SERVICE MANUAL
AND
REPAIR PARTS
FOR
TWO SPEED DRIVE II
(TSDrII)

WARNING - Read this manual before any installation, maintenance and operation.

MANUFACTURERS OF MECHANICAL AND
ELECTRICAL POWER TRANSMISSION EQUIPMENT
FORCE CONTROL INDUSTRIES, INC.

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The Force Control Two Speed Drive II (TSDrII) is built from five separate modules. Each module offers several choices, making a complete unit essentially tailor-made specifically for each application.

1-1 MODULE DESCRIPTION
(See Figures 1-1 and 1-2)

Item A - MAIN DRIVE MOTOR

The High Speed Main Drive Motor provides acceleration and running torque to the driven machine. U-line motors are normally used, while others are available for special needs. The most common base speed of the main drive motor is 1800 rpm. Horsepowers available are from 1 to 7-1/2. All motors are supplied T.E.F.C. unless otherwise specified.

Item B - MAIN DRIVE MOTOR C-FACE MOUNTING ADAPTER

The C-Face Adapter, as shown in Figures 1.1 and 1.2, connects the main housing of the TSDrII to the accessory end of the main drive motor. It is mounted to the main drive motor via a standard NEMA C-Face pilot. The Adapter is available with NEMA C-Face pilot diameters of 4-1/2” and 81/2”.

Item C - TSDrII CLUTCH and BRAKE

As noted above, the TSDrII is mounted to the main drive motor with a C-Face Adapter. Torque is transmitted from the motor to the drive, by mating the accessory shaft of the main motor with a female hub in the drive. The male shaft of the motor is then locked to the female hub of the drive with a tapered locking element.

The TSDrII Clutch and Brake are of the spring set, air release type. This means that if no air is supplied to the drive, by the control valve or because of power failure, the clutch and the brake will be set by spring pressure. To release the clutch and/or the brake, air pressure must be supplied to the clutch and/or brake ports. (See Section 1-4)

The TSDrII has a built in gear reducer. This offers the advantage of being more compact and easier to maintain than a drive with an external bolt on gear reducer. The gear reducer is of the worm and gear type and runs in the same oil as the TSDrII.

Item D - FEED MOTOR DRIVE

The Feed Drive Motor can be belt driven to the drive, as in Figure 1.1, or can be C-Face coupled to the drive, as in Figure 1.2. If the Feed Motor is belt driven, the ratio of the belt drive can be varied. By varying the belt drive ratio along with the gear reducer ratio, a wide range of feed speeds can be realized. Speeds from 119 RPM all the way down to 18 RPM are possible by using different combinations of gear reducer and belt drive ratios.
synchronous belt drive is used for a positive transmission of motor torque to the drive.

Different mounting arrangements are available to suit different space requirements. See pages 24 and 25 for Belt Drive Mounting Arrangements.

The Feed Drive Motor can also be C-Face coupled to the TSDrII. The motor is attached to the drive with a C-Face adapter that uses a NEMA C-Face pilot diameter of 4-1/2 inches. The shaft of the feed motor mates with a keyed female shaft in the drive to transmit torque to the TSDrII. However, the range different feed speeds is limited with this method. Only the gear reducer ratio can be changed to obtain different speeds as opposed to the belt feed drive.

**NOTE**

The C-Face arrangement cannot be used when reversing loads are transmitted to the Feed Motor.

**Item E - FEED DRIVE MOTOR**

The Feed Drive is either foot mounted or C-Face mounted to the TSDrII. Standard feed drive motors are 1800 RPM and range from 1/4 to 1-1/2 horsepower.

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**1-2 THE OIL SHEAR PRINCIPLE**

Conventional clutches and brakes depend on the friction between solid surfaces operating in air to transmit torque. Friction does the job, but produces a great amount of heat and wear. The TSDrII Clutch and Brake units are oil shear drives, with the friction surfaces operating in a constantly replenished film of oil. The oil molecules tend to cling to each other and to the friction surfaces. As moving and stationary elements are brought together, a thin but positive film of oil is maintained between them, controlled by the clamping pressure and carefully designed grooves in the elements. Torque is transmitted from one element to the other through the viscous shear of the oil film. So long as there is relative motion between the elements, they are protected by the oil, thus greatly reducing wear. The constantly replenished oil film also effectively transmits heat away from the friction elements.

**1-3 CLUTCH and BRAKE DESCRIPTION**

In the TSDrII Clutch and Brake, the friction surfaces consists of alternate carbon steel Drive Plates and a resilient paper based friction material bonded to steel discs. These are called Friction Discs. The oil control

![Figure 1.3 - TSDr II Clutch and Brake Assembly](image)
grooves are machined into the friction discs. The discs have internal teeth which mate with a spline on the hubs for both clutch and brake applications. The steel plates are keyed to the input shaft in the clutch and to the housing for the brake. The splined sections of the hubs contain centrifugal impellers to maintain a positive flow of oil between the discs and plates.

1-4 CLUTCH and BRAKE OPERATION

The TSDrll Clutch and Brake cross section, Figure 1.4, shows the unit in the off position with the clutch and brake engaged. This is the normal position when air and electrical services are off.

In the drive, springs are used to force the brake piston against the brake disc pack. The force of the piston is great enough to lock the disc pack solid which in turn keeps the worm shaft and the input shaft from turning. The clutch works in the same manner except its purpose is to couple and uncouple the input shaft to the hub. So that in Figure 1.4, with both the clutch and brake engaged, the input shaft is coupled to the hub and neither is free to turn.

The main Drive Motor is coupled to the hub and with the TSDrll in the off position it is not free to run. To run, air is applied to the clutch port. The air pressure overcomes the spring pressure to move the piston away from the clutch disc pack. With the clutch disc pack unclamped, the hub is uncoupled from the input shaft allowing the main drive motor to run freely. To stop the main motor the brake is left engaged and air is exhausted from the clutch port. The clutch piston is then forced by springs to clamp the clutch disc pack. This again couples the hub to the input shaft, which is locked by the brake, thus stopping the main drive motor.

To run the feed drive motor, the main drive motor is brought to a stop or near stop as described above. Air is applied to the brake port to overcome the spring pressure and move the piston away from the brake disc pack. With the brake disc pack released, the feed motor is free to run the worm shaft. Torque is transmitted from the worm shaft, to the worm gear to the input shaft. Since the clutch disc pack is clamped, torque is transmitted from the input shaft, thru the disc pack, to the hub and out to the main drive motor. This would complete a full cycle.
## Section 2
### SPECIFICATIONS

