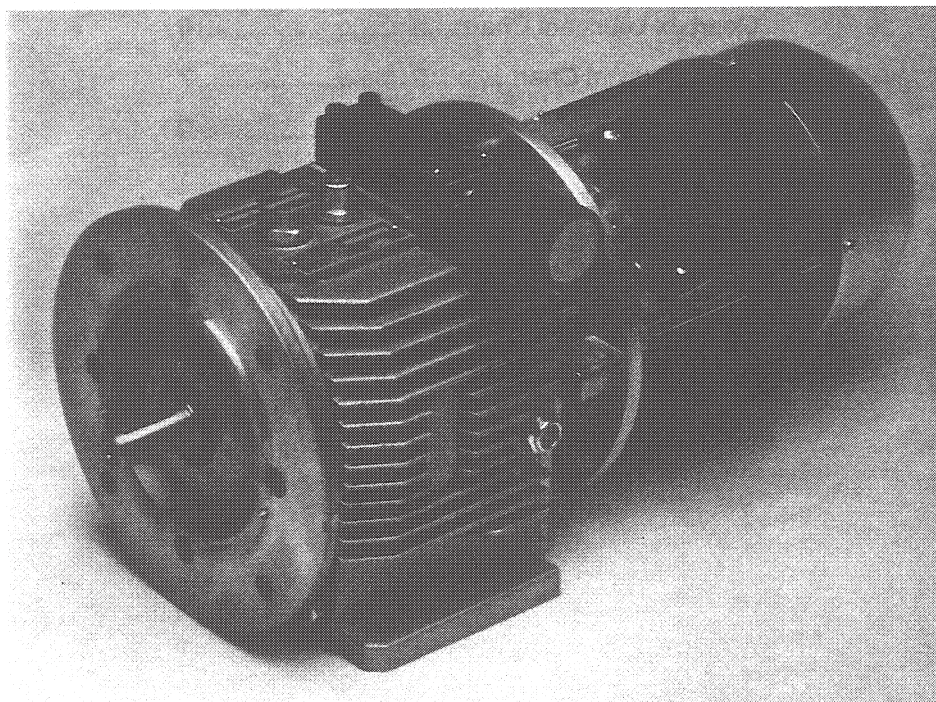


# HSV-A Hydrostatic Speed Variator

Service Manual

Form 1098



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## Introduction

The Hydrostatic Speed Variator (HSV) is an integrated hydrostatic transmission which is designed to vary the speed of fixed speed industrial base motors. Its ability to do this is a result of a variable displacement hydraulic piston pump and a fixed displacement hydraulic piston motor. Both hydraulic pump and motor are contained and coupled inside of the HSV case. Variation of the pump flow rate results in variation of the motor RPM.

## Safety Notice

Proper installation and maintenance is important to the safe, reliable operation of all HSV's. The maintenance procedures recommended and described in this manual are effective methods of installing and servicing your HSV and should be followed closely.

## Unpacking

Before leaving the factory every HSV drive system is fully tested, checked for damage and properly packaged. If your unit is damaged or is short any items file a claim with the carrier for any damages and notify TB Wood's Incorporated of the damage or any shortages.

## Product Identification

After unpacking the HSV take a moment to note the information on the tags provided. Verify the part number on the "Name Plate" tag with the part number on your order. The tag is located on the top of the HSV. Please take a moment to record the serial and part numbers in the space provided below.

**Serial #** \_\_\_\_\_ **Part No.** \_\_\_\_\_ - \_\_\_\_\_

# Mounting Positions of the HSV

The standard mounting position of the HSV is horizontal (B3) and your HSV will be equipped that way unless ordered differently. If you decide to change the position yourself, then determine from figure 1 which mounting configuration you want. For configurations B3 and V5 no change is necessary. For all other positions follow the instructions and diagrams that follow.

## Horizontal - Position B

The HSV is capable of being installed with the shafts inclined up to 30° from the horizontal by increasing the oil level slightly. See chart on page 7 for required oil levels.

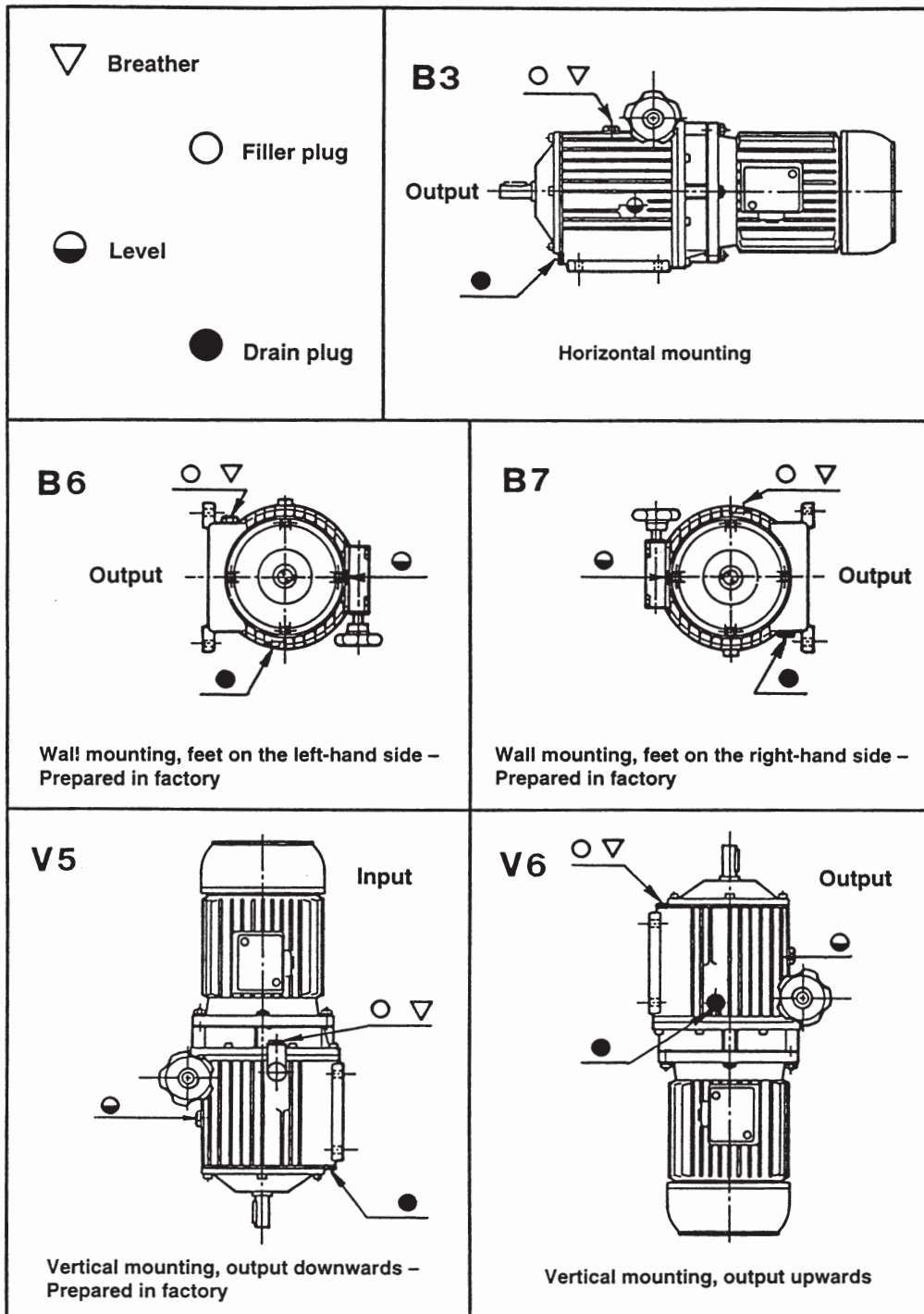
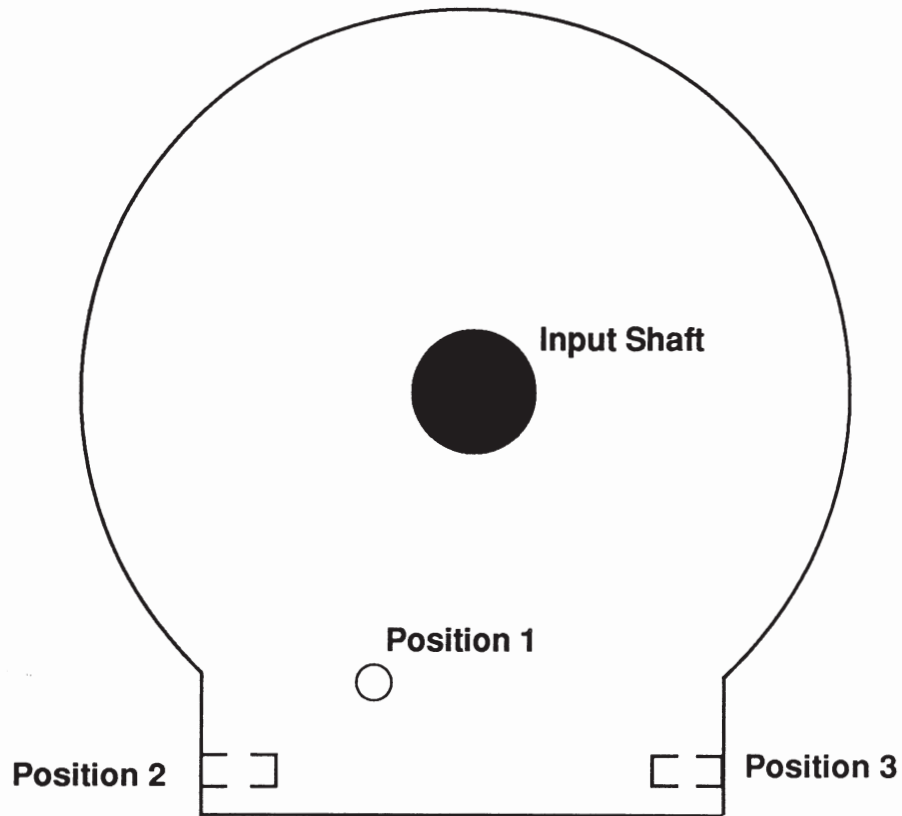


Figure 1

# Oil Control Set Screw Location



Mounting	Set Screw Positions		
	Short Set Screw	Long Set Screw	Undercut Set Screw
B3 or V5	1	3	2
B3, B6 or V6	2	3	1
B3, B7, or V6	3	2	1

Figure 2



1. Remove the motor, motor mounting flange and set unit vertically.
2. Remove all three set screws while taking note of the reference number describing each set screw as shown in figure 2.
3. Remove old loctite from the threads, apply new loctite 242 to the threads and reinstall the set screws while referencing figures 2.

## HSV Installation Procedures

**Caution:** Rotating equipment is potentially dangerous and should be properly shielded. The user should check for all applicable safety codes in their area and provide a suitable guard.

1. Select a support base for the HSV which is adequately sized and solid enough to prevent vibration and breakage. The support surface should be flat within .004 inches. Mounting position should be located so that good air movement is capable around HSV, motor and gearbox; drain plug is easily accessible and the sight glass is visible.
2. Mount HSV to support base and level. If reducer is supplied with the HSV, be sure to solidly mount the reducer and the HSV to the support base and level the combination.
3. Before installing any couplings, sprockets, sheaves, etc., be sure to reference the shaft load capability table. At this time connect the coupling, sprocket, sheave, etc. to the output shaft. Follow all manufacturers recommendations for alignment and any other concerns. Do not hammer any parts onto the HSV shaft; this will damage the bearings. Instead, we recommend heating the part to 150 to 200 degrees Fahrenheit before installing onto the shaft.

## Shaft Load Table

Verify max permissible, radial and/or axial loads allowed on the output shaft of variator and motor-variator.

### RADIAL LOADS

The loads can be calculated with the following formula:

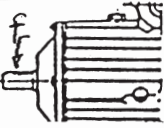
$$\frac{Fr = 24 \times Mt \times K}{d}$$

Fr = radial load lb  
Mt = torque on shaft in lb-ft  
D = diameter of chain wheel, etc. in inches

Select K from table below:

1	Chain wheel
1.25	Gear
1.5	Vee-Belt Sheave
2.5	Flat Belt Pulley

The calculated values must be equal or lower than the data given in the tables and are considered for loads applied in the middle of the shaft extension.

Size	A2	A4	A8
	Variator or motor variator: permissible radial loads on output shaft		
	85	112	180

Note: Axial load not to exceed 1/5 of Fr

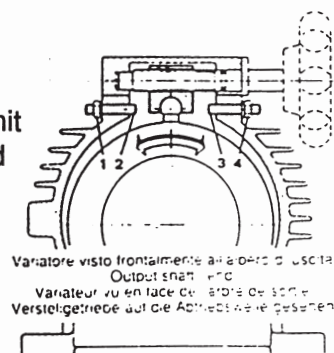
4. Connect motor to HSV input if not already attached and supply with 440 volts. 220 volts will result in the derating of the HSV by 30%. When wiring the motor, be sure to follow manufacturers recommended instructions and all applicable wiring codes. Also, be sure that the motor is wired to give the proper direction of clockwise rotation when looking at the input shaft.

# HSV Start-up Procedures

1. Before starting the HSV, check the oil level at the sight port and make sure that the control is set for very low output RPM. To set the HSV for a low RPM it needs to be set near the center of travel.

For a handwheel (code 00) and the motor control (code 20) simply turn the control shaft and count the number of turns between minimum and maximum; then set halfway between them. For the lever control (code 3) set the lever half way through the arc.

2. Remove red plug from top of HSV and install the provided breather with HSV.
3. Start the motor and verify that the input rotation is clockwise when viewing the input shaft from the input end.
4. Set the control at a low output RPM and let the HSV run under no load for 3 to 4 hours. This helps break in the HSV. Please note that if the HSV sits idle for more than 1 month, always follow this procedure before putting HSV under load.
5. If the HSV is installed in a cold environment, the unit should be allowed 15 to 20 minutes after every start up to warm the oil before applying load.
6. The HSV has been provided with set screws which are stops used for presetting any two output speeds. Once the presets are tightened then the useful range of the HSV only exists between the two presets. To limit or to exclude the adjustment in the clockwise rotation: turn nut 1 out and turn screw 2 in till it reaches the adjusting mechanism. To limit or to exclude the adjustment in the anticlockwise rotation: turn nut 4 out and turn screw 3 in till it reaches the adjusting mechanism. Conclude the operation by blocking nut 1 or 4.
7. At full load the HSV operating temperature will be approximately 110 degrees Farenheit above the ambient temperature.
8. Also note that motor amp draw for a machine at full load rating should run within the safety factor rating of the motor. This is only true for a factory supplied motor. If a factory supplied motor is not running within the safety factor rating then consult the "Troubleshooting" section. When the HSV is new, one can expect the motor to draw 5 - 10% more amperage than after the HSV has passed through the break-in period.



# HSV Maintenance Procedures

Note: The warranty will be voided if the following maintenance procedures are not followed.

1. Consult the "Oil Specifications Chart" to find the proper oil type and quantity for the HSV. The factory fill is Mobile SHC626 or Mobile SHC629
2. Change the oil after the first 200 hours of operation and every 2000 hours of operation after that.
3. Clean magnetic filter that is attached to the drain plug at each oil change.
4. To ensure adequate cooling, clean fins of HSV and insure that the motor fan air passages are clear.
5. Wood's helical speed reducers are filled with fluid grease lubricant at the factory. Initial fill will last 10,000 operating hours at temperatures ranging between 10 and 120 degrees Fahrenheit.
6. Before refilling the gear reducer be sure to clean the case thoroughly.
7. Consult Lubricant charts for recommended oils, the necessary volumes to fill the HSV and gearbox properly and which oils can extend the duration of time between oil changes.

**Please save this manual for future reference.**

**If you wish to rebuild the HSV in the future please contact the factory for instructions.**

# Gearbox Lubricant Charts

## Amount of Lubricant Required (Quarts)

Mtg. Pos.	Reducer Size							
	DC02	DC11	DC12	DC23	DC33	DC43	DC53	DC63
<b>B3</b>	0.3	0.3	0.3	1.2	2.1	3.0	4.9	8.0
<b>B6</b>	0.7	0.5	0.8	2.2	3.2	4.1	6.9	16.0
<b>B7</b>	0.7	0.5	0.8	2.2	3.2	4.1	6.9	13.0
<b>V5</b>	0.8	0.6	1.1	3.7	5.7	7.6	10.0	20.0
<b>V6</b>	0.9	0.5	1.2	3.6	4.9	7.0	9.9	20.0

## Recommended Lubricants

Type of Lubricant	Ambient Temp. Range (°F)	kin Viscosity (cSt) at 40°C (mm 2/S)	Viscosity SUS 175 100°F	AGMA Lubricant No.	ISO Grade	AMOCO	CHEVRON	EXXON	MOBIL	SHELL	TEXACO
Oil	15 to 125	198 to 242	900 to 1100	5EP	220EP	Amogear EP220	NL Gear Compound 220	Spartan EP220	Mobil Gear 630	Omala Oil 220	Meropa 220
	-10 to +75°	90 to 765	465 to 165	3-4EP	100-150EP	Amogear EP150	NL Gear Compound 150	Spartan EP150	Mobil 629	Omala Oil 100	Meropa 150
	Below 10††	15 to 680	....	135 to 165	....	....	EP Hydraulic ....	Univis Oil 22	Mobil D.T.E. J13	....	Texamatic Fluid 9226 or Texamatic Type F
Oil - Synthetic	-40° to 175††	....	90 to 4000	....	....	....	....	....	Mobil SHC 629 or 634	....	Synstar GL75W-140
Fluid Grease	5° to 120°	....	....	....	....	....	....	....	....	....	Markfak 00

For bearings not lubricated in oil bath use a lithium base bearing grease, NLGI #2 or #3.

† Ambient temperatures below -20°F and above 140°F require special oil seals.

†† Consult with the factory for these applications.

Bold ambient temperature indicates factory filled.



# HSV Lubricant Chart

## Standard Oils

Variator Size	Ambient Temperature	Gulf Oil	Amoco Oil	Shell Oil	Mobil
					Anti-Wear Hydraulic Oils
A2	5°-35°F <sup>(1)</sup>	Harmony 68 AW	Rykon 68	Tellus 68	DTE 16
A4	35°-86°F	Harmony 100 AW	Rykon 100	Tellus 100	DTE 18 or DTE Oil Heavy
A8	86°-104°F <sup>(2)</sup>	Harmony 150 AW	Amovis 150	Turbo 150	DTE 18 or DTE Oil Heavy

## Synthetic Oils & Food Grade

Variator Size	Ambient Temperature	Lubriplate Hydraulic Oils	Extended Drain Synthetic Oils <sup>(3)</sup>		USDA Food Grade Lubricants
			Mobile	Lubriplate	
A2	5°-35°F	HO-68 or HO-2	SHC 626	SPO-233	
A4	35°-86°F	HO-2A	SHC 629	SPO-244	Contact Factory
A8	86°-104°F	HO-3	SHC 629	SPO-244	

(1) Electric oil preheater (Code P) recommended for temperatures below 5°F.

(2) Oil cooler (Code R) highly recommended for temperatures above 104°F.

