# Stratoflex

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

*Catalog 106-W*
*September 2002*

*The World Standard*

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Stratoflex Products Division
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## Introduction

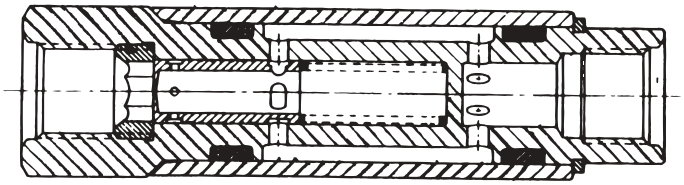
**DEFINITION AND PURPOSE**

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.

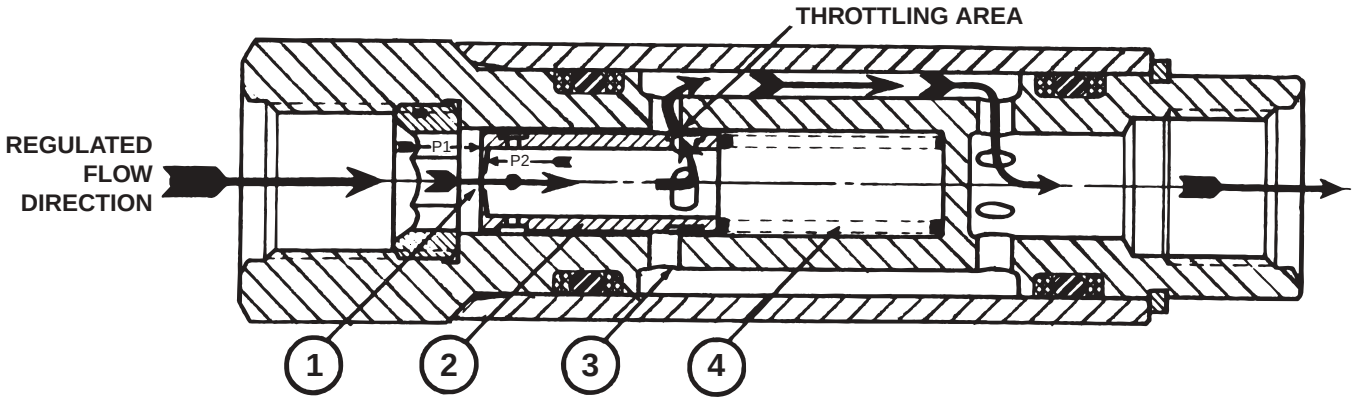
**GENERAL APPLICATION DATA**

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 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 P1 minus P2. Pressure P1 acts on the face of the piston and pressure P2 acts on the downstream face of the piston. Because of the lower pressure (P2) 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.



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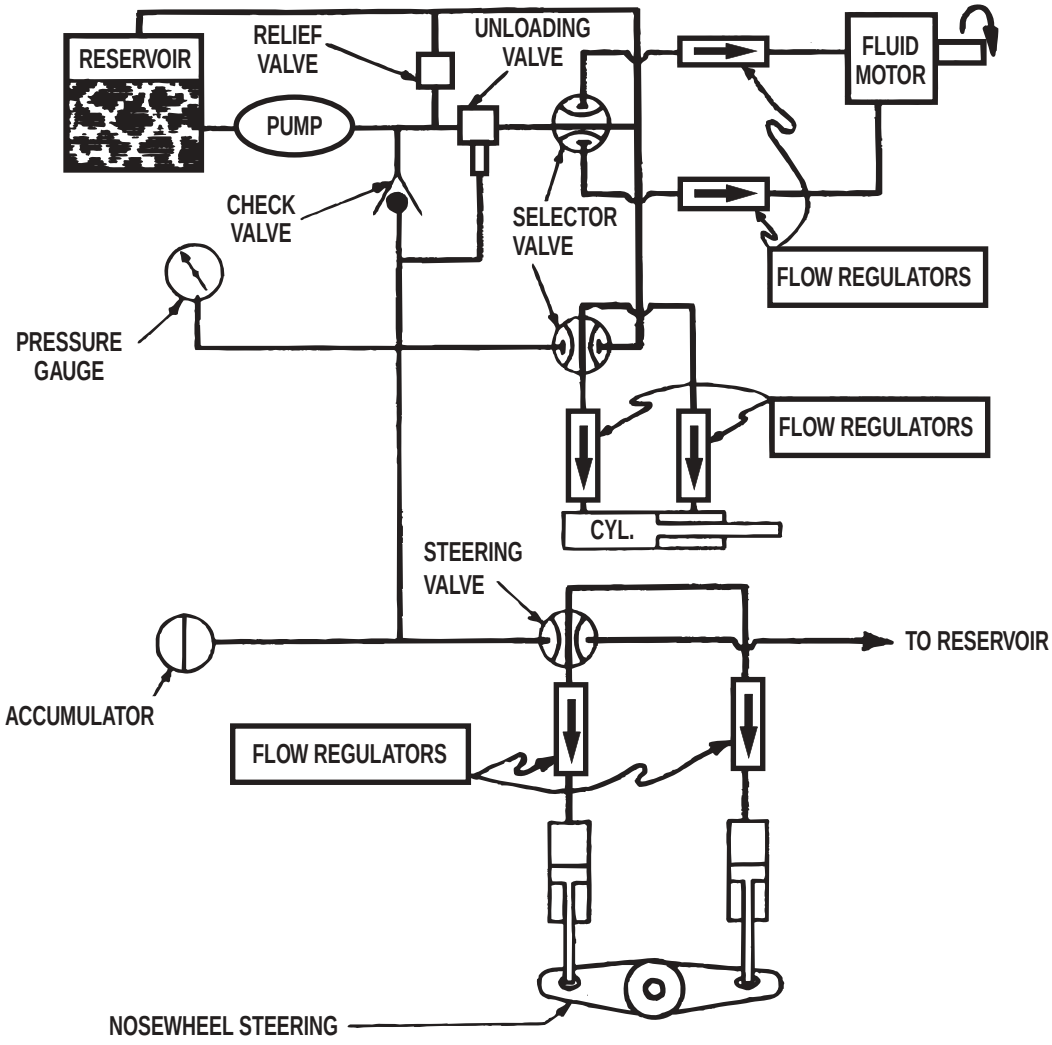
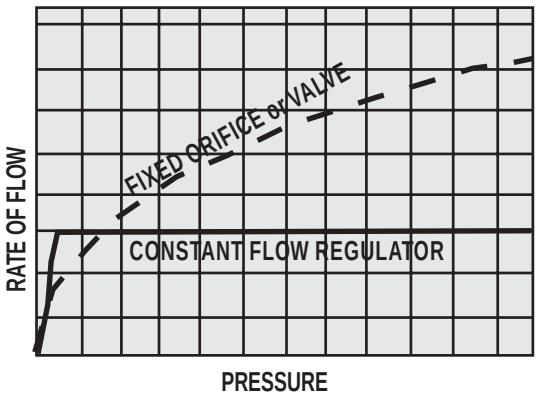
## Aircraft Hydraulic System, Typical Schematic Showing Location and Application of Various Waterman Hydraulic Flow Regulators




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.



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# 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 / 203.2 cubic mm, a 10 cubic inch / 254 cubic mm 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 / 1.03 bar 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 / .379 lpm. under ideal conditions, It is not considered practical to utilize this type in critical systems where reverse flows are less than 1.0 gpm / 3.79 lpm.

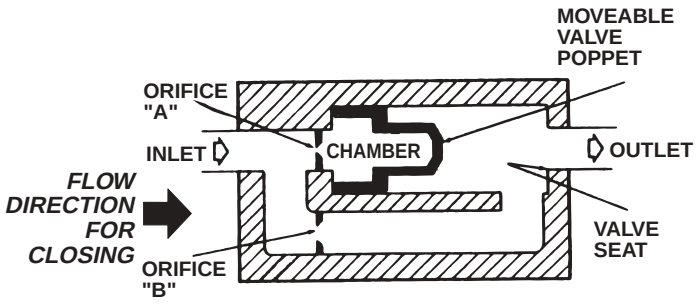
THE TYPE 3 FUSE is intended for use with continuous flow devices such as fluid motors and will provide an effective means of closing off the pressure line in the event of sudden increase in flow rate, as might be caused by line loss or motor overspeed. Resetting requirements and provisions are identical to those of the Type I 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 / 25.4 cubic mm to fill the valve chamber and we desire a 100 cubic inch / 2540 cubic mm 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 an 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.



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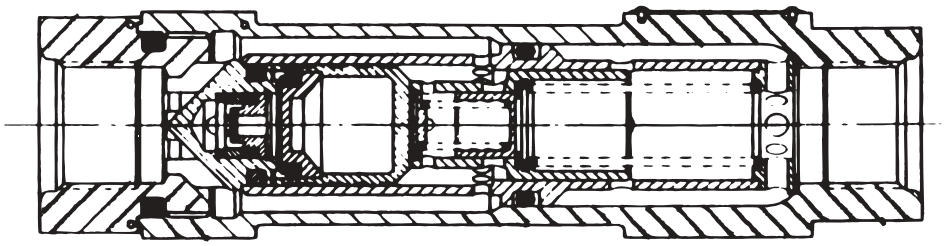
# Operation of Type I Hydraulic Fuse

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).

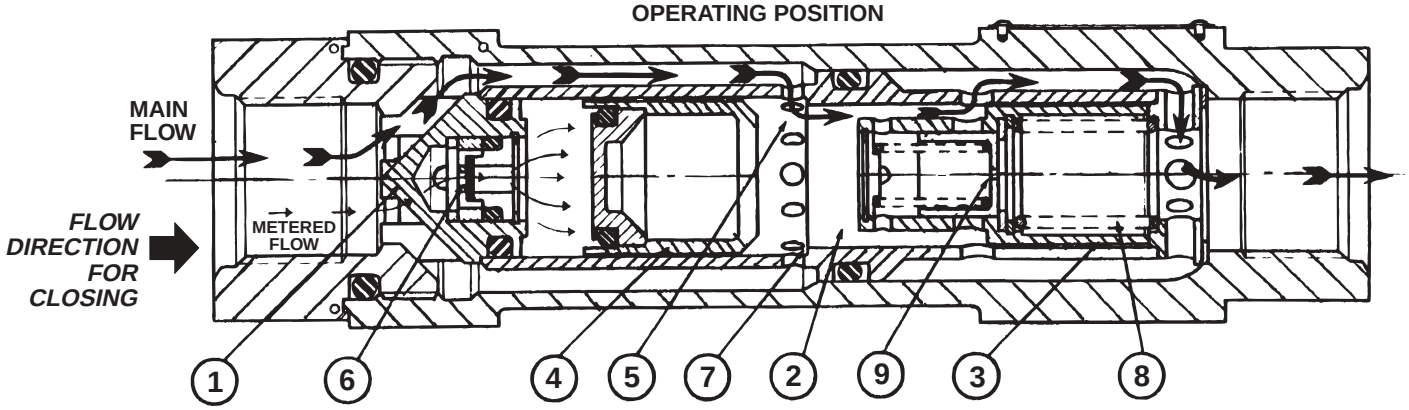
The main flow passing through the drilled holes (5) produces a slight pressure drop. Since the main piston offers negligible friction resistance because of its hollow, buoyant design, the pressure drop which occurs across the drilled holes is equal to that across the metered flow orifice (6). As a result 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 / .345 bar. 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.

**STATIC POSITION**



**OPERATING POSITION**



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## 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) in now free to move, its movement being proportional to the amount of fluid passing through the fuse, as in the Type I Fuse.

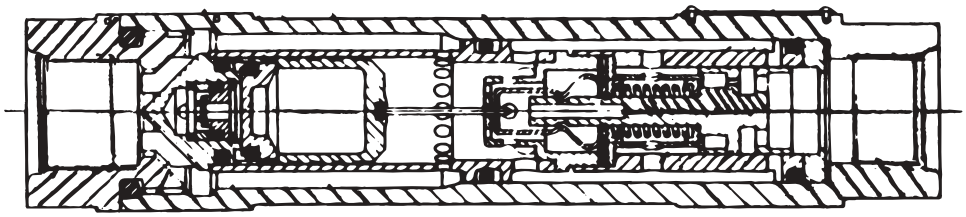
Whenever fluid is passed in excess of the calibrated capacity of the fuse, it will close by the action of the main piston seating against shoulder (5). Once fused, the valve will remain closed until reverse flow pressure occurs. Piston assembly is held closed by the gripping action of the lock spring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

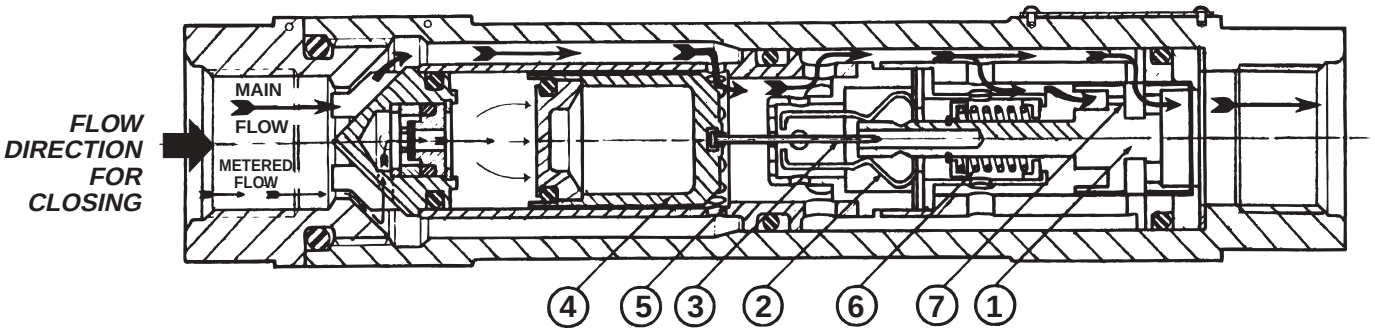
Any interruption of flow through the fuse removes the operating force from the lock piston (1) allowing the spring (6) to return the lock piston to the static position. This action allows the lock spring to grip and hold the piston subassembly in the position assumed at the moment of interruption of 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**



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# Operation of Type III Hydraulic Fuse

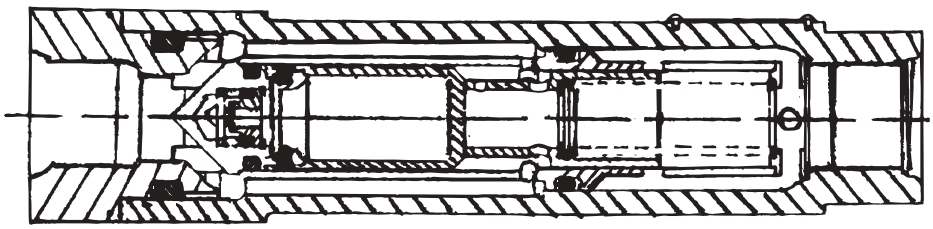
THE TYPE III FUSE (Automatic Excess Flow Velocity) provides protection against unnecessary fluid loss in those systems in which flow in the direction of closing is continuous and not limited to a fixed volume. The principle of operation of this fuse is identical to the Type I fuse except that its closing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

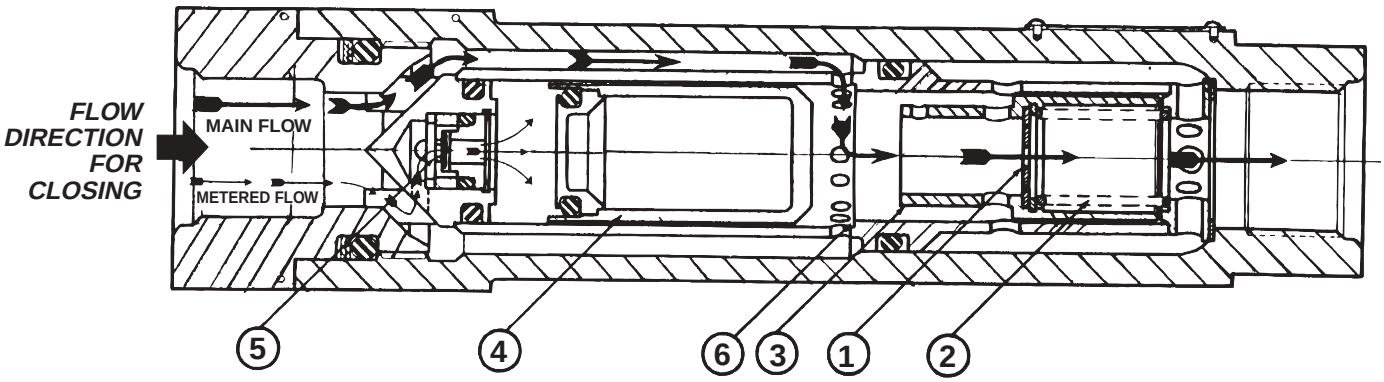
The main piston (4) follows this motion to the right and continues to do so until the flow through the metering orifice (5) has reached a capacity proportionate to the precalibrated volumetric delay (cubic inches / cubic mm). When this amount has been passed, the main piston will have assumed a position 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 / .345 bar. 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**



