

ACCURATE FORCE PNEUMATICS

When you need
pneumatic control of
force, motion and displacement
to deliver unparalleled
accuracy and resolution:

It's Airpot first.

Start your design with an Accurate Force Pneumatics optimized system.

Whether you are designing or improving a product line to better serve your customers, or building specialized equipment to do high-level testing, precision assembly, or research, Airpot can be a valuable resource for you.

Why? Because Airpot Corp. specializes and excels in applications for which precise, accurate pneumatic control of actuation, damping or displacement is required.

At the heart of our capabilities you'll find instrument-quality pneumatic piston/cylinder devices that employ precision technology and special materials to eliminate friction—*without lubricants*.

They are specifically designed for highly accurate and repeatable force control. By blending optimal combinations of our unique technology products with the best performing pneumatic system control components, our Accurate Force Pneumatics (AFP) packaged systems can offer designers levels of force and motion control *virtually unobtainable by any other pneumatic means*.

Our AFP packages contain the critical components you'll need and expect for:

- Superior force control
- Accuracy
- Repeatability
- Responsiveness
- Pressure regulation



Airpel-AB, actuation with air bearing technology

From the initial air input to the final force output, you'll find the AFP system that's been optimized for you will typically cost less than any other methods providing comparable functions and performance.

If your pneumatically actuated mechanism will need output accuracy, first consider an Airpot AFP component or system package. We've already done most of the work for you, so you can save much of the time and expense you might ordinarily spend researching compatible components to optimize your system.

Deciding on just the right system is a remarkably easy process you'll discover as you read on.

Providing precise force: To begin, let's start at the end

When designing a mechanism that must move, clamp, hold, press, support, or touch something, the first considerations must include what needs to happen at the end of the operation (the output). This typically involves decisions about the amount of force that needs to be applied to do some work at, or near the point of the output, at what rate, and how accurately. Once this is determined,

the upstream requirements for producing the desired output force and controlling it to avoid undesired results must be addressed.

In a pneumatic system designed to generate a force output, the primary actuation component commonly considered is an air cylinder. But to apply a highly accurate, repeatable force, it must have the lowest possible friction and may need to be controlled by one or more precise devices upstream of the cylinder.

If the design does require an accurate force output, there are no pneumatic actuators with greater capability than Airpot Self-Aligning Pneumatic Actuators, Airpel Anti-Stiction cylinders, Airpel Plus, and Airpel-AB zero-friction air cylinders.

The unique properties of these devices will allow your output mechanism to move, hold, support, or press with a force that has amazing accuracy, repeatability, and responsiveness over a wide temperature range, without lubrication, and with extraordinary cycle life. Once you know the level of force control you need, configuring most of the pneumatic system can be accomplished easily by choosing the right components.

Selecting the most appropriate Actuator

To begin, take a look at the Actuator models on the AFP Comparison/Selection Guide on the outer flap of this folder. Additional

details can be found on our website, airpot.com, or in our catalog "The Complete Book of Airpot" which is also available online.

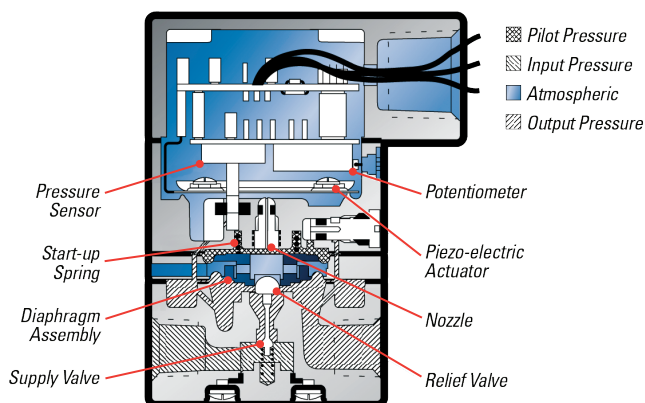
Precisely controlling the actuation pressure

To get the most accurate control of the cylinder's output force, the next upstream component will often be a complementary proportional pneumatic pressure-control device. To provide this control function with our actuators, we have selected the most suitable models of self-correcting, miniature E/P transducers offering closed-loop pressure feedback circuitry for precise, responsive, and stable pressure. Turn the flap to page 3 for the Transducer section of the "AFP Comparison/Selection Guide" to see what we mean.



