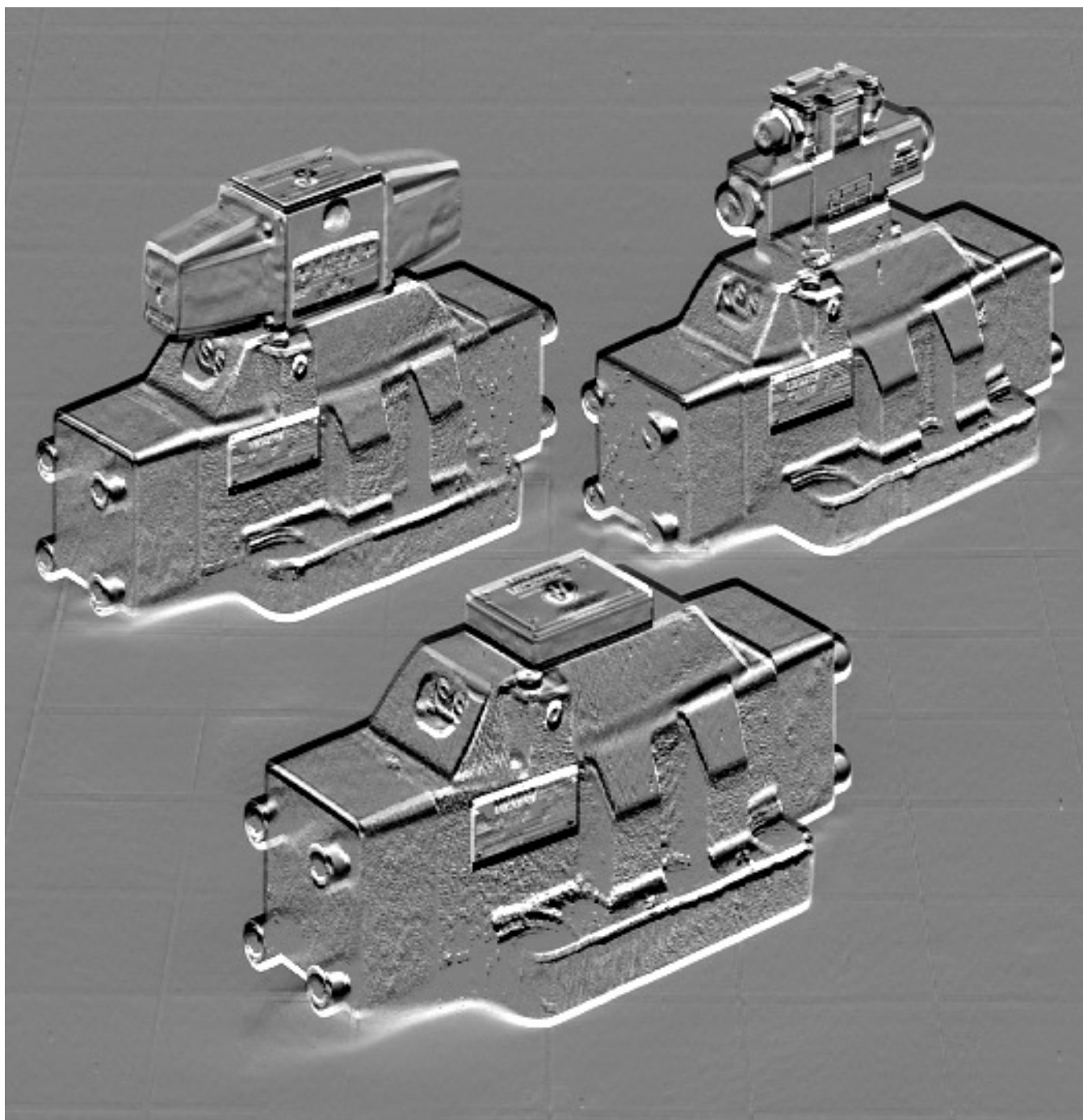


Directional Control Valves



DG3V-10/DG5V-10 Solenoid Pilot Operated



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Section I. - Introduction

A. Purpose of Manual

This manual describes operational characteristics, maintenance requirements, and overhaul information for Vickers by Danfoss DG3V-10 and DG5V-10 series single stage and two stage pilot operated and hydraulic operated directional valves. The information contained herein pertains to the latest design series as listed in Table 1.

B. Related Publications

Service parts and installation dimensions are not contained in this manual. The parts and installation drawings listed in Table 1 are available from any Vickers by Danfoss Distributor

C. Model Codes

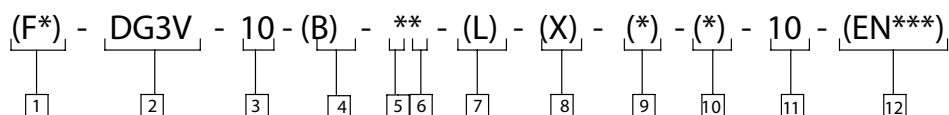
Variations within each basic model series are covered in the model code. See Table 2. Each unit has a model code stamped into the main stage nameplate. Service inquiries should always include the complete model number as noted on the nameplate.

Model Description	Application Drawing	Parts Drawing
DG3V-10*A	5007.01/EN/0196/ A	5007.05/EN/0496/S
DG3V-10*C		
DG3V-10*D		
DG5V-10*A		5007.06/RN/0496/S
DG5V-10*B		
DG5V-10*C		
DG5V-10*D		
DG5V-10*DA		
DG5V-10*DB		
DG5V-10*N		

Table 1. Related Publications

Model Code Breakdown

Model Code



1 Special Seals (Omit if not required) F3 - Seals for fire resistant fluids. F6 - Seals for water glycol.	33 - Closed P, open A&B to T over tapers 52 - Closed center, regen. by sol. 'A' 521 - Closed center, regen. by sol. 'B'	7 - Stroke adjusters on cylinder 'A' end only (available on AL, C & Blank (no spring) models) 8 - Stroke adjusters on cylinder 'B' end only (available on AL, C, & Blank (no spring) models) 2-7 - If both are required (available on A, C, & Blank (no spring) models) 2-8 - If both are required (available on AL left hand build, C & Blank (no spring) models)
2 Directional Control Valve DG3V - Subplate mounting; pilot operated, remote operator. Pressure rating 350 bar (5000 psi) for P, A & B ports. (See pressure tabulation below.)	6 Spool/Spring Arrangement Blank - No spring A - Spring offset to cylinder 'A' C - Spring centered D - Pressure centered 140-210 bar (2000 - 3000 psi) (See spool/spring combinations below)	
3 Valve Size 10 - Valve size CETOP 10, ISO 4401-10, NFPA D10	7 Left Hand Build L - 'A' Models only, omit if not required.	10 Check Valve in Pressure Port Not available for 'D' models Omit if not required. K - 0,3 bar (5 psi) check Q - 2,4 bar (35 psi) check R - 3,4 bar (50 psi) check S - 5,2 bar (75 psi) check
4 Gauge Ports Blank - .4375-20 UNF-2B Thread B - 1/4 BSP Thread	8 Fast Response X - Not available with CETOP 3 pilots or pressure centered 'D' and 'DB' models.	
5 Spool Types 0 - Open to T all ports 1 - Open P&A to T, closed B 2 - Closed to T all ports 3 - Closed P&B, open A to T 4 - Tandem P to T, closed crossover 6 - Closed P only, open A&B to T 7 - Open P to A&B, closed T 8 - Tandem P to T, open crossover 9 - Open to T all ports over tapers 11 - Open P&B to T, closed A 31 - Closed P&A, open B to T	9 Spool Control Modifications (Omit if not required) 1 - Stroke adjustment (both ends) available on C & Blank (no spring) models 2 - Pilot choke adjustment (available on all models) 3 - Pilot choke and stroke adjusters (both ends) (available on C & Blank (no spring) models)	11 Design Number Subject to change. Installation dimensions remain as shown for design numbers 10 through 19.
		12 Special Modifications (Omit if not required) EN503 - Reduced overall axial length for close quarter applications.

Model Code

(F*) - DG5V - 10- * - (R) - (B) - * - (L) - (**) - (X) - (*) - (E) - (T) - (*) - (V)M - (S*) - * * * * - (L) - (*) - * - (**) - 10 - (EN***)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

1 Special Seals

(Omit if not required)

F3 - Seals for fire resistant fluids.

F6 - Seals for water glycol.

2 Directional Control Valve

DG5V - Subplate mounting; solenoid controlled; pilot operated. Pressure rating 350 bar (5000 psi) for P, A, & B ports.

Note

Note: 210 bar (3000 psi) for pressure centered D models.

3 Valve Size

10 - Valve size CETOP 10, ISO 4401-10, NFPA D10

4 Pilot Valve Type

H - CETOP 3 mounting pattern, High performance

S - CETOP 3 mounting pattern, Std. performance

A - CETOP 5 mounting pattern, Air gap

F - CETOP 5 mounting pattern, Wet armature

V - CETOP 5 mounting pattern, Wet armature

W - CETOP 5 mounting pattern, Wet armature

(See page NO TAG for descriptions)

5 Reducer Module

(Omit if not required)

R - A (air gap) and W (wet armature) piloted models when pilot pressure exceeds 210 bar (3000 psi); F and V (wet armature) when pilot pressure exceeds 310 bar (4500 psi).

6 Gauge Ports

Blank - .4375-20 UNF-2B Thread

B - 1/4 BSP Thread

M - ISO 6149 port

7 Spool Types

0 - Open to T all ports

1 - Open P&A to T, closed B

2 - Closed to T all ports

3 - Closed P&B, open A to T

4 - Tandem P to T, closed crossover

6 - Closed P only, open A&B to T

7 - Open P to A&B, closed T

8 - Tandem P to T, open crossover

9 - Open to T all ports over tapers

11 - Open P&B to T, closed A

31 - Closed P&A, open B to T

33 - Closed P, open A&B to T over tapers

52 - Closed center, regen. by sol. 'A'

56 - A&B to T, P blocked, regen.

by sol. 'A'

521 - Closed center, regen. by sol. 'B'

561 - A&B to T, P blocked, regen.

by sol. 'B'

8 Spool/Spring Arrangement

A - Spring offset

B - Spring centered with solenoid 'A' removed

C - Spring centered

D - Pressure centered 210-350 bar (2000-3000 psi)

DA - Pressure centered 20-70 bar (300-1000 psi)

DB - Pressure centered 70-210 bar (1000-2000 psi)

N - Detented

9 Left Hand Build

L - Single solenoid models only, omit if not required.

10 Manual Override Options

CETOP 3 piloted models only, omit if not required.

Blank - Plain override in solenoid ends only.

H - Waterproof override in solenoid ends only.

H2 - Waterproof override in both ends of single solenoid.

P2 - Plain override in both ends of single solenoid.

Y - Lockable manual override in solenoid ends only.

Z - No override in either end.

11 Fast Response

X - (Omit for standard internal pilot pressure models)

Note

Not available for pilot pressures above 210 bar (3000 psi), pressure centered models must have 'DA' 20-70 bar (300-1000 psi) in model code. Not available for H or S piloted models.

12 Spool Control Modifications

(Omit if not required)

1 - Stroke adjustment (both ends) (available on B, C, & N models)

2 - Pilot choke adjustment (available on all models)

3 - Pilot choke and stroke adjustments (both ends) (available on B, C, & N models)

7 - Stroke adjustment on cylinder 'A' end only (available on A, B, C, & N models)

8 - Stroke adjustment on cylinder 'B' end only (available on AL, B, C, N, & D(*) models)

2-7 - If both are required (available on A, B, C, & N models)

2-8 - If both are required (available on AL, B, C, N, & D(*) models)

CAUTION



Stroke adjust pilot pressure models are rated to a maximum of 210 bar (3000 psi). Use reducer module if pilot pressure exceeds 210 bar (3000 psi).

13 External Pilot Pressure

E - External pilot pressure. Omit for internal pilot pressure models.

14 Internal Pilot Drain

T - Internal pilot drain to 'T' port. Omit for external pilot drain models.

15 Check Valve in Pressure Port

Not available for D(*) models. Omit if not required.

K - 0,3 bar (5 psi) check

Q - 2,5 bar (35 psi) check

R - 3,5 bar (50 psi) check

S - 5, bar (75 psi) check

Section II. - Description

A. General

Directional valves are devices used to change the flow direction of fluid within a hydraulic circuit. A valve is designed to control the direction of movement of a work cylinder or the direction of rotation of a fluid motor.

B. Basic Four-Way Sliding Spool Directional Valve Construction

Vickers valve bodies have a precision machined bore in which a very close tolerance spool is suspended on a film of hydraulic fluid. Spool lands and body cavities are designed to divide the bore openings into separate chambers. Ports in the body lead into these chambers so that spool position determines which ports are open or closed. See Figure 1. Oil

flow is directed from one port to another within the body and out of a port to the work

C. Two Stage Directional Valve Construction

Two stage directional valves are pilot pressure operated. A two stage valve is constructed by combining a pilot valve and a larger main stage valve into one assembly. The pilot valve, usually a DG4S4 or DG4V-3 is mounted on top of the main stage valve. The pilot valve controls spool movement with the electrical solenoids. When a solenoid is energized (activated), the pilot spool moves and fluid is diverted to the mainstage; thus controlling main stage spool movement. Figure 2 illustrates the basic construction of a two stage, pilot operated directional valve.

