Hydraulic Amplifier
Electrically Controlled

APPLICATIONS

The electrically controlled hydraulic amplifier is a pilot operated, linear servo actuator used in conjunction with the Woodward 2301, 500 Series or NetCon® electronic controls. The amplifier contains a Woodward EG-3P actuator which converts the electric control signal to a rotary output which controls the servo output position taken by the amplifier. The amplifier is capable of operating the control mechanisms for steam turbines or large engines which require relatively large forces and work capacity beyond that of the actuators normally used with 2301, 500 Series, and NetCon controls.

FEATURES

Two models of this type amplifier are available. The large 7.25 inch (184 mm) and the smaller 5.25 inch (133 mm) models are basically the same except for the diameter of their servo pistons. The 7.25 inch model is capable of developing about twice the force and over double the work capacity of the 5.25 inch model under the same operating conditions. Either size amplifier may operate as single-acting or differential (double-acting). The single-acting is pressure actuated in the increase fuel direction and spring loaded in the decrease fuel direction. Pressure oil moves the differential servo in both increase and decrease directions. The differential amplifier normally has a light return spring to ensure closing the valve during shutdown.

When supply oil pressure is low at start-up, the force available in a differential amplifier may not be sufficient to move the servo to the increase position. An optional transfer valve may be installed to temporarily convert the differential amplifier to a single-acting operation, resulting in more output force on start-up. As oil pressure increases, this transfer valve unseats and re-establishes differential operation.

The EG-3P actuator is an integral part of this amplifier with factory installed hydraulic and electrical connections. The actuator is equipped with an oil motor for rotating the pilot valve bushing to reduce static friction. An internal orifice is supplied for regulating the oil flow to the motor. The actuator also has a maximum stop adjustment to limit the output shaft position, thereby limiting the stroke of the amplifier servo.

The amplifier has two adjustments used for matching the level and range of the servo with that of the actuator output shaft.

An additional option is a port for starting oil which provides a means of opening the fuel or steam valve prior to start-up. In all applications where starting oil is required, a three-way valve (not supplied by Woodward) must be connected to the starting oil port.

- High work output
- Rapid response
- Internal electric actuator
- Independent starting system

SPECIFICATIONS

INPUT

Resistance (Actuator Coil): 30–35 Ω at 20 °C/68 °F
Maximum Allowable Current: 400 mA
Typical Operating Current Range: 25 to 160 mA
Plug Receptacle: 4 pin MS-3102C-145-2P

OUTPUT

Model	5.25 inch (133 mm)	7.25 inch (184 mm)
Rod Size (dia.)	1.375 inch (35 mm)	1.375 inch (35 mm)
Thread Size	1.00 inch–12 UNF2A	1.00 inch–12 UNF2A
Max. Stroke	2.50 ±.030 inch (63.5 ± 0.76 mm)	3.00 ±.030 inch (76.2 ± 0.76 mm)

Maximum Stalling Force in Increase Direction
Differential Servo
5.25 inch: 9.6P 7.25 inch: 24.5P
Spring Return Servo
5.25 inch: 20.2P – (F1 + KX) 7.25 inch: 39.8P – (F1 +KX)
where: P = supply pressure
F1 = spring preload
K = spring scale
X = amplifier stroke
Max Side Load on Output Shaft
100 lbs (445 N/45 kg)

ADJUSTMENTS

(Accessible by removing cover plate, excluding the EG3P actuator)
Maximum Stop
0.25 inch–28 x 1.25 inch oval point set screw located on end of EG-3P actuator
Level
0.25 inch–28 hex locknut on adjustable link between actuator output shaft and amplifier floating lever
Range
0.375 inch–24 x 0.750 inch UNF-3A socket head screw (3/16 Allen wrench) on floating lever

Typical Calibration	**5.25 inch**	**7.25 inch**
25 mA input	0.025 inch (0.64 mm)	0.150 inch (3.81 mm)
160 mA input	2.165 inch (54.99 mm)	2.720 inch (69.09 mm)

