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BACK

Design Concepts

Eaton's Carter brand Model 60700-1 pressure control coupler provides connection to all hydrant valves and adapters in accordance with API bulletin 1584, pressure and deadman control. It is a direct acting type control unit which features simplicity of operation and maintenance.

Features

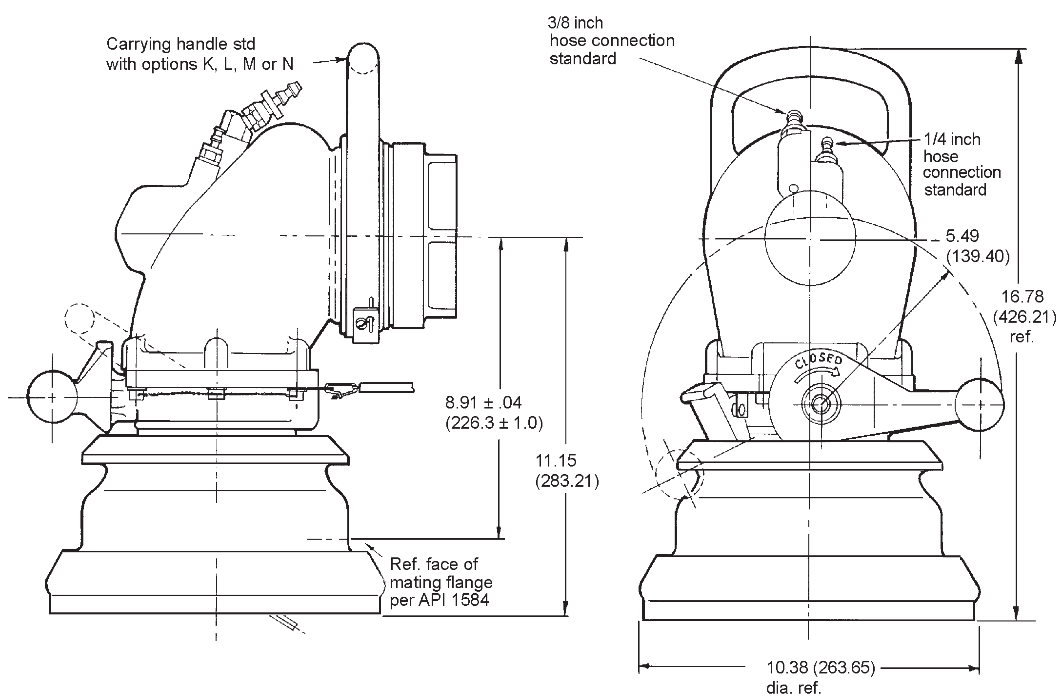
- Low pressure drop — 21.0 psi (1.448 bar) across Carter brand Model 60554 hydrant and Model 60700-1M at 1,000 US gpm (3785 l/min)
- Provides stable pressure control throughout normal operating flow ranges
- Lightweight, yet rugged, for easy one-man operation
- Incorporates full safety interlock with flow control handle to prevent accidental fuel spillage. Cannot be disconnected when open nor opened when disconnected
- Easy push-on, pull-off connection of coupler to pit valve
- Simple, straight forward, modular design results in easy maintenance
- Adjustable closing time from 2-5 seconds
- Fixed opening time — no adjustment
- 3 & 4 inch NPT & BSPP outlets available

Technical Information

- Working pressure — 200 psi (13.790 bar)
- Proof pressure — 450 psi (31.026 bar)
- Closing time — 2-5 seconds (adjustable)
- Opening time — 5-10 seconds (no adjustment)
- Overshoot — 50 US gal. (189 l) maximum at 1000 US gpm (3785 l/min)
- Air pressure operated. Nominal bias (air pressure required above control pressure) — 25 psi (1.723 bar). Bias increases to approximately 33 psi (2.275 bar) at flow rates up to 1200 US gpm (4542 l/min)
- Fully open pressure drop — 21.0 psi (1.448 bar) at 1,000 US gpm (3785 l/min) when mated to Model 60554 hydrant. (See graph on page 4 for more data)
- Mates all adapters in accordance with API bulletin 1584

Envelope Dimensions

Dimensions shown in inches (millimeters)



Pressure Control Valve Operation

Figure A (below, right) is a schematic diagram of the fuel pressure control elbow assembly module (unit) on which the major functional elements are illustrated and labeled.