Airpot and ControlAir join forces in Airpot's AFP packaged systems for actuation you can count on.

Used extensively by professionals who demand maximum performance and reliability, ControlAir's Type 900X transducer meets our exacting standards.



A biomorph piezo actuator encapsulated in a protective skin provides a constant defense against humidity and contaminants.

Regulating the air ...

It is equally important to provide accurate, reliable pressure regulation either directly to the actuator or to the proportional pressure controlling device. Airpot has selected the most suitable regulators for our components and systems, designed to cover the variety of size, pressure, and accuracy requirements that are most commonly encountered in demanding AFP applications. Please see the Filter section in the “AFP Comparison/Selection Guide” on page 3.



Precision Filter-Filter Regulator (FFR)

combines the ideal filters for this purpose to insure that the precision of the downstream control components will be properly protected from detrimental contaminants such as sub-micron particles, mist, oil, and water that may be in the supply air. Refer to page 3 to compare filter models.

Putting it all together: Your optimized system

Regardless of which precision actuator seems to be the right one for the job, for the best performance of the actuation system, it is only logical that all the pneumatic devices that handle the air and control the cylinders properly match and complement the air cylinder's level of accuracy. For this purpose, we developed **AFP Packaged Systems**.

Because we have already selected the most complementary components for air preparation, pressure regulation, and dynamic

pressure control for our instrumentquality cylinders, we can provide them as a package to suit your specific needs. Each optimized system will include most of the critical components between the air supply and the force output needed to achieve the accuracy and precision actuation objectives of your design. This makes it possible for you to obtain the primary components of a high precision pneumatic system all together from one source, ready to install — all with the reassuring knowledge that they are properly suited to one other and very nicely priced, too, we might add.

Designed to offer configuration flexibility, our AFP systems ensure optimum performance at the lowest overall cost. What's more, we're sure they'll save you valuable research and development time, too.

Now for your AFP System Package Choices

- 1 Actuation Device**
Choose one Airpot Self-Aligning Actuator, Airpel Anti-Stiction Cylinder, Airpel Plus, or Airpel-AB.
 - +**
 - 2 Proportional Pressure Control**
Choose one transducer.
 - +**
 - 3 Clean Air and Regulation**
Choose one Airpel FFR combination (filter-filter-regulator).
- Find your preferred actuation device from our complete selection.

If multiples of any individual component are desired for your system, the component can be added to your specifically configured system.

The performance specifications of each of the individual components selected will combine to determine the minimum capabilities of the entire system. As a guide, the following chart is provided to show the typical output characteristics for the most common system components. Results will vary depending on your particular combination. If greater levels of accuracy are required, please discuss your application with us.

Once you have selected the system you'd like, just contact us for pricing and a delivery schedule. At the time of your first order, you will be given a dedicated, exclusive part number which will identify your unique AFP system, making any future orders you may have even easier than 1-2-3.

And while any component may be purchased separately, you'll be pleased to know that all complete AFP systems are priced at an attractive discount over individual component prices.

So, when you need pneumatic control and accurate force? Remember, it's Airpot first. We'll get your project moving.

Airpot®

AFP Systems Comparison/Selection Guide

To configure a system, fill in each box at right with your preferred component. Contact Airpot for discounted package prices.

Optimized AFP System Example

ACTUATOR MODELS [See Note 1]						
Self-Aligning/Airpel	56/NA	95/9	160/16	240/24	325/32	444/NA
Force output (lbs /psi)	0.038	0.105	0.309	0.701	1.281	2.405
Bore (inch)	0.220	0.366	0.627	0.945	1.289	1.750
Maximum operating pressure (psi)	125	100	100	100	100	100
Available in actuator type	Self-Aligning	All	All	All	All	Self-Aligning

