

Stratoflex

***Waterman Hydraulic Fuses and Flow
Regulators for the Aerospace Industry***

*Catalog 106-W
December 1999*



The World Standard

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Table of Contents

Hydraulic Flow Regulators - Introduction and Operation.....	2-3
Hydraulic Fuses - Introduction and Operation.....	4-8
Hydraulic Flow Regulators for Military Aircraft.....	9-13
Hydraulic Flow Regulators for Commercial Aircraft.....	14-19
Hydraulic Fuses for Military Aircraft, Type I.....	20-23
Hydraulic Fuses for Military Aircraft, Type II.....	23
Hydraulic Fuses for Military Aircraft, Type III.....	24-25
Hydraulic Fuses for Commercial Aircraft, Type I.....	26-29
Hydraulic Fuses for Commercial Aircraft, Type II.....	30
Offer of Sale.....	31

Hydraulic Flow Regulators

Introduction

DEFINITION AND PURPOSE

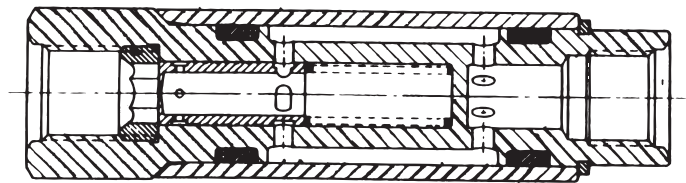
Hydraulic Flow Regulators are components that are installed in a hydraulic line to limit the rate of flow within predetermined values, regardless of variations in system pressure or workloads.

GENERAL APPLICATION DATA

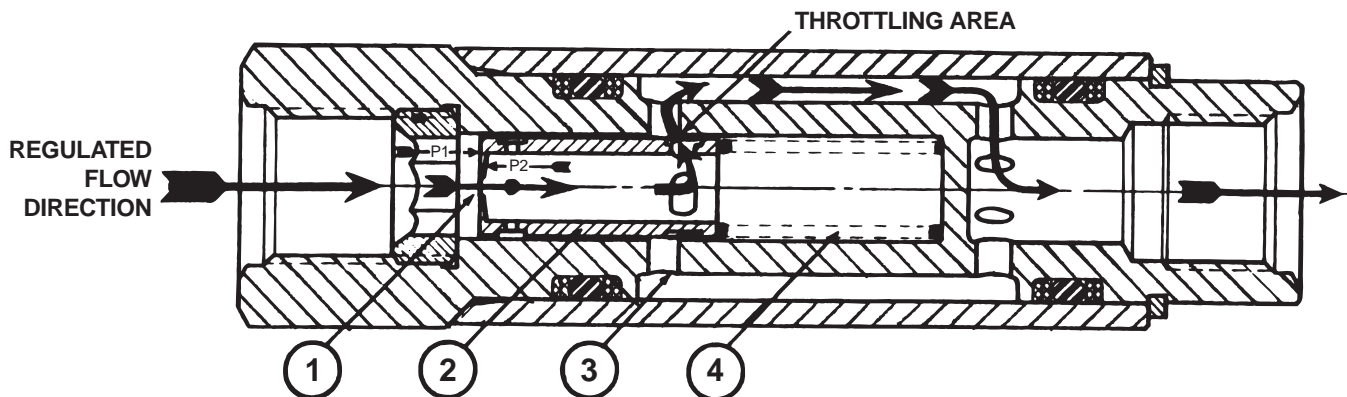
Hydraulic system engineers often are faced with the problem of controlling hydraulic actuator velocities within specified time limits. This problem becomes complicated when system pressures change and actuator loadings vary during the operating cycle. With a hydraulic flow regulator in the circuit, actuator velocities will be controlled within precise time limits

because of the unit's ability to maintain a constant rate of flow even though system and actuator pressures change. A typical application for flow regulators is in an aircraft landing gear system. Here aerodynamic considerations dictate that the gear retraction occur quickly; the airframe structure requires that dynamic forces be minimized to preclude structural damage. A properly selected flow regulator in the system will satisfy adequately both of these design requirements.

STATIC POSITION



Method of Operation



Flow entering the regulator passes through the sharp-edged orifice (1), then flows radially outward through milled slots in the piston (2) and the drilled holes in the body (3). Fluid flows unobstructed through the remaining portion of the regulator to the sub-system.

As flow passes through the valve, in the regulated direction shown by the arrows, there is a predetermined pressure drop created by the slight restriction of the orifice. This pressure drop is equal to P_1 minus P_2 . Pressure P_1 acts on the face of the piston and pressure P_2 acts on the downstream face of the piston. Because of the lower pressure (P_2) at the spring side of the piston, it will move to the right whenever the force on the piston offsets the force of spring (4). If there is even a slight increase or decrease in flow through the orifice, it "senses" this variation by either increasing or decreasing the pressure drop at the orifice. This slight change in pressure drop is transmitted to the piston, which in turn will "correct" for the slight flow change by

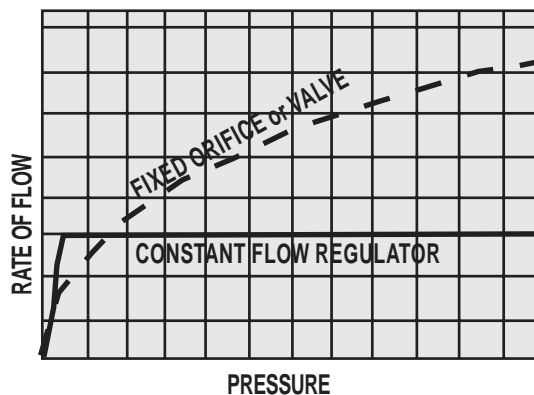
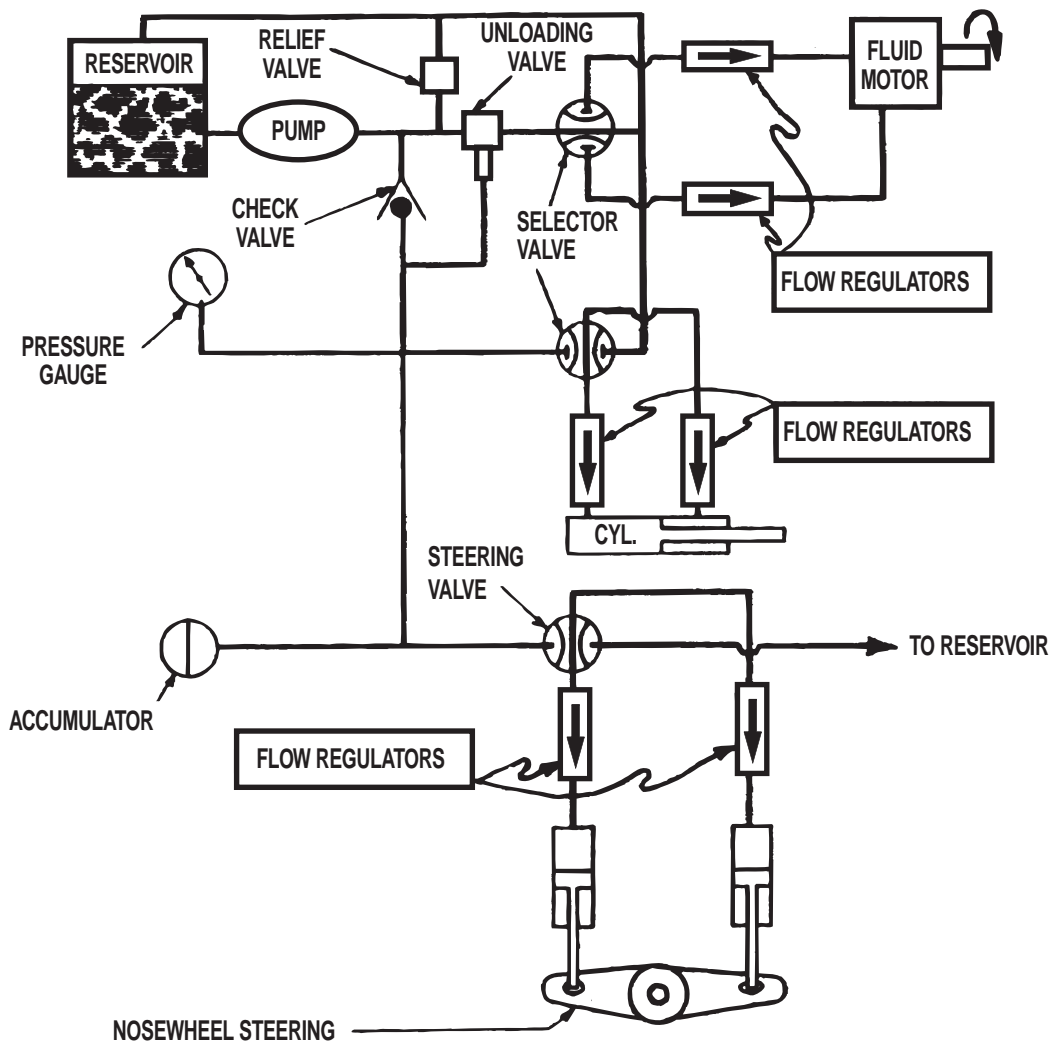
either increasing or decreasing the throttling area.

This throttling action of the piston controls the rate of total flow through the valve by controlling the flow through the orifice. The regulator relies on the slight orifice pressure drop for its operating force, keeping the flow rate through the unit constant. This condition continues regardless of upstream or downstream pressure, provided the upstream pressure is at least 70 psi greater than the downstream pressure. While this basic operating pressure differential applies to standard models, it can be reduced in special units when needed for more critical applications.

Flow in the reverse direction is not controlled, but another regulator in the line can be used for whatever flow control might be needed.

Hydraulic Flow Regulators

Aircraft Hydraulic System, Typical Schematic Showing Location and Application of Various Waterman Hydraulic Flow Regulators



This graphic representation illustrates flow characteristics of the Pressure Compensated Flow Regulator compared with those of a fixed orifice (or restrictor valve).

In the fixed orifice, the rate of flow varies as the square root of the pressure differential.

Pressure differential does NOT affect the rate of flow though a Pressure Compensated Flow Regulator.

Hydraulic Fuses

Introduction

DEFINITION

Hydraulic fuses are "normally open" valves which are designed and constructed to close only in the event of certain types of system malfunction. The fuse is intended primarily to protect the system from loss of reservoir fluid in the event of a ruptured tube, hose or component.

TYPES 1 and 2 FUSES are considered to be "quantity measuring" fuses because they react and close only after passing a pre-determined quantity of fluid without regard to the rate of flow or pressure of the fluid being passed. THE TYPE 3 FUSE is considered to be a "velocity fuse" since it will close when line velocity or fluid flow rate reaches or exceeds a predetermined value, without regard to system pressure or total quantity of fluid passed.

Hydraulic fuses (like their electrical counterparts) are completely non-functional in normal operation. They add no undue restriction to flow passage and will not hamper the operation of high-rate cycling devices such as brake anti-skid controls.

GENERAL APPLICATION & PURPOSE

THE TYPE 1 and 2 FUSES are intended to protect sub-systems which have fixed displacement components, such as linear or rotary actuators of limited stroke. In such applications it is customary to utilize a fuse which is calibrated to pass a slightly greater volume of fluid than the actuator would require in a complete cycle under the most demanding circumstance. For example, in a wheel brake application where the maximum fluid requirement would be 8 cubic inches, a 10 cubic inch fuse would provide ample protection. After passing fluid in the normal direction, the fuse will re-set prior to the next cycle; this must and does occur even though flows are normal and fuse does not close.

It is in the method of re-set that fuse types 1 and 2 differ. THE TYPE 1 FUSE will re-set itself (virtually instantaneously) by means of an internal spring mechanism whenever flow through the unit ceases, provided it has not closed completely due to having passed its rated volume of fluid. Should the fuse have closed due to an excess volume, it will remain closed so long as there is pressure on the inlet port of approximately 15 psi or more greater than the outlet port. Resetting of a closed TYPE 1 FUSE will occur whenever inlet and outlet port pressures are equalized.

THE TYPE 2 FUSE requires resetting between cycles or partial cycles and this is accomplished by reverse flow. When installed in a line to a double acting cylinder, or a spring return single acting cylinder, the normal return flow from cylinder return will give automatic re-set. While this fuse will re-set with return flow rates as low as 0.1 gpm. under ideal conditions, It is not considered practical to utilize this type in critical systems where reverse flows are less than 1.0 gpm.

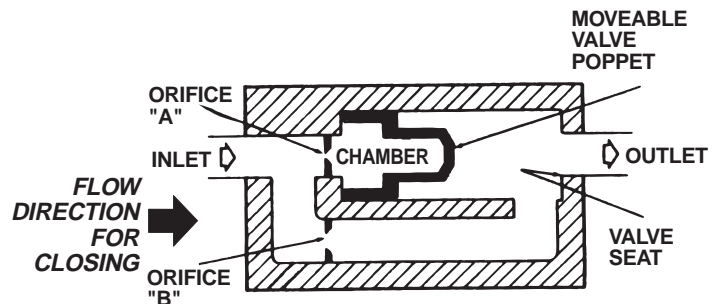
THE TYPE 3 FUSE is intended for use with continuous flow devices such as fluid motors and will provide an effective means of closing off the pressure line in the event of sudden increase in flow rate, as might be caused by line loss or motor overspeed. Resetting requirements and provisions are identical to those of the Type 1 fuse.

AVAILABLE TYPES

The Type 1 and Type 2 fuses are available as qualified products to military Specification MIL-F-5508 and are shown on standard drawings AN6281 (Type 1) and AN6282 (Type 2) in specific capacities. These types also are available in a wide variety of non-standard configurations, with or without by-pass valves, in different tube sizes and for different fluids to serve many applications. The Type 3 fuse is available in several configurations but is not covered by Military Standard drawings or specifications.

PRINCIPLE OF OPERATION

Waterman quantity measuring hydraulic fuses operate on what might be termed a "divided flow" principle. Reduced to the ultimate degree of simplicity for sake of illustration, the following figure should clarify the operating scheme. Note that the entering flow is divided into two paths through orifices "A" and "B".



Flow past large orifice "B" goes through the valve with a minimum of restriction. As this flow passes through, a proportional amount of fluid is metered through orifice "A" into the chamber. As the chamber fills, the valve poppet moves toward the valve seat; when the valve reaches the seat all flow through the unit will be stopped. Calibration of a fuse to pass a given quantity of fluid before closing thus becomes a simple matter of ratio between orifice sizes. For example, if it requires 1 cubic inch to fill the valve chamber and we desire a 100 cubic inch fuse, we utilize an orifice ratio A:B which is in the area of 1:100, or the same ratio as chamber volume to desired capacity.