The inner and outer piston assembly has been split on figure A so that the lower half illustrates the position of the pistons when the unit is closed. The upper half of the piston assembly illustrates the position of the pistons when the unit is partly open and regulating fuel pressure.

With the coupler engaged and the poppets open, hydrant pressure is available at the unit's outer piston seat. The unit's piston is held normally closed by piston spring force until air pressure is applied, usually through a deadman valve.

In common with pilot operated pressure control valves, this direct operated unit incorporates an air pressure over regulated fuel pressure bias. In this direct operated unit, however, the bias is provided by the main piston spring which is not adjustable.

The piston spring design is such that the spring bias force equals approximately 25 psi (1.723 bar) air over fuel pressure when the unit piston is near the seat and as much as 33 psi (2.275 bar) air over fuel pressure when the piston is full open. These numbers cannot be absolute for all possible installations since there is a small area imbalance in the piston open direction caused by slight differences in sealing diameters of the outer piston's dynamic seal and its seat.

If the regulated pressure at the remote sensed delivery point is not correct the air pressure is adjusted up or down to achieve the desired delivery pressure. Of course, if the delivery pressure is low because inlet pressure is insufficient to overcome system resistance at high flow rates, then increasing the air pressure will not increase the delivery pressure (since the unit is already fully opened under those conditions) and will result in higher downstream pressure during normal shutoff. It should also be understood that using very high air pressure to compensate for system pressure losses will result in high shut-off and surge pressures.

Refueling

Considering the previous discussion about bias, assuming that the unit has been filled and properly bled of air and that the deadman air pressure is preset at the desired value, then the only action required to operate the unit is to squeeze the deadman valve to apply the air pressure and open the piston.

The main piston opening rate is limited by a check valve in the fuel sense passage that restricts displacement of fuel from the fuel control chamber as the chamber's volume decreases when the piston opens.

The piston continues to open until the pressure at the remote sensed point, transmitted back through the fuel sense line, reaches the range that is equal to the applied air pressure less the bias force of the main piston spring. At this flow rate, the main piston modulates to maintain an equilibrium of forces across the inner piston and provides automatic pressure control by varying the effective flow area at the outer piston.

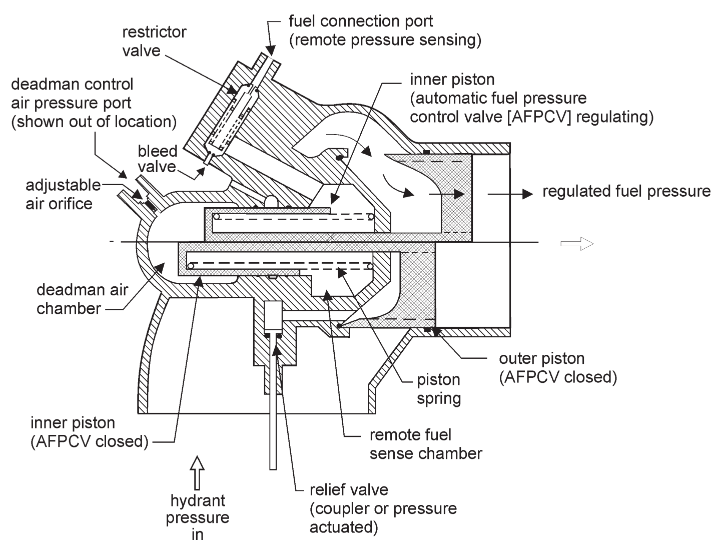
As the aircraft tanks progressively fill and shut off, the flow reductions in each instance cause the pressure to increase at the remote sensing point. These pressure increases are transmitted back though the fuel sense hose. The previously mentioned check valve is lightly spring loaded in that it begins to open when the fuel sense line pressure is approximately 1.5 psig greater than the inner fuel piston chamber pressure, creating a variable orifice in parallel with the very small orifice that restricts control fuel flow in the reverse direction. The increase in fuel chamber pressure causes the piston to move in the closed direction, reducing the outlet pressure, until the fuel pressure transmitted back through the fuel sense line has established a new force equilibrium condition about which the piston modulates until the next aircraft tank fills and shuts off.

