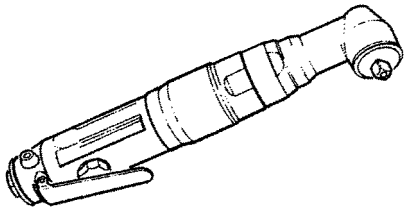
03535572

Form P6846
Edition 3
February, 1994

OPERATION AND MAINTENANCE MANUAL
for
SERIES 6WT AUTOMATIC SHUTOFF TORQUE TRANSDUCER ANGLE WRENCHES



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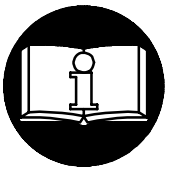


⚠ WARNING

IMPORTANT SAFETY INFORMATION ENCLOSED.
READ THIS MANUAL BEFORE OPERATING TOOL.

FAILURE TO OBSERVE THE FOLLOWING WARNINGS COULD RESULT IN INJURY.

- Always operate, inspect and maintain this tool in accordance with American National Standards Institute Safety Code for Portable Air Tools (ANSI B186.1).
- For safety, top performance, and maximum durability of parts, operate this tool at 90 psig (6.2 bar/620 kPa) maximum air pressure at the inlet with 3/8" (10 mm) inside diameter air supply hose.
- Air powered tools can vibrate in use. Vibration, repetitive motions or uncomfortable positions may be harmful to your hands and arms. Stop using any tool if discomfort, tingling feeling or pain occurs. Seek medical advice before resuming use.
- Always turn off the air supply and disconnect the air supply hose before installing, removing or adjusting any accessory on this tool, or before performing any maintenance on this tool.
- Keep hands, loose clothing and long hair away from rotating end of tool.
- Anticipate and be alert for sudden changes in motion during start up and operation of any power tool.
- Tool accessory may continue to rotate briefly after throttle is released.
- Do not lubricate tools with flammable or volatile liquids such as kerosene, diesel or jet fuel.
- Do not remove any labels. Replace any damaged label.
- Use accessories recommended by Ingersoll-Rand.
- Use only impact sockets and accessories. Do not use hand (chrome) sockets or accessories.

NOTICE

The use of other than genuine Ingersoll-Rand replacement parts may result in safety hazards, decreased tool performance and increased maintenance, and may invalidate all warranties.

Ingersoll-Rand is not responsible for customer modification of tools for applications on which Ingersoll-Rand was not consulted.

Repairs should be made only by authorized, trained personnel. Consult your nearest Ingersoll-Rand Authorized Servicenter.

It is the responsibility of the employer to place the information in this manual into the hands of the operator.

Refer All Communications to the Nearest Ingersoll-Rand Office or Distributor.

Printed in U.S.A.

INGERSOLL-RAND®
PROFESSIONAL TOOLS

WARNING LABEL IDENTIFICATION

⚠ WARNING

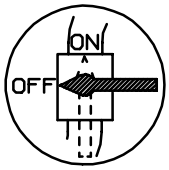
FAILURE TO OBSERVE THE FOLLOWING WARNINGS COULD RESULT IN INJURY.

⚠ WARNING

Always wear eye protection when operating or performing maintenance on this tool.

⚠ WARNING

Always wear hearing protection when operating this tool.



⚠ WARNING

Always turn off the air supply and disconnect the air supply hose before installing, removing or adjusting any accessory on this tool, or before performing any maintenance on this tool.

⚠ WARNING

Air powered tools can vibrate in use. Vibration, repetitive motions or uncomfortable positions may be harmful to your hands and arms. Stop using any tool if discomfort, tingling feeling or pain occurs. Seek medical advice before resuming use.

⚠ WARNING

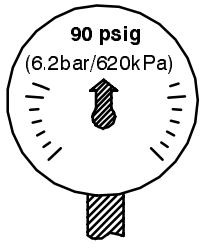
Do not carry the tool by the hose.

⚠ WARNING

Do not use damaged, frayed or deteriorated air hoses and fittings.

⚠ WARNING

Keep body stance balanced and firm. Do not overreach when operating this tool.



⚠ WARNING

Operate at 90 psig (6.2 bar/620 kPa) Maximum air pressure.

PLACING TOOL IN SERVICE

LUBRICATION

Ingersoll-Rand No. 10 **Ingersoll-Rand No. 67**

Always use an air line lubricator with this tool.
We recommend the following Filter–Lubricator–Regulator Unit:

For USA - No. C11-03-G00
For International - No. C16-C3-A29

Before starting the tool and after two hours of operation, unless the air line lubricator is used, detach the air hose and inject about 2 cc of Ingersoll-Rand No. 10 Oil into the air inlet.

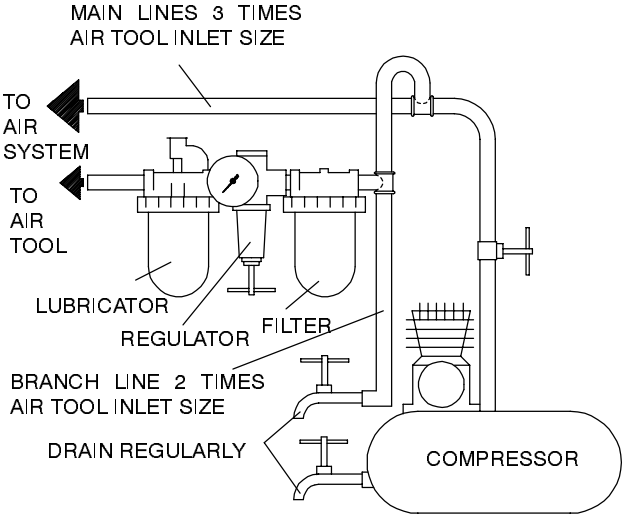
After each forty-eight hours of operation, or as experience indicates, inject 6 to 8 cc of Ingersoll-Rand No. 67 Grease into the Grease Fitting.

INSTALLATION

Air Supply and Connections

Always use clean dry air. Dust, corrosive fumes and/or excessive moisture can ruin the motor of an air tool. An air line filter can greatly increase the life of an air tool. The filter removes dust and moisture.

Low pressure (under 90 psig; 6.2 bar/620 kPa) reduces the speed of all air tools. Low air pressure not only wastes time, but also costs money. High air pressure (over 90 psig; 6.2 bar/620 kPa) raises performance beyond the rated capacity of the tool and could cause injury. Be sure all hoses and fittings are the correct size and are tightly secured.
See Dwg. TPD905-1 for a typical piping arrangement.



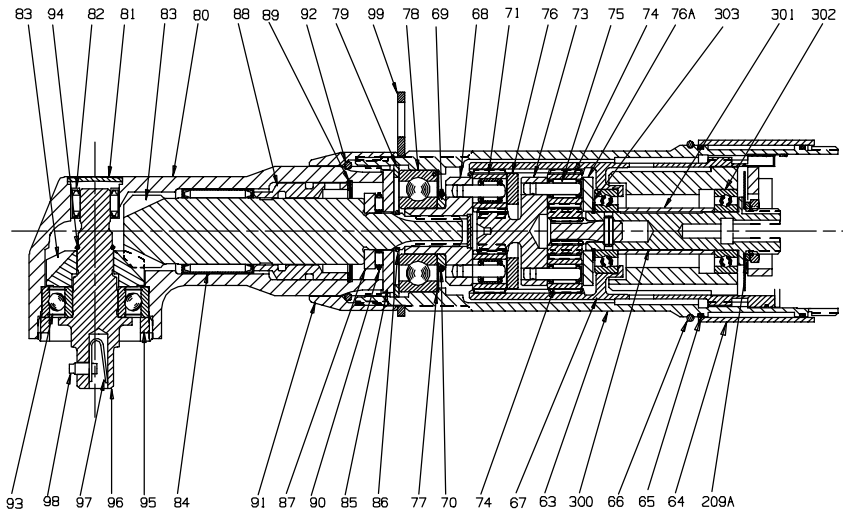
(Dwg. TPD905-1)

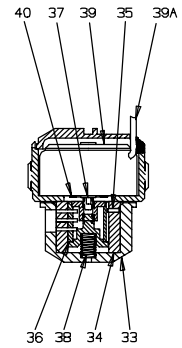
Series 6WT Automatic Shutoff Torque Transducer Angle Wrenches are designed for running small threaded fasteners in applications requiring precise torque repeatability.