CONTROL QUALITIES

Time Constant Hydraulic Amplifier
5.25 inch: $0.2p^{-0.5}$ sec 7.25 inch: $0.5p^{-0.5}$ sec
where p = supply pressure in psig
Time Constant EG-3P: $0.5p^{-0.5} + 0.0028p^{+0.5}$ sec
Hysteresis: Within 3%

CONSTRUCTION

Cover: Cast aluminum
Case: Cast ductile iron or grey iron
Output Rod: Hardened AISI 410 stainless steel
Internal Parts: Stainless steel or case hardened carbon steel
Mass/Weight
5.25 inch: 165 lbs/75 kg 7.25 inch: 215 lbs/98 kg

MOUNTING

Attitude: Vertical or horizontal with electrical connector up
Bolts: 0.625 diameter (4)

HYDRAULIC SUPPLY

Type
Petroleum based oils (some synthetic lubricants are acceptable for use with Woodward hydraulic amplifiers, contact Woodward for specific oil recommendations)
Source
Prime mover lubricating system or external independent supply
Normal Operating Supply Pressure
690 to 3450 kPa (100 to 500 psi)
Flow
For step input, instantaneous flow to 378 L/min (100 US gal/min) with supply pressure of 827 kPa (120 psig); steady state leakage less than 15 L/min (4 US gal/min) at 1034 kPa (150 psi) 60 SSU—for example, use 20 L/min (5 US gal/min) pump with accumulators
Supply Filters: 10–15 µm (nominal)
Viscosity: Up to 3000 SSU, but normal performance is based on 50 to 1000 SSU
Operating Temperature
–29 to +116 °C (–20 to +240 °F) maximum

HYDRAULIC FITTINGS

Supply Inlet

5.25 inch	**7.25 inch**
1.062–12 UN 2B thread	1.625–12 UN 2B thread
0.812 deep (ref. MS 16142)	0.906 deep (ref. MS 16142)

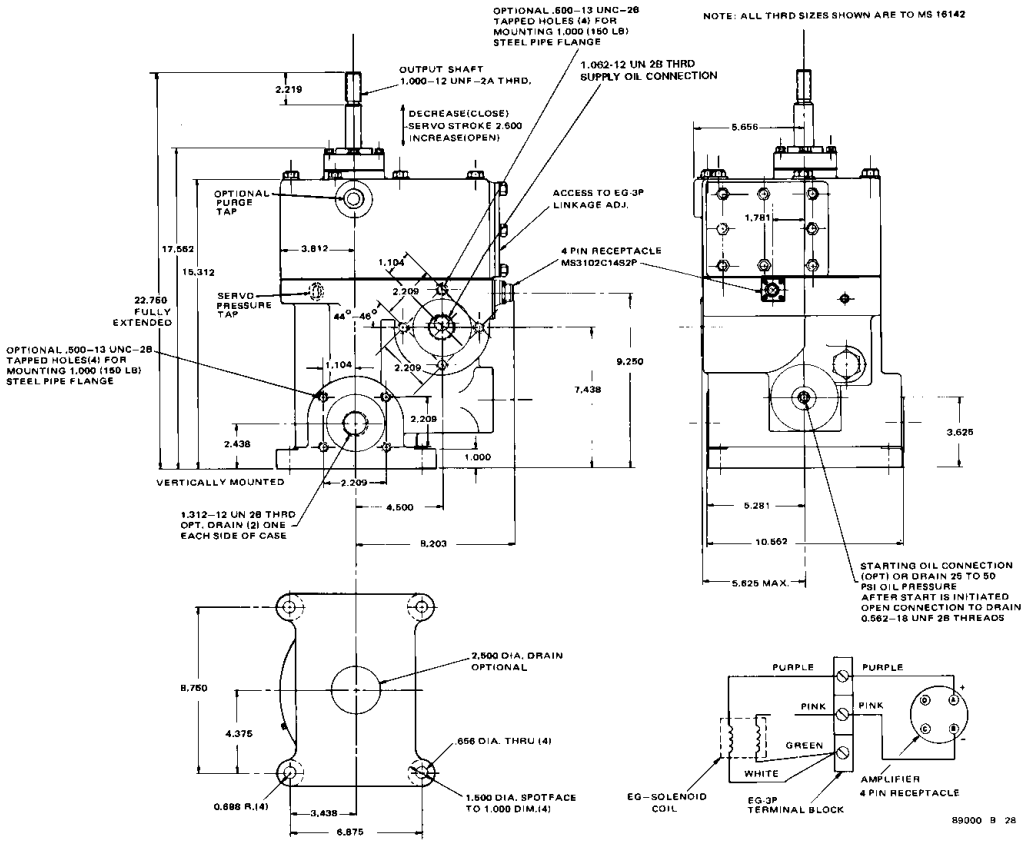
Drain
1.312–12 UN 2B thread, (ref. MS 16142) each side of the case; optional internal drain through case bottom is normally plugged
Starting Oil Inlet
0.562–18 UNF 2B thread (ref. MS 16142); inlet is normally plugged; starting oil option must be specified with purchase order

