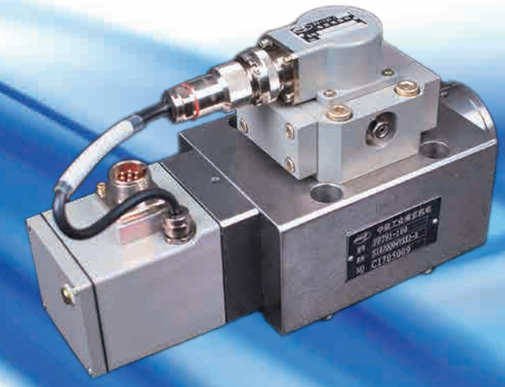
FF-791 SERIES

large flow 3 stage EHSV



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609伺服阀

AVIC NANJING SERVO CONTROL SYSTEM CO.,LTD

航空工业南京伺服控制系统有限公司

CATALOG

FF-791 SERIES
INTRODUCTION

With over 50 years of manufacture, FF-791 series servo valves of AVIC Nanjing Servo Control Systems Co.,Ltd have been widely used in metallurgy,chemical industry,manufacture,geological exploration,construction,power generation,textiles,printing and various kinds of test equipment.Now we can deliver over 10000 pieces annually.FF-791 is an affordable equivalent to Moog 72.It boasts a large share of domestic market and enjoys great reputation among users both at home and abroad.

Servo valves in this catalog are in conformity with GJB3370-1998 of China military standard for servo valves used for aviation .

Our quality management system has passed ISO 9001:2000 quality assurance standard.

Note

Please clear the whole hydraulic system before installing servo valve as per ISO 6072.

Please refer to general technical data and electrical performance.

This catalog is for users with professional knowledge.Please refer to this catalog to ensure that all necessary characteristics for the safety and function of the system are given.We reserve the right to change the specifications in this catalog before notice.Please contact AVIC Nanjing Servo Control Systems Co.,Ltd in case of any doubt.

609F is the trademark of former China Research Institute of Aero-Accessories (NO 609 Research Institute). AVIC Nanjing Servo Control Systems Co.,Ltd,a restructuring unit of 609,reserves the right to ownership,change.

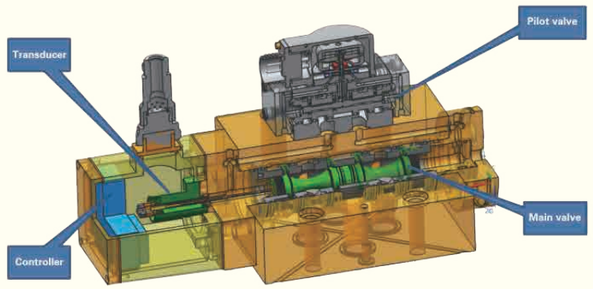
For further information, please visit us at http://www.njservo.com

※ Characteristics

·High static flow rate and high dynamic response;
·Internal integrated electronics together with LVDT and other parts form internal closed loop control of servo valve;
·Excellent output linearity;
·High threshold and low hysteresis;
·Optional pilot supply and return connection via fifth and sixth port in valve body;
·External electrical null adjustment.

※ Structure

FF-791 is a high flow rate and high response flow control three stage EHSV and consists of 2 stage high precision flow control EHSV in the pilot stage and main sliding valve in the main stage,LVDT and integrated electronics.



※ Operation

An electrical command signal is applied to the integrated control amplifier which drives a current through the pilot valve coils. The pilot valve produces differential pressure in its control ports.This pressure difference results in a pilot flow which causes main spool displacement.The position transducer measures the position of the main spool. This signal then is demodulated and fed back to the control amplifier where it is compared with the command signal.The control amplifier drives the pilot valve till the error between command signal and feedback signal is zero.Thus,the position of the main spool is proportional to the electrical command signal.