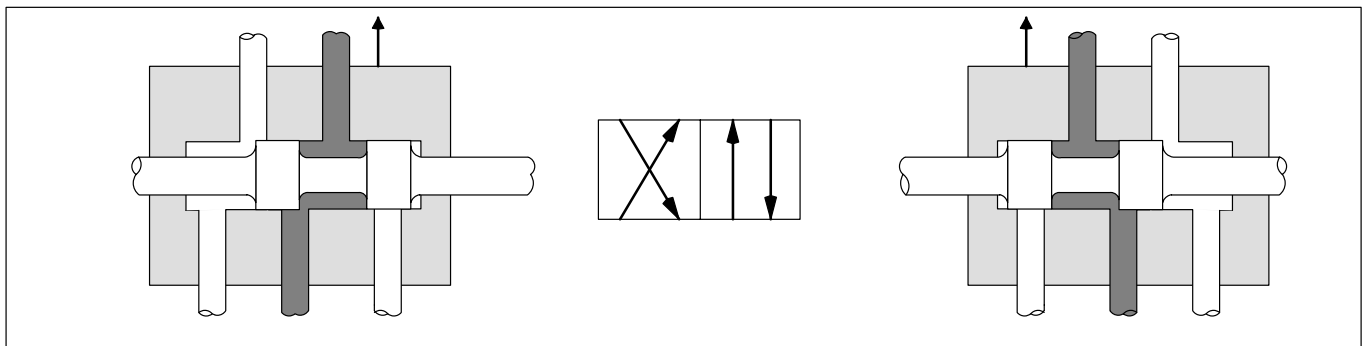


Figure 1. Spool Type Four-Way Valve

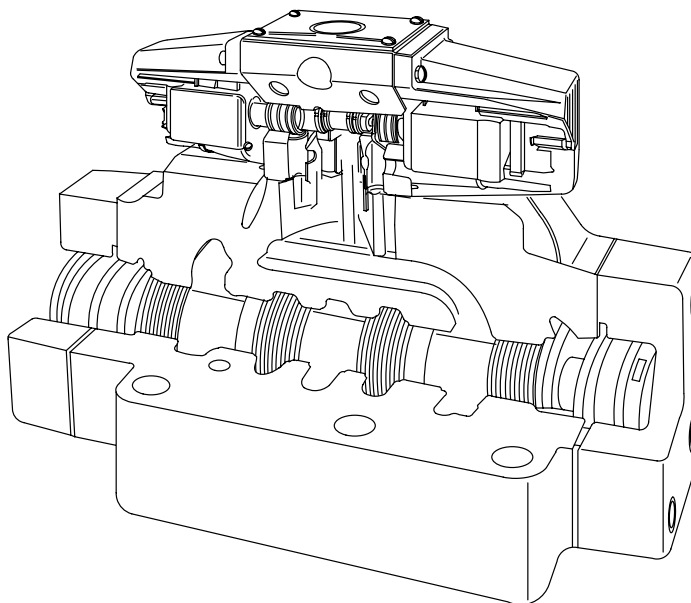


Figure 2. Typical 'DG5' Type Solenoid Controlled, Pilot Operated Valve

Section III. - Valve Operation

A. General

Directional valve operation is determined by four factors: spool type, spool positioning, method of control, and special features. Proper selection of the above factors establish and regulate desired flow paths through the internal ports of the valve. The following information discusses those factors with respect to valve operation.

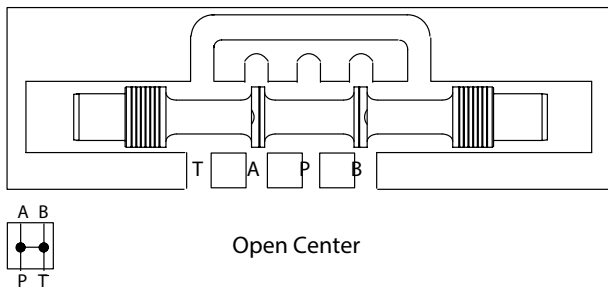
B. Spool Types - Main Stage Section

Operation of spools are governed by their design as well as the means of control. The most common designs are open center, closed center and tandem. During the following discussion, basic spool design is related to valve port openings, with the spool in center position. Port openings are stated as: P-Pressure Port, A&B-Actuator Ports, and T-Tank or Reservoir Port.

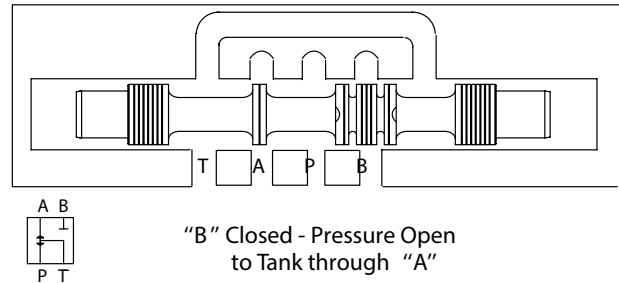
1. Open Center Spools (0, 1, 9 and 11 types): Open center valves are used in single operations where no other operation is performed by the same source of power and where cylinders do not have to be held by pressure. Open center spools are also used to minimize shock in a system. Shock develops when a valve spool is shifted from one position to another across center position. The smoothest possible minimum shock condition is obtained when fluid under pressure is allowed to discharge to tank as the spool passes center condition.

Open center with (A) or (B) ports blocked. A spool of this type is generally used to operate a cylinder. When the spool is centered, a cylinder port is blocked and the cylinder is held in a definite position. In some circuits, flow from the tank port is piped into the pressure port of another valve. This allows the same source of power to operate two different cylinders. This type of arrangement may be used in a system containing a number of operations. However, each operation must be performed in a certain sequence, with only one operation taking place at any one time.

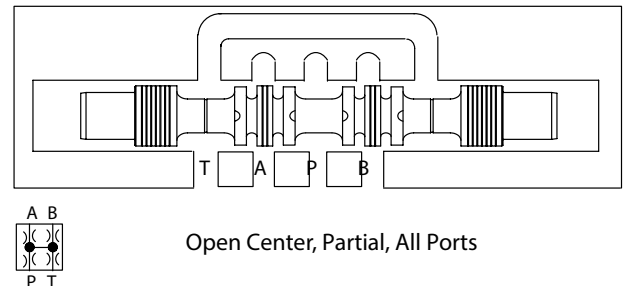
A. Type '0' spool is designed with ports (P), (B), (A) and (T) interconnected when the spool is in center position. These ports are momentarily interconnected during spool crossover when the pilot valve solenoid is activated. This permits smooth rapid cycle operation.



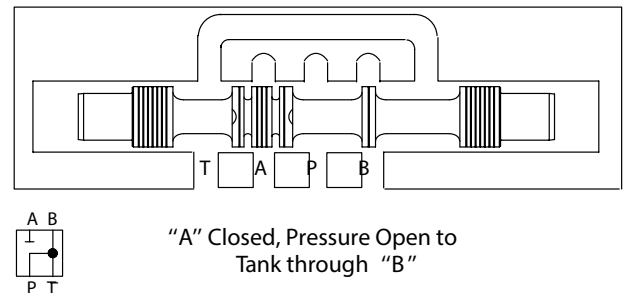
B. Type '1' spool is designed with ports (P), (A) and (T) interconnected. Port (B) is blocked in center position.



C. Type '9' spool is similar to type '0' spool except all ports are partially open in center position.

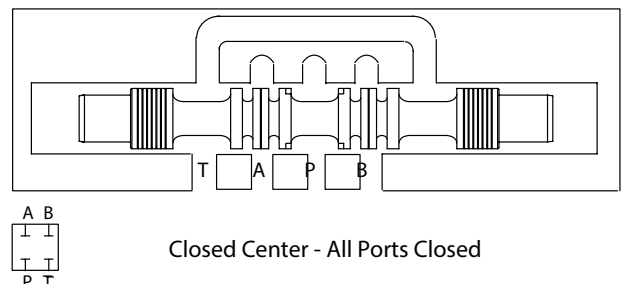


D. Type '11' spool is a type '1' spool reversed in the bore. The type '11' spool interconnects (P), (B) and (T) in center position with (A) blocked.

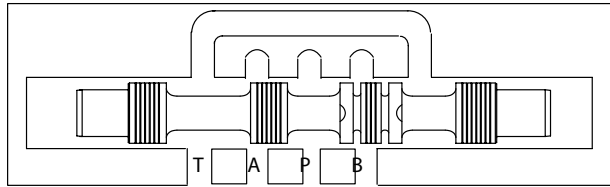


2. Closed Center Spools (2, 3, 6, 31, 33, 52 and 521 types): Closed center spools are used where two or more operations are performed by a single pump or an accumulator. Closed center valves prevent the loss of fluid from the pump or accumulator when the spool crosses center.

A. Type '2' spool blocks ports (P), (A), (B) and (T) from one another in the center position. The ports are momentarily blocked during spool crossover.

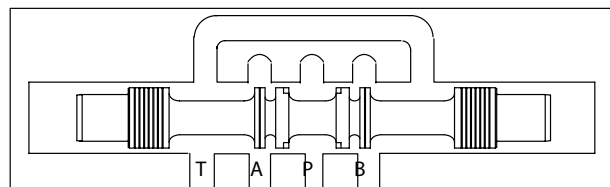


B. Type '3' spool is designed with ports (A) and (T) interconnected and ports (P) and (B) blocked in the center position.



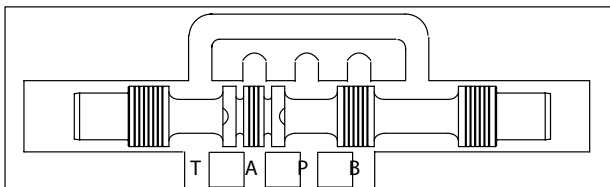
Pressure and "B" Closed - "A" Open to Tank

C. Type '6' spool is interconnected at ports (A), (B) and (T). Port (P) is blocked in the center position.



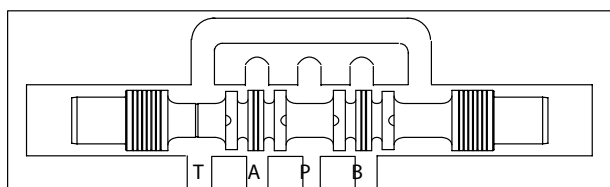
Pressure Closed - "A" & "B" Open to Tank

D. Type '31' spool is a type '3' spool reversed in the bore. A type '31' spool is interconnected at ports (B) and (T), but blocked at ports (P) and (A) in the center position.



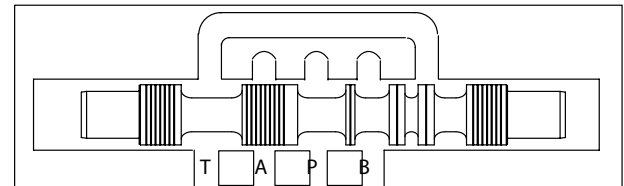
Pressure and "A" Closed - "B" Open to Tank

E. Type '33' spool provides controlled leakage from port (A) and (B) to port (T). Port (P) is blocked in the center position.



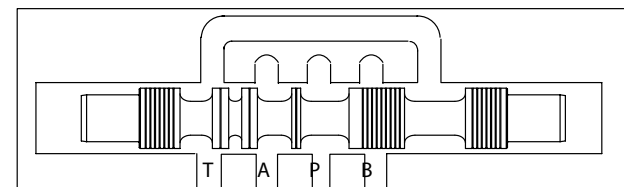
Closed Center - Bleed "A" & "B"

F. Type '52' spool



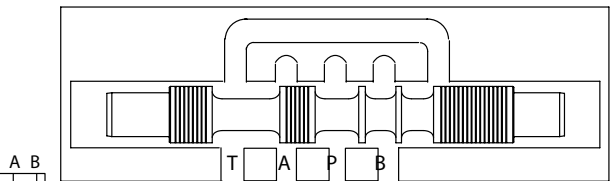
Closed Center, Regen. by Solenoid 'A'

G. Type '521' spool

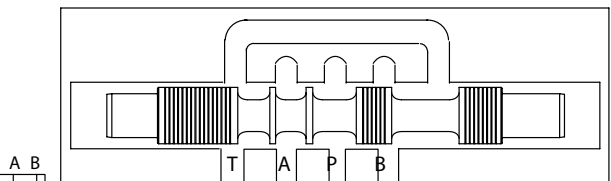


Closed Center, Regen. by Solenoid 'B'

H. Type '56' spool

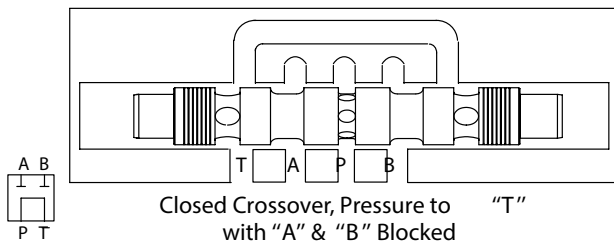


I. Type '561' spool

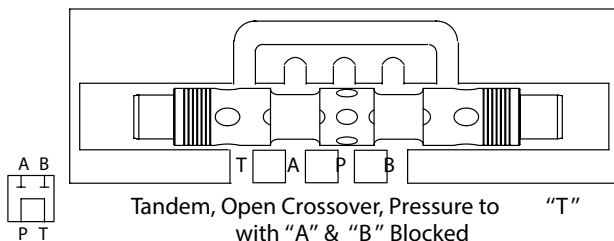


3. Tandem spools (4 and 8 types): Tandem spool valves are used in hydraulic circuits where two or more hydraulic cylinders or motors are controlled from a single source of power. The valve's spool is designed so that in center position, all cylinder connections are blocked and full pump delivery is connected to tank. The tank connection of one valve may be connected to the pressure connection of another valve and both valves operated simultaneously as long as the combined pressures developed by the two loads are within the capabilities of the power source.

