

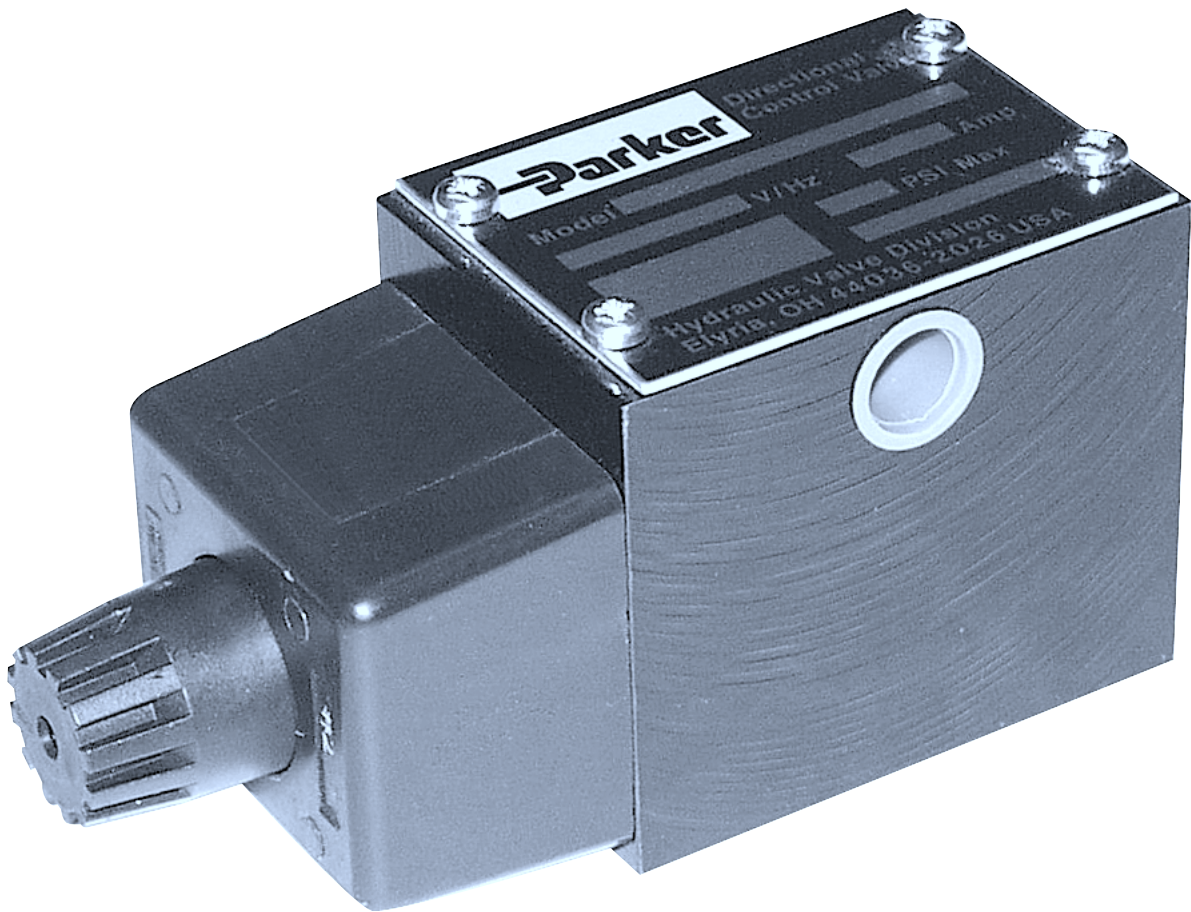


Bulletin 2542-M15/USA  
Service Bulletin

# Series D3W, K Style

Effective: January 1, 2000

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 **WARNING**

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS AND/OR SYSTEMS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

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**D**

Directional Control Valve

**3**

Basic Valve

**W**

Actuator

Spool

**K**

Style

Seal

Solenoid Voltage

Connector Package

NFPA D05  
 CETOP 5  
 NG 10

Wet armature  
 solenoid

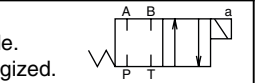
| Code | Description  |
|------|--------------|
| N    | Nitrile      |
| V    | Fluorocarbon |

| Code | Description         |
|------|---------------------|
| E    | 24/60 - 24/50 VAC   |
| Y *  | 120/60 - 110/50 VAC |
| T *  | 240/60 - 220/50 VAC |
| K #  | 12 VDC              |
| J #  | 24 VDC              |
| D    | 120 VDC             |
| Z    | 250 VDC             |

\* Available in low watt version with integral rectifier.  
 # Low Watt Coil available.

| Code    | Symbol | Code | Symbol |
|---------|--------|------|--------|
| 1       |        | 11   |        |
| 2       |        | 12   |        |
| 3       |        | 15   |        |
| 4       |        | 16   |        |
| 5       |        | 21†  |        |
| 6       |        | 22†  |        |
| 7       |        | 81†  |        |
| 8*, 9** |        | 82†  |        |
| 10†     |        |      |        |

| Code | Description   |
|------|---|
| K    | Single solenoid, 2 position.<br>Spring offset to center. A side.<br>P to A and B to T when energized. |



This condition varies with spool code

| Code | Description         |
|------|---------------------|
| C    | Conduit Cavity      |
| K    | Conduit Adaptor     |
| P    | Hirschmann w/Plug   |
| W*   | Hirschmann w/o Plug |
| S    | Double Spade        |
| E    | Explosion Proof     |

\*Not available with signal lights.

\* 8 spool has closed crossover  
 \*\* 9 spool has open crossover  
 † Available only with rectified AC coils or high watt DC coils

**Ordering Information**

**Directional Control Valves  
Series D3W, K Style**



**Solenoid Options**

| Code | Coil                    |
|------|-------------------------|
| Omit | High Watt               |
| D†   | Explosion Proof, EExd   |
| F    | Low Watt                |
| U    | Explosion Proof, UL/CSA |

† Explosion proof coils are 60 Hz at standard voltage; dual rating not available.



**Tube Options**

| Code | Description  |
|------|--------------|
| Omit | Low Pressure |



**Manual Override Options**

| Code | Description                |
|------|----------------------------|
| Omit | Standard Tube              |
| P    | Extended Manual Override   |
| R    | Repairable Manual Override |



**Electrical Options**

| Code | Description               |
|------|---------------------------|
| Omit | No Option                 |
| V    | Varistor Surge Suppressor |
| Z    | AC Rectified Coil         |

| Code | Description                |
|------|----------------------------|
| Omit | Standard Response          |
| S4   | Soft Shift, 0.040" Orifice |
| S7†  | Soft Shift, 0.070" Orifice |
| I7   | Monitor Switch*            |

\* Single solenoid models only. Not CE or CSA approved.  
† Recommended for spools 3, 4, 15.



