

# Moog Servovalve Service

## Understanding your Repair Quotation

Industrial Group (Tewkesbury) MOOG CONTROLS LTD Ashchurch Tewkesbury Glos GL20 8NA, England		Tel.: (01684) 296600 / Fax: (01684) 278410 Internet: www.moog.co.uk/industrial				
		<b>COST ESTIMATE 42E</b>		<b>Customer No. 42</b>		
Invoicing Address		Date 03 Nov		Your Order		
UNITED KINGDOM		Your Contact		Phone / Fax		
Expiration Date: 08 Dec Payment: 30DAYS FROM INV DATE Delivery Conditions: Our VAT ID No.: GB 302 3780 91 Your VAT ID No.:		Our Contact		Phone / Fax		
Page: 1 of 2						
Item	Moog Part-No.	Description	Delivery Date Year/Week	Quantity	Unit Price GBP	Total Price GBP
1	E760	SERVOVALVE ASSY	01 Jan 2044	1	627.20	627.20
Serial No.: Motorcap over pressure. Pilot porting X External Y Internal. Base O-rings are missing. Coils passed clip test ok. Signs of Contamination. Excessive Null Bias. Internal Leakage is satisfactory. Ball glitch evident. Filter is contaminated lightly with fibres and burnt oil deposits. O-rings are satisfactory. Armature feedback S/Aball is heavily worn and flapper is ringed. Bushing and spool assembly is worn but serviceable. Class 3 service required: Strip down, ultrasonically clean, replace or repair torque motor. Repairs include: re-push nozzles and re-shim as necessary. Replace seals, filters and re-assemble. Re-test.						
<small>Terms and conditions may be found at: <a href="http://www.moog.com/Media/1/1/termsAndConditionsOfSaleUK.pdf">http://www.moog.com/Media/1/1/termsAndConditionsOfSaleUK.pdf</a></small> <small>Bank Details for Payment to MCL: HSBC, 3 Riverside, Temple Quay, Bristol, BS1 6ER                  GBP: Payments IBAN: GB28 2608 0000 0000 0000 0000                  USD: Payments IBAN: GB28 2608 0000 0000 0000 0000                  EURO: Payments IBAN: GB28 2608 0000 0000 0000 0000</small>						



# Moog Servovalve Service

## Understanding Your Repair Quotation



This document has been produced to enable you to easily interpret the test results supplied by our Service Team. Should you have any queries, please do not hesitate to contact the team. Details can be found at the back of this document.

### Page 1 Explained

Section	Section Title	Description
1	Cost Estimate reference code and customer details	Used to identify the repair estimate. Shows reference, customer identification and internal administration contact information.
2	Estimate expiry date and payment terms	Details the expiry date of the estimate, customer's payment terms as defined by our business system, delivery conditions and our VAT number.
3	Repair Model Number and Estimate	Lists the model numbers being inspected. The delivery date on the report will usually read 01 Jan 2044. The actual date will be advised on receipt of the purchase order.
4	Description of inspection results and recommendations	Lists results and recommendations produced during our initial checks. Will also indicate the recommended class of service required to bring your product back within Moog specification or to customer specific requirements.  Information regarding the terminology used in these descriptions can be found in the glossary of terms in the back of this document.

Industrial Group (Tewkesbury)  
MOOG CONTROLS LTD  
Ashchurch Tewkesbury  
Glos GL20 3BA, England  
Tel.: (01684) 296600 / Fax: (01684) 278410  
Internet: www.moog.co.uk/industrial

**MOOG**  
Invoicing Address

UNITED KINGDOM

Expiration Date: 08 Dec  
Payment: 30DAYS FROM INV DATE  
Delivery Conditions:  
Our VAT ID No.: GB 302 3780 91

**COST ESTIMATE 42E**  
Date 03 Nov  
Your Order  
Your Contact  
Our Contact

Customer No. 42  
Phone / Fax  
Phone / Fax

Page: 1 of 2

Item	Moog Part-No.	Description	Delivery Date Year/Week	Quantity	Unit Price GBP	Total Price GBP
1	E760	SERVOVALVE ASSY	01 Jan 2044	1	627.20	627.20

Serial No.:  
Motorcap over pressure. Pilot porting X External Y Internal.  
Base O-rings are missing. Coils passed c/p test ok.  
Signs of Contamination: Excessive Null Bias. Internal Leakage is satisfactory. Ball glitch evident.  
Filter is contaminated lightly with fibres and burnt oil deposits.  
O-rings are satisfactory. Armature feedback S/Abail is heavily worn and flapper is ringed. Bushing and spool assembly is worn but serviceable.  
Class 3 service required: Strip down, ultrasonically clean, replace or repair torque motor. Repairs include: re-push nozzles and re-shim as necessary. Replace seals, filters and re-assemble. Re-test.