HOW TO ORDER AN ANGLE WRENCH*

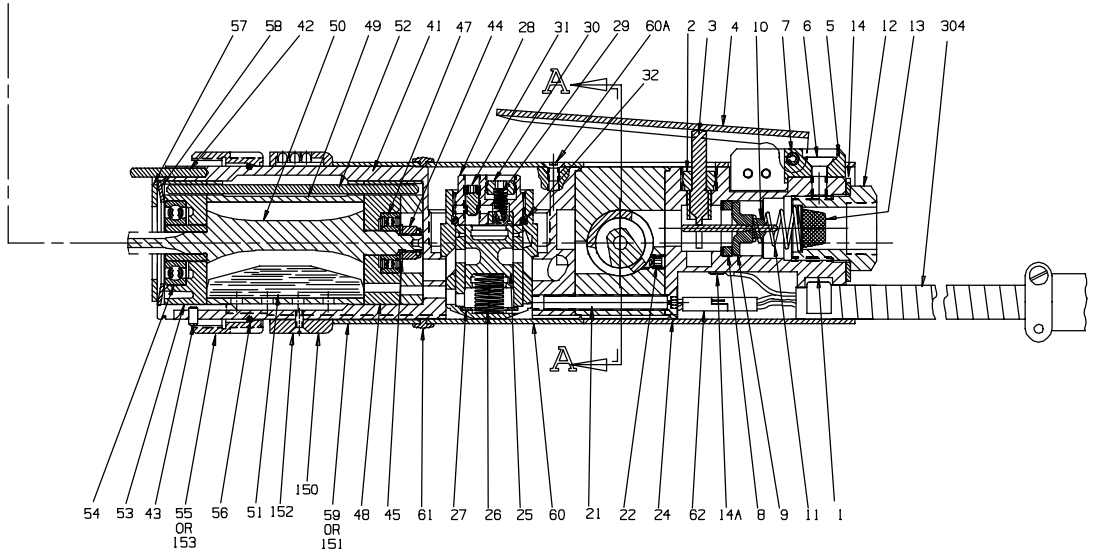
Model	Torque Range (Soft Draw) 50 psi Pressure in-lb	50 psi Pressure Nm	90 psi Pressure in-lb	90 psi Pressure Nm	Free Speed, rpm	Drive Type
REVERSIBLE AUTOMATIC SHUTOFF TORQUE TRANSDUCER ANGLE WRENCH						
6WRTM3TT	4.8	6.5	8.5	11.5	725	3/8
6WRTN3TT	5.7	7.7	10.2	13.8	625	3/8
6WRTP3TT	7.2	9.7	12.9	17.4	450	3/8
6WRTQ3TT	9.5	12.8	16.9	22.8	350	3/8
6WRTR3TT	12.0	16.2	21.4	26.9	300	3/8
NONREVERSIBLE AUTOMATIC SHUTOFF TORQUE TRANSDUCER ANGLE WRENCH						
6WTM3TT	4.9	6.6	8.8	11.9	875	3/8
6WTN3TT	5.9	8.0	10.5	14.2	750	3/8
6WTP3TT	7.8	10.5	13.9	18.8	575	3/8
6WTQ3TT	10.1	13.6	18.1	24.4	450	3/8
6WTR3TT	12.9	17.4	23.0	31.1	350	3/8

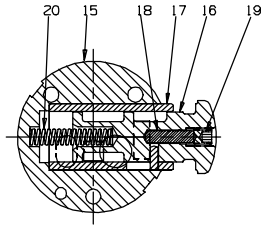
* Add "**ME**" for Magnetic Encoder and/or "**S**" for Electronic Shutoff.

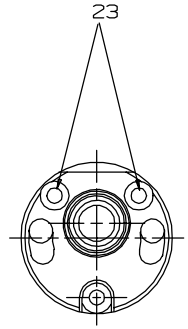




6WT ELECTRIC SHUTOFF VALVE







SEC. A--A

(Dwg. TPA1362–1)

PART NUMBER FOR ORDERING

		Ratio					
		M	N	P	Q	R	
	Throttle Housing Assembly	X	X	X	X	X	400–35–A23
1	Throttle Housing	X	X	X	X	X	400–35–23
2	Throttle Plunger Bushing	X	X	X	X	X	400–35–26
3	Throttle Plunger	X	X	X	X	X	400–35–27
4	Throttle Lever	X	X	X	X	X	7L–273
5	Throttle Lever Block	x	X	X	X	X	400–35–25
6	Lever Block Screw	X	X	X	x	X	400–35–54
7	Throttle Lever Pin	X	X	X	X	X	7L–120
8	Throttle Valve Seat Support	X	X	X	X	X	7RAK–304
9	Throttle Valve Seat	X	X	X	X	X	7RAK–303
10	Throttle Valve	X	X	X	X	X	7RAK–302
11	Throttle Valve Spring	X	X	X	X	X	7L–51
12	Inlet Bushing	X	X	X	X	X	7L–565
13	Inlet Screen	X	X	X	X	X	R0A2–61
14	Rear Exhaust Deflector	X	X	X	X	X	400–35–28
14A	Ground Screw	X	X	X	X	X	400–25–74–7
15	Reverse Valve Housing Assembly (for reversible models only)	X	X	X	X	X	400–35–A24
16	Reverse Valve	X	X	X	X	X	6WRT–329
17	Reverse Valve Lock Pin	X	X	X	X	X	SPA102R–668
18	Lock Pin Retainer	X	X	X	X	X	7RL–56
19	Retainer Setscrew	X	X	X	X	X	7RL–669
20	Reverse Valve Spring	X	X	X	X	X	55RP–515
21	Bushing Setscrew	X	X	X	X	X	R38M–532
22	Throttle Housing Screw						
	for reversible models	X	X	X	X	X	400–35–56
	for nonreversible models	X	X	X	X	X	400–35–83
23	Throttle Housing Cap Screw (2)						
	for reversible models	X	X	X	X	X	400–35–68
	for nonreversible models	X	X	X	X	X	400–35–69

PART NUMBER FOR ORDERING

			Ratio					
			M	N	P	Q	R	
	24	Throttle Housing Sleeve						
		for reversible models	X	X	X	X	X	400-35-31
		for nonreversible models	X	X	X	X	X	400-35-31-1
+	25	Shutoff Valve	X	X	X	X	X	6WT-172
+	26	Shutoff Valve Spring	X	X	X	X	X	6WT-171
+	27	Shutoff Valve Stop	X	X	X	X	X	400-35-66
+		Regulator Body Assembly	X	X	X	X	X	6WT-A173
	28	Regulator Body	X	X	X	X	X	6WT-173
	29	Regulator Spring	X	X	X	X	X	6WT-180
	30	Regulator Adjustment Screw	X	X	X	X	X	6WT-174
		Pressure Port Plug	X	X	X	X	X	5081T-266
	31	Bleed Adjustment Screw	X	X	X	X	X	6WT-175A
+	32	Regulator Body Seal	X	X	X	X	X	182A53-610
#	33	Electric Valve Bushing	X	X	X	X	X	400-35-55
#	34	Valve Body Assembly	X	X	X	X	X	400-35-A85
#	35	Electric Shutoff Valve Pin	X	X	X	X	X	400-35-75
#	36	Electric Shutoff Valve Assembly	X	X	X	X	X	400-35-A81
#	37	Electric Shutoff Valve Adjustment Screw	X	X	X	X	X	400-35-74
#	38	Solenoid Spring	X	X	X	X	X	400-35-73
#	39	Solenoid Assembly	X	X	X	X	X	400-35-A72
#	39A	Solenoid Cable Assembly	X	X	X	X	X	400-35-70-2
#	40	Valve Adjusting Shim Packet	X	X	X	X	X	400-35-95-4
	41	Motor Housing Assembly	X	X	X	X	X	400-35-A18
	*	Warning Label	X	X	X	X	X	WARNING-7-99
	42	Motor Housing Alignment Pin (2)	X	X	X	X	X	3RL-302
	43	Housing Orientation Pin	X	X	X	X	X	400-35-53
	44	Rear Rotor Bearing Retaining Nut	X	X	X	X	X	6WT-118
	45	Rear Rotor Bearing Washer	X	X	X	X	X	6WT-117
	46	Rear End Plate Gasket	X	X	X	X	X	6WRT-739
	47	Rear Rotor Bearing	X	X	X	X	X	DG20-22

* Not illustrated.

\+ This part used in tools that have model numbers ending with the letters “TT”.

\# This part used in tools that have model numbers ending with the letters “TTS” or “TTMES”.

