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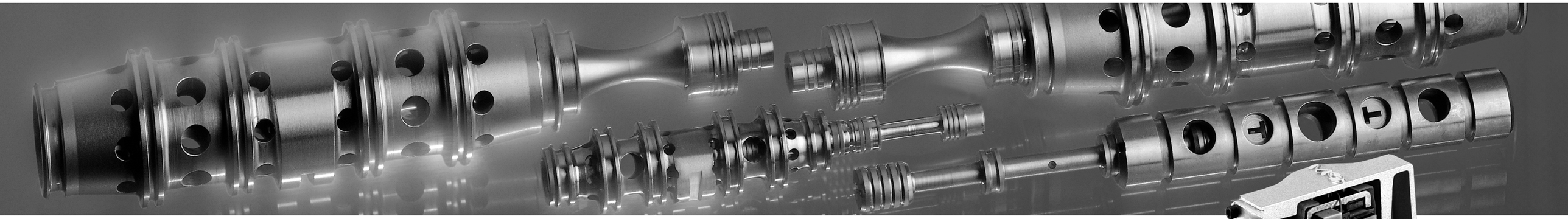
MOOG

Servovalves
D761 Series
ISO 10372 Size 04



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SERV D761 - EN / 07.99

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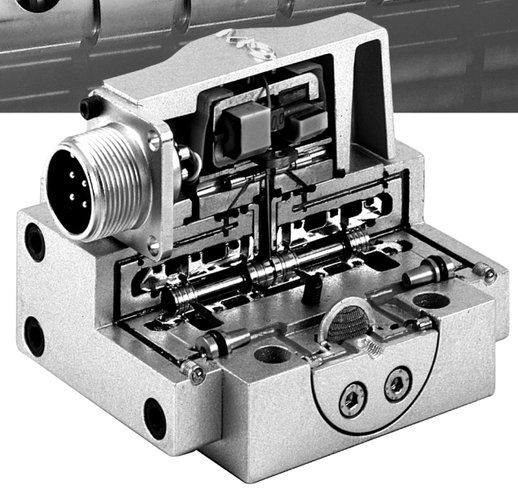
Operating Instructions



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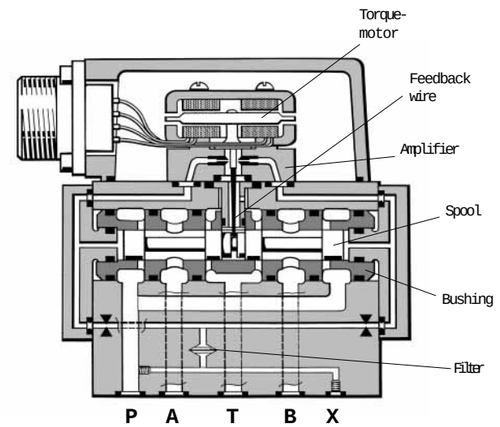

1. Safety Instructions

1.1 Warnings and symbols

ATTENTION — refers to special orders and prohibitions to prevent damage

DANGER — refers to special orders and prohibitions to prevent injury or property damage

1.2 Correct application

1.2.1 The valves series D761 are control valves suited for electrohydraulic position-, velocity-, pressure- and force control. The valves are designed for flow rate control in hydraulic systems that operate with mineral oil based fluids. Others on request.

DANGER Using the valves for purposes other than those mentioned above is considered contrary to the intended use. The user bears entirely the risk of such misuse.

Correct application involves also observing the operating instruction and complying with the inspection and maintenance directives.

1.3 Organizational measures

1.3.1 We recommend to include this operating instruction into the maintenance plan of the machine / plant.

1.3.2 In addition to the operating instruction, observe also all other generally applicable legal and other mandatory regulations relevant to accident prevention and environmental protection. Instruct the operator accordingly.

1.3.3 All safety and danger prevention instructions of the machine/plant must meet the requirements of EN 982.

1.4 Selection and qualification of personnel

1.4.1 Only well-trained and instructed personnel are allowed to work with MOOG control valves.

1.4.2 Work with electrohydraulic valves must be carried out only by personnel having special knowledge and experience in plants running with electrohydraulic controls.