16

Model Choice

ACTUATOR TYPES [See Note 1]				
FEATURES	Self-Aligning	Airpel	Airpel Plus	Airpel-AB
Low friction (good = very low)	Good	Good	Better	Best
Degree of force resolution accuracy	Good	Good	Better	Best
Most precise repeatability	Good	Good	Better	Best
Relative cost factor average: lowest = 1 [See Note 2]	1	1.2	2	3.3
Minimum operating pressure (psi)	< 0.2	< 0.2	< 0.2	5 (vertical)/20 (horizontal)
Longest potential cycle life [See Note 3]	Excellent	Excellent	Excellent	Best
Can be pressurized in both directions	—	✓	—	—
Can be pressurized to extend	✓	✓	✓	✓
Counterbalancing or constant load under pressure	Good	Good	Better	Best
Can vacuum actuate	✓	✓	—	—
Smallest OD and length for bore and stroke	✓	—	—	—
Lightest weight	✓	—	—	—
Steel tube outer construction	—	✓	✓	✓
Most forgiving rod alignment	Best	Fair	Good	Good
Rod end threaded-fixed	Avail	Avail	Avail	Avail
Integrated threaded ball-joint rod end	Avail	—	Avail	Avail
Most versatile for customizing	✓	—	—	—
Pivotable cylinder mount available	—	✓	—	—

Self-Aligning
[See Note 1]

Actuator Choice

TRANSDUCERS [See Note 4]					
	AFPT1	AFPT2	AFPT3	AFPT4	AFPT5
Pressure range (psi)	0–15	0–30	0–60	2–60	2–100
Accuracy (% of span)	±0.1	±0.1	±0.1	±0.1	±0.1
Deadband (% of span)	0.02	0.02	0.02	0.02	0.02
Relative cost factor average (lowest cost = 1)	1.04	1.04	1.04	1	1

AFPT 2

Transducer Choice

FILTER-FILTER-REGULATORS: FFRs [See Note 4]					
REGULATOR	PFRN1-1/ PFRG1-1	PFRN1-2/ PFRG1-2	SFRN1-1/ SFRG1-1	PFRN3-1/ PFRG3-1	SFRN3-1/ SFRG3-1
Most compact	✓	✓	✓	—	—
Precision or standard regulator	Precision	Precision	Standard	Precision	Standard
Highest flow rate	—	—	—	✓	✓
Relative cost factor average (lowest cost = 1)	1.5	1.5	1	2.4	1.4
Set pressure range (psi)	0.7–60	0.7–100	7–120	5–120	7–120
Regulator repeatability (psi)	0.3	0.3	n/a	0.63	n/a
Air consumption (std L/min)	<=1.3	<=1.3	n/a	<=5	n/a
Sensitivity (psi)	.06	.06	n/a	0.25	n/a
Dual filtration	5 micron and .01 coalescing filters all models				

PFRN 1-1

FFR Choice

Notes

1. A more detailed actuator model must be configured to define its stroke and mounting options. To determine the individual model numbers for each of the basic actuator types shown above, please see the model specifications pages on airpot.com or in our printed catalog "The Complete Book of Airpot."

2. Average for stock units in quantities less than 25

3. When used in accordance with recommended specifications/installation guidelines

4. If no transducer is needed for your application, select an FFR model that includes a precision regulator. If one of our transducers is used, you can reduce cost by selecting an FFR that uses a standard regulator.

Optimizing your system is as easy as 1-2-3.

1



*Self-Aligning
Actuator*



The Anti-Stiction Air Cylinder



Airpel Plus – 4x less friction



Airpel-AB ZERO friction

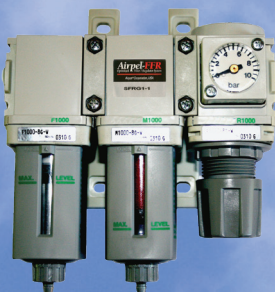
2



*ControlAir transducers,
precision and standard*



3



*Filter-Filter-Regulators
really clean air, precise regulation*



4

*Four? The 4th step is the easiest of all.
Contact one of our helpful design engineers and let's get started.
Visit us on the web at airpot.com, give us a call at 800-848-7681, or stop by
the plant if you're in the area. 35 Lois Street, Norwalk Connecticut 06851.*

Airpot® Corp
Motion Controlled. Problem Solved.