In the actual fuse as produced in quantity manufacture, there is no real similarity to this simple sketch, even though this does illustrate the operating principles. Reference is now made to the true cross-section of a fuse of each type as a detailed explanation of operation is given for each of the three types.

Hydraulic Fuses

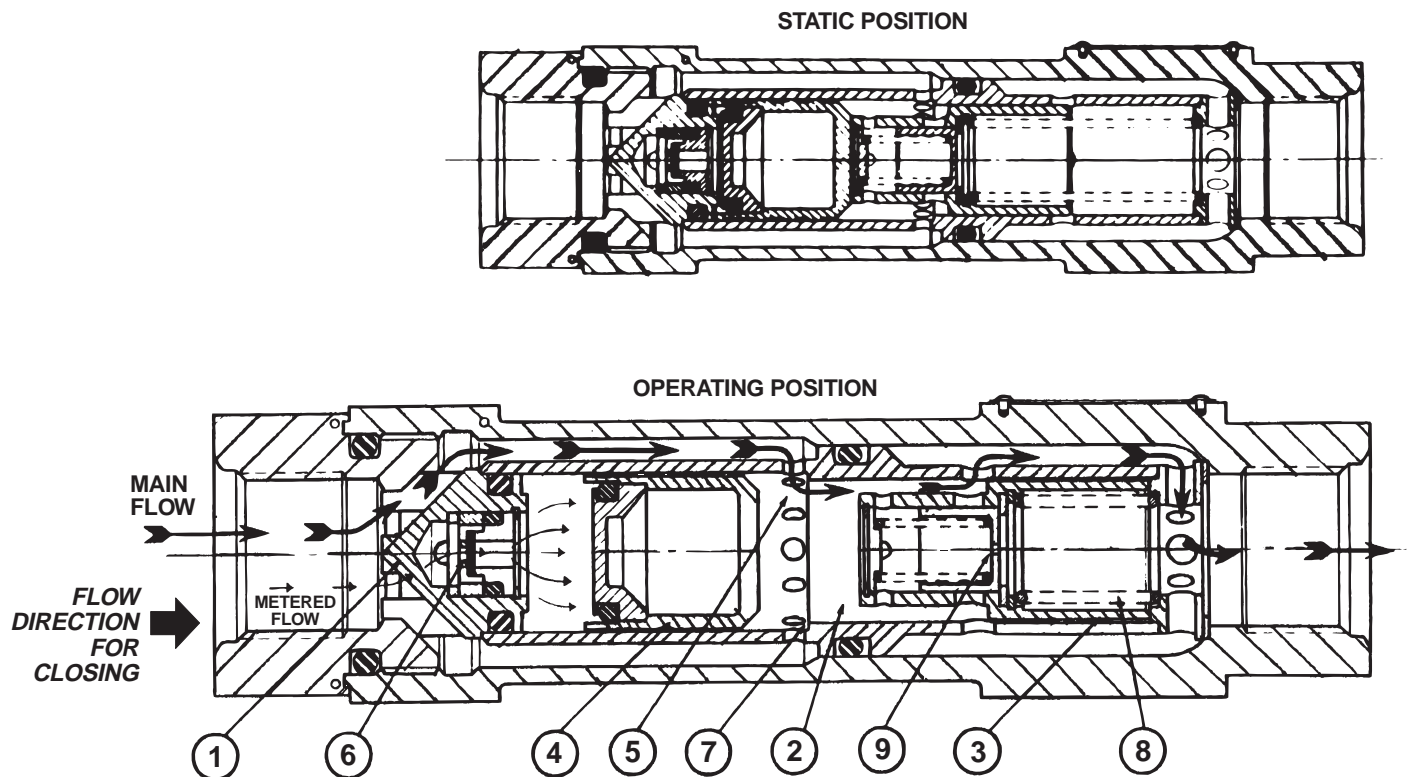
Operation of Type I Hydraulic Fuse

Fluid entering the TYPE I FUSE is divided into two flow paths by the control head (1). The main flow follows the path shown by the bold arrows. Metered flow enters the chamber (2) and exerts a force against the spring piston (3), which permits displacement of the main piston (4).

The main flow passing through the drilled holes (5) produces a slight pressure drop. Since the main piston offers negligible friction resistance because of its hollow, buoyant design, the pressure drop which occurs across the drilled holes is equal to that across the metered flow orifice (6). As a result of this, the metered flow is always proportional to the main flow; consequently, piston displacement is proportional to the quantity of main flow passed. During a normal flow cycle to a sub-system, the piston does not travel its entire stroke since the fuse's rated capacity is larger than the sub-system it protects. In the event of sub-system failure the piston travels

its entire stroke, contacting the shoulder (7) of the sleeve and preventing further flow to the sub-system. Once fused, the line will remain fused until the inlet pressure is reduced to approximately 5 psi. Reduction of the inlet pressure to this figure will permit the spring (8) to resume its original position and return the main piston to its static position, preparing the fuse for another cycle.

In normal operation, the check (9) will permit a small quantity of fluid passage to the sub-system and preclude the possibility of the fuse closing at extremely low flow rates. During any reverse flow operation of the cycle, the check will upset to permit free flow through the fuse. At this point in the cycle, the small metering orifice also acts as a check valve since it is displaced from its seat to permit free exit of the fluid which has previously moved the main piston to its seated position.



Hydraulic Fuses

Operation of Type II Hydraulic Fuse

THE TYPE II FUSE incorporates a special resetting mechanism which allows the fuse to be reset only by reverse flow. Otherwise, its general operation is quite similar to that of the Type I Fuse previously described.

As fluid enters the fuse it follows the two different paths noted by the arrows. The entering fluid exerts a force on the lock piston (1) which causes it to move to the right. In doing so, this movement disengages the lock spring (2) from its grip on the piston pin (3). This disengaging action is accomplished by the cam configuration of the lock piston. Main piston (4) is now free to move, its movement being proportional to the amount of fluid passing through the fuse, as in the Type I Fuse.

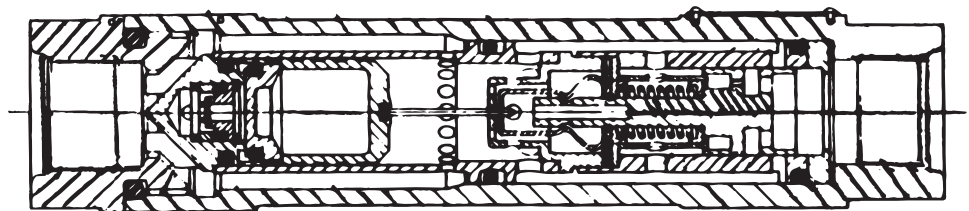
Whenever fluid is passed in excess of the calibrated capacity of the fuse, it will close by the action of the main piston seating against shoulder (5). Once fused, the valve will remain closed until reverse flow pressure occurs. Piston assembly is held closed by the gripping action of the lock spring (2).

Should reverse flow be applied to the fuse, the lock piston (1) is moved to the left. In doing so, the cam on the lock piston disengages the lock spring from the piston subassembly. The free piston subassembly moves to the left until it reaches its static or reset position.

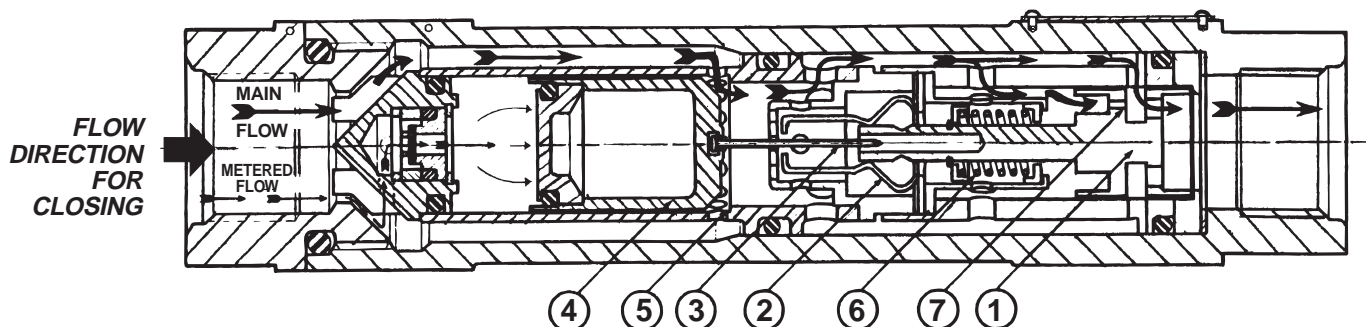
Any interruption of flow through the fuse removes the operating force from the lock piston (1) allowing the spring (6) to return the lock piston to the static position. This action allows the lock spring to grip and hold the piston subassembly in the position assumed at the moment of interruption of flow. This design feature of the Type II Fuse makes it possible for the fuse to totalize the quantity of fluid passed, regardless of the number of interruptions of closing flow, provided that none of the flow interruptions are accompanied by reverse flow.

In normal operation, the drilled hole (7) allows a small quantity of fluid flow, which precludes the possibility of the fuse closing at extremely low flow rates.

STATIC POSITION



OPERATING POSITION



Hydraulic Fuses

Operation of Type III Hydraulic Fuse

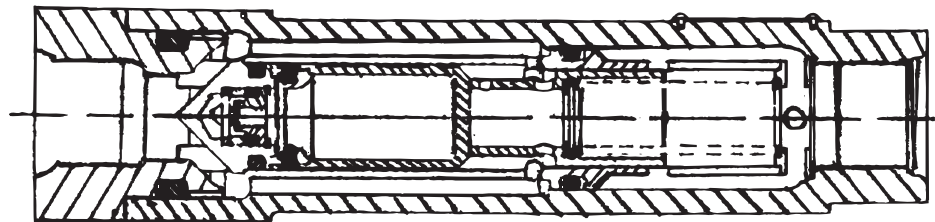
THE TYPE III FUSE (Automatic Excess Flow Velocity) provides protection against unnecessary fluid loss in those systems in which flow in the direction of closing is continuous and not limited to a fixed volume. The principle of operation of this fuse is identical to the Type I fuse except that its closing can only occur when a predetermined flow rate is reached or exceeded.

Fluid in the closing flow direction enters the fuse and follows the paths shown. As fluid passes through the lower orifice (1), a force is applied against the spring (2). At flows up to and including the normal rate of the system, the lower piston assembly (3) will remain in the static position shown. In the event of higher operating flow rates caused by component failure downstream, the pressure drop and resulting force on the lower piston assembly (3) will become greater. This force overcomes the resistant spring force (2).

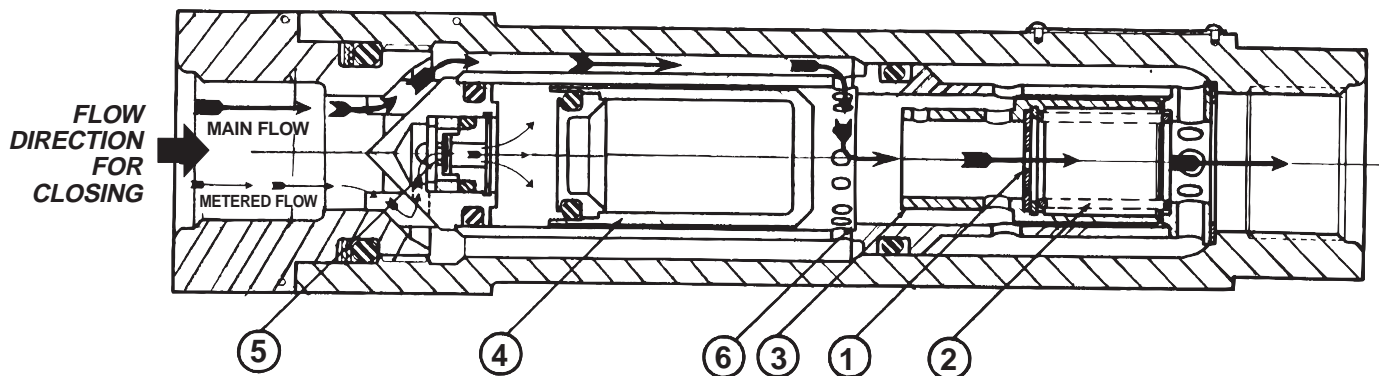
The main piston (4) follows this motion to the right and continues to do so until the flow through the metering orifice (5) has reached a capacity proportionate to the precalibrated volumetric delay (cubic inches). When this amount has been passed, the main piston will have assumed a position against shoulder (6). This serves to seal off all flow in the unit, closing the line. In order to prevent the fuse from inadvertently closing off because of surge flows that exceed normal system flow rates, the fuse incorporates the delayed action feature just described.

A line, once fused, will remain fused until the differential pressure is reduced to approximately 5 psi. Reduction of the inlet pressure will permit the spring to displace the lower piston assembly toward the inlet of the fuse, thereby re-establishing normal position of the internal working parts. During reverse flow, the valve will allow free flow through the fuse and all parts will orient themselves in a static position.