FF-791 SERIES
PRODUCT OVERVIEW

Performance

Working pressure:
Main stage: Port P、Aand B: ≤31.5bar With X (internal): ≤31.5bar
With X (external): ≤350bar Port T (internal): ≤210bar
Port T (external): ≤350bar
Pilot valve: Port P、And B: ≤31.5bar Port T: ≤210bar
Temperature and humidity: Ambient temperature: -20℃～+60℃ Fluid temperature: -20℃～+80℃
Relative humidity: 10%～90%
Sealing material: NBR,FPM (other materials at request)
Working fluid: Petrol based hydraulic fluid per DIN 51524 or hydraulic fluid viscosity 10～400mm²/s at 38℃ as per clients.
Recommend yh-15 or yh-10 aircraft fluid .
Fluid viscosity: cSt 5～400, recommend cSt 15
Fluid viscosity: cSt 5～400, recommend cSt 15
System filtration: Pilot valve: High pressure filter, mounted in the main flow without by-pass, but with dirt indicator. If possible, directly upstream of valve.For system with a fast regulating VD-pump, outside system circulating filter is recommended.
Main stage: High pressure filter as for the pilot stage, outside system circulating filter is recommended.
Cleanliness class: for normal operation: NAS 1638: 5 for longer life: NAS 1638: 4
for normal operation: ISO 4406: 14/11 for longer life: ISO 4406: 13/10
Note: contamination level affects servo valve performance greatly(spool null position, resolution) and wear (metering edges, pressure gain, leakage)
Filter rating: for normal operation$\beta_{10}\geqslant 75$ (10μabsolute) for longer life $\beta_3\geqslant 75$ (3μabsolute)
Installation options: any position or move with system.
Vibration: 30g, (3 axis)
Protection plate: Included in standard delivery

Flow calculation

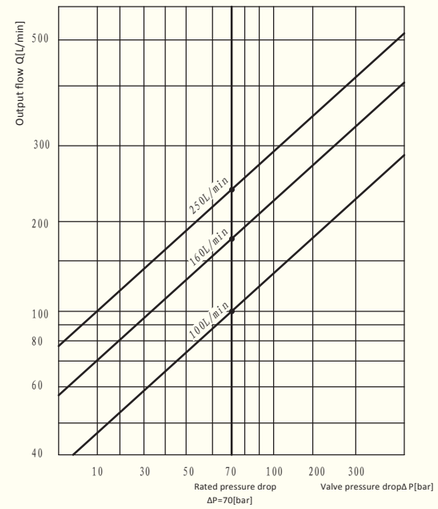
Valve actual flow will be decided by spool position and pressure drop between valve supply and return chambers.Under rated pressure drop ΔP=210bar (3050psi) and 100% command signal when valve spool moves furthest,valve flow rate is defined as rated flow Q_N.

At non-rated pressure drop and given commander signal,valve flow is proportional to square root of valve supply and return chamber.

$$Q=Q_N\sqrt{\frac{\Delta P}{\Delta P_N}}$$

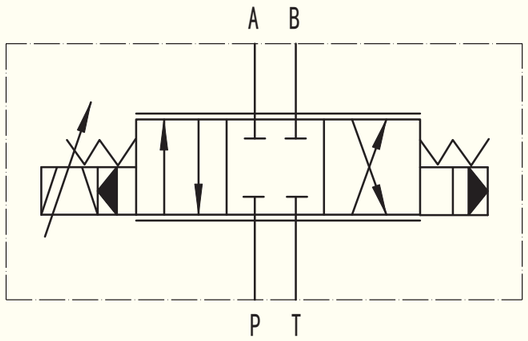
Q_N—valve rated flow rate (L/min)
ΔP—valve actual pressure drop (MPa)
ΔP_N—valve rated pressure drop (MPa)
Q—valve actual flow rate (L/min)

When the average flow rate of P,1,2 or R is less than 30m/s(98ft/s),valve volume flow Q can be calculated using this method.

