

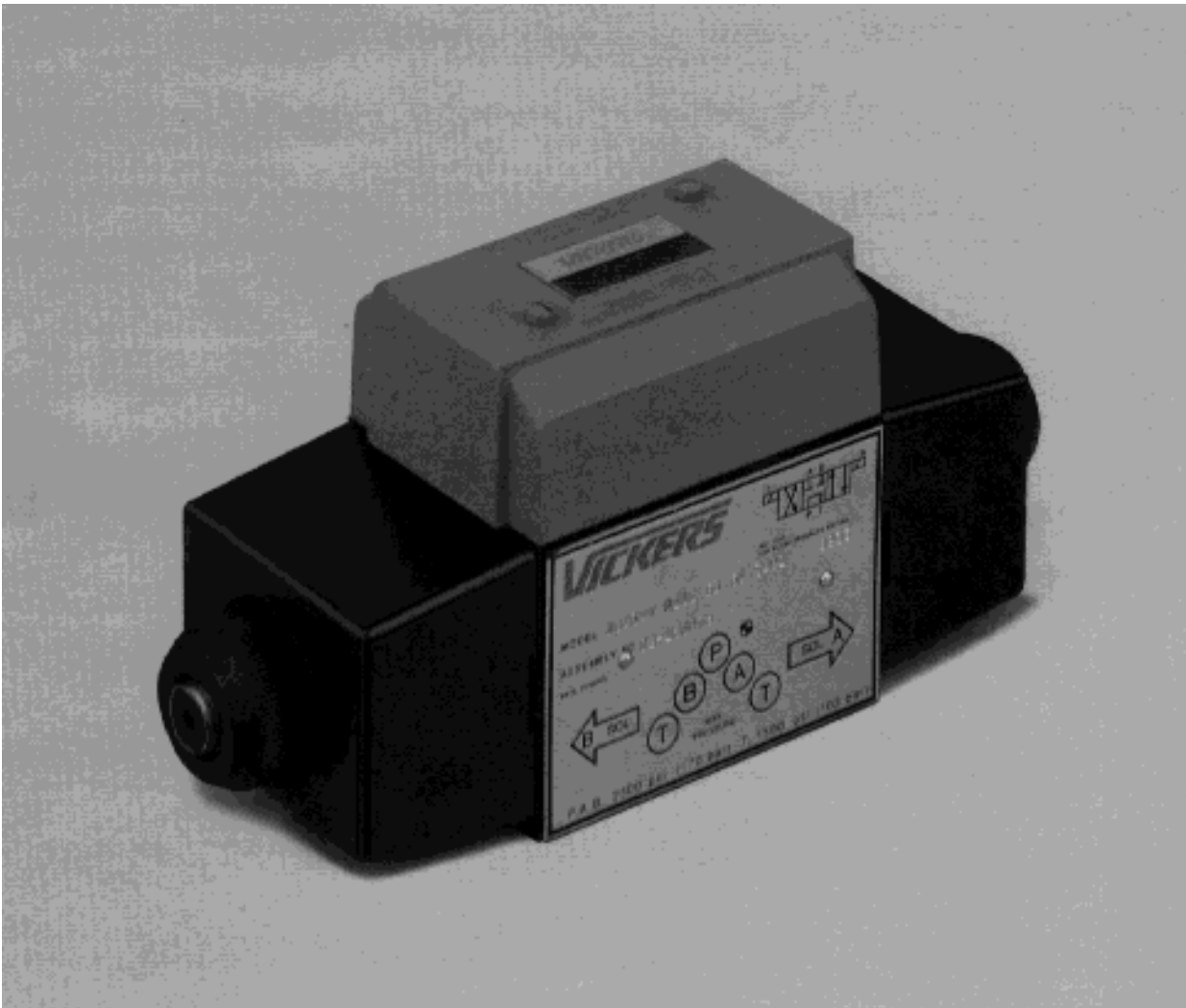
VICKERS®

Directional Controls



Soft Shift Directional Control Valve

DG4S4-01-60-S*** Design



VICKERS

Revised 3/95

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Introduction

The DG4S4-01-60-S*** directional control is a solenoid operated, 4-way, soft-shift valve having a unique five-chamber design.

The spool end land configuration isolates the core tube volume from the valve's tank cavity. This volume is

displaced through an orifice in each solenoid armature to increase the shift and dropout periods.

System shock is greatly reduced by metering the flow across the special spool land as well as spool modulation produced by the armature orifice.

The valve terminal box contains a bridge rectifier, allowing alternating current to be applied directly to the valve.

Therefore, the solenoid winding senses only direct current, eliminating the "in-rush" characteristic of a standard AC solenoid.

Features & Benefits

- Low cost alternative to pilot-operated and proportional valves.
- Mounts interchangeable with any NFPA D05, CETOP 5, ISO 05 valve.
- Conventional direct-solenoid operated valve design with contoured spool and controlled solenoid shift speed.
- Available in single or double solenoid configurations.
- Wet armature solenoids for quieter operation and long life with no dynamic seals to leak.
- Rectifier is housed in the terminal junction box and is protected from moisture and dirt.
- Coil has plug-in construction and is held on by a nut enabling quick coil voltage interchange or service, without breaking into the hydraulic envelope.
- DC solenoid prevents coil burnout during controlled rate of solenoid shift. Conventional alternating input current is converted to direct current through a rectifier located in the terminal box. For example: 110-120 50/60V AC and 220-240 50/60V AC are converted to 105V DC and 214V DC, respectively.
- A larger diameter spool combined with five-chamber body core passages results in lower pressure drop.
- Milled metering notches on the spool enable precise control of flow rate change as the spool is shifted.
- Four-land spool permits manufacturing of a consistently rounder spool for better balance in the bore and lower spool wear and less leakage.
- Five-chamber body design isolates the tank passages from the core tube so that pressure spikes or surges are not transmitted to the solenoid core tube.
- NFPA fatigue pressure rated at 250 bar (3600 psi)
- Easily interchangeable orifice plugs allow for fine tuning of valve shift time to each application.
- Solenoid indicator lights are available.