Self-Aligning Actuator Specifications

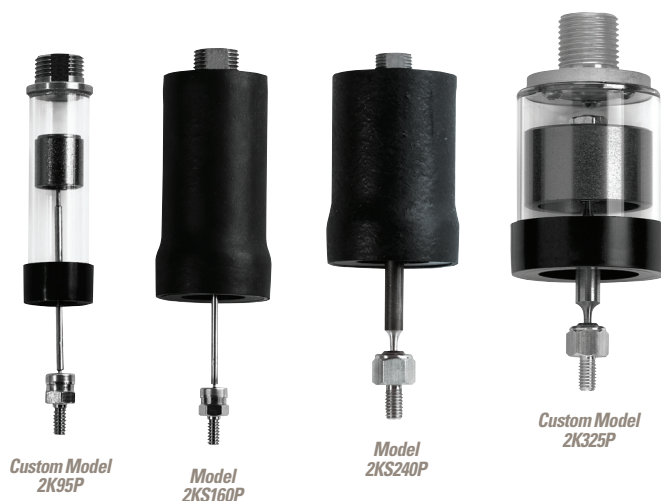
	2K56P	2K95P	2K160P	2K240P	2K325P	2K444P
Dimensional & Performance Specifications						
Bore (in)	.220	.366	.627	.945	1.281	1.750
Piston area (in ²)	.038	.105	.309	.701	1.289	2.405
Strokes (in)	0.5–6.0 depending on model (custom strokes and rod lengths available on request)					
Pressure range: full vacuum to (psi)	125	100	100	100	100	100
Force output at maximum pressure (lb)	4.75	10.5	30.9	70.1	128.9	240.5
Force factor rear side (factor x pressure = force output)	.038	.105	.309	.701	1.289	2.405
Minimum pressure differential required for actuation (psi)	.05	.05	.05	.05	.05	.05
Friction coefficient	.2	.2	.2	.2	.2	.2
Typical piston friction as % of load (without side load) *	.5–1.5	.5–1.5	.5–1.5	.5–1.5	.5–1.5	.5–1.5
Operating temperature range (°C/°F)	–55 to +150 –67 to +302	–55 to +150 –67 to +302	–55 to +150 –67 to +302	–55 to +150 –67 to +302	–55 to +150 –67 to +302	–55 to +150 –67 to +302

■ *Note: If operating at temperatures over 70°C (158°F) please advise factory.

Maximum Leak at Reference Pressures						
At pressure psi =	65/125	50/100	50/100	50/100	50/100	50/100
Maximum leak rate (standard L/min)	.190/.570	.36/1.17	.74/2.78	1.06/5.60	2.12/9.6	3.6/15.0

■ Note: If you require lower leak rates, please consult an Airpot applications engineer by contacting us at 800-848-7681 or engineering@airpot.com.

Component Weights						
Fixed mass (gram) (cylinder, bottom, etc.) = (C1 x stroke) + C2	C1	1.2	2.9	6.1	11.5	17.5
	C2	6.4	8.9	13.6	40.6	60.3
Movable mass (gram) (piston and rod) = (C3 x stroke) + C4	C3	.2	.4	.4	1.3	6.3
	C4	1.4	2.8	4.3	8.3	31.6



Actuators you can count on

The connecting rods—with ball joints at each end—provide easy, accurate low-friction alignment.

And, Airpot's Self-Aligning Actuators won't deteriorate, stick, or change properties due to humidity and temperature extremes or extended periods of non-use.



Airpel Specifications - Imperial Models

	E9	E16	E24
Dimensional & Performance Specifications			
Bore (in) <i>Note: 1.281" bore available in metric</i>	.366	.627	.945
Piston area (in²)	.105	.309	.701
Strokes (in)	0.5–12 depending on model (custom strokes and rod lengths available on request)		
Pressure range: full vacuum to (psi)	100	100	100
Force output at maximum pressure on rear side (lb)	10.5	30.9	70.1
Force output at maximum pressure on rod side (lb)	9.3	27.6	65.2
Force factor rear side (factor x pressure = force output)	.105	.309	.701
Force factor rod side (factor x pressure = force output)	.093	.276	.652
Minimum pressure differential required for actuation (psi)	<.2	<.2	<.2
Typical piston friction as % of load (without side load)	1–2	1–2	1–2
Operating temperature range (°C / °F)	–55 to +150 / –67 to +302	–55 to +150 / –67 to +302	–55 to +150 / –67 to +302

■ NOTE: Custom strokes and other features are available upon request. Please contact an Airpot applications engineer at 800-848-7681 or engineering@airpot.com.