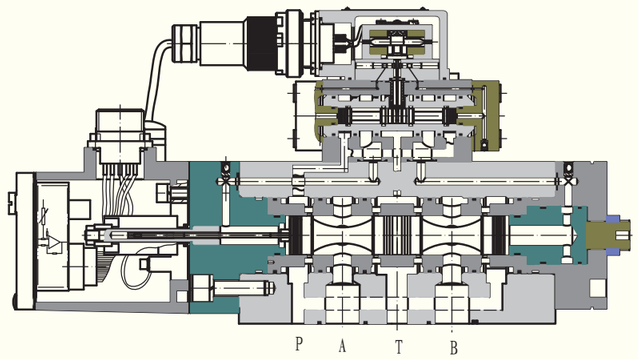


Flow Diagram
At 100% commander signal, valve flow rate is linear with valve pressure drop.Note: 70bar=1017psi。

Hydraulic symbol



This symbol is for EHSV status with supply pressure,electricity and command signal at 0.



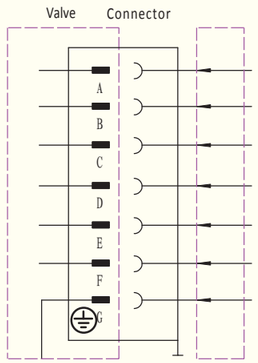
Note：Supply pressure port P；
Return pressure port R（T）；
Control port A；
Control port B.

FF-791 SERIES
FUNCTION and ELECTRICAL DATA

Electrical characteristic

1、15VDC supply

15V supply wiring diagram for valves with 6 pin connector.



功能	电流指令	电压指令
供电	+(15±3) VDC供电	
供电	-(15±3) VDC供电	
信号地（0V）	⊥0	
输入指令	（0～±10）mA，负载阻抗1KΩ	（0～±10）V，负载阻抗10KΩ
输入指令（差动）	指令输入 I_3=-I_1:（0～±10）mA (Re=200KΩ) 指令输入（反向） I_1=-I_3:（0～±10）mA	U_{D-E}=（0～±10）V(Re=10KΩ）
阀芯位移信号	（0～±10）mA，最大负载阻抗1KΩ	（0～±10）V，输出阻抗50Ω
保护地		

注：差动输入不论电压信号还是电流信号，输入电压U_{D-3}和U_{E-3}都须限制在-15V～+32V之间

Voltage command signal：0～±10V

The spool stroke of main valve is proportional to（UD-UE）.100% valve opening P→A，B→T.is achieved at （UD-UE）=+10V. At 0V command the spool is in centred position.The input stage is a differential amplifier.If only one command signal is available,pin D or E is connected to signal ground at cabinet side according to the required operating direction.

Current command input：0～±10mA

The spool stroke of main valve is proportional to ID=-IE.100% valve opening P→A，B→T.is achieved at ID=+10mA. At 0mA.command the spool is in centred position.The input pins D and E are inverting.Either pin D or E is used according to the required operating direction. The other pin is connected to signal ground at cabinet side.

Actual spool position output signal：0～±10V

The actual spool position value can be measured at pin F.This signal can be used for monitoring valve operation purpose.Valve spool stroke range corresponds to±10V.100% valve opening P→A，B→T.is achieved at signal of +10V.

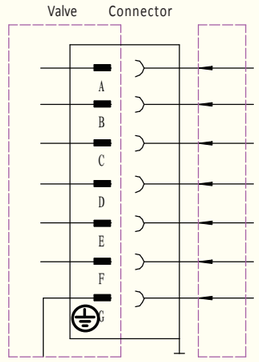
Actual spool position output signal：0～±10mA

The actual spool position value can be measured at pin F.This signal can be used for monitoring valve operation purpose.Valve spool stroke range corresponds to±10mA.100% valve opening P→A，B→T.is achieved at signal of +10mA.

Electrical characteristic

2、 24VDC supply

For 24Vsupply wiring diagram please refer to the figure below.