PART NUMBER FOR ORDERING

		Ratio					
		M	N	P	Q	R	
48	Rear End Plate						
	for reversible models	X	X	X	X	X	6WRT-12
	for nonreversible models	X	X	X	X	X	6WT-12
49	Cylinder						
	for reversible models	X	X	X	X	X	6WRT-3
	for nonreversible models	X	X	X	X	X	6WT-3
50	Rotor	X	X	X	X	X	6WTL-53
51	Vane Packet (set of 5 Vanes)	X	X	X	X	X	6WT-42-5
52	Cylinder Dowel	X	X	X	X	X	6WT-98
53	Front End Plate	X	X	X	X	X	6WT-11
54	Front Rotor Bearing	X	X	X	X	X	R00H-97
55	Coupling Nut	X	X	X	X	X	400-35-6
56	Housing Coupling Ring	X	X	X	X	X	400-35-37
57	Transducer Housing Spacer	X	X	X	X	X	400-35-21
58	Motor Clamp Washer	X	X	X	X	X	M004-207
*	Housing Connector Retainer	X	X	X	X	X	400-35-38
59	Housing Sleeve	X	X	X	X	X	400-35-29
60	Housing Sleeve (pair)	X	X	X	X	X	400-35-30
60A	Housing Sleeve Screw (4)	X	X	X	X	X	400-35-65
61	Housing Sleeve Ring	X	X	X	X	X	400-35-67
62	Transducer Cable Assembly	X	X	X	X	X	400-35-70
*	Connecting Retainer (Transducer)	X	X	X	X	X	400-35-38
*	Connecting Retainer (Housing)	X	X	X	X	X	400-35-63
63	Ring Gear Housing Assembly	X	X	X	X	X	400-35-A2
64	Deflector	X	X	X	X	X	400-35-7
65	Deflector Seal (2)	X	X	X	X	X	AG20-103
66	Deflector Retaining Ring	X	X	X	X	X	400-35-79
*	Housing Sleeve Screw	X	X	X	X	X	400-35-65-1
67	Transducer Ring Gear Assembly	X	X	X	X	X	400-35-A1

* Not illustrated.

PART NUMBER FOR ORDERING →

		Ratio					
		M	N	P	Q	R	
	GEARING						
68	Spindle	X	X				400–35–78–2
68	Spindle			X	X	X	400–35–78–1
69	Seal Support	X	X	X	X	X	5RAK–5
70	Seal	X	X	X	X	X	182A53–610
71	Spindle Planet Gear (3)	X	X				6WTN–A10
71	Spindle Planet Gear (3)			X	X	X	6WTP–A10
73	Gear Head	X					6LM–216
73	Gear Head		X				6LN–216
73	Gear Head			X			6LP–216
73	Gear Head				X		6LQ–216A
73	Gear Head					X	6LR–216A
74	Gear Head Planet Gear (3)	X					6WTM–10
74	Gear Head Planet Gear (3)		X	X			6WTN–A10
74	Gear Head Planet Gear (3)				X		6WTP–A10
74	Gear Head Planet Gear (3)					X	6WTK–A10
75	Gear Head Planet Gear Bearing (3) (1 for each gear)	X					6WTM–500
76	Gear Head Spacer	X	X	X	X	X	6LM–80
76A	Gear Spacer	X	X	X	X	X	400–25–201
77	Grease Shield	X	X	X	X	X	5R–701
78	Spindle Bearing	X	X	X	X	X	R1L–24
79	Spindle Bearing Retainer	X	X	X	X	X	7L–28
*	Rotor Pinion						
	for M ratio	X					6WTM–17
	for N ratio		X				6WTN–17
300	Encoder Shaft	X	X	X			400–35–3–M
300	Encoder Shaft				X		400–35–3–Q
300	Encoder Shaft					X	400–35–3–R
301	Encoder Shaft Bushing	X	X	X	X	X	400–35–5
302	Encoder Shaft Bearing	X	X	X	X	X	WFS182–24
*	Encoder Wave Washer	X	X	X	X	X	DG20–278
303	Encoder Shaft Retaining Ring	X	X	X	X	X	400–25–75–1
304	Code Connector Assembly	X	X	X	X	X	400–25

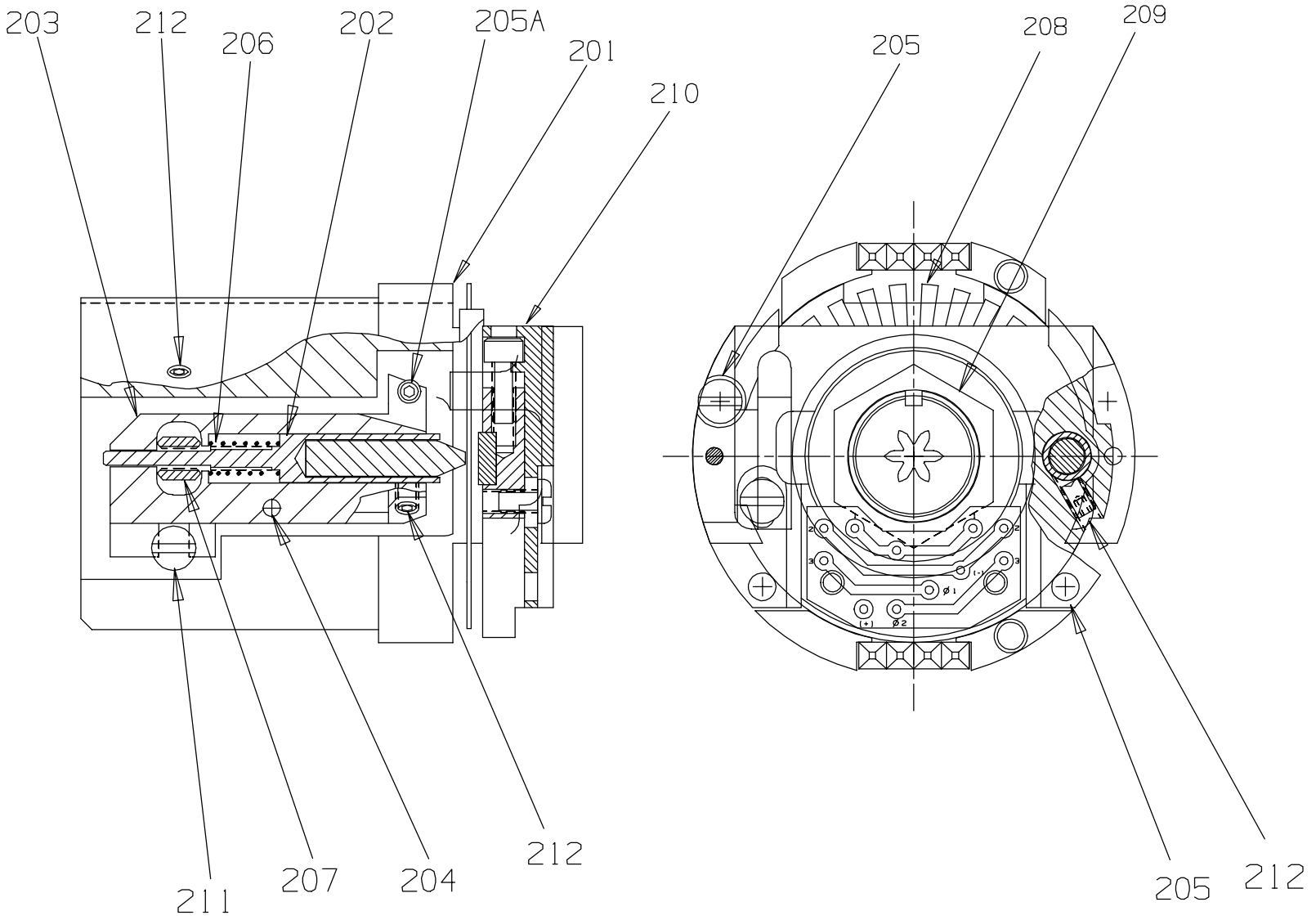
* Not illustrated.

PART NUMBER FOR ORDERING →

		Ratio					
		M	N	P	Q	R	
	ANGLE ATTACHMENT						
	Angle Attachment	X	X	X	X	X	7L3D6
80	Angle Housing Assembly	X	X	X	X	X	7L3A-B550
*	Grease Fitting	X	X	X	X	X	D0F9-879
81	Angle Housing Cap	X	X	X	X	X	8SA32-110
82	Upper Spindle Bearing	X	X	X	X	X	8SA32-608
83	Matched Bevel Gear Set	X	X	X	X	X	7L3A-A552
84	Bevel Pinion Bearing	X	X	X	X	X	182A53-606
85	Rear Thrust Bearing Seat	X	X	X	X	X	7L2A-682
86	Bearing Seat Retainer	X	X	X	X	X	1415A12-6
87	Front Thrust Bearing Seat	X	X	X	X	X	141A12-683
88	Bevel Pinion Bearing Spacer	X	X	X	X	X	182A53-165
89	Bearing Spacer Retainer	X	X	X	X	X	182A53-685
90	Bevel Pinion Thrust Bearing	X	X	X	X	X	161A32-105
91	Coupling Nut	X	X	X	X	X	7L-27
92	Coupling Nut Retainer	X	X	X	X	X	5C1-29
93	Lower Spindle Bearing	X	X	X	X	X	8SA32-593
94	Bevel Gear Retainer	X	X	X	X	X	8SA32-578
95	Spindle Bearing Cap	X	X	X	X	X	8SA32-531
96	Socket Adapter Spindle Assembly	X	X	X	X	X	8SA32-P507-3/8
97	Socket Retaining Spring	X	X	X	X	X	401-718
98	Socket Retaining Pin	X	X	X	X	X	5020-716
99	Horizontal Hanger	X	X	X	X	X	6WS-366

* Not illustrated.