**Shift Response and Indication**



**Approvals**

| Code | Description    |
|------|----------------|
| Omit | Standard Valve |
| 4    | CSA Approval   |
| K    | UL Recognition |



**Variations**

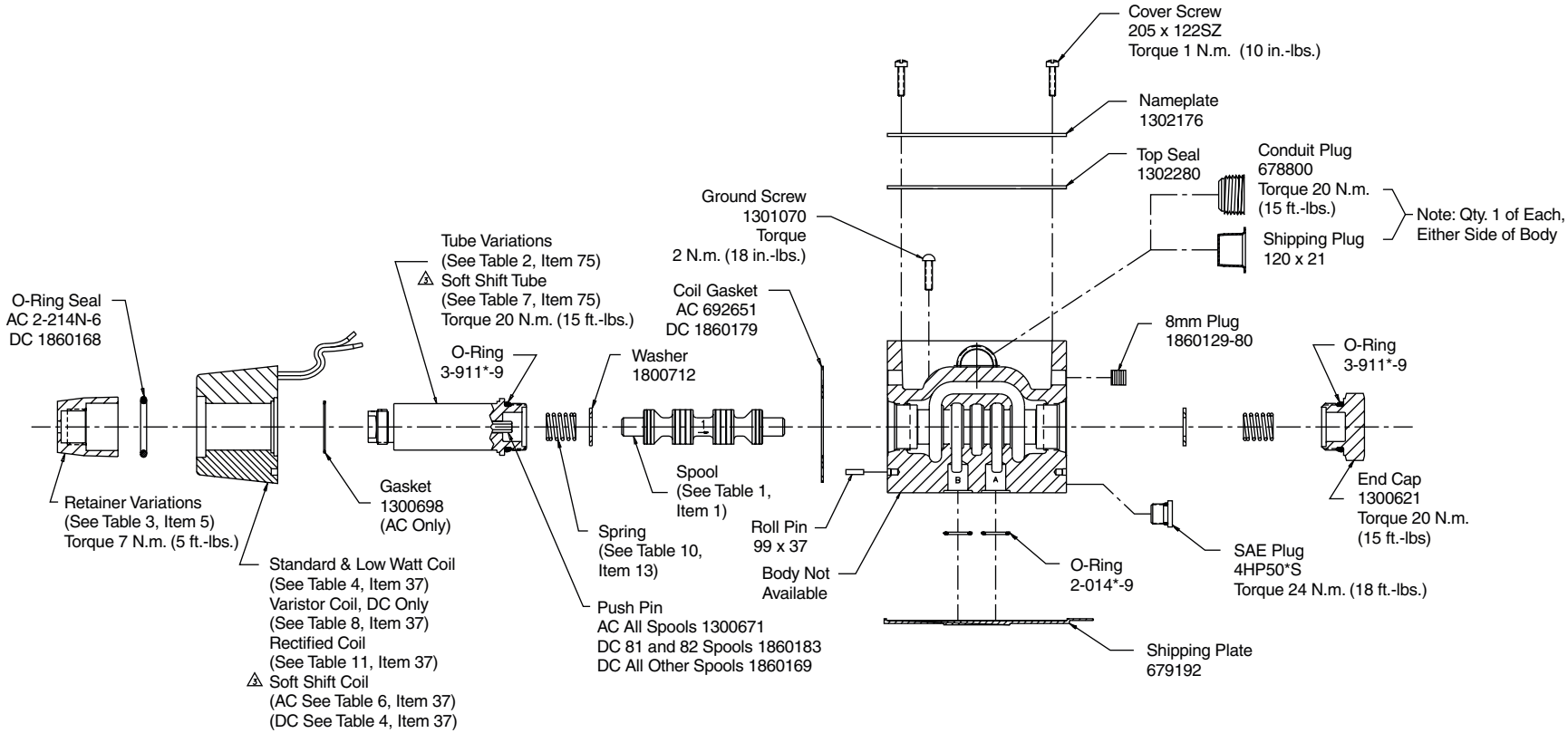
| Code | Description   |
|------|---|
| Omit | Standard Valve                                      |
| 5    | Signal Lights                                       |
| 6    | Manaplug, Brad Harrison Mini                        |
| 7    | Manaplug, Brad Harrison Micro (M12x1)               |
| 56   | Manaplug (Mini) with Lights                         |
| 57   | Manaplug (Micro) with Lights (M12x1)                |
| 1A   | Manaplug (Mini) Single Sol. 5-Pin                   |
| 1B   | Manaplug (Micro) Single Sol. 5-Pin (M12x1)          |
| 1C   | Manaplug (Mini) Single Sol. 5-Pin w/Lights          |
| 1D   | Manaplug (Micro) Single Sol. 5-Pin w/Lights (M12x1) |



**Design Series**

**NOTE:**  
Not required when ordering.

| Valve Weight:      |                   |
|--------------------|-------------------|
| Single Solenoid:   |                   |
| AC                 | 4.3 kg (9.5 lbs)  |
| DC                 | 5.3 kg (11.6 lbs) |
| Standard Bolt Kit: |                   |
| BK98               |                   |