功能	电流指令		电压指令
供电	24VDC供电(最小18V，最大32V)，Imax=300mA		
供电/信号地	⊥0		
使能信号 非使能信号	V_{c-0}>+8.5VDC V_{c-0}<+6.5VDC	24VDC时，Ie=2.0mA	
输入指令（差动）	指令输入 $I_3=-I_1$：(0～±10)mA 指令输入（反向） $I_1=-I_2$：(0～±10)mA	(Re=200KΩ)	U_{D-E}=(0～±10)V(Re=10KΩ)
阀芯位移信号	(4～±20)mA，12mA时阀芯位于中位，负载阻抗为(100～500)Ω		
保护地			

注：差动输入不论电压信号还是电流信号，输入电压U_{D-0}和U_{E-0}都须限制在-15V～+32V之间

Voltage command signal：0～±10V

The spool stroke of main valve is proportional to（UD-UE）.100% valve opening P→A，B→T.is achieved at （UD-UE）=+10V. At 0V command the spool is in centred position.The input stage is a differential amplifier.If only one command signal is available,pin D or E is connected to signal ground at cabinet side according to the required operating direction.

Current command input：0～±10mA

The spool stroke of main valve is proportional to ID=-IE.100% valve opening P→A，B→T.is achieved at ID=+10mA. At 0mA.command the spool is in centred position.The input pins D and E are inverting.Either pin D or E is used according to the required operating direction. The other pin is connected to signal ground at cabinet side.

Actual spool position output signal：4mA～20mA

The actual spool position value can be measured at pin F.This signal can be used for monitoring valve operation purpose.Valve spool stroke range corresponds to4mA～20mA.100% valve opening P→A，B→T.is achieved at signal of 20mA.At +12 mA.command the spool is in centred position.

The position signal output 4 to 20 mA allows to detect a cable break when IF=0.For failure detection purpose it is advised to connect pin F of the mating connector and route this signal to the control cabinet

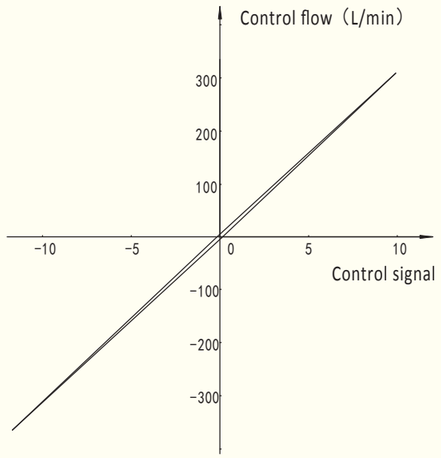
FF-791 series EHSV performance

item \ type	unit	FF-791		
Supply pressure range	MPa	2～31.5		
Rated supply pressure Ps	MPa	21		
Rated flow Qn（7MPa 下）	L/min	100	160	250
Supply voltage VDC	V	15、24		
Hysteresis	%	≤0.5		
Threshold	%	≤0.2		
Linearity	%	≤7.5		
Symmetry	%	≤10		
Pressure gain	%	＞30		
Internal leakage	L/min	≤5	≤7	≤10
Null bias	%	≤±3		
Lap	%	≤±2.5		
Null shift with supply pressure（60%～110%）Ps	%	≤±4		
Null shift with return pressure（2%～20%）Ps	%	≤±4		
Null shift with temperature（－20℃～＋60℃）	%	≤±4		
Step response	ms	3～10		
Working temperature	℃	-20～+60		
Net weight	Kg	≤13		

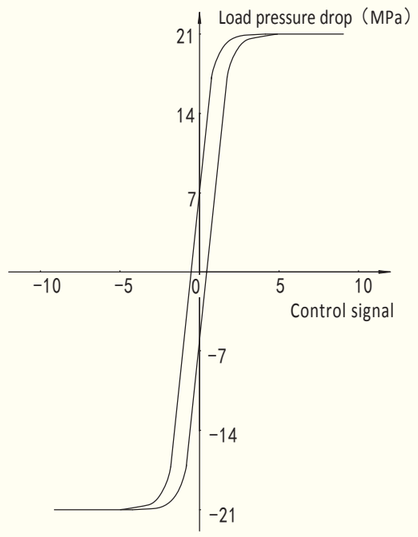
Note：FF-113 is totally interchangeable with MOOG 72 in terms of technical data and dimension.
And custom design is available at request.
1bar=14.5psi；
1gpm=3.785L/min.