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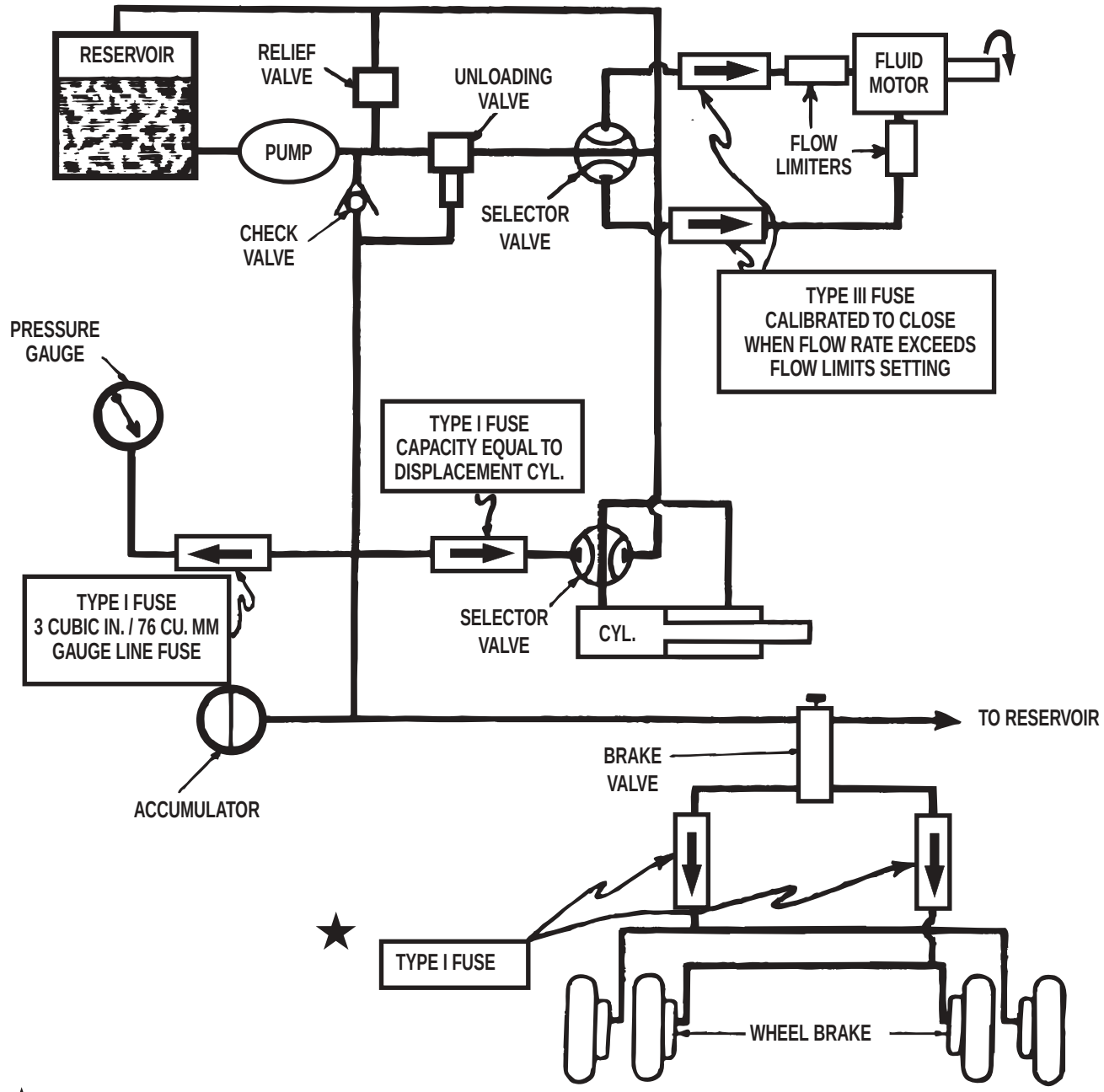
## Aircraft Hydraulic System, Typical Schematic Showing Location and Application of Various Waterman Hydraulic Fuses




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



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## Hydraulic Flow Regulator for Military Aircraft 30A4

**PRESSURE COMPENSATED FIXED FLOW REGULATOR**

**SERVICE PRESSURE:** 3000 psi / 206.84 bar

**TEMPERATURE RANGE:** -65° to +275°F
-54° to +135°C

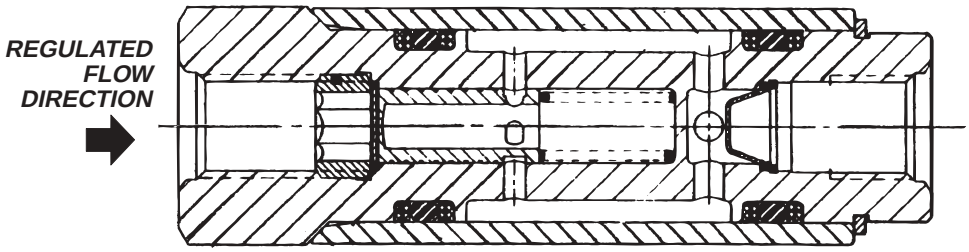
**PORTS:** AND10050-4 for 1/4 inch / 6.35 mm O.D. Tubing

**FLUID:** MIL-H-5606

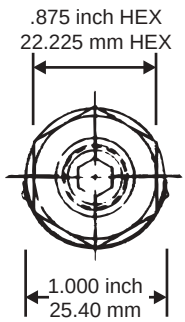
**RECOMMENDED APPROXIMATE FLOW RANGE:** 0.5 to 1.2 gpm / .19 to 4.54 lpm

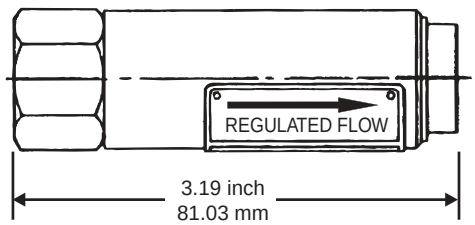
**FLOW TOLERANCE:**
From +70 to 275°F / +21° to 136°C, +10% and -15% at -65°F / -54°C, ±20%

**WEIGHT:** 0.20 lbs. / 90.7 g




**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 / 206.84 bar

**TEMPERATURE RANGE:** -65 to +275°F
-54° to +135°C

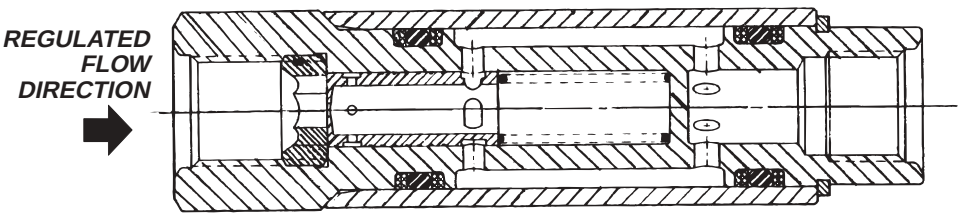
**PORTS:** AND10050-6 for 3/8 inch / 9.53 mm O.D. Tubing

**FLUID:** MIL-H-5606

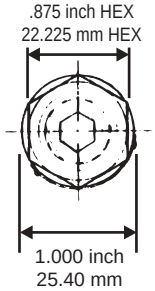
**RECOMMENDED APPROXIMATE FLOW RANGE:** 0.5 to 3.5 gpm / .19 to 13.25 lpm

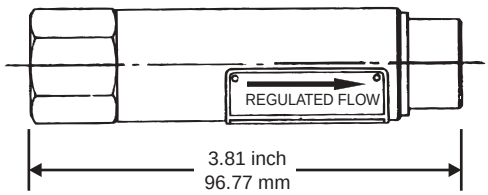
**FLOW TOLERANCE:**
From +70 to 275°F / +21° to 135°C, 0.5 to 1.49 gpm / .189 to 5.64: +10%, -15%
1.5 gpm / 5.67 and above: +5%, -10%
at -65°F / -54°C, ±20%

**WEIGHT:** 0.22 lbs. / 99.8 g




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



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## Hydraulic Flow Regulator for Military Aircraft 30A8

**PRESSURE COMPENSATED FIXED FLOW REGULATOR**

**SERVICE PRESSURE:** 3000 psi / 206.84 bar

**TEMPERATURE RANGE:** -65° to +275°F
-54° to +135°C

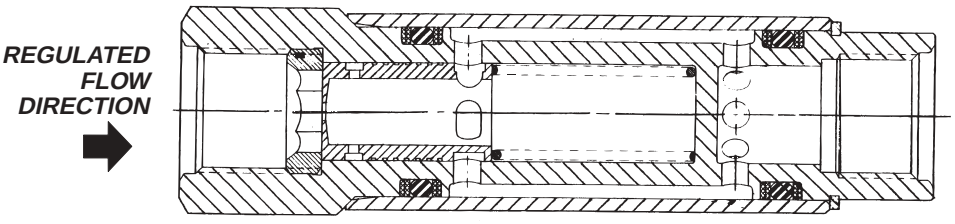
**PORTS:** AND10050-8 for 1/2 inch / 12.7 mm O.D. Tubing

**FLUID:** MIL-H-5606

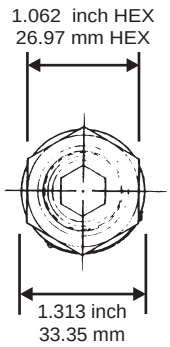
**RECOMMENDED APPROXIMATE FLOW RANGE:** 1.0 to 6.0 gpm / .379 to 22.71 lpm

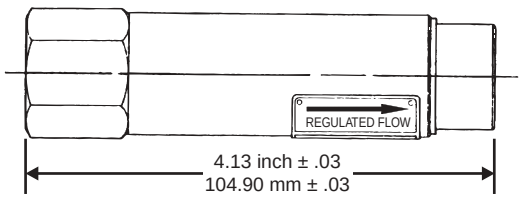
**FLOW TOLERANCE:**
From +70 to 275°F / +21° to 136°C, 1.0 to 1.49 gpm / 5.68 lpm: +10%, -15%
1.5 gpm / 5.68 lpm and up: +5%, -10%
at -65°F / -54°C, ±20%

**WEIGHT:** 0.35 lbs. / 158.76 g




**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 / 206.84 bar

**TEMPERATURE RANGE:** -65 to +275°F
-54° to +135°C

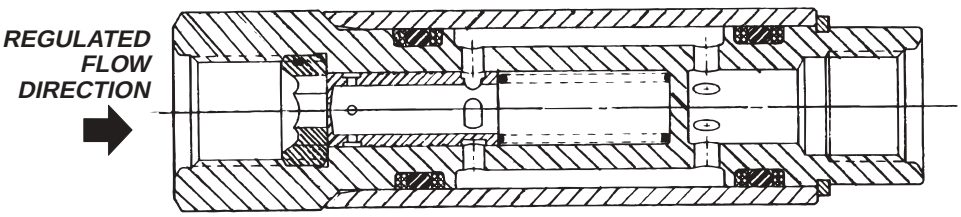
**PORTS:** AND10050-10 for 5/8 inch / 15.88 mm O.D. Tubing

**FLUID:** MIL-H-5606

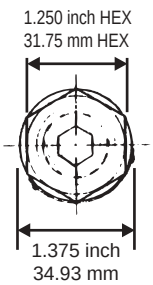
**RECOMMENDED APPROXIMATE FLOW RANGE:** 4.0 to 10.5 gpm / 15.14 to 39.45 lpm

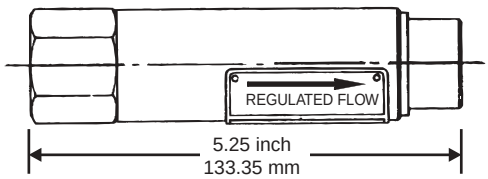
**FLOW TOLERANCE:**
From +70 to 275°F / +21° to 135°C, +5%, -10%
at -65°F / -54°F, ±20%

**WEIGHT:** 0.50 lbs. / 226.80 g




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



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Fort Worth, Texas

# Hydraulic Flow Regulator for Military Aircraft 30A12

**PRESSURE COMPENSATED FIXED FLOW REGULATOR**

**SERVICE PRESSURE:** 3000 psi / 206.84 bar

**TEMPERATURE RANGE:** -65° to +275°F
-54° to + 135°C

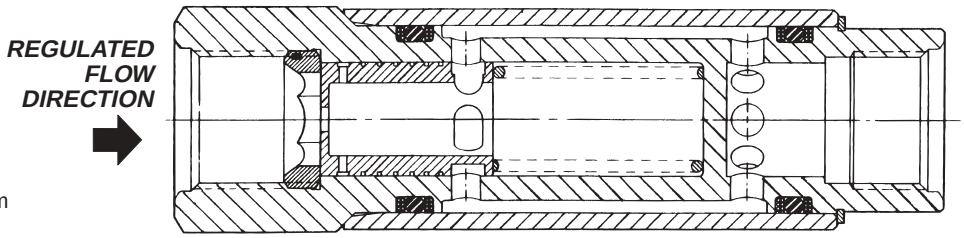
**PORTS:** AND10050-12 for 3/4 inch / 19.05 mm O.D. Tubing

**FLUID:** MIL-H-5606

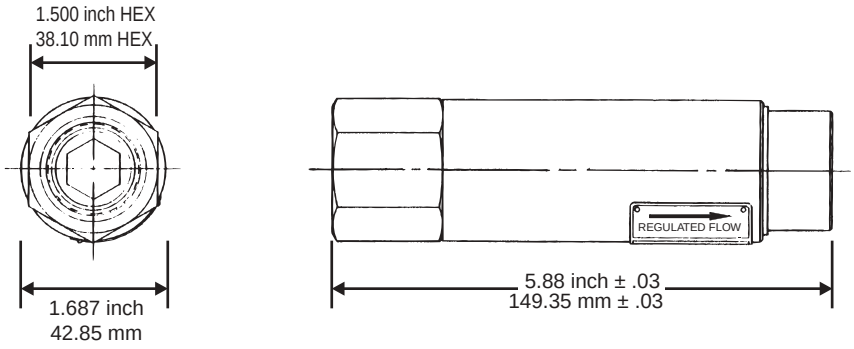
**RECOMMENDED APPROXIMATE FLOW RANGE:** 6.5 to 12.0 gpm / 24.98 to 45.42 lpm

**FLOW TOLERANCE:**
From +70 to 275°F / +21° to 136°C, +5%, -10%
at -65°F / -54°C, ±20%

**WEIGHT:** 0.85 lbs. / 385.55 g




**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 / 206.84 bar

**TEMPERATURE RANGE:** -65 to +160°F
-54° to +71°C

**PORTS:** AND10050-4 for 1/4 inch / 6.35 mm O.D. Tubing

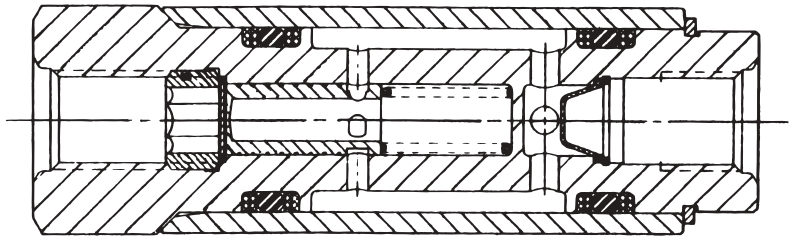
**FLUID:** MIL-H-5606

**RECOMMENDED APPROXIMATE FLOW RANGE:** 0.5 to 1.2 gpm / .190 to 4.54 lpm

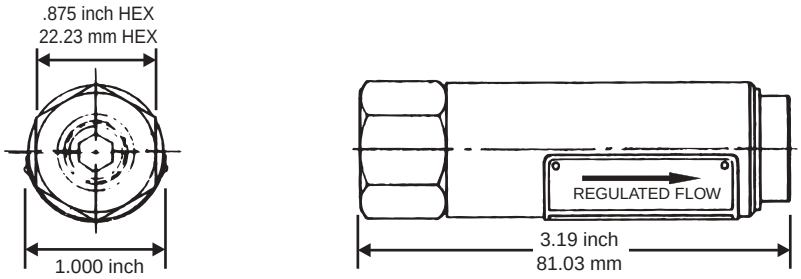
**FLOW TOLERANCE:**
From +70 to 160°F / +21 to 71°C, +10% and 15%
at -65°F / -54°C, ±20%