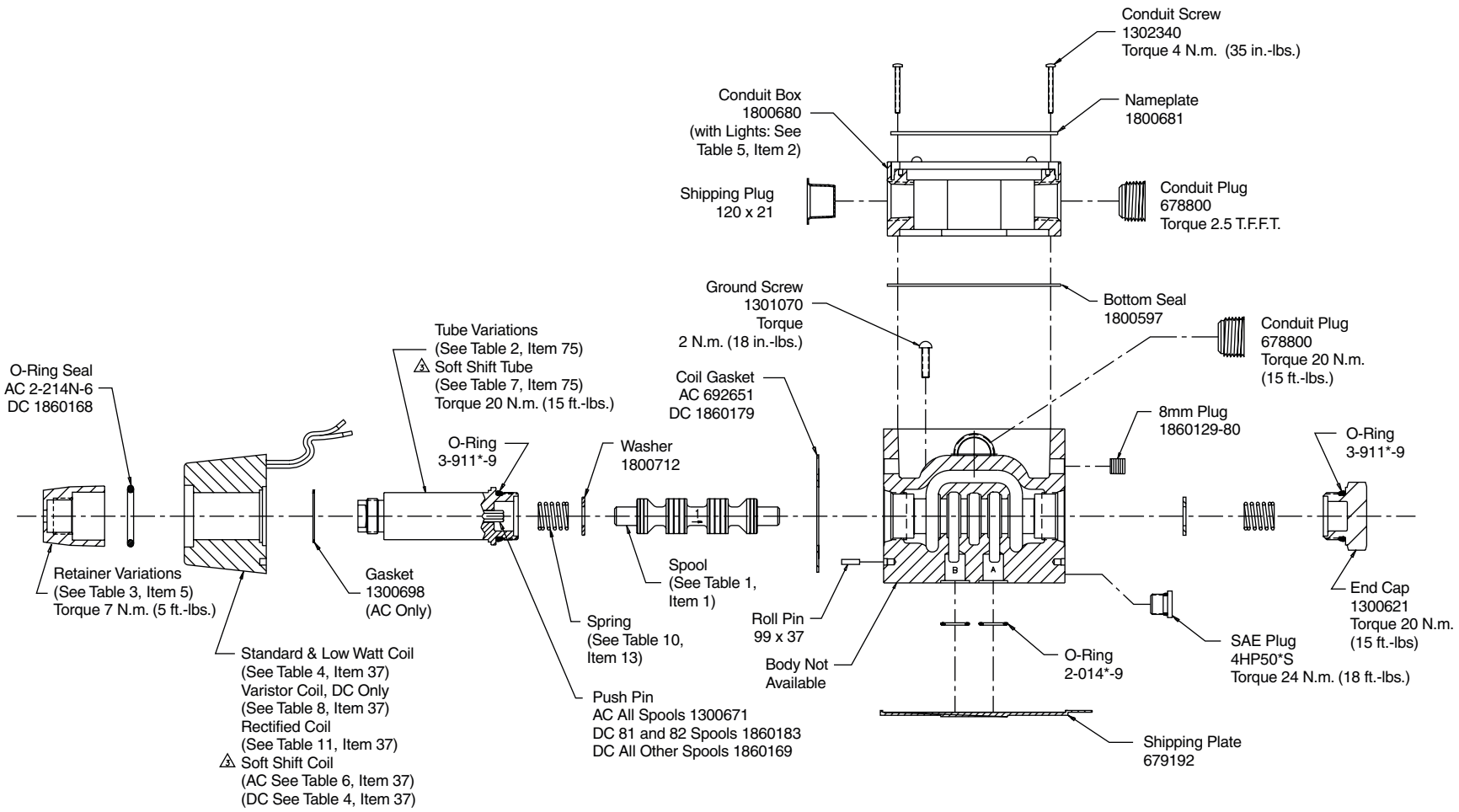


AC Solenoid  
DC Solenoid

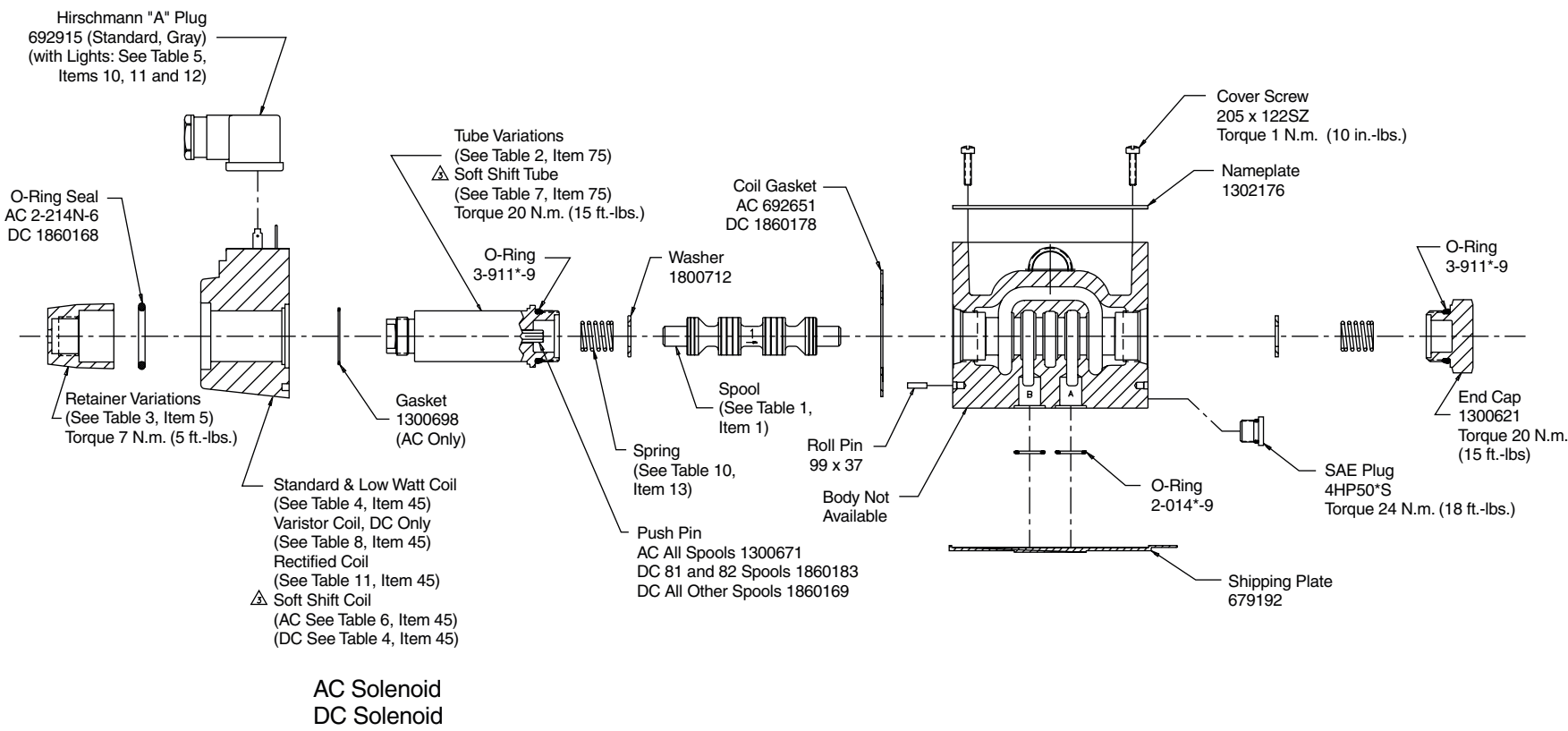
D3W Single AC Solenoid Model  
D3W Single DC Solenoid Model

NOTES:

- \* Indicates Seal Compound: N-Nitrile, V-Fluorocarbon.
- AC Components Shown. See Tables for DC Components Where Applicable.
- See Detail "A" in Tables Location.



NOTES:  
1) \* Indicates Seal Compound: N-Nitrile, V-Fluorocarbon.  
2) AC Components Shown. See Tables for DC Components Where Applicable.  
△ See Detail "A" in Tables Location.

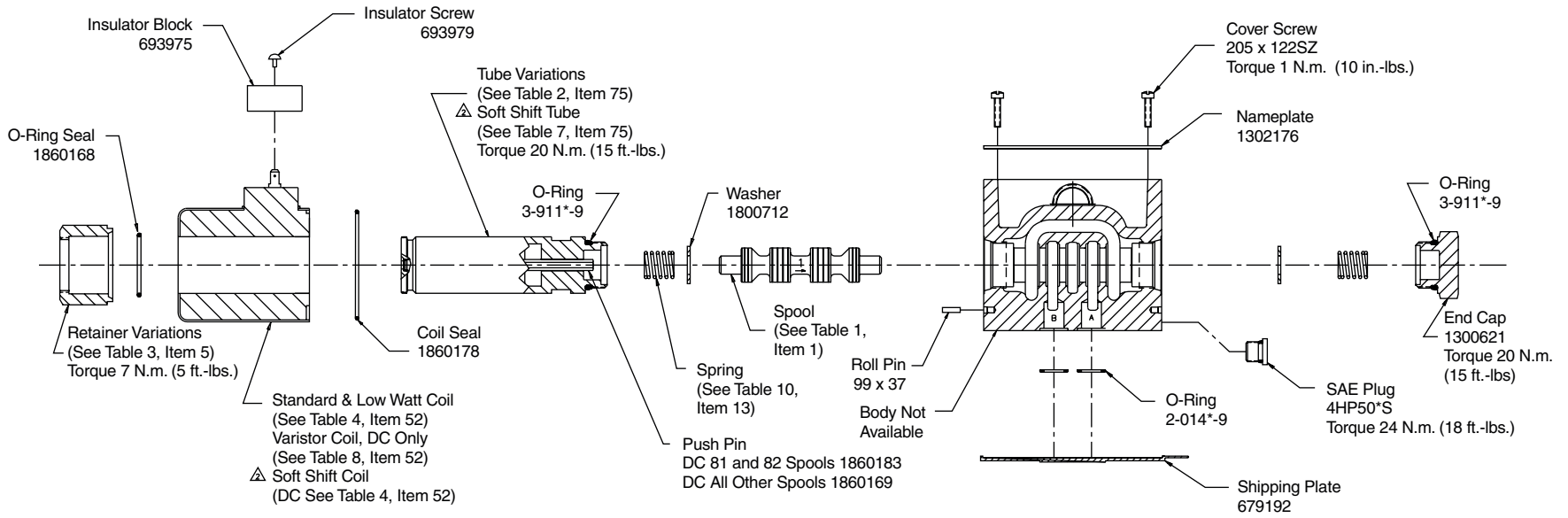


D3W Single AC Solenoid Model  
 D3W Single DC Solenoid Model

**NOTES:**

- \* Indicates Seal Compound: N-Nitrile, V-Fluorocarbon.
  - AC Components Shown. See Tables for DC Components Where Applicable.
- △ See Detail "A" in Tables Location.