#### 2-1 PERFORMANCE SPECIFICATIONS

<table>
<thead>
<tr>
<th>HORSE POWER</th>
<th>RPM</th>
<th>MOTOR FRAME</th>
<th>CYCLIC INERTIA (Lb. Ft.²)</th>
<th>TOTAL DRIVE CYCLIC INERTIA (Lb. Ft.²)</th>
<th>DRIVE NO LOAD STARTS PER MINUTE</th>
<th>SPRING SET CLUTCH TORQUE (Lb. Ft.)</th>
<th>SUGGESTED INCHING MOTOR HORSE POWER ***</th>
<th>MAXIMUM REFLECTED INERTIA MAIN MOTOR CAN START (Lb. Ft.²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1200</td>
<td>184U</td>
<td>0.29</td>
<td>0.34</td>
<td>32.4</td>
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<td>1.5</td>
<td>1200</td>
<td>213U</td>
<td>0.36</td>
<td>0.41</td>
<td>43.0</td>
<td>23</td>
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<td>2</td>
<td>1200</td>
<td>215U</td>
<td>0.48</td>
<td>0.53</td>
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<td>71</td>
<td>104</td>
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<tr>
<td>3</td>
<td>1200</td>
<td>254U</td>
<td>2.05</td>
<td>2.10</td>
<td>20.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1200</td>
<td>256U</td>
<td>2.73</td>
<td>2.78</td>
<td>19.6</td>
<td>77*</td>
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<td></td>
</tr>
<tr>
<td>1</td>
<td>1800</td>
<td>182U</td>
<td>0.24</td>
<td>0.29</td>
<td>12.4</td>
<td>.75</td>
<td>5.8</td>
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<td>1800</td>
<td>184U</td>
<td>0.22</td>
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<td>2</td>
<td>1800</td>
<td>213U</td>
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<td>0.31</td>
<td>33.5</td>
<td>.75</td>
<td>11</td>
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</tr>
<tr>
<td>3</td>
<td>1800</td>
<td>215U</td>
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<td>0.44</td>
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</tr>
<tr>
<td>5</td>
<td>1800</td>
<td>254U</td>
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<td>1.21</td>
<td>28.9</td>
<td>1</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>7.5</td>
<td>1800</td>
<td>256U</td>
<td>1.34</td>
<td>1.39</td>
<td>11.5</td>
<td>1</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>1800</td>
<td>256U</td>
<td>1.34</td>
<td>1.39</td>
<td>11.5</td>
<td></td>
<td>51</td>
<td></td>
</tr>
</tbody>
</table>

* Drive will be shipped with this torque unless otherwise specified on the order.

** The Clutch Torque also dictates the Braking Torque.

*** With 10:1 speed difference from high to low speed.

To Determine the Starts per Minute capability of the TSDrII when installed, use the following formula:

\[
S / M_1 = \frac{W_{K_D}^2}{W_{K_D}^2 + W_{K_L}^2} \times S / M
\]

- \( S / M_1 \) = Starts per Min. capability of installed drive.
- \( W_{K_D}^2 \) = Inertia of Two Speed Drive from Specification Table.
- \( W_{K_L}^2 \) = Inertia of driven load reflected to Two Speed Drive.
- \( S / M \) = No Load Starts per Minute rating from Specification Table.
Section 3
INSTALLATION

IMPORTANT SAFETY PRECAUTIONS
The Two Speed Drive units described in this manual must not be installed in any manner except as specified herein, and must not be operated at speeds, horsepower loads or temperatures other than those specified in the manual. Failure to limit operation of the Drive to the conditions specified could damage the units and may cause malfunction or damage to interconnected equipment and void the warranty.

Suitable guards for rotating shafts and couplings must be used at all times when operating equipment and is the responsibility of the customer.

WARNING
Before installation and attempting any repairs to the drive, open the disconnects to both motors, shut off air supply to the drive and lock them out to avoid possibility of personal injury. Bleed off pressure trapped in the pneumatic system.

3-1 RECEIVING THE DRIVE
Check the drive for shortage or damage immediately after arrival. Prompt reporting to the carrier’s agent, with notations made on the freight bill, will expedite satisfactory adjustment by the carrier. When unloading or handling the drive, keep it upright. All Drives are filled with oil, ready to run, when shipped. However, before placing the unit in service or storage, check the oil level to make sure none has spilled out in transit. Add oil if necessary (refer to Section 4 LUBRICATION). If the drive is not to be installed and operated soon after arrival, store it in a clean, dry place having a slow, moderate change in ambient temperature. Actuate pistons and rotate shafts once a month to re-lubricate working surfaces.

3-2 MOUNTING THE TSDrII TO AN EXISTING MAIN DRIVE MOTOR
The Two Speed Drive II may come partially filled with oil, so after installation to the Main Drive Motor is complete, you will need to check the oil level and add oil as described in Section 4 - LUBRICATION.

1. Make sure that the mounting surfaces on both the motor and TSDrII unit are thoroughly cleaned and suitable for mounting.
2. Attach an overhead hoist and appropriate sling to the unit and slide it over the motor shaft until the pilot is snug against the motor register.
3. Loosely attach the Clutch and Brake Unit with (4) Mounting Bolts (#142) and (4) Lockwashers (#169) to the motor face. DO NOT TIGHTEN THESE BOLTS YET.
4. Remove the Sight Gauge (#87) from the rear of the Piston Retainer (#17).
5. Back the Clutch and Brake Unit 1/32” off the motor face. Use a 1/32” shim to verify this.
6. Insert a 3/8” Socket Torque Wrench into the sight gauge hole, long enough to reach the head of the Collet Bolt (#143). Torque to 75 Ft. Lbs.
7. This tightening procedure will pull the unit back against the motor face. Torque the (4) Mounting Bolts (#142) to 60 Ft.Lbs.
8. Replace the Sight Gauge (#87) and fill with fresh oil as described in Section 4 - LUBRICATION.

3-3 MOUNTING THE COMPLETE DRIVE
Installation of the Drive should be made in much the same manner, and receive the same care as for a precision gear reducer. Standard Drives are designed for horizontal operation. Note the following precautions when mounting the drive.
1. The Drive should be mounted on a firm, level base or foundation.
2. Use socket head cap screws or SAE grade 5 bolts to bolt the drive securely in place. Before tightening down the bolts, check alignment with driven machinery, then re-check after tightening.
3. If the Main Motor Shaft is to be directly coupled, use only a flexible coupling (with horsepower service factor 3 to 1) to take care of maximum torque requirements. Make sure that the shafts to be coupled are concentric within the coupling manufacturers’ specifications. Check for horizontal, vertical or angular misalignment. Use shims as necessary to correct any misalignment.
CAUTION
Do not drive couplings or bushings on shaft, as this may damage the bearings.
If the motor drives a belt, coat shaft with heavy oil before installing pulley. See cautionary note above. Mount pulley as close to motor bearing as possible, and align to run true.

CAUTION:
Excessive belt tension will damage bearings.

4-2 CHANGING THE OIL
Every three months completely drain the oil from the drive using the drain plugs provided. If the oil sight gauge is dirty it should be removed and cleaned.

3-4 WIRED SPECIFICATIONS
(See Motor Plate)

3-5 PNEUMATICS
For the least delay in actuation use 3/8" tube or hose and mount the valve as close to the drive as possible. Use of bottom air ports, with valve lower than ports will prevent accumulation of airline moisture in the TSDri (See Figure 6.1 on page 11).

3-6 START UP
1. Lock out machine and air. Verify that power is OFF to avoid personal injury.
2. Re-check all air connections for tightness and check to see that they are correct as shown in the Pneumatic Schematic (Figure 6.1).
3. Set air regulators to: 60 PSI minimum, 80 PSI maximum
4. Unlock main disconnect.
5. Check out slow speed mode for proper rotation and adjust all limit switches as needed.
6. Check operation of main motor.