Maximum Leak at Reference Pressures			
Maximum leak at 50 psi by piston (standard L/min)	1.16	1.39	2.2
Maximum leak at 50 psi by rod (standard L/min)	2.2	2.6	2.0

Component Weights			
Weight of piston / rod assembly only (gram)			
Single rod end models	4.5 + (1.36 x stroke)	16 + (3.6 x stroke)	40.64 + (6.46 x stroke)
Double rod end models	9.93 + (3.24 x stroke)	29.08 + (8.00 x stroke)	73.28 + (12.92 x stroke)
Weight of complete unit (gram)			
Single rod end models	31.7 + (9.52 x stroke)	64.6 + (15.8 x stroke)	156.42 + (31.12 x stroke)
Double rod end models	38.46 + (11.74 x stroke)	84.49 + (21.68 x stroke)	203.9 + (37.58 x stroke)

METRIC



Model E9 DU



Model E16 DN



Model E24 DD

Airpel
Anti-Stiction® and ultra-low friction for sensitive motion



Airpel Specifications - Metric Models

	M9	M16	M24	M32
Dimensional & Performance Specifications				
Bore (mm)	9.3	15.9	24.0	32.5
Piston area (mm ²)	67.7	198	452	830
Strokes (mm)	12.5–300 depending on model (custom strokes and rod lengths available on request)			
Maximum pressure: (MPa)	0.7	0.7	0.7	0.7
Suitable for vacuum actuation?	Yes	Yes	Yes	No
Force output at maximum pressure on rear side (N)	47.4	139	316	581
Force output at maximum pressure on rod side (N)	42.0	125	294	526
Force factor rear side [factor x pressure (MPa) = force output (N)]	67.7	198	452	830
Force factor rod side [factor x pressure (MPa) = force output (N)]	60.0	178	420	751
Minimum pressure differential required for actuation (MPa)	< 0.0015	< 0.0015	< 0.0015	< 0.0035
Typical piston friction as % of load (without side load)	1–2	1–2	1–2	1–2
Operating temperature range (°C / °F)	–55 to +150 / –67 to +302	–55 to +150 / –67 to +302	–55 to +150 / –67 to +302	–55 to +150 / –67 to +302
■ NOTE: Custom strokes and other features are available upon request. Please contact an Airpot applications engineer at 800 848-7681 or engineering@airpot.com .				

Maximum Leak at Reference Pressures				
Maximum leak at 0.34 MPa by piston (standard L/min)	1.16	1.39	2.2	2.2
Maximum leak at 0.34 MPa by rod (standard L/min)	2.2	2.6	2.6	2.0

Component Weights				
<i>Weight of piston/rod assembly (gram)</i>				
Single rod end models	4.5 + (0.053 x stroke)	16 + (0.142 x stroke)	41.4 + (0.254 x stroke)	82.6 + (0.56 x stroke)
Double rod end models	8.87 + (0.13 x stroke)	28.48 + (0.315 x stroke)	74.28 + (0.509 x stroke)	–
<i>Weight of complete unit (gram)</i>				
Single rod end models	31.7 + (0.375 x stroke)	64.6 + (0.622 x stroke)	157.18 + (1.225 x stroke)	616 + (3.66 x stroke)
Double rod end models	41.02 + (0.462 x stroke)	80.45 + (0.854 x stroke)	204.9 + (1.480 x stroke)	–