A. Type '4' spool allows oil to circulate freely from port (P) to port (T) in the center position. Ports (A) and (B) are blocked to the workload.



B. Type '8' spool is designed similar to type '4' spool. Ports (P) and (T) are connected in the center position. However, ports (A) and (B) are momentarily open during spool crossover.



C. Methods of Spool Control, Main Stage

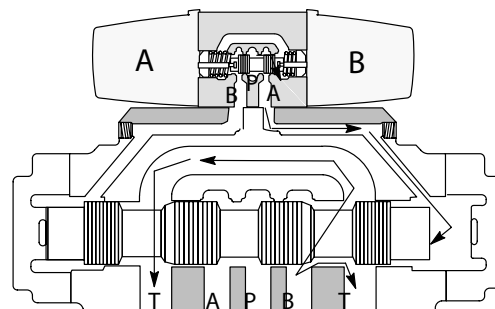
1. Remote Pilot Source: Main stage valves are available for use with a remote source. This means that the valve is shifted from a remote pressure source by other valves in the logic circuit.
2. Integral Pilot Valve: The integral pilot type two stage valve is a very common valve used in the field today. Two stage valves allow large volumes of fluid to be switched to and from an actuator with minimum power required for control. Reference figures 3 through 7 shown in the following section.

D. Main Stage Spool Position

Main stage spools are positioned within the valve by special arrangements. The four basic main stage positioning arrangements are: no spring-floating, spring centered, spring offset and pressure centered.

The following paragraphs (1 through 4) describe these arrangements. A fifth function can be obtained by the use of a detent pilot valve. This function is described in paragraph five.

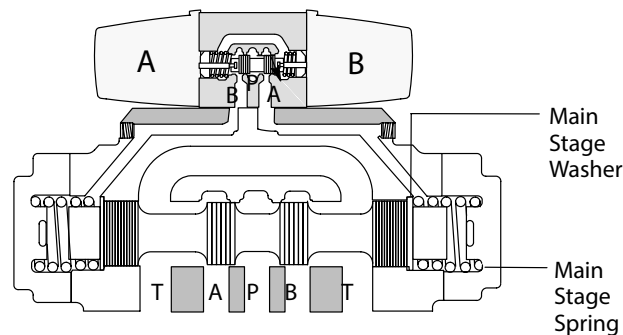
1. No Spring-Floating: When centering springs are omitted from the main stage spool, the spool is said to be floating. If control pressure is removed, a floating spool can move from its last position under the influence of gravity or tank line pressure. This must be considered during the design of the system. Units with floating type spools have the model code letter omitted. Figure 3 illustrates floating spool positioning in a two-stage valve.



1. Solenoid "A" is energized and shifts pilot spool to the right. This opens pressure to pilot port "A" and the main stage spool.
2. When solenoid "A" is energized, the main stage spool will shift left. Flow from P → A and B → T is obtained.
3. Main stage spool will stay in this position until solenoid "B" is energized, but may float to other positions with both solenoids de-energized.

Figure 3. No Springs, Floating Model

2. Spring Centered: A spring and washer arrangement is used on both ends of the main stage spool in the spring centered configuration. If control pressure is removed from a spring centered spool, the valve will go to the center position due to spring force. Two configurations of a two-stage spring centered valve can be obtained, a type 'B' and a type 'C'. If one solenoid is used on a spring centered pilot valve, the model code is identified with the letter 'B'. When two solenoids are used, the model code is identified with the letter 'C'. Figure 4 illustrates spool positioning of a two-stage spring centered 'C' model.



1. Solenoids are de-energized. Pilot spool is in center position due to spring force.
2. Main stage springs and washers keep main stage spool at center position. Flow is A & B → T with → P blocked.
When solenoid "A" is energized, the pilot spool will shift to the right, causing the main stage spool to shift left. Flow would then be P → A and B → T.

Figure 4. Spring Centered "C" Model

3. **Spring Offset:** Single stage spring offset models use one spring to return the spool to an offset position. In two-stage models, the spring and washer is removed from the main stage and offset action is obtained from the pilot valve. Offset pilots have a solenoid removed from the spring end of the valve. Spring offset pilots have a solenoid removed from the spring end of the valve. Spring offset pilots control the main stage when the solenoid is de-energized, through spring action, so long as pilot pressure is available. Spring offset valves have the letter 'A' stamped into the nameplate. Figure 5 illustrates an offset two-stage valve.

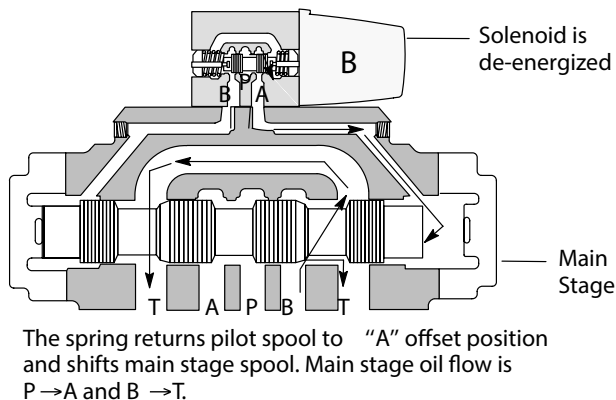


Figure 5. Spring Offset "A" Model

WARNING

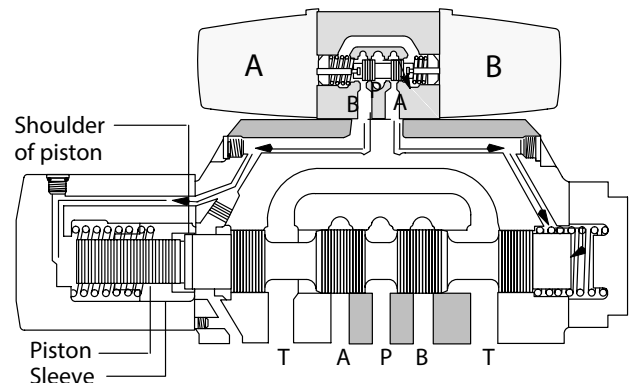
If pilot pressure is lost, mainstage spool is free to float.

4. **Pressure Centered:** Pressure centered valves provide more positive centering arrangement than normal spring centered valves. This is accomplished in the following manner:

Assume both pilot valve solenoids are de-energized and the main stage spool is positioned to the left (see Figure 6). Pilot pressure is applied to both ends of the main stage from the number seven (7) pilot spool. The sleeve moves to the right under the influence of the spring and pilot pressure until the position shoulder is contacted. Since the sleeve and piston areas are greater than the total spool area at the right hand end of the valve, the sleeve continues to move to the right carrying the piston with it until it contacts the valve body (center position).

Assume the main stage spool was positioned to the right with both pilot valve solenoids de-energized, pilot pressure is applied to the sleeve and piston areas on the left side but the sleeve is bottomed against the valve body at this time. Only the piston area applies force to the left end of the spool. Since the spool land area at the right side is greater than the piston area, the spool will be forced to the left until the piston shoulder butts against the sleeve (center position).

If pilot pressure falls below 20 bar (300 psi), the centering springs will cause the spool to center within the valve body.



1. Solenoids are de-energized. Pilot spool is in center position. (P → A & B, T blocked) (shown).
2. Pilot pressure keeps main stage spool in center position. Flow is blocked to all ports.
3. When solenoid "B" is energized, the pilot spool shifts to the left. Oil under pressure enters piston area causing the main stage spool to shift to the right. Main stage flow from P → B and A → T is obtained.

Figure 6. Pressure Centered "D" Model

Pressure centered valves are not available with integral check valves. Pressure centered models have the letter 'D' stamped into the unit nameplate. Figure 6 illustrates spool/spring arrangements on pressure centered models.

Note

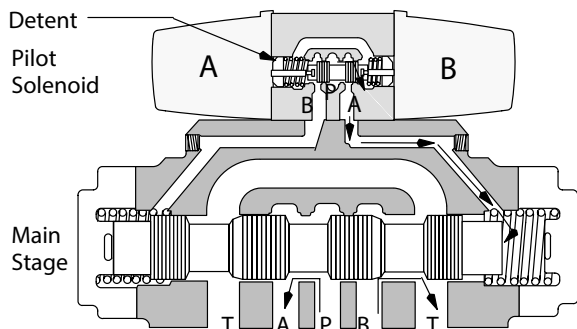
A fifth condition of the main stage spool can be obtained through the use of a detent pilot stage. Refer to the following paragraph.

5. **Detent Valve Operation:** Detent valve operation can be achieved by installing a detent into the pilot valve. A detent is assembled on one or both ends of the pilot spool depending on the type of pilot valve used. When a pilot valve solenoid is de-energized, the detent holds the pilot spool in the last position attained and the main stage spool remains in its last position.

WARNING

If pilot pressure fails or falls below the minimum requirement of 5 bar (75 psi), the main stage spool will shift to center position even though the pilot valve remains in the last detent position. For this reason, flow conditions in center or neutral position must be selected with care.

Detent models are indicated by the letter 'N' stamped into the unit nameplate. Figure 7 illustrates the spool/spring arrangement on detent models.



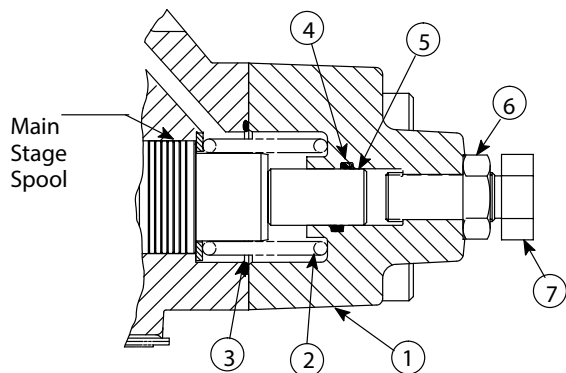
1. Solenoid "A" is energized and shifts pilot spool to the right.
2. Which causes main stage spool to shift left. Oil flow from P → A and B → T is obtained.
3. Main stage spool remains in position attained due to pilot valve detent until solenoid "B" is energized. (Note: If pilot pressure fails, the main stage will shift to center position.)

Figure 7. Detented "N" Model

E. Optional Features (Main Stage)

Control of the mainstage spool travel can be modified with certain optional features. The most common features are discussed in the following paragraphs.

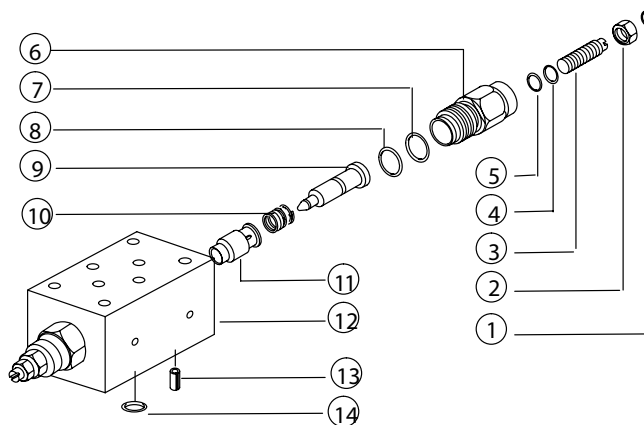
1. Stroke Limiter Adjustment (Fig. 8): Main stage spool travel can be limited by using stroke adjust covers. Stroke adjust covers may be used on one or both ends of the main stage section. When the stroke is limited, maximum flow through the valve is reduced (assuming same inlet pressure). This slows the actuator movement. To limit the spool travel, loosen the jam nut and turn adjusting screw clockwise.