Section 4
LUBRICATION

4-1 CHECKING THE OIL LEVEL
When the drive is installed and weekly thereafter, or until experience dictates otherwise, check the oil level in the TSDri clutch and brake. Always check the oil level with the drive at room temperature and while it's not running.
The TSDri has an oil sight gauge located at the end of the drive. The oil level is to show at the center of the gauge.

4-2 CHANGING THE OIL
Every three months completely drain the oil from the drive using the drain plugs provided. If the oil sight gauge is dirty it should be removed and cleaned.

Reinstall the drain plugs and refill the drive to the center of the sight gauge with fresh oil.

CAUTION
Do not overfill the TSDri. Excess oil will cause the unit to overheat.

4-3 TYPE OF OIL
Use only Mobil Automatic Transmission Fluid type ATF-210 or Type "F". Always use the type of oil specified on the name plate.
Section 5
OPERATIONAL CHECKS

5-1 TSDrlI CLUTCH and BRAKE

CAUTION

Make operational checks with the drive shut down. Do not remove plugs while drive is Running.

Provisions for manual operational checks are to be made if the unit has been removed for repair. Set up temporary manually controlled air connections to the drive for the required 60 to 80 PSI air supply.

Manually apply valve air pressure to the clutch port. Observe the clutch piston and check that it actuates quickly and smoothly. If the piston action is irregular, or if it tends to stick or bind, internal damage may be indicated. Also, listen for air leaks and look for air bubbles in the oil that would indicate damage to the piston seals.

Exhaust clutch air pressure and check to see that the piston moves to engage the clutch stack.

Check brake operation by applying 80 psi to the brake port and manually turn the worm shaft. If the worm shaft can be turned by hand then the brake piston has been actuated. If after applying air pressure to the brake port the worm shaft cannot be turned by hand then damage to the piston seals would be indicated.

5-2 DRIVE MOTORS

Check wiring connections against the diagram on the motor nameplate. “Bump” the motor and check the direction of rotation. Check for tightness of connections.

5-3 PNEUMATIC CONTROL

The typical pneumatic control for the TSDrlI will not supply air to the drive when electrical power is off. In this mode the brake and clutch stacks are clamped so that the main and feed motors can not run. With a 60 PSI minimum air supply to the valve, the clutch is released by energizing the valve solenoid for the clutch. With the clutch valve solenoid energized, the clutch piston will move away from the clutch stack. De-energizing the clutch valve solenoid will allow the piston to move back to engage the clutch stack.

The brake is released in the same manner as the clutch. The brake valve solenoid is energized, at which time air will be applied to the brake port. The air will move the piston away from the brake stack. Again the valve should be supplied with a 60 PSI minimum air supply. Air pressures should be checked at the clutch and brake ports with diagnostic pressure gauges.
## Section 6
### TROUBLESHOOTING

### 6-1 CLUTCH/BRAKE TROUBLESHOOTING CHART

<table>
<thead>
<tr>
<th>TROUBLE</th>
<th>POSSIBLE CAUSE</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Section A</strong></td>
<td>• Electrical control circuit.</td>
<td>• Check control circuit.</td>
</tr>
<tr>
<td>Both clutch and/or brake fail to engage properly.</td>
<td>• Air supply pressure regulator or piping.</td>
<td>• Check diagnostic pressure gauges.</td>
</tr>
<tr>
<td></td>
<td>• Worn friction surfaces.</td>
<td>• Check for improper operation or leaks.</td>
</tr>
<tr>
<td></td>
<td>• Piston sticking - broken return spring.</td>
<td>• Check parts for wear and replace. if necessary.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Disassemble to the extent necessary and inspect for damaged parts.</td>
</tr>
<tr>
<td><strong>Section B</strong></td>
<td>• Air pressure too high.</td>
<td>• Reduce air pressure</td>
</tr>
<tr>
<td>Picks up load too quickly.</td>
<td>• Low oil level.</td>
<td>• Check oil level and add if necessary.</td>
</tr>
<tr>
<td><strong>Section C</strong></td>
<td>• Electrical control circuit.</td>
<td>• Check control circuit.</td>
</tr>
<tr>
<td>Clutch fails to disengage properly.</td>
<td>• Valve not functioning properly.</td>
<td>• Check valve operation. Replace if necessary.</td>
</tr>
<tr>
<td></td>
<td>• Low air pressure.</td>
<td>• Increase air pressure to 60 PSI min.</td>
</tr>
<tr>
<td><strong>Section D</strong></td>
<td>• Mounted on poor foundation.</td>
<td>• Improve installation.</td>
</tr>
<tr>
<td>Noise and vibration.</td>
<td>• Misaligned couplings.</td>
<td>• Tighten mounting foot bolts.</td>
</tr>
<tr>
<td></td>
<td>• Damaged bearing.</td>
<td>• Recheck alignment and realign.</td>
</tr>
<tr>
<td><strong>Section E</strong></td>
<td>• Clutch engaged with main motor running.</td>
<td>• Check control circuit.</td>
</tr>
<tr>
<td>Noise: High pitch whine</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6-1 CLUTCH/BRAKE TROUBLESHOOTING CHART *(Concluded)*

<table>
<thead>
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<th>TROUBLE</th>
<th>POSSIBLE CAUSE</th>
<th>REMEDY</th>
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</thead>
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<td>• Electrical control circuit.</td>
<td>• Check control circuit.</td>
</tr>
<tr>
<td>Brake fails to disengage properly.</td>
<td>• Valve not functioning properly.</td>
<td>• Check valve operation. Replace if necessary.</td>
</tr>
<tr>
<td></td>
<td>• Low air pressure.</td>
<td>• Increase air pressure to 60 PSI min.</td>
</tr>
<tr>
<td><strong>Section G</strong></td>
<td>• Clutch or brake fails to engage properly causing excessive slippage.</td>
<td>• Refer to Sections A, B &amp; G</td>
</tr>
<tr>
<td>Drive overheats. (Max. 225°)</td>
<td>• Inertia or resistance changed.</td>
<td>• Check with Force Control engineering.</td>
</tr>
<tr>
<td></td>
<td>• Improper oil level.</td>
<td>• Check oil level. Add or drain oil, as necessary.</td>
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<td><strong>Section H</strong></td>
<td>• Oil seals.</td>
<td>• Disassemble and replace.</td>
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<tr>
<td>Oil leakage.</td>
<td>• Gaskets.</td>
<td>• Tighten all external bolts.</td>
</tr>
<tr>
<td></td>
<td>• Poor ventilation.</td>
<td>• Remove breather and clean.</td>
</tr>
<tr>
<td></td>
<td>• Seal retainers.</td>
<td>• Tighten if loose.</td>
</tr>
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<td><strong>Section I</strong></td>
<td>• Damaged seal around piston.</td>
<td>• Disassemble and repair.</td>
</tr>
<tr>
<td>Oil leakage out breather.</td>
<td>• Oil level too high.</td>
<td>• Drain excess oil.</td>
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<tr>
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<td>• Bearings damaged.</td>
<td>• Disassemble and replace.</td>
</tr>
<tr>
<td>Shaft end play excessive. (.020” Max.)</td>
<td></td>
<td></td>
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<tr>
<td><strong>Section K</strong></td>
<td>• Air pressure changed.</td>
<td>• Check air pressure.</td>
</tr>
<tr>
<td>Clutch or brake does not repeat.</td>
<td>• Oil temperature changed.</td>
<td>• Check temperature.</td>
</tr>
<tr>
<td></td>
<td>• Resistance in machine changed.</td>
<td>• Lubricate machine bearings</td>
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## 6-2 PNEUMATIC SYSTEM TROUBLESHOOTING CHART