General Information

Basic Characteristics

- Max. pressure ports P, A & B:
Up to 250 bar
(3600 psi) depending
on fluid
- Max. pressure port T:
70 bar (1000 psi)
- Max. flow rates . . . Up to 75 l/min
(20 USgpm)
depending on spool
- Operating temp. 20° to 82° C
(70° to 180° F)
- Fluid viscosity . . . 14-54 cSt
(75-250 SUS)

Mounting Interface

ISO 4401-05
CETOP 5
NFPA D05

Seals & Fluid Cleanliness

Fluorocarbon seals are standard and are suitable for use with phosphate ester type fluids or its blends, water glycol, water-in-oil emulsion fluids and petroleum oil. Refer to 694 for hydraulic fluid and temperature recommendations.

Proper fluid condition is essential for long and satisfactory life of hydraulic components and systems. Hydraulic fluid must have the correct balance of cleanliness, materials and additives for protection against wear of components, elevated viscosity and inclusion of air.

Essential information on the correct methods for treating hydraulic fluid is included in Vickers publication 561; "Vickers Guide to Systemic Contamination Control," available from your local Vickers distributor or by contacting Vickers, Incorporated.

Recommended filtration and the selection of products to control fluid condition are included in 561.

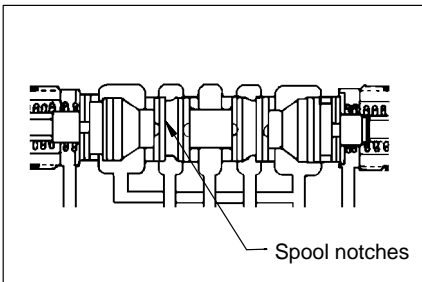
Recommended cleanliness levels using petroleum oil under common conditions is based on the highest fluid pressure levels in the system.

Directional controls, regardless of manufacturer, will operate with fluids showing a higher cleanliness code. The operating life of the control, and other components in the system, will be less however. For maximum life and best system performance, cleanliness codes as defined below should be achieved.

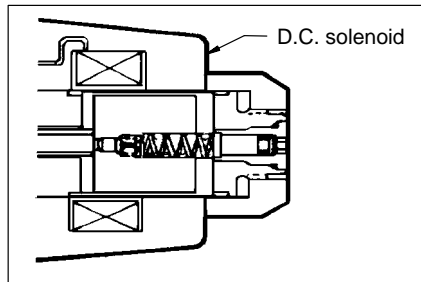
Fluids other than petroleum, severe service cycles or temperature extremes are cause for adjustment of these cleanliness codes. See Vickers Publication 561 for exact details.

System Pressure			
	1000 psi	2000 psi	3000+ psi
Valves	20/18/15	20/18/15	19/17/14

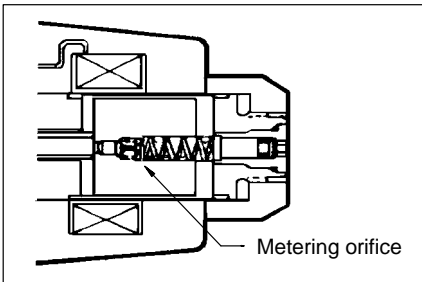
Operating Principles



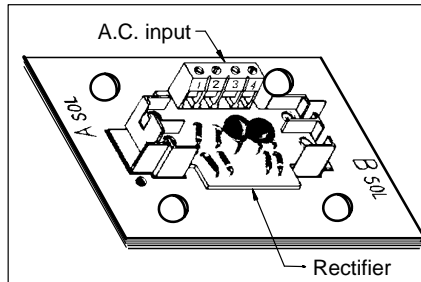
Spools with contoured or notched lands are used to provide maximum control of flow rate change as the spool is shifted.



D.C. solenoids prevent coil burnout during controlled rate of solenoid shift.



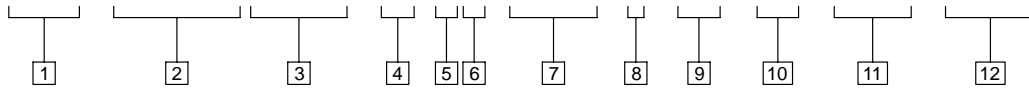
Spool shift speed is controlled by a metering orifice in the solenoid. Three orifice sizes are available to meet your application.



Conventional alternating current (120/60 or 110/50) input is converted to D.C. through a rectifier located in the terminal box.

Model Code

(F3) - DG4S4 (L) W - 01 ** - (U) - * - *** - 60 - (LH) - S *****



1 Seals

Blank – Standard seals
F3 – Special seals

2 Valve Type

D – Directional control valve
G – Manifold or subplate mounted
4 – Solenoid operated
S – Sliding spool
4 – 4-way flow direction

3 Electrical Accessories

Blank - For “U” type connectors
W – Terminal box
LW – Terminal box with lights

4 Interface

01 – ISO-4401-AC-05-4-A,
NFPA D05, CETOP 5

5 Spool Types

A models – 0, 2, 9
B models – 0, 2, 6, 8
C models – 0, 2, 6, 8

6 Spool/Spring Arrangement

A – Spring offset, P to A
B – Spring centered, solenoid “a” removed
C – Spring centered, three position

7 Wet Armature Solenoid(s)
(non-serviceable core tubes)

Blank – Plug-in coils
U – DIN 43650 coil(s)* without electrical plug (non-rectified)
U1 – Connector fitted (DC only)
U6 – Connector fitted w/lights (DC only)
U11 – Connector fitted w/ rectifier & lights (AC only)
U12 – Connector fitted w/rectifier

8 Coil Identification Letter(s)
(See “Solenoids” below)

9 Soft Shift Orifice

Blank – Standard (.047) **
.062 – .062 inch
.078 – .078 inch
(see response times, page 7)

10 Design Number

Subject to change.
Installation dimensions remain as shown for designs 60 through 69.

11 Left-hand Assembly

Omit for right-hand assembly with solenoid “a” removed.

12 Special Soft Shift Solenoids

S491 – Standard valve
S528 – Canadian Standards Assoc. CSA certification

Solenoids

Solenoid Identification Letter	Solenoid Voltage Rating	Holding Amps (rms)	Holding Watts
BB	120 VAC 60Hz Rectified	0.38	40
	110 VAC 50Hz 105 VDC	0.35	35
BD	240 VAC 60 Hz Rectified	0.19	40
	220 VAC 50 Hz 214 V DC	0.17	35
G	12V DC non-rectified	—	42
H	24 V DC non-rectified	—	42

* Note that the U type coils are non-rectified and require a connector with rectifier when using AC current.
A non-rectified connector must be used when supplying DC current.