**WEIGHT:** 0.20 lbs. / 90.72 g

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




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






**Parker Hannifin Corporation**
Stratoflex Products Division
Fort Worth, Texas

## Hydraulic Flow Regulator for Military Aircraft 1121-6

**PRESSURE COMPENSATED FIXED FLOW REGULATOR**

**SERVICE PRESSURE:** 3000 psi / 206.84 bar

**TEMPERATURE RANGE:** -65° to + 160°F
-54° to + 71°C

**PORTS:** AND10050-6 for 3/8 inch / 9.53 mm O.D. Tubing

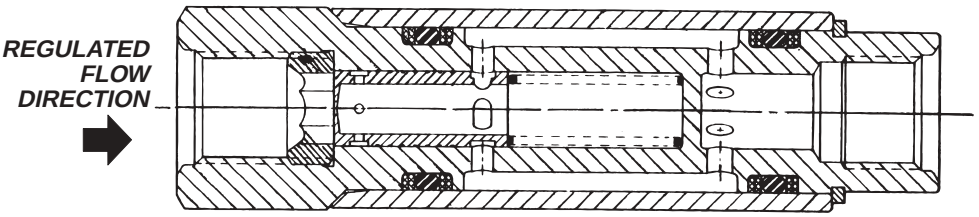
**FLUID:** MIL-H-5606

**RECOMMENDED APPROXIMATE FLOW RANGE:** 0.5 to 3.5 gpm / .190 to 13.251 lpm

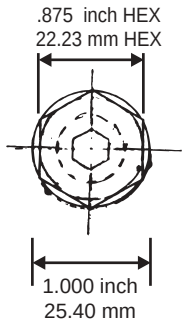
**FLOW TOLERANCE:**
From +70 to 160°F / +21 to 71°C, 0.5 to 1.49 gpm
/
.19 to. 5.64 lpm: +10% -15%
1.5 gpm / 5.68 lpm and above: +5%, -10%
at -65°F /-54°C, ±20%

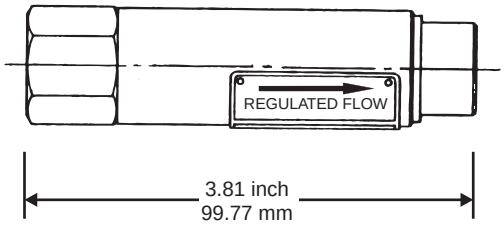
**WEIGHT:** 0.22 lbs. / 199.8 g

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




**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 / 206.84 bar

**TEMPERATURE RANGE:** -65 to +160°F
-54 to +71°C

**PORTS:** AND10050-8 for 1/2 inch / 12.7 mm O.D. Tubing

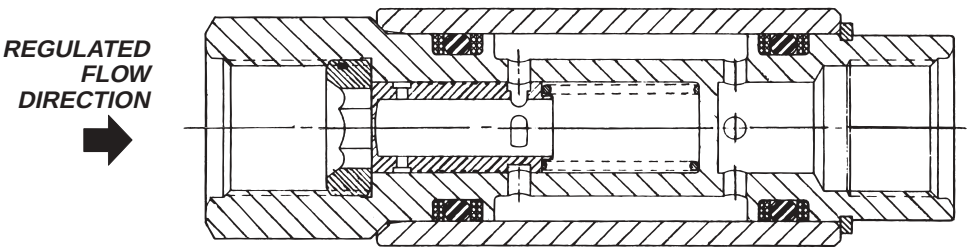
**FLUID:** MIL-H-5606

**RECOMMENDED APPROXIMATE FLOW RANGE:** 1.0 to 6.0 gpm / 3.79 to 22.71 lpm

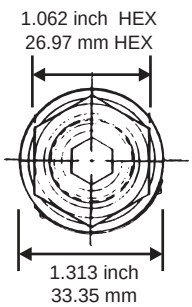
**FLOW TOLERANCE:**
From +70 to 160°F / + 21 to 71°C, 1.0 to 1.49 gpm
/
3.79 to 5.68 lpg : +10%, -15%
1.5 gpm / 5.68 lpm and up: +5%, -10%
at -65°F / -54°C, ±20%

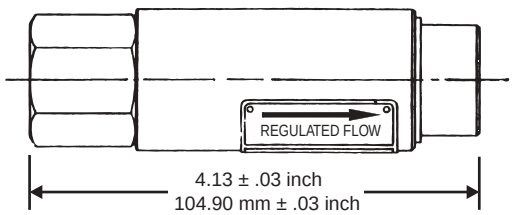
**WEIGHT:** 0.35 lbs. / 158.76 g

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




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






**Parker Hannifin Corporation**
Stratoflex Products Division
Fort Worth, Texas

# Hydraulic Flow Regulator for Military Aircraft 1121-10

**PRESSURE COMPENSATED FIXED FLOW REGULATOR**

**SERVICE PRESSURE:** 3000 psi / 206.84 bar

**TEMPERATURE RANGE:** -65° to +160°F
-54° to +71°C

**PORTS:** AND10050-10 for 5/8 inch / 15.88 mm O.D. Tubing

**FLUID:** MIL-H-5606

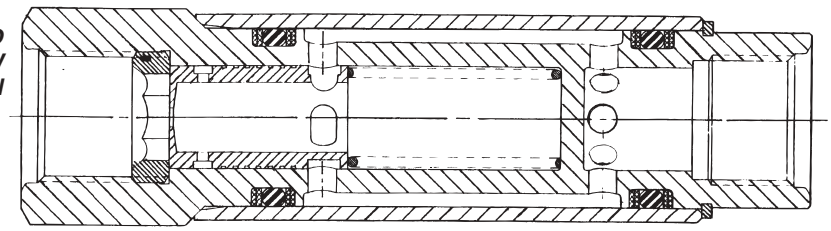
**RECOMMENDED APPROXIMATE FLOW RANGE:** 4.0 to 15.0 gpm / 15.14 to 56.78 lpm

**FLOW TOLERANCE:**
From +70 to 160°F / +21 to 71°C, +5%, -10%
at -65°F, / -54°C ±20%

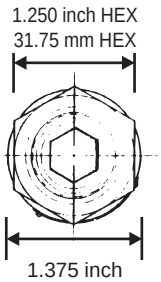
**WEIGHT:** 0.50 lbs. / 226.80 g

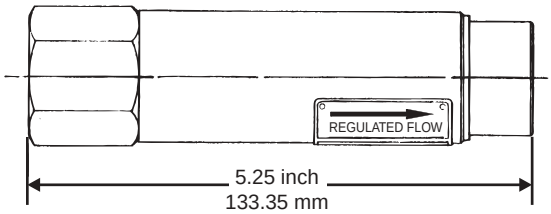
Some flow rates meet requirements of Standard Part Number MS28886, qualified under Specification MIL-V-8566

***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 / 206.84 bar

**TEMPERATURE RANGE:** -65 to +160°F
-54 to +71°C

**PORTS:** AND10050-12 for 3/4 inch / 19.05 mm O.D. Tubing

**FLUID:** MIL-H-5606

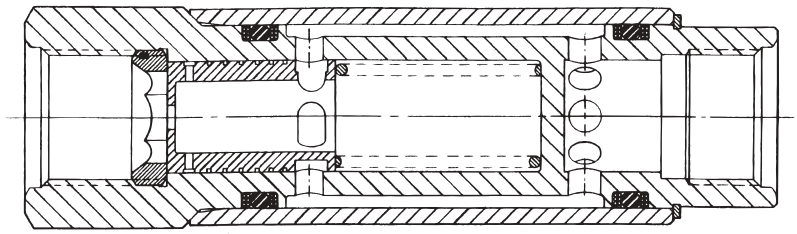
**RECOMMENDED APPROXIMATE FLOW RANGE:** 6.5 to 12 gpm / 24.61 to 45.42 lpm

**FLOW TOLERANC**E:
From +70 to 160°F / +21 to 71°C, +5%, -10%
at -65°F / -54°C, ±20%

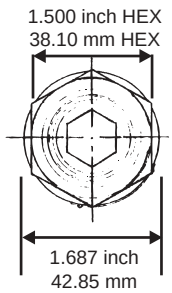
**WEIGHT:** 0.85 lbs. / 385.55 g

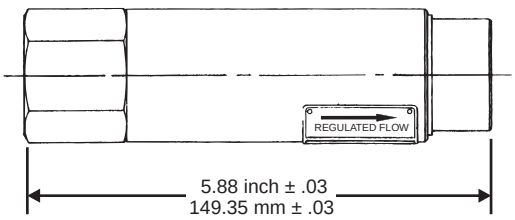
Some flow rates meet requirements of Standard Part Number MS28886, qualified under Specification MIL-V-8566

***REGULATED FLOW DIRECTION***



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






**Parker Hannifin Corporation**
Stratoflex Products Division
Fort Worth, Texas

# Hydraulic Flow Regulator for Military Aircraft
# 24A6

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

**SERVICE PRESSURE:** 3000 psi / 206.84 bar

**TEMPERATURE RANGE:** -65° to +275°F
-54° to +135°C

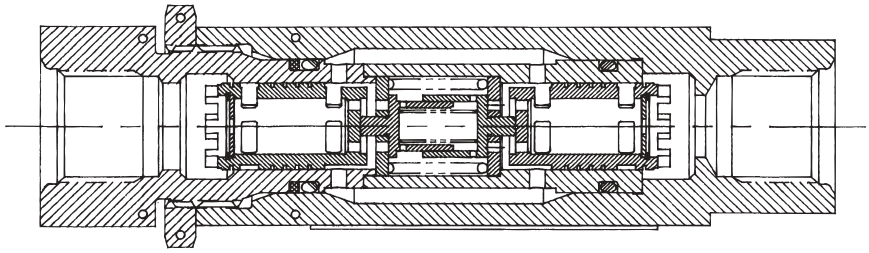
**PORTS:** AND10050-6 for 3/8 inch / 9.53 mm O.D. Tubing

**FLUID:** MIL-H-5606

**RECOMMENDED APPROXIMATE FLOW RANGE:** .5 to 3.5 gpm / .190 to 13.251 lpm

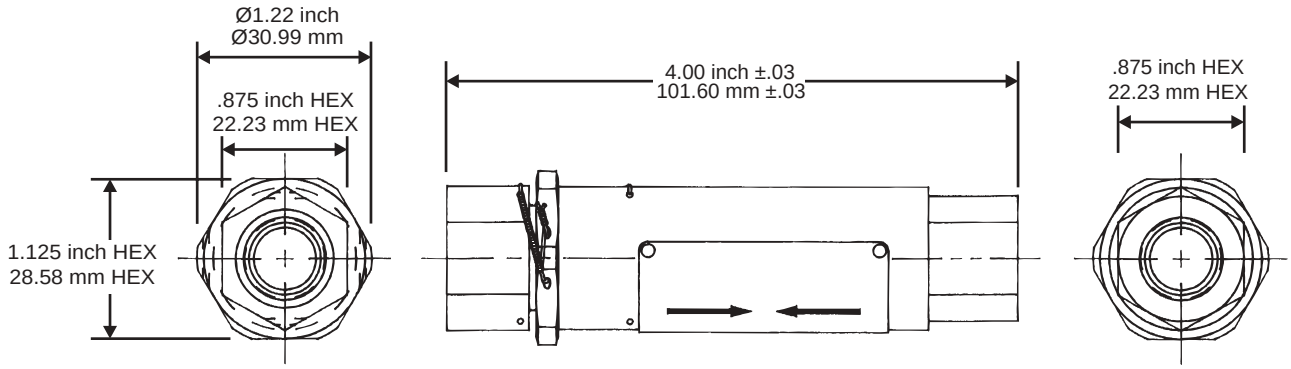
**FLOW TOLERANCE:**
From +70 to 275°F / +21 to 135°C:
0.5 to 1.49 gpm / 1.89 to 5.64 lpm: +10%, -15%
1.5 to 3.5 gpm / 5.68 to 13.25 lpm: +5%, -10%
at -65°F / 53°C, ±20%

**WEIGHT:** 0.25 lbs. / 113.40 g (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.**






**Parker Hannifin Corporation**
Stratoflex Products Division
Fort Worth, Texas

# Hydraulic Flow Regulator for Commercial Aircraft 1121S-4

**PRESSURE COMPENSATED FIXED FLOW REGULATOR**

**SERVICE PRESSURE:** 3000 psi / 206.84 bar

**TEMPERATURE RANGE:** -65 to +160°F
-54 to +71°C

**PORTS:** AND10050-4 for 1/4 inch / 6.35 mm O.D. Tubing

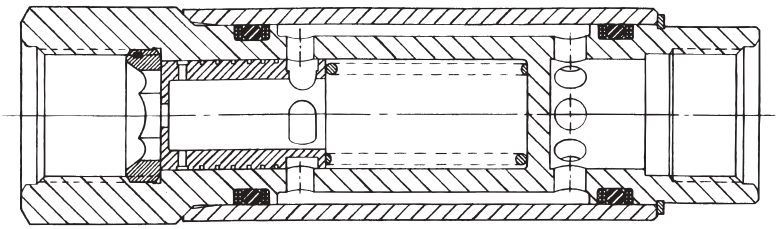
**FLUID:** Skydrol

**RECOMMENDED APPROXIMATE FLOW RANGE:** 0.5 to 1.2 gpm / 1.89 to 4.54 lpm

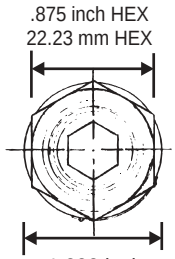
**FLOW TOLERANCE:**
From +70 to 160°F / +21° to 160°C, +10% and -15% at -65°F / -54°C, ±20%

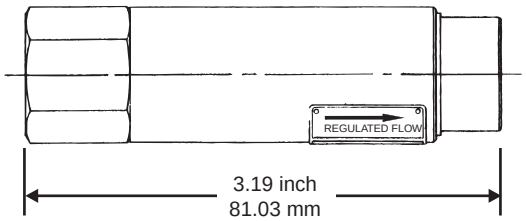
**WEIGHT:** 0.20 lbs. / 90.72 g

***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 / 206.84 bar

**TEMPERATURE RANGE:** -65 to +160°F
-54 to + 71°C

**PORTS:** AND10050-6 for 3/8 inch / 9.53 mm O.D. Tubing

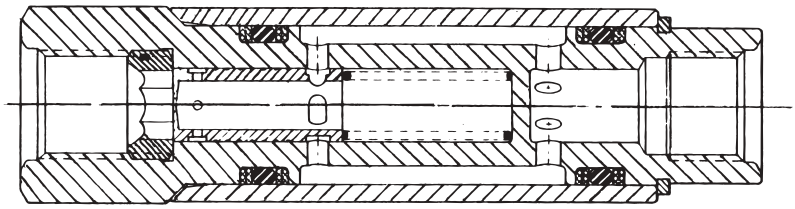
**FLUID:** Skydrol

**RECOMMENDED APPROXIMATE FLOW RANGE:** 0.5 to 3.5 gpm / 1.89 to 13.25 lpm

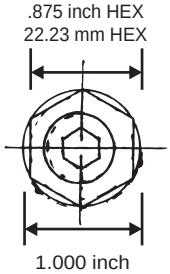
**FLOW TOLERANCE:**
From +70 to 160°F / +21 to 160°C, 0.5 to 1.49 gpm / 1.89 to 5.64 lpm +10%, -15%
1.5 gpm / 5.68 lpm and above: +5%, -10%
at -65°F / -54°C, ±20%

