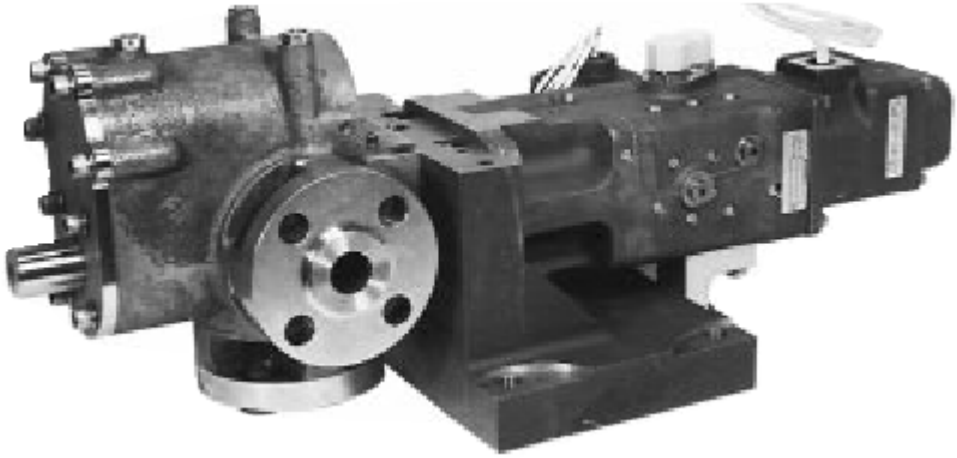
3151A Water Valve

and TM Actuator
for Gas Turbine Water Injection Systems



- Used in gas turbine nitrous oxide emission-reduction systems
- Fast response–accurate control
- Resists cavitation, erosion, and corrosion

Applications

The 3151A Water Valve/TM-40LP Actuator assembly is used as part of a gas turbine nitrous oxide emission-reduction system. The assembly meters water into an industrial gas turbine's combustion chamber, lowering combustion temperature.

Description

In normal operation, Woodward's electronic control positions the water valve to closely follow fuel-flow schedule. This positioning accuracy, together with the actuator's fast response time, prevents excess water injection into the turbine during transients.

The ability to quickly and accurately meter water over a large range, accomplishes two other very important tasks. It holds water costs to a minimum by metering only the exact amount of water required for effective emission control, and it prevents serious damage to the turbine resulting from excess water "wash-outs."

The assembly's efficient design provides an internal metered bypass flow for pump stability and efficient pump utilization.

The assembly is designed for use with supply pressures from 2413 to 10 342 kPa (350 to 1500 psi), and it can meter up to 250 L/min (66 gal[US]/min) of water, irrespective of supply pressure.

The valve's flow accuracy is 5% of point or 0.5% of maximum flow—whichever value is greater.

Standard seal material allows operation with supply water temperature up to 66 °C (150 °F).

Features

The water-valve assembly is designed for long life and has passed accelerated life tests.

Woodward's 3151A Water Valve has a resistance to cavitation, corrosion, and erosion surpassing that of similar valves.

The water valve achieves its high degree of reliability through the use of ceramic technology, hardened stainless steel parts, and a spool-type metering valve.

The valve housing is made of stainless steel to resist corrosion. A specially designed, cavitation-resistant, hardened, stainless-steel sleeve is used in the bypass port area—an area subject to cavitation.

Water lacks lubricity, and ceramic technology is used on the metering spool to prevent galling of moving parts. Also, the ceramic is highly resistant to erosion caused by high-velocity water streams in the spool area.

The water valve is activated by a fast-response electrohydraulic actuator designed for use with Woodward electronic controls.

Contact Woodward for information regarding UL approval if using this actuator in hazardous locations.

Operation

The actuator operates proportionally with an electronic control.

The water valve/actuator assembly is designed to meter water to a gas turbine as established by a predetermined flow versus valve position schedule.

This function is accomplished by a variable-area-metering valve and a single-stage, throttling, delta-P regulator piston.

The variable-area-metering valve consists of a set of contoured ports located at one end of the metering sleeve. The opening of these ports is determined by the position of the metering-valve plunger controlled by the actuator. The single-stage regulator piston senses and controls the pressure drop across the metering ports so flow is unaffected by variations in valve inlet or discharge pressures.

An optional transducer is available to provide information on the exact position of the metering plunger. This feature enhances metering accuracy.