Part No.	Part Name	Part No.	Part Name
1	Cover	5	Piston
2	Spring	6	Jamnut
3	O-Ring	7	Adjuster Screw
4	Back-up Ring		

Figure 8. Stroke Adjuster Feature

2. Pilot Choke Option (Fig. 9): A pilot choke increases the amount of time it takes to shift the main stage spool from one position to another. Increasing shift time lowers the possibility of developing large flow transients in the circuit. A pilot choke is designed to allow free flow to one end of the main stage spool but restricts flow out of the opposite end. The rate of spool travel, in either direction, can be slowed by loosening a locknut and turning an adjusting screw clockwise. To increase the rate of spool travel, turn the adjusting screws counterclockwise. When a pilot choke is used, pilot pressure should be taken from a constant pressure source. The pilot choke is mounted between the pilot valve and the main stage sections.



Part No.	Part Name	Part No.	Part Name
1	Retaining Ring	8	Back-up Ring
2	Nut	9	Needle
3	Adjusting Screw	10	Spring
4	"O" Ring	11	Sleeve
5	Back-up Ring	12	Body
6	Needle Housing	13	Dowel Pin
7	"O" Ring	14	"O" Ring

Figure 9. Pilot Choke

3. Reducer Module (Fig 10): The reducer module is required for Air Gap and Wet Armature piloted models when pilot pressure exceeds 210 bar (3000 psi). These two-stage spool valves maintain a reduced outlet pressure against variations in inlet pressure. These valves are able to act as relief valves (at 50% of the maximum flow) to prevent excess pressure being developed when an actuator is subject to a reactive load.

4. Fast Response Option: Some applications require the main stage spool to shift at a faster than normal rate. For such applications, the fast response option is used. This option requires the removal of an orifice plug within the main

stage body. When the orifice plug is removed, larger volumes of fluid will enter the pilot valve section. When the pilot valve shifts, the main stage spool responds at a faster rate. However, this also generates transients that increase system shock. For this reason, the fast response option is not recommended when pilot pressures exceed 210 bar (3000 psi). Fast response models have the letter "X" stamped into the unit nameplate (i.e. DG5V-10-062**X-51). Table 2 compares standard shift times to the fast response option. Figures 21 through 26 show the location of the orifice plugs that must be removed for the fast response option.

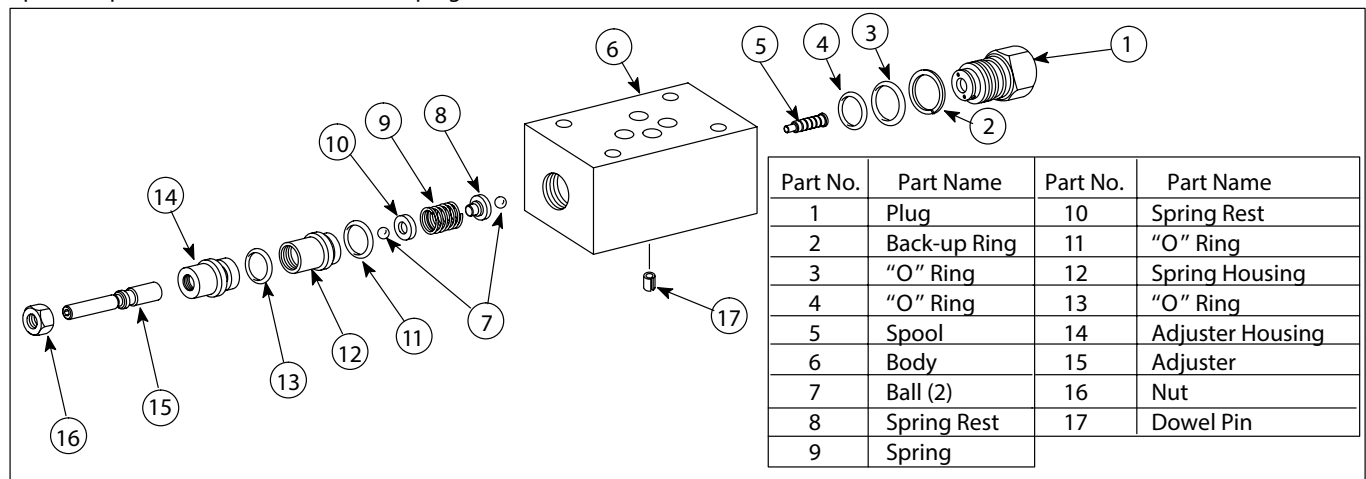


Figure 10. Reducer Module

Table 2. Shift Response Times w/CETOP 3 Pilot (Fast Response option not available)

Valve Type	Condition	Pilot Pressure 10 bar (150 psi)		Pilot Pressure 100 bar (1500 psi)		Pilot Pressure 210 bar (3000 psi)	
		Voltage		Voltage		Voltage	
		"AC "	"DC "	"AC "	"DC "	"AC "	"DC "
3-Position Spring Centered	Pilot Pressure Applied Shift from Center to Offset	50 mS	80 mS	45 mS	60 mS	35 mS	55 mS
2-Position Spring Offset	Pilot Pressure Applied Shift from Offset to Offset	200 mS	210 mS	90 mS	130 mS	75 mS	100 mS
3-Position Spring Centered	Pilot Pressure Removed Shift from Offset to Center	50 mS	75 mS ▲	50 mS	75 mS ▲	50 mS	75 mS ▲
2-Position Spring Offset	Pilot Pressure Removed Shift from Offset to Offset	50 mS	80 mS ▲	50 mS	80 mS ▲	50 mS	80 mS ▲

Table 2. Shift Response Times w/CETOP 5 Pilot (Fast Response option not available for pilot pressures over 14 0 bar (2000 psi)

Valve Type	Condition	Pilot Pressure 10 bar (150 psi)		Pilot Pressure 100 bar (1500 psi)		Pilot Pressure 210 bar (3000 psi)	
		Voltage		Voltage		Voltage	
		"AC "	"DC "	"AC "	"DC "	"AC "	"DC "
3-Position Spring Centered	Pilot Pressure Applied - Shift from Center to Offset (Standard/Fast Response)	50/50 mS	80/80 mS	45/25 mS	75/60 mS	37/NA mS	70/NA mS
2-Position Spring Offset	Pilot Pressure Applied - Shift from Offset to Offset (Standard/Fast Response)	185/175 mS	240/190 mS	85/70 mS	130/125 mS	50/NA mS	115/NA mS
3-Position Spring Centered	Pilot Pressure Removed - Shift from Offset to Center (Standard/Fast Response)	50 mS	80 mS ▲	50 mS	80 mS ▲	50 mS	80 mS ▲
2-Position Spring Offset	Pilot Pressure Removed - Shift from Offset to Offset (Standard/Fast Response)	75 mS	110 mS ▲	50 mS	110 mS ▲	30/NA mS	110/NA mS ▲

▲ "DC" pilot runs without arc suppression devices. If diodes or other devices are used, de-energize times will be longer.

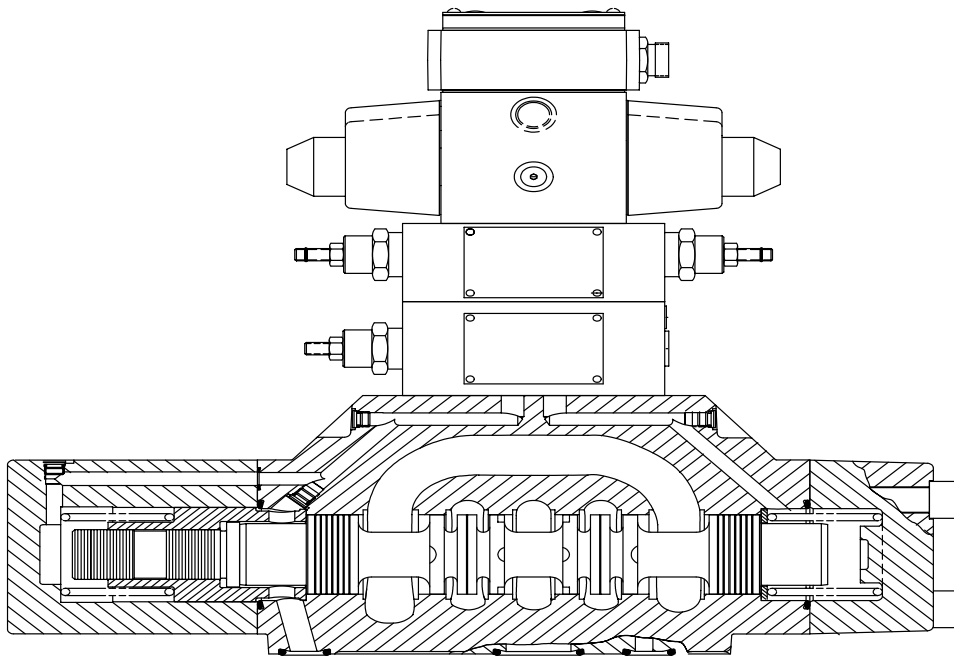


Figure 11. DG5V10 with DG4S4-01 Pilot

Section IV - Pilot Valve Section

A. Spool Type - Pilot Valve Section

To maintain proper control, closed center pilot spools are normally used in two stage valves. In most cases, a number "6" type pilot spool is used.

When a type "4" or "8" main stage spool is used, the letter "V" is inserted into the pilot valve model code.

B. Spool Positioning - Pilot Valve Section

Pilot spools are positioned within the valve by special spool arrangements. The three basic pilot valve spool arrangements are spring centered, spring offset and detents. The following paragraphs (1 through 3) describe pilot spool arrangements.

1. **Spring Centered:** A spring and washer are installed at each end of the pilot valve spool. The spring moves the spool until the washer contacts the end of the valve body. In the deenergized condition of the pilot valve, the spool is held in center position within the body by the springs and washers.
2. **Spring Offset:** Spring offset models use one spring and washer to return the pilot valve spool to an offset position. In this model, a solenoid is completely removed from the spring end of the pilot valve. Solenoid operating power is reduced by the sacrifice of the center spool position.
3. **Detents:** A detent mechanism is installed on one or both ends of the pilot valve spool. Detent valve solenoids can be momentarily energized to the correct position and then power may be removed from the solenoid. This reduces the input control power below that of an offset model.

The detent(s) hold the pilot spool in the last position attained until the opposite solenoid is energized. As in the offset valve, solenoid power is reduced by the sacrifice of the center spool position.

C. Methods of Control - Pilot Valve

The following pilot control methods are available for pilot spool position.

Control	Model Codes
Electrical Solenoid	DG4S4-01, DG4V-3, DG4V-3S

1. **Remote Pilot:** Pilot valves, such as a DG3V3, are available for use with a remote pilot source. This means that a valve can be shifted from a remote pressure source by other valves in the logic circuit. Refer to service parts drawings listed in Table 1.
2. **Electrical Solenoid Pilot Operation:** Electrical solenoids are attached to the pilot valve body. Internal push pins connect the solenoid to the pilot spool. When the magnetic field of solenoid "B" is energized, the solenoid armature moves the push pin and shifts the pilot spool towards solenoid "A" (see Figure 12a). When solenoid "A" is energized, the pilot spool shifts toward solenoid "B" (see Figure 12b). When both solenoids are de-energized, the pilot spool shifts to center position (see Figure 12c).

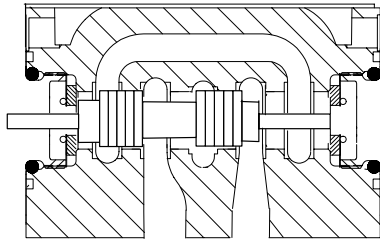


Figure 12a. Flow Conditions
Pressure to "B" - "A" to Tank

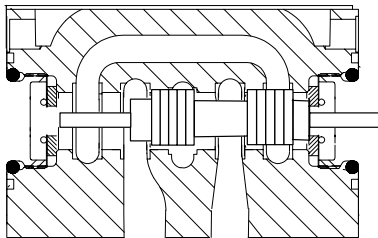


Figure 12b. Flow Conditions
Pressure to "A" - "B" to Tank

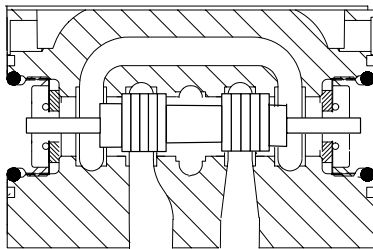


Figure 12c. Flow Conditions
Flow Blocked (Center Condition #2 Spool)

CAUTION



DO NOT energize both (AC) solenoids simultaneously. Sustained operation with both solenoids energized will cause excessive current in the coil and accelerates burnout.

A. Electrical Solenoid Types Available: Three basic types of electrical solenoids exist: Wet armature, air gap and high performance. The unit nameplate identifies the type of solenoid being used. See the model code in Table 2. If a 50 or 51 design two stage valve is equipped with a DG4V-3 pilot valve, the letter "M" is stamped into the nameplate (i.e. DG5V-062*-M-51). The letter "M" indicates an adapter plate is used to provide the necessary DG4V-3 pilot valve interface requirements.

B. Wet Armature Type Solenoids: Wet armature solenoids are standard on DG4V-3, DG4S4-01-60, and DG4V4-01 pilot valves only. Wet armature solenoids have many design advantages over other types of solenoids. Some advantages include cooler operation, static sealing arrangements, immunity to moisture and greater burn-out resistance. DG4V-3 and DG4S4-01* wet armature solenoids are not serviced with individual parts. Service is provided by replacing the entire core tube subassembly. Parts can be removed, cleaned and seals replaced on "W3" type solenoids.