SERVO

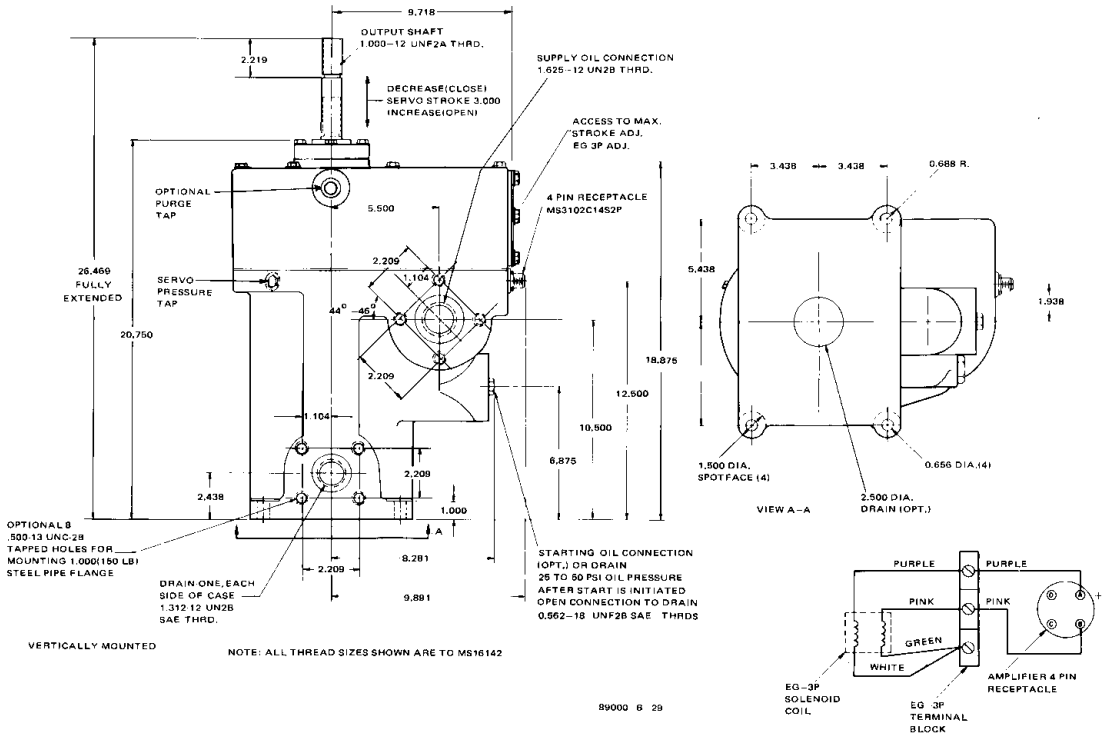
Piston Diameter
5.25 inch: 5.25 inch/133 mm
7.25 inch: 7.25 inch/184 mm
Operation
Single-acting or differential; operation is according to customer requirements