Terms and conditions may be found at: <http://www.moog.com/Module7/TermsAndConditionsOfSaleUK.pdf>

Bank Details for Payment to MCL: HSBC, 3 Shergoate, Temple Quay Bristol, BS1 6ER  
GBF Payments IBAN: GB24 3089 40 34 13 123456789  
USD Payments IBAN: US24 3089 40 34 13 123456789  
EURO Payments IBAN: GB24 3089 40 34 13 123456789

### Page 2 Explained

Section	Section Title	Description
1	Continuation of model numbers and inspection results	An additional area for larger orders requiring more space for model numbers and inspection results.
2	Authorisation Form	To be filled out by the customer, with the information required by Moog to process the order and authorise the repair, including purchase order number.
3	Estimate Summary	Shows the total cost including VAT, & Shipping for the entire estimate.

Industrial Group (Tewkesbury)  
MOOG CONTROLS LTD  
Ashchurch Tewkesbury  
Glos GL20 3BA, England  
Tel.: (01684) 296600 / Fax: (01684) 278410  
Internet: www.moog.co.uk/industrial

**MOOG**

**COST ESTIMATE 42**  
Date 03 Nov  
Customer No. 42

Page: 2 of 2

Item	Moog Part-No.	Description	Delivery Date Year/Week	Quantity	Unit Price GBP	Total Price GBP
1						

Authorisation is required prior to any further work being carried out, please complete this section below, sign and return this quotation.

Name: \_\_\_\_\_ Signature: \_\_\_\_\_  
Your Order No.: \_\_\_\_\_ Date: \_\_\_\_\_  
Proceed with repair YES/NO **2** Return the product without repair YES/NO  
Delivery Address: \_\_\_\_\_ (A charge of 0 (GBP) each, will be charged for inspection)

Shipping Address	Sub-Total	627.20
	Freight	59.00
	Net Total	686.20
UNITED KINGDOM	Total Tax	102.93
Shipped by	Total Amount GBP	789.13

3

Terms and conditions may be found at: <http://www.moog.com/Module7/TermsAndConditionsOfSaleUK.pdf>

Bank Details for Payment to MCL: HSBC, 3 Shergoate, Temple Quay Bristol, BS1 6ER  
GBF Payments IBAN: GB24 3089 40 34 13 123456789  
USD Payments IBAN: US24 3089 40 34 13 123456789  
EURO Payments IBAN: GB24 3089 40 34 13 123456789

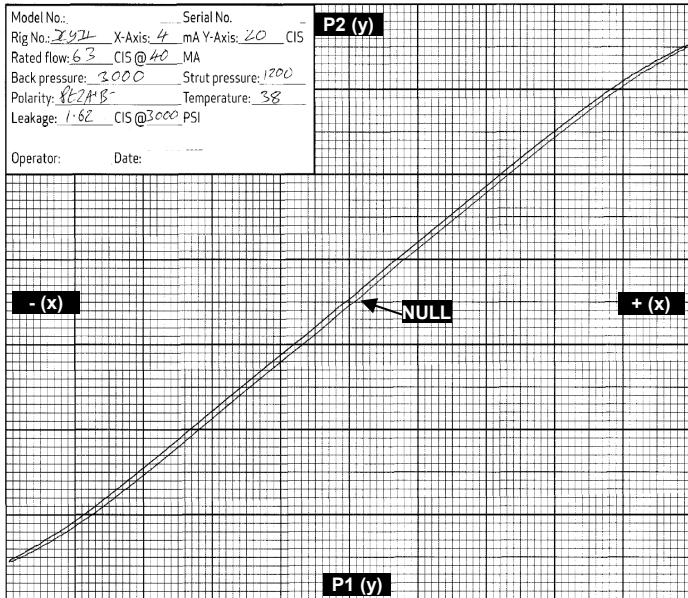
# Moog Servovalve Service

Accompanying Documentation (on request)



Test plots many accompany your report to show the flow characteristics or leakage level within the servovalve. These reports can vary in appearance depending on the test rig used when your valve was inspected. The following pages give examples of test plots with a brief explanation of what is being.

## Expanded Flow Plot \*



An expanded flow plot is the most common type which accompanies test data. This plot shows your servovalve flow performance and indicates other characteristics including Hysteresis, lap condition, and null bias.