C. Air Gap Solenoids: DG4S4-01 pilot valves are usually equipped with air gap solenoids. Air gap solenoids are isolated from system fluid and can be removed and replaced without disturbing the system. A push pin and sliding seal couple the solenoid to the valve spool (see Figures 13a and 13b).

E. Electrical Solenoid Voltage Requirement: Electrical solenoids are available in various AC and DC voltage ranges. The standard voltage and frequency range is 115V AC, 60 Hz. Refer to parts and service drawings for units with non-standard voltage ranges. Fifty (-50) and fifty-one (-51) design units have the voltage and frequency range stamped into the nameplate if other than standard. Ten (-10), twenty (-20) and fifty-three (-53) design units use an identification letter for the coil voltage and frequency.

F. Electrical Solenoid Ground Connections and Wiring Housing: An electrical wiring housing with a $\frac{1}{2}$ " NPTF thread connection is available on DG4V-3 and DG4S4-01 pilot valves. the wiring housing can be rotated 180° from the position shown in Figure 13a. Wire grounding screws are provided for convenience.

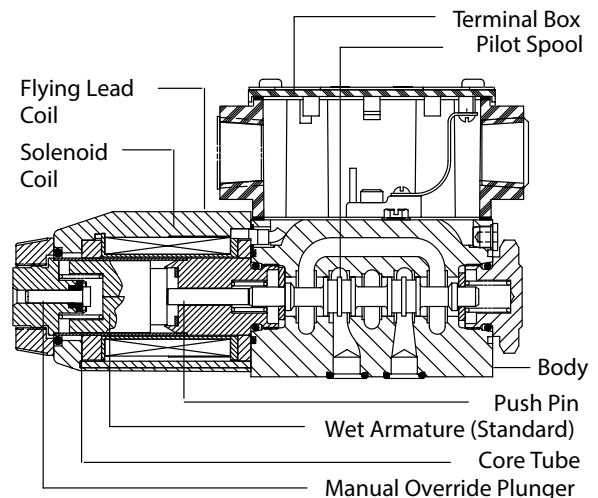


Figure 13a. Typical DG4V-3(S)-A/B-FW-60

G. Manual Override: each solenoid (electrical or air type) has a manual override plunger to shift the pilot spool. This feature allows a technician to shift the pilot spool when electricity or air pressure is not available. Refer to Figures 13a or 13b. To operate the manual override feature, obtain a small rod and push in on the plunger.

5. Accessories for Electrical Type Solenoids: The model code (Table 2) indicates the type of accessories used on directional valves. Obtain a parts and service drawing for your particular model (see Table 1). Most accessories pertain to the pilot section. The most common types of accessories are discussed in the following paragraphs (A through F).

A. Hazardous Location Solenoids: This type of is used at locations where added protection from electrical shortage failure is mandatory, the solenoid housing is designed to completely enclose all wiring connections to the valve. Hazardous location valves are underwriters approved Class 1, Group D or Class 2, Group E-F-G, for 155 and 230 volts, 60 Hz service.

B. Monitor (Limit) Switch Feature: The monitor switch feature can be incorporate into a basic spring offset directional valve. The switch monitors pilot valve spool position and an be wired into control circuits. This permits electrical interlocking of various hydraulic controlled motions without resorting to external mechanical arrangements. The monitor switch is a single pole, double throw contact arrangement with "A"-normally closed and "B"- normally open. Switch ratings are noted on installation drawing (Table 1). The monitor switch housing does not provide a manual plunger for operation of the switch or valve.

C. Insta-Plug Connectors: Pilot valves can be supplied with electrical connectors called insta-plugs. These connectors allow quick disconnect of electrical power from the valve. The following data pertains to the insta-plug feature:

PA- A prefix of PA in the model code indicates the male plug section of the insta-plug feature is included on the valve.

PB- A prefix of PB in the model code indicates both the male plug and female receptacle are included with the valve. the insta-plug feature is available on both the DG4V-3 and DG4S4-01 series directional valves.

Wiring Note

Connect white wires to "A" solenoid and black wires to the "B" solenoid. Refer to parts drawing (Table 1) for additional data.

D. Brad Harrison Connectors: Brad Harrison connectors thread into the $\frac{1}{2}$ " NPTF opening in the wiring housing of a DG4V-3 or a DG4S4-01 directional valve.

PA3- A prefix of PA3 in the model code indicates the three pin male connector is included with the valve.

PA5- A prefix of PA5 in the model code indicates the five pin male connector is included with the valve.

Female Brad Harrison connectors are not available from Vickers and must be supplied by the customer.

E. Solenoid Indicator Lights: Solenoid indicator lights are available for installation on both the DG4V-3 and DG4S4-01 series directional valves. Indicator lights are connected across the solenoids and will light when voltage is present at the solenoid. This gives an indication to the technician which solenoid is energized and aids in troubleshooting a system. Refer to the appropriate parts drawing for additional information.

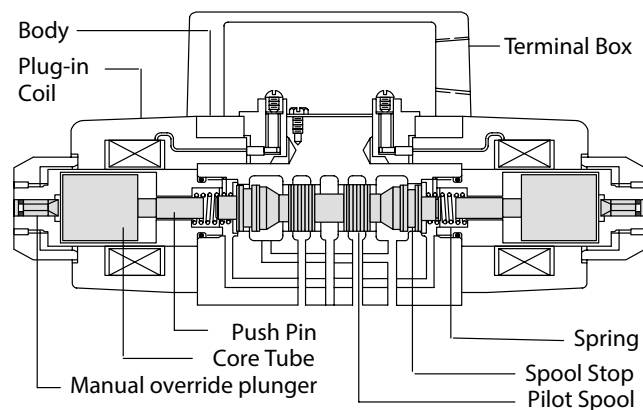


Figure 13b. Typical DG4V4-01-C-10

Section V - Internal Valve Functions

A. General

To insure the proper application of a two stage valve, pilot pressure, pilot drain and integral check valve options must be considered. The following paragraphs (B through D) discuss these options.

B. Pilot Pressure

1. Internal Pilot Pressure (Standard): Internal pilot pressure can be obtained in two ways and must be tailored for the application. Models with closed center type spools automatically provide internal pilot pressure. Models that use open center spools require a check valve in the pressure (P)

port to maintain minimum pilot pressure. In most cases, maximum internal pilot pressure is rated to 210 bar maximum (3000 PSI). Minimum pilot pressure ratings are noted in the installation drawings (see Table 1).

2. External Pilot Pressure: When pilot pressure from a separate source is used, it must be connected to the "X" port (external pilot pressure connection). Models that use external pilot pressure do not require a check valve at the pressure port. External pilot pressure models are identified with the letter "E" stamped in the unit nameplate (i.e. DG5V-10-S-2C-*E-M-*10). See installation drawings for maximum external pilot pressure.

3. Pilot Pressure Conversions: If it is necessary to convert your unit from external pilot pressure to internal pilot pressure or vice versa, internal plug(s) must be removed or added to the main stage body. See the figures noted in installation plug tables for internal plug locations.

4. Pressure Centered "D" Models (H06 & -10 Series only): A pre-set pilot pressure can be obtained in these models. Refer to the model code in Table 2 for pressure settings. Pilot pressure can be increased or decreased by simply changing internal plugs in the main stage body. Refer to plug table in parts drawing for part numbers and see the figures noted in installation plug tables for internal plug locations.

C. Pilot Valve Drains

1. Internal Drain: Internal drain models are used when pressure surges in the tank line are small and CAN NOT overcome pilot pressure.

To shift a pilot spool, pilot pressure must always exceed tank pressure by a minimum amount. Figure 14 is an example showing pilot pressure vs. tank pressure. Refer to the unit installation drawing for minimum pressure ratings. Internal pilot drain models have the letter "T" stamped on the unit nameplate (i.e. DG5V-10-S-2C-*-T-M-*-10).

Note

A 10 bar (150 PSIG) ΔP must always be maintained to shift closed center spools. A 5 bar (75 PSIG) ΔP must always be maintained to shift open center pilot spools.

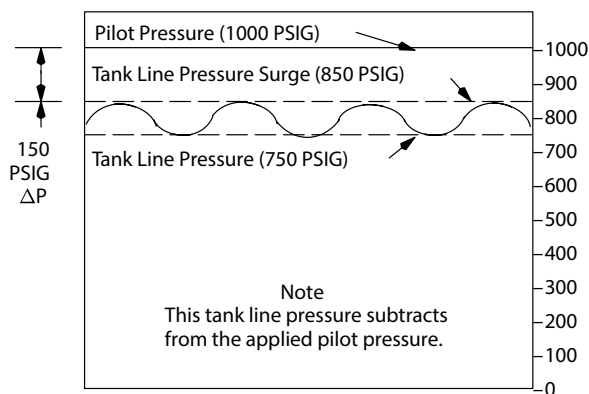


Figure 14. Pilot Valve-Internal Drain

2. External Drain (Standard): External drain models are recommended if pressure surges in the tank line CAN overcome pilot pressure. Drain connection "Y" is used for externally drained models. Pressure centered "D" models use two drain connections "Y" and "W". All external drain connections MUST be piped directly to tank through surge free lines. Refer to the installation drawing (Table 1) for further information.

3. Drain Conversions: If it is necessary to convert your unit from external drain to internal drain or vice versa, an internal "T" plug must be added or removed to the main body section.

D. Integral Check Valves

Check valves are located within the pressure port of the main stage section. The purpose of the check valve is to develop back pressure, at the pressure port, when open center or tandem main stage spools are used. Back pressure is necessary to maintain internal pilot pressure when the main stage spool shifts to open center position. Table 3 indicates when an integral check valve is required.

Pilot Pressure Source	Integral Check Valve Required	Main Stage Spool Type
Internal	Yes	0, 1, 4, 8, 9, 11
	No	2, 3, 6, 31, 33
External	No	All spools

Table 3. Integral Check Valve Circuit Requirements

Integral check valves are available at various cracking pressure ranges. The unit nameplate identifies which check valve is used (i.e. DG5V-10-S-2C-*-T-M-*-10). Refer to installation drawing (Table 1) for additional check valve information.

Note

As an alternate to the integral check valve, a 3.5/5 bar (50/75 PSI) check valve can be installed in the tank line of the valve to obtain pilot pressure.

Section VI - Installation

A. Service Drawings

The service drawings listed in Table 1 show installation dimensions, port locations and operating parameters. Manifold, subplate and bolt kit information is also included.

Note

Detent valves must be installed with the valve spool in the horizontal position for good machine reliability. The mounting position of spring offset and spring centered models is unrestricted.

Note

Make sure the “Y” drain port is piped directly to the tank. Back pressure cannot be tolerated at this valve port.

CAUTION



On solenoid operated directional valves, ensure an electrical ground is connected to the valve. This prevents the possibility of a shock hazard if a coil develops a short circuit to the frame.

B. Fluids and Seals

Standard seals (Nitrile) can be used with petroleum, water-glycols, and water-oil emulsion type fluids.

F1 seals (Butyl, EPR) must be used for alkyl phosphate-ester base fluids and aircraft type fire-resistant fluids. F1 seals cannot be used with petroleum or phosphate ester-hydrocarbon blends.

F3 seals (Viton ®) can be used with all commonly used industrial hydraulic fluids. Viton ® is compatible with petroleum, water-base and synthetic fire-resistant fluids.

® Viton is a registered trademark of E.I. DuPont

F6 seals (Nitrile) can be used with petroleum, water-glycols, and water-oil emulsion type fluids.

The following table summarizes the compatibilities of the most common phosphate ester fluids.

Fluid Type	F1	F3	F6
Skydrol	Yes	No	No
Pydraul 10-E	Yes	No	No
Pydraul 29-E-L-T, 50-E 65-E, 115-E	Yes	Yes	Yes
Pydraul 230-C, 312-C, 540-C	No	Yes	Yes
Fyrquel & Fyrlube	Yes	Yes	Yes
Fyrtek	No	Yes	Yes
Houghton Safe 1000 Series	Yes	Yes	Yes

C. Piping and Tubing

1. All pipes and tubing must be thoroughly cleaned before installation. Recommended cleaning methods are sandblasting, wire brushing and pickling.
2. To minimize flow resistance and the possibility of external leakage, use only the necessary fittings and connections required for proper installation.
3. The number of bends in tubing should be kept to a minimum to prevent excessive turbulence and friction of fluid flow. Tubing must not be bent too sharply. The recommended radius for tube ends is three times the inside diameter.

D. Hydraulic Fluid Recommendations

Hydraulic fluid within the systems performs the dual function of lubrication and transmission of power. To insure proper lubrication, system life, and component reliability, fluid selection should be made carefully with the assistance of a reputable supplier. Fluid selection should be acceptable for use with all valves, motors and pumps within the system.

The fluid recommendations noted in the data sheet are based on our experience in industry as a hydraulic component supplier. Where special considerations indicate a need to depart from these recommendations, see your Vickers by Danfoss sales representative.

E. Cleanliness

To ensure your hydraulic system is clean, perform the following steps:

Clean (flush) the entire system to remove paint, metal chips, welding shot, etc.

Filter each oil change to prevent introduction of contaminants.

Provide continuous oil filtration to remove sludge, products of wear and corrosion generated during the life of the system.

Provide protection to all areas that can introduce airborne contaminants into the system.

Perform regular servicing procedures of filters, breathers, and reservoirs.

F. Overload Protection

A relief valve must be installed in the system as close to the pump as possible. the relief valve limits pressure in the system to a prescribed maximum. The setting of the relief valve depends on the work requirements of the system.

Section VII - Service, Inspection & Maintenance

A. Service Tools

No special tools are required to service this valve series.

B. Inspection

Periodic inspection of the fluid condition and tube or piping connections can save time consuming breakdown and unnecessary parts replacement. the following should be checked regularly.

1. All hydraulic connections must be kept tight. A loose connection in a pressure line will permit the fluid to leak out. If the fluid level becomes so low as to uncover the inlet pipe opening in the reservoir, extensive damage to the system can result. Loose connections also permit air to be drawn into the system resulting in a noisy and/or erratic operation.
2. Clean fluid is the best insurance for long service life. Therefore, check the reservoir periodically for dirt and other contaminants. If the fluid becomes contaminated, flush the entire system and add new fluid.
3. Filter elements should also be checked periodically. A clogged filter element will cause higher pressure drops within the system.
4. Air bubbles in the reservoir can ruin the valve and other components. If bubbles are seen, locate the source of the air and seal the leak.

C. Adding Fluid to the System

When hydraulic fluid is added to replenish the system, pour it through a fine wire screen (200 mesh or finer). When applicable, pump the fluid through a 10 micron filter. DO NOT use a cloth to strain the fluid or lint may enter the system.

D. Adjustments

No periodic adjustments are required other than normal system maintenance,

E. Replacement Parts

Reliable operation throughout the specified operating range is assured only if genuine Vickers by Danfoss parts are used. Sophisticated design processes and material are used in the manufacture of our parts. Substitutions may result in early failure. Part numbers are shown in the parts and service drawings listed in Table 1.

F. Product Life

The service life of this product is dependent upon environment, duty cycle, operating parameters and system cleanliness. Since these parameters vary from application to application, the ultimate user must determine and establish the periodic maintenance required to maximize life and detect potential component failure.

G. Troubleshooting

Table 4 lists the common difficulties experienced with directional valves and systems. It also indicates the probable causes and remedies for each of the troubles listed.

Also remember that many apparent failures may actually be the failure of other parts of the system. The cause of improper operation is best diagnosed with adequate testing equipment and a thorough understanding of the complete hydraulic system.

TROUBLE	PROBABLE CAUSE	REMEDY
Valve spool fails to move	Dirt in system	Disassemble, clean and flush.
	Solenoids inoperative	Check electrical source and solenoids.
	Improper assembly	Check proper assembly. Refer to appropriate figure and assembly procedure.
	Improper installation connections	Check installation drawings
Valve produces undesirable response	Improper valve assembly Improper installation connections	Checks parts drawing and installation drawing for proper assembly and installation connections
	Solenoid wiring reversed	Reverse connections to the solenoids

Table 4. Troubleshooting Chart

Section VIII - Overhaul

WARNING



Before breaking a circuit connection, ensure system power is off and system pressure has been relieved. Lower all vertical cylinders, discharge accumulators and block any load whose movement could generate pressure. Plug all units and cap all lines to prevent entry of dirt into the unit or system.

A. Unit Removal

1. Thoroughly clean the exterior of the valve and the area around the valve to prevent contamination of the system during removal.
2. Remove the valve from its subplate or mounting pad as follows:
 - A. If the valve is equipped with the insta-plug feature, loosen the two slotted screws and unplug the electrical wiring from the pilot section.
 - B. If the valve has an air operated section, turn off air supply and disconnect the pressure lines from the connection plate.

WARNING



In the following step make sure electrical power is off, then disconnect the solenoid wiring. Label each wire to provide assembly information.

C. If the valve has standard electrically operated solenoids, remove the four nameplate screws on top of the pilot section. Move nameplate and gasket aside to expose interior of the wire cavity. Disconnect solenoid wiring.

D. Loosen the six mounting screws that hold the main stage section to the mounting pad. Be ready to catch the fluid retained inside the lines and valve.

E. Remove the valve from the mounting pad and set it on a clean work bench. Use a chain lift when necessary.

B. Disassembly (General)

The manual describes the disassembly sequence of a typical DG5V-10 two-stage directional valve. See Figures 15 and 17. Slight variations may be noted on your model depending on the type of accessories and unit design. Figure 15 may be used for all models, except pressure centered "D" models regardless of the design. Refer to Section E and Figure 17 for pressure centered "D" models. Figure 18 shows the disassembly sequence of a DG4V-3(S)-*A(L)/B(L)-FJ/FW-60 standard performance pilot valve. If your pilot valve is a DG4S4-01, refer to Figure 19.

C. Pilot Valve and Module Removal (Refer to Figure 15)

1. Remove four screws (1) and pilot valve (2), pilot choke (3), and reducer (4) from main stage body (5).
2. Remove "O" rings (6) from pilot choke and reducer.
3. Remove four screws (7) and adapter plate (8) from body.

Note

The following section pertains to main stage disassembly. If your unit does not require main stage disassembly, omit the following section.

D. General Main Stage Disassembly (Refer to Figure 15)

WARNING



Spring in end cover is under tension. Slowly remove end cover screws alternatively to avoid damage to equipment and injury to personnel

Note

Repeat steps 1 and 2 for opposite side cover disassembly.

1. Loosen four end cover screws (10) from end cover (11). Be ready to catch any oil trapped inside the unit. Remove end cover from body and discard "O" ring (12).

Note

Spring and washer do not exist on floating type models or on opposite side of spring offset "A" models.

2. Remove spring (13) and washer (14) from main stage spool (15).
3. Remove main stage spool from body.
4. Turn body on its side and remove plugs (23) and "O" rings (16, 22, 24, and 25) from body. Discard "O" rings.

Note

- DO NOT remove the internal plugs of body unless inspection reveals a problem.
- Refer to figures 21 thru 26 for internal plug locations.

5. Remove plugs (21) and "O" rings (26) from body. Discard "O" rings.

If necessary, remove rest pins (27) with vise grip pliers.

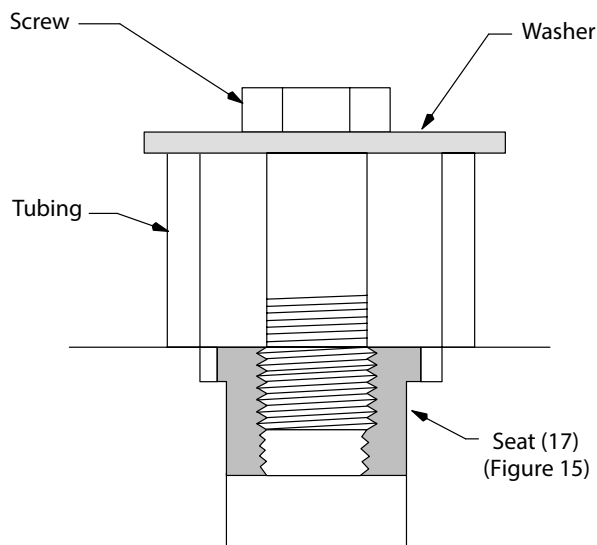
Note

The following step pertains to integral check valve models only. DO NOT remove check valve parts unless inspection or unit operation indicates a check valve problem. If check valve removal is necessary, perform step 8.

8. Select the correct screw listed in Table 7. Obtain a piece of pipe or tubing with an inside diameter that is slightly larger than the outside diameter of the seat. Also obtain a flat washer. Remove seat (17), Figure 16, per instructions noted in Figure 16. Remove poppet (18), spring (19), and sleeve (20) from body.

Screw Dia./ Thread Type	Screw Length
1.125 –7 UNC –2B	76.2mm (3 in.)

Table 7. Screw Tabulation for Seat Removal



Note

Thread seat (17), then place tubing and washer over seat area as shown. Thread the screw into seat. Tighten the screw to remove seat.

Figure 16. Check Valve Seat Removal

E. Pressure Centered Main Stage Disassembly (Refer to Figure 17)

1. Remove four screws (1) and name plate (2) from crossover plate (4).
2. Remove four screws (3) and crossover plate from main stage body (6).
3. Remove and discard two "O" rings (5) from crossover plate.

Note

The following section pertains to main stage disassembly. If your unit does not require main stage disassembly, omit the following section.

4. Loosen four end cover screws (7) from end cover (8). Be ready to catch any oil trapped inside the unit. Remove end cover, spring (10) and discard "O" ring (9).
5. Remove sleeve (11) and piston (12) from main stage spool (13).
6. Remove main stage spool from body.
7. Remove plug (14) and "O" ring (15) from cover. Discard "O" ring.

Note

Perform step 8 for opposite side cover disassembly. Note that centering springs are different.

8. Loosen four end cover screws (16) from end cover (17). Be ready to catch any oil trapped inside the unit. Remove end cover, spring (19) and centering washer (20).
9. Turn the body on its side and remove plugs (23) and "O" rings (21 and 22) from body. Discard "O" rings.

Note

- DO NOT remove the internal plugs of body unless inspection reveals a problem.
- Refer to figures 21 thru 26 for internal plug locations.

10. Remove plugs (25) and "O" rings (24) from body. Discard "O" rings.
11. If necessary, remove rest pins (28) with vise grip pliers.

F. High/Standard Performance Pilot Valve Disassembly (Refer to Figure 18)

Note

The following steps describe the disassembly sequence of a DG4V-3(S)-*A(L)/B(L)-FJ/FW-60 pilot valve.

1. Remove the four screws (1) from name plate (2) and remove the nameplate, cover (3) and gasket (4) from the terminal box (5). Discard gasket (4).
2. Remove two screws (7) and strap (8) from the terminal box (5).
3. Remove two screws (9), ground screw (11), terminal box (5) and gasket (6) from body (10). Discard gasket (6).

Note

If the pilot valve is equipped with two solenoids, perform steps 4 through 6 for opposite end of body (10).

4. Remove knob (12) from core tube S/A (21). Remove coil (14) from body (10) and discard "O" Rings (13) and (15).
5. Remove push pin (18), spring 917, washer (19) or (20) and "O" Ring (15) from body (10). Remove "O" Ring (16) from core tube S/A (21).
6. Remove pilot spool (22) from body (10).
7. Secure the body and remove plug (24) and "O" Ring (25) from body (10). Discard "O" Ring (25).
8. If necessary, remove rest pins (26) with vise grip pliers.

G. Wet Armature Pilot Valve Disassembly (Refer to Figure 19)

Note

The following steps describe the disassembly sequence of a DG4S4-01*B/C-(U)-*-60 pilot valve.

1. Remove the four screws (1) from name plate (2) and remove the nameplate from the body (5). Remove screw (4) and gasket & wire S/A (3) from body (5).

Note

If the pilot valve is equipped with two solenoids, perform steps 3 through 6 for opposite end of body (5).

2. Remove knob (8) and "O" Ring (9) from core tube S/A (20). Remove coil (10) from body (5) and discard gasket (14) and "O" Ring (9).

Note

Perform step 4 for models equipped with DIN coils.

3. Remove DIN connector (13) and plug (12) from coil (11).

4. Remove knob (8) and "O" Ring (9) from core tube S/A (20). Remove coil (11) from body (5) and discard gasket (14) and "O" Ring (9). Remove plug (12) from coil.
5. Remove washer (15), stop (16), spring (17), push pin (18) and "O" ring (19) from core tube S/A (20). Discard "O" Ring (19).
6. Remove pilot spool (21) from body (5).
7. Remove plugs (24) and (22) and "O" Ring (23) from body (5). Discard "O" Ring (23).
8. Secure the body and remove plugs (25 and 27) from body (5). Remove "O" Rings (26 and 28) from plugs and discard. Remove and discard "O" Ring (29).

H. Cleaning

All parts must be thoroughly cleaned and kept clean during inspection and assembly. Close tolerance of valve bodies and spools make this requirement critical. Clean all parts with a commercial solvent that is compatible with system fluid. Compressed air may be used to clean valve, but it must be filtered to remove water and contamination. Clean compressed air is particularly useful for cleaning spool orifices, body passages and drying parts.

I. Inspection, Repair and Replacement

1. Check that all internal passages are clean and free from obstruction. Examine all mating surfaces for nicks and burrs. Minor nicks and burrs can be removed with crocus cloth or an India stone.

CAUTION



DO NOT stone the edges of spool sealing lands. Remove minor burrs with #500 grit paper. Use the paper very lightly on the outer diameter of each spool.