<table>
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<th>POSSIBLE CAUSE</th>
<th>REMEDY</th>
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<tr>
<td><strong>Section A</strong>&lt;br&gt;Excessive water in exhaust.</td>
<td>• Wet air supply.</td>
<td>• Check supply line.</td>
</tr>
</tbody>
</table>
| **Section B**<br>Brake or clutch fails to disengage properly. | • Low air pressure. | • Increase one regulator at a time in steps until satisfactory air pressure is attained.  
• Valves. | • Check valve operation.  
Replace if necessary. |
| **Section C**<br>Slow response of clutch/brake. | • Air supply starvation. | • Insufficient air supply. Add accumulator tank before valves.  
(150 Cu. In. per Min.)  
• Exhaust muffler.  
• Air supply  
• Oil in exhaust. | • Remove and clean.  
• Valves too far from drive.  
• Air lines too small. Use 3/8” or 1/2” lines with adapters to 1/4”  
• Check drive for piston leakage.  
• Check air line for source.  
(Lubricated air is not recommended.) |
| **Section D**<br>Brake engages improperly. | • Control signal. | • Check limit switch. |

### TDSrII CONTROL LOGIC

<table>
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<tr>
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<th>SOLENOID</th>
<th>PRESSURIZED PORTS</th>
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<td>STOP</td>
<td>1 2</td>
<td>—</td>
<td>OFF OFF</td>
</tr>
<tr>
<td>RAPID</td>
<td>1 2</td>
<td>CLUTCH ON</td>
<td>— OFF</td>
</tr>
<tr>
<td>FEED</td>
<td>2 1</td>
<td>BRAKE OFF</td>
<td>ON OFF</td>
</tr>
</tbody>
</table>

**FILTER and REGULATOR SUPPLIED by CUSTOMER**

**NOTE:**

SOL. #1 - HARDWIRED IN PARALLEL WITH MAIN MOTOR STARTER CONTACCTOR COIL.  
SOL. #2 - HARDWIRED IN PARALLEL WITH FEED MOTOR STARTER CONTACCTOR COIL.

---

**Figure 6.1 - Typical Pneumatic Schematic**
Section 7
DISASSEMBLY

7-1 GENERAL INFORMATION

When disassembling the Two Speed Drive, remove only enough to gain access to the modular unit that requires repair.

Unless the drive is to be completely overhauled, the modules should be disassembled only to the extent necessary to gain access to worn or damaged parts.

CAUTION
Supporting the parts of drive as they are removed by use of an overhead crane and soft sling is recommended, as required.

7-2 FEED MOTOR REMOVAL

If the Feed Motor is foot mounted, first remove the Belt Guard Cover (#105). Loosen Cap Screws (#153) which bolt the motor to the mounting base. Next slide the motor on its mounting base until there is enough slack in the Belt (#106) to remove it. Unscrew socket set screws holding the Pulley (#101) to its bushing and remove the pulley and bushing from the motor shaft. Remove loosened Cap Screws (#153) and lift the motor from its mounting base. (See pages 26 and 27 for different motor mounting arrangements.)

If the motor is C-face mounted, remove Cap Screws (#154) which bolts the motor to the C-face adapter. With the bolts removed, slide the motor backwards and out of the C-face adapter.

TSD II Clutch and Brake

7-3 PISTON HOUSING SUBASSEMBLY REMOVAL

1. Drain all of the oil from the drive.

2. Removal of (7) Cap Screws (#144) will allow the piston housing subassembly to be separated from the main housing subassembly.

CAUTION
Piston Housing (#16) and Piston Retainer (#17) are under spring pressure. Do not remove Cap Screws (#180) as shown in Figure 7.3.

3. Once the piston housing subassembly has been removed from the main housing subassembly, the Clutch Friction Discs (#12) and the Clutch Drive Plates (#13) can be removed for inspection. (See Section 8 for removal, cleaning and inspection procedure of the drive plates and friction discs.)
7-4 DISASSEMBLY - PISTON HOUSING SUBASSEMBLY

1. Evenly back out (2) Cap Screws (#180)

   **CAUTION**

   The Piston Housing Subassembly is under spring pressure and care must be taken to avoid personal injury when removing these (2) cap screws.

2. Piston (#18), Clutch Thrust Plate (#19) and Bearing (#51) can be removed as an assembly from the piston bore for inspection.

3. Remove (2) O-Rings (#75) and Liner (#80) from the Piston (#18) (See Figure 7-4).

4. Remove O-Ring (#76) and Liner (#81) from Piston Housing (#16) (See Figure 7-5).

5. Use an arbor press to remove Bearing (#51) from Clutch Thrust Plate (#19) and Piston (#18) if necessary.

**NOTE**

Do not attempt removal of Bearing (#51) unless replacement is required.

Roll Pins (#85) are permanently pressed into the piston and should not be removed. Consult factory if replacement is necessary.

7-5 MAIN DRIVE MOTOR REMOVAL

1. Remove (4) Cap Screws (#141) and separate the Main Housing Subassembly from the Input Subassembly. Jack screw holes are located in the C-Face Adapter (#1) to aid in separation.

2. Next remove (4) Cap Screws (#142), which bolts the Motor to the C-Face Adapter (#1).

3. Remove Cap Screw (#143) from the Hub (#2). Insert a 1/2"-13 x 4-1/2" Lg. Threaded Rod into the Collet (#6) so that there is still approximately 1/4" of thread left in the end of the Hub (#2). Install a 5/8"-11 x 2" Lg. Hex Hd. Screw into the Hub (#2). Tighten the Hex Hd. Screw to loosen the Hub on the Collet. (See Figure 7.6)

4. After Hub (#2) has been loosened from the Main Motor Shaft, slide the entire Input Subassembly back from the Main Motor.

7-6 DISASSEMBLY - INPUT SUBASSEMBLY

Disassemble the Input Subassembly as required, noting the following:

1. Use an arbor press to remove Bearing (#50) and Hub #2) from the C-Face adapter (#1), if necessary.

   **NOTE:**

   Do not remove the Bearing (#50) unless it has to be replaced.
2. The Bearing Cup (#54) and the Oil Seal (#62) will remain with the C-Face Adapter (#1) when disassembled. **Remove these only if replacement is necessary.**

**7-7 BRAKE REMOVAL & DISASSEMBLY**

If the Brake needs to be removed or inspected, disassemble as required, noting the following.

1. To remove the Brake Assembly, remove (2) Cap Screws (#352) and (2) Lockwashers (#327).

2. Remove the Adapter Plate (#900) from the back of the brake by taking out the (2) Screws (#255) and (2) Lockwashers (#328).