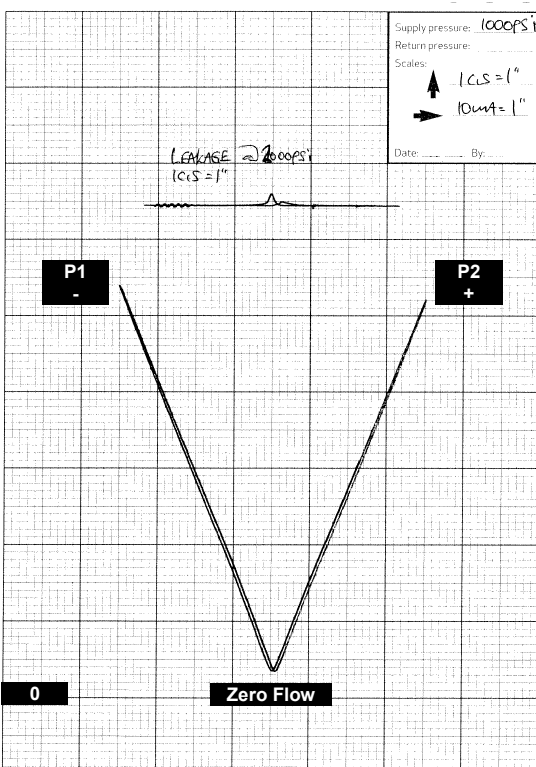
This measurement is obtained using a flow meter between the two service ports. During this test we exercise the servovalve to perform a full cycle starting at Null Position (Spool Centre).

A command signal is applied to cycle the servovalve to maximum positive, returning through the null point to the maximum negative, and returning back to null.

These plots may vary slightly in appearance depending on the characteristics of the servovalve under test.

These plots should be accompanied by a legend (see in the top left corner in this example), which will indicate the scaled unit of measure. In most circumstances, the x-axis plots the command signal, and the Y-axis plots the flow rate.

## Return Flow Plot \*



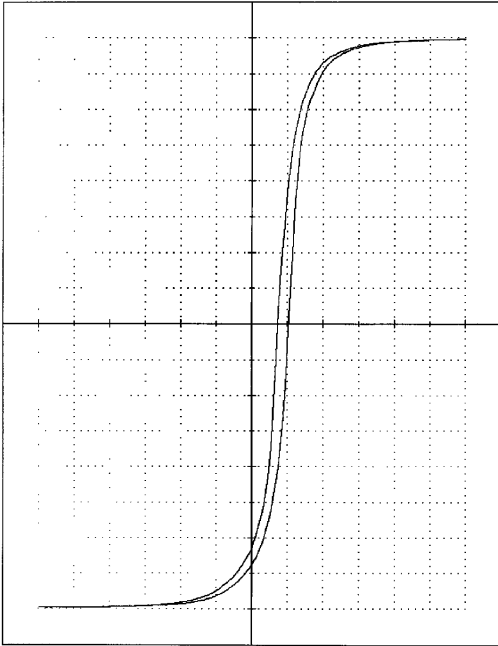
This type of plot differs from the usual expanded flow plot because the measurement of flow is taken in the return port.

Since the measurement is taken in the return port, the direction of flow in the service ports does not affect the plot as flow to the return port is always in the same direction and this is the reason why there is no negative portion on the plot. The test method is the same as explained previously in the expanded flow plot. The values measured with this technique will include the internal leakage, and this is the reason why the lowest value appears above zero flow.

The second plot above the V, shows the internal leakage levels of a servovalve. Leakage through null position (spool centre) will in most cases show a rise in leakage, and either side of the null region is referred to as Tare Leakage.

\* It is quite common that the above two plots are separate.

## Delta P Plot



The final example to the left is referred to as a Delta P plot. This plots the relationship between pressure drop across the valve and flow rate achieved. This plot does not always accompany all valve repair documentation.

## About Contamination

70% to 80% of hydraulic system problems and failures can be attributed to contamination.

### Sources of contamination

External – Contaminants enter the system from an external source. This could be through insufficient seals, inadequate air breathers, opening the reservoir lid or dirty oil being added to the system.