DC Solenoid

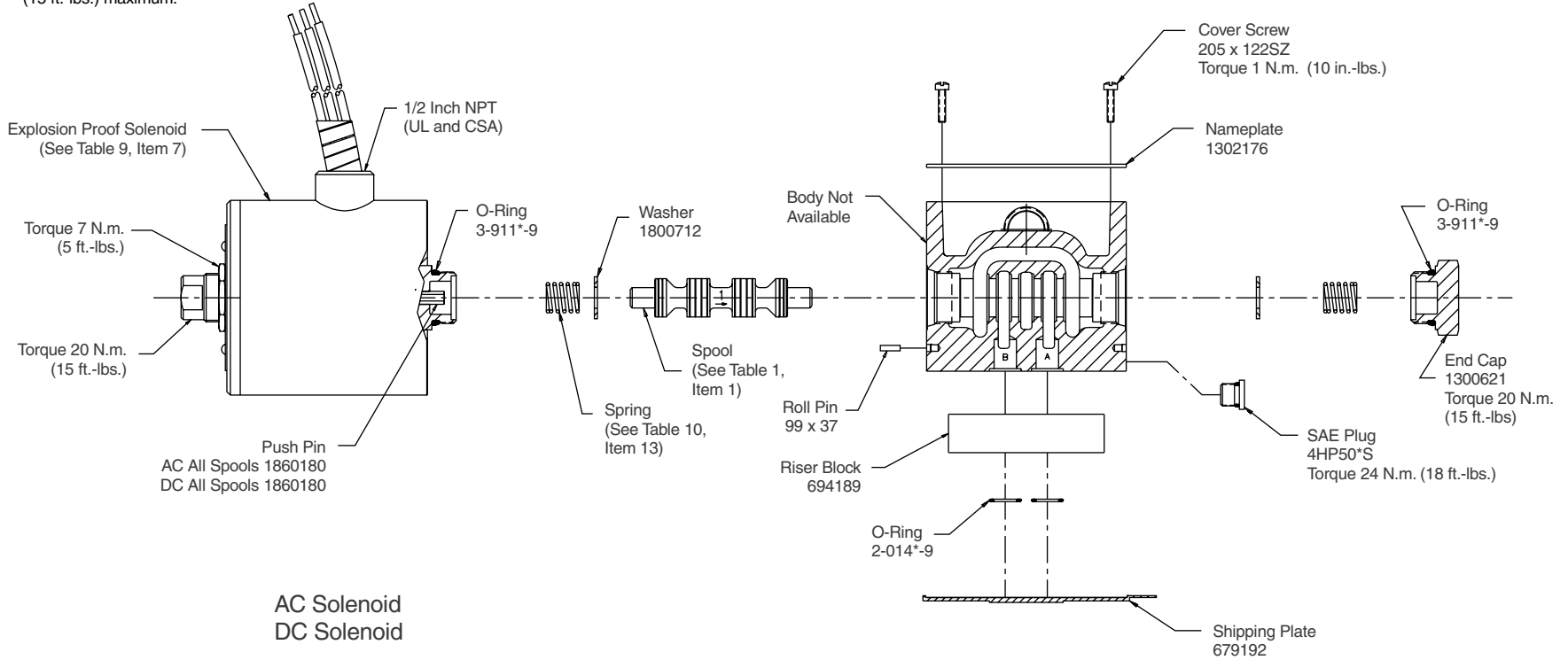
D3W Single DC Solenoid Model

NOTES:

- 1) \* Indicates Seal Compound: N-Nitrile, V-Fluorocarbon.
- △ See Detail "A" in Tables Location.

**ALIGNMENT INSTRUCTIONS**

1. Loosen or remove hex nut.
2. Loosen the large end cap by turning it counter-clockwise as viewed from the end.
3. Rotate the coil to align the conduit.
4. Tighten the large end cap by hand. Use of any tools could damage the unit. A .002 inch feeler gage should not enter the joint between the coil and the end cap.
5. Replace the hex nut and torque to 20 N.m. (15 ft.-lbs.) maximum.



AC Solenoid  
 DC Solenoid

D3W Single AC Solenoid Model  
 D3W Single DC Solenoid Model

**NOTES:**

- 1) \* Indicates Seal Compound: N-Nitrile, V-Fluorocarbon.
- 2) AC Components Shown, See Tables for DC Components Where Applicable.

1  
4

| CODE | ITEM | PART NUMBER | QTY | DESCRIPTION        |
|------|------|-------------|-----|--------------------|
| 1    | 1    | 1300601     | 1   | #1 SPOOL           |
| 2    | 1    | 1300602     | 1   | #2 SPOOL           |
| 3    | 1    | 1300603     | 1   | #3 SPOOL           |
| 4    | 1    | 1300604     | 1   | #4 SPOOL           |
| 5    | 1    | 1300605     | 1   | #5 SPOOL           |
| 6    | 1    | 1300606     | 1   | #6 SPOOL           |
| 7    | 1    | 1300607     | 1   | #7 SPOOL           |
| 8    | 1    | 1300608     | 1   | #8 SPOOL           |
| 9    | 1    | 1300609     | 1   | #9 SPOOL           |
| 10   | 1    | 1300610     | 1   | #10 SPOOL          |
| 11   | 1    | 1300611     | 1   | #11 SPOOL          |
| 12   | 1    | 1300664     | 1   | #12 SPOOL          |
| 14   | 1    | 1300607     | 1   | #7 SPOOL REVERSED  |
| 15   | 1    | 1300603     | 1   | #3 SPOOL REVERSED  |
| 16   | 1    | 1300605     | 1   | #5 SPOOL REVERSED  |
| 21   | 1    | 1301701     | 1   | #21 SPOOL          |
| 22   | 1    | 1301701     | 1   | #21 SPOOL REVERSED |
| 81   | 1    | 1210161     | 1   | #81 SPOOL          |
| 82   | 1    | 1210162     | 1   | #82 SPOOL          |

2

3

**NOTES:**

- 1 ARROW POINTS TOWARD "A" PORT FOR ALL SPOOLS EXCEPT 14,15, 16 AND 22.
- 2 FOR "E" AND "K" STYLES WITH 8 OR 9 SPOOLS, SOLENOID IS ON OPPOSITE END OF THAT SHOWN IN ILLUSTRATION.
- 3 81 AND 82 SPOOLS NOT APPLICABLE WITH EXPLOSION PROOF OPTIONS.
- 4 10,21,22,81 AND 82 SPOOLS ONLY AVAILABLE IN RECTIFIED AC OR HIGH WATT DC ONLY.