STATIC POSITION

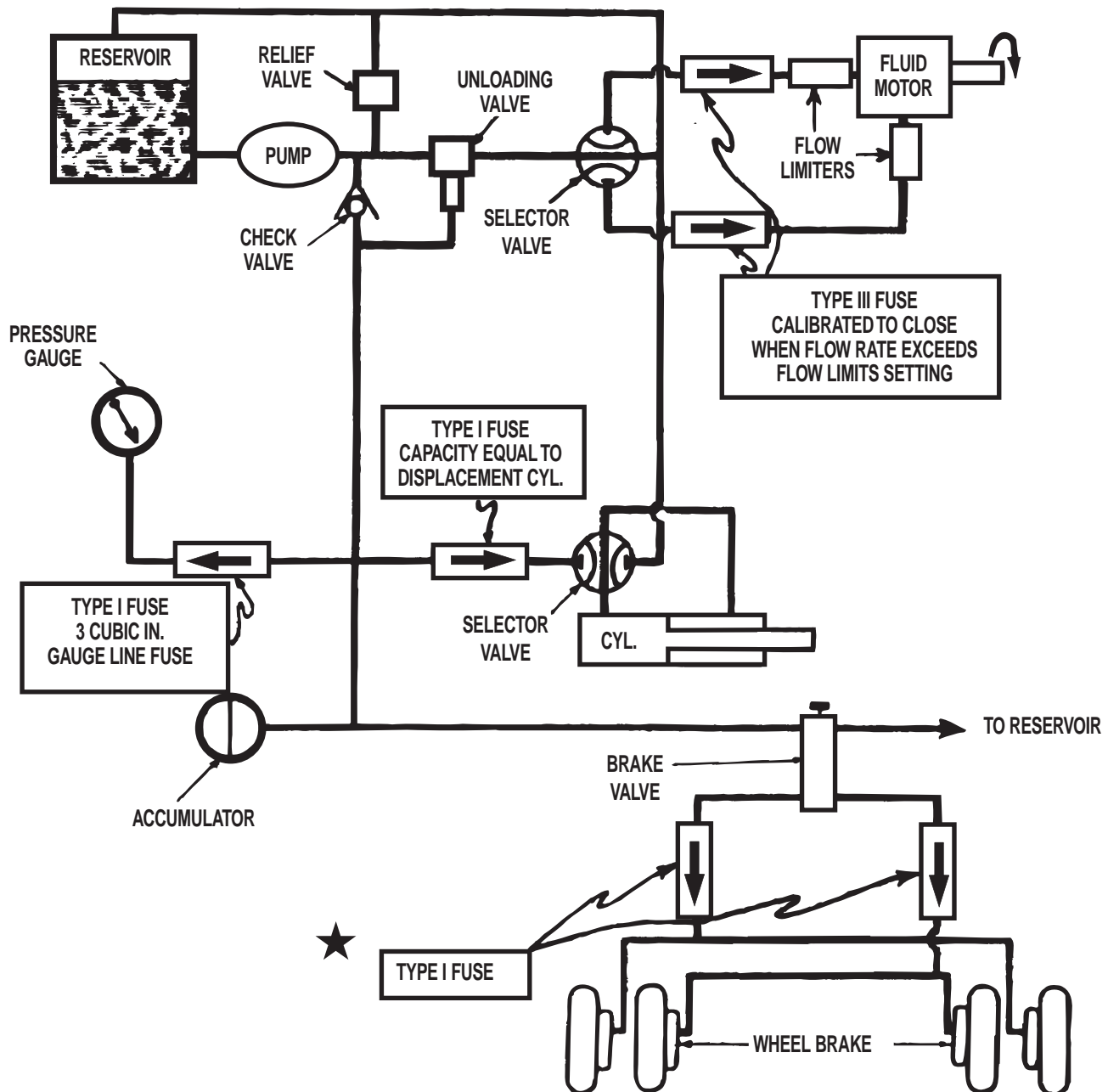


OPERATING POSITION



Hydraulic Fuses

Aircraft Hydraulic System, Typical Schematic Showing Location and Application of Various Waterman Hydraulic Fuses



★ FOR SYSTEMS NOT UTILIZING A PRESSURIZED RESERVOIR, THE TYPE II FUSE MIGHT BE BETTER ADAPTED.

Hydraulic Flow Regulators

Hydraulic Flow Regulator for Military Aircraft 30A4

**PRESSURE COMPENSATED
FIXED FLOW REGULATOR**

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65° to +275°F

PORTS: AND10050-4 for 1/4 O.D. Tubing

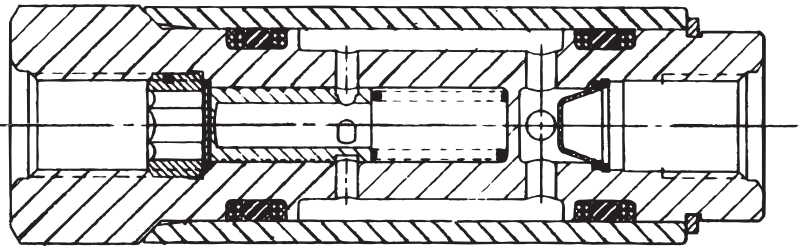
FLUID: MIL-H-5606

**RECOMMENDED APPROXIMATE FLOW
RANGE:** 0.5 to 1.2 gpm

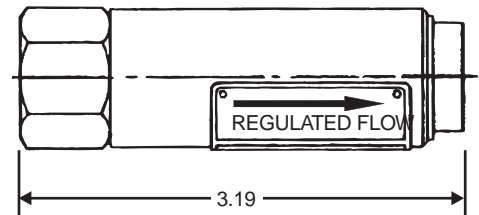
FLOW TOLERANCE:
From +70 to 275°F, +10% and -15%
at -65°F, ±20%

WEIGHT: 0.20 lbs.

**REGULATED
FLOW
DIRECTION**



THIS FLOW REGULATOR SHOWN IN STATIC POSITION.
For information on details of operation, see page 2.



Hydraulic Flow Regulator for Military Aircraft 30A6

**PRESSURE COMPENSATED
FIXED FLOW REGULATOR**

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +275°F

PORTS: AND10050-6 for 3/8 O.D. Tubing

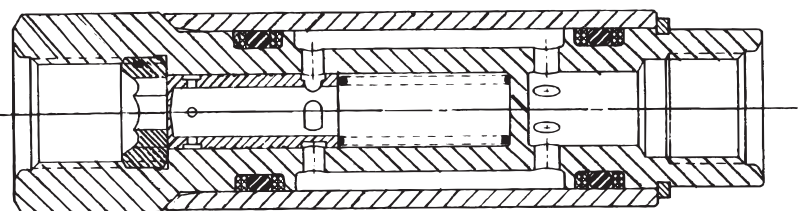
FLUID: MIL-H-5606

**RECOMMENDED APPROXIMATE FLOW
RANGE:** 0.5 to 3.5 gpm

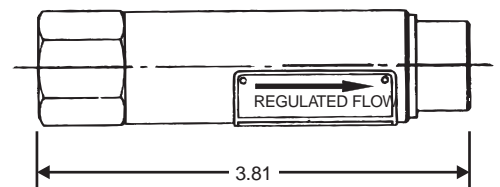
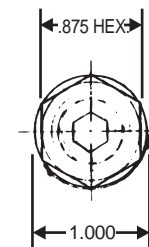
FLOW TOLERANCE:
From +70 to 275°F, 0.5 to 1.49 gpm: +10%, -15%
1.5 gpm and above: +5%, -10%
at -65°F, ±20%

WEIGHT: 0.22 lbs.

**REGULATED
FLOW
DIRECTION**



THIS FLOW REGULATOR SHOWN IN STATIC POSITION.
For information on details of operation, see page 2.



Hydraulic Flow Regulators

Hydraulic Flow Regulator for Military Aircraft 30A8

**PRESSURE COMPENSATED
FIXED FLOW REGULATOR**

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65° to +275°F

PORTS: AND10050-8 for 1/2 O.D. Tubing

FLUID: MIL-H-5606

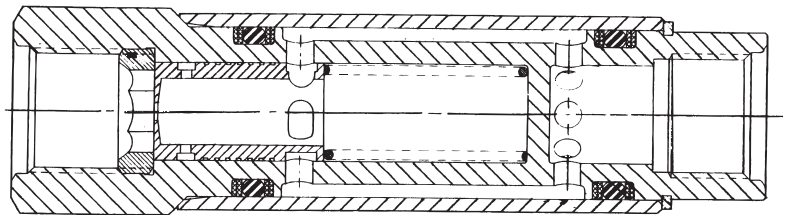
**RECOMMENDED APPROXIMATE FLOW
RANGE:** 1.0 TO 6.0 gpm

FLOW TOLERANCE:

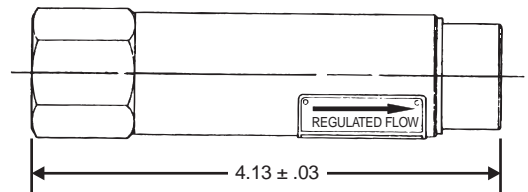
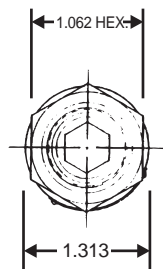
From +70 to 275°F, 1.0 to 1.49 gpm: +10%, -15%
1.5 gpm and up: +5%, -10%
at -65°F, ±20%

WEIGHT: 0.35 lbs.

**REGULATED
FLOW
DIRECTION**



**THIS FLOW REGULATOR SHOWN IN STATIC POSITION.
For information on details of operation, see page 2.**



Hydraulic Flow Regulator for Military Aircraft 30A10

**PRESSURE COMPENSATED
FIXED FLOW REGULATOR**

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +275°F

PORTS: AND10050-10 for 5/8 O.D. Tubing

FLUID: MIL-H-5606

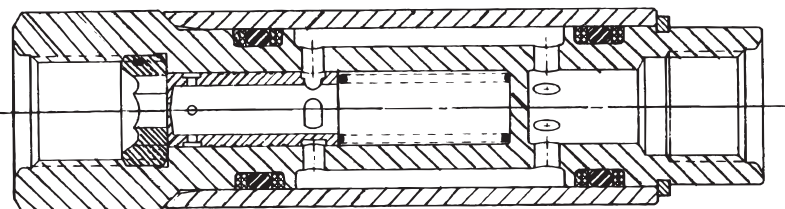
**RECOMMENDED APPROXIMATE FLOW
RANGE:** 4.0 to 10.5 gpm

FLOW TOLERANCE:

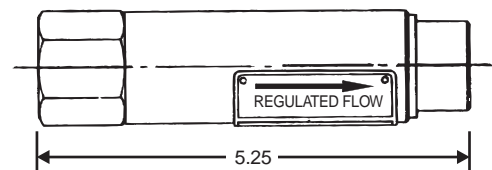
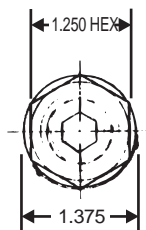
From +70 to 275°F, +5%, -10%
at -65°F, ±20%

WEIGHT: 0.50 lbs.

**REGULATED
FLOW
DIRECTION**



**THIS FLOW REGULATOR SHOWN IN STATIC POSITION.
For information on details of operation, see page 2.**



Hydraulic Flow Regulators

Hydraulic Flow Regulator for Military Aircraft 30A12

**PRESSURE COMPENSATED
FIXED FLOW REGULATOR**

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65° to +275°F

PORTS: AND10050-12 for 3/4 O.D. Tubing

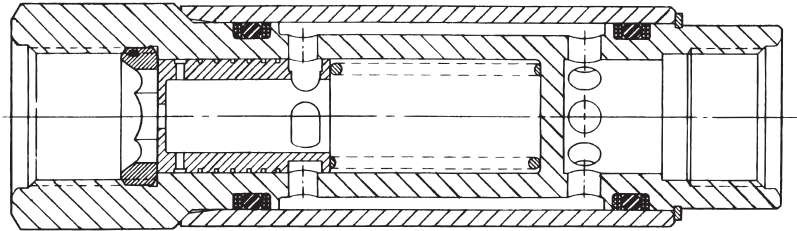
FLUID: MIL-H-5606

**RECOMMENDED APPROXIMATE FLOW
RANGE:** 6.5 to 12.0 gpm

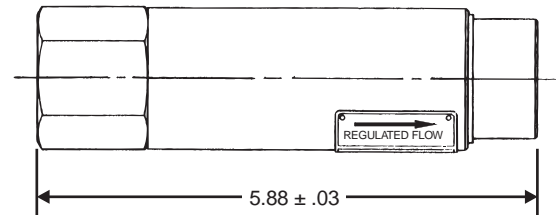
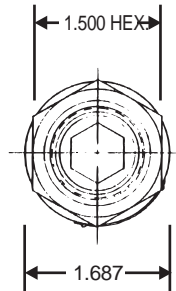
FLOW TOLERANCE:
From +70 to 275°F, +5%, -10%
at -65°F, ±20%

WEIGHT: 0.85 lbs.

**REGULATED
FLOW
DIRECTION**



THIS FLOW REGULATOR SHOWN IN STATIC POSITION.
For information on details of operation, see page 2.



Hydraulic Flow Regulator for Military Aircraft 1121-4

**PRESSURE COMPENSATED
FIXED FLOW REGULATOR**

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +160°F

PORTS: AND10050-4 for 1/4 O.D. Tubing

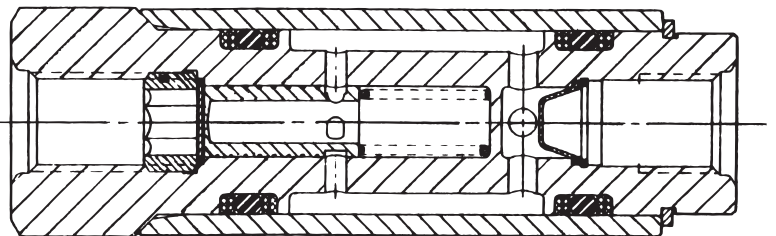
FLUID: MIL-H-5606

**RECOMMENDED APPROXIMATE FLOW
RANGE:** 0.5 to 1.2 gpm

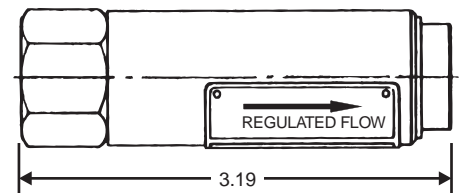
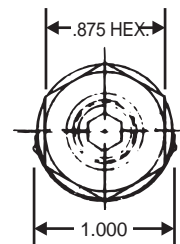
FLOW TOLERANCE:
From +70 to 160°F, +10% and 15%
at -65°F, ±20%

WEIGHT: 0.20 lbs.

**REGULATED
FLOW
DIRECTION**



THIS FLOW REGULATOR SHOWN IN STATIC POSITION.
For information on details of operation, see page 2.



Some flow rates meet requirements of Standard Part Number
MS28886, qualified under Specification MIL-V-8566

Hydraulic Flow Regulators

Hydraulic Flow Regulator for Military Aircraft 1121-6

**PRESSURE COMPENSATED
FIXED FLOW REGULATOR**

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65° to +160°F

PORTS: AND10050-6 for 3/8 O.D. Tubing

FLUID: MIL-H-5606

**RECOMMENDED APPROXIMATE FLOW
RANGE:** 0.5 to 3.5 gpm

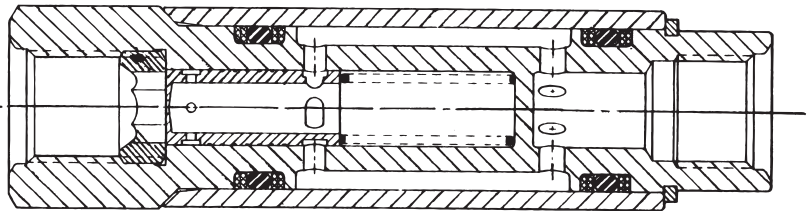
FLOW TOLERANCE:

From +70 to 160°F, 0.5 to 1.49 gpm: +10% -15%
1.5 gpm and above: +5%, -10%
at -65°F, ±20%

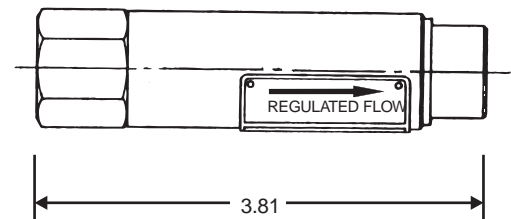
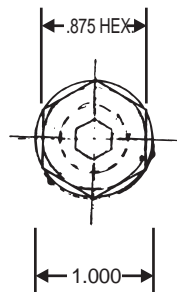
WEIGHT: 0.22 lbs.