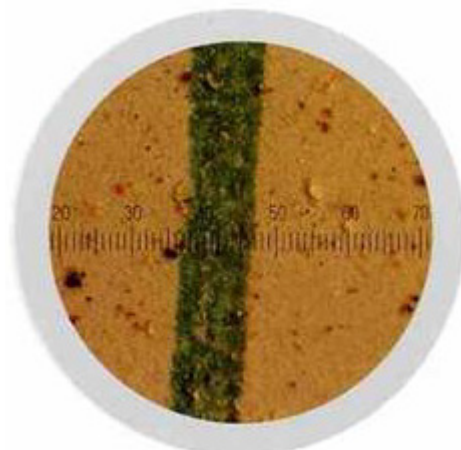
Internal – Contamination from within the system can be self-generated particles from components wearing in the system, or from breakdown of fluid itself.

Moog repair reports do not identify sources of contamination, or indicate contamination levels within your system. The only way to do this correctly is to have an oil sample from your system analysed under microscope by a trained and proficient person. Moog offer an oil sampling service, which includes testing for contamination, viscosity and water content of your oil.

It is very important the person responsible for maintenance of your system is aware of the effects of contamination, how to identify sources of contamination and the required cleanliness levels required for the components in your system.

### Training to increase the uptime of your machinery

Moog in partnership with the NFPC offer courses on effective maintenance of hydraulic systems. For more information on our oil sampling service or our training courses please contact us.



## Training Courses



### Effective Maintenance Of Hydraulic Servo Systems

This course will concentrate on the necessary maintenance processes and procedures that must be in place to ensure the effective and continuous operation of servo valves.

### Installing & Commissioning of Servovalves and Servo-Proportional Valves

This course is aimed at engineers who already have some experience in commissioning hydraulic equipment, but now need to improve their skills in order to work effectively, efficiently and safely with open-loop and closed-loop electro-hydraulic systems.



### Moog Training Course Contacts

**Mark Greenway**

**Email:** [mgreenway@moog.com](mailto:mgreenway@moog.com)

**Tel:** 01684 278223

**Caroline Sheppard**

**Email:** [csheppard@moog.com](mailto:csheppard@moog.com)

**Tel:** 01684 278369

## Our Service and Repair Team

If any information contained within the repair information you receive is unclear, please do not hesitate to contact one of our team listed below for further information.

**Caroline Sheppard**

**Email:** [csheppard@moog.com](mailto:csheppard@moog.com)

**Tel:** 01684 278369

**Jo Foster**

**Email:** [jfoster@moog.com](mailto:jfoster@moog.com)

**Tel:** 01684 278220

**Brian Sims**

**Email:** [bsims@moog.com](mailto:bsims@moog.com)

**Tel:** 01684 278383

Technical Support

**Graham Spaul**

**Email:** [gspaul@moog.com](mailto:gspaul@moog.com)

**Tel:** 01684 278515

Moog Industrial Group  
Ashchurch Industrial Estate  
Tewkesbury  
Gloucestershire GL20 8NA  
United Kingdom

**Tel:** +44 (0) 1684 296600

**Fax:** +44 (0) 1684 278410

**Email:** [Service.uk@moog.com](mailto:Service.uk@moog.com)

**Web:** [www.moog.co.uk/industrial](http://www.moog.co.uk/industrial)



# Moog Servovalve Service



## Glossary of Terms

### Electrical

<b>Coil Impedance</b>	The complex ratio of coil voltage to coil current. Coil impedance will vary with signal frequency, amplitude, and other operating conditions, but can be approximated by the dc coil resistance (R ohms) and the apparent coil inductance (L henrys) measured at a signal frequency.	<b>Polarity</b>	Distinction between positive and negative poles of the electrical signal.
<b>Dither</b>	An ac signal sometimes superimposed on the servovalve input to improve system resolution. Dither is expressed by the dither frequency (Hz) and the peak-to-peak dither current amplitude (ma).	<b>Rated Current</b>	The specified input of either polarity to produce rated flow, expressed in milliamperes (ma). Rated current is specified for a particular coil configuration (differential, series, individual or parallel coils) and does not include null bias current.
<b>Input Current</b>	The electrical current to the valve which commands control flow, expressed in milliamperes (ma).		