OPTIONAL FEATURES

Pilot Valve System
Solid or yield (use yield with starting oil); spring loaded to either minimum or maximum fuel
Return Spring
Various return springs are available depending upon operating conditions and amplifier size
Starting Oil
172 to 345 kPa (25 to 50 psi) starting oil pressure required; use yield pilot valve system
Transfer Valve
Senses supply pressure and temporarily converts the differential amplifier to single-acting servo operation to aid in starting the prime mover
Flange Fittings
Optional supply and drain connections for mounting 1.000 inch (150 lbs) steel pipe (per ANSI B16.5)



Typical Outline Drawing of 5.25-inch Hydraulic Amplifier



Typical Outline Drawing of 7.25-inch Hydraulic Amplifier

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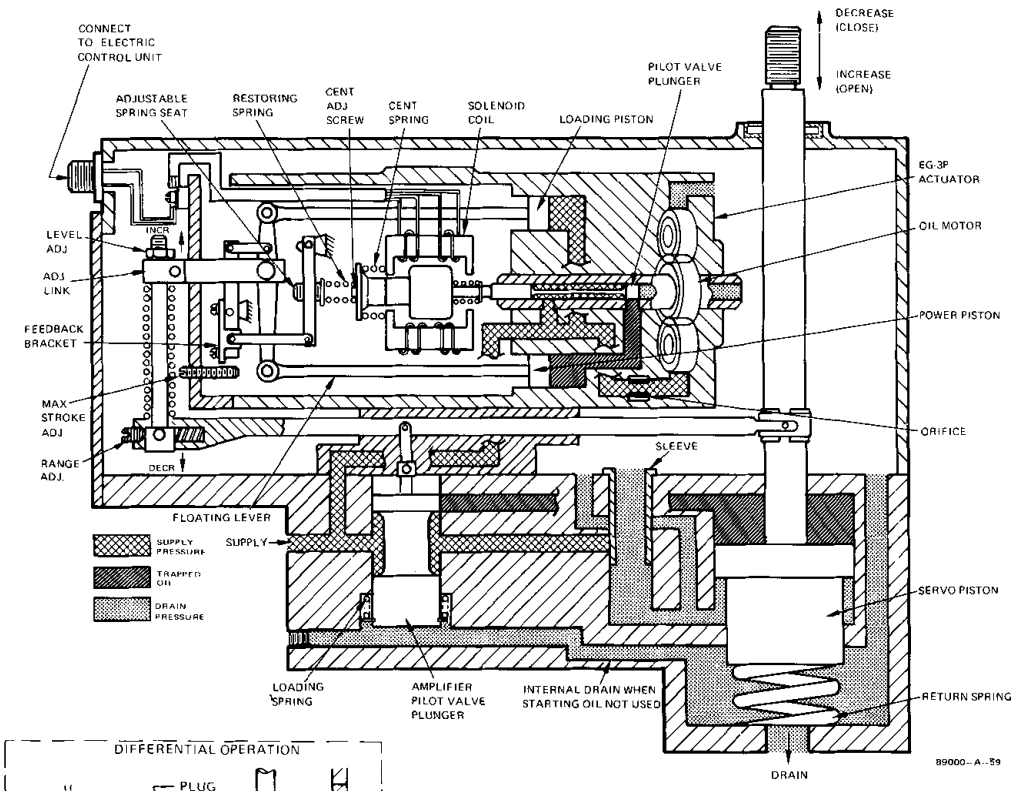

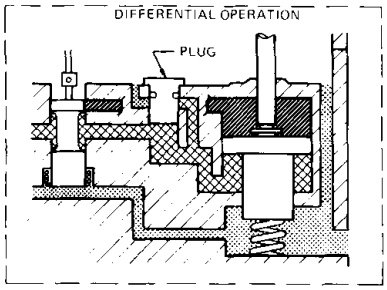

(Differential Plug)

Schematic Diagram of 5.25-inch Hydraulic Amplifier

For more information contact: