; 0-Ring</td>
<td>ME016000</td>
<td>ME012013A1</td>
</tr>
<tr>
<td>AM-</td>
<td>SAE A (2 Bolt)</td>
<td>Manifold</td>
<td>ME016000</td>
<td>ME012028A1</td>
</tr>
<tr>
<td>MM-</td>
<td>Standard (4 Bolt)</td>
<td>Manifold</td>
<td>ME016000</td>
<td>ME012018A1</td>
</tr>
<tr>
<td>AT-</td>
<td>SAE A (2 Bolt)</td>
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**REAR PORTING**

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<th>DESCRIPTION</th>
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**Service Parts List Chart**

**DISPLACEMENT GROUP**

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<th>BOLT (7)</th>
<th>BOLT (7)</th>
<th>BOLT (7)</th>
<th>ROTOR THICKNESS</th>
<th>ROTOR SET</th>
<th>FREE RUNNING</th>
<th>DRIVE LINK</th>
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**SERVICE PARTS**

| SERIES | TF | ME018000A1 | ME015000 | 477342 | 068024 | 071019 | 400136 | 069017 | 028515 | 068027 | 478035 | 029118 |

**Notes:**

- (Not available in clutch motor)
- Caution: Refer to the original equipment manufacturer of the equipment using the Torqmotor for assembly numbers not listed below.
**Torqmotor™ Service Procedure**

**TF, TG, TH and TL Series**

Parker Hannifin Corporation

Hydraulic Pump/Motor Division
Greeneville, TN 37745  US

---

**EXPLODED VIEW**

**ITEM #**
1. Long 6B Snapwire Groove 01- MB019001 MB019301
2. Long Woodruff, 1/4” Tap Snapwire Groove 02- MB019002 MB019302
3. 1.25” Straight Keyed 5/8-18 Int. Thd. 03- MB019003 MB019303
4. 1/8B Spline 04- MB019004 MB019304
5. 14 Tooth Spline 5/8-18 Int. Thd. 05- MB019005 MB019305
6. 10 Tooth Spline 06- MB019006 MB019306
7. 15 Tooth Spline 07- MB019007 MB019307
8. 1.25” Tapered Shaft 08- MB019000 MB019300
9. 19 Tooth Spline (16/32) 09- MB019011
10. 1.25” Tapered 1.38” Tapered 1.125-18 Thd. 11- MB019010
12. 1.25” Str. Nitrotec C 12- MB019040

**DESCRIPTION**
- **COUPLING SHAFT**
  - MB019001 MB019301
  - MB019002 MB019302
  - MB019003 MB019303
  - MB019004 MB019304
  - MB019005 MB019305
  - MB019006 MB019306
  - MB019007 MB019307
  - MB019000 MB019300
  - MB019011
  - MB019040

**EXPLODED VIEW**

**ITEM #**
1. Long 6B Snapwire Groove 01- MB019001 MB019301
2. Long Woodruff, 1/4” Tap Snapwire Groove 02- MB019002 MB019302
3. 1.25” Straight Keyed 5/8-18 Int. Thd. 03- MB019003 MB019303
4. 1/8B Spline 04- MB019004 MB019304
5. 14 Tooth Spline 5/8-18 Int. Thd. 05- MB019005 MB019305
6. 10 Tooth Spline 06- MB019006 MB019306
7. 15 Tooth Spline 07- MB019007 MB019307
8. 1.25” Tapered Shaft 08- MB019000 MB019300
9. 19 Tooth Spline (16/32) 09- MB019011
10. 1.25” Str. Nitrotec C 10- MB019040

**DESCRIPTION**
- **COUPLING SHAFT**
  - MB019001 MB019301
  - MB019002 MB019302
  - MB019003 MB019303
  - MB019004 MB019304
  - MB019005 MB019305
  - MB019006 MB019306
  - MB019007 MB019307
  - MB019000 MB019300
  - MB019011
  - MB019040

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**Disclosure**

- **1** Service housing ass'y #18 with part number suffix-A1 includes item #13, #14 two req'd, #15 and #19.
- **2** Select the required bolt number in designated “DISPLACEMENT GROUP” under bolt item #1A, #1B or #1C shown in designated “OPTION GROUP.”
- **3** 1-1/4” UNEF slotted nut #025113 is required on 1-1/4” tapered shaft if designated “OPTION GROUP” is AAAF, AAAN, or AAAP.
- **4** ITEM #22 is part of plug & o-ring ass'y but can be serviced separately.
- **5** Service endcover ME016001J1 includes two #032790 o-rings, ITEM 18A on.
- **6** For reversed timed manifold, use ME015001.
- **7** Special seal kit #SK000002 for units that use fire retardant fluids includes six #032820 seal rings, #032435 commutator seal, #032818 inner seal, #028515 and #029118 back washers, #478035 dirt & water, #400140 bearing cups, one #401622 snap ring, one #401632 retaining ring, and one #406018 grease pack, bulletin #50071.
- **8** Standard seal kit #SK000092 includes six #032790 seal rings, #032435 commutator seal, #032817 inner seal, #028515 and #029118 back washers, #478035 dirt & water, #400140 bearing cups, one #401622 snap ring, one #401632 retaining ring, and one #478030 dirt and water seal.
- **9** Standard seal kit #SK000092 for motor only. If repairing clutch, need #SK000039. Kit includes two #067033 bearing and cone assemblies, two #400140 bearing cups, one #401614 thrust washer, one #401622 snap ring, one #401632 retaining ring, and one #478030 dirt and water seal.

For reverse timed manifold, use ME015001.
**Torqmotor™ Service Procedure**

**TF, TG, TH and TL Series**

Parker Hannifin Corporation
Hydraulic Pump/Motor Division
Greeneville, TN 37745 US

---

**EXPLODED VIEW**

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<th>DESCRIPTION</th>
<th>ITEM #</th>
<th>COMMUTATOR</th>
<th>MANIFOLD</th>
<th>WEAR PLATE</th>
<th>THRUST BEARING</th>
<th>INNER BEARING</th>
<th>THRUST WASHER(2)</th>
<th>THRUST BEARING</th>
<th>BACKUP WASHER</th>
<th>OUTER BEARING</th>
<th>DIRT &amp; WATER SEAL</th>
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**DISPLACEMENT GROUP**

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<td>0195- 12.0</td>
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<td>0280- 17.1</td>
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<td>0310- 18.9</td>
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**Housing Group**

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<th>PORTING</th>
<th>SERVICE HOUSING ASS'Y</th>
<th>O-RING (2)</th>
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<th>SENSOR</th>
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Caution:
The charted component service information is for the Torqmotors listed only. Refer to the original equipment manufacturer of the equipment using the Torqmotor for assembly numbers not listed below.

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**Parker Hannifin Corporation**
Hydraulic Pump/Motor Division
Greeneville, TN 37745 US

14
## TG Service Parts List Chart

### Torqmotor™ Service Procedure
TF, TG, TH and TL Series

**Parker Hannifin Corporation**
Hydraulic Pump/Motor Division
Greeneville, TN 37745  US

---

#### EXPLODED VIEW

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<th>COUPLING SHAFT ITEM #</th>
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<th>12C</th>
<th>12D</th>
<th>12E</th>
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<td>Long 6B Snapwire Groove</td>
<td>ME019001</td>
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<td>ME019002</td>
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<th>COMMUTATOR SEAL</th>
<th>SEAL RING</th>
<th>INNER SEAL</th>
<th>PLUG &amp; O-RING ASSEMBLY</th>
<th>O-RING</th>
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For reverse timed manifold, use ME015001.
1 Service housing ass’y ITEM #18 with part number suffix-A3 includes ITEM #13, #14 two req’d, #15 and #19.
2 Select the required bolt number in designated “DISPLACEMENT GROUP” under bolt ITEM #1, 1A, 1B or 1C shown in designated “OPTION GROUP.”
3 1/20 UNEF slotted nut #025113 is required on 1-1/4" tapered shaft if the designated “OPTION GROUP” is AAAF, AAAN, or AAAP.
4 ITEM #22 is part of plug & o-ring ass’y but can be serviced separately.
5 Service end cover ME016001J1 includes two #032790 o-rings, ITEM 18A on the exploded ass’y view that can also be serviced separately.
6 End cover assembly item #2 also includes item #21, #22, and #24 and if required item #23. All but item #21 can be serviced separately.
7 ME018001A1 commutator ass’y. is required if the designated “OPTION GROUP” is AAAM, AAAN, or AAAP.
8 Order (2) #032790 seals for parts when ordering manifold-style porting.
TH Service Parts List Chart

**Torqmotor™ Service Procedure**
**TF, TG, TH and TL Series**

Parker Hannifin Corporation
Hydraulic Pump/Motor Division
Greeneville, TN 37745  US

---

**TH Service Parts List Chart**

**Chart Use Example:**
TH0140MS310AAAB Torqmotor™ includes part numbers listed to the right of TH (SERIES), 0140 (DISP.), M (MOUNTING), S (PORTING), 31 (SHAFT), 0 (ROTATION), and AAAB (OPTION) shown in the left hand column of the chart.

**Caution:**
The charted component service information is for the Torqmotors listed only. Refer to the original equipment manufacturer of the equipment using the Torqmotor for assembly numbers not listed below.

**EXPLODED VIEW**

**ITEM #**

**DESCRIPTION**

**SERIES**

**COMMUTATOR ASSEMBLY**

**MANIFOLD (SEE NOTE)**

**WEAR PLATE**

**THRU LTS BEARING**

**INNER BEARING**

**THRU LTS BEARING (2)**

**THRU LTS BEARING BACKUP**

**OUTER BEARING**

**DRT & WATER BACKUP**

**BACKUP WASHER**

**TH- Service Part #**

**EXPLODED VIEW**

**ITEM #**

**DESCRIPTION**

**SERVICE**

**MOUNTING**

**PORTING**

**HOUSING ASS’Y**

**REAR PORTING**

**MOUNTING CODE**

**Porting Code**

**SERIAL HOUSING ASS’Y**

**HOUSING GROUP**

**REAR PORTING**

**MOUNTING CODE**

**Porting Code**

**SERIAL HOUSING ASS’Y**

**COUPLING SHAFT GROUP**

**ITEM #**

**COUPLING SHAFT**

**KEY**

**NUT**

**WASHER**

**7/8-14x1.250 BOLT**

**LOCK WASHER**

**RETEAINING RING**

---

**EXPLODED VIEW**

**ITEM #**

**DESCRIPTION**

**COUPLING SHAFT**

**KEY**

**NUT**

**WASHER**

**7/8-14x1.250 BOLT**

**LOCK WASHER**

**REETAINING RING**

19- 1 3/8” Tapered Shaft MJ019011
31- 1-1/2” Tapered Shaft MJ019000 039046* (3/8x1) 025131
32- 1-1/2” Straight Key MJ019001 039040** (3/8x1.43) 028492 021483 028966 401464
36- 17 Tooth Spline MJ019002
62- 14 Tooth Spline MJ019007
73- 17 Tooth Spline M12 Tap MJ019009

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16

Parker Hannifin Corporation
Hydraulic Pump/Motor Division
Greeneville, TN 37745  US
For reverse timed manifold, use ME015001.

1 Service housing ass’y ITEM #18 with part number suffix-A1 includes ITEM #13, #14 two req’d, #15 and #19.

2 Select the required bolt number in designated “DISPLACEMENT GROUP” under bolt ITEM #1, 1A, 1B or 1C shown in designated “OPTION GROUP.”

3 1-20 UNEF slotted nut #025133 is required if the designated “OPTION GROUP” is AAAF, AAAN, or AAAU.

4 ITEM #22 is part of plug & o-ring ass’y but can be serviced separately.

5 Service and cover ME016001J1 includes two #032790 o-rings, ITEM 18A on the exploded ass’y view that can also be serviced separately.

6 End cover assembly item #2 also includes item #21, #22, #24 and if required item #23. All but item #21 can be serviced separately.

7 ME018001A1 commutator ass’y is required if the designated “OPTION GROUP” is AAAM, AAAN, or AAAP.

Standard seal kit SK000115 includes six #032819 seal rings, #032435 commutator seal, #032836 inner seal, #028537 and #028538 backup washers, #478063 dirt & water, #406018 grease pack, bulletin #050016.