1.5 Safety instructions for specific operational phases

1.5.1 Take the necessary precautions to ensure that the machine/plant is used only when in a safe and reliable state.

1.5.2 Check the machine/plant at least once per working shift for obvious damage and defects (i.e. leakage). Report any changes to the responsible group / person immediately. If necessary, stop the machine immediately and secure it.

1.5.3 In the event of malfunctions, stop the machine/plant immediately and secure it. Have any defects rectified immediately.

1.5.4 DANGER If the machine/plant is completely shut down for maintenance and repair work at the valve, it must be secured against inadvertent start up by:

- ❒ Locking the principal control elements and removing the key.
- ❒ attaching a warning sign to the main switch.

1.6 Safety instructions for the operation of hydraulic plants

1.6.1 Work on electrohydraulic equipment must be carried out DANGER only by personnel having special knowledge and experience in electrohydraulic controls.

1.6.2 Check all lines, hoses and fittings of the plant regularly for leaks and obvious damage. Repair damage immediately. Splashed oil may cause injury and fire.

1.6.3 Before removing the valve depressurize all system sections DANGER to be opened, pressure lines and accumulators of the hydraulic system in accordance with the specific instructions for the plant.

1.6.4 When handling oil, grease and other chemical substances, observe safety regulations valid for each product.

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8. Tools, Spare Parts and Accessories

8.1 Tools

Tools are only required for for installation, nulladjustment and filter replacement.

8.1.1 Installation of the valve

8.1.1.1 Mounting of the valve requires Allan wrench SW 6

8.1.2 Nulladjustment

8.1.2.1 For jam nut, cranked ring wrench 3/8"

8.1.2.2 For adjustor pin, Allan wrench 3/32"

8.1.3 Filter replacement

8.1.3.1 For removal and mounting of the cover, Allan wrench SW 3

8.1.3.2 For extraction of the filter disk use of a scriber or small screw driver is suggested.

8.1.3.3 For mounting the o-ring on the cover and for inserting o-rings into the valve base clean grease is required.

ATTENTION For valves having EPDM o-rings (Letter **E** in type designation) **normal grease must not be used. Instead use special grease (LUBRICANT MOOG NO. A22596).**

8.1.4 Assembly of crimp contacts of the connector as per descripton section 3.3.1 on page 4

Item	Qty.	Description	MOOG Part No.
1	1	Crimp pliers	C21162 001
2	1	Positioner, tool insert for contact sizes 16 und 20	C21163 001
3	1	Installation tool for contact size 16	C21164 001
4	1	Replacement tool for contact size 16	C21165 001

The complete tool set for crimping can be obtained from MOOG by ordering part no. **C21166 001.**

8.2 Spare Parts

MOOG Part No.	Description	Pos.[1])	Dimensions	Material	Qty.
42082 022	O-ring, ports P, T, A, B,		ID 10,2 x Ø 1,78	FPM Sh 85	4 pcs.
42082 013	O-ring, port X		ID 9,25 x Ø 1,78	FPM Sh 85	1 pc.
A67999 065	Replaceable filter disk	13	65 µm nominal		1 pc.
A25163 013 015	O-ring, for filter change	58	ID 13 x Ø 1,5	FPM Sh 85	2 pc.
66098 040 006	set screw, port X (internal/external)		M4 x 6 DIN EN ISO 4762-8.8		1 pc.
A25528 040	Seal ring, port X		ID 4,5 / AD 7		1 pc.

[1]) see sketch chapter 5.1, Filter replacement, page 6

8.3 Accessories (not included in delivery)

MOOG Part No.	Description	Dimensions / Notes	Qty.
B46744 004	Mating connector, 4-pole, Mil C5015/14S-2S (for cable dia min 6,5 mm, max 9,5 mm)	waterproof, protection IP65	
A03665-080-045	Mounting bolts	M8x45 DIN EN ISO 4762-10.9	4 pcs.
	Mounting manifold	see special data sheet	
55127 001	Flushing plate (for internal pilot supply)		
55127 002	Flushing plate (for external pilot supply)		

Our quality management system is certified in accordance with DIN EN ISO 9001

DIN ISO 9001 certified BVQI

ATTENTION **Note: Turn adjustor only slightly!**

Do not turn the adjustor more than one quarter turn in either direction (± 20 degrees is equivalent to ± 10% null shift).