** Not recommended for type 8 spool when operating at maximum flow and pressure.

Operating Data

Functional Symbols

Standard Spool Types	Graphic Symbol Center Condition	"A" Models ▲ Spring Offset	"B" Models ▲ Spring Centered	"C" Models Spring Centered
0				
2				
6				
8				
9				

▲ Standard (right hand) build shown. "A" solenoid omitted.

Note
When solenoid "a" is energized, flow is "P" to "A". When solenoid "b" is energized, flow is "P" to "B". This is in accordance with the ANSI-B93.9 standard.

Note
Solenoid designations "a" and "b" are identified on the diagram plate on the side of the valve.

Solenoid Energizing

Spring centered and spring offset valves will be spring positioned unless the solenoid is energized continuously.

NOTE

Any sliding spool valve, if held shifted under pressure for long periods, may stick and not spring return, due to silting. Therefore, it is recommended that the valve be cycled periodically to prevent this from occurring.

Bleeding Procedure

Apply a minimum of 3.4 bar (50 psi) tank pressure. Shift either solenoid "a" or "b". Loosen manual actuators in solenoid ends until air is evacuated. Tighten manual actuators. No further bleeding should be required.

To fully utilize the features of the soft shift solenoid, the core tubes must remain full of oil. The tank line must be plumbed so that the tank port is always flooded with oil. Addition of a back pressure check valve may be required to prevent bleed down.

Response Time

Response times are increased over that of a standard solenoid. These times are influenced by flow, pressure, applied solenoid voltage, oil and ambient temperatures. Response times can be fine tuned to the application by orifices that are changeable via the manual actuator in the solenoid end.

The DG4S4-01**-60-S*** valve comes with a .047 inch diameter orifice as standard. A .062 and a .078 inch orifices are also available.

Response times shown below were established with a system pressure of 250 bar (3600 psi), flow of 38 l/min (10 USgpm), solenoid voltage at 100% of rating and 38° C (110° F) oil temperature.

The given response times were measured from the point of energization/ de-energization to the point of first indication of inlet pressure change.

Response up to full system pressure is dependent on the system's compressed volume and can vary with each application.

Orifice & Tool Kit

For fine tuning shift performance, orifices must be ordered separately. The following kit comes with:

- Two (2) .047, .062 and .078 inch diameter orifices.
- One (1) Installation tool.
- One (1) $5/32$ " hex key.
- One (1) $3/32$ " hex key.

Order #02-119131

Response Time / Orifice Changing Procedure

Response Time

Model	Valve type	Spool type	Spool response (ms)					
			Shift			Return		
			Orifice dia. (in.)			Orifice dia. (in.)		
			.047	.062	.078	.047	.062	.078
A	Spring offset	0	140	100	80	260	230	200
		2	110	100	90	300	250	210
		9	150	100	90	250	210	190
C/B	Spring centered	0	150	100	80	280	240	200
		2	160	110	90	380	330	300
		6	190	120	100	190	160	150
		8	200	140	100	200	160	140

Orifice Changing Procedure

WARNING

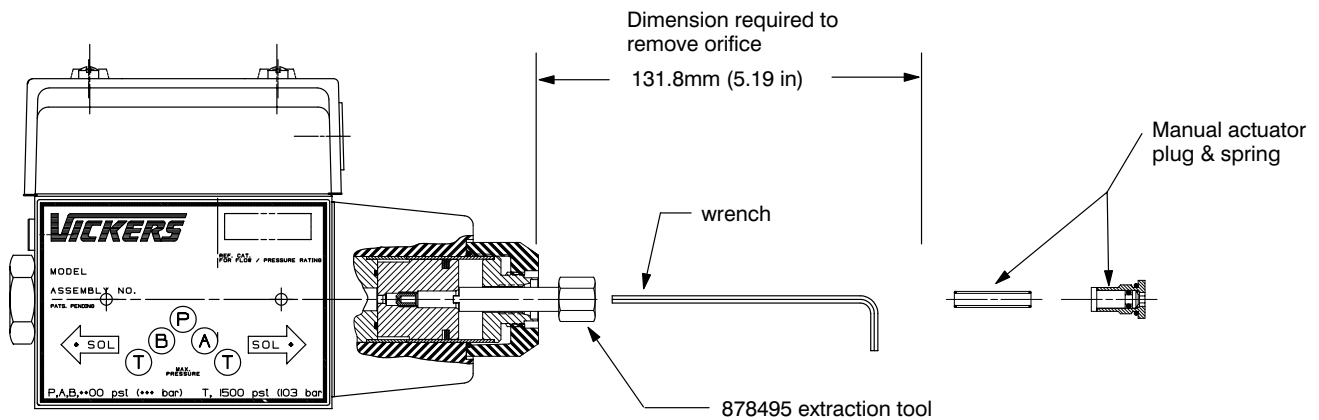
Before breaking a circuit connection make certain that power is OFF and system pressure has been released. Lower all vertical cylinders, discharge accumulators and block any load whose movement could generate pressure. Plug all removed units and cap all lines to prevent the entry of dirt into the system.

1. Using a $\frac{5}{32}$ " hex key, remove manual actuator plug and spring from the end of solenoid (Tightening torque 6.2-7.3 Nm 55-65 lbf. in.)

2. Insert extraction tool (878495) into solenoid via the manual actuator opening. Rotate tool until aligned and push into slot in armature.

3. Using $\frac{1}{2}$ " wrench and tool to prevent the armature from rotating, insert $\frac{3}{32}$ " hex key down the center of tool and remove orifice plug.

4. Replace by the same method, tightening orifice snug to ensure bottoming of threads. Smaller orifices increase response times. Larger orifices decrease response times. The .047 in. dia. orifice is standard in the valve.



Orifice & tool kit 02-119131

For fine tuning shift performance, orifices must be ordered separately. The kit includes (2) each of .047, .062, & .078 in. dia. orifices, (1) installation tool, (1) $\frac{5}{32}$ " hex key and (1) $\frac{3}{32}$ " hex key.

Performance Data

Pressure Drops

The pressure drop curves give approximate pressure drop (ΔP) when passing 21 cSt (100 SUS) fluid (having .865 specific gravity) through the indicated flow path.