When the last aircraft tank has shut-off, the conditions described above cause the unit piston to fully close and block hydrant pressure, preventing high pressures from reaching the aircraft manifolds as well as the servicer delivery equipment.

The rapid response inherent in a direct acting regulator combined with the essentially free flow of control fuel into the remote fuel sense chamber makes the unit an effective automatic surge control device when fueling aircraft with fast closing (1-2 second) shut-off valves.

Release of the deadman valve at any time will cause the unit to close. The piston closing rate in this mode of operation is a function of the air passage orifice (adjustable), the air hose volume, and any restrictions in the deadman valve. (The fuel restrictor check valve does not significantly affect closing rate since it easily opens to allow fuel to enter the fuel sense chamber in this closing mode.) The bias force supplied by the piston spring causes the unit piston to be fully closed by the time the air pressure on the air side of the unit inner piston has decayed to about 20 psi (1.378 bar).

Figure A



Defueling Operation

Defueling - General

Should it become necessary, or desirable, to defuel through the pressure control coupler, it is necessary to either apply an air pressure that is at least 30-35 psi (2.068-2.413 bar) higher than the defuel pressure, or to provide a means of blocking the fuel sense pressure and venting the unit fuel sense chamber to a vented container.

Obviously, if adequate air pressure is available, the simplest method of defueling consists of merely applying enough air pressure to overcome the closing forces created by the fuel sense (defuel) pressure and the piston spring.

Direct acting pressure regulators of this type may become unstable at some point in the piston stroke during reverse fuel flow. So it is mandatory that the unit is fully opened by enough air pressure (30-35 psi [2.068-2.413 bar] greater than the maximum defuel pressure) to overcome the defuel pressure and piston spring forces before start of reverse flow.

If it is necessary to defuel into a relatively high pressure hydrant system, it is reasonable to assume that sufficient air pressure may not be available. The balance of this discussion is concerned with methods of venting the fuel sense chamber to permit opening of the unit with air pressure no higher than that required for normal operation.

Defueling - Frequent

If the fuel control coupler is installed on a servicer or dispenser that is frequently used for defuel operations, then it is perhaps desirable that the dispenser design include a spring-loaded, two position, three-way selector valve in the fuel sense line between the unit and the remote sensed location. Such a valve should be installed so that, with the spring holding the valve in the “normal” position, two of the valve’s ports provide through and unrestricted transmission of the fuel sense pressure while the third port is blocked.

Manually overriding the spring and holding the valve in the “defuel” position should, in turn, block the remote sensed point port of the valve and cause the unit fuel sense connection to communicate with the selector valves’ third port. This port might best be connected through a simple check valve and suitable tubing or hose to a small, vented container. The selector valve’s design should be such that release of the control handle results in spring return of the valve to the “normal” position to provide fail safe deadman-type operation.

A simple check valve should be provided between the selector valve’s third port and the vented container so that flow is free out of the valve, but air return is blocked. (The check valve flow arrow should point away from the selector valve.)

The vented container can be quite small, since the fuel displaced by the unit piston when it opens is on the order of one cupful. Of course, if the servicer is already equipped with a “dump tank”, then an additional container is not required.