4.3.2 While adjusting watch the actuator (motor) motion to find the null position. With overlapped valves turn the adjustor carefully in both directions to just start motion and then back into deadzone midposition between those two wrench positions.

4.3 .3 After proper nulladjustment hold the adjustor with the 3/32" Allan wrench and lock jam nut by tightening it to **7 Nm** with the 3/8" ring wrench.
Mount the mating connector again.

4.4 Setting up

4.4.1 Set up machine / plant according to the operation instructions of the manufacturer after the valve has been installed.
ATTENTION Vent hydraulic system!

4.4.2 The safety instructions of the machine / plant manufacturer must be observed.

4.4.2 Observe oil temperature.

4.4.3 Check hydraulic system for external leakage!

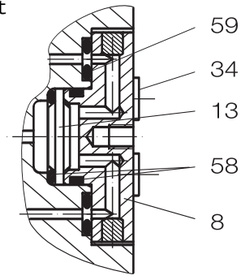
5. Maintenance

Besides regular visual inspection for external leakage and filter replacement, valve maintenance work is not required.

All repairs of MOOG valves can only be performed at facilities listed in MOOG World Wide Service Network (see back cover).

5.1 Filter replacement

The built-in filter disk protects orifices and nozzles against coarse contaminants. With severe contamination the valve response will be slowed down.
ATTENTION **Replace filter!**
ATTENTION Before starting to work on the valve clean the external surface around the filter cover!
ATTENTION **Attention:** The filter disk (13) is flown from inside to the outside. After removal of the cover (8) any contamination particles are at the inside of the disk (13) and therefore can not be seen from outside.



5.1.1 Remove 4 internal hex bolts (34) using Allan wrench (SW3). Remove cover (8). Remove the filter disk (13) now accessible by using a scriber or a fine screwdriver as extraction tool.

5.1.2 Check o-rings (58) and (59) for damage. Replace if necessary.

5.1.3 Insert o-ring (58) behind the filter disk first. Then insert the new filter disk (13) such that the side with the notch at the rim points outward. Mount the second o-ring (58) on the cover (8) using clean grease and mount cover to the valve body. Torque the 4 bolts (34) **to 4 Nm**.

5.1.4 Check valve for external leakage after pressurizing it.

6. Malfunctions, Causes and Elimination

For trouble shooting D761 - Series valves use of MOOG Valve Tester Model B96634 is suggested. See Operation Instruction "MOOG Valve Tester"

6.1 Leakage at the mounting surface of the valve

- ❒ Have all seals been installed properly at ports A, B, P, T and X?
- ❒ Have the mounting bolts been tightened correctly?

ATTENTION Pay attention to the required torque!
Tighten bolts diagonally changing!

6.2 No hydraulic response of the valve

- ❒ Check coil resistance using an Ohmmeter. (see page 5 for values).
- ❒ Check for electric input signal.
- ❒ Check the mating connector for corrosion!
- ❒ Is hydraulic pressure present?
- ❒ Is the filter disk contaminated?
- ❒ Check pilot supply. Do you need internal or external?
- ❒ Is pilot pressure present?

6.3 Instability of the system, plant oscillates

- ❒ Check whether input signal is stable.
- ❒ Check filter disk for contamination.

6.4 At zero command signal the load drifts slowly (open loop)

- ❒ Adjust valve null according to 4.3

6.5 With hydraulics ON valve goes hardover

ATTENTION Orifice contaminated (plugged).
Send valve to MOOG service center.

7. Declaration of Manufacturer

A Declaration of Manufacturer according to EC machine directive 98/37/EG is available for servo valves D761 Series and will be supplied upon request.