Static performance curve： It is measured at system supply pressure of 210bar (3050psi),
fluid viscosity of 32mm²/s(1.26in²/s) and fluid temperature of 40°C(104°F).

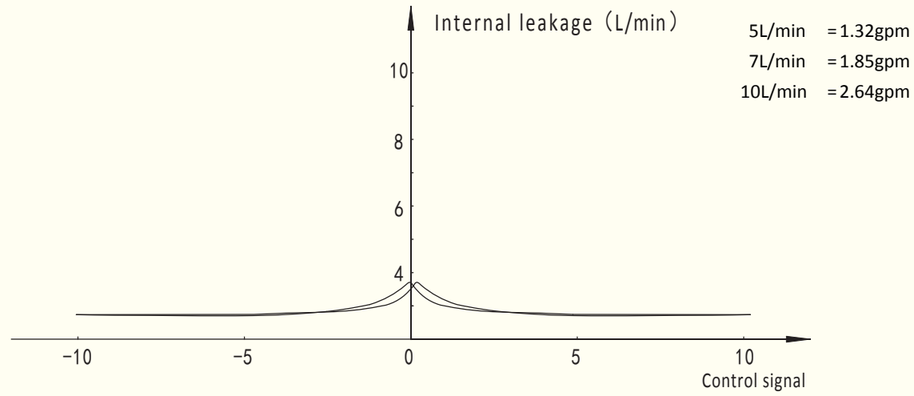
Flow characteristic curve：



Pressure characteristic curve：



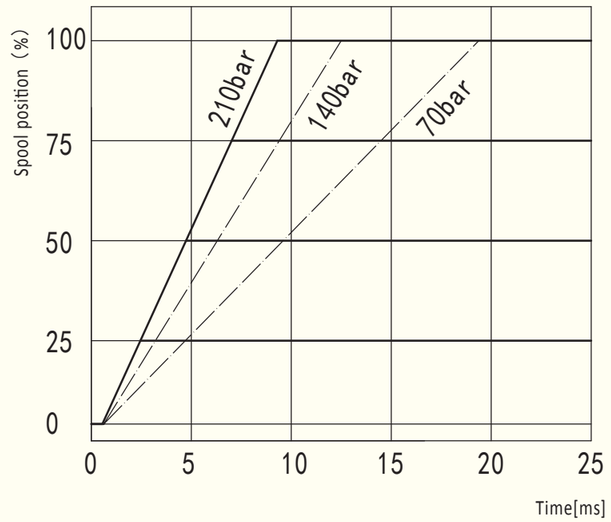
Internal leakage curve：



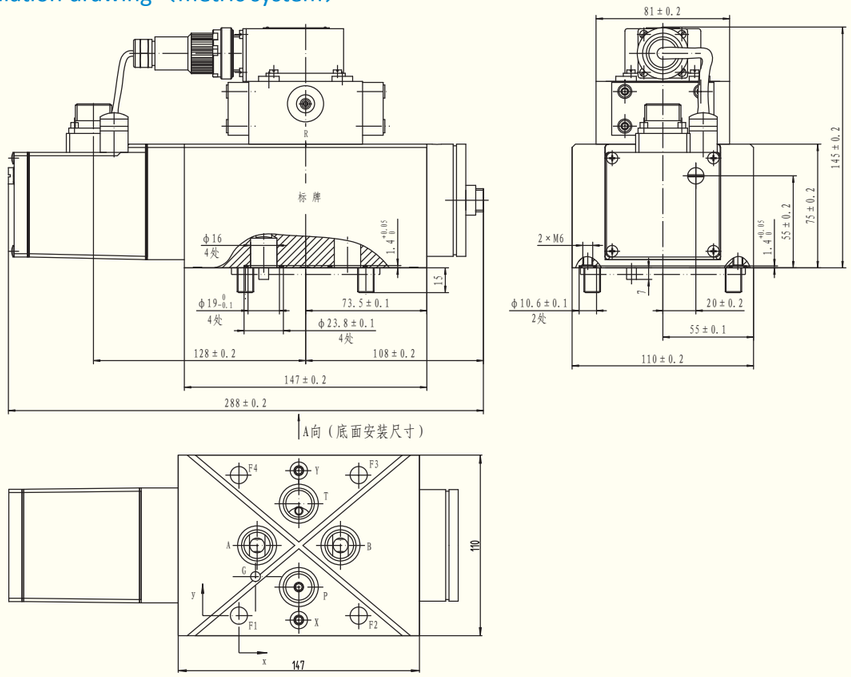
note：Flow characteristic curve measured at 70bar.