With a servicer so equipped, defueling procedures are simplified to applying defuel pressure equal to hydrant pressure, holding the fuel sense selector in the “defuel” position, applying deadman air pressure, and increasing the defuel pressure to the valve necessary to off-load the fuel at the desired rate.

At the conclusion of defueling operations, the defuel pressure should be decreased to equal hydrant pressure, then the deadman air and fuel sense selector valve may be released to close the unit.

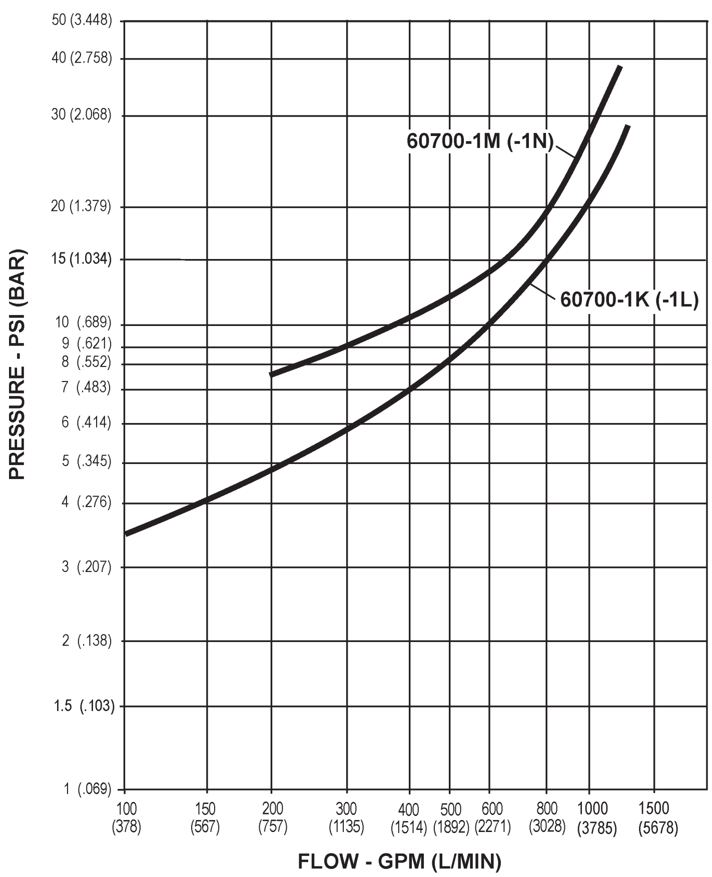
Defueling - Infrequent

If the unit is installed on a servicer that is used in defueling operations very infrequently, then inclusion of the design provisions discussed above (frequent defueling) is perhaps not justifiable nor warranted.

In this case, it will be necessary to disconnect the fuel sense hose at the remote sense point, and plug or cap the port at the remote sense location. The disconnected hose must be left open to atmosphere while the unit is opened and closed during the off-loading operation.

It is also necessary to refill and bleed air from the fuel sense hose and inner piston fuel chamber when the fuel sense hose is reconnected following the defuel on/off loading operations.