MAGNETIC ENCODER



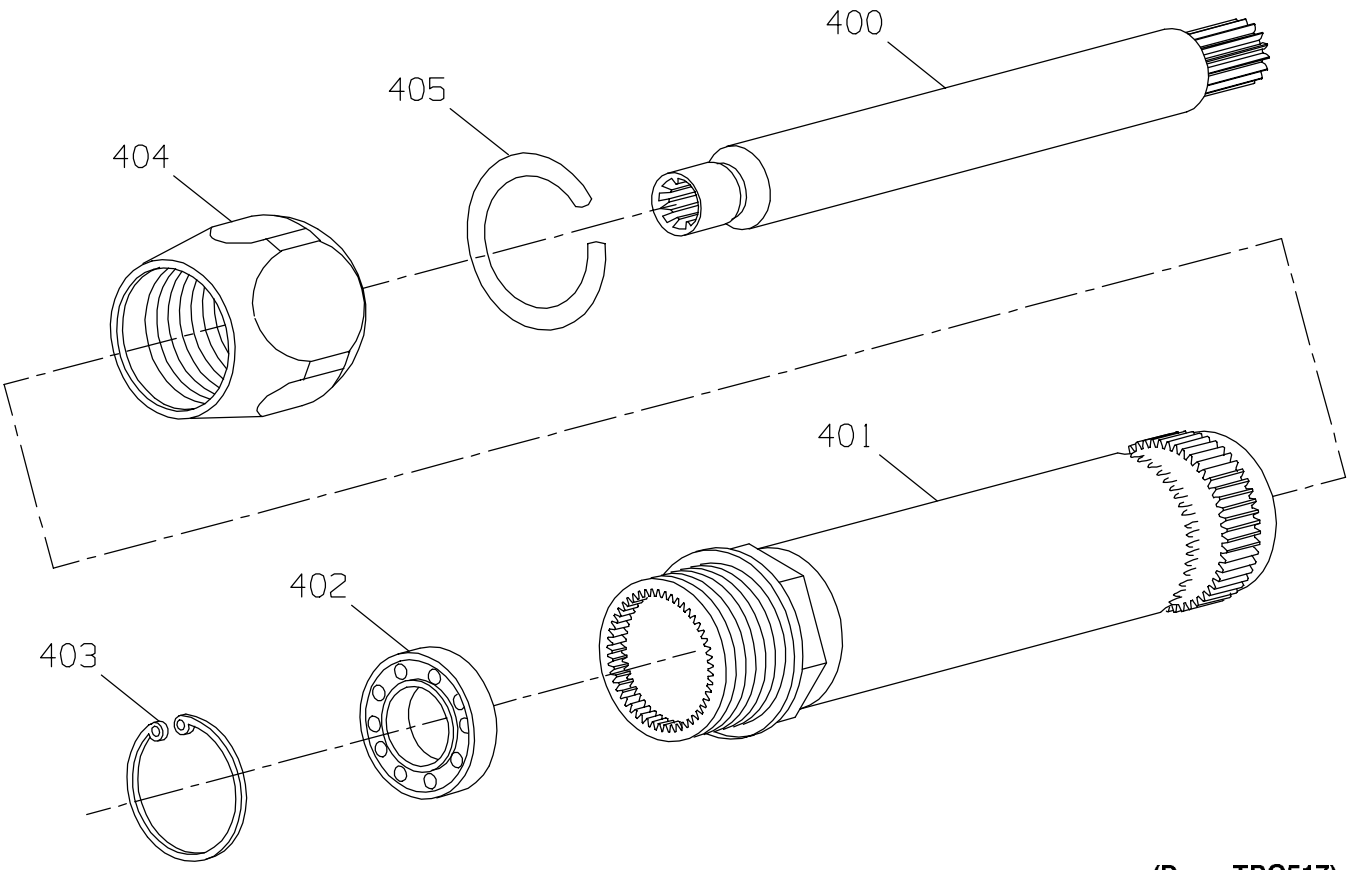
(Dwg. TPD1445)

PART NUMBER FOR ORDERING →

		Ratio					
		M	N	P	Q	R	
	MAGNETIC ENCODER						
201	Encoder Body	X	X	X	X	X	400-35-15
202	Magnet Assembly (2)	X	X	X	X	X	400-35-A82
203	Magnet Adjusting Support	X	X	X	X	X	400-35-62
204	Pivot Pin Adjustment	X	X	X	X	X	R02W-332
205	Setscrew (4)	X	X	X	X	X	400-35-97
205A	Adjusting Lock Screw	X	X	X	X	X	400-35-96
206	Magnet Spring (2)	X	X	X	X	X	400-25-129-5
207	Magnet Adjusting Nut (2)	X	X	X	X	X	400-25-179
208	Encoder Disk	X	X	X	X	X	400-35-35
209	Encoder Disk Nut	X	X	X	X	X	400-25-102-2
209A	Encoder Washer	X	X	X	X	X	400-35-76
*	Shim Packet						
	0.001 (amber)	X	X	X	X	X	400-25-182-1
	0.003 (green)	X	X	X	X	X	400-25-182-2
	0.005 (blue)	X	X	X	X	X	400-25-182-3
	0.010 (brown)	X	X	X	X	X	400-25-182-4
*	Cable Assembly	X	X	X	X	X	400-35-70-1
210	Encoder Pick-Up Assembly	X	X	X	X	X	400-35-A64
211	Encoder Lock Screw	X	X	X	X	X	400-25-74-11
212	Magnet Lock Screw (3)	X	X	X	X	X	400-35-87
*	Grease Gun	X	X	X	X	X	R000A2-228
*	Bearing Cap Wrench	X	X	X	X	X	8SA32-26
*	Bearing Inserting Tool	X	X	X	X	X	7L3A-950
*	Rockwell (LRM) Encoder Amplifier Assembly	X	X	X	X	X	400-25-198
*	Microswitch and Lever Assembly	X	X	X	X	X	400-35-90
*	Lever	X	X	X	X	X	7L-273
*	Lever Pin	X	X	X	X	X	7L-120
*	Lever Block	X	X	X	X	X	400-35-25
*	Switch Screw	X	X	X	X	X	WWA10-150
*	Microswitch	X	X	X	X	X	400-25-136

* Not illustrated.

ANGLE HOUSING EXTENSION ASSEMBLY



(Dwg. TPC517)

PART NUMBER FOR ORDERING

	4" Angle Housing Extension Assembly	6WT–A327–4
400	Extension Arbor	6WT–327–4
401	Arbor Housing	6WT–43–4
402	Arbor Bearing	R1L–24
403	Bearing Retaining Ring	7L–28
404	Coupling Nut	7L–27
405	Coupling Nut Retainer	5C1–29

6TLP LIGHT PACKAGE

ILLUSTRATION NO.	PART NUMBER	DESCRIPTION
150	400-35-A98	Light Ring Assembly ★
151	400-35-107	Housing Sleeve
152	400-35-65	Screw
153	400-35-100	Coupling Nut

★ When ordering the Light Ring Assembly (150), include the **NAME** and **VOLTAGE** of the Control System.

NOTICE

For the 6TLP Light Package on Series 6WT Transducer Angle Wrench, the 400-35-107 Housing Sleeve, item (151), replaces the 400-35-29 Housing Sleeve. Also, 400-35-100 Coupling Nut, item (153), replaces the 400-35-6 Coupling Nut. All other parts are the same. The new 400-35-107 Housing Sleeve and 400-35-100 Coupling Nut are NOT interchangeable with the 400-35-29 Housing Sleeve and 400-35-6 Coupling Nut.

⚠ WARNING

Always wear eye protection when operating or performing maintenance on this tool.

Always turn off air supply and disconnect air supply hose before installing, removing or adjusting any accessory on this tool, or before performing any maintenance on this tool.

LUBRICATION

Each time the Series 6WT Angle Wrench is disassembled for maintenance, repair or replacement of parts, lubricate the tool as follows:

1. Work approximately 1.5 cc of Ingersoll-Rand No. 67 Grease into the Rear Rotor Bearing (47), Front Rotor Bearing (54), and the Spindle Bearing (78).
2. Work 10 to 12 cc of Ingersoll-Rand No. 67 Grease into the gear train. Grease the Planet Gear Bearing (75), the gear teeth inside Transducer Ring Gear (67) and the planet gear shafts on the Spindle (68) and the Gear Head (73).
3. Work 0.5 to 1.0 cc of Ingersoll-Rand No. 67 Grease into the Lower Spindle Bearing (93).
4. Work 0.5 to 1.0 cc of Ingersoll-Rand No. 67 Grease into the Upper Spindle Bearing (82), Bevel Pinion Bearing (84), and the Bevel Pinion Thrust Bearing (90). Apply 6 to 8 cc of Grease to the Matched Bevel Gear Set (83).
5. Inject about 2 cc of Ingersoll-Rand No. 10 Oil into the Inlet Bushing (12) before starting the tool.