Dynamic performance curve： It is measured at system supply pressure of 210bar (3050psi),
fluid viscosity of 32mm²/s(1.26in²/s) and fluid temperature of 40°C(104°F).

Step response curve：



Installation drawing（metric system）



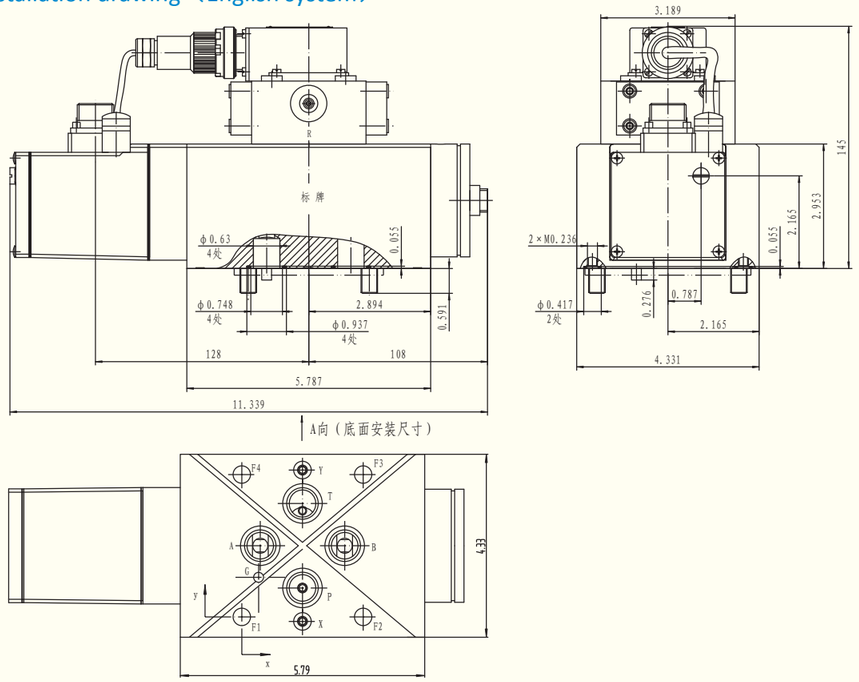
mm

	P	X	A	T	Y	B	G	F1	F2	F3	F4
	Φ16	Φ4	Φ16	Φ16	Φ4	Φ16	Φ6	M10	M10	M10	M10
x	36.5	36.5	11.1	36.5	36.5	61.9	11.1	0	73	73	0
y	17.4	-2.6	42.8	88.2	88.2	42.8	23.7	0	0	85.6	85.6

Spare parts and accessories

O ring(included in standard delivery)
for port P、T、A、B　　4，ID 20.35×Φ1.78
for port X、Y　　2，ID 7.65×Φ1.78
Mating connector
6+ PE-pole DIN 43563
Installation bolt（included in standard delivery）
M10×50 ISO 4762-10.9（GB 70-2008）　　4

Installation drawing（English system）



inch

	P	X	A	T	Y	B	G	31	F2	F3	F4
	Φ0.63	Φ0.157	Φ0.63	Φ0.63	Φ0.157	Φ0.63	Φ0.236	M10	M10	M10	M10
x	1.437	1.437	0.437	1.437	1.437	2.437	0.437	0.000	2.874	2.874	0.000
y	0.685	-0.102	1.685	2.685	3.472	1.685	0.933	0.000	0.000	3.370	3.370