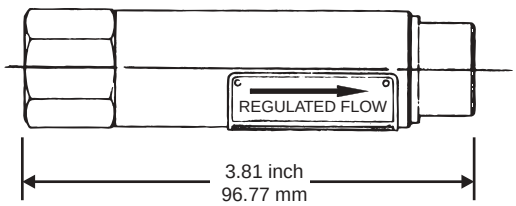
**WEIGHT:** 0.22 lbs / 99.79 g

***REGULATED FLOW DIRECTION***



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






**Parker Hannifin Corporation**
Stratoflex Products Division
Fort Worth, Texas

## Hydraulic Flow Regulator for Commercial Aircraft 1121S-8

**PRESSURE COMPENSATED FIXED FLOW REGULATOR**

**SERVICE PRESSURE:** 3000 psi / 206.84 bar

**TEMPERATURE RANGE:** -65 to +160°F
-54 to +71C

**PORTS:** AND10050-8 for 1/2 inch / 12.7 mm O.D. Tubing

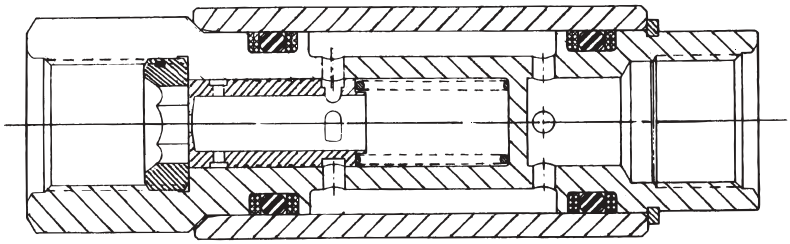
**FLUID:** Skydrol

**RECOMMENDED APPROXIMATE FLOW RANGE:** 1.0 to 6.0 gpm / .379 to 22.71 lpm

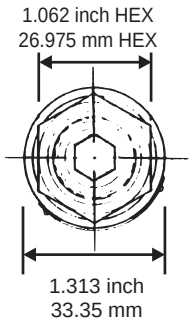
**FLOW TOLERANCE:**
From +70 to 160°F / +21 to 71°C , 1.0 to 1.49 gpm / 3.79 to 5.64 lpm: +10%, -15%
1.5 gpm / 5.68 lpm and up: +5%, -10%
at -65°F / - 53°C, ±20%

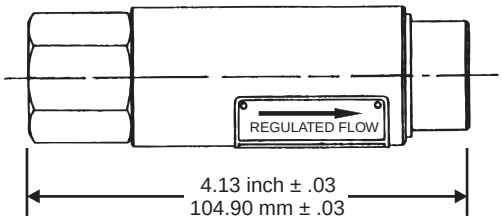
**WEIGHT:** 0.35 lbs./ 158.76 g

***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 / 206.84 bar

**TEMPERATURE RANGE:** -65 to +160°F
-54° to +71°C

**PORTS:** AND10050-10 for 5/8 inch / 15.88 mm O.D. Tubing

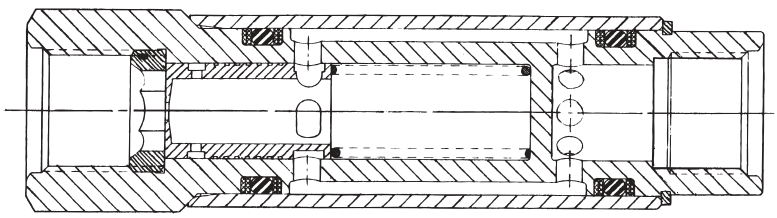
**FLUID:** Skydrol

**RECOMMENDED APPROXIMATE FLOW RANGE:** 4.0 to 10.5 gpm / 15.14 to 39.75 lpm

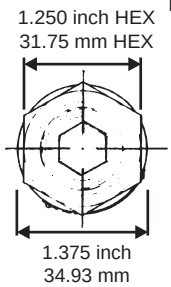
**FLOW TOLERANC**E:
From +70 to 160°F / +21 to 71°C, +5%, -10%
at -65°F / -53°C, ±20%

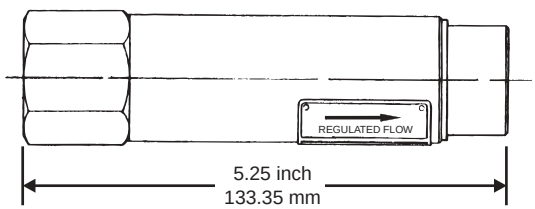
**WEIGHT:** 0.50 lbs. / 22.80 g

***REGULATED FLOW DIRECTION***



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






**Parker Hannifin Corporation**
Stratoflex Products Division
Fort Worth, Texas

# Hydraulic Flow Regulator for Commercial Aircraft 1121S-12

**PRESSURE COMPENSATED FIXED FLOW REGULATOR**

**SERVICE PRESSURE:** 3000 psi / 206.84 bar

**TEMPERATURE RANGE:** -65 to +160°F
-54 to +71°C

**PORTS:** AND10050-12 for 3/4 inch / 19.05 mm O.D. Tubing

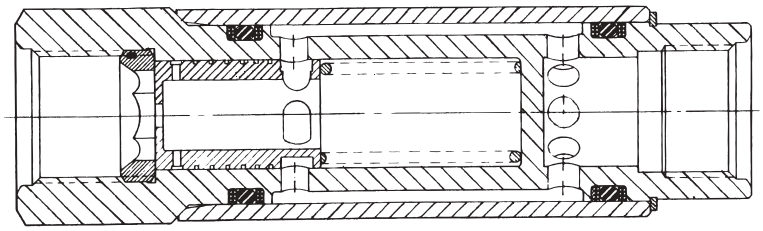
**FLUID:** Skydrol

**RECOMMENDED APPROXIMATE FLOW RANGE:** 6.5 to 12.0 gpm / 24.61 to 45.42 lpm

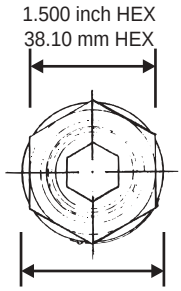
**FLOW TOLERANCE:**
From +70 to 160°F / +21 to 71°C, +5%, -10%
at -65°F / -53°C, ±20%

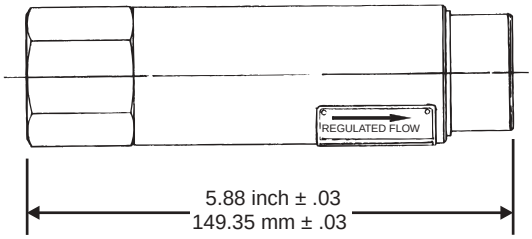
**WEIGHT:** 0.85 lbs. / 385.55 g

***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 / 206.84 bar

**TEMPERATURE RANGE:** -65 to +160°F
-54 to +71°C

**FLUID:** Skydrol

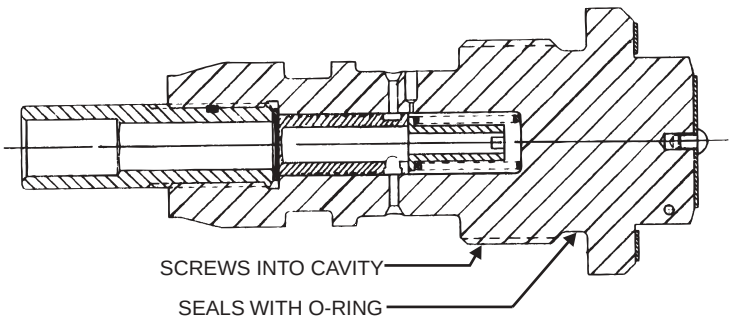
**RECOMMENDED APPROXIMATE FLOW RANGE:** 0.08 to 1.2 gpm / .30 to 4.54 lpm

**FLOW TOLERANCE:**
From +70 to 160°F / +21 to 71°C, +10%, -15%
at -65°F / -54°C, ±20%

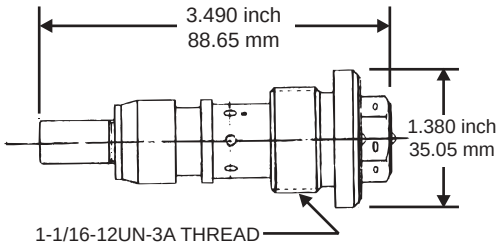
**WEIGHT:** 0.30 lbs. / 136.07 g

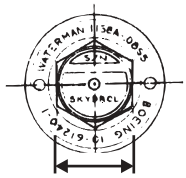
**Other models for flow rates up to 3.5 gpm / 13.25 lpm.**

***REGULATED FLOW DIRECTION***




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






**Parker Hannifin Corporation**
Stratoflex Products Division
Fort Worth, Texas

## Hydraulic Flow Regulator for Commercial Aircraft 1158C

**PRESSURE COMPENSATED FIXED FLOW REGULATOR**

**SERVICE PRESSURE:** 3000 psi / 206.84 bar

**TEMPERATURE RANGE:** -65 to +160°F
-54 to +71°C

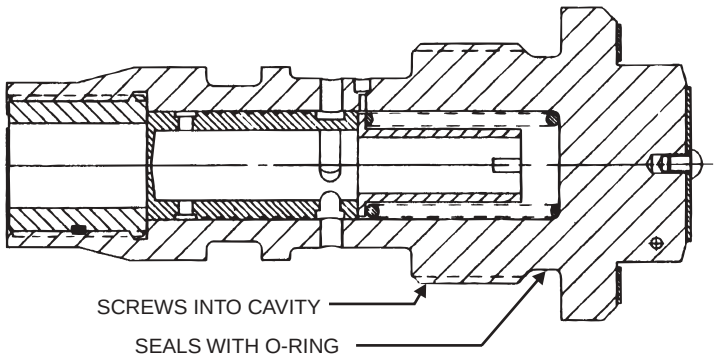
**FLUID:** Skydrol

**RECOMMENDED APPROXIMATE FLOW RANGE:** 1.5 to 6.0 gpm / 5.68 to 22.71 lpm

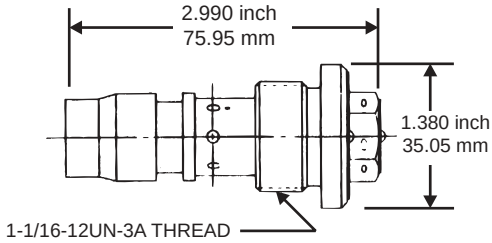
**FLOW TOLERANCE:**
At **+**70 to 160°F / +21 to 71°C, +5%, -10%
at -65°F / -53°C, ±20%

**WEIGHT:** 0.30 lbs. / 136.07 g

***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 / 206.84 bar

**TEMPERATURE RANGE:** -65 to +160°F
-54 to +71°C

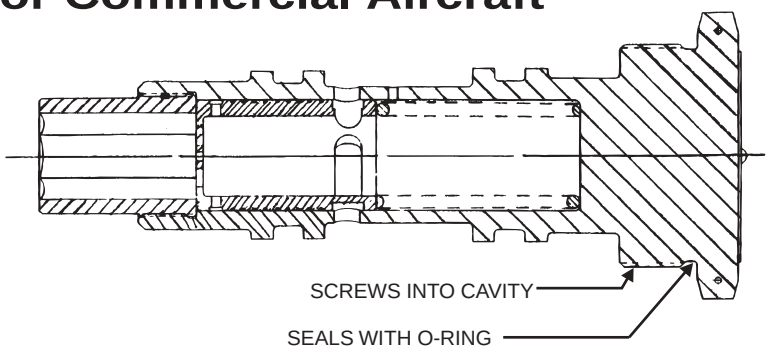
**FLUID:** Skydrol

**RECOMMENDED APPROXIMATE FLOW RANGE:** 10.0 to 40.0 gpm / 37.85 to 151.42 lpm

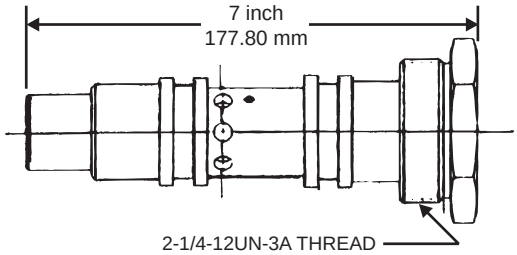
**FLOW TOLERANC**E:
At 0 to 160°F / -18 to +71°C, +5%, -10%
at -65°F / -53°C, ±20%

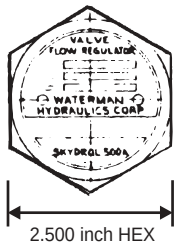
**WEIGHT:** 1.4 lbs. / 635.04 g

***REGULATED FLOW DIRECTION***




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






**Parker Hannifin Corporation**
Stratoflex Products Division
Fort Worth, Texas

# Hydraulic Flow Regulator for Commercial Aircraft 1162C

**PRESSURE COMPENSATED FIXED FLOW REGULATOR**

**SERVICE PRESSURE:** 3000 psi / 206.84 bar

**TEMPERATURE RANGE:** -65 to +160°F
-54 to +71°C

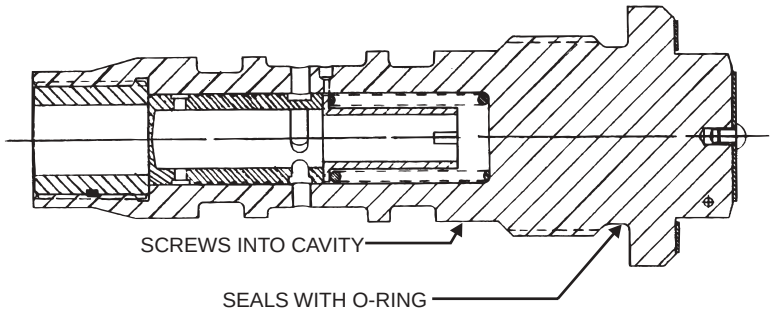
**FLUID:** Skydrol

**RECOMMENDED APPROXIMATE FLOW RANGE:** 1.0 to 6.0 gpm / 3.79 to 22.71 lpm

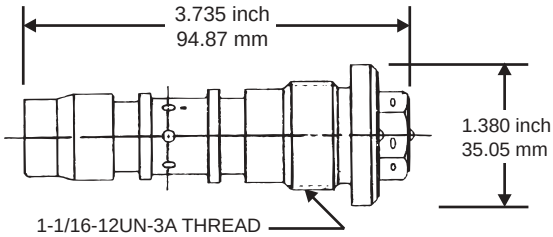
**FLOW TOLERANCE:**
At 0 to 160°F / -18 to 71°C, 1.0 to 1.49 gpm / 3.79 to 5.64 lpm: +10%, -15%
1.5 to 6.0 gpm / 5.80 to 22.71 lpm: +5%, -10%
at -65°F / -53°C, ±20%

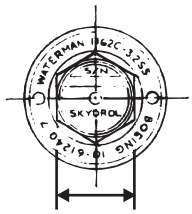
**WEIGHT:** 0.33 lbs./ 149.69 g

***REGULATED FLOW DIRECTION***




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




.750 inch HEX
19.05 mm HEX

# Hydraulic Flow Regulator for Commercial Aircraft 1122X Series

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

**SERVICE PRESSURE:** 3000 psi / 206.84 bar

**TEMPERATURE RANGE:** -65 to +255°F / -54 to +124°C; momentary peak to 275°F / 135°C

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

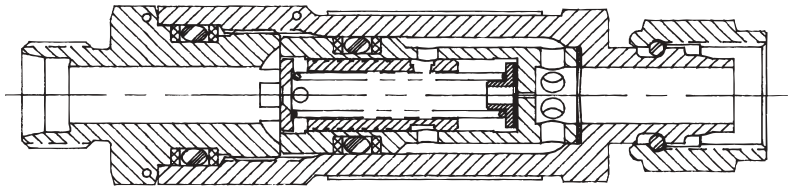
**FLUID:** Skydrol

**RECOMMENDED APPROXIMATE FLOW RANGE:** 1.0 to 2.5 gpm / 3.79 to 9.46 lpm

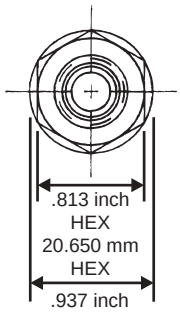
**FLOW TOLERANC**E:
From **+**70 to 225°F / +21 to 107°C
1.0 to 1.49 gpm / 3.79 to 5.64 lpm: +10%, -15%
1.5 gpm / 5.68 lpm and up: +5%, -10%
at -65°F / -53°C, ±20%

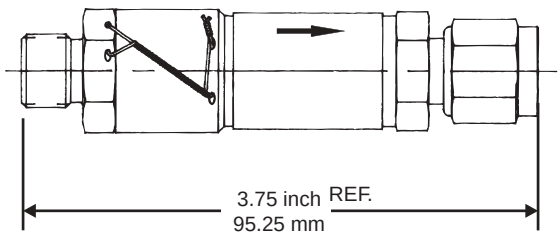
**WEIGHT:** 0.45 lbs. / 204.12 g. Actual weight depends upon port configurations