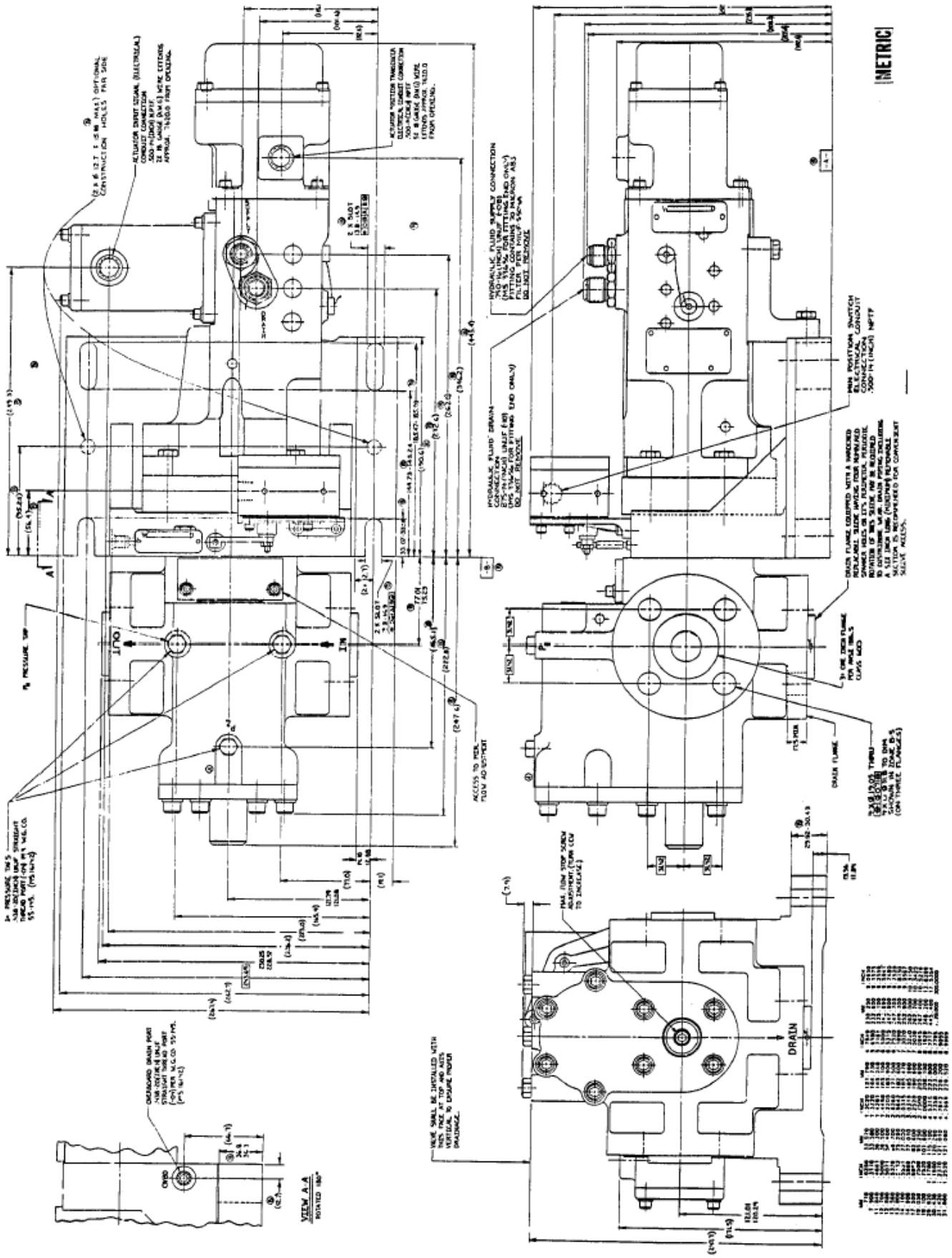
Specifications

3151A Water Valve

Minimum Flow	3.8 L/min (1.0 gal[US]/min)
Maximum Flow	250 L/min (66 gal[US]/min)
Water Pump Type	High pressure centrifugal
Minimum Supply Pressure	2413 kPa (350 psi)
Maximum Supply Pressure	10 342 kPa (1500 psi)
Degree-of-Flow Accuracy	Flow accuracy is either 5% of point or 0.5% of point or 0.5% of maximum flow—whichever is greatest
Supply Temperature	66 °C (150 °F) maximum, 0 °C (32 °F) minimum with standard seal material

TM-40LP Actuator Supply Characteristics

Fluid Type	Mineral or synthetic based oils, diesel fuels, or light distillate fuels
Specific Gravity	0.6 to 1.0
Recommended Viscosity	0.6 to 400 centistokes 150–200 SSU ISO 32 grade
External Hydraulic Filtration Required	10 µm nominal
Hydraulic Cleanliness Level	ISO 4406 20/18/15 minimum
Supply Pressure	2758–8274 kPa (400–1200 psig)
Steady State Flow	2758 kPa/400 psig—1.1 L/min (0.3 gal[US]/min) 8274 kPa/1200 psig—1.9 L/min (0.5 gal[US]/min)
Maximum Transient Flow	2758 kPa/400 psig—9.5 L/min (2.5 gal[US]/min) 8274 kPa/1200 psig—13.2 L/min (3.5 gal[US]/min)



Outline Drawing
(Do not use for construction)

TM-40LP Actuator Output Characteristics

Stroke	12.7 mm (0.50 inch)
Standard Input Signal	0.020 to 0.200 A coil current (dual coil option available)

Null current shifts of up to ±4% of maximum rated current (200 mA) can occur due to variations in the following parameters: hydraulic supply and return pressures hydraulic fluid temperature servovalve and actuator wear.

Due to the inherent null shifts and position drift of all hydraulic servovalves and proportional actuators, engine control applications must be designed with these errors in mind.

Work Capacity	62 J (46 ft-lb) at 8274 kPa/1200 psig supply pressure
Output Force	4893 N (1100 lbs force) maximum at 8274 kPa/1200 psig supply pressure
Slew Time	0.150 seconds maximum
Hysteresis	±1.0% of travel
Threshold	Less than 0.25% of maximum rated current of 200 mA

Woodward recommends that adequate dither be used on all hydraulic actuators to minimize mA threshold and hysteresis which can result from second stage static friction or hydraulic contamination.

Dither is a low-amplitude, relatively high-frequency periodic signal that is superimposed on the servovalve input current signal. A typical dither signal generated by a Woodward control is:

25 Hz, 0–10 mA (tunable) amplitude

25% duty cycle, bipolar, square wave

Adequate dither is defined as that amount which produces no more than 0.013 mm (0.0005 inch) total oscillation in output shaft position.

WOODWARD

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