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2 Description

2.1 Operation

2.1.1 General

The D761 Series servo valves are throttle valves for 3- and preferably 4-way applications. They consist of an electromechanical transformer (torque motor), a hydraulic amplifier (nozzle/flapper principle), a spool in a bushing and a cantilever feedback spring. The torque motor contains coils, pole pieces, permanent magnets and an armature. The armature is connected to a flexible tube which allows a limited rotation of the armature and at the same time seals the electromagnetic components against the hydraulic fluid.
The hydraulic amplifier is a full bridge arrangement with two upstream fixed orifices and two downstream variable orifices created by two nozzles and a flapper between them. The flapper is connected at its upper end to the centre of the armature and extends downward through the flexure tube to the nozzles. A deflection of the flapper between the nozzles changes the size of the variable orifices in opposite sense.

The 4-way spool controls fluid flow from pressure port to one of the load ports and also from the other load port to return.
Deflection of the feedback spring due to spool displacement produces a torque which is fed back to the torquemotor.

2.1.2 Operating principle

An electric current (command or input signal) is applied to the coils of the torquemotor and produces depending on the current polarity a clockwise or counterclockwise torque to the armature. The thereby deflected nozzle flapper system creates a pressure difference across the drive areas of the spool and effects its movement. The feedback spring connected to the armature engages with its lower end into a slot of the spool and is thus deflected by spool displacement. The motion of the spool stops when feedback torque and electromagnetic torque are in equilibrium. Then the flapper is again in hydraulic centre position (approximately). Thus the position of the spool is proportional to the electric command signal.

2.2 Technical data

Series			**D761- .....S.....**	**D761- .....H.....**
Mounting pattern			ISO 10372 - 04 - 04 - 0 - 92	ISO 10372 - 04 - 04 - 0 - 92
Pilot connection			optional, internal or external	optional, internal or external
Mounting direction			any, fixed or movable	any, fixed or movable
Vibration			30 g, 3 axes	30 g, 3 axes
Mass		[kg]	1	1
Rated flow Q_N at Δp_N = 35 bar per land, tolerance ±10 %		[l/min]	see nameplate of the valve	see nameplate of the valve
Max. valve flow Q_{max}		[l/min]	120	80
Null leakage flow[1])	total, max.	[l/min]	1,1 to 2,0	1,4 to 2,3
Null leakage flow[1])	pilot stage only	[l/min]	0,45	0,7
Pilot flow[2])	max, at 100% step input	[l/min]	0,2	0,3
Max. operating pressure p_{max}				
	ports P, X, A, B	[bar]	315 (350 bar upon request)	315 (350 bar upon request)
	port T	[bar]	210	210
Temperature range	Ambient	[°C]	– 20 to + 60	– 20 to + 60
	Fluid	[°C]	– 20 to + 100	– 20 to + 100
Operating fluid			mineral oil based hydraulic fluid according to DIN 51524, part 1 to 3, others upon request	
Viscosity	recommended	[mm²/s]	15 to 100	15 to 100
System filtration			High pressure filter, mounted in the main flow without bypass, but with dirt alarm	
Class of cleanliness according to				
ISO 4406	for normal operation		14 / 11	14 / 11
	for longer life		13 / 10 or better	13 / 10 or better
NAS 1638	for normal operation		5	5
	for longer life		4 or better	4 or better
Filter rating	for normal operation		$\beta_{10} \geq 75$ (10 µm absolute)	$\beta_{10} \geq 75$ (10 µm absolute)
	for longer life		$\beta_5 \geq 75$ (5 µm absolute)	$\beta_5 \geq 75$ (5 µm absolute)

[2]) At 210 bar pilot or operating pressure, fluid viscositiy of 32 mm²/s and fluid temperature of 40°C

For additional technical information, such as dimensions, ordering information etc. see catalogue D761 Series.

3 Installation

3.1 General Information

3.1.1 Compare model number and valve type with information from the hydraulic schematic or bill of material.

3.1.2 The valve can be mounted in all directions, fixed or moveable.

3.1.3 Check mounting surface for planeness (0,02 mm for 100 mm) and surface roughness (Ra <1 µm)

3.1.4 Pay attention to cleanliness of mounting surface and surroundings when installing the valve.

3.1.5 Use lint-free tissue to clean!

3.1.6 Before installation, remove protection plate from the valve and keep it for later repair.

3.1.7 Pay attention to correct position of ports and location of o-rings during installation.

3.1.8 Use socket head bolts according to DIN EN ISO 4762 (hitherto DIN 912) for mounting, strength class 10.9, and tighten them diagonally changing according to table. Torque tolerance +/- 10 %.