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<th>INNER SEAL</th>
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**Torqmotor™ Service Procedure**

**TF, TG, TH and TL Series**

Parker Hannifin Corporation
Hydraulic Pump/Motor Division
Greeneville, TN 37745 US

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**EXPLODED VIEW**

**ITEM #**

**DESCRIPTION**

1. **COMMUTATOR ASSEMBLY** (see note)

2. **MANIFOLD**

3. **THRUST BEARING**

4. **INNER BEARING**

5. **THRUST WASHER**

6. **BACKUP WASHER**

7. **OUTER BEARING**

8. **DIRT & WATER SEAL**

9. **BACKUP WASHER**

**TL- Service Part #** ME018000A1 TL015000 068024 071031 028024 069017 028515 068027 478035 029118

---

**SERVICE PARTS LIST CHART**

**Chart Use Example:**

TL0240US080AAAB Torqmotor™ includes part numbers listed to the right of TL (SERIES), 0240 (DISP.), US (MOUNTING/PORTING), 08 (SHAFT), 0 (ROTATION), and AAAB (OPTION) shown in the left hand column of the chart.

**Caution:**

The charted component service information is for the Torqmotors listed only. Refer to the original equipment manufacturer of the equipment using the Torqmotor for assembly numbers not listed below.

---

**EXPLODED VIEW**

**ITEM #**

**DESCRIPTION**

1. **SERVICE REAR MOUNTING**

2. **HOUSING ASS’Y**

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<th><strong>US</strong>- Wheel Mt. (4 Bolt)</th>
<th>7/8&quot; O-Ring</th>
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<td><strong>UB</strong>- Wheel Mt. (4 Bolt)</td>
<td>7/8&quot; Rear Radial</td>
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**EXPLODED VIEW**

**ITEM #**

**DESCRIPTION**

1. **COUPLING**

2. **5/8-18 LOCK WASHER**

3. **5/8-18 BOLT WASHER**

4. **5/8-18 RETAINING RING**

**OPTION GROUP**

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Shaft seal #16 can be replaced without replacing back up ring, #17, or backup washer, #25. Inspect items #17 and #25 to be sure wear or corrosion has not affected these parts. If not, remove the old shaft seal, noting position and direction of seal lip. To replace the new shaft seal, use only fingers (tools not required) and replace the seal from the rear of the motor.

If corrosion or wear is a problem and item #17 and #25 must be replaced, the factory recommends replacing the entire housing assembly (TL012xxx0A1).

---

Shaft nuts are zinc dichromate.
Preparation Before Disassembly

- Before you disassemble the Torqmotor™ unit or any of its components read this entire manual. It provides important information on parts and procedures you will need to know to service the Torqmotor™.

- Determine the type of end construction from the alternate views shown on the exploded view.

- The Series TF, TG, TL & TH Torqmotors™ will have a 5 inch (127.9 mm) main body outside diameter and seven 3/8 24 UNF 2A cover bolts.

- Refer to “Tools and Materials Required for Services” section for tools and other items required to service the Torqmotor™ and have them available.

- Thoroughly clean off all outside dirt, especially from around fittings and hose connections, before disconnecting and removing the Torqmotor™. Remove rust or corrosion from coupling shaft.

- Remove coupling shaft connections and hose fittings and immediately plug port holes and fluid lines.

- Remove the Torqmotor™ from system, drain it of fluid and take it to a clean work surface.

- Clean and dry the Torqmotor™ before you start to disassemble the unit.

- As you disassemble the Torqmotor™ clean all parts, except seals, in clean petroleum-based solvent, and blow them dry.

WARNING: petroleum-base solvents 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.

- Keep parts separate to avoid nicks and burrs.

- Discard all seals and seal rings as they are removed from the Torqmotor™. Replace all seals, seal rings and any damaged or worn parts with genuine Parker or OEM approved service parts.
Disassembly and Inspection

Reference Exploded Assembly View

1. Place the Torqmotor™ in a soft jawed vise, with coupling shaft (12) pointed down and the vise jaws clamping firmly on the sides of the housing (18) mounting flange or port bosses. Remove manifold port O-Rings (18A) if applicable.

**WARNING**

**WARNING:** IF THE TORQMOTOR™ IS NOT FIRMLY HELD IN THE VISE, IT COULD BE DISLODGED DURING THE SERVICE PROCEDURES, CAUSING INJURY.

2. Scribe an alignment mark down and across the Torqmotor™ components from end cover (2) to housing (18) to facilitate reassembly orientation where required. Loosen two shuttle or relief valve plugs (21) for disassembly later if included in end cover. 3/16 or 3/8 inch Allen wrench or 1 inch hex socket required. SEE FIGURES 2 & 3.

3. Remove the seven special ring head bolts (1, 1A, 1B, or 1C) using an appropriate 9/16 inch size socket. SEE FIGURE 4. Inspect bolts for damaged threads, or sealing rings, under the bolt head. Replace damaged bolts. SEE FIGURE 5.
Remove end cover & inspect bolts

4. Remove end cover assembly (2) and seal ring (4). Discard seal ring. SEE FIGURE 6.

NOTE

NOTE: Refer to the appropriate “alternate cover construction” on the exploded view to determine the end cover construction being serviced.

Remove plugs and valves

5. If the end cover (2) is equipped with shuttle valve or relief valve (24) components, remove the two previously loosened plugs (21) and o-rings (22). SEE FIGURE 7.

CAUTION

CAUTION: Be ready to catch the shuttle valve or relief valve components that will fall out of the end cover valve cavity when the plugs are removed.

NOTE

NOTE: O-ring (22) is not included in seal kits but serviced separately if required.

NOTE

NOTE: The insert and if included the orifice plug in the end cover (2) must not be removed as they are serviced as an integral part of the end cover.

Wash & inspect end cover

6. Thoroughly wash end cover (2) in proper solvent and blow dry. Be sure the end cover valve apertures, including the internal orifice plug, are free of contamination. Inspect end cover for cracks and the bolt head recesses for good bolt head sealing surfaces. Replace end cover as necessary. SEE FIGURE 8.

NOTE

NOTE: A polished pattern (not scratches) on the cover from rotation of the commutator (5) is normal. Discoloration would indicate excess fluid temperature, thermal shock, or excess speed and require system investigation for cause and close inspection of end cover, commutator, manifold, and rotor set.

Remove & inspect commutator ring

8. Remove commutator (5) and seal ring (3) Remove seal ring from commutator, using an air hose to blow air into ring groove until seal ring is lifted out and discard seal ring. Inspect commutator for cracks or burrs, wear, scoring, spalling or brinelling. If any of these conditions exist, replace commutator and commutator ring as a matched set. SEE FIGURE 10 & 11.

9. Remove manifold (7) and inspect for cracks surface scoring, brinelling or spalling. Replace manifold if any of these conditions exist. SEE FIGURE 12. A polished pattern on the ground surface from commutator or rotor rotation is normal. Remove and discard the seal rings (4) that are on both sides of the manifold.