IMPERIAL 



Model M9 DD



Model M16 DN



Model M24 DU



Model M32 DU

Airpel
Anti-Stiction® and ultra-low friction for sensitive motion



Airpel Plus Specifications

	MP9	MP16	MP24	MP32
Dimensional & Performance Specifications				
Air Cylinder Type	Single acting, air extend	Single acting, air extend	Single acting, air extend	Single acting, air extend
Bore (mm)	9.3	15.9	24.0	32.5
Piston area (mm ²)	67.7	198	452	830
Strokes (mm)	10.0–300 depending on model (custom strokes and rod lengths available on request)			
Force factor (factor x pressure [MPa] = force output [N])	67.7	198	452	830
Maximum pressure (MPa)	0.7	0.7	0.7	0.7
Minimum pressure (MPa)	0.0015	0.0015	0.0015	0.0015
Maximum leak at 0.34 MPa (standard L/min)	1.7	2.1	3.3	3.3
Piston friction with air supply above 0.2 MPa (cylinder horizontal)	0.5% of load max	0.5% of load max	0.5% of load max	0.5% of load max
Piston friction with air supply above 0.04 MPa (cylinder vertical)	0.5% of load max	0.5% of load max	0.5% of load max	0.5% of load max
Operating temperature range (°C/°F)	–20 to +85/–4 to +185	–20 to +85/–4 to +185	–20 to +85/–4 to +185	–20 to +85/–4 to +185

Component Weights				
	MP9S-NF	MP16S-NX	MP24S-NX	MP32S-NX
Weight of piston/rod assembly only (gram)	5.4 + (0.06 x stroke)	16.4 + (0.15 x stroke)	25.5 + (0.25 x stroke)	65.2 + (0.39 x stroke)
Weight of complete unit (gram)	24.9 + (0.38 x stroke)	57.3 + (0.66 x stroke)	112.1 + (1.22 x stroke)	484.4 + (3.49 x stroke)
	MP9S-NV	MP16S-NV	MP24S-NV	MP32S-NV
Weight of piston/rod assembly only (gram)	4.5 + (0.06 x stroke)	13.3 + (0.15 x stroke)	22.8 + (0.25 x stroke)	61.2 + (0.39 x stroke)
Weight of complete unit (gram)	24.1 + (0.38 x stroke)	50.6 + (0.66 x stroke)	109.5 + (1.22 x stroke)	480.4 + (3.49 x stroke)
	MP9S-SF	MP16S-SX	MP24S-SX	–
Weight of piston/rod assembly only (gram)	5.4 + (0.06 x stroke)	16.4 + (0.15 x stroke)	25.5 + (0.25 x stroke)	–
Weight of complete unit (gram)	28.5 + (0.38 x stroke)	62.4 + (0.66 x stroke)	132.4 + (1.22 x stroke)	–
	MP9S-SV	MP16S-SV	MP24S-SV	–
Weight of piston/rod assembly only (gram)	4.5 + (0.06 x stroke)	13.3 + (0.15 x stroke)	22.8 + (0.25 x stroke)	–
Weight of complete unit (gram)	27.6 + (0.37 x stroke)	59.3 + (0.66 x stroke)	129.8 + (1.22 x stroke)	–

Other Important Information

- Airpel-MP cylinders must be supplied with clean, dry, unlubricated air, with particle filtration at one micron or less. A coalescing filter is required.
- Airpel-MP cylinders are intended for use in straight line applications. Joints are provided to handle small misalignments, so care should be taken to minimize parallel and angular misalignment.
- Airpel-MP cylinders require external stops. Piston must not be used as a stop in either direction.
- Because they are nearly frictionless, Airpel-MP cylinders can be used at high speeds. Very high speeds in the extending direction, however, can reduce the air bearing effect, possibly causing additional friction.
- Airpel-MP cylinders cannot be used with vacuum. ■ Consult the factory if you wish to use gases other than air.

MORE 



Model MP9S-SF



Model MP16S-NV



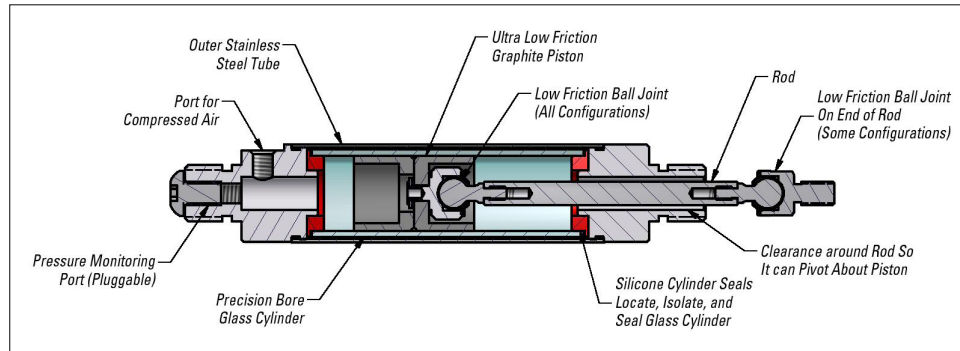
Model MP32S-NX



Model MP24S-NX



Airpel Plus, explained



Where does Airpel Plus fit in?

To expand and enhance the Airpel family of accurate force, ultra low-friction air cylinders, we developed the Airpel Plus line.

These Airpel models occupy the middle of the price/performance range between our standard Anti-Stiction® Airpel and the Force Without Friction® Airpel-AB.® By combining features and components from these original two designs, we are able to offer a high-performance air cylinder for applications requiring even lower friction than the standard Airpel but at a price well below our top-of-the-line Airpel-AB.

The Airpel Plus uses the same individually matched graphite piston and borosilicate glass cylinder combination as our standard Airpel. But the piston construction of the Plus takes advantage of our unique Airpel-AB technology.

The result is an air cylinder with friction levels approaching a mere 25% of the standard Airpel model. This allows for even greater force accuracy and more precise resolution while offering a significant cost savings over the Airpel-AB.

Welcome news, we know.

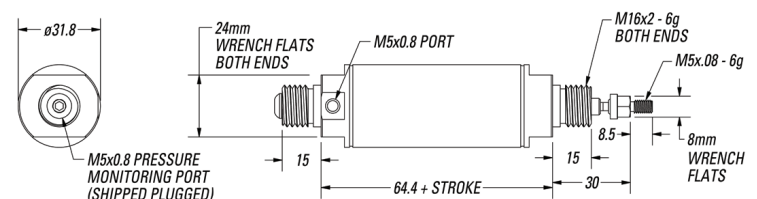
In addition, the Airpel Plus offers almost the same wide

operating temperature range (-20°C to +85°C) of our AB, plus the long life of our original Anti-Stiction Airpel. Airpel Plus models are currently available in standard configurations as single acting—extension models with the same metric sizes, threads, mounts and strokes as the Airpel-AB, so most models can be easily interchanged if you are unsure which product will best meet your requirements—or if needs change with new designs.

These versatile Airpels can also be made in double-acting configurations upon request (and ideally after discussion with our application engineers about retraction direction characteristics).

You'll find these actuators are perfectly suited for counter-balancing, tension control, and almost any other application requiring highly accurate force control.

Just imagine!



Airpel-AB Specifications

	MAB9	MAB16	MAB24	MAB32
Dimensional & Performance Specifications				
Air cylinder type	Single acting, air extend	Single acting, air extend	Single acting, air extend	Single acting, air extend
Bore (mm)	9.3	15.9	24.0	32.5
Piston area (mm ²)	67.7	198	452	830
Strokes (mm)	10.0–300.0 depending on model (custom strokes and rod lengths available on request)			
Force factor (factor x pressure [MPa] = force output [N])	67.7	198	452	830
Maximum pressure (MPa)	0.7	0.7	0.7	0.7
Minimum pressure (MPa) with cylinder horizontal <i>(See Note 1.)</i>	0.15	0.15	0.15	0.15
Minimum pressure (MPa) with cylinder vertical	0.03	0.03	0.03	0.03
Maximum leak at 0.2 MPa (standard L/min)	5	6	9	14
Typical leak at 0.2 MPa (standard L/min)	3.5	4	6	10
Piston friction (N) with air supply above minimum pressure	0	0	0	0
Operating temperature range (°C/°F)	–20 to +90/–4 to +194	–20 to +60/–4 to +140	–20 to +50/–4 to +122	–20 to +40/–4 to +104

■ *Note 1: Minimum pressure may be lower with short stroke units because of lower rod mass.*