| CODE      | ITEM | PART NUMBER | QTY | DESCRIPTION                   |
|-----------|------|-------------|-----|-------------------------------|
| OMIT or F | 75   | 1300666     | A/R | A.C. TUBE 1500 PSI            |
|           |      | 1860163     |     | D.C. TUBE 1500 PSI            |
| P or FP   | 75   | 1860174     | A/R | EXTENDED A.C. TUBE 1500 PSI   |
|           |      | 1860165     |     | EXTENDED D.C. TUBE 1500 PSI   |
| R or FR   | 75   | 1860175     | A/R | REPAIRABLE A.C. TUBE 1500 PSI |
|           |      | 1860166     |     | REPAIRABLE D.C. TUBE 1500 PSI |

| CODE                 | ITEM | PART NUMBER | QTY | DESCRIPTION                  |
|----------------------|------|-------------|-----|------------------------------|
| ALL EXCEPT R,S,P & T | 5    | 693568      | A/R | AC STANDARD RETAINER         |
|                      |      | 1860167     |     | DC STANDARD RETAINER         |
| P or FP<br>HP or FHP | 5    | 1300128     | A/R | AC EXT. OVERRIDE RETAINER    |
|                      |      | 1860171     |     | DC EXT. OVERRIDE RETAINER    |
|                      |      | 697161      |     | EXTENDED OVERRIDE BOOT       |
| ALL R<br>ALL S       | 5    | 1300700     | A/R | AC REPAIR. OVERRIDE RETAINER |
|                      |      | 1860167     |     | DC REPAIR. OVERRIDE RETAINER |
| ALL T                | 5    | 693568      | A/R | AC STANDARD RETAINER         |
|                      |      | 1300812     |     | TAMPERPROOF DISC (AC ONLY)   |
|                      |      | 1300532     |     | TAMPERPROOF DISC (AC ONLY)   |
|                      |      | 1860182     |     | DC TAMPERPROOF RETAINER      |

|                |  | C<br>(CONDUIT) | P/W<br>(HIRSCHMANN) | S<br>(DUAL SPADE) |
|----------------|--|----------------|---------------------|-------------------|
| SOL CONNECTION |  | 37             | 45                  | 52                |
| ITEM           |  |                |                     |                   |

| CODE | DESCRIPTION                 | QTY | PART NUMBER | PART NUMBER | PART NUMBER |
|------|-----------------------------|-----|-------------|-------------|-------------|
| E*   | 24/50-24/60 VAC, 32/36 WATT | A/R | 691745-1    | 1300574     | N/A         |
| Y*   | 120/60-110/50 VAC, 32 WATT  | A/R | 691740-1    | 691750      | N/A         |
| T*   | 240/60-220/50 VAC, 32 WATT  | A/R | 691743-1    | 693987      | N/A         |
| K*   | 12 VDC, 36 WATT             | A/R | 1860156-K   | 1860152-K   | 1860160-K   |
| K*F  | 12 VDC, 18 WATT (LOW WATT)  | A/R | 1860157-K   | 1860153-K   | 1860161-K   |
| J*   | 24 VDC, 36 WATT             | A/R | 1860156-J   | 1860152-J   | 1860160-J   |
| J*F  | 24 VDC, 18 WATT (LOW WATT)  | A/R | 1860157-J   | 1860153-J   | 1860161-J   |
| D*   | 120 VDC                     | A/R | 1860156-D   | 1860152-D   | 1860160-D   |
| Z*   | 250 VDC                     | A/R | 1860156-Z   | 1860152-Z   | 1860160-Z   |

**Table 5 (Signal Lights)**

| CODE             | ITEM | PART NUMBER | QTY | DESCRIPTION               | CODE | ITEM | PART NUMBER | QTY | DESCRIPTION               |
|------------------|------|-------------|-----|---------------------------|------|------|-------------|-----|---------------------------|
| ALL PLUGS (*P*5) | 10   | A697047     | A/R | LABEL - "A" SOLENOID      | YK*5 | 2    | 1800679-Y   | 1   | CONDUIT BOX COVER, 120VAC |
|                  | 11   | A697048     | A/R | LABEL - "B" SOLENOID      | TK*5 |      | 1800679-T   | 1   | CONDUIT BOX COVER, 240VAC |
|                  |      |             |     |                           | EK*5 |      | 1800679-E   | 1   | CONDUIT BOX COVER, 24VAC  |
| YP*5             |      | B694936     | A/R | PLUG WITH LIGHT, 100-120V | KK*5 |      | 1800679-K   | 1   | CONDUIT BOX COVER, 12VDC  |
| TP*5             |      | B694936     | A/R | PLUG WITH LIGHT, 240V     | JK*5 |      | 1800679-J   | 1   | CONDUIT BOX COVER, 24VDC  |
| KP*5             | 12   | B694935     | A/R | PLUG WITH LIGHT, 12V      | DK*5 |      | 1800679-D   | 1   | CONDUIT BOX COVER, 120VDC |
| JP*5             |      | B694935     | A/R | PLUG WITH LIGHT, 24V      | ZK*5 |      | 1800679-Z   | 1   | CONDUIT BOX COVER, 250VDC |
| DP*5             |      | B694936     | A/R | PLUG WITH LIGHT, 100-120V |      |      | 697799      | 1   | WARNING LABEL             |

**Table 6 (Soft Shift Coils, AC Only)**

| <b>Table 6 (Soft Shift Coils, AC Only)</b> |                             |     |               |                  |  |
|--|-----------------------------|-----|---------------|------------------|--|
| SOL CONNECTION                             |                             |     | C/K (CONDUIT) | P/W (HIRSCHMANN) |  |
| ITEM                                       |                             |     | 37            | 45               |  |
| CODE                                       | DESCRIPTION                 | QTY | PART NUMBER   | PART NUMBER      |  |
| E*   | 24/50-24/60 VAC, 32/36 WATT | A/R | 1860158-E     | 1860154-E        |  |
| Y*   | 120/60-110/50 VAC, 32 WATT  | A/R | 1860158-Y     | 1860154-Y        |  |
| T*   | 240/60-220/50 VAC, 32 WATT  | A/R | 1860158-T     | 1860154-T        |  |

**Table 7 (Soft Shift Tubes, AC or DC)**

| CODE | ITEM | PART NUMBER | QTY | DESCRIPTION                            |
|------|------|-------------|-----|--|
| S4   | 75   | 1860172-4   | A/R | AC 1500 PSI SOFT SHIFT TUBE            |
| S7   | 75   | 1860172-7   | A/R | AC 1500 PSI SOFT SHIFT TUBE            |
| RS4  | 75   | 1860164     | A/R | AC 1500 PSI REPAIRABLE SOFT SHIFT TUBE |
|      |      | 1301663     | A/R | .040 ORIFICE                           |
| RS7  |      | 1860164     | A/R | AC 1500 PSI REPAIRABLE SOFT SHIFT TUBE |
|      |      | 1800748     | A/R | .070 ORIFICE                           |

**Table 8 (Varistor Coils, DC Only)**

| <b>Table 8 (Varistor Coils, DC Only)</b> |             |     |               |                  |                |
|--|-------------|-----|---------------|------------------|----------------|
| SOL CONNECTION                           |             |     | C/K (CONDUIT) | P/W (HIRSCHMANN) | S (DUAL SPADE) |
| ITEM                                     |             |     | 37            | 45               | 52             |
| CODE                                     | DESCRIPTION | QTY | PART NUMBER   | PART NUMBER      | PART NUMBER    |
| K*                                       | 12 VDC      | A/R | 1860159-K     | 1860155-K        | 1860162-K      |
| J*                                       | 24 VDC      | A/R | 1860159-J     | 1860155-J        | 1860162-J      |
| D*                                       | 120 VDC     | A/R | 1860159-D     | 1860155-D        | 1860162-D      |
| Z*                                       | 250 VDC     | A/R | 1860159-Z     | 1860155-Z        | 1860162-Z      |