For any other viscosity, the pressure drop (ΔP) will change as follows:

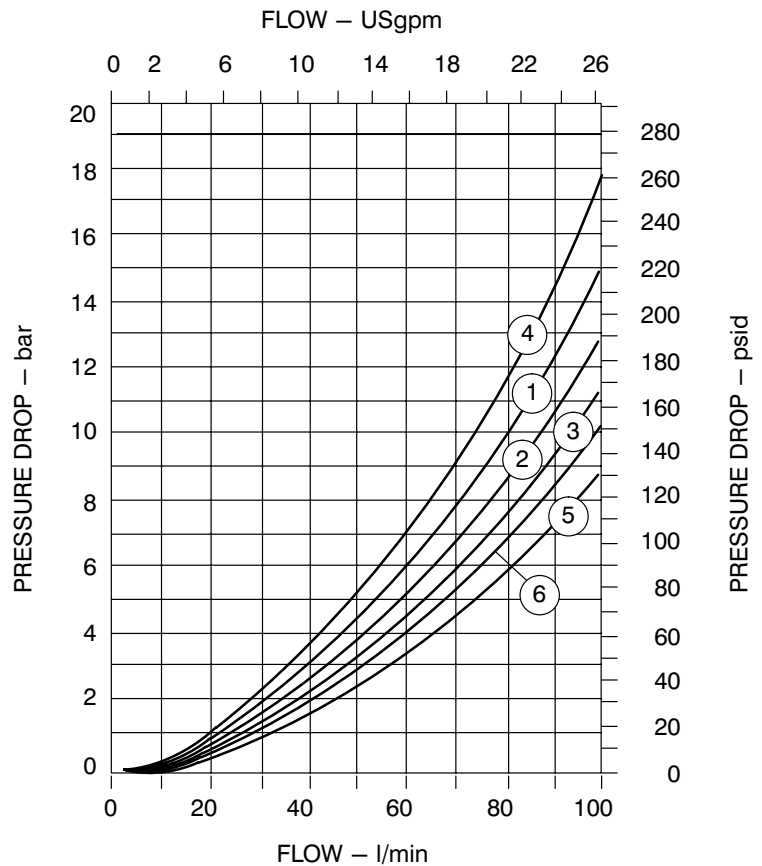
Viscosity cSt (SUS)	14 (75)	32 (150)	43 (200)	54 (250)	65 (300)	76 (350)	87 (400)
% of ΔP (Approx)	91	111	119	126	132	137	141

For any other specific gravity (G_1), the pressure drop (ΔP_1) will be approximately: $\Delta P_1 = \Delta P (G_1/G)$

Pressure Drop Curves

Pressure drop curve reference chart

Spool type	Curve numbers				
	P-A	B-T	P-B	A-T	P-T
0C/B	3	3	3	3	5
2C/B	1	1	1	2	—
6C/B	3	5	3	5	—
8C/B	4	1	4	2	6
0A	1	1	1	1	—
2A	1	1	1	1	—
9A	1	1	1	1	—



Performance Data

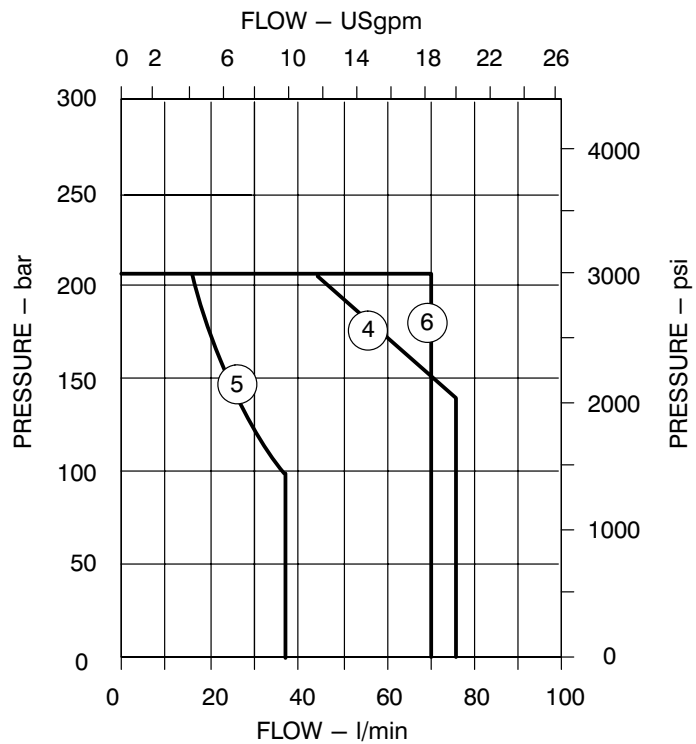
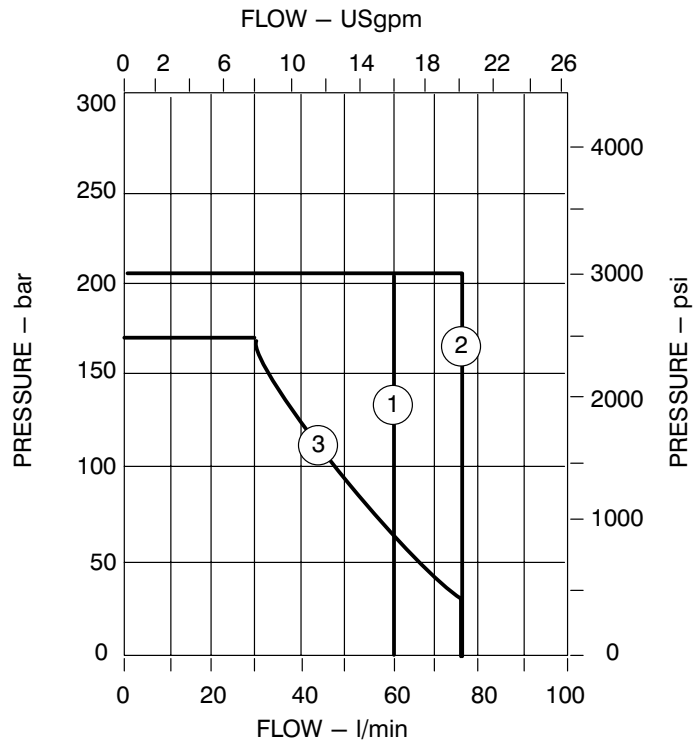
Maximum Flow Data

Maximum recommended flow data is for 90% nominal voltage in a 4-way circuit with cylinder ports either looped or blocked and containing 2,5 liter (.66 USgpm) compressed volume. Performance may vary when certain spools are used in 3-way circuits.