Some flow rates meet requirements of Standard Part Number
MS28886, qualified under Specification MIL-V-8566

**REGULATED
FLOW
DIRECTION**



THIS FLOW REGULATOR SHOWN IN STATIC POSITION.
For information on details of operation, see page 2.



Hydraulic Flow Regulator for Military Aircraft 1121-8

**PRESSURE COMPENSATED
FIXED FLOW REGULATOR**

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +160°F

PORTS: AND10050-8 for 1/2 O.D. Tubing

FLUID: MIL-H-5606

**RECOMMENDED APPROXIMATE FLOW
RANGE:** 1.0 to 6.0 gpm

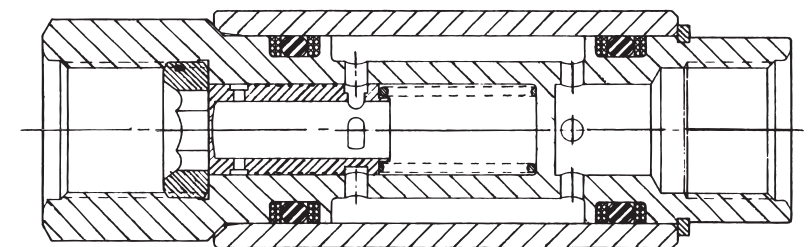
FLOW TOLERANCE:

From +70 to 160°F, 1.0 to 1.49 gpm: +10%, -15%
1.5 gpm and up: +5%, -10%
at -65°F, ±20%

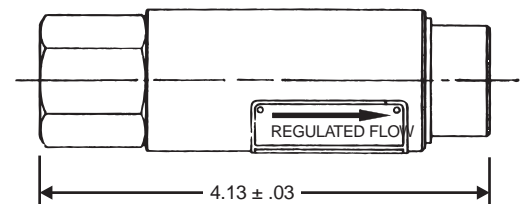
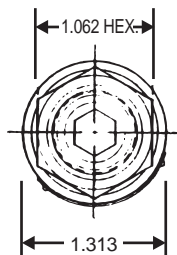
WEIGHT: 0.35 lbs.

Some flow rates meet requirements of Standard Part Number
MS28886, qualified under Specification MIL-V-8566

**REGULATED
FLOW
DIRECTION**



THIS FLOW REGULATOR SHOWN IN STATIC POSITION.
For information on details of operation, see page 2.



Hydraulic Flow Regulators

Hydraulic Flow Regulator for Military Aircraft 1121-10

**PRESSURE COMPENSATED
FIXED FLOW REGULATOR**

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65° to +160°F

PORTS: AND10050-10 for 5/8 O.D. Tubing

FLUID: MIL-H-5606

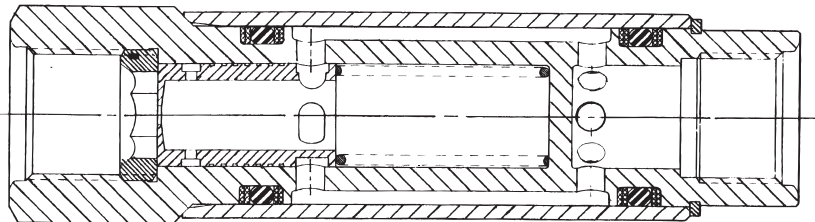
**RECOMMENDED APPROXIMATE FLOW
RANGE:** 4.0 to 15.0 gpm

FLOW TOLERANCE:
From +70 to 160°F, +5%, -10%
at -65°F, ±20%

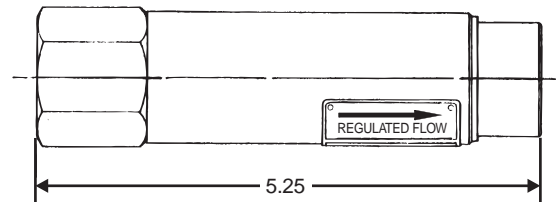
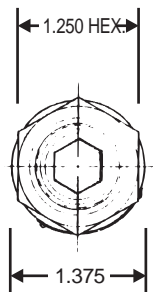
WEIGHT: 0.50 lbs.

Some flow rates meet requirements of Standard Part Number
MS28886, qualified under Specification MIL-V-8566

**REGULATED
FLOW
DIRECTION**



THIS FLOW REGULATOR SHOWN IN STATIC POSITION.
For information on details of operation, see page 2.



Hydraulic Flow Regulator for Military Aircraft 1121-12

**PRESSURE COMPENSATED
FIXED FLOW REGULATOR**

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +160°F

PORTS: AND10050-12 for 3/4 O.D. Tubing

FLUID: MIL-H-5606

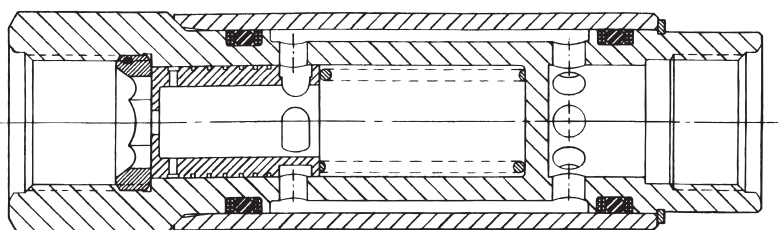
**RECOMMENDED APPROXIMATE FLOW
RANGE:** 6.5 to 12 gpm

FLOW TOLERANCE:
From +70 to 160°F, +5%, -10%
at -65°F, ±20%

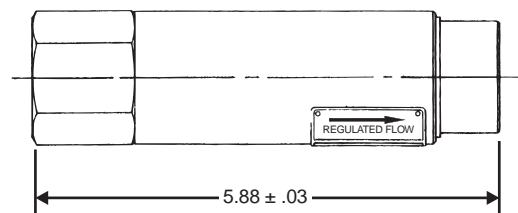
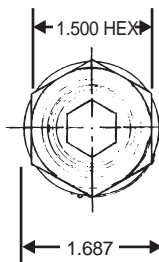
WEIGHT: 0.85 lbs.

Some flow rates meet requirements of Standard Part Number
MS28886, qualified under Specification MIL-V-8566

**REGULATED
FLOW
DIRECTION**



THIS FLOW REGULATOR SHOWN IN STATIC POSITION.
For information on details of operation, see page 2.



Hydraulic Flow Regulators

Hydraulic Flow Regulator for Military Aircraft 24A6

**TWO-WAY PRESSURE COMPENSATED
FIXED FLOW REGULATOR**

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65° to +275°F

PORTS: AND10050-6 for 3/8 O.D. Tubing

FLUID: MIL-H-5606

**RECOMMENDED APPROXIMATE FLOW
RANGE:** .5 to 3.5 gpm

FLOW TOLERANCE:

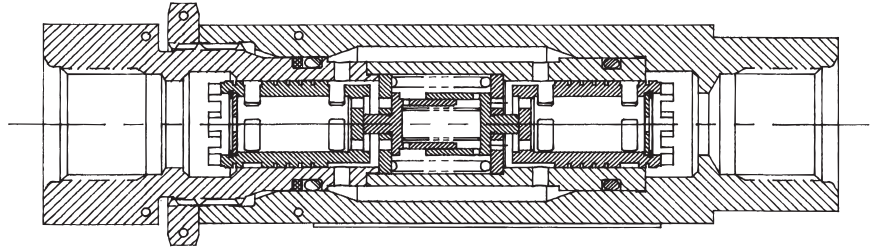
From +70 to 275°F:

0.5 to 1.49 gpm: +10%, -15%

1.5 to 3.5 gpm: +5%, -10%

at -65°F, ±20%

WEIGHT: 0.25 lbs. (estimated)



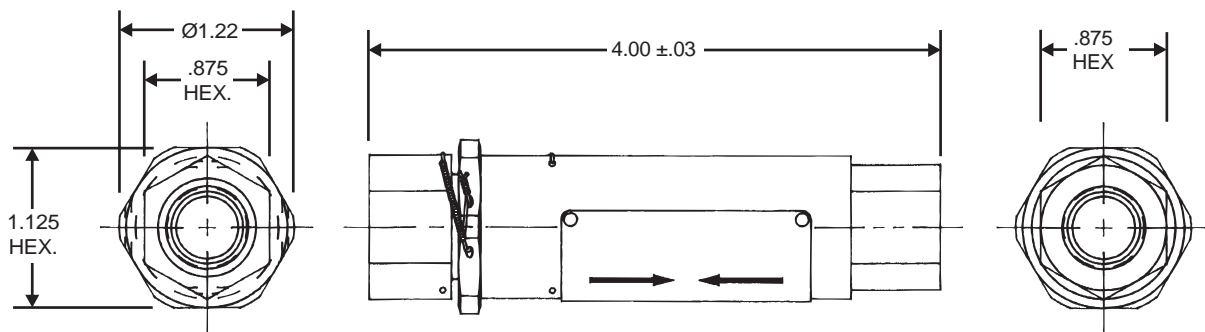
**MAJOR
REGULATED FLOW
DIRECTION**



**MINOR
REGULATED FLOW
DIRECTION**



**THIS FLOW REGULATOR SHOWN IN STATIC POSITION.
For information on details of operation, see page 2.**



Hydraulic Flow Regulators

Hydraulic Flow Regulator for Commercial Aircraft 1121S-4

**PRESSURE COMPENSATED
FIXED FLOW REGULATOR**

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +160°F

PORTS: AND10050-4 for 1/4 O.D. Tubing

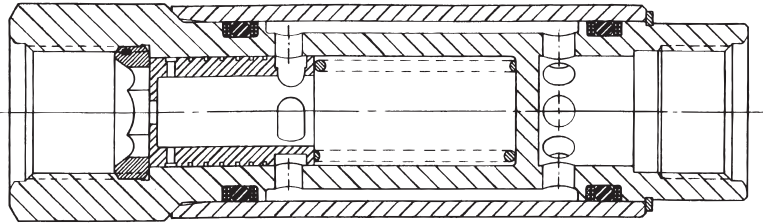
FLUID: Skydrol

**RECOMMENDED APPROXIMATE FLOW
RANGE:** 0.5 to 1.2 gpm

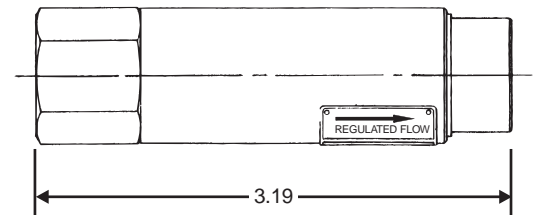
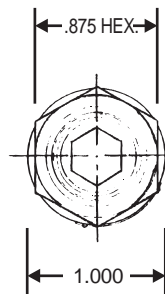
FLOW TOLERANCE:
From +70 to 160°F, +10% and -15%
at -65°F, ±20%

WEIGHT: 0.20 lbs.

**REGULATED
FLOW
DIRECTION**



THIS FLOW REGULATOR SHOWN IN STATIC POSITION.
For information on details of operation, see page 2.



Hydraulic Flow Regulator for Commercial Aircraft 1121S-6

**PRESSURE COMPENSATED
FIXED FLOW REGULATOR**

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +160°F

PORTS: AND10050-6 for 3/8 O.D. Tubing

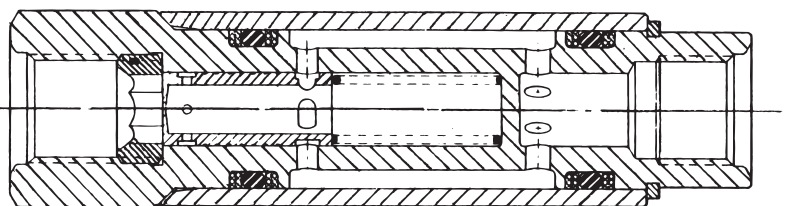
FLUID: Skydrol

**RECOMMENDED APPROXIMATE FLOW
RANGE:** 0.5 to 3.5 gpm

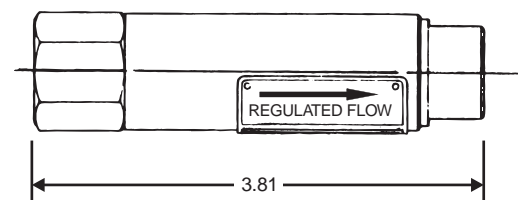
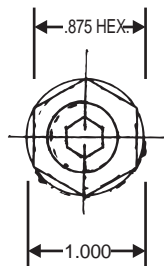
FLOW TOLERANCE:
From +70 to 160°F, 0.5 to 1.49 gpm: +10%, -15%
1.5 gpm and above: +5%, -10%
at -65°F, ±20%

WEIGHT: 0.22 lbs.

**REGULATED
FLOW
DIRECTION**



THIS FLOW REGULATOR SHOWN IN STATIC POSITION.
For information on details of operation, see page 2.



Hydraulic Flow Regulators

Hydraulic Flow Regulator for Commercial Aircraft 1121S-8

**PRESSURE COMPENSATED
FIXED FLOW REGULATOR**

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +160°F

PORTS: AND10050-8 for 1/2 O.D. Tubing

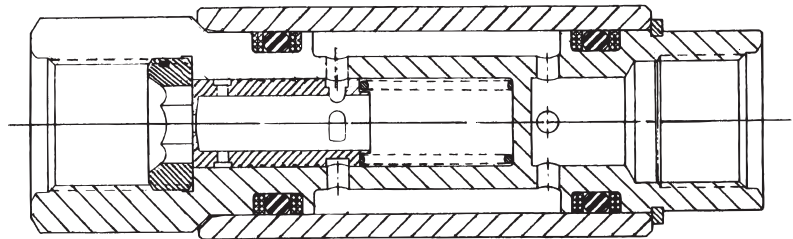
FLUID: Skydrol

**RECOMMENDED APPROXIMATE FLOW
RANGE:** 1.0 to 6.0 gpm

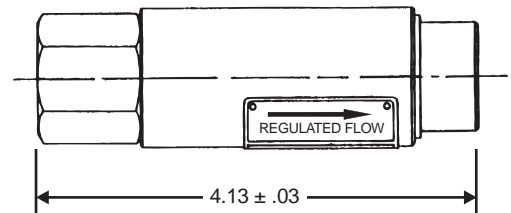
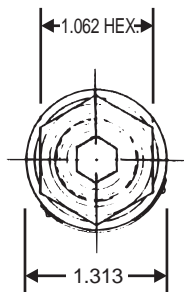
FLOW TOLERANCE:
From +70 to 160°F, 1.0 to 1.49 gpm: +10%, -15%
1.5 gpm and up: +5%, -10%
at -65°F, ±20%

WEIGHT: 0.35 lbs.