Mounting pattern ISO 10372	Bolts to DIN EN ISO 4762	Qty.	Torque [Nm]
04-04-0-92	M8 x 45	4	18

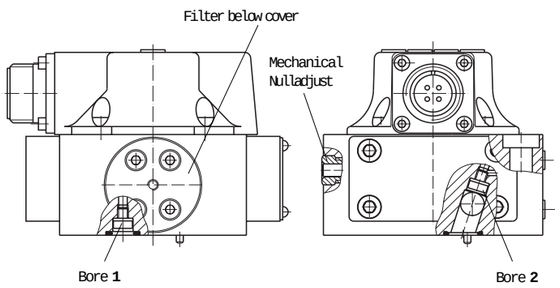
3.2 Conversion internal/external

3.2.1 The pilot connection mode is indicated on the nameplate (see type designation)

3.2.2 For the location of the code letter see example of type designation: **S10FOFM4NBL**. The meaning of this code letter is as follows:

Pilot pressure	15 to 210 bar	15 to 315 bar	25 to 350 bar
Internal	4	(former A, E and J)	
External	5	(former C, G and L)	

3.2.3 Conversion instruction
For operation with internal or external pilot supply connection convert valve according to the following drawing and instruction.



Pilotflow Supply	Screw plug (M 4 x 6 DIN EN ISO 4762) Bore 1	Bore 2
internal P	closed	open
external X	open	closed

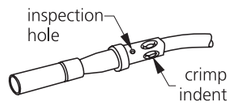
3.3 Electric connection

The specified mating connector is designed for **crimp contacts of size 16**. Former connectors had solder contacts.

3.3.1 Instruction for Crimping
If you order the connector the necessary socket contacts are enclosed in the delivery bag of the mating connector supplied with the valve.
Special tools are required for preparing cables and connectors. (These tools are listed in chapter 8.1 "Tools"). Pay attention to the wiring instructions, which are to be found in this assembly instruction. The complete instructions can be received from MOOG together with the tools set.

3.3.1.1 Baring wires
Bare cables professionally to a length of 6,5 mm. Don't damage conductor or squeeze insulation.

3.3.1.2 Wiring contacts
Connect contacts only with prescribed tools (see 8.1 and assembly instructions)
After crimping check whether
- ❒ wire can be seen through the inspection hole in the contact
- ❒ none of the contacts is bent or damaged
- ❒ no strand is outside the termination hole
- ❒ a proper crimp termination with eight crimp indents has been performed.



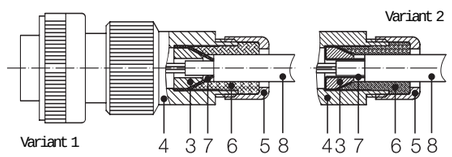
3.3.1.3 Assembling contacts
After wiring the contacts, the leads have to be pulled through all accessories used, such as grommet, ferrule, endbell and cable clamp. Make sure that leads are inserted through the appropriate cavity of grommet. In order to ease insertion of leads, the contacts have to be dipped in Isopropyl.

3.3.1.4 Inserting contacts
Dip contacts in Isopropyl and insert them with prescribed tool (see 8.1 and assembly instructions) through the grommet with constant pressure (into the insulator) until it snaps into its position. Insert contacts according to marking on the insulator.
Also insert unwired contacts in order to guarantee proper sealing.

3.3.1.5 Removing contacts
All accessories are removed in reverse direction as described in chapter 3.3.1.3 Remove contacts with prescribed tool according to assembly instructions.

3.3.1.6 Shielding
When fixing a shielding braid to connector with DZ-adaptor
- ❒ Loosen lock nut (5). Slide heat shrink component (6) and lock nut (5) over cable(8).

Variant 1
- ❒ Push shielding braid (7) onto endbell (3).
- ❒ Remove protruding braid wires.



Variant 2
- ❒ Push endbell (3) over cable and place shielding braid (7) externally over endbell (3).
- ❒ Mount locknut (5) on shell (4).