   **CAUTION** - This Adapter Plate (#900) is under spring pressure so back-out the (2) Screws (#255) in an even manner.

3. Remove and discard Gasket (#322).

4. Remove Piston (#303) from end housing bore for access to the Drive Plates (#12), Friction Discs (#313), O-Rings (#339, #340) and Liners (#342, #343). **See Section 8 for removal, cleaning and inspection of the Drive Plates and Friction Discs.**

5. Remove O-Rings (#339, #340) and Liners (#342, #343) from the End Housing (#309).

6. Remove Screw (#351). It may be necessary to apply heat to the screw to release the bond of the Loctite. Install a 3/8"-16 x 1/2" Lg. Soc. Set Screw into the Collet (#306). Then install a 1/2"-13 X 2" Lg. Hex Hd. Screw into the Hub (#2). Tighten the Hex Hd. Screw to loosen the Hub off of the Collet as shown in Figure 7.7.

**7-8 WORM SHAFT REMOVAL**

*(Belt Drive Only)*

Remove the Worm Shaft only if it becomes necessary to replace it or the bearings. Also if the Main Housing Subassembly is to be disassembled.

1. If the Worm Shaft (#37) has an external key-way, place masking tape over key way to protect the Oil Seal (#63).

2. Take out (4) Cap Screws (#145) and (4) Lockwashers (#174) and remove Bearing Retainer (#22).

3. Remove Shims (#132). **These must be saved to be used again at reassembly.**

4. Remove Adapter (#901) by removing (4) Cap Screws (#145) and (4) Lockwashers (#174). Also remove Gasket (#46).

5. Remove the Bearing Spacers (#23, #26) and both Bearing Cups (#56) from the bearing bores in the Main Housing.

6. Use an arbor press to remove the Worm Shaft (#37) from the Main Housing. An internal lip on the drive side will catch and remove the Bearing Cone (#55) located on the drive side of the Worm Shaft. The remaining Bearing Cone (#55) on the brake side can be pressed off with an arbor press.

---

**Figure 7.7 - Removing Hub off of Collet**

**Figure 7.8 - Belt Drive Worm Shaft Removal**
(C-Face Drive Only)

1. Take out (4) Cap Screws (#145) and (4) Lockwashers (#174) to remove C-Face Adapter (#5).
2. The Oil Seal (#64) and the Gasket (#46) can be removed if necessary. Discard the Gasket (#46).
3. Remove Adapter (#901) by taking out (4) Cap Screws (#145) and (4) Lockwashers (#174). Remove gasket (#46) on this side and discard.
4. Pull the Bearing Spacer (#26) off the Worm shaft (#37).
5. The Worm Shaft (#37) can manually be pushed out of the Main Housing to the brake side. Bearing (#57) will be retained on the Worm Shaft during removal.
6. Use an arbor press to remove Bearing (#57) from the Worm Shaft, if necessary.

**NOTE:**
Only remove this Bearing is replacement is required.

### 7-9 MAIN HOUSING DISASSEMBLY

Disassemble the Main Housing as required for inspection or repair as required, noting the following:

1. Manually remove the Input Shaft Subassembly from the main housing bore. This Subassembly consists of Input Shaft (#20), Bearing (#52), Bearing Cone (#53), Spacer (#21) and Worm Gear (#38).

Figure 7.9 - Belt Drive Worm Shaft Removal

Figure 7.10 - Main Housing Disassembly

2. After removal of the Input Shaft Subassembly, remove Shims (#137) from the Main Housing. These shims must be saved for reassembly.
3. If necessary, use an arbor press to remove the bearings, spacer and worm gear from the input shaft.

**NOTE:**
Do not attempt removal of Bearings (#52, #53), Spacer (#21) and Worm Gear (#38) unless replacement is necessary.

This completes the disassembly procedure for the Two Speed Drive II Unit.
WARNING
Petroleum-base cleaning solvents are flammable and open flames or smoking by personnel in the vicinity of these solvents is extremely hazardous and must not be permitted.

8-1 CLEANING AND INSPECTION
Clean metal parts in a suitable solvent and dry in a stream of low pressure compressed air. Clean the clutch and brake plates and discs one at a time, keeping parts in the same order as they were when removed. After cleaning, inspect parts for cracks, distortion, scoring, nicks, burrs or other damage which would affect serviceability. **Pay particular attention to the following:**

1. Check the disc wear surfaces for scoring, galling or evidence of uneven wear.
2. Check the clutch and brake plates for scoring or galling. Make sure they are flat. If a perceptible ridge is worn in any of the drive plates, replace all of the drive plates and friction discs as a complete set.
3. Carefully check the piston and bore surfaces for nicks, scratches, scoring or other damage which would affect operation or cause leakage.
4. Pay particular attention to Wear Sleeve (#67) and shafts in the area of rotary seals. Check for nicks, scratches or other damage which would cause leakage. Replace any damaged parts.
5. It is not necessary to remove the ball bearings to check their operation. Slowly rotate the free race of each bearing by hand checking to see if it turns freely without rough or flat spots.

8-2 REPAIR AND REPLACEMENT
A fine stone or crocus cloth may be used to remove minor surface defects from parts so long as the operating or sealing action of the part is not affected. The use of coarser abrasives or other machining methods should not be attempted. Otherwise, damaged parts should be replaced. **Replacement is recommended also for the following, as applicable:**

1. Replace all O-rings, liners, gaskets and oil seals removed during the course of disassembly.
2. Replace clutch or brake discs and drive plates in complete sets only.
Section 9
REASSEMBLY

9-1 GENERAL INSTRUCTIONS

Note the following general reassembly instructions, as applicable:

1. Lubricate O-rings and the lips of oil seals with oil (the same as used in the assembled unit) immediately before assembly and installation of mating parts.

2. O-ring liners will be easier to install if heated in an oven to 200° F maximum.

3. The installation of press-fitted parts can be eased by heating the outside parts in an oven. Heat bearings to 250° F maximum.

WARNING
Use Suitable Gloves When Handling Heated Parts.

9-2 INPUT SUBASSEMBLY

1. Place a light coating of Permatex Form-A-Gasket in oil seal bore of C-Face Adapter (#1) and press Oil Seal (#62) into bore. (See Figure 9-1)

2. Place a light coating of Loctite RC/680 on the outside of Bearing Cup (#54) and press it into the bore of C-Face Adapter (#1). Bolt C-Face Adapter to motor flange with (4) Washers (#169) and (4) Screws (#142).

3. Press Bearing (#50) on to Hub (#2).

4. Place a light coating of Loctite #2717 on the inside of Wear Sleeve (#67) and press it on to Hub (#2).

5. Insert Collet (#6) into bore of Hub (#2). Apply a coat of Loctite Threadlocker #271 to threads of Cap Screw (#143). Install Cap Screw (#143) along with Seal Washer (#43) by inserting it into Hub (#2) and threading it into Collet (#6) one or two turns. Do not tighten Cap Screw (#143) as the collet must be loose in its bore at this point. (See Figure 9-2.)