**REGULATED
FLOW
DIRECTION**



**THIS FLOW REGULATOR SHOWN IN STATIC POSITION.
For information on details of operation, see page 2.**



Hydraulic Flow Regulator for Commercial Aircraft 1121S-10

**PRESSURE COMPENSATED
FIXED FLOW REGULATOR**

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +160°F

PORTS: AND10050-10 for 5/8 O.D. Tubing

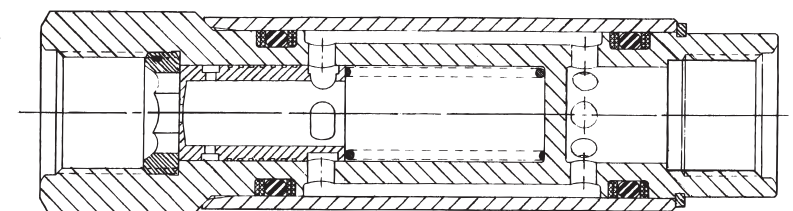
FLUID: Skydrol

**RECOMMENDED APPROXIMATE FLOW
RANGE:** 4.0 to 10.5 gpm

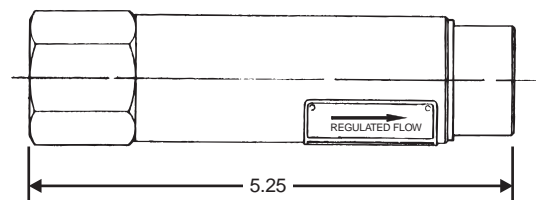
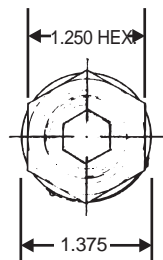
FLOW TOLERANCE:
From +70 to 160°F, +5%, -10%
at -65°F, ±20%

WEIGHT: 0.50 lbs.

**REGULATED
FLOW
DIRECTION**



**THIS FLOW REGULATOR SHOWN IN STATIC POSITION.
For information on details of operation, see page 2.**



Hydraulic Flow Regulators

Hydraulic Flow Regulator for Commercial Aircraft 1121S-12

**PRESSURE COMPENSATED
FIXED FLOW REGULATOR**

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +160°F

PORTS: AND10050-12 for 3/4 O.D. Tubing

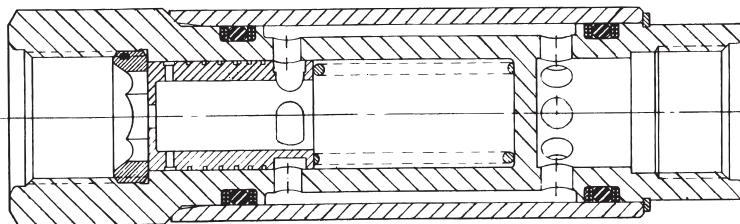
FLUID: Skydrol

**RECOMMENDED APPROXIMATE FLOW
RANGE:** 6.5 to 12.0 gpm

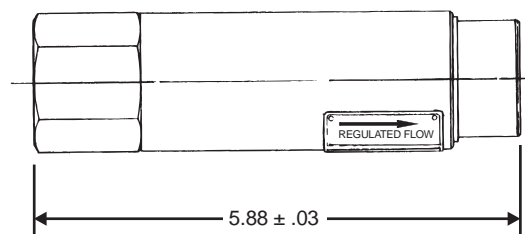
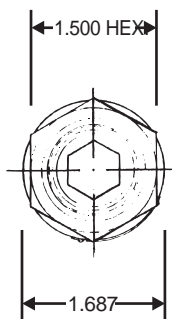
FLOW TOLERANCE:
From +70 to 160°F, +5%, -10%
at -65°F, ±20%

WEIGHT: 0.85 lbs.

**REGULATED
FLOW
DIRECTION**



**THIS FLOW REGULATOR SHOWN IN STATIC POSITION.
For information on details of operation, see page 2.**



Hydraulic Flow Regulator for Commercial Aircraft 1158A

**PRESSURE COMPENSATED
FIXED FLOW REGULATOR**

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +160°F

FLUID: Skydrol

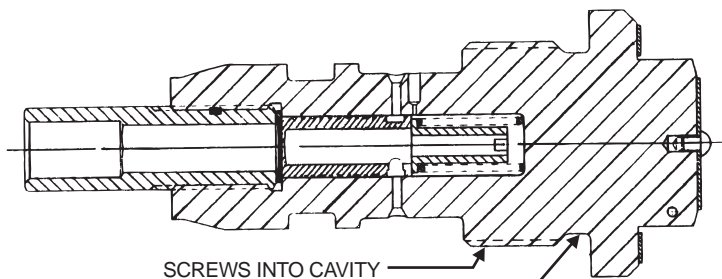
**RECOMMENDED APPROXIMATE FLOW
RANGE:** 0.08 to 1.2 gpm

FLOW TOLERANCE:
From +70 to 160°F, +10%, -15%
at -65°F, ±20%

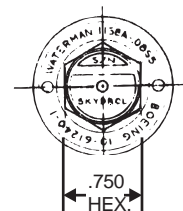
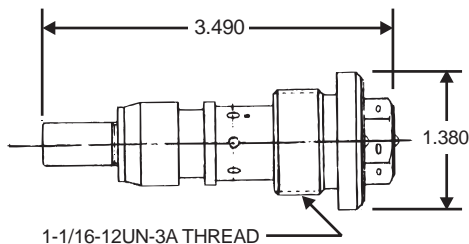
WEIGHT: 0.30 lbs.

Other models for flow rates up to 3.5 gpm.

**REGULATED
FLOW
DIRECTION**



**THIS FLOW REGULATOR SHOWN IN STATIC POSITION.
For information on details of operation, see page 2.**



Hydraulic Flow Regulators

Hydraulic Flow Regulator for Commercial Aircraft 1158C

**PRESSURE COMPENSATED
FIXED FLOW REGULATOR**

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +160°F

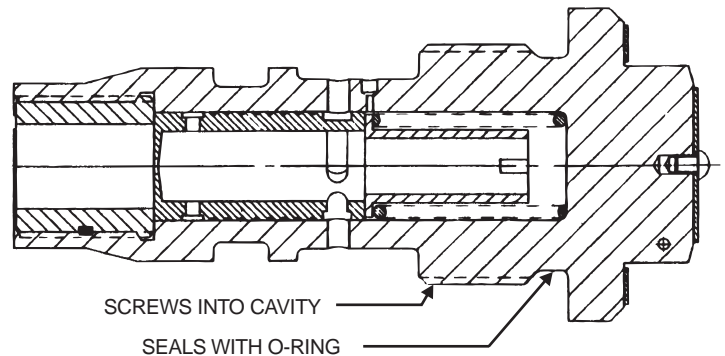
FLUID: Skydrol

**RECOMMENDED APPROXIMATE FLOW
RANGE:** 1.5 to 6.0 gpm

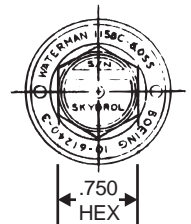
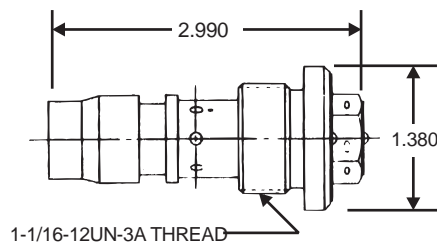
FLOW TOLERANCE:
At 70 to 160°F, +5%, -10%
at -65°F, ±20%

WEIGHT: 0.30 lbs.

**REGULATED
FLOW
DIRECTION**



**THIS FLOW REGULATOR SHOWN IN STATIC POSITION.
For information on details of operation, see page 2.**



Hydraulic Flow Regulator for Commercial Aircraft 1162A

**PRESSURE COMPENSATED
FIXED FLOW REGULATOR**

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +160°F

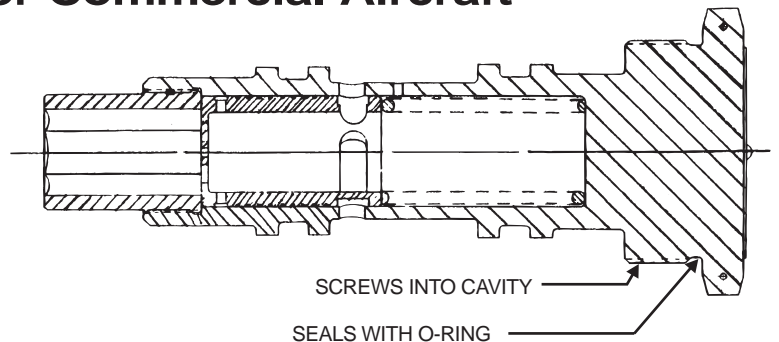
FLUID: Skydrol

**RECOMMENDED APPROXIMATE FLOW
RANGE:** 10.0 to 40.0 gpm

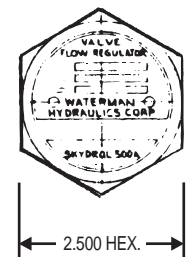
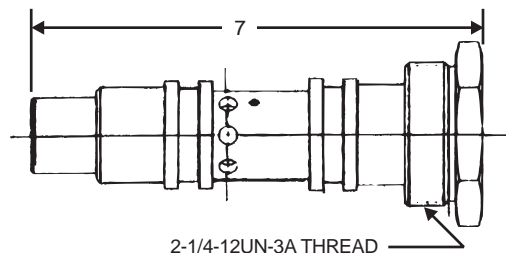
FLOW TOLERANCE:
At 0 to 160°F, +5%, -10%
at -65°F, ±20%

WEIGHT: 1.4 lbs.

**REGULATED
FLOW
DIRECTION**



**THIS FLOW REGULATOR SHOWN IN STATIC POSITION.
For information on details of operation, see page 2.**



Hydraulic Flow Regulators

Hydraulic Flow Regulator for Commercial Aircraft 1121S-12

**PRESSURE COMPENSATED
FIXED FLOW REGULATOR**

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +160°F

PORTS: AND10050-12 for 3/4 O.D. Tubing

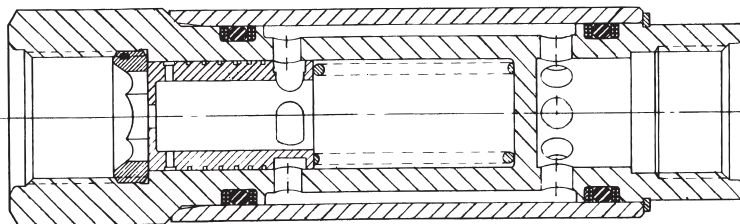
FLUID: Skydrol

**RECOMMENDED APPROXIMATE FLOW
RANGE:** 6.5 to 12.0 gpm

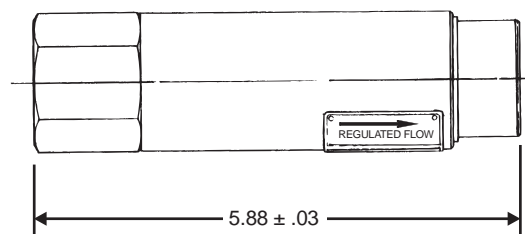
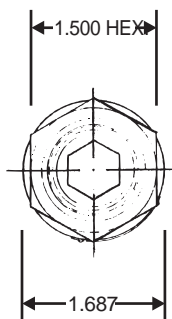
FLOW TOLERANCE:
From +70 to 160°F, +5%, -10%
at -65°F, ±20%

WEIGHT: 0.85 lbs.

**REGULATED
FLOW
DIRECTION**



**THIS FLOW REGULATOR SHOWN IN STATIC POSITION.
For information on details of operation, see page 2.**



Hydraulic Flow Regulator for Commercial Aircraft 1158A

**PRESSURE COMPENSATED
FIXED FLOW REGULATOR**

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +160°F

FLUID: Skydrol

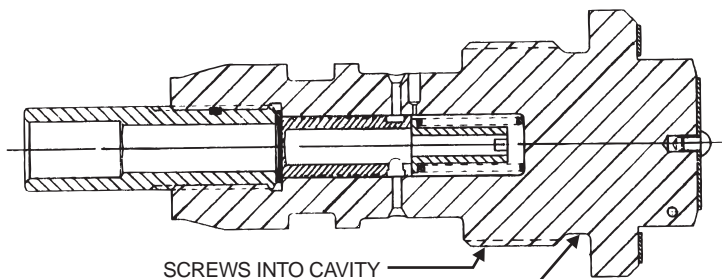
**RECOMMENDED APPROXIMATE FLOW
RANGE:** 0.08 to 1.2 gpm

FLOW TOLERANCE:
From +70 to 160°F, +10%, -15%
at -65°F, ±20%

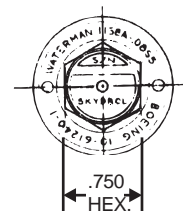
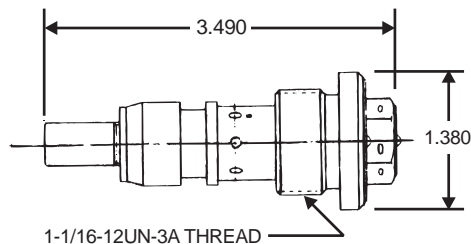
WEIGHT: 0.30 lbs.

Other models for flow rates up to 3.5 gpm.

**REGULATED
FLOW
DIRECTION**



**THIS FLOW REGULATOR SHOWN IN STATIC POSITION.
For information on details of operation, see page 2.**



Hydraulic Flow Regulators

Hydraulic Flow Regulator for Commercial Aircraft 1158C

**PRESSURE COMPENSATED
FIXED FLOW REGULATOR**

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +160°F

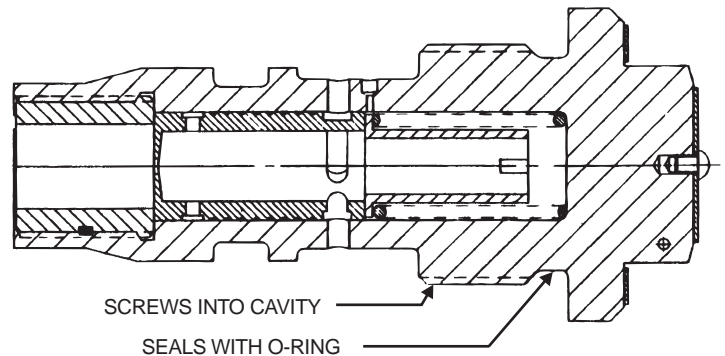
FLUID: Skydrol

**RECOMMENDED APPROXIMATE FLOW
RANGE:** 1.5 to 6.0 gpm

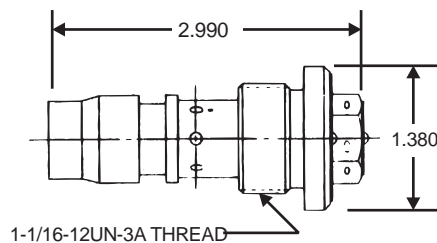
FLOW TOLERANCE:
At 70 to 160°F, +5%, -10%
at -65°F, ±20%

WEIGHT: 0.30 lbs.