**Table 9 (Explosion Proof Coils)**

| Table 9 (Explosion Proof Coils) |             |             |             |              |
|---------------------------------|-------------|-------------|-------------|--------------|
|                                 |             | D (CENELEC) |             | U (UL & CSA) |
| SOL CONNECTION                  |             | 7           |             | 7            |
| ITEM                            |             | 7           |             | 7            |
| CODE                            | DESCRIPTION | QTY         | PART NUMBER | PART NUMBER  |
| YE                              | 120/60 VAC  | A/R         | 1302310-Y   | 132308-Y     |
| TE                              | 240/60 VAC  | A/R         | 1302310-T   | 132308-T     |
| PE                              | 110/50 VAC  | A/R         | 1302310-P   | 132308-P     |
| NE                              | 220/50 VAC  | A/R         | 1302310-N   | 132308-N     |
| KE                              | 12 VDC      | A/R         | 1302310-K   | 132308-K     |
| JE                              | 24 VDC      | A/R         | 1302310-J   | 132308-J     |
| DE                              | 120 VDC     | A/R         | 1302310-D   | 132308-D     |
| ZE                              | 250 VDC     | A/R         | 1302310-Z   | 132308-Z     |

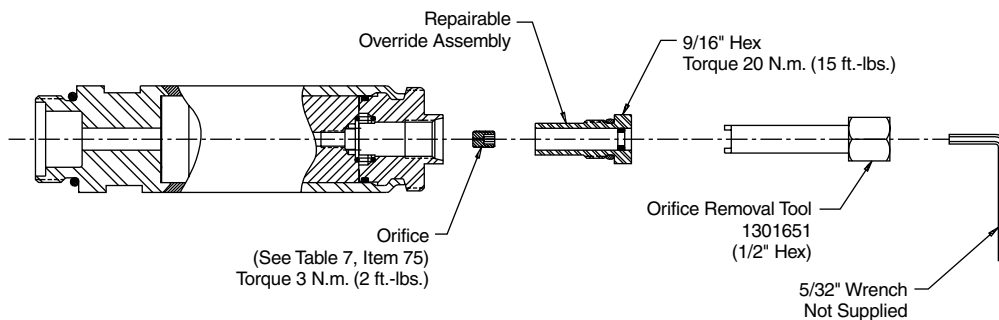
**Table 10 (Springs)**

| CODE         | ITEM | PART NUMBER | QTY | DESCRIPTION   |
|--------------|------|-------------|-----|---|
| ALL EXCEPT F | 13   | 1301262     | 2   | AC SPRING FOR SPOOLS 1,2,3,4,5,6,11,12,15,16        |
|              |      | 1301263     |     | AC SPRING FOR SPOOLS 7,8,9,14                       |
| ALL EXCEPT F | 13   | 1800683     | 2   | DC SPRING FOR SPOOLS 1,3,4,5,6,10,11,15,16,21,81,82 |
|              |      | 1800684     |     | DC SPRING FOR SPOOLS 2,7,8,9,12,14                  |
| F            | 13   | 1800685     | 2   | DC LOW WATT SPRING FOR SPOOLS 1,3,4,5,6,11,15,16    |
|              |      | 1800686     |     | DC LOW WATT SPRING FOR SPOOLS 2,7,8,9,12,14         |

**Table 11 (Rectified Coils, AC Only)**

|                |                             | C/K (CONDUIT) |             | P/W (HIRSCHMANN) |
|----------------|-----------------------------|---------------|-------------|------------------|
| SOL CONNECTION |                             | 37            |             | 45               |
| ITEM           |                             | 37            |             | 45               |
| CODE           | DESCRIPTION                 | QTY           | PART NUMBER | PART NUMBER      |
| E*             | 24/50-24/60 VAC, 32/36 WATT | A/R           | 1860158-E   | 1860154-E        |
| Y*             | 120/60-110/50 VAC, 32 WATT  | A/R           | 1860158-Y   | 1860154-Y        |
| T*             | 240/60-220/50 VAC, 32 WATT  | A/R           | 1860158-T   | 1860154-T        |

**Detail A: Repairable Soft Shift Option  
 (Codes "RS4" and "RS7")**



**Solenoid Ratings\*\***

|   |              |
|---|--------------|
| <b>Insulation</b>                             | Class H      |
| <b>Allowable Deviation from rated voltage</b> | -10% to +15% |
| <b>Armature</b>                               | Wet pin type |

\*\* DC Solenoids available with optional molded metal oxide varistor (MOV) for surge suppression.  
 Leadwire length 6" from coil face.

**D3W\*\*\*\*F Solenoid Electrical Characteristics†**

| Solenoid Code | Nominal Volts/Hz | In Rush Amps | Holding Amps | Watts |
|---------------|------------------|--------------|--------------|-------|
| KF            | 12 VDC           | —            | 3.00         | 18    |
| JF            | 24 VDC           | —            | 0.75         | 18    |

† Based on nominal voltage @ 22°C (72°F)

**D3W Solenoid Electrical Characteristics†**

| Solenoid Code | Nominal Volts/Hz | In Rush VA | Holding VA | Nominal Watts (Ref) |
|---------------|------------------|------------|------------|---------------------|
| Y             | 120/60           | 298        | 95         | 32                  |
|               | 110/50           | 294        | 102        |                     |
| T             | 240/60           | 288        | 96         | 32                  |
|               | 220/50           | 288        | 101        |                     |
| E             | 24/60            | 290        | 77         | 32                  |
|               | 24/50            | 381        | 110        |                     |
| K             | 12 VDC           | —          | 3.00†      | 36                  |
| J             | 24 VDC           | —          | 1.50†      | 36                  |
| D             | 120 VDC          | —          | 0.30†      | 36                  |
| Z             | 250 VDC          | —          | 0.14†      | 36                  |

† DC holding amps.