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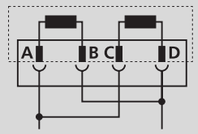
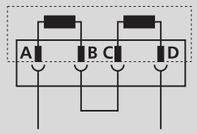
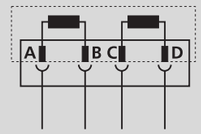
3.3.2 Connector wiring

Electric connection with 4-pole connector to Mil C5015/14S-2
The torque motor has 2 coils. The leads of the coils are single connected to the pins.

For operation in parallel, series or single coil mode the corresponding wiring must be done in the mating connector **by the customer**.

Connector Mil C5015/14S-2		Parallel wiring			Series wiring			Single coils		
										
		A B C D			A B C D			A B C D		
Type designation letter		**H**	**L**	**N**	**H**	**L**	**N**	**H**	**L**	**N**
Input resistance (25°C)	[Ω]	100	40	20	400	160	80	200	80	40
Rated current	[mA]	± 15	± 40	± 60	± 7,5	± 20	± 30	± 15	± 40	± 60
Inductance (at 60 Hz)	[H]	0,59	0,18	0,10	2,2	0,66	0,36	0,72	0,22	0,12
Electrical power	[W]	0,023	0,064	0,072	0,023	0,064	0,072	0,045	0,128	0,144
Connections for valve opening P ◗ B, A ◗ T		A and C (+) B and D (–)			A (+), D (–) B and C connected			A (+), B (–) or C (+), D (–)		

ACHTUNG **Note: Before applying electric signals the pilot stage has to be pressurized.**

4 Setting up

This information is valid for new installations to be put into operation as well as for repair cases.

4.1 Filling the hydraulic system

ATTENTION New oil is never clean. Therefore the system should generally be filled by using a filling filter. This fine mesh filter should at least comply with the following requirement: $ß_{10} \geq 75$ (10 µm absolute).

4.2 Flushing the hydraulic system

ATTENTION Before the hydraulic system is put into operation for the first time (also after modifications) it has to be flushed carefully according to the instructions of the manufacturer of the machine/plant.

4.2.1 Before flushing suitable flushing elements have to be inserted in the pressure filters instead of the high pressure elements.

4.2.2 Before flushing the operational temperature of the hydraulic system should be achieved. Observe temperature!

4.2.3 A flushing plate or, if the system allows, a directional valve should be mounted in place of the MOOG porportional valve. The P- and T-connections are flushed through the flushing plate. The user A- and B- connections can also be flushed by the directional valve.

ATTENTION Attention, the directional valve can lead to unpermissible movements of the load (i.e. with parallel drives), which may result in damage of the machine/plant. Instructions of the manufacturer have to be strictly observed.

Minimum flushing time **t** can be calculated as follows:

$$t = \frac{V}{Q} \cdot 5$$

V = content of reservoir [liter]
Q = flow rate of the pump [l/min]
t = flushing time [hours]

4.2.4 The flushing process can be considered successful when a system cleanliness of 14/11 according ISO 4406 or class 5 according NAS 1638 or better is achieved. A long life of the metering lands of the servo valve can be expected for this cleanliness class.

4.2.5 ATTENTION Replace flushing elements in the pressure filters by suitable high pressure elements after flushing. Install MOOG servo valve instead of flushing plate or directional valve.

4.3 Nulladjustment

The hydraulic null of the valve is preset at the factory with a tolerance of +/- 2% of rated signal. If necessary this null can be changed by the user of the valve.
The valve null is adjusted by an excentre pin which engages into a slot of the bushing. By turning this adjustor the bushing is shifted relatively to the spool. A mark on the hex of the adjustor indicates the orientation of the excentre pin.

ATTENTION **A mechanical null adjust is not available with special valve models having a fixed pin. This adjustor shows no hex.**

4.3.1 **Procedure**: Clean the valve externally. Remove the mating connector.

- ❒ Mount cranked ring wrench 3/8" on jam nut.
- ❒ Insert 3/32" Allan wrench through ring wrench opening into internal hex of adjustor.
- ❒ Release jam nut just enough (approximately 1/2 turn) to enable turning of the adjustor.

Clockwise rotation of the adjustor will increase flow out of port B.