**NOTE**

**NOTE:** The manifold is constructed of plates bonded together to form an integral component not subject to further disassembly for service. Compare configuration of both sides of the manifold to ensure that same surface is reassembled against the rotor set.

10. Remove rotor set (8) and wearplate (9), together to retain the rotor set in its assembled form, maintaining the same rotor vane (8C) to stator (8B) contact surfaces. SEE FIGURE 13. The drive link (10) may come away from the coupling shaft (12) with the rotor set, and wearplate. You may have to shift the rotor set on the wearplate to work the drive link out of the rotor (8A) and wearplate. SEE FIGURE 14. Inspect the rotor set in its assembled form for nicks, scoring, or spalling on any surface and for broken or worn splines. If the rotor set component requires replacement, the complete rotor set must be replaced as it is a matched set. Inspect the wearplate for cracks, brinelling, or scoring. Discard seal ring (4) that is between the rotor set and wearplate.

**NOTE**

**NOTE:** The rotor set (8) components may become disassembled during service procedures. Marking the surface of the rotor and stator that is facing UP, with etching ink or grease pencil before removal from Torqmotor™ will ensure correct reassembly of rotor into stator and rotor set into Torqmotor™. Marking all rotor components and mating spline components for exact repositioning at assembly will ensure maximum wear life and performance of rotor set and Torqmotor™.
NOTE: Series TG or TH may have a rotor set with two stator halves (8B & 8D) with a seal ring (4) between them and two sets of seven vanes (8C & 8E). Discard seal ring only if stator halves become disassembled during the service procedures.

NOTE: A polished pattern on the wear plate from rotor rotation is normal.

Check rotor, vane clearance

11. Place rotor set (8) and wear plate (9) on a flat surface and center rotor (8A) in stator (8B) such that two rotor lobes (180 degrees apart) and a roller vane (8C) centerline are on the same stator centerline. Check the rotor lobe to roller vane clearance with a feeler gage at this common centerline. If there is more than .005 inches (0.13 mm) of clearance, replace rotor set. SEE FIGURE 15.

NOTE: If rotor set (8) has two stator halves (8B & 8D) and two sets of seven vanes (8C & 8E) as shown in the alternate construction TG rotor set assembly view, check the rotor lobe to roller vane clearance at both ends of rotor.

Remove & inspect drive link

12. Remove drive link (10) from coupling shaft (12) if it was not removed with rotor set and wear plate. Inspect drive link for cracks and worn or damaged splines. No perceptible lash (play) should be noted between mating spline parts. SEE FIGURE 16. Remove and discard seal ring (4) from housing (18).

Remove thrust bearing

13. Remove thrust bearing (11) from top of coupling shaft. Inspect for wear, brinelling, corrosion and a full complement of retained rollers. SEE FIGURE 17.
Check coupling shaft for rust or corrosion

14. Check exposed portion of coupling shaft (12) to be sure you have removed all signs of rust and corrosion which might prevent its withdrawal through the seal and bearing. Crocus cloth or fine emery paper may be used. SEE FIGURE 18. Remove any key (12A), nut (12B), washer (12C), bolt (12D), lock washer (12E), or retaining ring (12F).

Remove & inspect coupling shaft

15. Remove coupling shaft (12), by pushing on the output end of shaft. SEE FIGURE 19. Inspect coupling shaft bearing and seal surfaces for spalling, nicks, grooves, severe wear or corrosion and discoloration. Inspect for damaged or worn internal and external splines or keyway. SEE FIGURE 20. Replace coupling shaft if any of these conditions exist.

NOTE

NOTE: Minor shaft wear in seal area is permissible. If wear exceeds .020 inches (0.51 mm) diametrically, replace coupling shaft.

NOTE

NOTE: A slight “polish” is permissible in the shaft bearing areas. Anything more would require coupling shaft replacement.

Remove seal ring from housing

16. Remove and discard seal ring (4) from housing (18).
Remove shaft seal, backup washer & backup ring

17. Remove shaft seal (16), backup ring (17), and backup washer (25) from housing by working them around unseated thrust washers (14) and thrust bearing (15) and out of the housing. Discard seal and washers. SEE FIGURE 21.

NOTE

NOTE: The original design units of Torqmotors™ did not include backup washer (25), but must include backup washer (25) when reassembled for service.

Remove dirt & water seal

18. Remove housing (18) from vise, invert it and remove and discard dirt & water seal (20). A blind hole bearing or seal puller is required. SEE FIGURE 22.

Inspect housing assembly

19. Inspect housing (18) assembly for cracks, the machined surfaces for nicks, burrs, brinelling or corrosion. Remove burrs that can be removed without changing dimensional characteristics. Inspect tapped holes for thread damage. SEE FIGURE 23. If the housing is defective in these areas, discard the housing assembly.
20. If the housing (18) assembly has passed inspection to this point, inspect the housing bearings (19) and (13) and if they are captured in the housing cavity the two thrust washers (14) and thrust bearing (15). The bearing rollers must be firmly retained in the bearing cages, but must rotate and orbit freely. All rollers and thrust washers must be free of brinelling and corrosion. SEE FIGURE 24. A bearing, or thrust washer that does not pass inspection must be replaced. If the housing has passed this inspection the disassembly of the Torqmotor™ is completed.

NOTE

NOTE: The depth or location of bearing (13) in relation to the housing wear plate surface and the depth or location of bearing (19) in relation to the beginning of bearing counter bore should be measured and noted before removing the bearings. This will facilitate the correct reassembly of new bearings. SEE FIGURE 25.

21. If the bearings or thrust washers must be replaced use a suitable size bearing puller to remove bearing (19) and (13) from housing (18) without damaging the housing. Remove thrust washers (14) and thrust bearing (15) and inspect. SEE FIGURES 26 & 27.

THE DISASSEMBLY OF TORQMotor™ IS COMPLETED.
• Replace all seals and seal rings with new ones each time you reassemble the Torqmotor™ unit. Lubricate all seals and seal rings with SAE 10W40 oil or clean grease before assembly.

• NOTE: Individual seals and seal rings as well as a complete seal kit are available. SEE FIGURE 28. The parts should be available through most OEM parts distributors or Parker approved Torqmotor™ 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 of the end cover, commutator set, manifold rotor set, wear plate and housing and from port and sealing areas.

WARNING

WARNING: SINCE THEY ARE FLAMMABLE, BE EXTREMELY CAREFUL WHEN USING ANY SOLVENT. EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH.