**Explosion Proof Solenoids**

**Explosion Proof Solenoid Ratings**

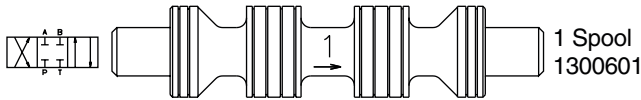
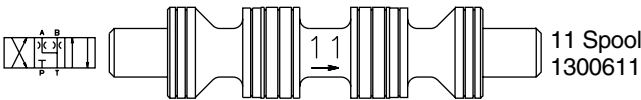
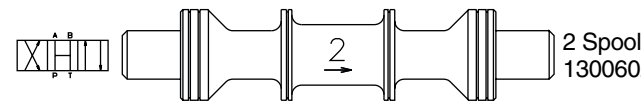
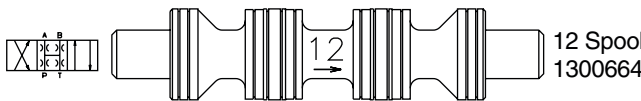
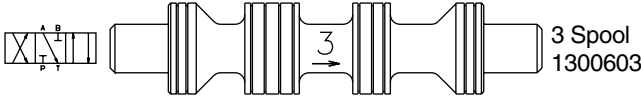
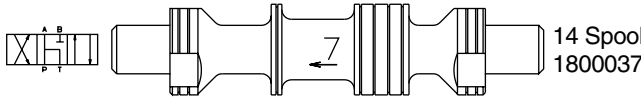
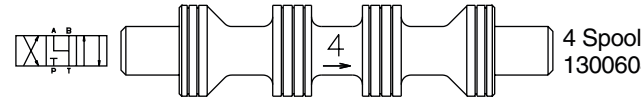
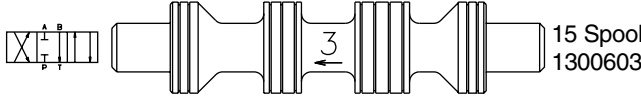
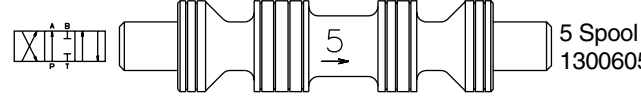
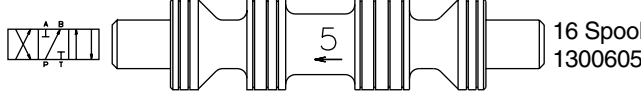
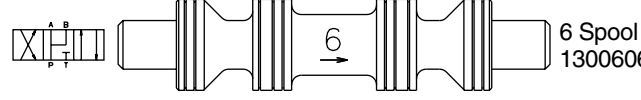
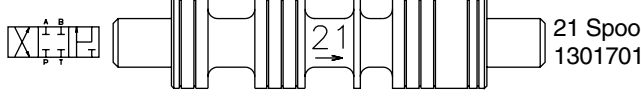
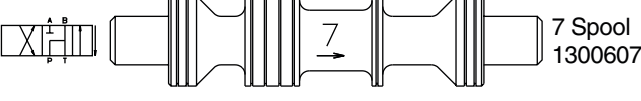
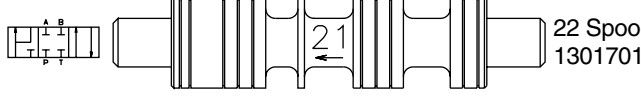
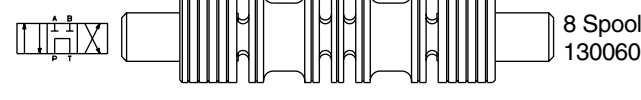
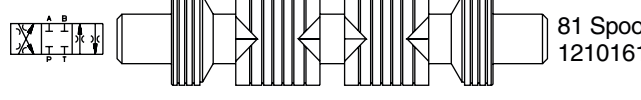
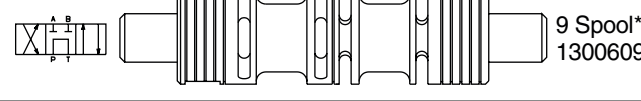
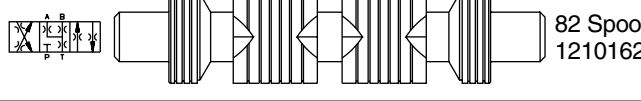
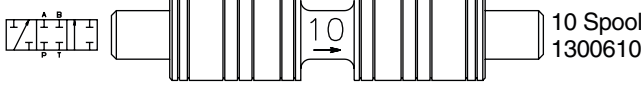
|                             |  |
|-----------------------------|--|
| <b>U.L. (EU)<br/>C.S.A.</b> | Class I, Div. 1 & 2, Groups C & D<br>Class II, Div 1 & 2, Groups E, F & G<br>As defined by the N.E.C |
| <b>CENELEC (ED)</b>         | Complies with BASEEFA requirements for BS5501: Parts 1 and 5 Ex'd<br>CENELEC EN50 – D18, Group II B  |

**Electrical Characteristics\* ED and EU**

| Solenoid Code | Nominal Volts/Hz | In Rush VA | Holding VA | Nominal Watts (Ref) |
|---------------|------------------|------------|------------|---------------------|
| Y             | 120/60           | 266        | 82         | 36                  |
| T             | 240/60           | 266        | 82         | 36                  |
| K             | 12 VDC           | —          | 3.00†      | 36                  |
| J             | 24 VDC           | —          | 1.50†      | 36                  |
| D             | 120 VDC          | —          | 0.30†      | 36                  |
| Z             | 250 VDC          | —          | 0.14†      | 36                  |

\*Dual frequency not available on explosion proof coils.

† DC holding amps.

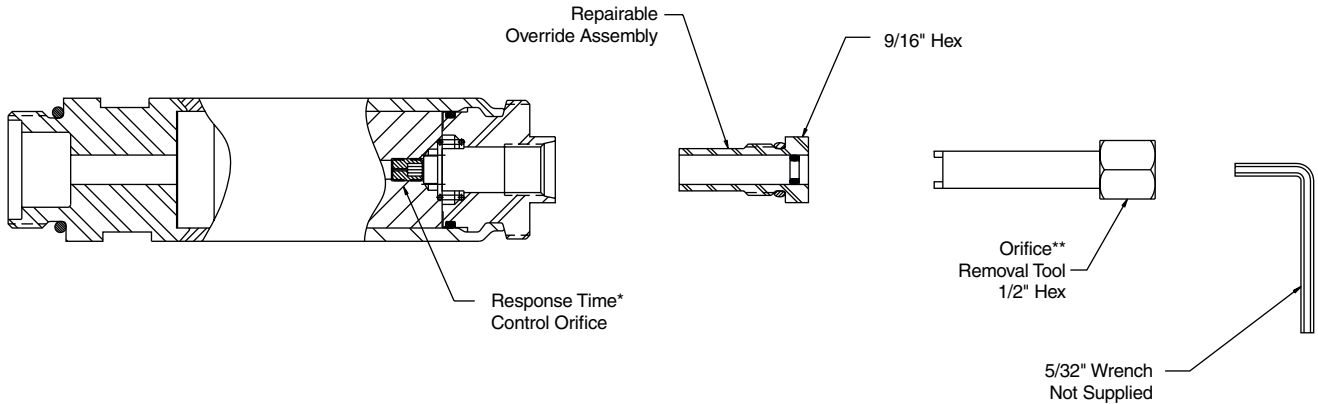
| <p>A-SOLENOID<br/>*(B-SOLENOID)</p>  | <p>A-SOLENOID<br/>*(B-SOLENOID)</p>  |
|--|--|
|  <p>1 Spool<br/>1300601</p>     |  <p>11 Spool<br/>1300611</p>   |
|  <p>2 Spool<br/>1300602</p>     |  <p>12 Spool<br/>1300664</p>   |
|  <p>3 Spool<br/>1300603</p>     |  <p>14 Spool<br/>1800037</p>   |
|  <p>4 Spool<br/>1300604</p>     |  <p>15 Spool<br/>1300603</p>   |
|  <p>5 Spool<br/>1300605</p>     |  <p>16 Spool<br/>1300605</p>   |
|  <p>6 Spool<br/>1300606</p>    |  <p>21 Spool<br/>1301701</p>  |
|  <p>7 Spool<br/>1300607</p>   |  <p>22 Spool<br/>1301701</p> |
|  <p>8 Spool*<br/>1300608</p>  |  <p>81 Spool<br/>1210161</p> |
|  <p>9 Spool**<br/>1300609</p> |  <p>82 Spool<br/>1210162</p> |
|  <p>10 Spool<br/>1300610</p>  |  |