***REGULATED FLOW DIRECTION***



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






**Parker Hannifin Corporation**
Stratoflex Products Division
Fort Worth, Texas

## Hydraulic Fuse for Military Aircraft 812-4

**HYDRAULIC FUSE, TYPE I**

**SERVICE PRESSURE:** 3000 psi / 206.84 bar

**TEMPERATURE RANGE:** -65 to +160°F
-54 to +71°C

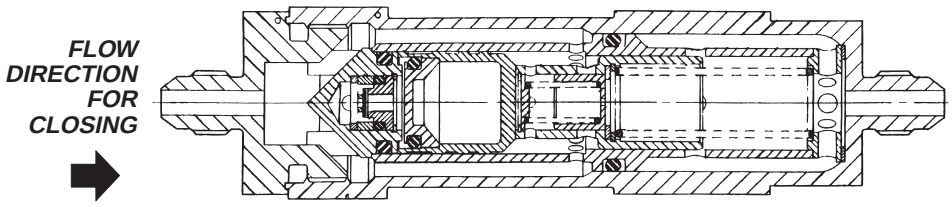
**PORTS:** MS33656-4 for 1/4 inch / 6.35 mm O.D. Tubing

**FLUID:** MIL-H-5606

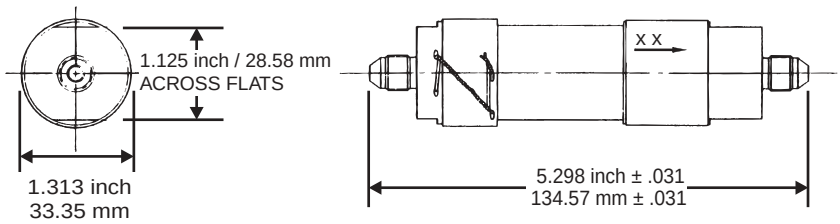
**RECOMMENDED FLOW:** 0.1 to 2.5 gpm / .379 to 9.46 lpm

**VOLUMETRIC CAPACITY:**
Generally 5 to 50 cu. in. / 127 to 1270 cu. mm, with larger capacities possible

**WEIGHT:** 0.35 lbs. / 158.76 g




**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 / 206.84 bar

**TEMPERATURE RANGE:** -65 to +160°F
-54 to +71°C

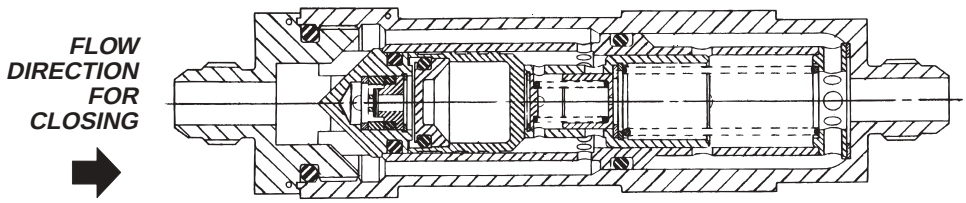
**PORTS:** MS33656-6 for 3/8 inch / 9.52 mm O.D. Tubing

**FLUID:** MIL-H-5606

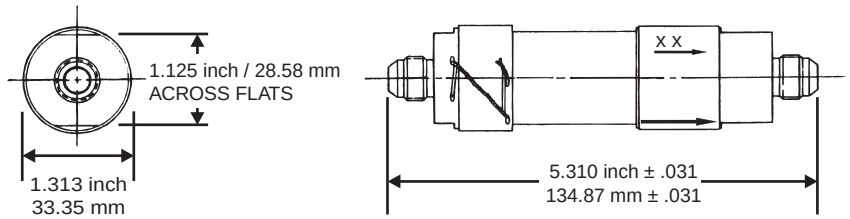
**RECOMMENDED FLOW:** 0.1 to 3.5 gpm / .379 to 13.25 lmp

**VOLUMETRIC CAPACITY:**
Generally 5 to 50 cu. in. / 127 to 1279 cu. mm, with larger capacities possible

**WEIGHT:** 0.40 lbs. / 181.44 g




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






**Parker Hannifin Corporation**
Stratoflex Products Division
Fort Worth, Texas

# Hydraulic Fuse for Military Aircraft 812-8

**HYDRAULIC FUSE, TYPE I**

**SERVICE PRESSURE:** 3000 psi / 206.84 bar

**TEMPERATURE RANGE:** -65 to +160°F
-54 to +71°C

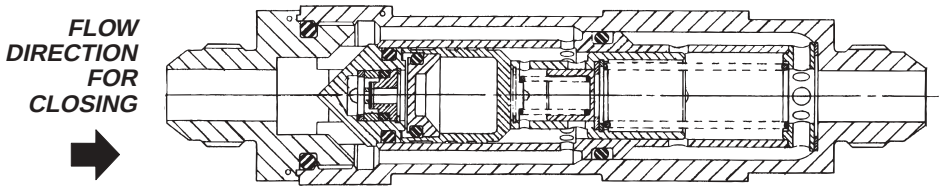
**PORTS:** MS33656-8 for 1/2 inch / 12.7 mm O.D. Tubing

**FLUID:** MIL-H-5606

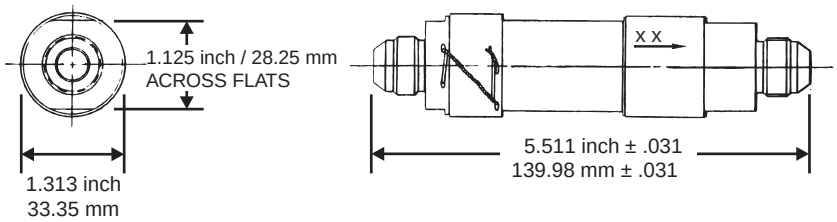
**RECOMMENDED FLOW:** 0.1 to 6.0 gpm / .379 to 22.71 lpm

**VOLUMETRIC CAPACITY:**
Generally 5 to 50 cu. in. / 127 to 1270 cu. mm, with larger capacities possible

**WEIGHT:** 0.45 lbs. / 104.12 g




**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 / 206.84 bar

**TEMPERATURE RANGE:** -65 to +160°F
-54 to +71°C

**PORTS:** AND10050-8 for 1/2 inch / 12.7 mm O.D. Tubing

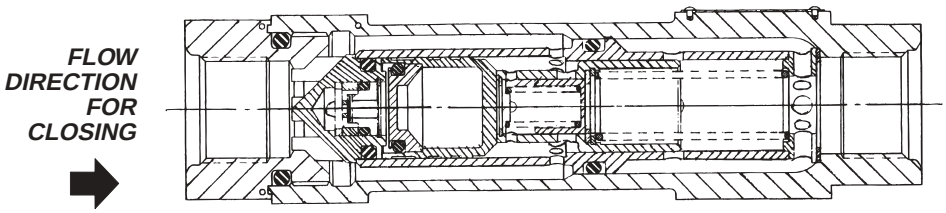
**FLUID:** MIL-H-5606

**RECOMMENDED FLOW:** 0.1 to 6.0 gpm / 1.379 to 22.71 lpm

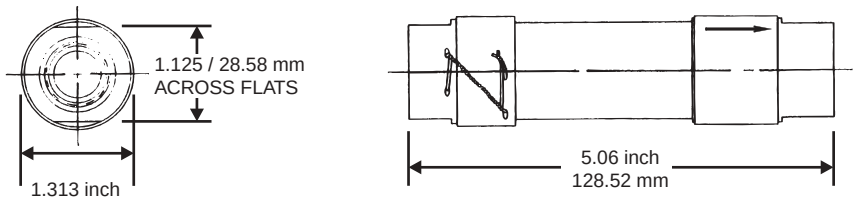
**VOLUMETRIC CAPACITY:**
Generally 5 to 50 cu. in. / 127 to 1270 cu. mm, with larger capacities possible

**WEIGHT:** 0.30 lbs. / 136.07 g

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




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






**Parker Hannifin Corporation**
Stratoflex Products Division
Fort Worth, Texas

# Hydraulic Fuse for Military Aircraft
# 840-8

**HYDRAULIC FUSE, TYPE I WITH MANUAL RESET**

**SERVICE PRESSURE:** 3000 psi / 206.84 bar

**TEMPERATURE RANGE:** -65 to +160°F
-54 to +71°C

**PORTS:** AND10050-8 for 1/2 inch / 12.7 mm O.D. Tubing

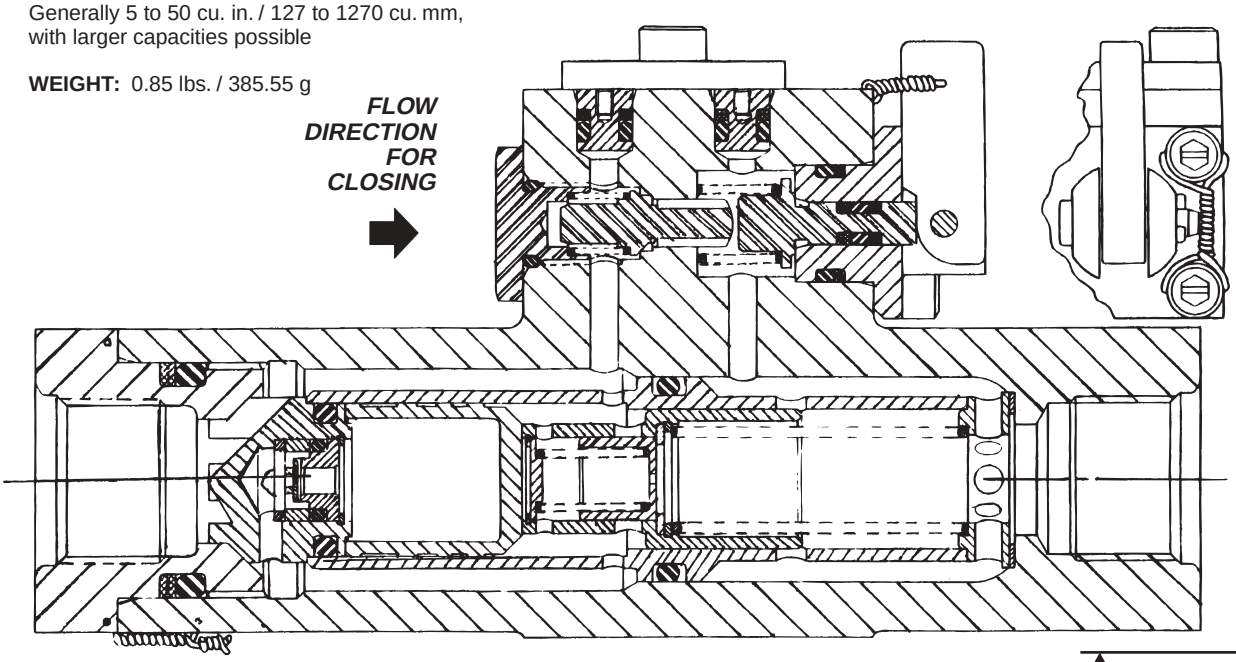
**FLUID:** MIL-H-5606

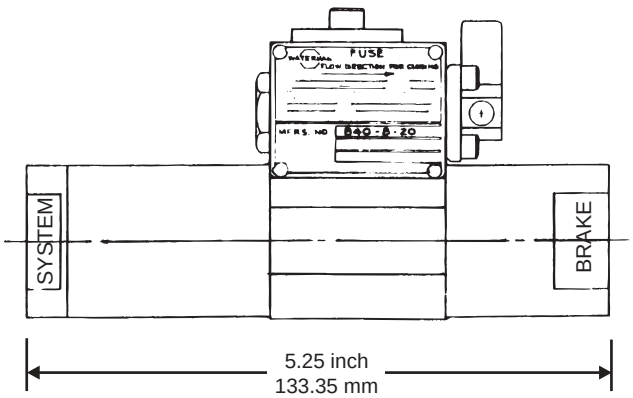
**RECOMMENDED FLOW:** 0.25 to 6.0 gpm / .946 to 22.71 lpm

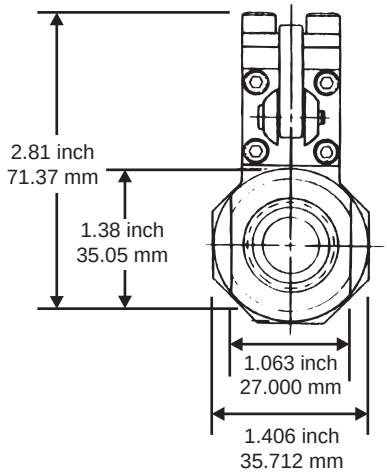
**VOLUMETRIC CAPACITY:**
Generally 5 to 50 cu. in. / 127 to 1270 cu. mm, with larger capacities possible

**WEIGHT:** 0.85 lbs. / 385.55 g

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






**Parker Hannifin Corporation**
Stratoflex Products Division
Fort Worth, Texas

# Hydraulic Fuse for Military Aircraft 1113-8

**HYDRAULIC FUSE, TYPE I**

**SERVICE PRESSURE:** 3000 psi / 206.84 bar

**TEMPERATURE RANGE:** -65 to +275°F
-54 to +135°C

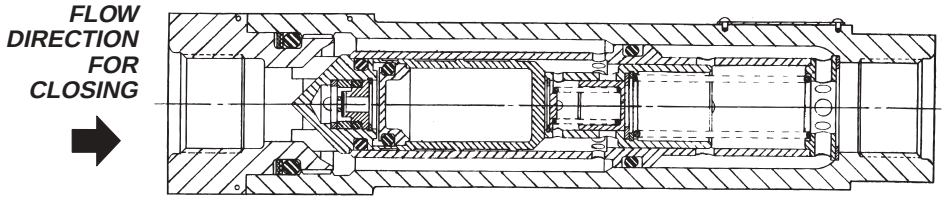
**PORTS:** AND10050-8 for 1/2 inch / 12.7 mm O.D. Tubing

**FLUID:** MIL-H-5606

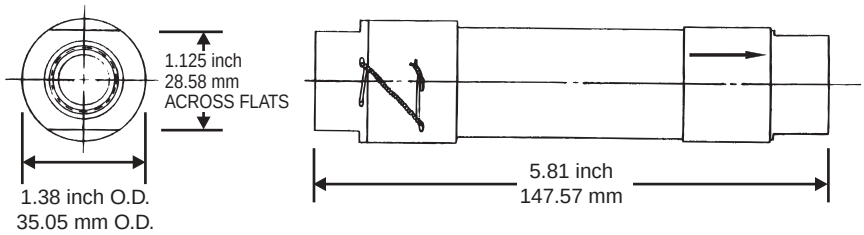
**RECOMMENDED FLOW:** 0.1 to 6.0 gpm / .379 to 22.71 lpm

**VOLUMETRIC CAPACITY:**
Generally 5 to 50 cu. in. / 127 to 1270 cu. mm, with larger capacities possible

**WEIGHT:** 0.40 lbs. / 181.44 g




**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 / 206.84 bar

**TEMPERATURE RANGE:** -65 to +160°F
-54 to +71°C

**PORTS:** AND10050-8 for 1/2 inch / 12.7 mm O.D. Tubing

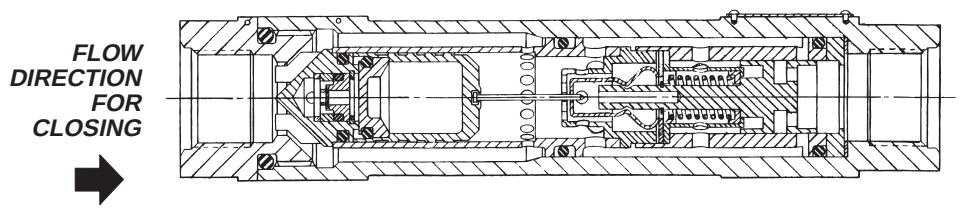
**FLUID:** MIL-H-5606

**RECOMMENDED FLOW:** 0.1 to 6.0 gpm / 3.79 to 22.71 lpm

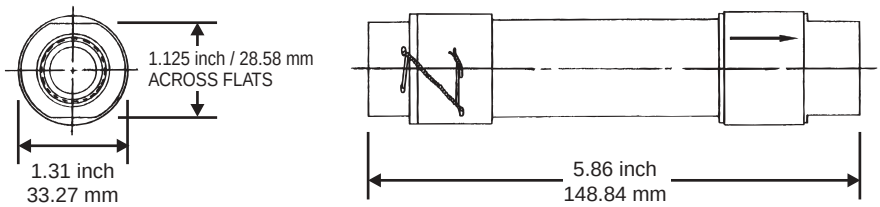
**VOLUMETRIC CAPACITY:**
Generally 5 to 50 cu. in. / 127 to 1270 cu. mm, with larger capacities possible