**REGULATED
FLOW
DIRECTION**



**THIS FLOW REGULATOR SHOWN IN STATIC POSITION.
For information on details of operation, see page 2.**



Hydraulic Flow Regulator for Commercial Aircraft 1162A

**PRESSURE COMPENSATED
FIXED FLOW REGULATOR**

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +160°F

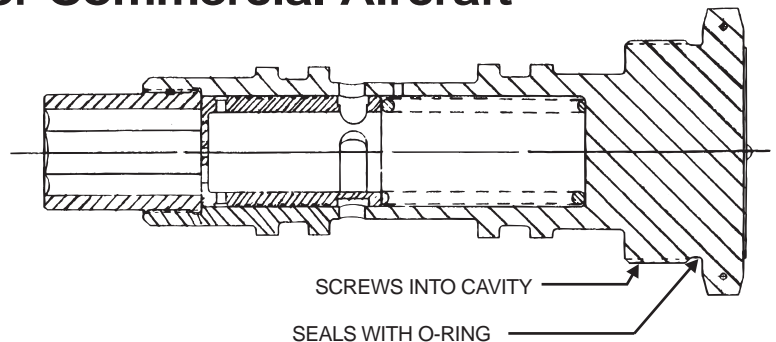
FLUID: Skydrol

**RECOMMENDED APPROXIMATE FLOW
RANGE:** 10.0 to 40.0 gpm

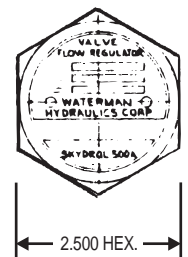
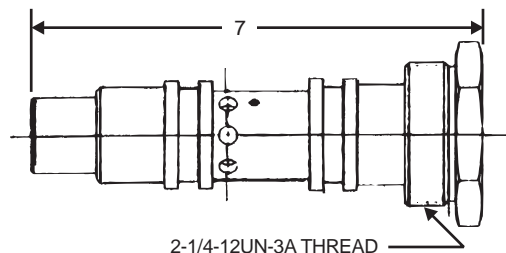
FLOW TOLERANCE:
At 0 to 160°F, +5%, -10%
at -65°F, ±20%

WEIGHT: 1.4 lbs.

**REGULATED
FLOW
DIRECTION**



**THIS FLOW REGULATOR SHOWN IN STATIC POSITION.
For information on details of operation, see page 2.**



Hydraulic Flow Regulators

Hydraulic Flow Regulator for Commercial Aircraft 1162C

**PRESSURE COMPENSATED
FIXED FLOW REGULATOR**

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +160°F

FLUID: Skydrol

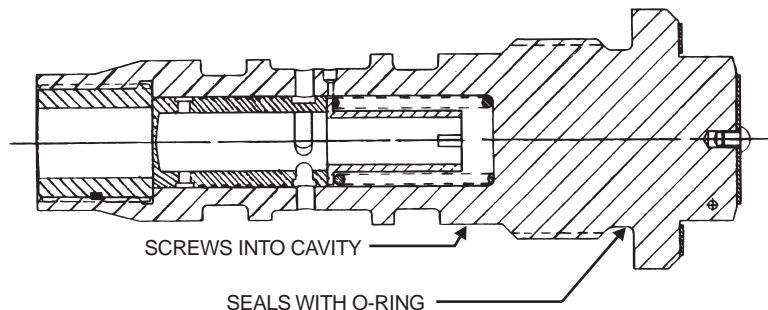
**RECOMMENDED APPROXIMATE FLOW
RANGE:** 1.0 to 6.0 gpm

FLOW TOLERANCE:

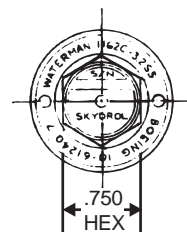
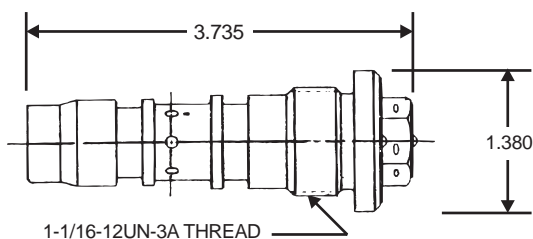
At 0 to 160°F, 1.0 to 1.49 gpm: +10%, -15%
1.5 to 6.0 gpm: +5%, -10%
at -65°F, ±20%

WEIGHT: 0.33 lbs.

**REGULATED
FLOW
DIRECTION**



THIS FLOW REGULATOR SHOWN IN STATIC POSITION.
For information on details of operation, see page 2.



Hydraulic Flow Regulator for Commercial Aircraft 1122X Series

**PRESSURE COMPENSATED
FIXED FLOW REGULATOR FOR
ANTI-SKID BRAKE SYSTEM
APPLICATIONS**

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +255°F
momentary peak to 275°F

PORTS: To suit customer requirements.
MS33514E6 inlet and NAS1760A06 outlet shown

FLUID: Skydrol

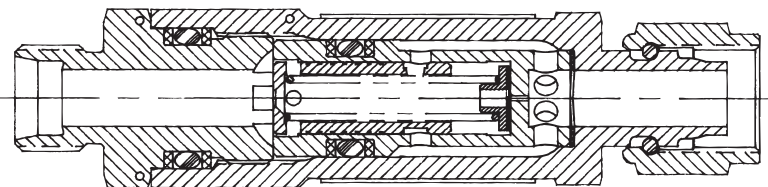
**RECOMMENDED APPROXIMATE FLOW
RANGE:** 1.0 to 2.5 gpm

FLOW TOLERANCE:

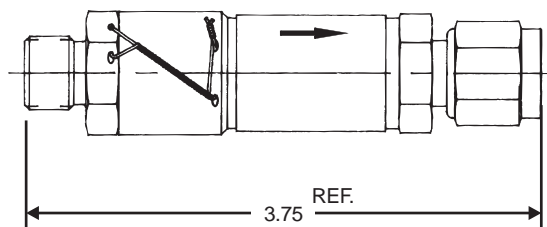
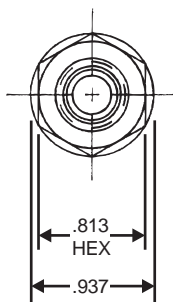
From 70 to 225°F;
1.0 to 1.49 gpm: +10%, -15%
1.5 and up: +5%, -10%
at -65°F, ±20%

WEIGHT: 0.45 lbs. Actual weight depends
upon port configurations

**REGULATED
FLOW
DIRECTION**



THIS FLOW REGULATOR SHOWN IN STATIC POSITION.
For information on details of operation, see page 2.



Hydraulic Fuses

Hydraulic Fuse for Military Aircraft 812-4

HYDRAULIC FUSE, TYPE I

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +160°F

PORTS: MS33656-4 for 1/4 O.D. Tubing

FLUID: MIL-H-5606

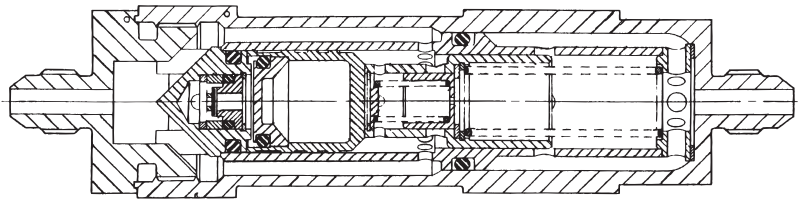
RECOMMENDED FLOW: 0.1 to 2.5 gpm

VOLUMETRIC CAPACITY:

Generally 5 to 50 cu. in., with larger capacities possible

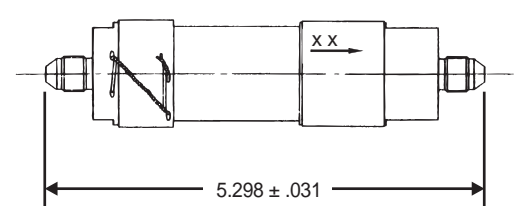
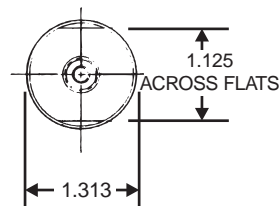
WEIGHT: 0.35 lbs.

**FLOW
DIRECTION
FOR
CLOSING**



THIS FUSE SHOWN IN STATIC POSITION.

For information on details of operation, see page 4 AND 5.



Hydraulic Fuse for Military Aircraft 812-6

HYDRAULIC FUSE, TYPE I

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +160°F

PORTS: MS33656-6 for 3/8 O.D. Tubing

FLUID: MIL-H-5606

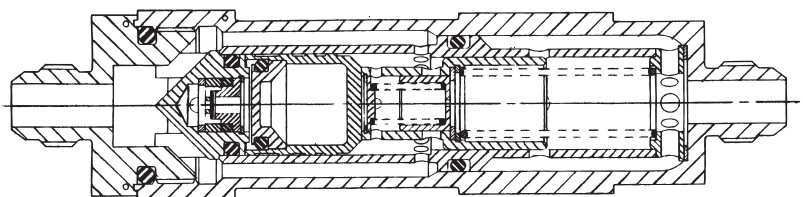
RECOMMENDED FLOW: 0.1 to 3.5 gpm

VOLUMETRIC CAPACITY:

Generally 5 to 50 cu. in., with larger capacities possible

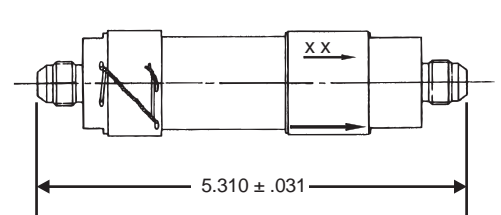
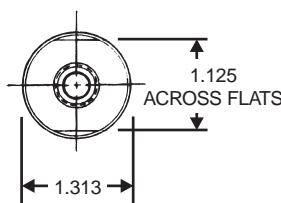
WEIGHT: 0.40 lbs.

**FLOW
DIRECTION
FOR
CLOSING**



THIS FUSE REGULATOR SHOWN IN STATIC POSITION.

For information on details of operation, see page 4 AND 5.



Hydraulic Fuses

Hydraulic Fuse for Military Aircraft 812-8

HYDRAULIC FUSE, TYPE I

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +160°F

PORTS: MS33656-8 for 1/2 O.D. Tubing

FLUID: MIL-H-5606

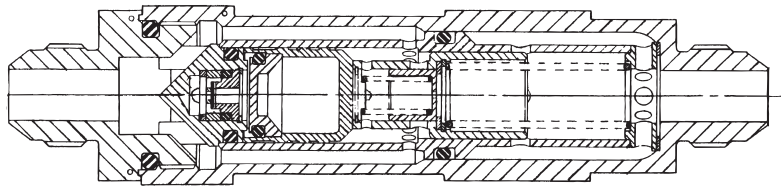
RECOMMENDED FLOW: 0.1 to 6.0 gpm

VOLUMETRIC CAPACITY:

Generally 5 to 50 cu. in., with larger capacities possible

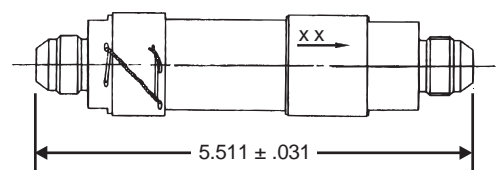
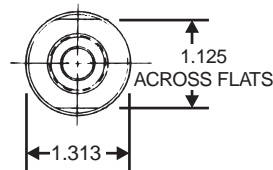
WEIGHT: 0.45 lbs.

**FLOW
DIRECTION
FOR
CLOSING**



THIS FUSE SHOWN IN STATIC POSITION.

For information on details of operation, see page 4 AND 5.



Hydraulic Fuse for Military Aircraft 831-8

HYDRAULIC FUSE, TYPE I

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +160°F

PORTS: AND10050-8 for 1/2 O.D. Tubing

FLUID: MIL-H-5606

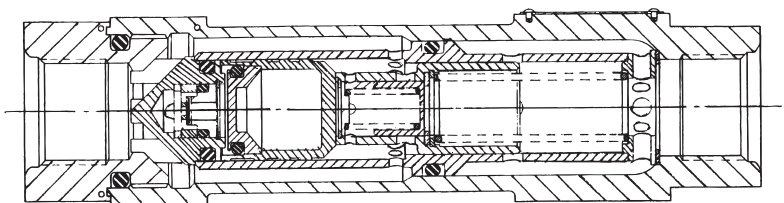
RECOMMENDED FLOW: 0.1 to 6.0 gpm

VOLUMETRIC CAPACITY:

Generally 5 to 50 cu. in., with larger capacities possible

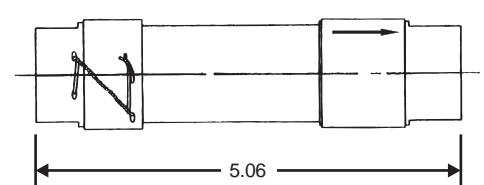
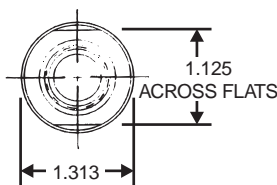
WEIGHT: 0.30 lbs.

**FLOW
DIRECTION
FOR
CLOSING**



THIS FUSE SHOWN IN STATIC POSITION.

For information on details of operation, see page 4 AND 5.