(3) Synthetic oils provide extended operating temperature ranges and lubricant life. Drain intervals may be extended up to 8,000 hours. Contact factory for more information.

## Amount of Lubricant Regulated

Mounting Position	HSV Size	A2	A4	A8
Horizontal	Quarts	0.60	0.85	1.05
	Liters	0.60	0.80	1.00
Vertical	Quarts	0.80	0.85	1.05
	Liters	0.80	0.50	1.05
Inclined 30°	Quarts	0.95	1.05	1.50
	Liters	0.95	1.00	1.40

The quantity of oil required by the variator changes according to the mounting position of the variator.

# HSV Troubleshooting

Problem	Cause	Remedy
<b>A. Will not hold speed or maintain torque.</b>	1. Operating temperature.	Refer to oil servicing chart.
	2. Variator leaking internally due to wear.	Variator must be rebuilt.
	3. Output RPM range too low.	If the actual maximum output speed is less than what the HSV is rated for, change the gearbox ratio so the HSV's output speed matches its rating.
	4. Charge pump pressure is too low.	Check set screw positions.
	5. Input speed too low.	Change motor to increase input RPM.
<b>B. Output shaft speed not constant.</b>	1. Periodic shock load too high causing relief valves to open.	Replace HSV with next larger HSV.
	2. Oil viscosity (grade) too low.	Refer to oil servicing chart.
	3. Variator size too small for application.	Replace with larger HSV.
<b>C. Operating temperature more than 210°F.</b>	1. Type of oil unsuitable.	Refer to oil servicing chart.
	2. Variator leaking internally due to wear.	Variator must be rebuilt.HSV's
	3. Excessive internal friction.	Variator must be rebuilt.
	4. Overloading.	Check load. If possible check motor amp draw.
	5. Ambient higher than 105°F.	Provide forced air, circulation.
<b>D. Excessive noise.</b>	1. Overloading.	Check load. If possible, check motor amp draw.
	2. Cavitation - Charge pump pressure too low.	Check set screw positions.
	3. Incorrect installation, base unsuitable.	Replace with sturdier base or install dampers.
	4. Ball bearings damaged.	Replace ball bearings
	5. Motor damaged.	Replace motor.

## HSV Troubleshooting (Continued)

Problem	Cause	Remedy
<b>E. Output shaft moves slowly.</b>	1. Oil level low.	Add oil.
	2. Motor turning wrong direction.	Reverse motor.
	3. Charge pump pressure too low.	Check set screw position.
	4. Output RPM range too low.	If the actual maximum output speed is less than what the HSV is rated for, change the gearbox ratio so the HSV's output speed matches its rating.
<b>F. Oil foaming excessively.</b>	1. Oil unsuitable	Refer to oil servicing charts.
	2. Oil level low.	Check oil level.
	3. Air drawn into pump.	O-ring between charge pump end cover and base is damaged.
<b>G. Variator input or output shaft seized.</b>	1. Variator pump or motor seized.	Pump or motor rotating groups must be replaced.
	2. Too much bearing friction.	Check ball bearings and replace if necessary.
<b>H. Variator difficult to start.</b>	1. Oil unsuitable.	Refer to oil servicing chart.
	2. Variator too small for application.	Replace with larger HSV.
	3. Motor voltage too low.	Check wiring and line voltage to motor.
	4. Output RPM range too low.	If the actual maximum output speed is less than what the HSV is rated for, change the gearbox ratio so the HSV's output speed matches its rating.