DISASSEMBLY

General Instructions

1. Do not disassemble the tool any further than necessary to replace or repair damaged parts.
2. Whenever grasping a tool or part in a vise, always use leather-covered or copper-covered vise jaws to protect the surface of the part and help prevent distortion. This is particularly true of threaded members and housings.
3. Do not remove any part which is a press fit in or on a subassembly unless the removal of that part is necessary for repairs or replacement.
4. Do not disassemble the tool unless you have a complete set of new gaskets and O-rings for replacement.
5. Do not press any needle bearing from a part unless you have a new needle bearing on hand for installation. Needle bearings are always damaged during the removal process.

Disassembly of the Angle Attachment

1. Carefully grasp the flats of the Coupling Nut (91) in leather-covered or copper-covered vise jaws so that the Angle Housing Assembly (80) is facing downward.

NOTICE

The Coupling Nut has left-hand threads. Remove the tool from the vise. Unscrew and remove the Coupling Nut from the Transducer Ring Gear Case (67).

2. Using a wrench on the flats of the Transducer Ring Gear Case, loosen the Gear Case from the Coupling Nut.

3. Carefully grasp the Angle Housing Assembly in leather-covered or copper-covered vise jaws with the Spindle (68) facing upward.

NOTICE

The Spindle Bearing Cap (95) has left-hand threads.

4. Using a No. 8SA32-26 Lower Bearing Cap Wrench, unscrew and remove the Spindle Bearing Cap. Withdraw the Spindle from the Angle Housing.
5. Inspect the Lower Spindle Bearing (93) for looseness or roughness. If either of these conditions exists, replace the Bearing as follows:
   a. Remove the Bevel Gear Retainer (94).
   b. Press the Bevel Gear (83) from the Spindle.
   c. Press the Lower Spindle Bearing from the Spindle.

NOTICE

Do not remove the Upper Spindle Bearing (82) unless you have a new Bearing ready to install. This type of Bearing is always damaged during the removal process.
The Angle Head will require a new Angle Housing Cap (81) when the Upper Spindle Bearing is installed.

6. If the Upper Spindle Bearing appears rough or loose, press it from the Angle Head.
7. Remove the Bearing Seat Retainer (86) and slide off the Rear Thrust Bearing Seat (85), Bevel Pinion Thrust Bearing (90) and Front Thrust Bearing Seat (87) from the pinion shaft.
8. Use a thin blade screwdriver to pry out and under the tab of the Bearing Spacer Retainer (89). Rotate the screwdriver around the pinion shaft to spiral the Retainer out of its groove. Using a hooked tool, reach into the Bevel Pinion Bearing Spacer (88) and hook the drilled cross-hole in the Spacer. Pull the Spacer from the Angle Housing.

NOTICE

Do not remove the Bevel Pinion and Bearing unless you have a new Bearing on hand. After the Angle Attachment is disassembled, check all parts for damage or wear.
If the gear teeth on either the Bevel Pinion or Bevel Gear are worn or chipped, replace both parts. These are a matched set and must be replaced with another matched set.

9. Grasp the spline of the pinion shaft in leather-covered or copper-covered vise jaws and while gently tapping on the rear face of the Angle Attachment with a soft hammer, pull the Bevel Pinion (83) and Bevel Pinion Bearing (84) from the Angle Attachment.

Disassembly of Gearing and Transducer

1. Hold the Angle Housing Assembly (80) in leather-covered or copper-covered vise jaws and unscrew the Coupling Nut (55).
2. Keeping the Angle Head in the vise, pull the tool apart at the Coupling Nut.

NOTICE

Work over a bench to prevent damage to parts if they should fall.

3. The Transducer Ring Gear Assembly (67) may remain in either the Motor Housing Assembly (41) or Gear Housing. If it remains in the Motor Housing, separate by pulling it away from the Motor Housing. If it remains in the Gear Housing, remove it from the vise and tap lightly at the rear of the Gear Housing.
4. Withdraw the Spindle (68) and Gear Head (73).
5. Remove the Connecting Retainer and Encoder Lock Screws (211).
6. Pull off the Encoder Pick-Up Assembly (210).
7. Remove the Encoder Shaft Retainer Ring (303).
8. Remove the Encoder Shaft (300) from the rear of the Encoder Body (201).
9. Remove the Encoder Body from the rear of the Transducer Ring Gear (67).
10. Tap the Encoder Shaft Bearings (302) from the Transducer and the Encoder Body.
11. To remove the Encoder Disk (208), loosen and remove the Encoder Disk Nut (209) and the Encoder Washer (209A).

Disassembly of the Magnet Assembly

CAUTION

To prevent loss of components, hold tool over a container on a workbench.

1. Loosen the Setscrew (205).
2. Turn the Magnet Adjusting Nut (207) counterclockwise until Magnet Assembly (202) can be pulled from the Encoder Body (201).

Disassembly of the Motor and Throttle

1. Grasp the splined end of the Rotor (50) in leather-covered or copper-covered vise jaws and pull the assembled motor from the Motor Housing Assembly (41).
2. Remove the Rear End Plate Gasket (46) from the Motor Housing.
3. Unscrew and remove the Rear Rotor Bearing Retaining Nut (44).

4. Remove the Rotor from the vise and remove the Rear Rotor Bearing Washer (45), Rear End Plate (48), Cylinder (49) and Vanes (51).
5. Check the Front Rotor Bearing (54) for damage or roughness. If replacement is necessary, support the Front End Plate (53) between two blocks of wood on the table of an arbor press. Press the Rotor from the Front Rotor Bearing. Using a flat face punch on the inner ring, tap the Bearing out of the End Plate.
6. Check the Rear Rotor Bearing (47) for damage or roughness. If replacement is necessary, use a flat face punch on the inner ring and tap the Bearing out of the End Plate.
7. Using a pin punch and hammer, drive the Throttle Lever Pin (7) out of the Throttle Lever Block (5) to release the Throttle Lever (4).
8. Being careful not to distort the Housing, grasp the flats on the Motor Housing in leather–covered or copper–covered vise jaws with the Inlet Bushing (12) upward.
9. Unscrew and remove the Inlet Bushing.
10. Remove the Throttle Valve Spring (11) and the Inlet Screen (13).
11. Remove the Rear Exhaust Deflector (14).
12. Lift out the Throttle Valve (10) and Throttle Plunger Assembly.

NOTICE

Only remove the Throttle Valve Seat (9) when replacing it or when the Throttle Plunger Bushing (2) must be replaced.

13. To remove the Throttle Valve Seat;
    a. Insert a wire hook through the central hole of the Seat.
    b. Hook the underside of the Throttle Valve Seat Support (8).
    c. Pull the Support and Seat out of the Motor Housing.
14. Before removing the Throttle Plunger Bushing, all seals and components must be removed from the Motor Housing.
    For 6WRT, remove the Reverse Valve. Refer to the section **Disassembly of the Reverse Valve**.
    For 6WT or 6WRT, remove the Shutoff Valve. Refer to the section **Disassembly of the Shutoff Valve**.
    To remove the Throttle Plunger Bushing, proceed as follows:
    a. Grasp the rear hub of the Motor Housing in leather–covered or copper–covered vise jaws with the Throttle Plunger Bushing upward.

CAUTION

Apply enough heat to warm the Motor Housing, but not enough heat to distort it.

    b. Using a torch, apply heat to the Motor Housing around the Bushing.
    c. Thread a No. 10–32 tap into the Bushing and pull the Bushing out of the Housing with the tap.

Disassembly of the Reverse Valve

1. Using a 3/32" Allen Wrench, remove the Retainer Setscrew (19).
2. Remove the Lock Pin Retainer (18).
3. Hold the Motor Housing vertically with the motor end downward. While applying light inward pressure to the Reverse Valve (16), tap the inlet end of the Housing with a plastic hammer to dislodge the Reverse Valve Lock Pin (17).

NOTICE

Be careful not to lose the Reverse Valve Spring (20) when removing the Reverse Valve.

4. Withdraw the Reverse Valve from the Housing.

Disassembly of the Shutoff Valve

1. Using a wrench, loosen and remove the Regulator Body (28).
2. With one hand over the shutoff valve opening, invert the Motor Housing and drop the Shutoff Valve (25) and Shutoff Valve Spring (26) out of the Housing.
3. Using a pointed pick, remove the Regulator Body Seal (32) and the Shutoff Valve Stop (27) from the Housing.