Maximum flow chart reference

Model	Spool type	Curve number
A	0	4
	2	5
	9	6
B/C	0	1
	2	2
	6	2
	8	3*

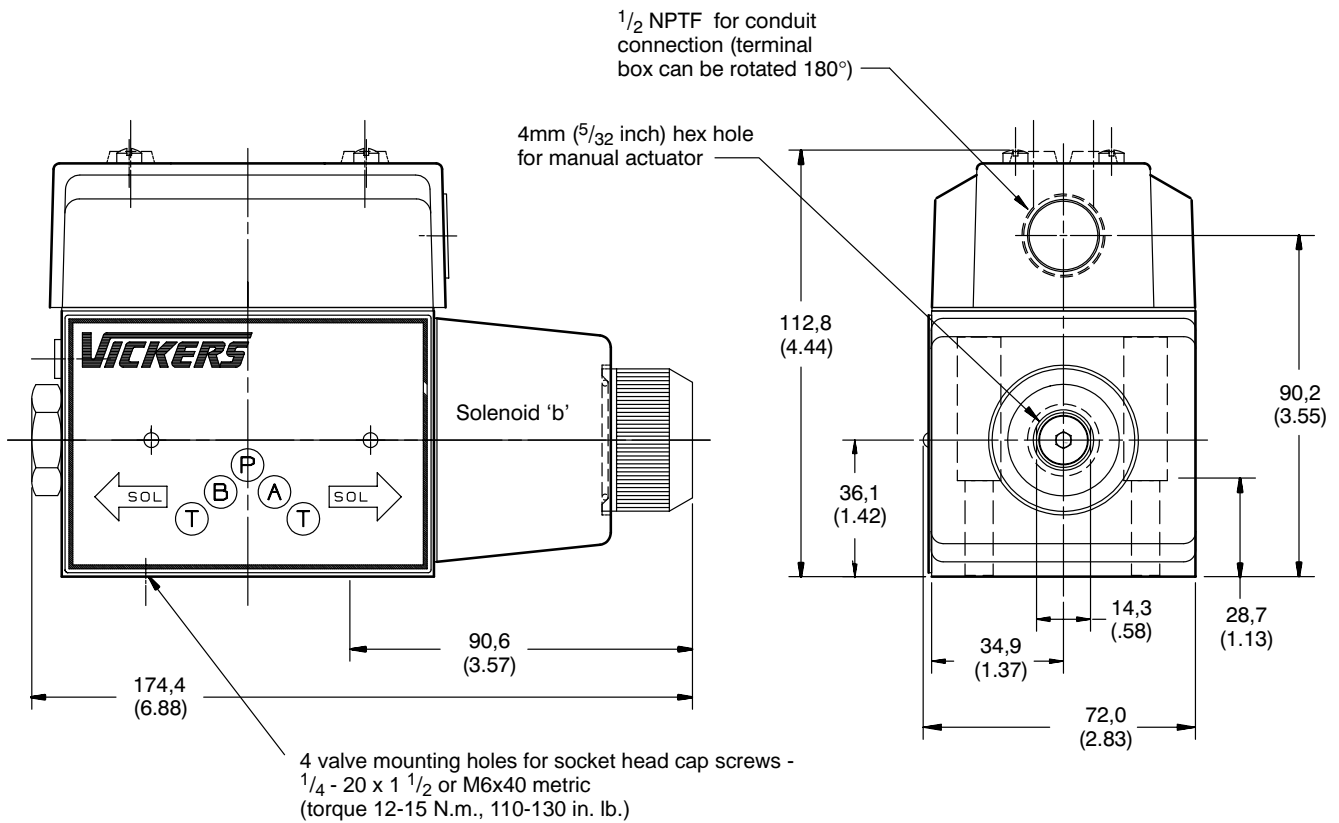
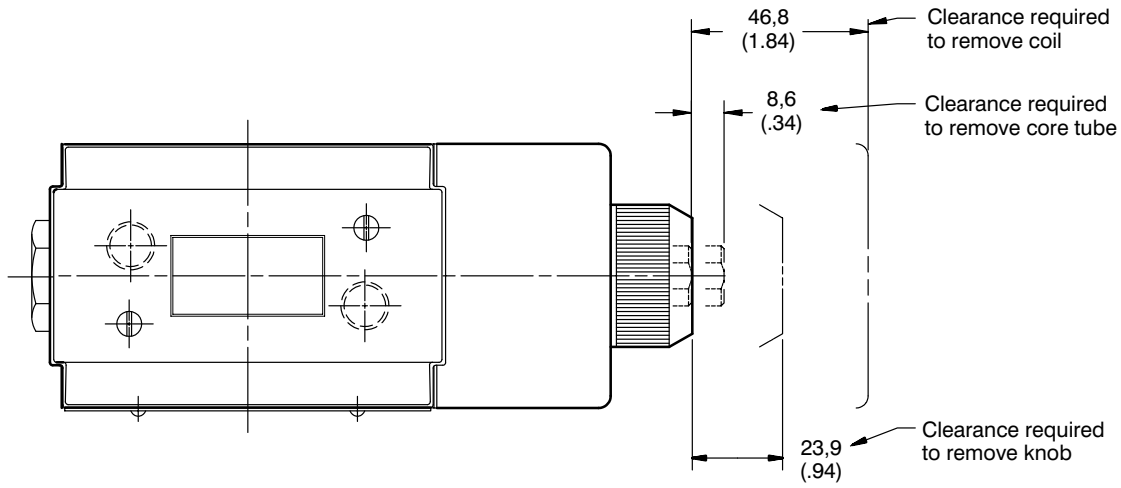
* .047 orifice not recommended at maximum flow curve.