Some volumetric capacities meet requirements of Standard Part Number AN6281, Spec. MIL-F-5508

Hydraulic Fuses

Hydraulic Fuse for Military Aircraft 840-8

HYDRAULIC FUSE, TYPE I WITH
MANUAL RESET

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +160°F

PORTS: AND10050-8 for 1/2 O.D. Tubing

FLUID: MIL-H-5606

RECOMMENDED FLOW: 0.25 to 6.0 gpm

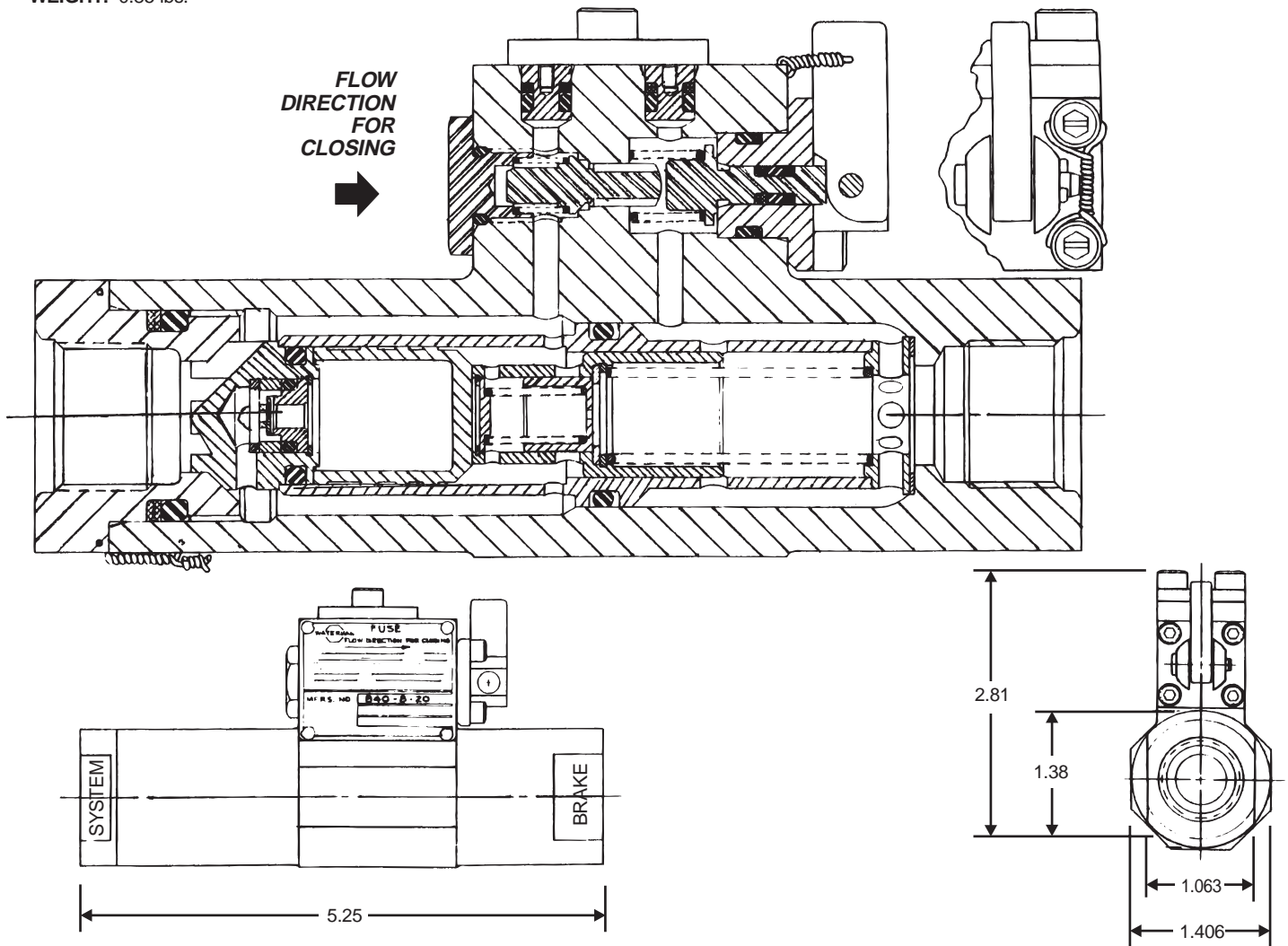
VOLUMETRIC CAPACITY:

Generally 5 to 50 cu. in., with larger capacities possible

WEIGHT: 0.85 lbs.

THIS FUSE SHOWN IN STATIC POSITION.

For information on details of operation, see page 4 AND 5.



Hydraulic Fuses

Hydraulic Fuse for Military Aircraft 1113-8

HYDRAULIC FUSE, TYPE I

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +275°F

PORTS: AND10050-8 for 1/2 O.D. Tubing

FLUID: MIL-H-5606

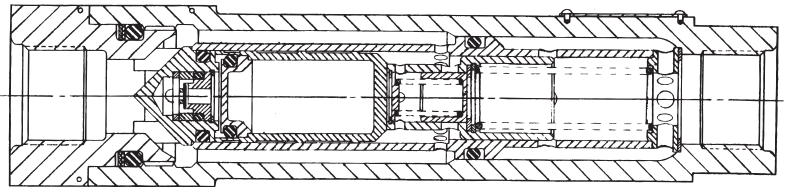
RECOMMENDED FLOW: 0.1 to 6.0 gpm

VOLUMETRIC CAPACITY:

Generally 5 to 50 cu. in., with larger capacities possible

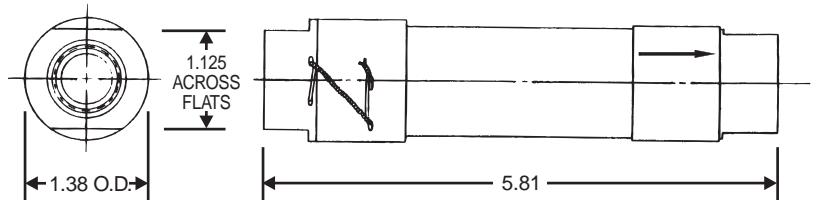
WEIGHT: 0.40 lbs.

**FLOW
DIRECTION
FOR
CLOSING**



THIS FUSE SHOWN IN STATIC POSITION.

For information on details of operation, see page 4 AND 5.



Hydraulic Fuse for Military Aircraft 900-8

HYDRAULIC FUSE, TYPE II

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +160°F

PORTS: AND10050-8 for 1/2 O.D. Tubing

FLUID: MIL-H-5606

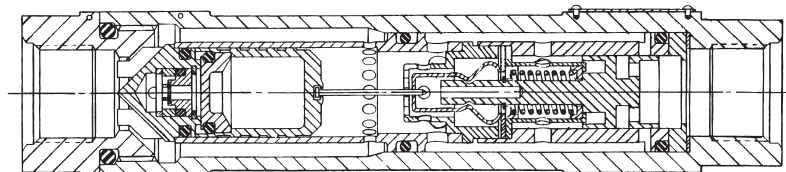
RECOMMENDED FLOW: 0.1 to 6.0 gpm

VOLUMETRIC CAPACITY:

Generally 5 to 50 cu. in., with larger capacities possible

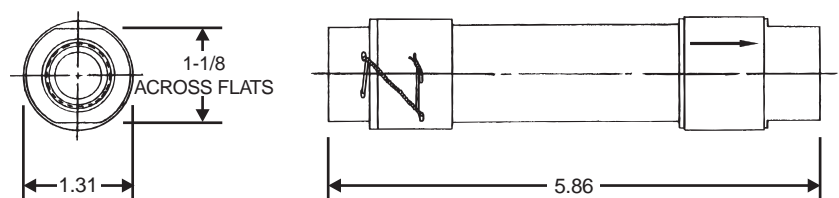
WEIGHT: 0.45 lbs.

**FLOW
DIRECTION
FOR
CLOSING**



THIS FUSE SHOWN IN STATIC POSITION.

For information on details of operation, see page 4 AND 6.



Some volumetric capacities meet requirements of Standard Part Number AN6282, Spec. MIL-F-5508

Hydraulic Fuses

Hydraulic Fuse for Military Aircraft 1134-4

HYDRAULIC FUSE, TYPE III

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +160°F

PORTS: AND10050-4 for 1/4 O.D. Tubing

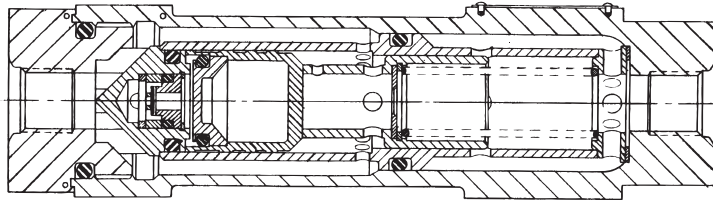
FLUID: MIL-H-5606

RECOMMENDED FLOW: 0.5 to 2.50 gpm

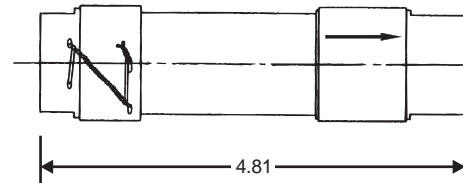
VOLUMETRIC DELAY:
3 - 9 cu. in. to 8 - 15 cu. in.

WEIGHT: 0.39 lbs.

**FLOW
DIRECTION
FOR
CLOSING**



THIS FUSE SHOWN IN STATIC POSITION.
For information on details of operation, see page 4 AND 7.



Hydraulic Fuse for Military Aircraft 1143-8

HYDRAULIC FUSE, TYPE III

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +275°F

PORTS: AND10050-8 for 1/2 O.D. Tubing

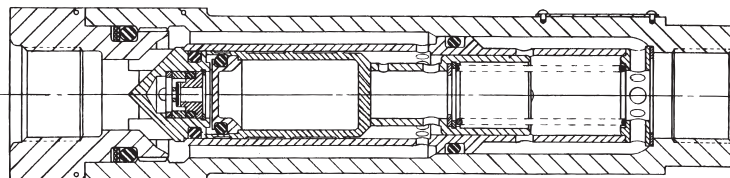
FLUID: MIL-H-5606

RECOMMENDED FLOW: 0.2 to 10.0 gpm

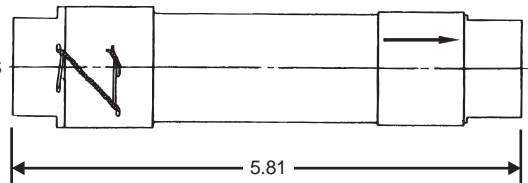
VOLUMETRIC DELAY:
3 - 9 cu. in. to 8 - 15 cu. in.

WEIGHT: 0.51 lbs.

**FLOW
DIRECTION
FOR
CLOSING**



THIS FUSE SHOWN IN STATIC POSITION.
For information on details of operation, see page 4 AND 7.



Hydraulic Fuses

Hydraulic Fuse for Military Aircraft 1134-8

HYDRAULIC FUSE, TYPE III

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +160°F

PORTS: AND10050-8 for 1/2 O.D. Tubing

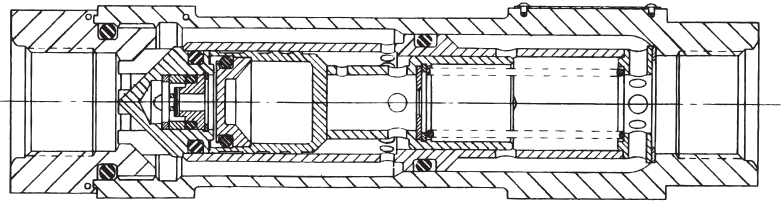
FLUID: MIL-H-5606

RECOMMENDED FLOW: 0.5 to 6.0 gpm

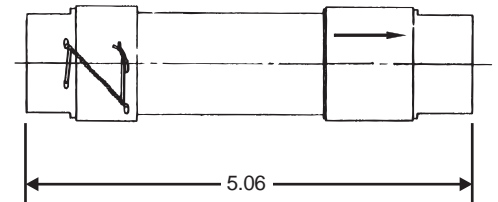
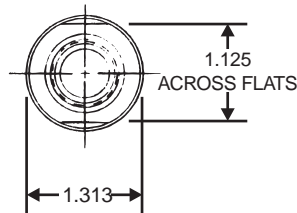
VOLUMETRIC DELAY:
3 - 9 cu. in. to 8 - 15 cu. in.

WEIGHT: 0.39 lbs.

**FLOW
DIRECTION
FOR
CLOSING**



THIS FUSE SHOWN IN STATIC POSITION.
For information on details of operation, see page 4 AND 7.



Hydraulic Fuses

Hydraulic Fuse for Commercial Aircraft G831-8

HYDRAULIC FUSE, TYPE I

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +160°F

PORTS: AND10050-8 for 1/2 O.D. Tubing

FLUID: Skydrol

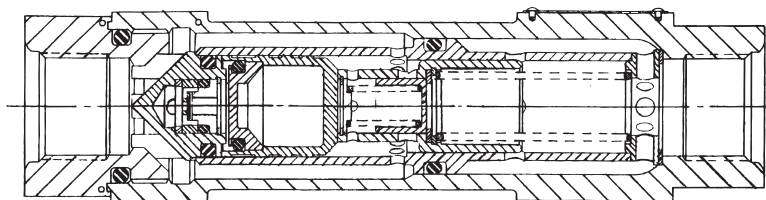
RECOMMENDED FLOW: 0.25 to 6.0 gpm

VOLUMETRIC CAPACITY:

Generally 5 to 50 cu. in., with larger capacities possible

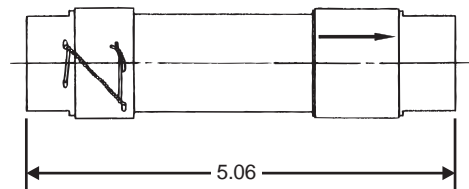
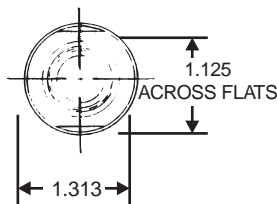
WEIGHT: 0.30 lbs.

**FLOW
DIRECTION
FOR
CLOSING**



THIS FUSE SHOWN IN STATIC POSITION.

For information on details of operation, see page 4 AND 5.