WARNING

WARNING: WEAR EYE PROTECTION AND BE SURE TO COMPLY WITH OSHA OR OTHER MAXIMUM AIR PRESSURE REQUIREMENTS.

1. Clamp the housing into a soft-jawed vise or similar support with the coupling shaft bore down, clamping against the mounting flange.

2. If the housing (18) bearing components were removed for replacement, thoroughly coat and pack a **new** outer bearing (19) with clean corrosion resistant grease recommended in the material section. Press the new bearing into the counterbore at the mounting flange end of the housing, using the appropriate sized bearing mandrel such as described in figure 1 or figure 2 which will control the bearing depth.

   Torqmotor™ housings require the use of the bearing mandrel shown in figure 2 to press bearing (19) into the housing to a required depth of .290/.310 inches (7.37/7.87 mm) from the outside end of the bearing counterbore. SEE FIGURE 29.

   Series TH Torqmotor housings require the use of a bearing mandrel. Consult factory for specifications.
NOTE: Bearing mandrel must be pressed against the lettered end of bearing shell. Take care that the housing bore is square with the press base and the bearing is not cocked when pressing a bearing into the housing.

CAUTION: If the bearing mandrel specified in the “Tools and Materials Required for Servicing” section is not available and alternate methods are used to press in bearing (13) and (19) the bearing depths specified must be achieved to insure adequate bearing support and correct relationship to adjacent components when assembled.

CAUTION: Because the bearing (13) and (19) have a press fit into the housing they must be discarded when removed. They must not be reused.

3. Press a new dirt and water seal (20) into the housing (18) outer bearing counterbore.

The dirt and water seal (20) must be pressed in with the lip facing out and until the seal is flush to .020 inches (.51 mm) below the end of housing. SEE FIGURE 30.
4. Invert housing (18) assembly into a soft jawed vise with the coupling shaft bore down, clamping against the mounting flange. SEE FIGURE 31.

5. The Torqmotor™ housing (18) requires that you assemble a **new** backup ring (17), **new** backup washer (25) & a **new** shaft seal (16), with the lip facing to the inside of Torqmotor (see figure 69A), thrust washer (14), thrust bearing (15) and a second thrust washer (14) in that order before pressing in the inner housing bearing (13). SEE FIGURE 32 & 33. When these components are in place, press **new** bearing (13) into the housing (18) to a depth of .105/.125 inches (2.67/3.18) below the housing wear plate contact face. Use the opposite end of the bearing mandrel used to press in outer bearing (19). Reference figure 2, in the “Tools and Materials Required for Servicing” section. SEE FIGURE 34.
Assemble backup washer & seal

6. A housing (18) that did not require replacement of the bearing package will require that the two “captured” thrust washers (14) and thrust bearing (15) be unseated and vertical to the counterbore and the new backup ring (17), new backup washer (25), and new seal (16) be worked around the thrust bearing package and placed into their respective counterbores. The seal lip must face out of the seal counterbore and toward the inside of Torqmotor™ (see figure 60). Be sure the thrust bearing package is reseated correctly after assembly of the seal and backup washer. SEE FIGURES 35 & 36.

CAUTION

CAUTION: Original design TF & TG Torqmotors™ that do not have backup washer (25) when disassembled must be assembled with a new backup ring (17), new backup washer (25), and new seal (16).

Apply masking tape to shaft

7. Apply masking tape around splines or keyway on shaft (12) to prevent damage to seal. SEE FIGURE 37.
Install coupling shaft

8. Be sure that a generous amount of clean corrosion resistant grease has been applied to the lower (outer) housing bearing (19). Install the coupling shaft (12) into housing (18), seating it against the second thrust washer (14). SEE FIGURE 38.

CAUTION

CAUTION: The outer bearing (19) is not lubricated by the system’s hydraulic fluid. Be sure it is thoroughly packed with the recommended grease, Parker Gear grease specification #045236, E/M Lubricant #K-70M.

NOTE

NOTE: Mobil Mobilitth SHC ® 460
NOTE: A 102 Tube (P/N 406010) is included in each seal kit.

NOTE

NOTE: The coupling shaft (12) will be approximately .10 inch (2.54 mm) below the housing wear plate surface to allow the assembly of thrust bearing (11). The coupling shaft must rotate smoothly on the thrust bearing package. SEE FIGURE 39.

Install thrust bearing

9. Install thrust bearing (11) onto the end of coupling shaft (12) only if you are servicing. SEE FIGURE 40.

Insert seal ring

10. Apply a small amount of clean grease to a new seal ring (4) and insert it into the housing (18) seal ring groove. SEE FIGURE 41.
Install drive link 11. Install drive link (10) the long splined end down into the coupling shaft (12) and engage the drive link splines into mesh with the coupling shaft splines. SEE FIGURE 42.

NOTE

NOTE: Use any alignment marks put on the coupling shaft and drive link before disassembly to assemble the drive link splines in their original position in the mating coupling shaft splines.

Assemble wear plate and seal ring 12. Assemble wear plate (9) over the drive link (10) and alignment studs onto the housing (18). SEE FIGURE 43.

Apply a small amount of clean grease to a new seal ring (4) and assemble it into the seal ring groove on the wear plate side of the rotor set stator (8B). SEE FIGURE 44.

Install the assembled rotor set and seal ring 13. Install the assembled rotor set (8) onto wear plate (9) with rotor (8A) counterbore and seal ring side down and the splines into mesh with the drive link splines. SEE FIGURE 45.

NOTE

NOTE: If necessary, go to the appropriate, “Rotor Set Component Assembly Procedure.”

NOTE

NOTE: The rotor set rotor counterbore side must be down against wear plate for drive link clearance and to maintain the original rotor-drive link spline contact. A rotor set without a counterbore and that was not etched before disassembly can be reinstalled using the drive link spline pattern on the rotor splines if apparent, to determine which side was down. The rotor set seal ring groove faces toward the wear plate (9).
Apply clean grease to a **new** seal ring (4) and assemble it in the seal ring groove in the rotor set contact side of manifold (7). SEE FIGURE 46.

### NOTE

**NOTE:** The manifold (7) is made up of several plates bonded together permanently to form an integral component. The manifold surface that must contact the rotor set has its series of irregular shaped cavities on the largest circumference or circle around the inside diameter. The polished impression left on the manifold by the rotor set is another indication of which surface must contact the rotor set.

### Install manifold and seal ring

14. Assemble the manifold (7) over the drive link (10) and onto the rotor set. Be sure the correct manifold surface is against the rotor set. SEE FIGURE 47.

Apply grease to a **new** seal ring (4) and insert it in the seal ring groove exposed on the manifold. SEE FIGURE 48.

### Install commutator ring

15. Assemble the commutator ring (6) onto the manifold. SEE FIGURE 49.
16. Assemble a new seal ring (3) flat side up, into commutator (5) and assemble commutator over the end of drive link (10) onto manifold (7) with seal ring side up. SEE FIGURES 50 and 51.

17. If shuttle valve components items #21, #22, #23, #24 were removed from the end cover (2) turn a plug (21) with a new o-ring (22), loosely into one end of the valve cavity in the end cover. Insert a spring (23) the valve (24) and the second spring (23) into the other end of the valve cavity. Turn the second plug (21) with a new o-ring (22) loosely into the end cover valve cavity. 3/16 inch Allen wrench required. SEE FIGURE 52.

18. If relief valve components items #21, #22, #24 were removed from the end cover (2) assemble a new o-ring (22) on the two plugs (21). Assemble a two piece relief valve (24) in each of the plugs, with the large end of the conical spring into the plug first and the small nut of the other valve piece in the small end of the conical spring. Turn each of the plug and relief valve assemblies into the end cover loosely to be torqued later. 3/8 inch Allen or 1 inch Hex socket required. SEE FIGURE 53.
Assemble seal ring & end cover

19. Assemble a new seal ring (4) into end cover (2) and assemble end cover onto the commutator set. SEE FIGURES 54 and 55.

NOTE

NOTE: If the end cover has a valve (24), use the line you previously scribed on the cover to radially align the end cover into its original position.

Assemble cover bolts

20. Assemble the 7 special bolts (1, 1A, 1B or 1C) and screw in finger tight. Alternately and progressively tighten the bolts to pull the end cover and other components into place with a final torque of 50-55 ft. lbs. (68-75 Nm) for the seven 3/8-24 threaded bolts. SEE FIGURES 56, 57 and 58.
NOTE

NOTE: The special bolts required for use with the relief or shuttle valve (24) end cover assembly (2) are longer than the bolts required with standard and cover assembly. Refer to the individual service parts lists or parts list charts for correct service part number if replacement is required.

Torque the valve plugs

21. Torque the two shuttle valve plug assemblies (21) in end cover assembly to 9-12 ft. lbs. (12-16 N m) if cover is so equipped. SEE FIGURE 59.

Torque the two relief valve plug assemblies (21) in end cover assembly to 45-55 ft. lbs. (61-75 N m) if cover is so equipped.

THE ASSEMBLY OF THE TORQMOTOR™ IS NOW COMPLETE EXCEPT FOR WOODRUFF KEY (12A), NUT (12B), WASHER (12C), BOLT (12D), LOCKWASHER (12E), RETAINER RING (12F) or PORT O-RINGS (18A) AT INSTALLATION IF APPLICABLE. PROCEED TO FINAL CHECKS SECTION.
One Piece Stator Construction

A disassembled rotor (8A) stator (8B) and vanes (8C) that cannot be readily assembled by hand can be assembled by the following procedures.

**Assemble stator**
1. Place stator (8B) onto wear plate (9) with seal ring (4) side down, after following Torqmotor™ assembly procedures 1 through 13. Be sure the seal ring is in place. SEE FIGURE 62.

**Insert two bolts**
2. If assembly alignment studs are not being utilized, align stator bolt holes with wear plate and housing bolt holes and turn two bolts (1) finger tight into bolt holes approximately 180 degrees apart to retain stator and wear plate stationary.

**Assemble rotor**
3. Assemble the rotor (8A), counterbore down if applicable, into stator (8B), and onto wear plate (9) with rotor splines into mesh with drive link (10) splines. SEE FIGURE 63.

**NOTE**
NOTE: If the manifold side of the rotor was etched during Torqmotor disassembly, this side should be up. If the rotor is not etched and does not have a counterbore, use the drive link spline contact pattern apparent on the rotor splines to determine the rotor side that must be against the wear plate.

**Assemble vanes**
4. Assemble six vanes (8C), or as many vanes that will readily assemble into the stator vane pockets. SEE FIGURE 64.

**CAUTION**
CAUTION: Excessive force used to push the rotor vanes into place could shear off the coating applied to the stator vane pockets.

**Assemble full complement of vanes**
5. Grasp the output end of coupling shaft (12) with locking pliers or other appropriate turning device and rotate coupling shaft, drive link and rotor to seat the rotor and the assembled vanes (8C) into stator (8B), creating the necessary clearance to assemble the seventh or full complement of seven vanes. Assemble the seven vanes using minimum force. SEE FIGURE 65.

**Remove two assembled bolts**
6. Remove the two assembled bolts (1) if used to retain stator and wear plate.

Go to Torqmotor™ assembly procedure #15, to continue Torqmotor™ assembly.
Two Piece Stator Construction

A disassembled rotor set (8) that cannot be readily assembled by hand and has a two piece stator can be assembled by the following procedures.

**Assemble stator halves**
1. Place stator half (8B) onto wear plate (9) with seal ring (4) side down, after following Torqmotor™ assembly procedures 1 through 13. Be sure the seal ring is in place.

**Insert two alignment studs**
2. Align stator bolt holes with wear plate and housing bolts and turn two alignment studs finger tight into bolt holes approximately 180 degrees apart to retain stator half and wear plate stationary.

**Assemble rotor**
3. Assemble rotor (8A), counterbore down if applicable, into stator half (8B), and onto wear plate (9) with rotor splines into mesh with drive link (10) splines.

**NOTE**
NOTE: Use any marking you applied to rotor set components to reassemble the components in their original relationship to ensure ultimate wear life and performance.

**Assemble vanes**
4. Assemble six vanes (8C), or as many vanes that will readily assemble into the stator vane pockets.

**CAUTION**
CAUTION: Excessive force used to push the rotor vanes into place could shear off the coating applied to the stator vane pockets.

**Assemble full complement of vanes**
5. Grasp the output end of coupling shaft (12) with locking pliers or other appropriate turning device and rotate coupling shaft, drive link and rotor to seat the rotor and the assembled vanes (8C) into stator half (8B), creating the necessary clearance to assemble the seventh or full complement of seven vanes. Assemble the seven vanes using minimum force.

**Assemble seal ring in stator half**
6. Place second stator half (8D) on a flat surface with seal ring groove up. Apply a small amount of grease to a new seal ring (4) and assemble it into stator half ring groove.
| Assemble second stator half | 7. Assemble the second stator half (8D) over the two alignment studs and rotor (8A) with seal ring side down onto the first stator half (8B) aligning any timing marks applied for this purpose. |
| CAUTION | CAUTION: If the stator half (8B) is a different height (thickness) than stator half (8D) the stator vanes (8C) or (8E) of the same length (height) as the stator half must be reassembled in their respective stator half for the rotor set to function properly. |
| Assemble vanes | 8. Assemble six vanes (8E), or as many vanes that will readily assemble into the stator vane pockets. |
| Assemble full complement of vanes | 9. Grasp the output end of coupling shaft (12) with locking pliers or other appropriate turning device and rotate coupling shaft, drive link and rotor to seat the rotor and the assembled vanes (8E) into stator (8D), creating the necessary clearance to assemble the seventh or full complement of seven vanes. Assemble the seven vanes using minimum force. Go to Torqmotor™ assembly procedure #15, to continue Torqmotor™ assembly. |
Final Checks

- Pressurize the Torqmotor™ with 100 p.s.i. dry air or nitrogen and submerge in solvent to check for external leaks.

- Check Torqmotor™ for rotation. Torque required to rotate coupling shaft should not be more than 50 ft. lbs. (68 N m)

- Pressure port with “B” cast under it on housing (18) is for clockwise coupling shaft rotation as viewed from the output end of coupling shaft. Pressure port with “A” case under it is for counter clockwise coupling shaft rotation.

- Use test stand if available, to check operation of the Torqmotor™.

Hydraulic Fluid

Keep the hydraulic system filled with one of the following:

- 10W40 SE or SF manufacturers suggested oil.

- Hydraulic fluid as recommended by equipment manufacturer, but the viscosity should not drop below 50 SSU or contain less than .125% zinc anti-wear additives.

**CAUTION: Do not mix oil types. Any mixture, or an unapproved 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.**

Filtration

Recommended filtration 40-50 micron.

Oil Temperature

Maximum operating temperature 200°F (93.3° C).
Tips for Maintaining the Torqmotor™ Hydraulic System

- 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 Torqmotor™ component. Replace the component with original equipment only.

- Do not cold straighten, hot straighten, or bend any Torqmotor™ part.

- Prevent dirt or other foreign matter from entering the hydraulic system. Clean the area around and the filler caps before checking oil level.

- Investigate and correct any external leak in the hydraulic system, no matter how minor the leak.

- Comply with manufacturer's specifications for cleaning or replacing the filter.

  **CAUTION:** Do not weld, braze, solder or any way alter any Torqmotor™ component.

  **CAUTION:** Maximum operating pressure must not exceed recommended Torqmotor™ 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 Torqmotor™ coupling shaft as this could damage the unit internally.

Parker extends close technical cooperation and assistance. If problems occur which you cannot solve, please contact your local Parker approved Distributor or Parker Technical Support. Our phone number and fax number and address are on the back cover of this manual.
Offer of Sale

The items described in this document and other documents and descriptions provided by Parker Hannifin Corporation, its subsidiaries and its authorized distributors ("Sellers") are hereby offered for sale at prices to be established by Seller. This offer and its acceptance by any customer ("Buyer") shall be governed by all of the following Terms and Conditions. Buyer's order for any item described in its document, when communicated to Seller verbally, or in writing, shall constitute acceptance of this offer. All goods, services or work described will be referred to as "Products."  

1. Terms and Conditions. Seller's willingness to offer Products, or accept an order for Products, to or from Buyer is subject to these Terms and Conditions or any newer version of the terms and conditions found on-line at www.parker.com/salemnterms/. Seller objects to any contrary or additional terms or conditions of Buyer's order or any other document attached to Buyer's order by Buyer or furnished to Seller by Buyer with these terms and conditions. Seller shall not indemnify Buyer under any circumstance except as otherwise provided.  

2. Price Adjustments; Payments. Prices stated on Seller's quote or other documentation offered by Seller are valid for 30 days, and do not include any sales, use, or other taxes unless specifically stated. Unless otherwise specified by Seller, all prices are F.O.C. Parker Office (FAA TERMS 2010). Payment in full is due 30 days from the date of invoice or such other term as required by Seller's Credit Department, after which Buyer shall pay interest on any unpaid invoices at the rate of 1.5% per month or the maximum allowable rate under applicable law.  

3. Delivery Dates; Title and Risk; Shipment. All delivery dates are approximate and Seller shall not be responsible for any damages resulting from any delay. Regardless of the manner of shipment, title to any product and risk or damage shall pass to Buyer upon placement of the products with the shipment carrier at Seller's facility. Unless otherwise stated, Seller may exercise its judgment in choosing the carrier and means of delivery. No delivery of shipment at Buyers' request beyond the respective dates indicated will be made except on terms that will indemnify, defend and hold Seller harmless against all loss and additional expense. Buyer shall be responsible for any additional handling charges as a result of Buyer's request to the contrary.  

4. Warranty. Seller warrants that the Products sold hereunder shall be free from defects in material or workmanship for a period of eighteen months from the date of delivery to Buyer or 2,000 hours of normal use, whichever occurs first. The prices charged for Seller's products are based upon the existing limited warranty stated above, and the following disclaimer: DISCLAIMER OF WARRANTY. Seller's LIABILITY TO BUYER AND OTHERS FOR ANY DEFECTIVE PRODUCT SOLD HEREUNDER IS LIMITED TO REPAIR OR REPLACEMENT THEREOF, IN SELLER'S SOLE DISCRETION. THE SOLE AND EXCLUSIVE REMEDIES OF BUYER UNDER THIS AGREEMENT ARE REPAIR OR REPLACEMENT OF DEFECTIVE PRODUCT. IN NO EVENT SHALL SELLER BE LIABLE TO BUYER FOR ANY SPECIAL INDIRECT, INCIDENTAL, CONSEQUENTIAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF, OR AS THE RESULT OF, THE SALE, DELIVERY, NON-DELIVERY, SERVICING, USE OR LOSS OF USE OF THE PRODUCTS OR ANY PART THEREOF, OR FOR ANY DAMAGES OR EXPENSES WHATSOEVER INCURRED WITHOUT SELLER'S WRITTEN CONSENT, EVEN IF SELLER HAS BEEN NEGLIGENT, WHETHER IN CONTRACT, TORT OR OTHERWISE.  