Installation Dimensions

Spring offset Spring centered

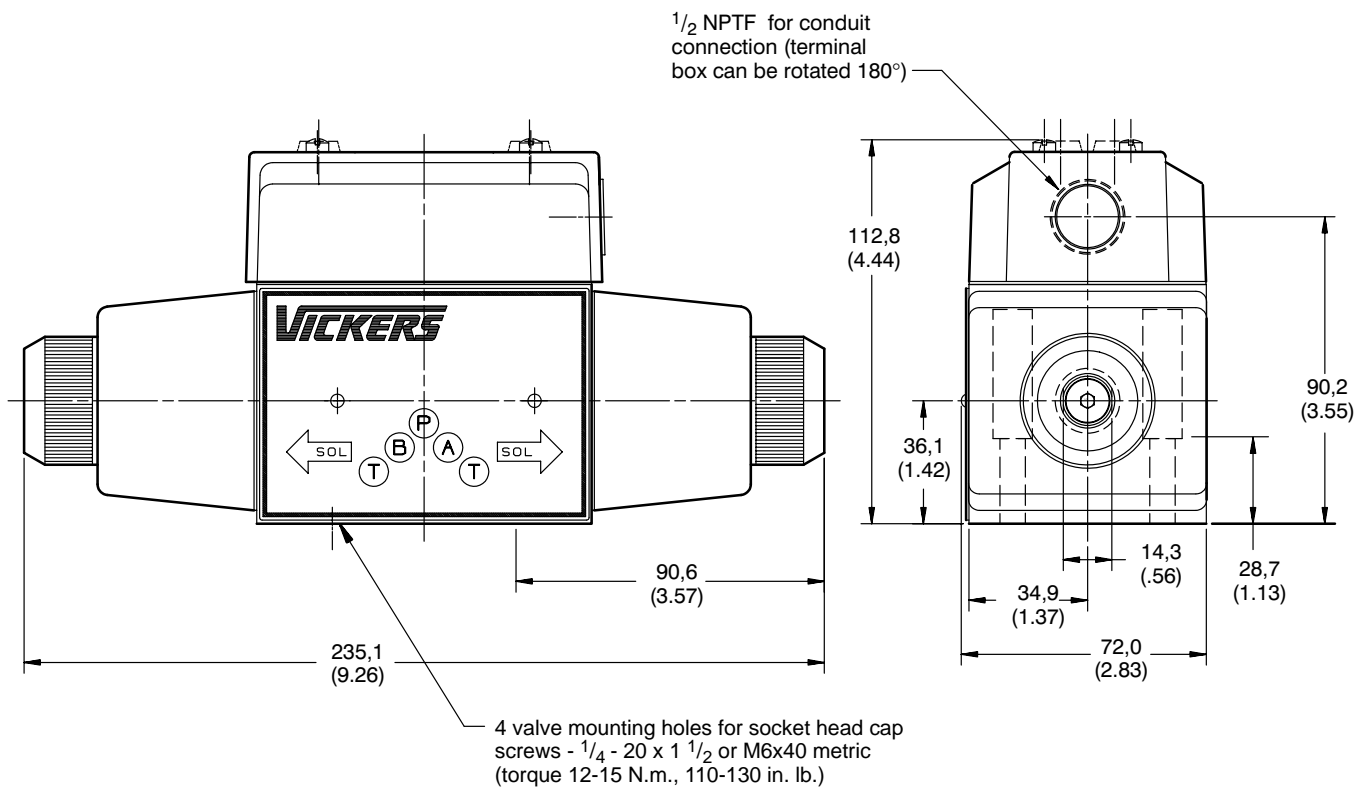
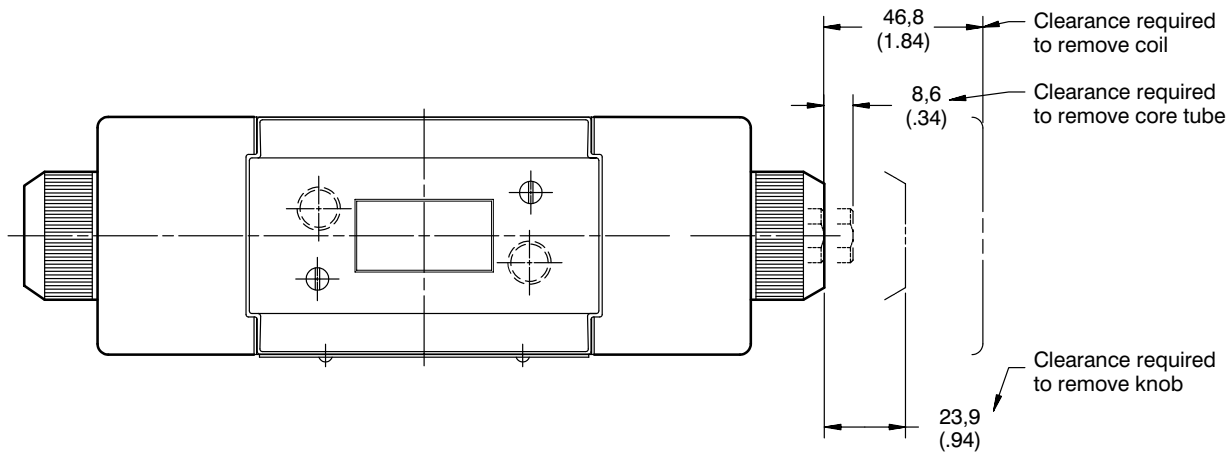
Millimeters (inches)