Hydraulic Fuses

Hydraulic Fuse for Commercial Aircraft G836-6

HYDRAULIC FUSE, TYPE I WITH
MANUAL RESET

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +160°F

PORTS: AND10050-6 for 3/8 O.D. Tubing

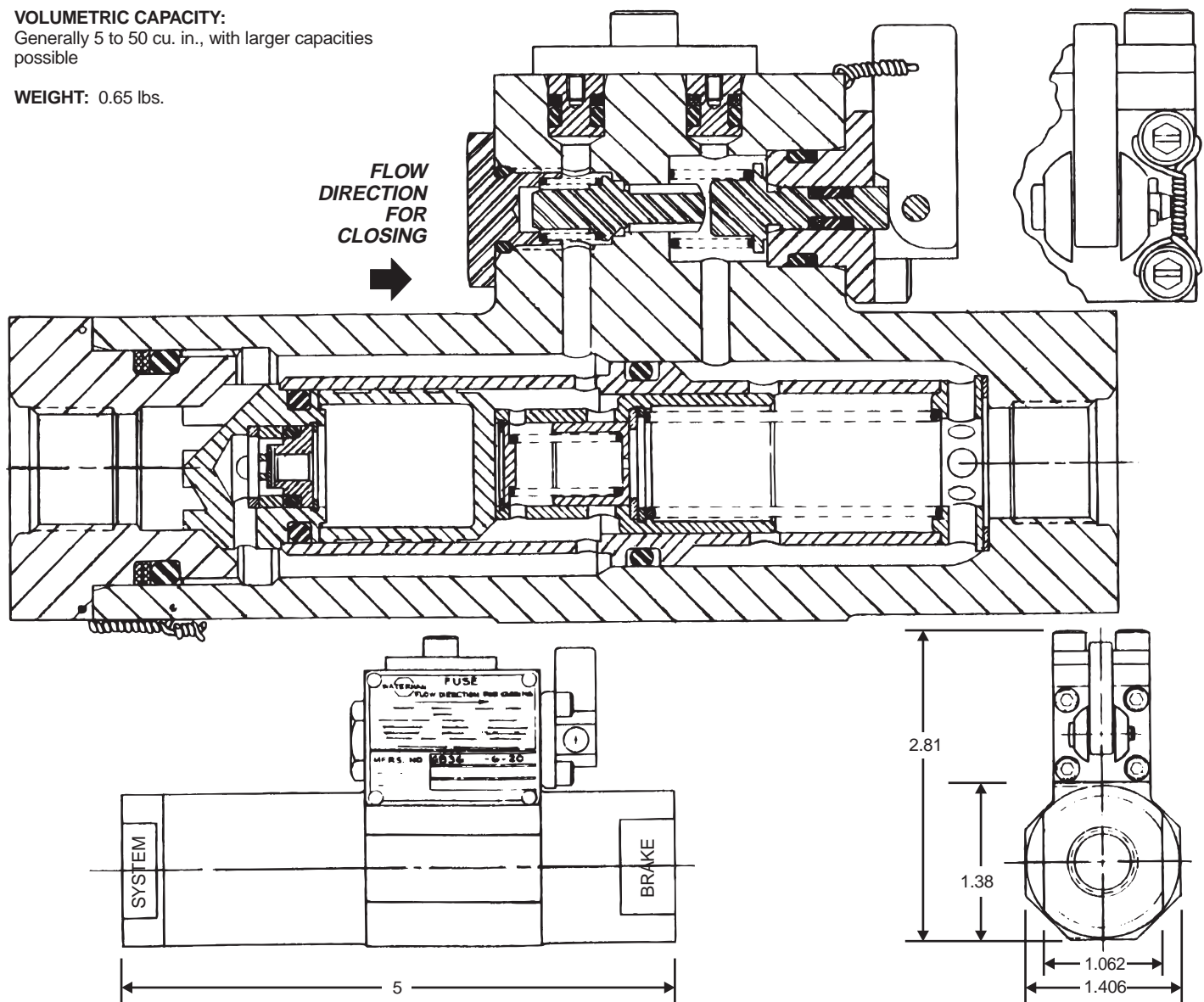
FLUID: Skydrol

RECOMMENDED FLOW: 0.25 to 3.5 gpm

VOLUMETRIC CAPACITY:
Generally 5 to 50 cu. in., with larger capacities
possible

WEIGHT: 0.65 lbs.

THIS FUSE SHOWN IN STATIC POSITION.
For information on details of operation, see page 4 AND 5.



Hydraulic Fuses

Hydraulic Fuse for Commercial Aircraft 837SD-8-6

HYDRAULIC FUSE, TYPE I WITH
MANUAL RESET AND PRESSURE
INDICATOR

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +160°F

PORTS: As Shown

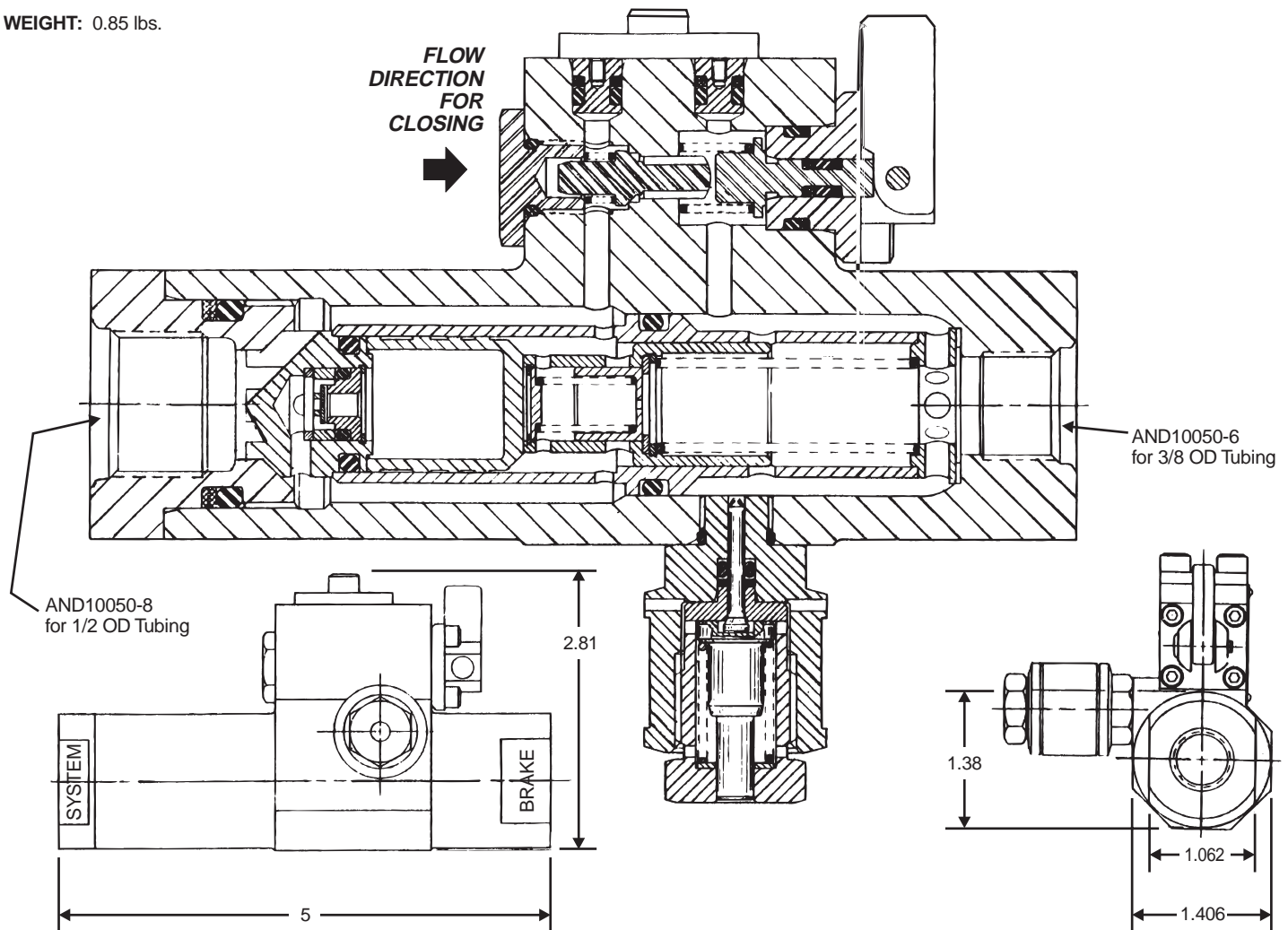
FLUID: Skydrol

RECOMMENDED FLOW: 0.25 to 3.5 gpm

VOLUMETRIC CAPACITY:
Generally 5 to 50 cu. in., with larger capacities
possible

WEIGHT: 0.85 lbs.

THIS FUSE SHOWN IN STATIC POSITION.
For information on details of operation, see page 4 AND 5.



Hydraulic Fuses

Hydraulic Fuse for Commercial Aircraft G8381-8

HYDRAULIC FUSE, TYPE I

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +160°F

PORTS: AND10050-8 for 1/2 O.D. Tubing

FLUID: Skydrol

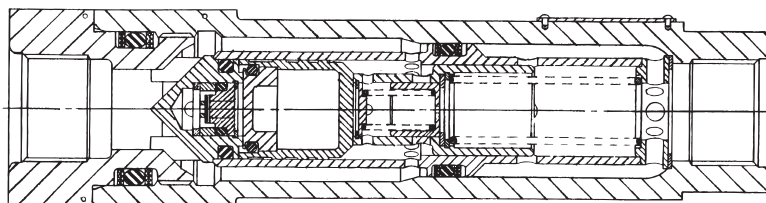
RECOMMENDED FLOW: 0.25 to 6.0 gpm

VOLUMETRIC CAPACITY:

Generally 5 to 50 cu. in., with larger capacities possible

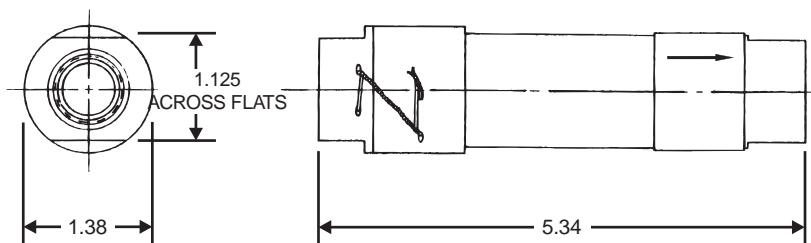
WEIGHT: 0.40 lbs.

**FLOW
DIRECTION
FOR
CLOSING**



THIS FUSE SHOWN IN STATIC POSITION.

For information on details of operation, see page 4 AND 5.



Hydraulic Fuses

Hydraulic Fuse for Commercial Aircraft G9051

HYDRAULIC FUSE, TYPE II
PLUG TYPE

SERVICE PRESSURE: 3000 psi

TEMPERATURE RANGE: -65 to +160°F

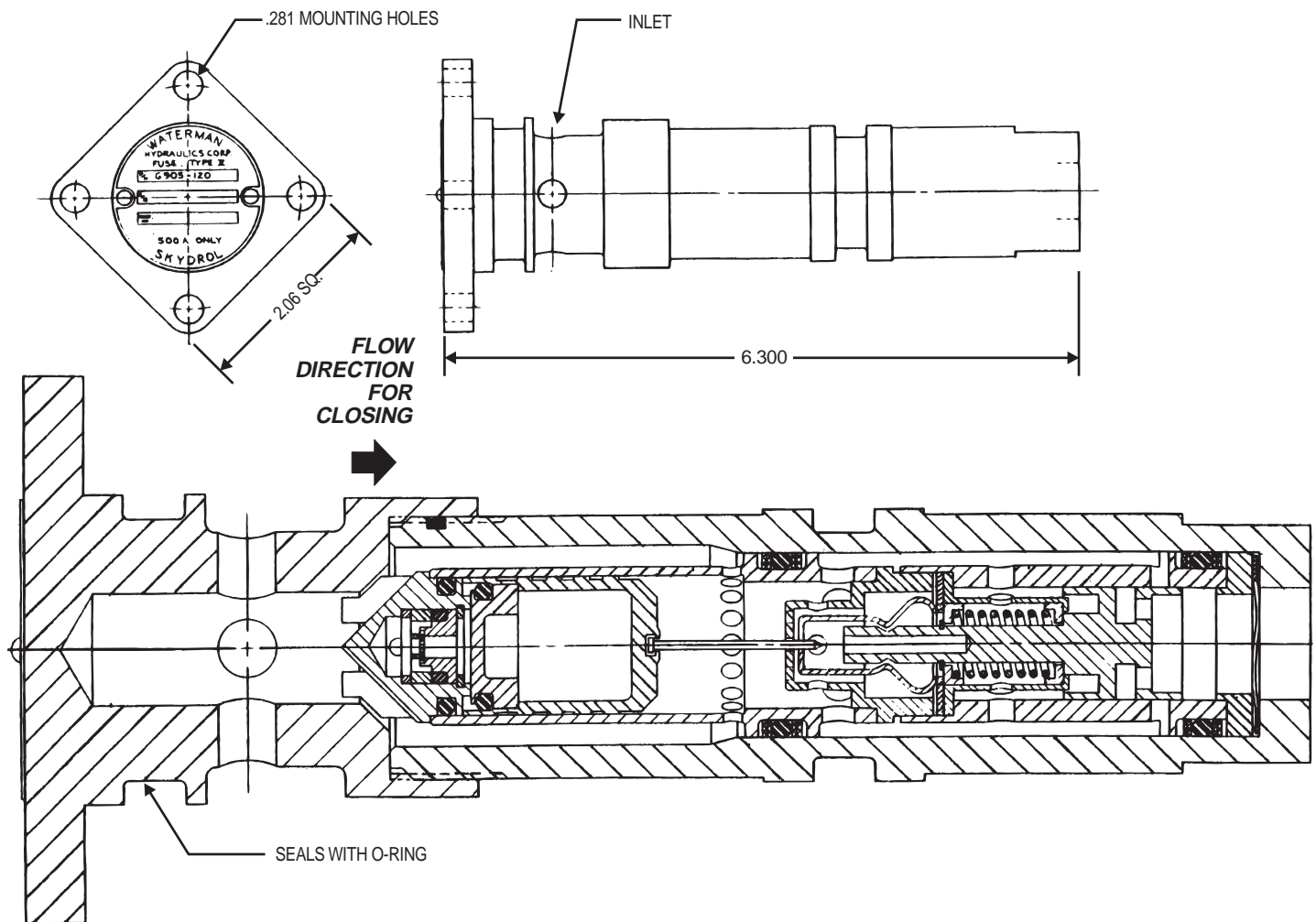
FLUID: Skydrol

RECOMMENDED FLOW: 0.25 to 6.0 gpm

VOLUMETRIC CAPACITY:
Generally 5 to 50 cu. in., with larger capacities
possible

WEIGHT: 0.50 lbs.

THIS FUSE SHOWN IN STATIC POSITION.
For information on details of operation, see page 4 AND 6.



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 7. **Special Tooling:** A tooling charge may be imposed for any special tooling, including without limitation, dies, fixtures, molds and patterns, acquired to manufacture items sold pursuant to this contract. Such special tooling shall be and remain Seller's property notwithstanding payment of any charges by Buyer. In no event will Buyer acquire any interest in apparatus belonging to Seller which is utilized in the manufacture of the items sold hereunder, even if such apparatus has been specially converted or adapted for such manufacture and notwithstanding any charges paid by Buyer. Unless otherwise agreed, Seller shall have the right to alter, discard or otherwise dispose of any special tooling or other property in its sole discretion at any time.
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 9. **Taxes:** Unless otherwise indicated on the face hereof, all prices and charges are exclusive of excise, sales, use, property, occupational or like taxes which may be imposed by any taxing authority upon the manufacture, sale or delivery of the items sold hereunder. If any such taxes must be paid by Seller or if Seller is liable for the collection of such tax, the amount thereof shall be in addition to the amounts for the items sold. Buyer agrees to pay all such taxes or to reimburse Seller therefore upon receipt of its invoice. If Buyer claims exemption from any sales, use or other tax imposed by any taxing authority, Buyer shall save Seller harmless from and against any such tax, together with any interest or penalties thereon which may be assessed if the items are held to be taxable.
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- If a claim is based on information provided by Buyer or if the design for an item delivered hereunder is specified in whole or in part by Buyer, Buyer shall defend and indemnify Seller for all costs, expenses or judgments resulting from any claim that such item infringes any patent, trademark, copyright, trade dress, trade secret or any similar right.
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PD4099 9/88

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Website: www.stratoflex.com