### Hydraulic

<b>Control Flow</b>	QV - The flow through the valve control ports to the load expressed in in <sup>3</sup> /sec (cis), gal/min (gpm), litres/min (lpm) or for fuel applications lbs/hr (pph).	<b>Rated Flow</b>	QR - The specified control flow corresponding to rated current and given supply and load pressure conditions. Rated flow is normally specified as the no-load flow and is expressed in cis, gpm, lpm or pph.
<b>Flow Gain</b>	The nominal relationship of control flow to input current, expressed as cis/ma, gpm/ma, lpm/ma or pph/ma.	<b>Load Pressure Drop</b>	PL - The differential pressure between the control ports (that is, across the load actuator), expressed in lbs/in <sup>2</sup> (psi), or bars.
<b>Internal Leakage</b>	The total internal valve flow from pressure to return with zero control flow (usually measured with control ports blocked), expressed in cis, gpm, lpm or pph. Leakage flow will vary with input current, generally being a maximum at the valve null (called null leakage).	<b>Valve Pressure Drop</b>	The sum of the differential pressures across the control orifices of the servovalve spool, expressed in psi or bars. Valve pressure drop will equal the supply pressure, minus the return pressure, minus the load pressure drop. [ PV = (PS-R) - PL ]
<b>No Load Flow</b>	The control flow with zero load pressure drop, expressed in cis, gpm, lpm or pph.		

### Performance

<b>Frequency Response</b>	The relationship of no-load control flow to input current when the current is made to vary sinusoidally at constant amplitude over a range of frequencies. Frequency response is expressed by the amplitude ratio (in decibels), and phase angle (in degrees), over a specific frequency range.	<b>Null Bias</b>	The input current required to bring the valve to null, excluding the effects of valve hysteresis. Expressed as percent of rated current.
<b>Hysteresis</b>	The difference in valve input currents required to produce the same valve output as the valve is slowly cycled between plus and minus rated current. Expressed as percent of rated current.	<b>Null Shift</b>	The change in null bias resulting from changes in operating conditions or environment. Expressed as percent of rated current.
<b>Lap</b>	In a sliding spool valve, the relative axial position relationship between the fixed and movable flow-metering edges with the spool at null. Lap is measured as the total separation at zero flow of straight line extensions of the nearly straight portions of the flow curve, drawn separately for each polarity. Expressed as percent of rated current.	<b>Pressure Gain</b>	The change of load pressure drop with input current and zero control flow (control ports blocked). Expressed as nominal psi/ma or bars/ma throughout the range of load pressure between $\pm 40\%$ supply pressure.
<b>Linearity</b>	The maximum deviation of control flow from the best straight line of flow gain. Expressed as percent of rated current.	<b>Symmetry</b>	The degree of equality between the flow gain of one polarity and that of reversed polarity, measured as the difference in flow gain for each polarity and expressed as percent of the greater.
<b>Null</b>	The condition where the valve supplies zero control flow at zero load pressure drop.	<b>Threshold</b>	The increment of input current required to produce a change in valve output. Valve threshold is usually measured as the current increment required to change from an increasing output to a decreasing output. Expressed as percent of rated current.
<b>Performs to Specification</b>	This indicates the unit has been checked against the Moog specification set for the model being tested		

### Repair Terms

<b>AFSA</b>	Armature Flapper Sub Assembly.	<b>LVDT</b>	Linear Variable Displacement Transducer. This is an electrical linear position sensor used in our electrical feedback valves to measure the spool position within the valve.
<b>Ball Glitch</b>	An expression used to indicate the amount of wear of the feedback wire ball and the interfacing hole/slot in the spool. For more information regarding this please ask for our Technical Look information brochure.	<b>Motorcap</b>	This is the external part of the valve covering the torque motor assembly or first stage of the valve. Usually located on top of the valve, usually made of plastic or metal material.
<b>BSA</b>	Bushing and Spool Assembly	<b>Null Condition</b>	This is the position of the spool in the valve when 0mA/0V signal is put in to the valve. The null condition is generally expressed as a mA or Voltage level which resembles how far from spool centre electrically the null position is.
<b>Contamination</b>	unwanted material in the hydraulic system/component. See common causes of contamination.	<b>Null Leakage</b>	This is the measure of leakage from the service ports to the tank when the valve spool is positioned in the null region.
<b>Flapper</b>	A component of the first stage of the valve which acts against the nozzles when a electrical current is applied to the coils. If the flapper is marked as 'ringed' this is a indication the valve has been overdriven or been in service for a long period of time without service. This form part of the AFSA	<b>Spool</b>	The part within the valve that physically controls the path of oil through the valve.
<b>Flexure Sleeve</b>	Also referred to as a flexure tube. This is the part of the valve that prevents oil flow to the electrical components of the torque motor. This forms part of the AFSA	<b>Tare Leakage</b>	This is the measure of the leakage level in the valve from pressure to tank through the nozzles which control the spool end pressures. For more information please ask for a copy of our Technical Look information brochure
<b>Internal Leakage</b>	Due to the nature in which servovalves are designed there has to be an internal leakage. This can be divided in to two types, tare leakage and null leakage.		