6. Place Hub Assembly (#2) onto the motor shaft by passing it thru C-Face Adapter (#1) and tapping it thru Oil Seal (#62) with a rubber mallet. Torque Cap Screw (#143) to 75 Lb/Ft. (See Figure 9-3.) Be sure not to preload Bearing (#40).

Figure 9.1 - Pressing Oil Seal (#62) Into Bore

Figure 9.2 - Inserting Collet (#6) Into Hub Bore

Figure 9.3 - Installing Input Subassembly On Motor
9-3 MAIN HOUSING SUBASSEMBLY

1. Press Bearing (#52), Worm Gear (#38), Key (#39), Spacer (#21) and Bearing Cone (#53) onto the Input Shaft (#20).

2. To determine Shim (#137) thickness, measure from Surface 'A' to Surface 'B', (See Figure 9.4).
   Subtract the dimension from 2.144". The result is the required Shim thickness.
   If the dimension from 'A' to 'B' is found to be 2.135" then 2.144"-2.135" = .009" (Shim thickness required).

3. Add Shim(s) into the bore of the main housing. Bearing end play is .002" to .004".

4. Install the assembled Input Shaft into the main housing.

9-4 WORM SHAFT REPLACEMENT

(Belt Drive Only)

1. Press (1) Bearing Cone (#55) onto the brake side of the Worm Shaft (#37) and slide the Worm Shaft (#37) into the main housing bore. (See Figure 9.5.)

2. Press the other Bearing Cone (#55) onto the drive side of the worm shaft with an arbor press. (See Figure 9.6).

3. Press Bearing Cups (#56) into bearing bores of the main housing.

4. Place Spacer (#23) into the brake side bearing bore of the main housing and slide the Spacer (#26) on to the Worm Shaft. (See Figure 9.7)

5. Install Gasket (#46) and bolt Adapter (#901) to the brake side of main housing with (4) Washers (#174) and (4) Screws (#145). (See Figure 9.7)

6. Press Oil Seal (#63) into Bearing Retainer (#22). Place Shims (#132) over the pilot of the bearing retainer and bolt the Bearing Retainer (#22) to the drive side of the main housing with (4) Washers (#174) and (4) Screws (#145). If the worm shaft has an external keyway, place masking tape over the keyway to prevent damage to the Oil Seal (#63) during installation of the Bearing Retainer (#22). (See Figure 9.7)
7. Check the worm shaft after installation for end play. This can be done by setting a Dial Indicator on the end of the worm shaft and manually pushing the shaft in and out while rotating it. The End-Play should be between .002"-.004". Add or subtract Shims (#132) as needed. (See Figure 9.8)

5. Press Oil Seal (#64) into the C-Face Adapter (#5). Replace Gasket (#46). Slide the C-Face Adapter over the Worm Shaft, being careful not to damage the Oil Seal Lip. Bolt to the Main Housing with (4) Washers (#174) and (4) Screws (#145).

9-5 MOUNTING MAIN HOUSING TO MAIN MOTOR C-FACE ADAPTER

1. Bolt the C-Face Adapter to the Main Housing using (4) Washers (#170) and (4) Screws (#141).

2. Snug bolts up evenly. Using feeler gages measure the gap between C-Face Adapter and Main Housing. Add .003" to the Feeler Gauge Dimension to get the required Shim Thickness. (See Figure 9.10)

(C-Face Drive Only)

1. Press Bearing (#57) onto Worm Shaft (#37).

2. Insert Worm Shaft and Bearing into Main Housing.

3. Install Gasket (#46) onto the brake side of Main Housing. Bolt Adapter (#901) to Main Housing with (4) Washers (#174) and (4) Screws (#145).

4. Insert Collet (#306), Screw (#351) along with the Seal Washer (#334) into the Hub (#302). Place Hub Subassembly onto the Worm Shaft and tighten Screw (#351) to a snug fit. (See Figure 9.9)

9-6 PISTON HOUSING ASSEMBLY

1. Press the Clutch Thrust Plate (#19) into Bearing (#51). Apply Loctite RC/680 to the outside diameter of Bearing (#51) and press the bearing and thrust plate into Piston (#18).
CAUTION
Do not support the Piston (#18) on Pins (#85) when pressing the bearing into it,

2. Replace O-Rings (#75) and Liner (#80) into the piston grooves. (See Figure 9.11.)

3. Install O-Ring (#76) and Liner (#81) into the Piston Housing (#16). (See Figure 9.12)

4. Push the Piston Subassembly into the Piston Housing.

CAUTION
Lubricate the liners with white Petroleum (USP), or equivalent, before installation. Use care when installing mating parts not to cut or damage the Piston Liners, (See Figure 9.13)

5. Place (8) Springs (#83) on the (8) Pins (#85). (See Figure 9.13)

6. Place Gasket (#45) between Piston Housing (#16) and Piston Retainer (#17). Bolt these two housings together using the two special Cap Screws (#180). (See Figure 9.14)

9-7 CLUTCH STACK
There will be (5) Drive Plates (#13) and (5) Friction Discs (#12) in the Clutch Stack. Install the Clutch Stack as described below. (See Figure 9.14)

1. Mate notches in the Drive Plates (#13) with the lugs of the Input Shaft (#20).

2. Mate the teeth of the Fiction Discs (#12) with the spline on Hub (#2).

3. Alternate Drive Plates and Friction Discs, starting with a Drive Plate and ending with a Friction Disc.

9-8 BOLTING PISTON HOUSING ASSEMBLY TO MAIN HOUSING

1. Install Gasket (#45) to Main Housing.

2. Bolt the Piston Housing Assembly to the Main Housing, using (7) Washers (#174) and (7) Screws (#144). Make sure that the spline of Clutch Thrust Plate (#19) and the spline of Hub (#2) mate properly during assembly.

9-9 BRAKE HUB INSTALLATION

(Belt Drive Only)

1. Drop Collet (#306) into Hub (#302). Apply a coat of Loctite Threadlocker #271 to Screw (#351) and thread it, along with Seal Washer (#334), into the Hub and Collet only one or two turns. DO NOT TIGHTEN SCREW (#351) AT THIS TIME.

2. Place the assembled Brake Hub on the Worm Shaft and torque screw (#351) to 25 Lb. Ft. (See Figure 9.15)
1. Remove previously installed Screw (#351) from the Hub (#302) and apply Loctite Thread Locker #271 to the screw threads. Reinstall Screw (#351) and Seal Washer (#334) back into Hub and torque to 25 Lb. Ft. (See Figure 9.15)

**9-10 BRAKE STACK AND END HOUSING SUBASSEMBLY**

1. Using Friction Discs (#313) and Drive Plates (#312) build up the Brake Stack, noting the following: (See Figure 9.16)
   a. Align the Drive Plates (#312) so that the dowel pins (#357) pass through the holes in the Drive Plates.
   b. Center Friction Discs (#313) on the drive plates and align the teeth of the discs as you stack them together.
   c. Alternate between drive plates and friction discs, beginning and ending with a drive plate.

2. Install O-Rings (#339, #340) and Liners (#342, #343) into End Housing (#309).

3. Push Piston (#303) into the bore of End Housing (#309). Be careful not to damage Liners (#342 and #343) during installation of the piston.