**WEIGHT:** 0.45 lbs. / 204.12 g

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




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






**Parker Hannifin Corporation**
Stratoflex Products Division
Fort Worth, Texas

## Hydraulic Fuse for Military Aircraft 1134-4

**HYDRAULIC FUSE, TYPE III**

**SERVICE PRESSURE:** 3000 psi / 206.84 bar

**TEMPERATURE RANGE:** -65 to +160°F
-54 to +71°C

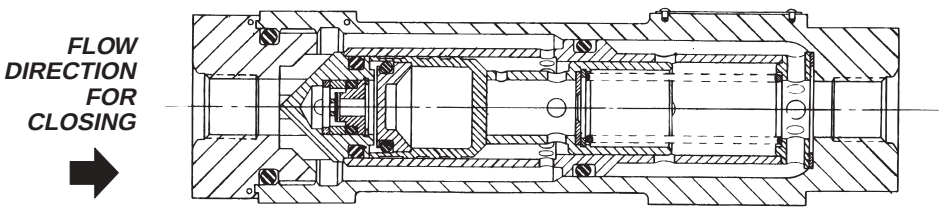
**PORTS:** AND10050-4 for ¼ inch / 6.35 mm O.D. Tubing

**FLUID:** MIL-H-5606

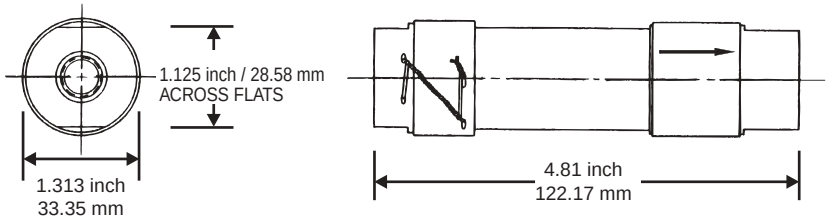
**RECOMMENDED FLOW:** 0.5 to 2.50 gpm / 1.89 to 9.46 lpm

**VOLUMETRIC DELAY:**
3 - 9 cu. in. / 76 - 229 cu. mm to 8 - 15 cu. in. / 203 - 381 cu. mm

**WEIGHT:** 0.39 lbs. / 176.90 g




**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 / 206.84 bar

**TEMPERATURE RANGE:** -65 to +275°F
-54 to +135°C

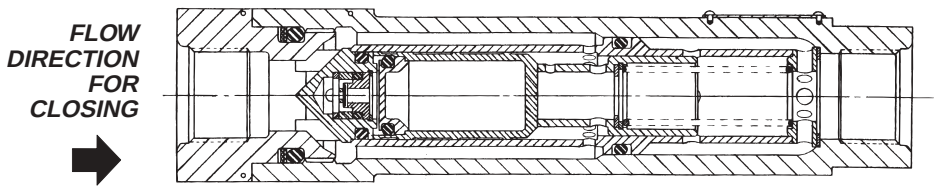
**PORTS:** AND10050-8 for ½ inch / 12.7 mm O.D. Tubing

**FLUID:** MIL-H-5606

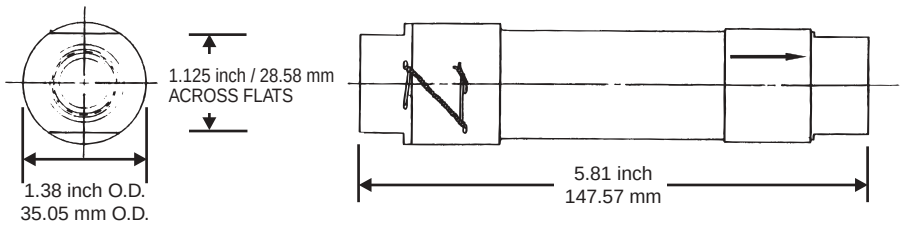
**RECOMMENDED FLOW:** 0.2 to 10.0 gpm / .76 to 37.85 lpm

**VOLUMETRIC DELAY:**
3 - 9 cu. in. / 76 - 229 cu. mm to 8 - 15 cu. in. / 203 - 381 cu. mm

**WEIGHT:** 0.51 lbs. / 231.33 g




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






**Parker Hannifin Corporation**
Stratoflex Products Division
Fort Worth, Texas

# Hydraulic Fuse for Military Aircraft
# 1134-8

**HYDRAULIC FUSE, TYPE III**

**SERVICE PRESSURE:** 3000 psi / 206.84 bar

**TEMPERATURE RANGE:** -65 to +160°F
-54 to +71°C

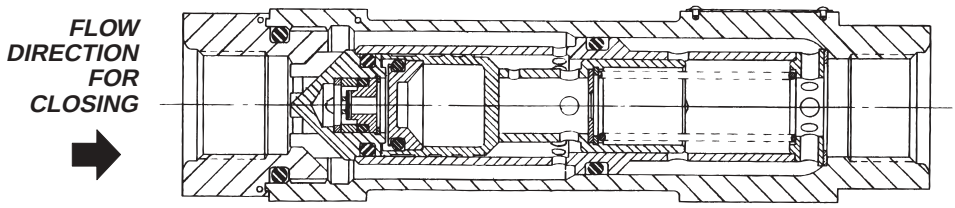
**PORTS:** AND10050-8 for ½ inch / 12.7 mm O.D. Tubing

**FLUID:** MIL-H-5606

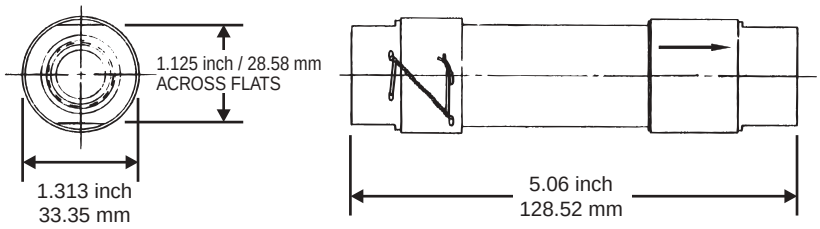
**RECOMMENDED FLOW:** 0.5 to 6.0 gpm / 18.93 to 22.71 lpm

**VOLUMETRIC DELAY:**
3 - 9 cu. in. / 76 - 229 cu. mm to 8 - 15 cu. in. / 203 - 381 cu. mm

**WEIGHT:** 0.39 lbs. / 176.90 g




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






**Parker Hannifin Corporation**
Stratoflex Products Division
Fort Worth, Texas

# Hydraulic Fuse for Commercial Aircraft
# G831-8

**HYDRAULIC FUSE, TYPE I**

**SERVICE PRESSURE:** 3000 psi / 206.84 bar

**TEMPERATURE RANGE:** -65 to +160°F
-54 to +71°C

**PORTS:** AND10050-8 for 1/2 inch / 12.7 mm O.D. Tubing

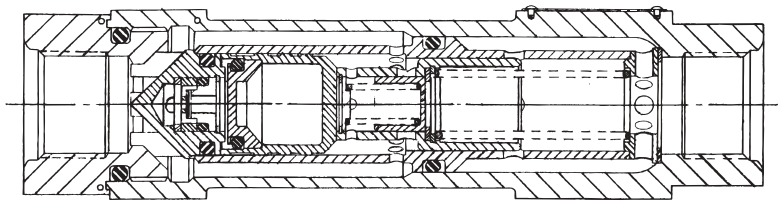
**FLUID:** Skydrol

**RECOMMENDED FLOW:** 0.25 to 6.0 gpm / .946 to 22.71 lpm

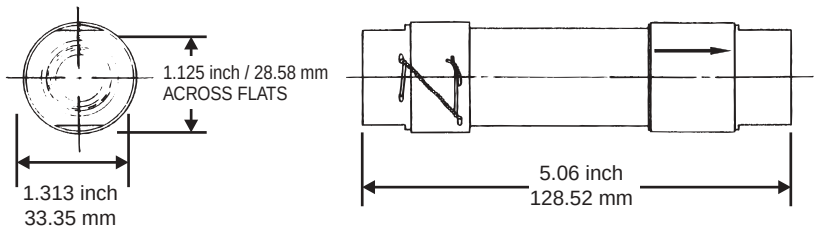
**VOLUMETRIC CAPACITY:**
Generally 5 to 50 cu. in. / 127 to 1270 cu. mm, with larger capacities possible

**WEIGHT:** 0.30 lbs. / 136.07 g

***FLOW DIRECTION FOR CLOSING***



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






**Parker Hannifin Corporation**
Stratoflex Products Division
Fort Worth, Texas

# Hydraulic Fuse for Commercial Aircraft
# G836-6

**HYDRAULIC FUSE, TYPE I WITH MANUAL RESET**

**SERVICE PRESSURE:** 3000 psi / 206.84 bar

**TEMPERATURE RANGE:** -65 to +160°F
-54 to +71°C

**PORTS:** AND10050-6 for 3/8 inch / 9.53 mm O.D. Tubing

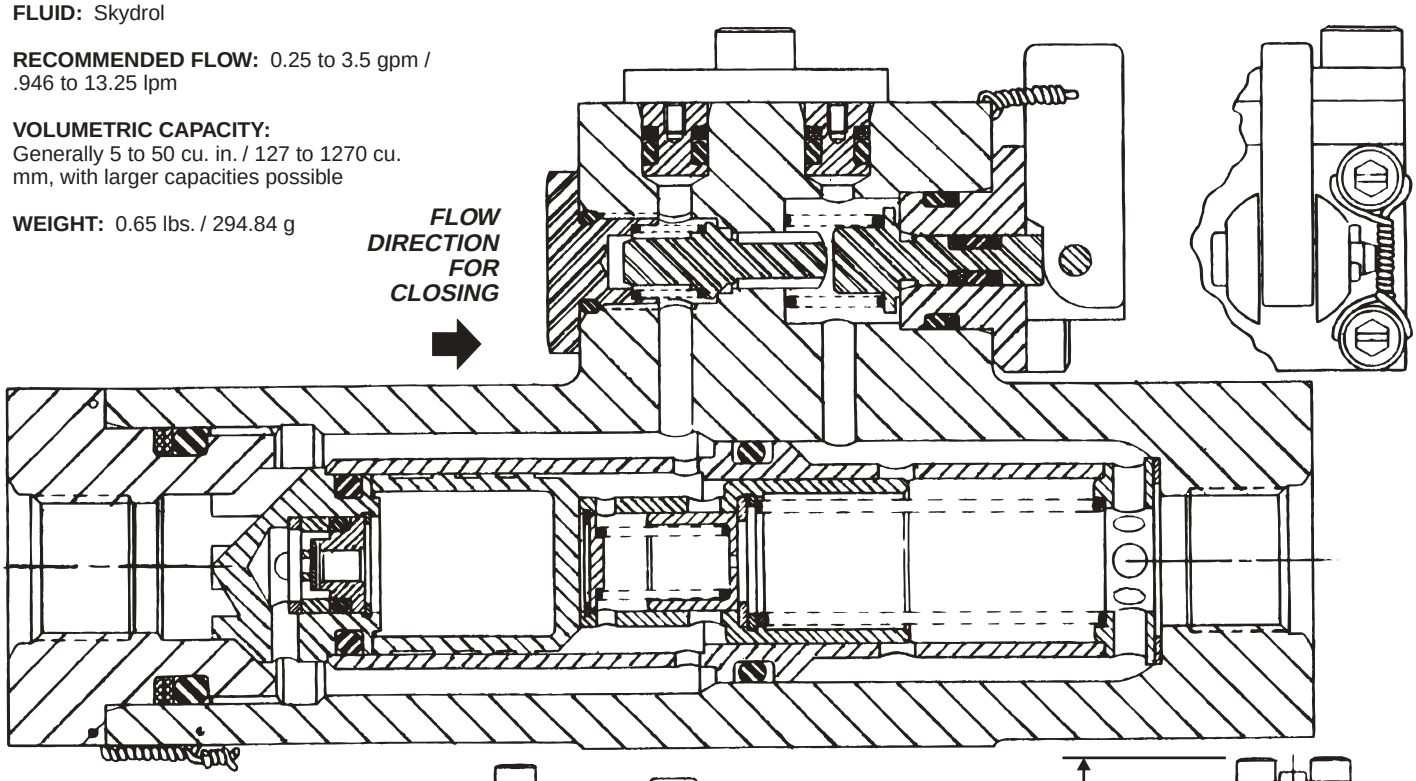
**FLUID:** Skydrol

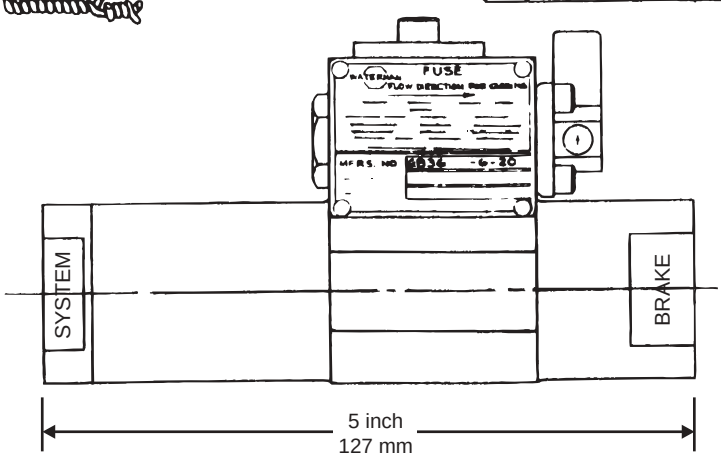
**RECOMMENDED FLOW:** 0.25 to 3.5 gpm / .946 to 13.25 lpm

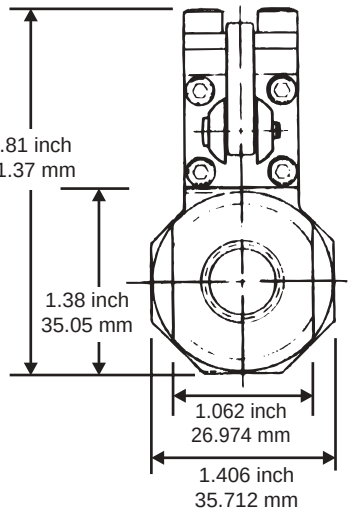
**VOLUMETRIC CAPACITY:**
Generally 5 to 50 cu. in. / 127 to 1270 cu. mm, with larger capacities possible