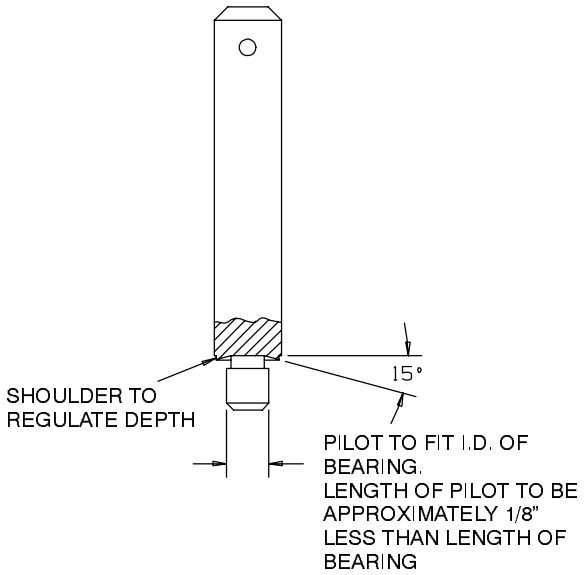
ASSEMBLY

General Instructions

1. Always press on the **inner** ring of a ball–type bearing when installing the bearing on a shaft.
2. Always press on the **outer** ring of a ball–type bearing when pressing the bearing into a bearing recess.
3. Whenever grasping a tool or part in a vise, always use leather–covered or copper–covered vise jaws. Take extra care with threaded parts and housings.
4. Except for bearings, always clean every part and wipe every part with a thin film of oil before installation.
5. Check every bearing for roughness. If an open bearing must be cleaned, wash it thoroughly in a clean, suitable, cleaning solution and dry with a clean cloth. **Sealed or shielded bearing should never be cleaned.** Work grease thoroughly into every open bearing before installation.
6. Apply a film of O–ring lubricant to all O–rings before final installation.

7. Unless otherwise noted, always press on the **stamped end** of a needle bearing when installing the needle bearing in a recess. Use a bearing inserting tool similar to the one shown in Dwg. TPD786.

Needle Bearing Inserting Tool



(Dwg. TPD786)

Assembly of the Shutoff Valve

1. Using a wooden dowel, push the Shutoff Valve Stop (27) to the bottom of the shutoff valve opening.
2. Install the Regulator Body Seal (32) in the groove near the bushing inside the shutoff valve opening.

NOTICE

Make certain the Shutoff Valve Spring (26) seats in the shutoff valve recess.

3. Insert the Shutoff Valve Spring and the Shutoff Valve (25) into the Housing.
4. Screw the Regulator Body (28) into the housing and tighten it to 12 to 15 ft-lb (16 to 20 Nm) torque.

Assembly of the Reverse Valve

1. Insert the Reverse Valve Lock Pin (17) into the hole in the side of the Reverse Valve (16).
2. Slip the Reverse Valve Spring (20) into the end of the Reverse Valve opposite the reverse valve knob.

NOTICE

If the Reverse Valve comes out of the Housing, the Lock Pin did not enter the L-shaped slot.

3. Holding the Reverse Valve with the Lock Pin upward, align the L-shaped slot inside the reverse valve bushing with the Lock Pin. Slide the Reverse Valve into the bushing until the Reverse Valve Spring is partially compressed. Rotate the assembled Housing and Valve one-half turn (180 degrees) and tap the Housing opposite the Lock Pin with a plastic hammer until the Lock Pin drops into the L-shaped slot. Slowly release the Reverse Valve.

NOTICE

The Retainer Setscrew (19) must not protrude from the Reverse Valve.

4. Install the Lock Pin Retainer (18) and Retainer Setscrew in the end of the Reverse Valve.
5. Operate the Reverse Valve to make certain it functions properly.

Assembly of the Motor and Throttle

1. If the Throttle Plunger Bushing (2) was removed, proceed as follows:
   a. Insert the Throttle Plunger Bushing into the Throttle Lever Block (5) to a depth approximately one-half the length of the Bushing.
   b. Put a few drops of M.I. Hernon (Grade AH114) sealant in the counterbore surrounding the outside diameter of the Bushing.
   c. Rotate the Bushing approximately 180 degrees to make certain the sealant makes complete contact around the outside of the Bushing.
   d. Push the Bushing into the Housing until it bottoms against the shoulder inside the Housing.
   e. Allow the sealant to cure for eight hours at room temperature.
2. Carefully grasp the flats on the Motor Housing in leather-covered or copper-covered vise jaws, inlet end facing upward.
3. If the Throttle Valve Seat (9) and Throttle Valve Seat Support (8) were removed, use a flat-faced rod 1/2" x 3" (13 mm x 76 mm) to push the Seat Support into the Motor Housing until it seats. Use the same rod to push the Seat into the Housing until it seats against the Seat Support.
4. Insert the Throttle Plunger (3) into the Plunger Bushing and rotate the Plunger until the hole in the Plunger aligns dead center with the hole in the Throttle Valve Seat.
5. Using needle nose pliers to hold the short-stem end of the Throttle Valve (10), install the Valve inserting the long-stem end through the hole in the Throttle Valve Seat and Throttle Plunger.
6. Install the Rear Exhaust Deflector (14).
7. Insert the Inlet Screen (13), closed end first, inside the external threaded end of the Inlet Bushing (12).
8. Insert the Throttle Valve Spring (11), large coil end first, into the Inlet Bushing making sure it contacts the Inlet Screen.

9. Thread the Inlet Bushing into the Motor Housing, making certain the Throttle Valve Spring encircles the short–stem end of the Throttle Valve. Tighten the Inlet Bushing to a minimum of 26 ft–lb (35 Nm) torque.
10. Note that the throttle lever pinhole in the Throttle Lever Block (5) is larger at one end than the other. Install the Throttle Lever (4), pressing the Throttle Lever Pin (7) into the large end of the pinhole.
11. Using a sleeve that contacts the outer ring of the Rear Rotor Bearing (47), press the Rear Rotor Bearing into the Rear End Plate (48) if the Bearing was removed.

NOTICE

The Rotor (50) must spin freely while holding the End Plate.

12. Place the Rear End Plate, bearing end trailing, on the threaded hub of the Rotor. Insert a 0.001" feeler gauge or shim between the face of the Rotor and End Plate. Place the Rear Rotor Bearing Washer (45) on the threaded hub of the Rotor. Thread the Rear Rotor Bearing Retaining Nut (44) onto the hub of the Rotor and tighten it until the feeler gauge has a slight drag during removal.
13. Lightly grasp the threaded hub of the Rotor in leather–covered or copper–covered vise jaws with the splined hub upward.
14. Wipe each Vane (51) with a film of light oil and place a Vane in each slot in the Rotor.
15. **For 6WT**, looking down the axis of the Rotor and Cylinder (49), position the Cylinder over the Rotor with the cylinder dowel hole at twelve o'clock, the notch in cylinder face at ten o'clock and the two slots in the side of the Cylinder at two o'clock. Place the Cylinder down over the Rotor and Vanes and against the Rear End Plate.
    For 6WRT, place the Cylinder down over the Rotor and Vanes and against the Rear End Plate.
16. Push the Front Rotor Bearing (54) into the recess in the Front End Plate (53).

NOTICE

Align the cylinder dowel hole in the Rear End Plate, Cylinder and Front End Plate before pressing the Bearing onto the shaft. After pressing the Bearing onto the shaft, lightly rap the end of the splined hub with a plastic hammer to relax the load on the Bearing. The Rotor must rotate in the Bearing without drag.

17. Remove the assembled Rotor from the vise and using a sleeve that contacts the inner ring of the Front Rotor Bearing, press the Bearing, flat side of the Front End Plate first, onto the rotor shaft.
18. Position the Rear End Plate Gasket (46) in the bottom of the motor housing bore so that the dowel hole and air inlet port in the Gasket align with the dowel hole and air inlet in the housing bore face.
19. Using an assembly dowel 3/32" x 10" (2.3 mm x 254 mm), align the dowel holes in the Front End Plate, Cylinder and Rear End Plate. Insert the assembly rod through the aligned holes so that about 3" (76 mm) of the rod extends beyond the Rear End Plate. Insert the extension into the dowel hole at the bottom of the housing bore, and slide the motor into the Motor Housing until it seats.
20. Withdraw the assembly dowel and insert the Cylinder Dowel (52) until the Cylinder Dowel is slightly below the surface of the Front End Plate.