\* 8 spool has closed crossover

\*\* 9 spool has open crossover

**Soft Shift with Tool**

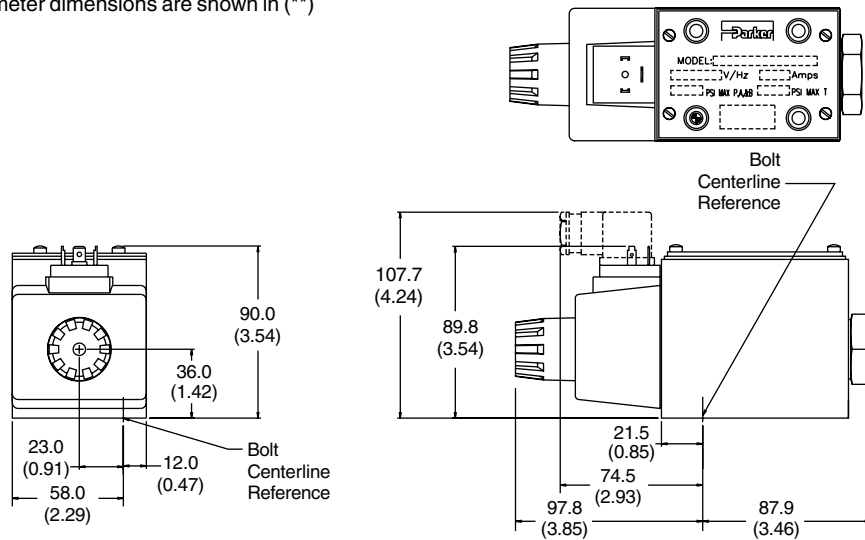
Repairable Soft Shift Tool



\*\* Orifice Removal Tool with Kit Part Number 1301661

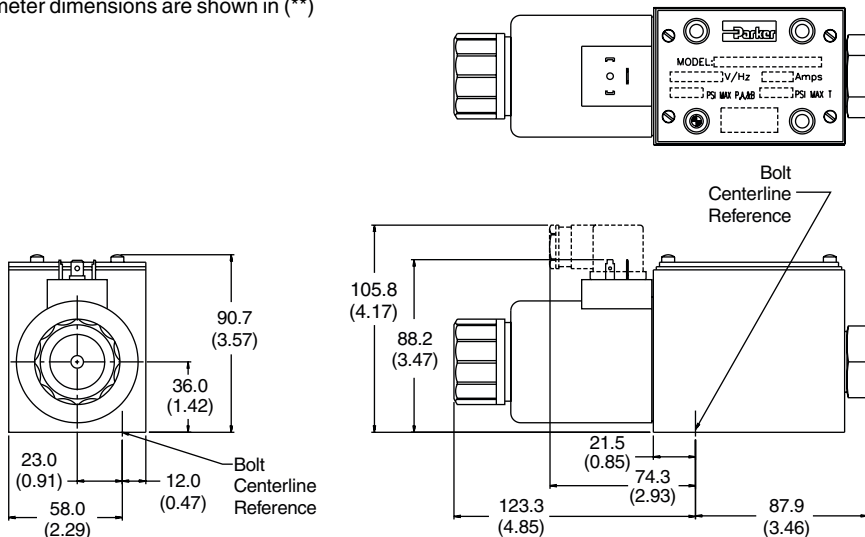
**Single Solenoid AC**

Inch equivalents for millimeter dimensions are shown in (\*\*)



**Single Solenoid DC**

Inch equivalents for millimeter dimensions are shown in (\*\*)





## Warning

Before any circuit connection is broken, be sure to turn off all power and relieve system pressure. Lower all vertical loads and cylinders, lock any load which could produce pressure and discharge any accumulators. Plug and cap all lines and openings to prevent contamination from entering the system.

## Cleaning and Inspection

1. Proper cleaning is a critical part of preventive maintenance in the use of directional control valves. All parts should be cleaned with a solvent that is compatible with the system fluid. Compressed air may also work well when cleaning orifices and passage ways, but proper filtration must be employed to remove water and contamination.

**NOTE:** Always make sure all parts have been cleaned before reassembling.

### 2. Inspection

- a. Inspect all passage ways for obstructions.
  - b. Inspect all washers, push pins, plungers and pole faces for signs of wear and/or mushrooming. Inspect all springs for signs of distortion. Replace parts as necessary.
  - c. Look for nicks and burrs on the spool and bore lands. Nicks in these areas indicate likely contamination of the system fluid.
3. If there are no signs of nicks or burrs on the spool and bore, check the spool movement as follows:
- a. Lubricate the spool and bore with clean system fluid.
  - b. Insert the spool back into the body and slowly move the spool back and forth. The spool should move freely. If there is any sticking between the spool and the bore, remove the spool and repeat 2a, 2c and 3a.
  - c. The spool movement can also be checked by placing the valve body on end and inserting the spool. Gravity will pull the spool to the other end if there is no sticking.
  - d. After several attempts have been made without resolution, replace the valve.

## Troubleshooting

### Problem: Valve spool fails to move

|                   | Cause                             | Recommendation   |
|-------------------|-----------------------------------|--|
| <b>Mechanical</b> | Recommended flow exceeded         | Check maximum flow rate for appropriate spool by spool function. |
|                   | Recommended pressure exceeded     | Check maximum pressure rating for valve.                         |
|                   | Improper installation connections | Check installation drawings.                                     |
|                   | Contamination in system           | Disassemble, inspect, clean and flush.                           |
|                   | Improper assembly                 | Check proper assembly. Refer to drawing for appropriate model.   |
|                   | Valve has silted                  | Disassemble and clean valve.                                     |
| <b>Electrical</b> | Power off                         | Turn power on.   |
|                   | Improper voltage                  | Check voltage requirements for valve model.                      |
|                   | Faulty connection                 | Check connections.   |
|                   | Faulty coil                       | Check coil resistance.   |

**Problem: Valve produces undesirable response**

|                   | <b>Cause</b>  | <b>Recommendation</b>  |
|-------------------|---|--|
| <b>Mechanical</b> | Recommended flow exceeded   | Check maximum flow rate for appropriate spool by spool function. |
|                   | Recommended pressure exceeded   | Check maximum pressure rating for valve.                         |
|                   | Improper installation connections   | Check installation drawings.                                     |
|                   | Contamination in system   | Disassemble, inspect, clean and flush.                           |
|                   | Improper assembly   | Check proper assembly. Refer to drawing for appropriate model.   |
|                   | Improper fluid  | Check fluid recommendations.                                     |
|                   | Recommended temperature exceeded (indicated by fluid discoloration or spool tarnishing) | Check maximum temperature recommendations.                       |
|                   | Incorrect orifice size (soft shift only)  | Check orifice size for desired response time.                    |
| <b>Electrical</b> | Improper voltage  | Check voltage requirements for valve model.                      |
|                   | Faulty connection   | Check connections.   |
|                   | Faulty coil   | Check coil resistance.   |

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**2. Payment:** Payment shall be made by Buyer net 30 days from the date of delivery of the items purchased hereunder. Amounts not timely paid shall bear interest at the maximum rate permitted by law for each month or portion thereof that the Buyer is late in making payment. Any claims by Buyer for omissions or shortages in a shipment shall be waived unless Seller receives notice thereof within 30 days after Buyer's receipt of the shipment.

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

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

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

**7. Special Tooling:** A tooling charge may be imposed for any special tooling, including without limitation, dies, fixtures, molds and patterns, acquired to manufacture items sold pursuant to this contract. Such special tooling shall be and remain Seller's property notwithstanding payment of any charges by Buyer. In no event will Buyer acquire any interest in apparatus belonging to Seller which is utilized in the manufacture of the items sold hereunder, even if such apparatus has been specially converted or adapted for such manufacture and notwithstanding any charges

paid by Buyer. Unless otherwise agreed, Seller shall have the right to alter, discard or otherwise dispose of any special tooling or other property in its sole discretion at any time.

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

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

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

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

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

9/91-P



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