2. Inspect all screws for evidence of damaged threads. If threads are damaged, replace the screws.
3. Inspect all springs for distortion or wear. The ends of the springs shall be square and parallel to each other. Replace springs that are damaged or distorted.
4. Check push pins, pole faces, washers, and manual plungers for burrs, cracks or mushrooming. Replace all parts that show evidence of wear.
5. Visually inspect the internal coring (bore) of each body for large scratches or erosion across the spool land sealing areas. If such evidence is found, replace valve. If the body bore passes inspection, check bore to spool clearance as follows:

A. Lubricate spools and body bores with clean system fluid. make sure the parts are clean.

B. Insert the spool into its body bore. Rotate the spool 360 ° while moving it back and forth. Observe the following:

If the spool does not move freely, the spool is sticking inside the body bore. Remove the spool and recheck the spool and body bore for scratches and/or burrs. remove any minor scratches or burrs with India stone or crocus cloth. Repeat steps A and B.

Note

An alternate test is to turn the body on end and allow gravity to pull the spool from the body into your hand. if the spool does not move under the influence of gravity, the spool is sticking inside the body bore.

If the spool binding persists, replace the valve.

Check the feel of the spool. If side movement of the spool can be felt within the body bore, the body/spool clearances are excessive. A new spool and body have a select fit of approximately 0.0002-0.0003 inch. Body/spool clearances in excess of this value may still work satisfactorily in your system; however, limitations are dependant on how much leakage your valve system can tolerate. Normally, excessive body/spool clearances dictate replacing the entire valve.

Note

- If a new spool is installed into a new or used body, break the feathered edges of the spool balancing grooves with a three or four cornered India stone. See Figure 20. Lightly polish the spool with #500 grit paper. Wash the spool in clean solvent. Repeat steps A and B.
 - Step 6 pertains to detented "N" pilot valves only.
6. Check the detent by moving the push pin through the detent. A steady frictional force should be observed. If the detent force is weak (less than 1 lb.), replace the detent subassembly. The detent should be assembled on the polished end of the spool.
 7. Perform a continuity test on each solenoid coil S/A. Resistance values will vary with the voltage rating of the coil. Refer to Table 8. This test is superficial, but a more rigorous test requires special equipment. If the coil seems to be burned or extreme heat is encountered during operation, the coil may be shorted. make sure the correct voltage is being applied to the coil.

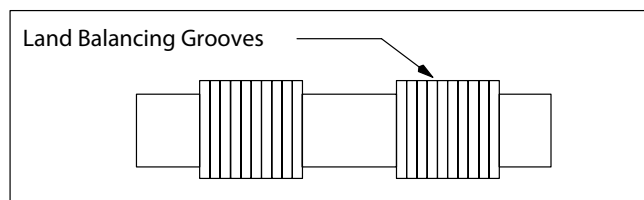


Figure 20. Spool Balancing Grooves

Voltage	Coil Resistance
6 DC	1.5 Ohms
12 DC	5 Ohms
24 DC	24 Ohms
48 DC	80 Ohms
115 DC	480 Ohms
230 DC	1800 Ohms
115 AC (60 Hz)	13 Ohms
230 AC (60 Hz)	50 Ohms
460 AC (60 Hz)	204 Ohms

Table 8. Coil Resistance

J. Assembly

Before assembly, obtain the correct seal kit as noted in the parts drawing. Lubricate all "O" rings and internal parts with clean system fluid to provide initial lubrication and facilitate assembly.

Check the model code to determine correct assembly of units. If a L.H. suffix appears in the model code, the pilot valve solenoid is assembled left hand. In such cases, all pilot valve parts are reversed except the body and spool,

Assembly will be in reverse of the disassembly sequence shown in Figures 15 and 17 unless otherwise specified.

K. General Main Stage Assembly

(Refer to Figure 15)

1. Install "O" rings (22) on plugs (23). Lubricate plug threads and install plugs into body (5). Torque plugs to value noted in parts drawing. Refer to Table 1.
2. Tap new rest pin(s) (26) into place if removed during disassembly.

Note

The following step pertains to integral check valve models.

3. Place spring (19) into poppet (18) and then install poppet into pressure port (P) cavity as shown. Obtain a suitable push rod and press seat (17) into pressure port (P) cavity. (See assembly drawing for seat orientation.) Use an arbor press for this operation. Install "O" ring (16) into pressure port mounting groove.
4. Install "O" rings (24) into 'X' and 'Y' port mounting grooves.
5. Install "O" rings (25) into port mounting grooves 'A', 'B', 'P' and 'T'.

-
6. Lubricate spool lands with clean system fluid and then carefully install spool (15) into main body bore. Make sure the spool moves freely inside the body bore and is oriented properly. (See parts drawing).

Note

Spring and washer do not exist on floating type models or on opposite side of spring offset "A" models.

7. Install washer (14) and spring (13) on end of spool.
8. Install "O" ring (12) into cover (11).
9. Install cover on body with four screws (10). Torque the screws to value noted in parts drawing. Refer to Table 1. Make sure cover is oriented properly (in line with body contours).

Note

Repeat steps 7 through 9 for opposite side cover assembly.

L. Pilot Valve and Module Assembly
(Refer to Figure 15)

1. Install plug (9) into adapter plate (8).
2. Install adapter plate on body (5) with four screws (7). Torque the screws to the value noted in parts drawing. Refer to Table 1.
3. Install "O" rings (6) in pilot choke (3) and pilot valve (2).
4. Install pilot choke and pilot valve on body with four screws (1). Torque the screws to the value noted in parts drawing. Refer to Table 1.

M. Pressure Centered Main Stage Assembly
(Refer to Figure 17)

1. Install "O" rings (24) on plugs (25). Lubricate plug threads and install plugs and set screws into body (6). Torque plugs to value noted in parts drawing. Refer to Table 1.
2. Tap new rest pin(s) (27) into place if removed during disassembly.
3. Install "O" rings (21) into 'X' and 'Y' port mounting grooves.
4. Install "O" rings (22) into port mounting grooves 'A', 'B' and 'T'.
5. Install "O" rings (23) in body.
6. Lubricate spool lands with clean system fluid and then carefully install spool (13) into main body bore. Make sure the spool moves freely inside the body bore and is oriented properly. (See parts drawing).
7. Install piston (12), sleeve (11) and spring (10) into cover (8).

8. Install "O" ring (9) in cover and install cover on body with four screws (7). Torque the screws to the value noted in parts drawing. Refer to Table 1.

9. Install centering washer (20) and spring (19) in body.

10. Install "O" ring (18) in cover (17) and install cover on body with four screws (16). Torque the screws to the value noted in parts drawing. Refer to Table 1.

11. Install "O" ring (15) and plugs (14) into cover (7).

12. Install crossover plate (4) on body with four screws (3). Torque screws to value noted in parts drawing. Refer to Table 1.

13. Install name plate (2) on crossover plate with four screws (1). Torque screws to value noted in parts drawing. Refer to Table 1.

M. High/Standard Performance Pilot Valve Assembly (Refer to Figure 18)

- 1.. Install "O" rings (25) on plugs (24). Lubricate plug threads and install into body (10). Install remaining "O" rings (25) into body (10). Torque plugs to the value shown in parts drawing. Refer to Table 1.
2. Lubricate pilot spool (22), then carefully install spool into the body (10).

Note

If pilot valve is equipped with two solenoids, repeat steps 3 through 7.

3. Assemble washer (19) or (20) on end of spool (22) with sharp break edge toward outside of body.
4. Install spring (18), push pin (17) and "O" ring (15) into body (10).
5. Install "O" ring (16) on core tube S/A (21) and install core tube S/A into body (10).
6. Install "O" ring (13) on core tube S/A (20).
7. Install coil (14) on body (10) and secure to core tube S/A (20) with knob (12).
8. Install gasket (6) and terminal box (5) on body (10) and secure with ground screw (11) and two screws (9).
9. Install strap (8) on terminal box (5) with two screws (7).
10. Install gasket (4), cover (3) and nameplate (2) on terminal box (5) with four screws (1).

N. Wet Armature Pilot Valve Assembly
(Refer to Figure 19)

- 1.. Install "O" rings (26) and (28) on plugs (25) and (27). Lubricate plug threads and install into body (5). Install "O" ring (29) into body (5). Torque plugs to the value shown in parts drawing. Refer to Table 1.

2. Lubricate pilot spool (21), then carefully install spool into the body (5).

Note

If pilot valve is equipped with two solenoids, repeat steps 3 through 6.

3. Install washer (15), stop (16), spring (17) and push pin (18) on spool (21).
4. Install "O" ring (19) on core tube S/A (20) and install core tube S/A into body (5).

5. Install "O" ring (9) on core tube S/A (20).

6. Install gasket (14) and coil (10) on body (5) and secure to core tube S/A (20) with knob (8).

Note

Perform step 7 for models equipped with DIN coils.

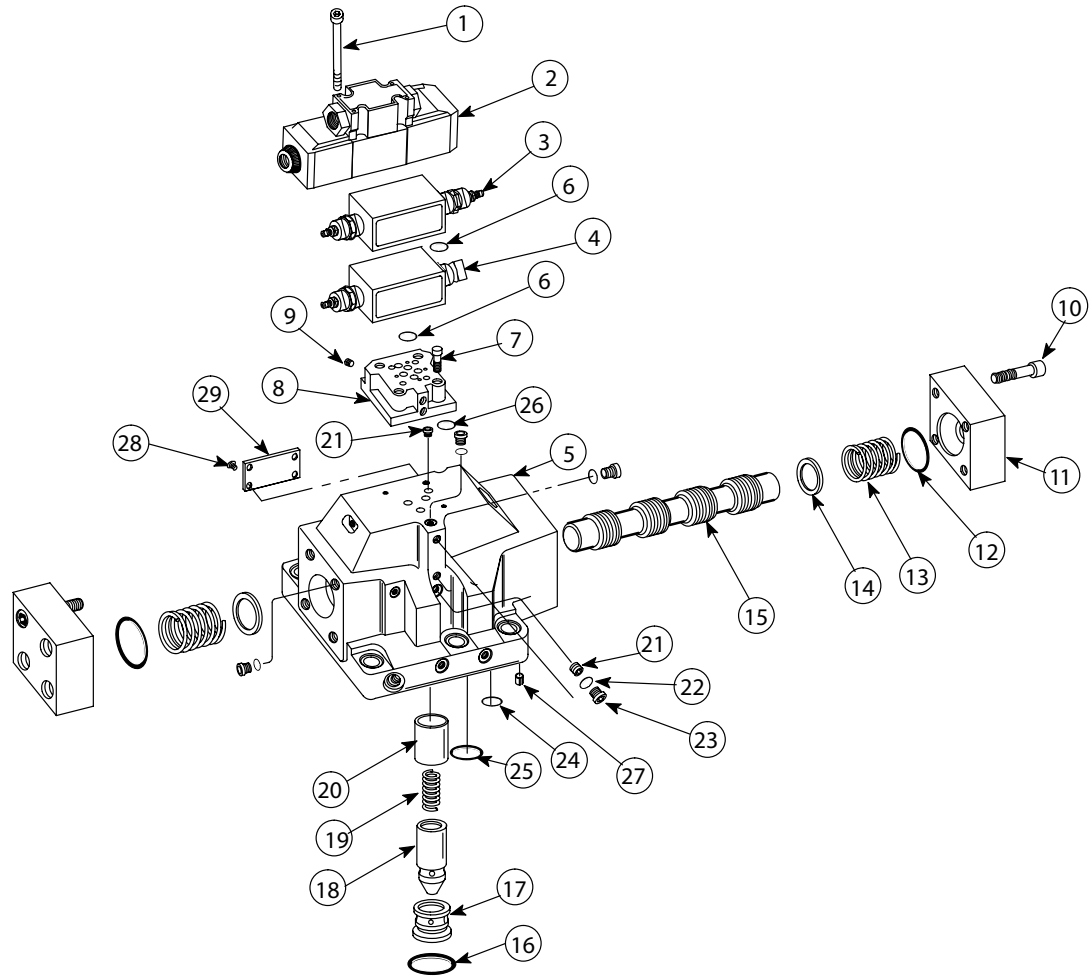
7. Install gasket (14) and coil (11) on body (5) and secure to core tube S/A (20) with knob (8). Install plug (12) and DIN connector (13) on coil (11).