Installation Dimensions

Spring centered

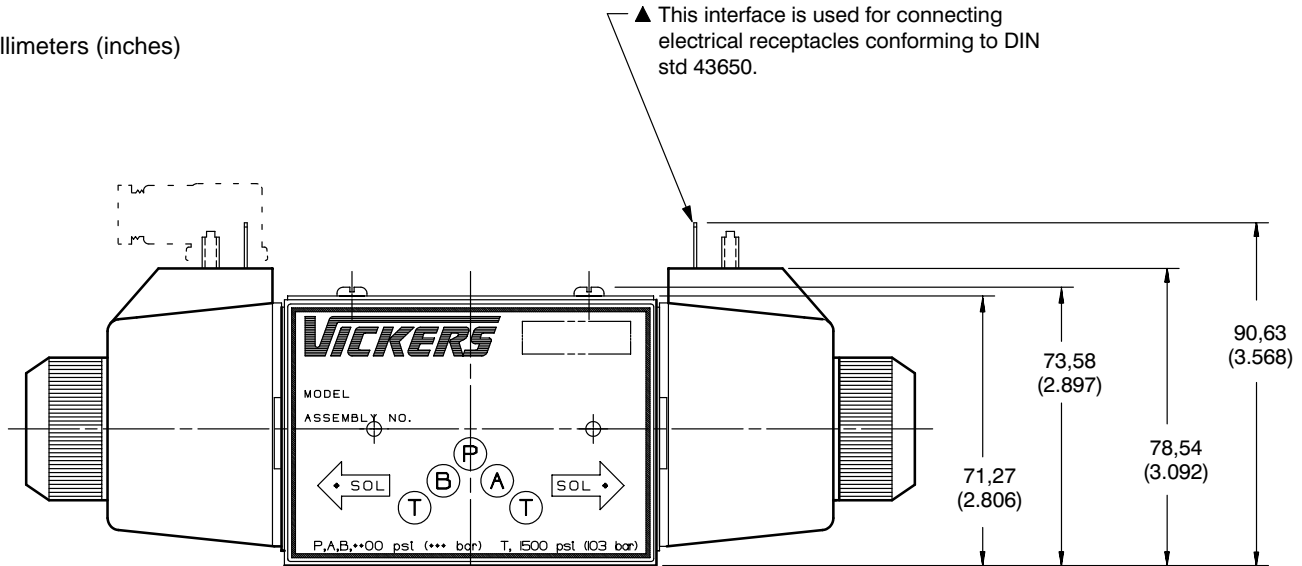
Millimeters (inches)



Installation Dimensions

DIN 43650 Connector

Millimeters (inches)



▲ **Plug connector**
(Order separately)
(ISO4400/DIN 43650)

**(Coils not rectified)
12 and 24V DC only**

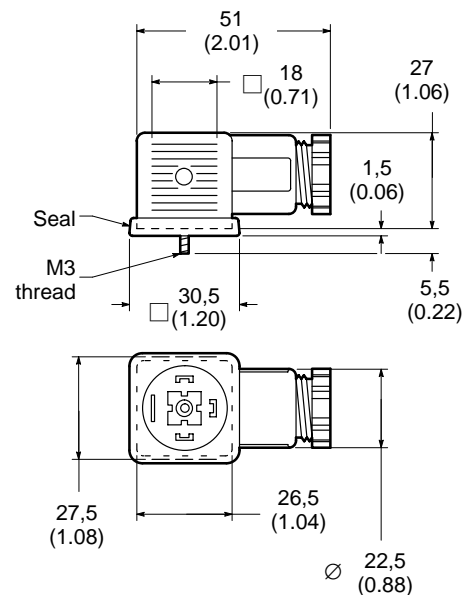
Cable diameter range ... Ø6–10 mm (0.24–0.40)
Wire section range Ø,5–1,5 mm² (0.0008–0.0023 in²)
Terminals Screw type
Type of protection IEC144 class IP65, when plugs are fitted correctly to the valves with the interface seals (supplied with plugs) in place.

Connector can be positioned at 90° intervals on valve by re-assembling contact holder into appropriate position inside connector housing.

Connectors with and without indicator lights are available (order separately):

Receptacle	Input Voltage (AC or DC)	Part Numbers	
		Gray – “A” sol.	Black – “B” sol.
U1 Coils without lights	All DC voltages	710776	710775
U6 Coils with lights	12-24	977467	977466
	100-125	977469	977468
	200-240	977471	977470
U11 Rectified coils with lights	12V AC	02-141358*	
	24V AC	02-141359*	
	110/120V AC	02-141360*	
	220/240V AC	02-141361*	
U12 Rectified coils without lights	All AC voltages	02-141357	02-141356

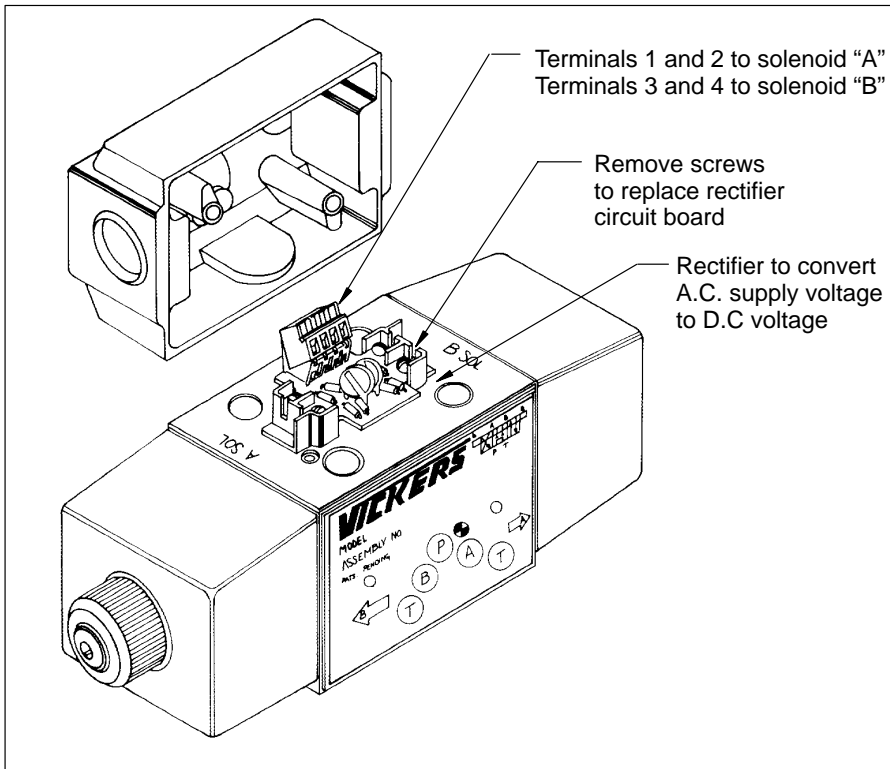
* Clear/translucent colored



Electrical Data

The DG4S4-01-60-S*** series valve is a solenoid operated directional control valve using special solenoids, a unique spool configuration and a rectifier package.

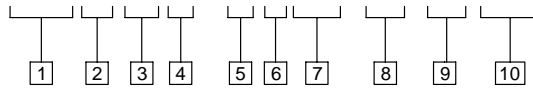
Rated supply voltage is 120V AC/60 Hz.
The rectifier package is enclosed within the terminal box and is protected against electrical surges with a M.O.V.