Flow Rates

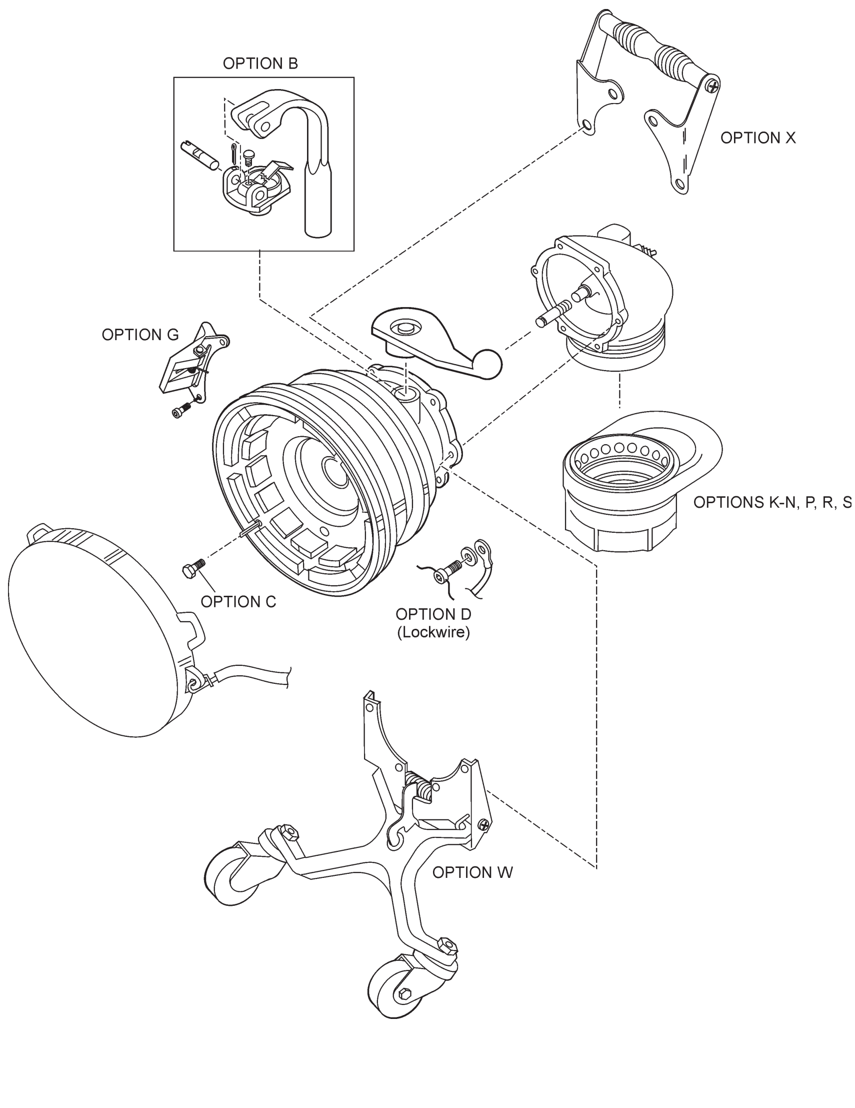


Curve 1	Typical Model 60700-1 with 4 inch QD outlet options
Curve 2	Typical Model 60700-1 with 3 inch QD outlets options

Ordering Data

The basic Model 60700-1 coupler includes a rigid operating handle and external dust cap. The basic model may be ordered with various options by adding one or more of the letters shown at right. The weight of the basic is 24.0 lbs. (10.886 kg).

Option Letter	Description	Weight lbs	kg	Comments
*B	Adds folding handle (41731	-0.10	- .045	Replaces standard rigid operating handle
C	Adds product selection (41802)	+0.10	.045	
D	Adds lockwire to attachment bolts	+0.10	.045	Locks bolts on upper & lower halves
G	Adds collar stop assembly (44140)	+0.30	.136	Extra collar lock protection
K	Adds 3 inch NPT female half QD & carrying handle (41730-3)	+4.00	1.814	
L	Adds 3 inch BSPP female half QD & carrying handle (41730-4)	+4.10	1.860	
M	Adds 4 inch NPT female half QD & carrying handle (41730-1)	+3.20	1.451	
N	Adds 4 inch BSPP female half QD & carrying handle (41730-2)	+3.20	1.451	
P	Adds 4 inch AASPT female half QD & carrying handle (60740)	+2.90	1.315	
W	Adds carriage assembly (60532A)	+6.25	2.835	
*X	Adds forward handle assembly (47073)	+1.20	0.544	
*	Option B must be used with option X			



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