4. Install Springs (#336) into Piston (#303). (See Figure 9.17)

5. Bolt End Housing (#309) to Adapter (#900) using (4) Washers (#327) and (4) Screws (#352). Make sure that the teeth of the Friction Discs (#313) properly engages the spline of Hub (#302).

6. Reinstall all pipe plugs, air breather and fittings removed at disassembly. (See Figure 9.18)
9-11 FEED MOTOR INSTALLATION

(C-Face Drive Only)

1. Slide Motor Shaft into end of Worm Shaft (#37) aligning key with internal keyway. Using (4) Washers (#172) and (4) Screws (#154), bolt Feed Motor to C-Face Adapter (#5) using (4) Washers (#172) and (4) Screws (#154).

(Belt Drive Only)

There are three basic mounting arrangements for belt driven units and they are:

A. Top Mounting (See Figure 9.20)
B. Bottom Mounting (See Figure 9.21)
C. Rear Mounting (See Figure 9.22)

1. Attach (2) Mounting Channels (#125) to Drive Unit with (4) Washers (#172) and (4) Screws (#146) and also (4) Flat Washers (#163) placed between channels and Drive Unit.

2. Attach (2) Mounting Bases (#126) to Feed Motor with (4) Washers (#173) and (4) Screws (#153).


NOTE
Do not tighten (4) Screws (#152) at this time because the motor position has to be adjusted for proper Timing Belt Tension.

4. Attach lower section of Belt Guard (#105) to Bearing Retainer (#22) with (4) Machine Screws (#181).


IMPORTANT
To insure satisfactory performance it is necessary that you follow all these instructions very carefully.

a. Clean shaft, bore and O.D. of bushings and pulley bore of all oil and dirt.
b. Insert bushing into pulley, matching set screw holes as shown in Figure 9.19.
c. Slide the assembled bushing and pulley onto the shaft.
d. Oil set screws and thread into holes A and C as shown in Figure 9.19.
e. Alternately torque the (2) set screws to 55 Lb. Ft.
f. Using a block or sleeve and a rubber mallet, tap the large end of the bushing. DO NOT TAP DIRECTLY ON THE BUSHING.
g. Repeat steps "e" and "f" until torque wrench reading is the same before and after tapping on the bushing.

6. As per General Instructions in Step 5, install Pulley (#100) and Bushing (#102) on Worm Shaft(#37) 1/8" from Bearing Retainer (#22) as shown in Figure 9.19.

7. As per General Instructions in Step 5 install Pulley (#101) and Bushing (#103) onto the Feed Motor Shaft. Use a straight edge for alignment as shown in Figure 9-19.

8. Slip Timing Belt (#106) onto the pulleys and adjust the motor position for proper Belt Tension Deflection as shown in Figure 9-19. Tighten down Screws (#152).

9. Attach upper and outer sections of Belt Guard (#105).

9-12 FINAL REASSEMBLY PROCEDURE

After complete reassembly, fill the unit with the proper amount and type of fresh oil. Refer to Section 4 - Lubrication.

Before placing the drive back in service, check out its Operation as described in Section 5 - Operational Checks.
A BELT DRIVE (FEED MOTOR-TOP MOUNTING)

Figure 9.20 - Belt Drive (Top Mounted Feed Motor)

B BELT DRIVE (FEED MOTOR-BOTTOM MOUNTING)

Figure 9.21 - Belt Drive (Bottom Mounted Feed Motor)
Figure 9.22 - Belt Drive (Rear Mounted Feed Motor)
Section 10
ORDERING REPAIR PARTS

10-1 GENERAL INFORMATION
This section illustrates, lists and describes available repair parts for the Force Control (TSDrII) Two Speed Drive. Exploded views with numbers are used to identify the various parts of the (TSDrII) Two Speed Drive. These numbers are listed in the parts list along with the part name and quantity used.

10-2 FACTORY REBUILD SERVICE
Reconditioning service of TSDrII Drives is offered by Force Control Industries at the factory. Unless major parts (such as housings, shafts, piston, etc.) are damaged, the cost of a complete factory rebuild will be 50% of the cost of a new unit. Before returning a unit for this service, however, be sure to first contact the Force Control Industries Service Sales Department for authorization and shipping instructions. Force Control Industries cannot be responsible for units returned to the factory without prior notice and authorization.

Care must be given to the packaging of returned drives. Always protect mounting feet by attaching to a skid. Shipment-damage drives always delay repairs. It is usually impossible to recover damage costs from the carrier. When possible, describe the problem experienced on your shipping papers.

Return to:
Force Control Industries, Inc.
3660 Dixie Highway
Fairfield, Ohio 45014
Telephone: 513-868-0900
Fax: 513-868-2105
E-Mail: info@forcecontrol.com

10-3 DRIVE MOTORS
The motors used with Force Control's Two Speed Drives are standard and may be repaired by any qualified motor rebuild facility.

10-4 ORDERING REPLACEMENT PARTS
When ordering replacement parts, please specify all of the following information:
1. Drive Model Number (on the nameplate).
2. Drive Serial Number (on the nameplate).
3. Part Reference Number or Letter.
4. Part Name (from the parts list).
5. Quantity.
6. Complete Shipping Information.

Failure to include information for items 1 thru 5 will only delay your parts order. Unless another method is specified for item 6, parts less than 70 pounds will be shipped United Parcel Service. Parts over 70 pounds will be shipped motor freight. Air freight and other transportation services are available, but only if specified on your order.

10-5 NAME PLATE INFORMATION
(See Pages 26 & 27 for Model Number Information)
10-6 MODEL NUMBERS

<p>| | | | | | | | | | |</p>
<table>
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Two Speed Drive II (1, 2)

Feed Speed (3, 4, 5)

**AVAILABLE FEED SPEEDS (RPM)**

<table>
<thead>
<tr>
<th>Foot Mounted Feed Motor</th>
<th>C-Face Mntd. Feed Motor</th>
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<tr>
<td>*013 029 049 073 099 133 †182 029</td>
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<td>*014 030 050 074 100 134 †185 036</td>
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<td>*015 031 051 075 101 135 †190 044</td>
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<td>*016 032 053 076 102 136 †194 058</td>
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<td>*017 033 054 077 106 146 †198 073</td>
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<tr>
<td>*018 034 055 080 107 †156 204 087</td>
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<td>*019 036 058 081 108 †157 209 117</td>
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<tr>
<td>020 037 059 082 109 †159 211 146</td>
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<tr>
<td>021 038 061 087 117 †160 219</td>
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<tr>
<td>022 040 062 088 119 †166</td>
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</tr>
<tr>
<td>023 041 063 090 122 †168</td>
<td></td>
</tr>
<tr>
<td>024 044 064 092 124 †171</td>
<td></td>
</tr>
<tr>
<td>025 045 066 093 125 †172</td>
<td></td>
</tr>
<tr>
<td>026 046 067 095 127 †175</td>
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</tr>
<tr>
<td>027 047 068 097 128 †179</td>
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</table>

* Indicates 1200 RPM Feed Motor  † Indicates Feed Motor must be rated above required torque rating.