Assembly of Transducer and Encoder

1. Insert Magnet Assembly (202) into Encoder Body (201) and turn Magnet Adjusting Nut (207) until Magnet Assembly is held in place.
2. Tighten Setscrew (205).
3. Place a small amount of Loctite®* No. 242 on the bore of the small bearing in the Transducer Ring Gear Assembly (67) and install the Front Shaft Bearing (302). Allow to cure before proceeding.
4. Slip Encoder Body (201) into Transducer Ring Gear Assembly.
5. Install Encoder Disk (208) in Encoder Shaft (300) using Shim Packet, Encoder Disk Nut (209) and Encoder Washer (209A).
6. To adjust clearance between Encoder Disk and Magnet Switches on Pick–Up Assembly, use shims from Shim Packet to obtain a clearance of 0.005" to 0.010".
7. There should be a clearance of 0.040" between the Magnet Assembly and Encoder Disk. (See Encoder Adjustment).
8. Lubricate gearing as instructed in **LUBRICATION** and place Gear Head Assembly (73) and/or Spindle Assembly (68) into the Transducer Ring Gear (67).
9. Place assembled Motor Housing Assembly (41) in leather–covered or copper–covered vise jaws.
10. Put Transducer with gearing into Motor Housing. Rotate Spindle to mesh gears on Rotor. Be sure Motor Clamp Washer (58) is in proper location and push Transducer up against Motor Housing.
11. Place the Gear Housing over the Transducer, aligning the Housing Pin (43) with the groove in the Gear Housing.
12. Rotate the Spindle to align the gearing while tightening the Coupling Nut (55) by hand.

* Registered trademark of Loctite Corportation.

13. Holding tool in leather-covered or copper-covered vise jaws by the Gear Housing, tighten Coupling Nut to 30 ft-lb (41 Nm) torque.

Assembly of the Gearing

1. Support the face of the Spindle (68), pin end downward, on the table of an arbor press.
2. Install the Seal Support (69), large end first, Seal (70) and Grease Shield (77) over the hub of the Spindle.
3. Using a sleeve that contacts the inner ring of the Bearing, press the Spindle Bearing (78) on to the hub of the Spindle until the Bearing seats against the Seal Support.
4. Grease the Bearings and Gear with Ingersoll-Rand No. 67 Grease and install them on the pins of the Spindle.
5. Install the Gear Head Spacer (76) in the Gear Case against the Spindle Planet Gears.
6. Grease the splined hub of the Gear Head (73) with Ingersoll-Rand No. 67 Grease and insert it into the Gear Case. The splined hub must pass through the Gear Head teeth of the Spindle Planet Gears.

NOTICE

Always press on the stamped end of the Bearing and center the Bearing in the Gear.

7. **For N, P, Q or R ratio**, if the Gear Head Planet Gear Bearings (75) are being replaced, use a bearing inserting tool similar to the one used with the Spindle Planet Gear Bearings and press the Bearings into the Gear Head Planet Gears (74).
   For M ratio, push the Gear Head Planet Gear Bearing (75) into the Gear Head Planet Gear (74).
8. Grease the Bearings and Gears and install them on the pins of the Gear Head.
9. **For M, N or P ratio**, grease the Rotor Pinion with Ingersoll-Rand No. 67 Grease and install it in the center of the Gear Head Planet Gears. Make certain the teeth of the Pinion and Planet Gears mesh.
10. Thread the assembled Gear Case onto the assembled Motor Housing until it is hand-tight. Make certain the gear teeth on the Spindle mesh with the gear teeth of the Rotor Pinion, Gear Head Planet Gears or Spindle Planet Gears.

NOTICE

Run the motor at free speed on low air pressure while final tightening the Gear Case. Listen while tightening to make certain the gears mesh properly.

11. Tighten the Gear Case between 30 to 35 ft-lb (41 to 47 Nm) torque.

Assembly of the Angle Attachment

1. Lubricate the Bevel Pinion (83) as instructed under **LUBRICATION** and insert it, gear end first, into the long bore of the Angle Housing (80).
2. Lubricate the Bevel Pinion Bearing (84) as instructed under **LUBRICATION** and insert it, stamped end first, into the bore of the Angle Housing and onto the bevel pinion shaft.
3. Use No. 7L3A-950 Bearing Inserting Tool and press the Bevel Pinion Bearing so the stamped face is a maximum of 1.35" (34.4 mm), but not less than 1.34" (34.1 mm) below the end face of the Angle Housing.
4. Insert the Bevel Pinion Bearing Spacer (88) over the splined end of the Bevel Pinion and into the Angle Housing until it is beyond the spacer retainer groove. Using a thin blade screwdriver, start the end of the Bearing Spacer Retainer (89) opposite the tab end into the groove in the Angle Housing. Rotate the screwdriver around the pinion shaft to spiral the Retainer into the groove.

NOTICE

Check to make sure the Retainer is completely seated.

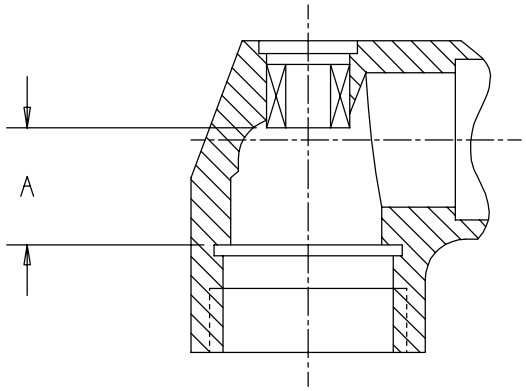
5. Lubricate the Bevel Pinion Thrust Bearing (90) as instructed under **LUBRICATION**. Install, in the order named, the Front Thrust Bearing Seat (87), Bevel Pinion Thrust Bearing and Rear Thrust Bearing Seat (85) over the splined end of the Bevel Pinion and retain the components by installing the Bearing Seat Retainer (86) on the pinion shaft.
6. If the Lower Spindle Bearing (93) has been removed, proceed as follows:
   a. Using a sleeve that will contact the inner ring of the Bearing, press the Bearing onto the Spindle (96). Press on the stamped side of the Bearing with the side marked with red toward the spindle shoulder.
   b. Press the Bevel Gear (83) onto the Spindle.
   c. Spread the Bevel Gear Retainer (94) and slip it over the end of the Spindle. Slide the Retainer down the spindle and into the groove around the Spindle to retain the Bevel Gear.

CAUTION

Press on the stamped face of the Bearing. Failure to do so will cause damage to the Bearing. Install a new Angle Housing Cap (81) into the top of the Angle Head.

7. If the Upper Spindle Bearing (83) has been removed, press a new Spindle Bearing into the Angle Head from the large threaded end to the dimension shown. See Dwg. TPD636.

Installation of Spindle Bearing in Angle Head



(Dwg. TPD636)

Minimum Dimension "A"		Maximum Dimension "A"	
in.	**mm**	**in.**	**mm**
0.718	18.25	0.728	18.50

8. Lubricate the Upper Spindle Bearing, Bevel Gear and Lower Spindle Bearing as instructed under **LUBRICATION** and install the Spindle in the Angle Housing.
9. Clean the threads on the Angle Housing and the Spindle Bearing Cap (95) and apply a film of VibraTite®** VC3 to the threads.
10. Using No. 8SA32–26 Lower Bearing Cap Wrench, install the Spindle Bearing Cap and tighten the Cap to a minimum of 25 ft–lb (34.0 Nm) torque.
11. Slide the Coupling Nut (91), threaded end trailing, over the splined end of the Angle Housing.
12. Apply the Coupling Nut Retainer (92) to the external groove on the splined end of the Angle Housing.
13. Engage the spline on the Bevel Pinion with the matching internal spline of the Spindle (68) and thread the Coupling Nut onto the Transducer Ring Gear (67). Tighten the Coupling Nut to a minimum of 25 ft–lb (34.0 Nm) torque. Check to make sure the square drive of the Angle Attachment aligns with the Throttle Lever (4).

ENCODER ADJUSTMENT

1. Connect the encoder circuit to a 5 VDC ± 5% power supply. Refer to wiring logic. Connect the output signal to a dual trace oscilloscope. Adjust the oscilloscope time base to 0.2 mS per division and vertical sensitivity to 1.0 volt per division.
2. With Transducer and Encoder Assembly in tool, operate tool at free speed and observe the oscilloscope.