All Customer Service phone numbers shown in bold

## Electromagnetic Clutches and Brakes

### Warner Electric

*Electromagnetic Clutches and Brakes*

New Hartford, CT - USA  
1-800-825-6544

*For application assistance:*  
1-800-825-9050

St Barthelemy d'Anjou, France  
+33 (0) 2 41 21 24 24

*Precision Electric Coils and Electromagnetic Clutches and Brakes*

Columbia City, IN - USA  
1-260-244-6183

### Matrix International

*Electromagnetic Clutches and Brakes, Pressure Operated Clutches and Brakes*

Brechin, Scotland  
+44 (0) 1356 602000

New Hartford, CT - USA  
1-800-825-6544

### Inertia Dynamics

*Spring Set Brakes; Power On and Wrap Spring Clutch/Brakes*

New Hartford, CT - USA  
1-800-800-6445

## Linear Products

### Warner Linear

*Linear Actuators*  
Belvidere, IL - USA  
1-800-825-6544

*For application assistance:*  
1-800-825-9050

St Barthelemy d'Anjou, France  
+33 (0) 2 41 21 24 24

## Couplings

### Ameridrives Couplings

*Mill Spindles, Ameriflex, Amerisc*

Erie, PA - USA  
1-814-480-5000

*Gear Couplings*

San Marcos, TX - USA  
1-800-458-0887

### Bibby Turboflex

*Disc, Gear, Grid Couplings, Overload Clutches*

Dewsbury, England  
+44 (0) 1924 460801

Boksburg, South Africa  
+27 11 918 4270

### TB Wood's

*Elastomeric Couplings*

Chambersburg, PA - USA  
1-888-829-6637 – Press #5

*For application assistance:*  
1-888-829-6637 – Press #7

*General Purpose Disc Couplings*

San Marcos, TX - USA  
1-888-449-9439

### Ameridrives Power Transmission

*Universal Joints, Drive Shafts, Mill Gear Couplings*

Green Bay, WI - USA  
1-920-593-2444

### Huco Dynatork

*Precision Couplings and Air Motors*

Hertford, England  
+44 (0) 1992 501900

Chambersburg, PA - USA  
1-800-829-6637

### Lamiflex Couplings

*Flexible Couplings, Bearing Isolators, and Coupling Guards*

São Paulo, SP - Brasil  
(11) 5679-6533

## Heavy Duty Clutches and Brakes

### Wichita Clutch

*Pneumatic Clutches and Brakes*

Wichita Falls, TX - USA  
1-800-964-3262

Bedford, England  
+44 (0) 1234 350311

### Twiflex Limited

*Caliper Brakes and Thrusters*

Twickenham, England  
+44 (0) 20 8894 1161

### Industrial Clutch

*Pneumatic and Oil Immersed Clutches and Brakes*

Waukesha, WI - USA  
1-262-547-3357

## Gearing

### Boston Gear

*Enclosed and Open Gearing, Electrical and Mechanical P.T. Components*

Charlotte, NC - USA  
1-800-825-6544

*For application assistance:*  
1-800-816-5608

### Bauer Gear Motor

*Geared Motors*

Esslingen, Germany  
+49 (711) 3518 0

Somerset, NJ - USA  
1-732-469-8770

### Nuttall Gear and Delroyd Worm Gear

*Worm Gear and Helical Speed Reducers*

Niagara Falls, NY - USA  
1-716-298-4100

## Overrunning Clutches

### Formsprag Clutch

*Overrunning Clutches and Holdbacks*

Warren, MI - USA  
1-800-348-0881 – Press #1

*For application assistance:*  
1-800-348-0881 – Press #2

### Marland Clutch

*Roller Ramp and Sprag Type Overrunning Clutches and Backstops*

South Beloit, IL - USA  
1-800-216-3515

### Stieber Clutch

*Overrunning Clutches and Holdbacks*

Heidelberg, Germany  
+49 (0) 6221 30 47 0

## Belted Drives and Sheaves

### TB Wood's

*Belted Drives*

Chambersburg, PA - USA  
1-888-829-6637 – Press #5

*For application assistance:*  
1-888-829-6637 – Press #7

## Engineered Bearing Assemblies

### Kilian Manufacturing

*Engineered Bearing Assemblies*

Syracuse, NY - USA  
1-315-432-0700

For information concerning our sales offices in Asia Pacific check our website  
[www.altramotion.com.cn](http://www.altramotion.com.cn)



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