**Feed Motor (8)**

<table>
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<tr>
<th></th>
<th>Foot Mounted, 5/8&quot; Shaft</th>
<th>C-Face, 5/8&quot; Shaft</th>
<th>Foot Mounted, 7/8&quot; Shaft</th>
<th>C-Face, 7/8&quot; Shaft</th>
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<tbody>
<tr>
<td>5</td>
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<tr>
<td>6</td>
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<td>7</td>
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<tr>
<td>8</td>
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</table>

**Main Motor C-Face Mtng.(6)**

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<tr>
<th>SHAFT DIA. (FU)</th>
<th>TENON DIA. (FAH)</th>
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<tr>
<td>A</td>
<td>7/8&quot;</td>
</tr>
<tr>
<td>B</td>
<td>7/8&quot;</td>
</tr>
<tr>
<td>C</td>
<td>1-1/8&quot;</td>
</tr>
<tr>
<td>D</td>
<td>1-3/8&quot;</td>
</tr>
</tbody>
</table>

**Assembly Configuration Options (7)**

**A. Main Motor Mounting**

- *F1
- F2
- W1
- *W2
- W8
- *W3
- W4
- *W6
- W7
- *W9
B. Foot Mounted Feed Motor Mounting

C. C-Face Feed Motor Mounting
# Parts List - Figure 10.1

<table>
<thead>
<tr>
<th>REF. No.</th>
<th>PART NAME</th>
<th>QTY.</th>
<th>REF. No.</th>
<th>PART NAME</th>
<th>QTY.</th>
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<tr>
<td>1</td>
<td>C-Face Adapter</td>
<td>1</td>
<td>143</td>
<td>Hex Hd. Screw, 3/8”-16 x 5” Lg</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Hub</td>
<td>1</td>
<td>144</td>
<td>Soc. Hd. Screw, 3/8”-16 x 4-1/2” Lg</td>
<td>7</td>
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<tr>
<td>5</td>
<td>Motor Mounting Flange</td>
<td>1</td>
<td>145</td>
<td>Soc. Hd. Screw, 3/8”-16 x 1-1/2” Lg</td>
<td>4</td>
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<tr>
<td>6</td>
<td>Collet</td>
<td>1</td>
<td>150</td>
<td>Soc. Hd. Screw, #10-24 x 1-1/4” Lg</td>
<td>2</td>
</tr>
<tr>
<td>*12</td>
<td>Friction Disc</td>
<td>5</td>
<td>154</td>
<td>Hex Hd. Screw, 3/8”-16 x 1” Lg</td>
<td>4</td>
</tr>
<tr>
<td>*13</td>
<td>Drive Plate</td>
<td>5</td>
<td>169</td>
<td>Lockwasher, Med. 1/2”</td>
<td>4</td>
</tr>
<tr>
<td>15</td>
<td>Main Housing</td>
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<td>Lockwasher, Med. 3/8”</td>
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<tr>
<td>16</td>
<td>Piston Housing</td>
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<td>172</td>
<td>Lockwasher, Hi Collar, 3/8”</td>
<td>4</td>
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<tr>
<td>17</td>
<td>Piston Retainer</td>
<td>1</td>
<td>174</td>
<td>Lockwasher, Hi Collar, 3/8”</td>
<td>13</td>
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<tr>
<td>18</td>
<td>Piston</td>
<td>1</td>
<td>177</td>
<td>Lockwasher, Hi Collar, #10”</td>
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<tr>
<td>**19</td>
<td>Thrust Plate, Clutch</td>
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<td>180</td>
<td>Ferry Hd. Screw, 3/8”-16 x 3” Lg</td>
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<tr>
<td>20</td>
<td>Input Shaft</td>
<td>1</td>
<td>190</td>
<td>Reducer Bushing, 1/2” x 1/4” NPT</td>
<td>1</td>
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<tr>
<td>21</td>
<td>Spacer</td>
<td>1</td>
<td>191</td>
<td>Pipe Plug, Mag. Sq. Hd., 1/4” NPT</td>
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<tr>
<td>22</td>
<td>Bearing Retainer (Belt Drive Only)</td>
<td>1</td>
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<td>Pipe Plug, Mag. Sq. Hd., 1/2” NPT</td>
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<tr>
<td>23</td>
<td>Bearing Spacer (Belt Drive Only)</td>
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<td>Pipe Plug, Sq. Hd., 1/2” NPT</td>
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<td>26</td>
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<td>Pipe Plug, C-Sunk, 1/4” NPT</td>
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<td>27</td>
<td>Spacer</td>
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<td>45° Street Elbow, 1/2” NPT</td>
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<td>37</td>
<td>Worm Shaft</td>
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<td>233</td>
<td>Oil, Mobil ATF-210 (Quart)</td>
<td>4 Qt.</td>
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<td>38</td>
<td>Worm Gear</td>
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<td>Warning Tag (Not shown)</td>
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<td>39</td>
<td>Key, 3/16” Sq. x 3/4” Lg</td>
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<td>Hub (Collet)</td>
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<td>*43</td>
<td>Copper Washer, 1/2”</td>
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<td>303</td>
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<td>*44</td>
<td>Shim</td>
<td>AR</td>
<td>306</td>
<td>Collet, 7/8” Shaft</td>
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<td>End Housing</td>
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<td>AR</td>
<td>*312</td>
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<td>*313</td>
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<td>Spring</td>
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<td>*339</td>
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<td>O-Ring</td>
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<td>O-Ring</td>
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<td>Heli-Coil Insert</td>
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<td>Liner, ID Sealing</td>
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<td>Dowel Pin, 1/4” Dia. x 1” Lg</td>
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<td>Spring</td>
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<td>**87</td>
<td>Sight Gauge</td>
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<td>Pipe Plug, C-Sunk, 1/8” NPT</td>
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<td>Breather</td>
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<td>*386</td>
<td>Wear Sleeve</td>
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<td>*902</td>
<td>Gasket</td>
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* - Indicates parts in Minor Overhaul Kit.

** - Indicates parts in Major Overhaul Kit. (This Major Overhaul Kit also includes all parts in the Minor Overhaul Kit.)

AR - As Required
Figure 10.1 - Two Speed Drive II (TSDrII)
# Manual Revision & Printing History

*Two Speed Drive II (TSDrII)*

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<th>REVISION NUMBER</th>
<th>REVISION DATE (Mo./Yr.)</th>
<th>PRINTING DATE (Mo./Yr.)</th>
<th>REVISION/ACTION DESCRIPTION</th>
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<td>4/91</td>
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<td>502-T2-003</td>
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<td>Changed both clutch and brake procedure to remove splined hubs from motor shaft.</td>
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<td>502-T2-004</td>
<td>10/03</td>
<td>Created complete digital file for web. Updated manual format. New cover and back. Added Warranty info. Added Performance Charts to Section 2 from APC. Added mounting procedure to existing Main Motor in Section 3. Expanded Model Number Info. and added Assembly Configurations from APC. Removed Detroit address.</td>
<td>JB</td>
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FORCE CONTROL INDUSTRIES, INC.

Worldwide Leader in Oil Shear Technology.

Providing today’s industries with Oil Shear Clutch and Brake Drives that delivers:
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Endurance • Performance
Dependability

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