5. Claims: Commencement of Actions. Buyer shall promptly inspect all Products upon delivery. No claims for shortages will be allowed unless reported to the Seller within 10 days of delivery. No other claims against Seller will be allowed unless asserted in writing within 30 days after delivery. Buyer shall notify Seller of any alleged breach of warranty within 30 days after the date the defect is or should have been discovered by Buyer. Any action based upon breach of this agreement or upon any other claim arising out of this sale (other than an action by Seller for an amount due on any invoice) must be commenced within 12 months from the date of the breach without regard to the date breach is discovered.  

6. LIMITATION OF LIABILITY. UPON NOTIFICATION, SELLER WILL, AT ITS OPTION, REPAIR OR REPLACE A DEFECTIVE PRODUCT OR REFUND THE PURCHASE PRICE. IN EVENT OF REPLACEMENT, SELLER WILL NOT, UNDER ANY CIRCUMSTANCES, BE LIABLE FOR ANY SPECIAL INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF, OR AS THE RESULT OF, THE SALE, DELIVERY, NON-DELIVERY, SERVICING, USE OR LOSS OF USE OF THE PRODUCTS OR ANY PART THEREOF, OR FOR ANY DAMAGES OR EXPENSES WHATSOEVER INCURRED WITHOUT SELLER'S WRITTEN CONSENT, EVEN IF SELLER HAS BEEN NEGLIGENT, WHETHER IN CONTRACT, TORT OR OTHERWISE LEGAL THEORY. IN NO EVENT SHALL SELLER'S LIABILITY UNDER ANY CLAIM MAKE THE TOTAL LIABILITY OF SELLER FOR ANY CAUSE WHATSOEVER MORE THAN THE PRICE OF THE PRODUCT.  

7. User Responsibility. The user, through its own analysis and testing, is solely responsible for making the final selection of the system and Product and assuring that all performance, endurance, maintenance, safety and warning requirements of the application are met. The user must analyze all aspects of the application and follow applicable installation, operation and service instructions. If Seller provides turnkey system options, the user is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the Products or systems.  

8. Loss to 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, will be considered obsolete and may be destroyed by Seller after two consecutive years have elapsed without Buyer ordering the items 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. Special Tooling. A tooling charge may be imposed for any special tooling, including without limitation, dies, fixtures, molds and patterns, acquired to manufacture Products. Such special tooling shall be and remain Seller's property notwithstanding payment of any royalty or other consideration to Buyer. In no event will Buyer acquire any interest in apparatus belonging to Seller which is utilized in the manufacture of the Products, 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.  

10. Buyer's Obligation; Rights of Seller. To secure payment of all sums due or otherwise, Seller shall retain a security interest in the goods delivered and this agreement shall be governed by the Uniform Commercial Code. All items furnished by Seller to any Buyer under this agreement, and all items furnished by Buyer to any Seller under this agreement, shall be held by Buyer in a merchantable condition for the benefit of Seller throughout the life of this agreement, and Buyer shall permit Seller to inspect the products at any time. Seller shall be responsible for all cost and risk of loss or damage to the products while in Seller's possession or control. Buyer's property, will be considered obsolete and may be destroyed by Seller after two years from the date the property is delivered. Seller shall not be responsible for any loss or damage to such property. Buyer's property (c) files a petition for relief in bankruptcy on its own behalf, or by a third party (d) makes an assignment for the benefit of creditors, or (e) dissolves or liquidates all or a majority of its assets.  

11. Governing Law. Buyer agrees to make any payment or give anything of value, directly or indirectly to any governmental foreign political party of a foreign political party, or foreign government, or any commercial entity or person, for the purpose of influencing such person to purchase products or otherwise benefit the business of Seller.  

12. Compliance with Law, U.K. Bribery Act and U.S. Foreign Corrupt Practices Act. Buyer agrees to comply with all laws and regulations, including both those of the United Kingdom and the United States of America, and of the country or countries of the Territory in which Buyer may operate, including without limitation the U.K. Bribery Act, the U.S. Foreign Corrupt Practices Act (“FCPA”), and the U.S. Anti-Kickback Act (the “Anti-Kickback Act”), and agrees to indemnify and hold harmless Seller from the consequences of any violation of such provisions by Buyer, its employees or agents. Buyer acknowledges that they are familiar with the provisions of the U.K. Bribery Act, the FCPA, and the Anti-Kickback Act, and certifies that their conduct will conform to the requirements thereof. In particular, Buyer represents and agrees that Buyer shall not make any payment or give anything of value, directly or indirectly to any governmental foreign political party of a foreign political party, or foreign government, or any commercial entity or person, for the purpose of influencing such person to purchase products or otherwise benefit the business of Seller.  

13. Entire Agreement. This agreement contains the entire agreement between the Seller and Buyer and constitutes the final, complete and exclusive expression of the terms of sale. All prior or contemporaneous written or oral agreements or negotiations with respect to the subject matter are herein merged.  

14. Force Majeure. Seller does not assume the risk 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, strikes or labor disputes, acts of any government or government agency, acts of nature, delays or failure in delivery from carriers or suppliers, shortages of materials, or any other cause beyond Seller's reasonable control.  

15. Waiver and Severability. Failure to enforce any provision of this agreement will in no way prejudice Seller's right to enforce such failure prejudice Seller's right to enforce any provision in the future. Violation of any provision of this agreement by legislation or other rule of law shall not invalidate any other provision herein. The remaining provi- sions of this agreement will remain in full force and effect.  

16. 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 Section. Seller will defend and indemnify Buyer against allegations of infringement in the future. Seller will indemnify Buyer against allegations of infringement in the future. Seller will indemnify Buyer against allegations of infringement in the future. Seller will indemnify Buyer against allegations of infringement in the future. Seller will indemnify Buyer against allegations of infringement in the future. Seller will indemnify Buyer against allegations of infringement in the future. Seller will indemnify Buyer against allegations of infringement in the future. Seller will indemnify Buyer against allegations of infringement in the future. Seller will indemnify Buyer against allegations of infringement in the future. Seller will indemnify Buyer against allegations of infringement in the future. Seller will indemnify Buyer against allegations of infringement in the future. Seller will indemnify Buyer against allegations of infringement in the future. Seller will indemnify Buyer against allegations of infringement in the future. Seller will indemnify Buyer against allegations of infringement in the future. Seller will indemnify Buyer against allegations of infringement in the future.