A-T Controls, Inc.
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Engineer: RMG **No.:** 00107
Date Created: 03/17/2026
Date Modified:

Fast-Acting Pneumatic Actuator Port Modification White Paper

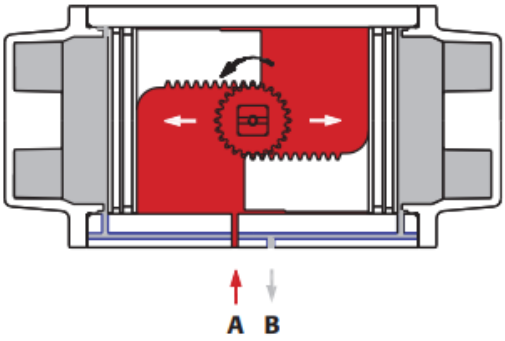
Overview:

Pneumatic actuators, such as the 3R Series, require inlet air flow and exhaust air flow to operate properly. For applications requiring fast actuation, both the supply air flow to the actuator and the exhaust capacity must be increased to accommodate higher flow demand.

A common misconception is that increasing supply pressure will improve actuator speed. In practice, this approach can produce the opposite effect. Higher pressure increases the amount of air that must be delivered to and exhausted from the actuator, which may result in slower cycle times if the flow capacity is not correspondingly increased.

Normal Operation:

For a 3R actuator in stock form, the air supply travels from the inlet port (A) through a small channel to the center cavity, pushing the pistons outward. Likewise, the air displaced by the pistons in the outer cavities are pushed out through small channels to the outlet port (B).



These small channels and the size of the solenoid valve are the limiting factors for speed of air supply and exhaust.

Fast Acting Modifications:

A port modification utilizes a larger inlet port drilled directly into the center cavity of the actuator. This not only bypasses the restrictive standard inlet channel but also allows for the use of a larger solenoid. The end caps are drilled and fitted with breathers to allow for air to be quickly exhausted during actuation and quickly replaced during release, again bypassing the restrictive standard channel. By enlarging the inlet, outlet, and solenoid, this method is effective in eliminating the weakest link in air flow restriction.

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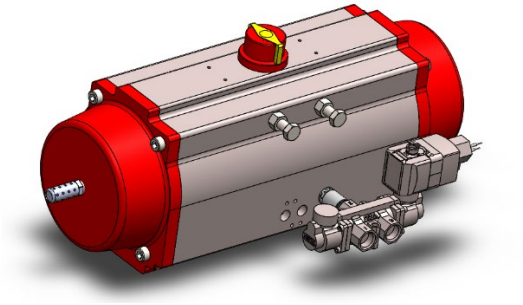
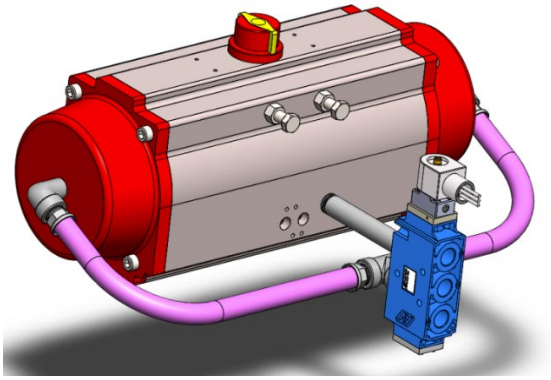
Spring Return and Spring Open Port Modifications:

A 3-way solenoid valve sends air through the larger inlet port, directly into the center cavity, driving the pistons outward. The air displaced by the pistons is quickly pushed out of the actuator through breathers in the end caps. When the actuator is deactivated, the springs push the pistons back inward, forcing the air back out through the enlarged port. The air needed to fill the volume by the receding pistons is pulled in through the breathers in the end caps.



Double-Acting Port Modification:

This configuration uses a 4-way solenoid valve with the primary port connected directly to the center cavity, and the secondary port is connected to fittings in the end caps with a TEE fitting. This configuration enables air to be charged and discharged quickly from both the center cavity and in the end caps, allowing for fast operation in both directions.



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Port Modifications Available:

¼" NPT – 3R40 and Larger
3/8" NPT – 3R130 and Larger
½" NPT – 3R300 and Larger
¾" NPT – 3R1000 and Larger
1" NPT – 3R2400 and Larger

How to Select a Port Modification:

For applications needing a 1-second cycle time, refer to the chart below. Modifications are based on actuator size and supply pressure.

Actuator	Stock Cycle Time	Port Modification Needed for 1 Second Cycle Time		
		60psi	80psi	100psi
3R10	N/A	Stock	Stock	Stock
3R20	0.5	Stock	Stock	Stock
3R40	0.6	Stock	Stock	Stock
3R80	1	Stock	Stock	Stock
3R130	1.2	1/4"	1/4"	1/4"
3R200	1.5	3/8"	3/8"	3/8"
3R300	2	3/8"	3/8"	3/8"
3R500	2.5	3/8"	1/2"	1/2"
3R700	2.9	1/2"	1/2"	1/2"
3R850	3.3	1/2"	3/4"	3/4"
3R1000	3.5	3/4"	3/4"	3/4"
3R1200	4.2	3/4"	3/4"	3/4"
3R1750	5	3/4"	1"	1"
3R2400	7	1"	1"	1"
3R2500	5	3/4"	3/4"	3/4"
3R2700	10	CF	CF	CF
3R3300	14	CF	CF	CF
3R3500	9	3/4"	3/4"	1"