**WEIGHT:** 0.65 lbs. / 294.84 g

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






**Parker Hannifin Corporation**
Stratoflex Products Division
Fort Worth, Texas

# Hydraulic Fuse for Commercial Aircraft
# 837SD-8-6

**HYDRAULIC FUSE, TYPE I WITH MANUAL RESET AND PRESSURE INDICATOR**

**SERVICE PRESSURE:** 3000 psi / 206.84 bar

**TEMPERATURE RANGE:** -65 to +160°F
-54 to +71°C

**PORTS:** As Shown

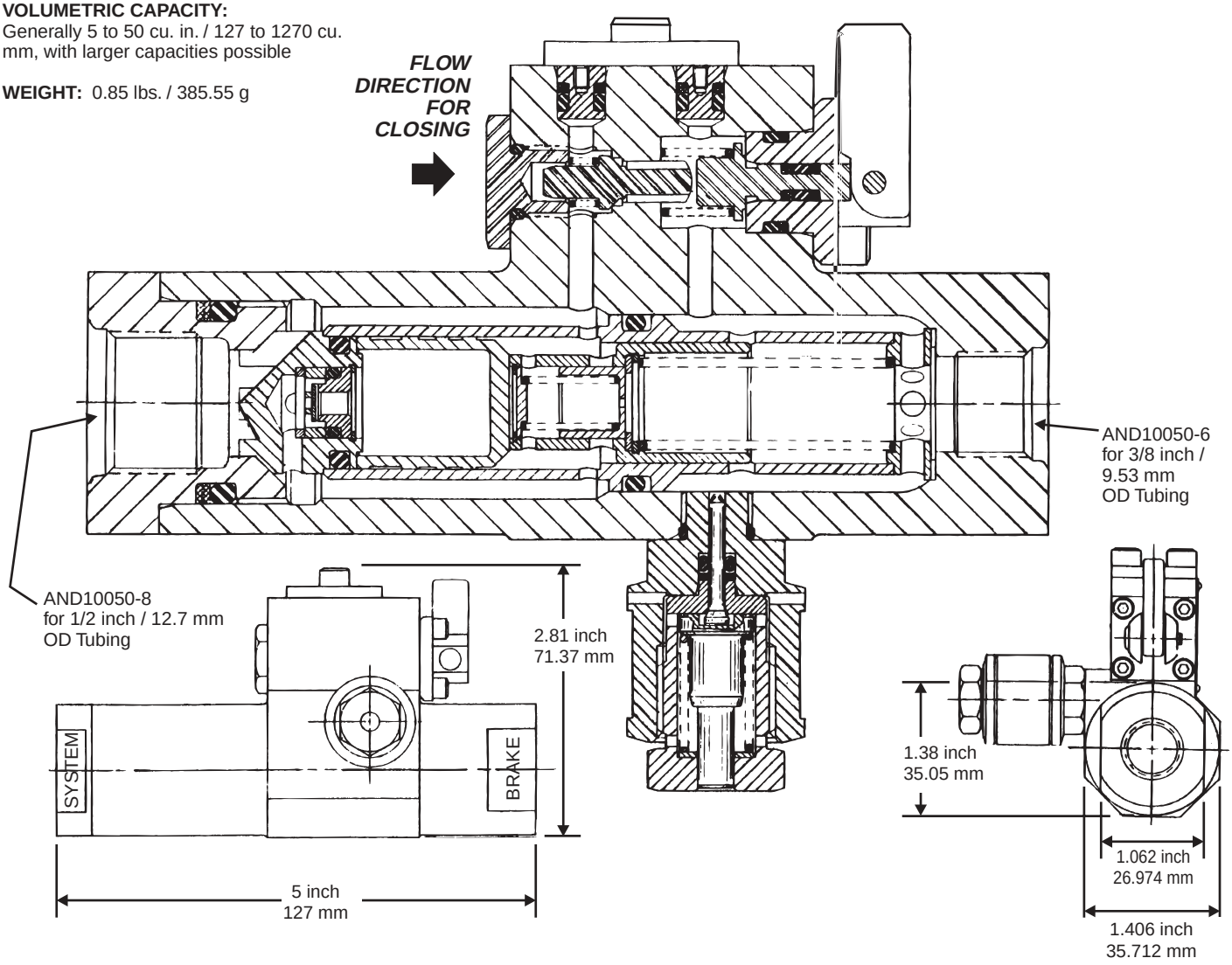
**FLUID:** Skydrol

**RECOMMENDED FLOW:** 0.25 to 3.5 gpm / .946 to 13.25 lpm

**VOLUMETRIC CAPACITY:**
Generally 5 to 50 cu. in. / 127 to 1270 cu. mm, with larger capacities possible

**WEIGHT:** 0.85 lbs. / 385.55 g

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






**Parker Hannifin Corporation**
Stratoflex Products Division
Fort Worth, Texas

# Hydraulic Fuse for Commercial Aircraft
# G8381-8

**HYDRAULIC FUSE, TYPE I**

**SERVICE PRESSURE:** 3000 psi / 206.84 bar

**TEMPERATURE RANGE:** -65 to +160°F
-54 to +71°C

**PORTS:** AND10050-8 for 1/2 inch / 12.7 mm O.D. Tubing

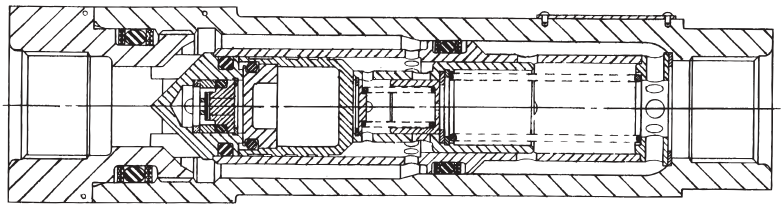
**FLUID:** Skydrol

**RECOMMENDED FLOW:** 0.25 to 6.0 gpm / .976 to 22.71 lpm

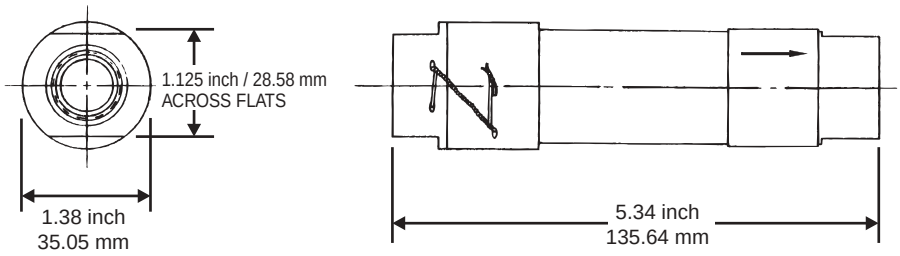
**VOLUMETRIC CAPACITY:**
Generally 5 to 50 cu. in. / 127 to 1270 cu. mm, with larger capacities possible

**WEIGHT:** 0.40 lbs. / 181.44 g

***FLOW DIRECTION FOR CLOSING***



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






**Parker Hannifin Corporation**
Stratoflex Products Division
Fort Worth, Texas

# Hydraulic Fuse for Commercial Aircraft
# G9051

**HYDRAULIC FUSE, TYPE II**
**PLUG TYPE**

**SERVICE PRESSURE:** 3000 psi / 206.84 bar

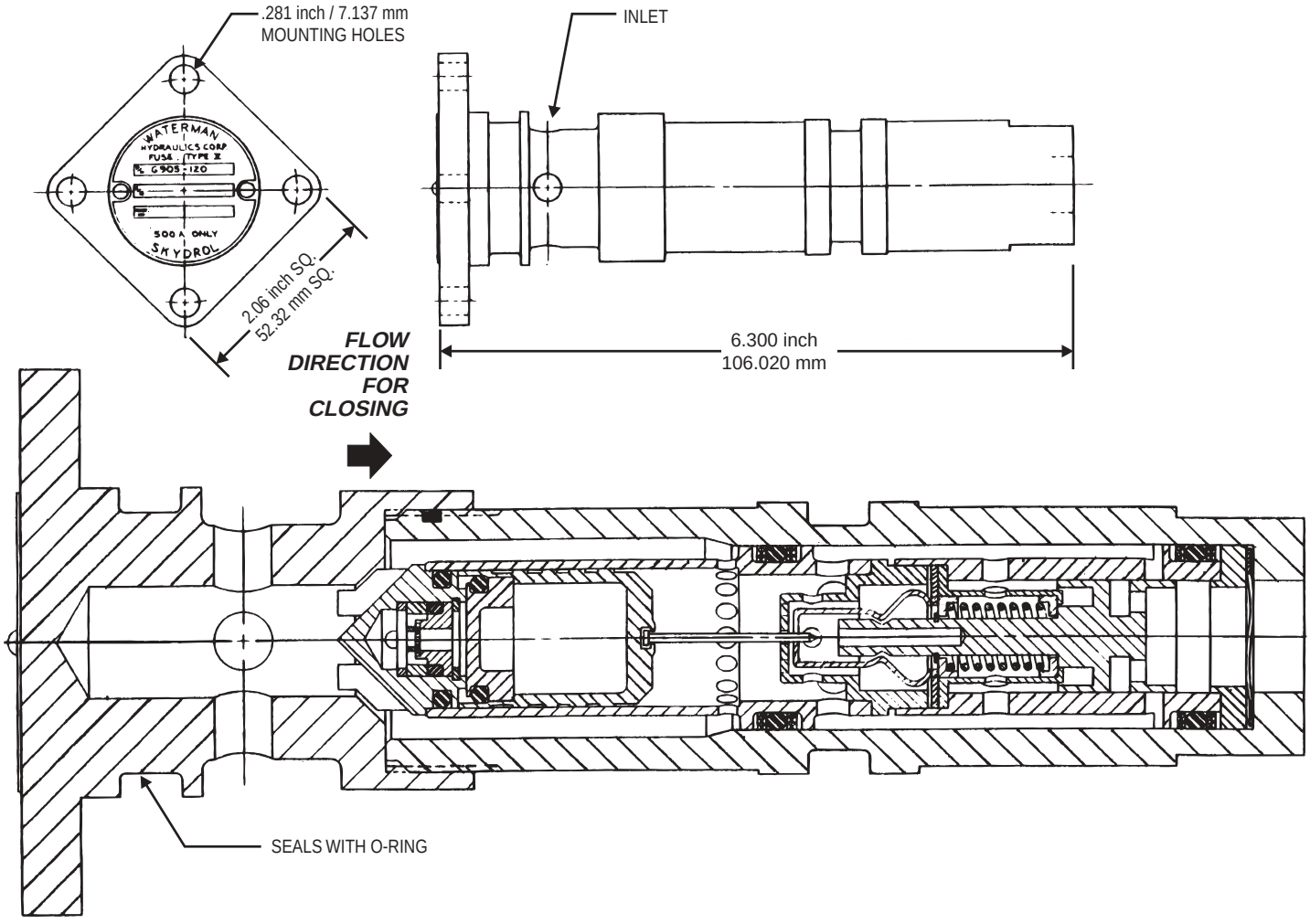
**TEMPERATURE RANGE:** -65 to +160°F
-54 to +71°C

**FLUID:** Skydrol

**RECOMMENDED FLOW:** 0.25 to 6.0 gpm / 9.76 to 22.71 lpm

**VOLUMETRIC CAPACITY:**
Generally 5 to 50 cu. in. / 127 to 1270 cu. mm, with larger capacities possible

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






**Parker Hannifin Corporation**
Stratoflex Products Division
Fort Worth, Texas

# Parker Safety Guide for Selecting and Using Hose, Tubing, Fittings and Related Accessories

**DANGER: Failure or improper selection or improper use of hose, fittings, or related accessories can cause death, personal injury and property damage. Possible consequences of failure or improper selection or improper use of hose, fittings, or related accessories include but are not limited to:**

- Explosion or burning of the conveyed fluid.
- Contact with conveyed fluids, hot, cold, toxic and injurious.
- Dangerously whipping hose.
- Loss of control system.
- High velocity fluid discharge.
- Fittings thrown off at high speed.
- Injection by high-pressure fluid discharge.

**Before selecting or using any Parker Hose or Fittings or related accessories, it is important that you read and follow the instructions below.**

**1.0 GENERAL INSTRUCTIONS**

**1.1 Scope:** This safety guide provides instructions for selecting and using (including assembling, installing, and maintaining) hose (including all rubber *and/or PTFE* products commonly called "hose" or "tubing"), fittings (including all products commonly called "fittings" or "couplings" for attachment to hose), and related accessories (including crimping and swaging machines and tooling). This safety guide is a supplement to and is to be used with, the specific Parker publications for the specific hose, fittings and related accessories that are being considered for use.

**1.2 Fail-Safe:** Hose and hose assemblies can and do fail without warning for many reasons. Design all systems and equipment in a fail-safe mode, so that failure of the hose or hose assembly will not endanger persons or property.

**1.3 Distribution:** Provide a copy of this safety guide to each person that is responsible for selecting or using hose and fitting products. Do not select or use hose and fittings without thoroughly reading and understanding this safety guide as well as the specific Parker publications for the products considered or selected.

**1.4 User Responsibility:** Due to the wide variety of operating conditions and uses for hose and fittings, Parker and its distributors do not represent or warrant that any particular hose or fitting is suitable for any specific end use system. Most Parker Stratoflex Products Division products are qualified to Military or Industry Standards. This safety guide does not analyze all technical parameters that must be considered in selecting a product. The user, through its own analysis and testing, is solely responsible for:

- Making the final selection of the hose and fitting.
- Assuring that the user's requirements are met and that the use presents no health or safety hazards.
- Providing all appropriate health and safety warnings on the equipment on which the hose and fittings are used.

**1.5 Additional Questions:** Call the appropriate Parker technical service department if you have any questions or require any additional information. See the Parker publication for the product being considered or used, for telephone numbers of the appropriate technical service department.

**2.0 HOSE AND FITTING SELECTION INSTRUCTIONS**

**2.1 Electrical Conductivity:** Certain applications require that a hose be nonconductive to prevent electrical current flow or maintain electrical isolation. Other applications require the hose to be sufficiently conductive to drain off static electricity; this is typical of rubber hose and of all aerospace fuel, oil and hydraulic PTFE hose. Extreme care must be exercised when selecting hose and fittings for these or any other applications in which electrical conductivity or non-conductivity is a factor.

For applications that require hose to be electrically nonconductive, only special nonconductive hose can be used. The manufacturer of the equipment in which the nonconductive hose is to be used must be consulted to be certain that the hose and fittings that are selected are proper for the application. Do not use any Parker hose or fitting for any such application requiring nonconductive hose unless (i) the application is expressly approved in the Parker technical publication for the product, (ii) the manufacturer of the equipment on which the hose is to be used specifically approves the particular Parker hose and fitting for such use.

The electrical conductivity or non-conductivity of hose and fittings is dependent upon many factors and may be susceptible to change. These factors include but are not limited to the various materials, including fitting finish, used to make the hose and the fittings, how the fittings contact the hose, age and amount of deterioration of damage or other changes and other factors. Aluminum fitting finish effects "conductivity"; anodize is non-conductive, while alodine is conductive.

**2.2 Pressure:** Hose selection must be made so that the published maximum recommended working pressure of the hose is equal to or greater than the maximum system pressure. Surge pressures in the system higher than the published maximum recommended working pressure would cause failure or shorten hose life. Do not confuse burst pressure or other pressure values with working pressure and do not use burst pressure or other pressure values for this purpose. Hose assemblies are "proof pressure" tested (normally 2 x working rated pressure) to confirm proper fabrication of the assembly. Gaseous test, including air-under-water, shall be at rated working pressure only and see 4.7 caution below. Care must be exercised to prevent water, or other fluid contaminants from unnecessarily contacting reinforcement, etc.

**2.3 Suction:** Hoses used for suction applications must be selected to insure that the hose will withstand the vacuum and pressure of the system. Improperly selected hose may collapse in suction application.

**2.4 Temperature:** Be certain that fluid and ambient temperatures, both steady and transient, do not exceed the limitations of the hose. Temperatures below and above the recommended limit can degrade hose to a point where a failure may occur and release fluid. Care must be taken when routing hose near hot objects (e.g. manifolds) to properly insulate and protect the hose. Fire sleeve is not intended as insulation.

**2.5 Fluid Compatibility:** Hose selection must assure compatibility of the hose tube, cover, reinforcement, and fittings with the fluid media used. Actual service life can only be determined by the end user by history or testing under all extreme conditions and other analysis.

**2.6 Permeation:** Permeation (that is, seepage through the hose) may occur from inside the hose to outside when hose is used with gases, liquid and gas fuels, and refrigerants (including but not limited to such materials as helium, fuel oil, natural gas, or refrigerant). This permeation may result in high concentrations of vapors, which are potentially flammable, explosive, or toxic, and in loss of fluid. Dangerous explosions, fires, and other hazards can result when using the wrong hose for such applications. The system designer must take into account the fact that this permeation will take place and must not use hose if this permeation could be hazardous. The system designer must take into account all legal, government, insurance, or any other special regulations, which govern the use of fuels and refrigerants. Never use a hose even though the fluid compatibility is acceptable without considering the potential hazardous effects that can result from permeation through the hose assembly.

**Gaseous permeation, particularly through a PTFE hose, occurs primarily if the gas is "stored" at pressure in the hose. Most standards limit the amount of permissible permeation.**

**2.7 Size:** Transmission of power by means of pressurized fluid varies with pressure and rate of flow. The size of the components must be adequate to keep pressure losses to a minimum, and avoid damage due to heat generation or excessive fluid velocity.

**2.8 Routing: Attention** must be given to optimum routing to minimize inherent problems (kinking or flow restriction due to hose collapse). See SAE AIR1569 for further information.

**2.9 Environment:** Care must be taken to insure that the hose and fittings are either compatible with or protected from the environment (that is, surrounding conditions) to which they are exposed. Environmental conditions including but not limited to ultraviolet radiation, sunlight, heat, ozone, moisture, water, salt water, chemicals and air pollutants can cause degradation and premature failure.

**2.10 Mechanical Loads:** External forces can significantly reduce hose life or cause failure. Mechanical loads, which must be considered, include excessive flexing, twist, kinking, tensile or side loads, bend radius, and vibration. Use of swivel type fittings or adapters may be required to insure no twist is put into the hose. Unusual applications may require special testing prior to hose selection.

**2.11 Physical Damage:** Care must be taken to protect hose from wear, snagging and cutting, which can cause premature hose failure. See SAE ARP1658 for Visual Guide.