Spare parts and accessories

O ring(included in standard delivery)
for P、T、A、B　　4 pieces，ID 0.8×Φ0.07
for port X、Y　　2 pieces，ID 0.3×Φ0.07
Mating connector
6+ PE-pole DIN 43563
Installation drawing（English system）
M10×50 ISO 4762-10.9（GB 70-2008）　　4 pieces

FF-791 series type designation:

S	25	J	O	Q	B	5	V	S	X	2	-	B

Model type

S	3 stage EHSV

Rated flow （ L/min, per land 3.5Mpa）

10	100
16	160
25	250

Maximum operating pressure（MPa）

J	315
K	350

Main spool type

O	4 way linear characteristic
X	special

Pilot valve

P	FF-131	standard
Q	FF-131	High response
R	FF-701	High response （ ±15V supply voltage）
S	FF-701	standard

Spool position of main stage without electrical supply

position		Pilot stage（bar）
O	undefined	⩾15
A	P→B，A→T	⩾15
B	P→A，B→T	⩾15

Function code

O	24V： without enable input
P	15V： without enable input
A	24V without enable signal applied spool in centred position
B	24V without enable input，A→T

Supply voltage

0	±15±3%VDC
2	24VDC（18-32）

input signal and spool output

	input	output
A	±10V	±10V
X	±10mA	±10mA

connector

S	6 +PE- pole，DIN 43563

Seal material

U	FPM viton，PUR ONLY FOR BUSHING
V	FPM viton

Pilot connection

	Supply X	return Y
4	internal	internal
5	external	internal
6	external	external
7	internal	external

ENTERPRISE PROFILE

AVIC Nanjing Servo Control System Co.,Ltd, a subsidiary of Nanjing Engineering Institute Of Aircraft Systems(former AVIC 609 Research Institute)，is the national leader in the research and development, manufacture of electro-hydraulic servo valves(EHSV in short) with the longest history(since 1968), the largest size and the most advanced level in China. AVIC also has invested in the company. Our company is mainly engaged in the research and development, manufacture, test and delivery and repairs of EHSV and also has the ability to develop servo systems and non-standard equipment for industrial applications.

We have a staff of over 200 people with 29 of them being engineers or senior engineers and 51 being senior technicians. Our factory covers an area of 10000 ㎡ and our lab covers an area of 4000 ㎡.We have over 300 sets of equipment and machines, with fixed assets valued at USD 25 million. We are the only one in China to carry out performance test and environment test and validation with working fluid of mineral based hydraulic fuel, phosphate fuel and fuel.

Our EHSV are widely used in aeronautics, space, navigation, metallurgy, machine manufacture, geological exploration, construction machines and all kinds of test equipment. In aeronautics applications, EHSV are used in rudder actuation system, front wheel control system, inlet control system, electronic anti-skid system, radar servo system, cargo door retraction system, engine digital control system, APS and APU.

Our product line covers over 200 models, including force-feedback single stage servo valve, nozzle –flapper two stage servo valve, jet pipe EHSV (jet pipe and jet deflector type),DDV and RDDV, combined control valve, electro-magnetic hydraulic lock, pressure-reducing valve ,hydraulic pump, servo amplifier and EHSV static and dynamic test bench. EHSV's working fluid covers mineral based hydraulic fuel, phosphate fuel and fuel.

We are also the national leader in terms of EHSV performance test and environment test and validation using hydraulic fluid and fuel. Our test bench includes static and dynamic test, high and low temperature, vibration and shock, temperature-altitude environment test. Temperature test bench can go as far as fluid temperature: -55℃～+150℃, environment temperature: -55℃～+250℃.



Now we are setting 2 national military standards and one industrial standard. We have 28 technical patents covering EHSV design, measurement and process and test method for whole valve and parts. We also have state of art equipment for hydraulic grinding, deburring etc.

AVIC Nanjing Servo Control System Co. boasts itself in its complete quality management system, advanced manufacture and development level. We are the national leader working towards the digitazition, intelligenzation and high pressuration of EHSV. We will strive to keep our clients happy.