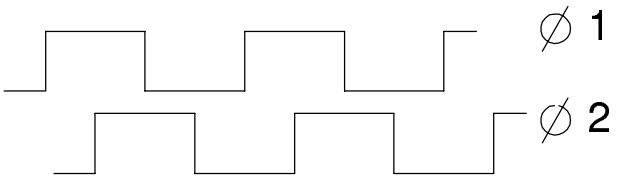
EXAMPLES OF OSCILLOSCOPE TRACES

Wire Color	Wire Gauge	Connector Pin	Logic	Equipment
Red	28	A	+ EXC.	Transducer
Black	28	B	– EXC.	Transducer
Green	28	C	+ SIG.	Transducer
White	28	D	– SIG.	Transducer
Shield	28	E	SHIELD	– – –
Blue	28	F	ϕ 2	Encoder
Red/Black	28	H	ϕ 1	Encoder
White/Black	28	P	(–) COMMON	Encoder
Orange	28	R	+ 5VDC	Encoder
Red	24	K	+ SOL.	Electric Shutoff
Black	24	L	– SOL.	Electric Shutoff

** Registered trademark of Loctite Corporation.

3. The scope trace should appear as shown in Dwg. TPD1098. If needed, adjust the magnetic switches in the Pick-Up Assembly (302) and Magnet Assemblies (308) to obtain desired signal.
4. Use Loctite No. 242 on Screw (211) and Nut (209); use fast drying lacquer sealer on Screws (207 and 211) after adjustments. Lock the Setscrew (211); then recheck signal with unit in tool prior to setting up of the Loctite and of the sealer.

Example of Oscilloscope Traces



(Dwg. TPD1098)

Motor Housing Cable Replacement

1. Hold Gear Housing (63) horizontally in leather-covered or copper-covered vise jaws.
2. Remove Lever Block Screw (6) and Throttle Lever Block (5).
3. Slide the Throttle Housing Sleeve (24) off rear of tool. Cable can then be unplugged and withdrawn from tool.
4. Plug in new cable and reverse above procedure.

TRANSDUCER CALIBRATION

Tool Model Numbers	Transducer Assembly Part Number	Max. Torque Rating and Full Scale Setting
All Models	400-35-A1	50 Nm

All transducer calibrations based on 2 MV/VOLT full scale signal output, 10 VOLT D.C. MAXIMUM input, using an 87.15 kilohm calibration resistor. Transducer bridge resistance 700 ohms.

1. Connect tool to a strain gauge signal conditioner such as the GSE Model 229 with an 87.15 kilohm external calibration resistor.
2. Set **BALANCE** control to zero.
3. Press the calibration switch and set the **SPAN** control to the appropriate **FULL SCALE SETTING**.
4. Recheck for zero; then reset the **SPAN** if necessary.

ELECTRIC SHUTOFF VALVE

NOTICE

The Electric Shutoff Valve Assembly (36) and Valve Body Assembly (34) are sold as matched sets for proper fit. If damage to either one occurs, Motor Housing Assembly (41) should be returned to the factory for repair and replacement of the valve parts.

DISASSEMBLY

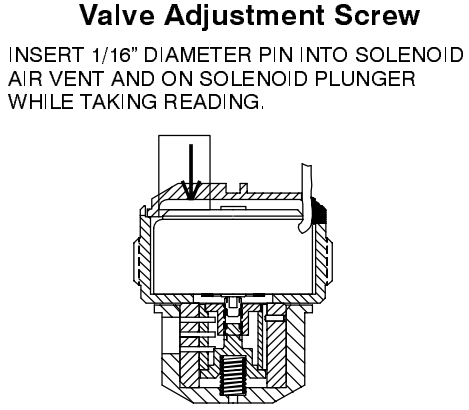
1. Remove the two Housing Sleeve Screws (60A) under Throttle Lever (4).
2. Slide off top half of Housing Sleeve Pair (60).
3. Remove Housing Screw from Housing Sleeve (59). Slide Sleeve and Ring forward to allow removal of Solenoid Assembly (39).
4. Unplug Connector at Solenoid Assembly. Using a spanner wrench or pin punch, remove the Solenoid Assembly from the Housing.

ASSEMBLY

1. Reverse procedure outlined in steps 1 through 4 of Disassembly. Be sure to place shims on Electric Shutoff Valve Assembly (36) as they were prior to disassembly.
2. If Solenoid Assembly (39) is being replaced, check Electric Shutoff Valve Assembly for proper alignment as follows:
   a. Disassemble Gear Case from Motor Housing and remove Motor.
   b. Install Electric Shutoff Valve Assembly (36) and Spring (38) into Valve Body Assembly (34).
   c. Assemble Solenoid Assembly hand-tight.
   d. Inspect through motor bore to see that Electric Shutoff Valve is in proper position when Solenoid is de-energized (i.e. linear ports completely blocked).
   e. If inspection shows that ports are not completely blocked, use Shim Packet (40) and Loctite Speedbonder* No. 324 to attach shims to the bottom of the Solenoid Assembly. Add shims until ports are completely blocked.

* Registered trademark of Loctite Corporation.

f. After proper shimming is accomplished, set the Valve Adjustment Screw (37) to proper height. See Dwg. TPD1097, using the following procedure:



(Dwg. TPD1097)

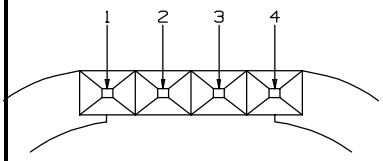
g. Inspect ports through motor bore to determine that they are completely open. Adjustment to open slots can be made by turning the Valve Adjustment Screw. Apply Loctite to screw threads prior to readjustment of Valve Adjustment Screw.

3. Apply a small amount of medium strength Loctite to Solenoid threads prior to reassembly. Tighten Solenoid to 4 ft–lb (5.4 Nm) of torque. Be careful not to allow Loctite to run into valve chamber. Let sealant set with Solenoid facing downward.

TROUBLESHOOTING GUIDE

Trouble	Probable Cause	Solution
Low power or low free speed	Low air pressure	Check the air pressure at the inlet. The pressure must not exceed 90 psig (6.2 bar/620 kPa).
	Plugged Inlet Bushing Screen or Air Strainer Screen	Clean the Screen in a clean, suitable, cleaning solution. If it cannot be cleaned, replace it.
	Worn or broken Vanes	Replace the **complete** set of Vanes.
	Loose Rotor Bearing Retaining Nut	Tighten the Nut.
	Worn or broken Cylinder	Replace the Cylinder if it is worn or broken or if the bore is scored or wavy.
	Scoring of End Plates	Replace End Plates if they are scored.
	Improper lubrication or dirt build–up in the motor.	Lubricate the motor as instructed in **LUBRICATION**. If lubrication does not result in satisfactory operation, disassemble the motor, inspect and clean all parts.
Scoring	Improper assembly	Make certain that all motor or Cylinder parts are properly aligned prior to clamping the motor assembly.
Gear Case gets hot	Excessive grease	Clean and inspect the gear case gearing parts and lubricate as instructed in **LUBRICATION**.
	Worn or damaged parts	Clean and inspect the Gear Case and gearing. Replace worn or broken components.
Tool fails to shut off	Dirt or burrs on Shutoff Valve or Bushing	Clean the parts and remove the burrs.
	Bleeder ports plugged	Clean the bleeder ports with a fine wire.

TROUBLESHOOTING GUIDE *(Continued)*

Trouble	Probable Cause	Solution
TRANSDUCER		
No torque signal when tightening fastener	Broken wire or connector	**EQUIPMENT: Volt/Ohmmeter** Replace defective components. Trace circuit for continuity; set meter to R x 1 scale, start measurements at External Cable and work inwards to transducer. Disassemble tool as required.
	Transducer defective  	Return unit to factory for repair. Set meter to R x 100 scale. Good unit should read: **PIN NO. — APPROX. READING** **1–2, 3–4 — 670–770 ohms** **1–3, 1–4, 2–3, 2–4 — 500–580 ohms**
Improper or low torque reading	Calibration off or wrong calibration resistor used	Recheck calibration.
	Bearing damaged in Angle Head causing drag	Replace Angle Head or bearing in Head.
ELECTRIC SHUTOFF *(normally closed type)*		
Fails to operate	Broken wire or connector or open Solenoid coil	**EQUIPMENT: Volt/Ohmmeter** Replace defective components. Trace circuit for continuity or shorts to casing. Set meter to R x 1 scale, start measurements at External Cable and work inward to Solenoids. Disassemble tool as required; meter (+) on black lead, (–) on red. Reading should be 28 to 32 ohms.
	Dirt on Valve Assembly or in Valve Body or damaged Valve	Disassemble and clean with a clean, suitable, cleaning solution; apply Ingersoll-Rand No. 10 Oil on Valve before assembly. If damaged, replace valve parts.
	Plugged vent hole in Motor Housing	Remove dirt with 0.03" diameter wire.
Leaks or fails to shut off	Valve misalignment	Readjust Valve.
	Weak or broken spring	Replace spring.
	Dirt on Valve Assembly or in Valve Body or damaged Valve	Disassemble, clean and lubricate. If damaged, replace Valve.
	Plugged vent holes in Solenoid	Remove dirt with 0.03" diameter wire. Be careful not to allow dirt to enter and be trapped in upper chamber of Solenoid.

NOTICE

SAVE THESE INSTRUCTIONS. DO NOT DESTROY.

NOTES