8. Install "O" ring (23) and plugs (22) and (24) in body (5).

9. Install diagram plate (7) on body (5) with four rivets (6).

10. Install gasket & wire S/A (3) and nameplate (2) on body (5) with screws (1) and (4).

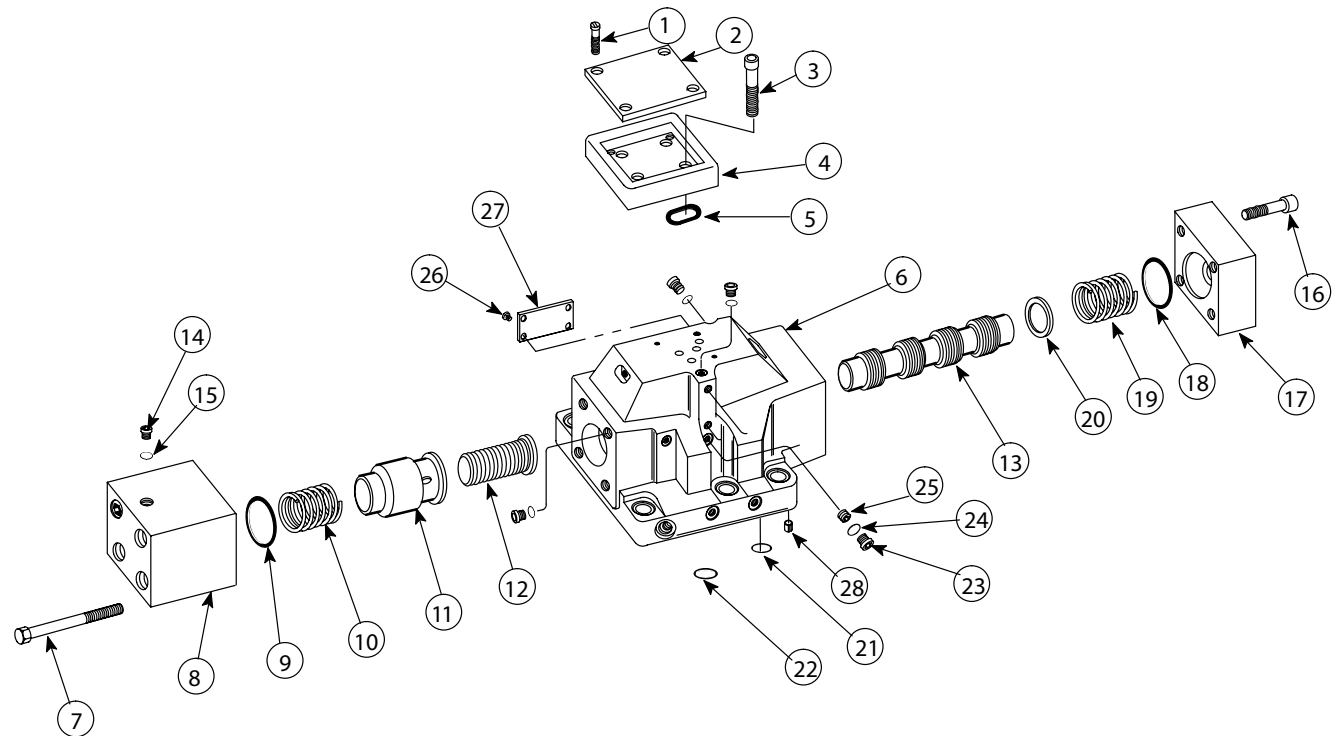
DG5V-10-S/H-*(C)-10



Item	Nomenclature	Quantity	Item	Nomenclature	Quantity
1	Screw	4	16	"O" Ring	3
2	Pilot Valve	1	17	Seat	1
3	Pilot Choke	1	18	Poppet	1
4	Reducer	1	19	Spring	1
5	Body	1	20	Sleeve	1
6	"O" Ring	9	21	Plug	4
7	Screw	4	22	"O" Ring	11
8	Adapter Plate	1	23	Plug	10
9	Plug	1	24	"O" Ring	2
10	Screw	8	25	"O" Ring	4
11	Cover	2	26	"O" Ring	4
12	"O" Ring	2	27	Rest Pin	2
13	Spring	2	28	Rivet	4
14	Washer	2	29	I.D. Plate	1
15	Spool	1			

Figure 15. Main Stage Section, Spring Centered "C" Model, DG5V-10-H/S -*(C)-(2)-10 with Check Valve Option

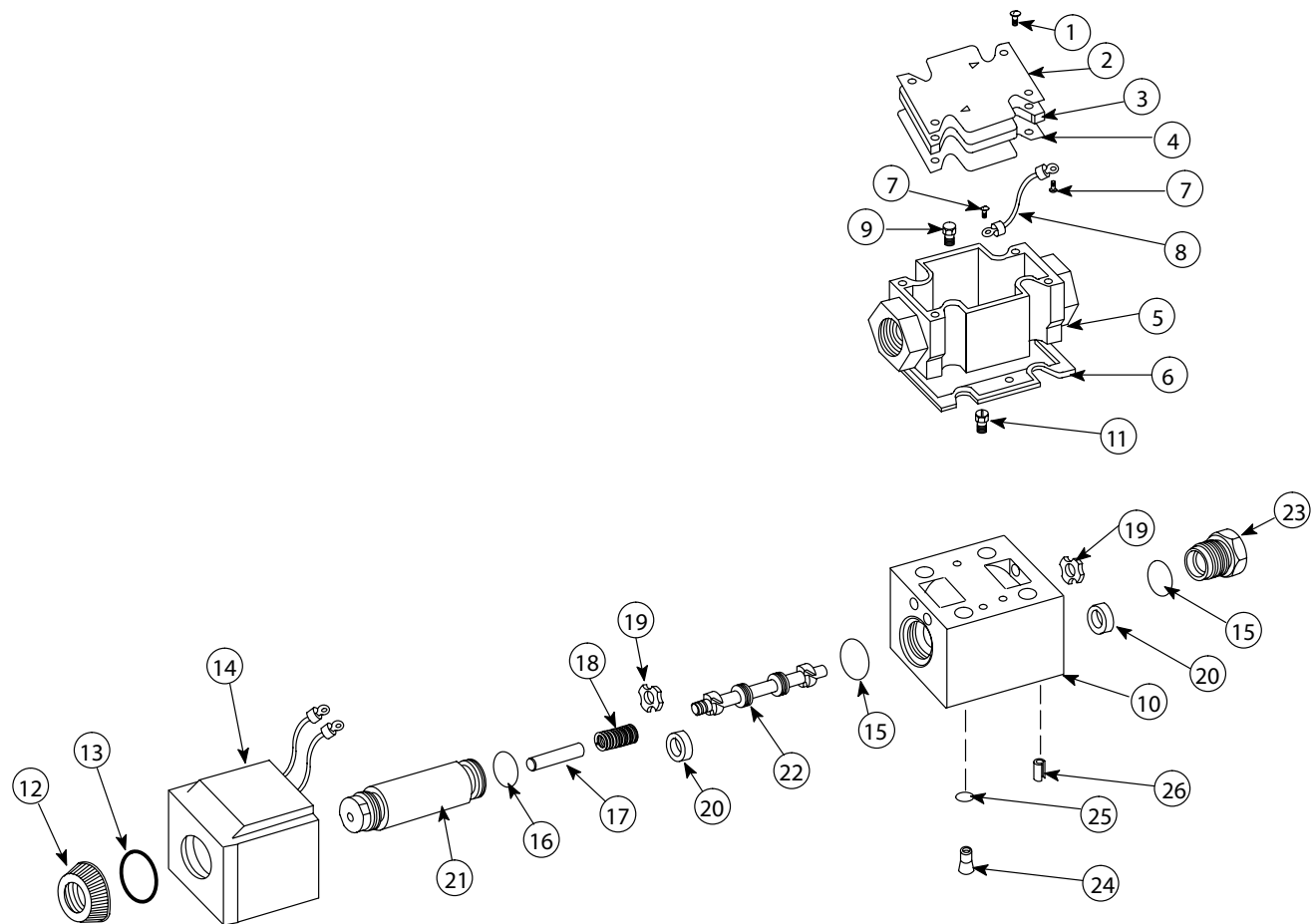
DG3V-10-*(D)-10



Item	Nomenclature	Quantity	Item	Nomenclature	Quantity
1	Screw	4	15	"O" Ring	1
2	Name Plate	1	16	Screw	4
3	Screw	4	17	Cover	1
4	Cover Plate	1	18	"O" Ring	1
5	"O" Ring	2	19	Spring	1
6	Body	1	20	Washer	1
7	Screw	4	21	"O" Ring	2
8	Cover	1	22	"O" Ring	3
9	"O" Ring	1	23	Plug	13
10	Spring	1	24	"O" Ring	13
11	Sleeve	1	25	Plug	4
12	Piston	1	26	Rivet	4
13	Spool	1	27	I.D. Plate	1
14	Plug	1	28	Rest Pin	2

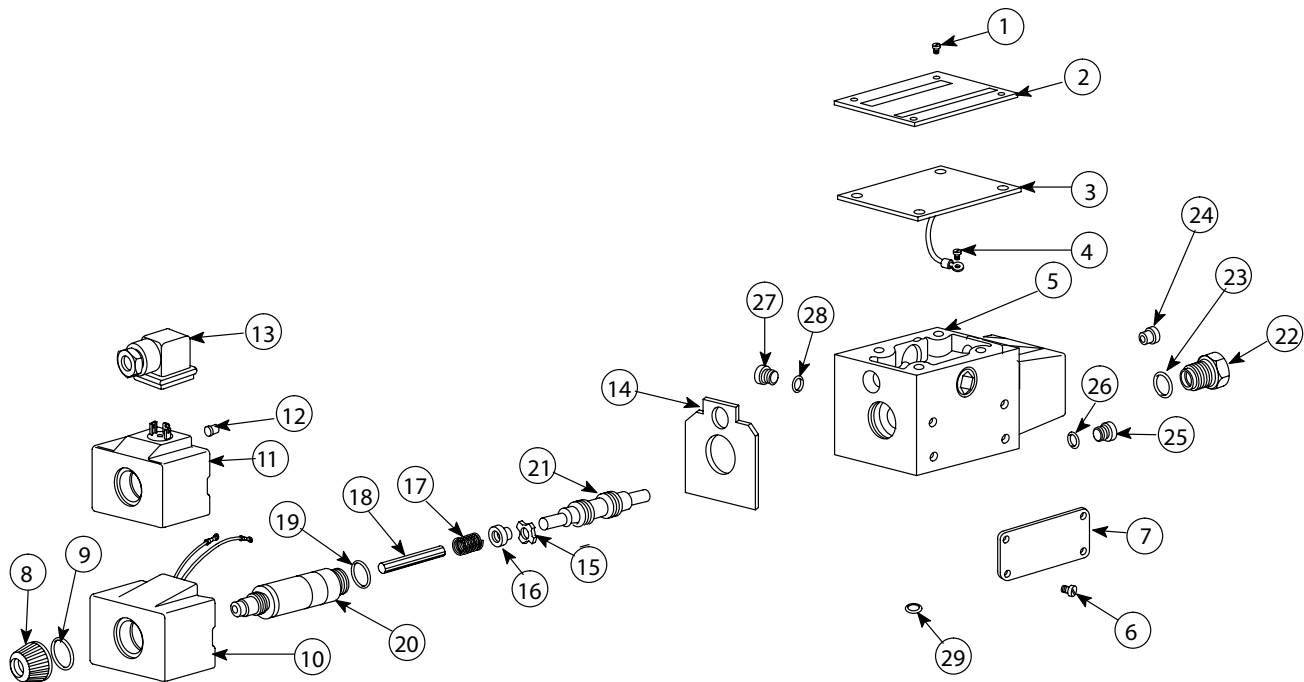
Figure 17. DG3V-10-*(D)-10 Pressure Centered

DG4V-3(S)-*A(L)/B(L)-FJ/FW-60



Item	Nomenclature	Qty	Item	Nomenclature	Qty
1	Screw	4	14	Coil	1
2	Nameplate	1	15	"O" Ring	2
3	Cover	1	16	"O" Ring	1
4	Gasket	1	17	Push Pin	1
5	Terminal Box	1	18	Spring	1
6	Gasket	1	19	Washer (DC models)	2
7	Screw	2	20	Washer (AC models)	2
8	Strap	1	21	Core Tube S/A	1
9	Screw	2	22	Spool	1
10	Body	1	23	Plug	1
11	Screw	1	24	Plug	1
12	Knob	1	25	"O" Ring	4
13	"O" Ring	1	26	Pin	1

Figure 18. Standard/High Performance Pilot Valve, DG4V-3(S)-*A(L)/B(L)-FJ/FW-60



Item	Nomenclature	Quantity	Item	Nomenclature	Quantity
1	Screw	4	16	Stop	2
2	Name Plate	1	17	Spring	2
3	Gasket & Wire S/A	1	18	Push Pin	2
4	Screw	1	19	"O" Ring	2
5	Body	1	20	Core Tube S/A	1
6	Rivet	4	21	Spool	1
7	Diagram Plate	1	22	Plug	1
8	Knob	2	23	"O" Ring	1
9	"O" Ring	2	24	Plug	1
10	Coil (Type A)	2	25	Plug	1
11	DIN Coil	2	26	"O" Ring	1
12	Plug	2	27	Plug	1
13	DIN Receptacle	2	28	"O" Ring	1
14	Gasket	2	29	"O" Ring	5
15	Washer	2			

Figure 19. Wet Armature Pilot Valve, DG4S4-01*B/C-(U)-*-60

Section IX - Start-Up and Test

A. Start-Up

Start the system and sequence the unit through all positions while watching for appropriate movement of actuators.

Improper or erratic movement of the actuators may indicate incorrect assembly of the unit or presence of trapped air.