**2.12 Proper End Fitting:** See instructions 3.2 through 3.5 below. Testing to industry standards such as MIL-A-5070, AS1339, J517, etc must substantiate these recommendations.

**2.13 Length:** When establishing a proper hose length, motion absorption, hose length changes due to pressure, and hose and machine tolerances must be considered.



**Parker Hannifin Corporation**
Stratoflex Products Division
Fort Worth, Texas

**2.14 Specifications and Standards:** When selecting hose and fittings, government, industry, and Parker specifications and recommendations must be reviewed and followed as applicable.

**2.15 Hose Cleanliness:** Hose components may vary in cleanliness levels. Care must be taken to insure that the assembly selected has an adequate level of cleanliness and compatibility for the application. See SAE AS611 for PTFE hose assembly cleanliness levels.

**2.16 Fire Resistant Fluids:** Some fire resistant fluids require the same hose as petroleum oil. Some use a special hose, while a few fluids will not work with any hose at all. See instructions 2.5 and 1.5. The wrong hose may fail after a very short service. In addition, all liquids but pure water may burn fiercely under certain conditions, and even pure water leakage may be hazardous.

**2.17 Radiant Heat:** Hose can be heated to destruction without contact by such nearby items as hot manifolds or molten metal. The same heat source may then initiate a fire. This can occur despite the presence of cool air around the hose.

**2.18 Welding or Brazing:** When using a torch or arc-welder in close proximity to hydraulic lines, the hydraulic lines should be removed or shielded with appropriate fire resistant materials. Flame or weld spatter could burn through the hose and possibly ignite escaping fluid resulting in a catastrophic failure. Heating of plated parts, including hose fittings and adapters, above 450° F *(232° C)* such as during welding, brazing, or soldering may emit deadly gases.

**2.19 Atomic Radiation:** Atomic radiation affects all materials used in hose assemblies. Since The long-term effects may be unknown, do not expose hose assemblies to atomic radiation.

**3.0 HOSE AND FITTING ASSEMBLY AND INSTALLATION INSTRUCTIONS**

**3.1 Pre-Installation and Periodic Inspection:** Prior to installation, a careful examination of the hose assembly must be performed. All components must be checked for correct style, size, part number, length, and minimum bend radius. In addition, the hose must be examined for cleanliness, broken wires, cuts, kinks, obstructions, blisters, cover looseness, or any other visible defects. Do not use any hose that has any of these conditions. See SAE ARP1658 for illustrations of damage conditions.

**3.2 Hose and Fitting Assembly:** Do not assemble a Parker fitting on a Parker hose that is not specifically listed by Parker for that fitting unless authorized in writing by the Engineering/Technical Manager or Chief Engineer of the appropriate Parker division. Do not assemble a Parker fitting on another manufacturers hose or a Parker hose to another manufacturers fitting unless: (i) the Engineering/Technical Manager or Chief Engineer of the appropriate Parker division approves the assembly in writing, (ii) the user verifies the assembly and the application through analysis and testing or (iii) fabricating MILSPEC assemblies in accordance with proper instructions. See instruction 1.4 above.

The Parker published instructions must be followed for assembling the fitting on the hose. These instructions are provided in the Parker fitting catalog for the specific Parker industrial fitting being used; most MILSPEC and Aerospace fitting to hose fabrication is closely controlled to authorized facilities.

**3.3 Related Accessories:** Do not crimp or swage any Parker hose or fittings with anything but the proper listed Parker swage or crimp machine and dies and in accordance with Parker published instructions. Do not crimp or swage another manufacturers hose fitting with a Parker crimp or swage die unless authorized in writing by the chief engineer of the appropriate Parker division.

**3.4 Parts:** Do not use any Parker hose fitting part (including but not limited to socket, shell, nipple, or insert) except with the correct Parker mating parts. in accordance with Parker published instructions, unless authorized in writing by the Engineering/Technical Manager or Chief Engineer of the appropriate Parker division. Do not use hose or fitting components from Parker Stratoflex Division with any hose or fitting components from any other Parker Division without this specific authorization. SPD and HPD fitting components shall not be mixed.

**3.5 Reusable/Permanent:** Do not reuse any reusable fitting product that blew off or pulled off a hose. Do not reuse any fitting component that is cracked or deformed beyond new part tolerance. Do not reuse hose. Do not reuse a Parker permanent (that is, crimped or swaged) hose fitting or any part thereof.

**3.6 Minimum Bend Radius**: Installation of a hose at less than the minimum listed bend radius may significantly reduce the hose life and cause premature failure. Particular attention must be given to preclude sharp bending at the hose/fitting juncture. If any Stratoflex Products Division hose has been bent to any radius less than its minimum bend radius (minor exceptions from proper authority) or has been kinked during installation, do not use such hose. Such hose is damaged and cannot be used and should be discarded.

**3.7 Twist Angle and Orientation:** Hose installations must be such that relative motion of machine components does not produce twisting. No twist in the hose is permitted during installation or use. See SAE AIR1569 for additional information.

**3.8 Securement:** In many applications, it may be necessary to restrain, protect, or guide the hose to protect it from damage by unnecessary flexing, pressure surges, and contact with other mechanical components. Care must be taken to insure such restraints do not introduce additional stress or wear points.

**3.9 Proper Connection of Ports:** Proper physical installation of the hose requires a correctly installed port connection insuring that no twist or torque is transferred to the hose confirm proper fabrication of the assembly. Gaseous test, including air-under-water, shall be at rated working pressure only and see 4.7 caution below. Care must be exercised to prevent water, or other fluid contaminants from unnecessarily contacting reinforcement, etc.

**3.10 External Damage:** Proper installation is not complete without insuring that tensile loads, side loads, kinking, flattening, potential abrasion, thread damage, or damage to sealing surfaces are corrected or eliminated. See instruction 2.10.

**3.11 System Checkout:** All air entrapment must be eliminated (see 4.7) and the system pressurized to the maximum systems pressure and checked for proper function and freedom from leaks. Personnel must stay out of potential hazardous areas while testing and using.

**3.12 Routing:** Hose should be routed in such a manner so if a failure does occur, oil or fuel mist will not come into contact with hot surfaces, open flame, or sparks, and the chance of personal injury is minimized.

**4.0 HOSE AND FITTING INSPECTION INSTRUCTIONS**

**4.1** Even with proper selection and installation, hose life may be significantly reduced without a continuing inspection program. The frequency of inspection should be determined by the system designer or end user taking into account the severity of the application and risk potential. An inspection program must be established and followed by the user and, at minimum, must include instructions 4.2 through 4.7, listed below.

**4.2 Visual Inspection Hose/Fitting:** Any of the following conditions require immediate shut down and replacement of the hose assembly: (See also ARP1658 for illustrations.)

- Fitting slippage on hose,
- Damaged, cut or abraded cover (any reinforcement exposed);
- Hard, stiff, heat cracked, or charred hose;
- Cracked, damaged, or badly corroded hose or fittings;
- Leaks at fitting or in hose;
- Kinked, crushed, flattened or twisted hose; and
- Blistered, soft, degraded, or loose cover.
- System malfunction including but not limited to, over-pressurization or pressure spikes.

**4.3 Visual Inspection All Other:** The following items must be tightened, repaired or replaced as required:

- Leaking port conditions;
- Remove excess dirt buildup;
- Clamps, guards, shields; and
- System fluid level, fluid type and any air entrapment.

**4.4 Functional Test:** Operate the system at maximum operating pressure and check for possible malfunctions and freedom from leaks. Personnel must avoid potential hazardous areas while testing and using the system.

**4.5 Replacement Intervals:** Specific replacement intervals must be considered based on previous service life, government or industry recommendations, or when failures could result in unacceptable downtime, damage. or injury risk. See instructions 1.2 and 4.2 above.

**4.6 Inspecting a Pressurized System:** Hydraulic power is accomplished by utilizing high-pressure fluids to do work. Hoses, fittings, and hose assemblies all contribute to doing work by transmitting fluids at high pressures. Fluids under pressure can be dangerous and potentially lethal and, therefore, extreme caution must be exercised when working with fluids under pressure and handling the hoses transporting the fluids. From time to time, hose assemblies will fail. Usually those failures are the result of some form of misapplication, abuse, or simply wear. When hoses fail, generally the high-pressure fluids inside escape in some sort of stream which may or may not be visible to the user. Under no circumstances should the user attempt to locate the leak by "feeling" with their hands or any other part of their body. High-pressure fluids can and will penetrate the skin and cause severe tissue damage and possibly loss of limb. Even seemingly minor hydraulic fluid injection injuries must be treated by a physician with knowledge of the tissue damaging properties of hydraulic fluid.

If a hose failure occurs, immediately shut down the equipment and leave the area until pressure has been completely released from the hose assembly. Simply shutting down the hydraulic pump may or may not eliminate the pressure in the hose assembly. Many times check valves, etc., are employed in a system and can cause pressure to remain in a hose assembly even when pumps or equipment are not operating. Tiny holes in the hose, commonly known as pinholes, can eject small, dangerously powerful but hard to see streams of hydraulic fluid. It may take several minutes or even hours for the pressure to be relieved so that the hose assembly may be examined safely.

Once the pressure has been reduced to zero. the hose assembly may be taken off the equipment and examined. It must always be replaced if a failure has occurred. Never attempt to patch or repair a hose assembly that has failed. Consult the nearest Parker distributor or the appropriate Parker division for hose assembly replacement information.

Never touch or examine a failed hose assembly unless it is obvious that the hose no longer contains fluid under pressure. The high-pressure fluid is extremely dangerous and can cause serious and potentially fatal injury.

**4.7 Gases:** Special care should be taken when working with gaseous systems. Gases are compressible, thus increase the danger of over-pressure, particularly during test. Sudden escape of gases can cause blindness if the escaping gases contact the eye and can cause freezing or other severe injuries if it contacts any other portion of the body.

# Offer of Sale

The items described in this document are hereby offered for sale at prices to be established by Parker Hannifin Corporation, its subsidiaries and its authorized distributors. This offer and its acceptance by any customer ("Buyer") shall be governed by all of the following Terms and Conditions. Buyer's order for any item described in its document, when communicated to Parker Hannifin Corporation, its subsidiary or an authorized distributor ("Seller'] verbally or in writing, shall constitute acceptance of this offer.

1. Terms and Conditions of Sale: All descriptions, quotations, proposals, offers, acknowledgments, acceptances and sales of Seller's products are subject to and shall be governed exclusively by the terms and conditions stated herein. Buyer's acceptance of any offer to sell is limited to these terms and conditions. Any terms or conditions in addition to, or inconsistent with those stated herein, proposed by Buyer in any acceptance of an offer by Seller, are hereby objected to No such additional, different or inconsistent terms and conditions shall become part of the contract between Buyer and Seller unless expressly accepted in writing by Seller. Seller's acceptance of any offer to purchase by Buyer is expressly conditional upon Buyer's assent to all the terms and conditions stated herein, including any terms in addition to, or inconsistent with those contained in Buyer's offer. Acceptance of Seller's products shall in all events constitute such assent.

2. Payment: Payment shall be made by Buyer net 30 days from the date of delivery of the items purchased hereunder. Any claims by Buyer for omissions or shortages in a shipment shall be waived unless Seller receives notice thereof within 30 days after Buyer's receipt of the shipment.

3. Delivery: Unless otherwise provided on the face hereof, delivery shall be made F.O.B. Seller's plant. Regardless of the method of delivery, however, risk of loss shall pass to Buyer upon Seller's delivery to a carrier. Any delivery dates shown are approximate only and Seller shall have no liability for any delays in delivery.

4. Warranty: Seller warrants that the items sold hereunder shall be free from defects in material or workmanship for a period of 365 days from the date of shipment to Buyer, or 2,00.0 hours of use, whichever expires first. THIS WARRANTY COMPRISES THE SOLE AND ENTIRE WAR. RANTY PERTAINING TO ITEMS PROVIDED HEREUNDER. SELLER MAKES NO OTHER WARRANTY, GUARANTEE, OR REPRESENTA TION OF ANY KIND WHATSOEVER. ALL OTHER WARRANTIES, INCLUDING BUT NOT LIMITED TO, MERCHANTIBILITY AND FITNESS FOR PURPOSE, WHETHER EXPRESS, IMPLIED, OR ARIS. ING BY OPERATION OF LAW, TRADE USAGE, OR COURSE OF DEAL ING ARE HEREBY DISCLAIMED. NOTWITHSTANDING THE FOREGOING, THERE ARE NO WARRAN. TIES WHATSOEVER ON ITEMS BUILT OR ACQUIRED WHOLLY OR PARTIALLY, TO BUYER'S DESIGNS OR SPECIFICATIONS.

5. Limitation Of Remedy: SELLER'S LIABILITY ARISING FROM OR IN ANY WAY CONNECTED WITH THE ITEMS SOLD OR THIS CONTRACT SHALL BE LIMITED EXCLUSIVELY TO REPAIR OR REPLACEMENT OF THE ITEMS SOLD OR REFUND OF THE PURCHASE PRICE PAID BY BUYER, AT SELLER'S SOLE OPTION. IN NO EVENT SHALL SELLER BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES OF ANY KIND OR NATURE WHATSOEVER, INCLUDING BUT NOT LIMITED TO LOST PROFITS ARISING FROM OR IN ANY WAY CONNECTED WITH THIS AGREEMENT OR ITEMS SOLD HEREUNDER, WHETHER ALLEGED TO ARISE FROM BREACH OF CONTRACT, EXPRESS OR IMPLIED WARRANTY, OR IN TORT, INCLUDING WITHOUT LIMITATION, NEGLIGENCE, FAILURE TO WARN OR STRICT LIABILITY.

6. Changes, Reschedules and Cancellations: Buyer may request to modify the designs or specifications for the items sold hereunder as well as the quantities and delivery dates thereof, or may request to cancel all or part of this order, however, no such requested modification or cancellation shall become part of the contract between Buyer and Seller unless accepted by Seller in a written amendment to this Agreement. Acceptance of any such requested modification or cancellation shall be at Seller's discretion, and shall be upon such terms and conditions as Seller may require.

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.

8. Buyer's Property: Any designs, tools, patterns, materials, drawings, confidential information or equipment furnished by Buyer or any other items which become Buyer's property, may be considered obsolete and may be destroyed by Seller after two (2) consecutive years have elapsed without Buyer placing an order for the items which are manufactured using such property. Seller shall not be responsible for any loss or damage to such property while it is in Seller's possession or control.

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.

10. Indemnity For Infringement of Intellectual Property Rights: Seller shall have no liability for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights except as provided in this Part 10. Seller will defend and indemnify Buyer against allegations of infringement of U.S. patents, U.S. trademarks, copyrights, trade dress and trade secrets (hereinafter 'Intellectual Property Rights'). Seller will defend at its expense and will pay the cost of any settlement or damages awarded in an action brought against Buyer based on an allegation that an item sold pursuant to this contract infringes the Intellectual Property Rights of a third party. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of such allegations of infringement, and Seller having sole control over the defense of any allegations or actions including all negotiations for settlement or compromise. If an item sold hereunder is subject to a claim that it infringes the Intellectual Property Rights of a third party, Seller may, at its sole expense and option, procure for Buyer the right to continue using said item, replace or modify said item so as to make it noninfringing, or offer to accept return of said item and return the purchase price less a reasonable allowance for depreciation. Notwithstanding the foregoing, Seller shall have no liability for claims of infringement based on information provided by Buyer, or directed to items delivered hereunder for which the designs are specified in whole or part by Buyer, or infringements resulting from the modification, combination or use in a system of any item sold hereunder. The foregoing provisions of this Part 10 shall constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for infringement of Intellectual Property Rights.

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.

11. Force Majeure: Seller does not assume the risk of and shall not be liable for delay or failure to perform any of Seller's obligations by reason of circumstances beyond the reasonable control of Seller (hereinafter 'events of Force Majeure]. Events of Force Majeure shall include without limitation, accidents, acts of God, strikes or labor disputes, acts, laws, rules or regulations of any government or government agency, fires, floods, delays or failures in delivery of carriers or suppliers, shortages of materials and any other cause beyond Seller's control.

12. Entire Agreement/Governing Law: The terms and conditions set forth herein, together with any amendments, modifications and any different terms or conditions expressly accepted by Seller in writing, shall constitute the entire Agreement concerning the items sold, and there are no oral or other representations or agreements which pertain thereto. This Agreement shall be governed in all respects by the law of the State of Ohio. No actions arising out of the sale of the items sold hereunder or this Agreement may be brought by either party more than two (2) years after the cause of action accrues.

# *Stratoflex Products Division Sales Offices*

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