DGVM*-5 Subplate

Model Code

DG V M * - 5 * SP ** 10 ***



1 Valve Type DG - Directional control valve	5 Valve Size 5 - CETOP 5	9 Design Number 10 - Design
2 Pressure Rating V - 345 bar (5000 psi)	6 Pipe Thread Size Blank - 1/4 NPTF/BSP X - 3/8 NPTF/BSP Y - 1/2 NPTF/BSP Z - 3/4 NPTF/BSP	10 Connection/Mounting Blank - NPTF Thread connection T** - SAE straight thread connection with .250-20 UNC-2B inch thread mounting. T10 - .8750-14 UNF-2B conn. T12 - 1.0625-12 UN-2B conn. C** - SAE straight thread connection with M6 x 1.8 metric thread C10 - .8750-14 UNF-2B conn. C12 - 1.0625-12 UN-2B conn.
3 Subplate M - Subplate	7 Subplate Options None provided	
4 Ports Blank - Back ports E - Side ports	8 Modification	

Ordering Information

Valves, subplates, connectors, and bolt kits must be ordered as separate items.

Example:

One (1)
DG4S4-012C-BB-60-S491 valve

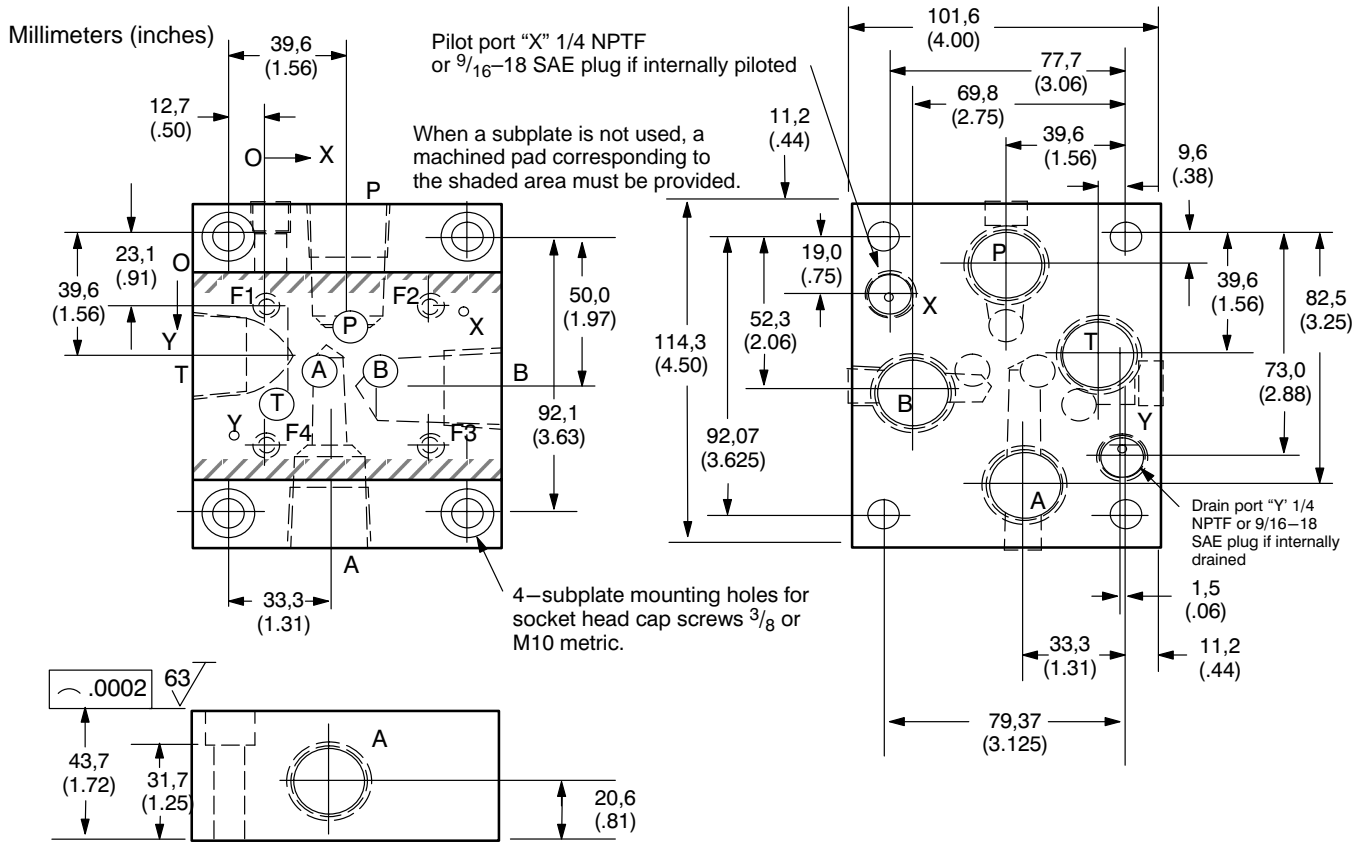
One (1)
DGVME-5-10-SP-T10 subplate

One (1)
BKDG01633 bolt kit

Torque Specifications

Maximum recommended mounting bolt torque is 13 N.m. (115 lb. in.).

Mounting Surface & Subplate Dimensions



	P	A	T	B	F1	F2	F3	F4	X	Y
X	27,0 1.06	16,7 0.66	3,2 0.13	37,3 1.47	0 0	54,0 2.125	54,0 2.125	0 0	65,0 2.56	11,2 0.44
Y	6,3 0.25	21,4 0.84	32,5 1.28	21,4 0.84	0 0	0 0	46,0 1.812	46,0 1.812	2,3 0.09	43,7 1.72
Q	11,2 max. 0.44	11,2 max. 0.44	11,2 max. 0.44	11,2 max. 0.44	M6 0.25	M6 0.25	M6 0.25	M6 0.25	3,1 0.12	3,1 0.12

Approximate weight: Standard subplates 2.7 kgs. (6 lbs.)

Bolt kits*

Includes (4) directional valve mounting bolts.

Model codes	Sizes	Thread
BKDG01-633	1/4 x 20 x 1 1/2	Inch
BK855993M	M6 x 1.0P x 40	Metric

* Bolt kits are ordered separately.

NOTE: Metric grade 10.9 (SAE grade 8) mounting bolts required.