	MAB9S-NF	MAB16S-NX	MAB24S-NX	MAB32S-NX
Component Weights				
Weight of piston/rod assembly only (gram)	10.1 + (0.06 x stroke)	34.9 + (0.15 x stroke)	63.1 + (0.25 x stroke)	164.4 + (0.39 x stroke)
Weight of complete unit (gram)	29.5 + (0.37 x stroke)	72.0 + (0.66 x stroke)	155.8 + (1.22 x stroke)	602.3 + (3.49 x stroke)
	MAB9S-NV	MAB16S-NV	MAB24S-NV	MAB32S-NV
Weight of piston/rod assembly only (gram)	9.4 + (0.06 x stroke)	31.9 + (0.15 x stroke)	60.5 + (0.25 x stroke)	159.7 + (0.39 x stroke)
Weight of complete unit (gram)	28.8 + (0.37 x stroke)	68.9 + (0.66 x stroke)	153.2 + (1.22 x stroke)	597.6 + (3.49 x stroke)
	MAB9S-SF	MAB16S-SX	MAB24S-SX	–
Weight of piston/rod assembly only (gram)	10.1 + (0.06 x stroke)	34.9 + (0.15 x stroke)	63.1 + (0.25 x stroke)	–
Weight of complete unit (gram)	33.1 + (0.37 x stroke)	80.7 + (0.66 x stroke)	176.1 + (1.22 x stroke)	–
	MAB9S-SV	MAB16S-SV	MAB24S-SV	–
Weight of piston/rod assembly only (gram)	9.4 + (0.06 x stroke)	31.9 + (0.15 x stroke)	60.5 + (0.25 x stroke)	–
Weight of complete unit (gram)	32.4 + (0.37 x stroke)	77.7 + (0.66 x stroke)	173.5 + (1.22 x stroke)	–

Other Important Information

- Airpel-AB cylinders must be supplied with clean, dry, unlubricated air, with particle filtration at one micron or less. A coalescing filter is required.
- Airpel-AB cylinders are intended for use in straight line applications. Joints are provided to handle small misalignments, so care should be taken to minimize parallel and angular misalignment.
- Airpel-AB cylinders require external stops. Piston must not be used as a stop in either direction.
- Because of the frictionless motion, Airpel-AB cylinders can be used at high speeds. Very high speeds in the extending direction, however, can reduce the air bearing effect, possibly causing the piston to touch the cylinder wall.
- Airpel-AB cylinders cannot be used with vacuum. ■ Please consult the factory if you wish to use gases other than air.

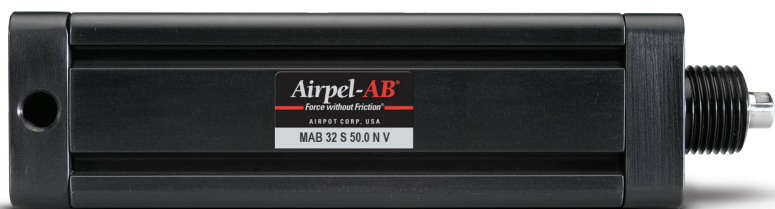
MORE 



Model MAB9S-SV



Model MAB16S-NX



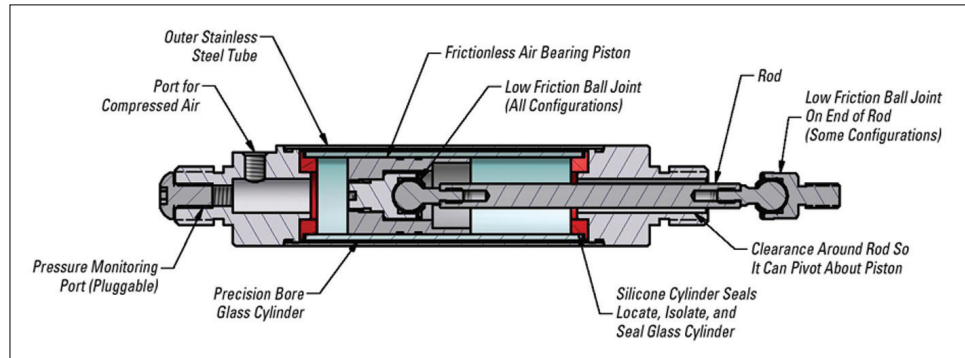
Model MAB32S-NV



Model MAB24S-NV



The Airpel-AB, explained



Just how does this work anyway?

The Airpel-AB Air Bearing Cylinder line features a specially shaped stainless steel piston that is precisely fitted to a borosilicate glass cylinder. The introduction of pressurized air into the air bearing's cylinder creates a *true* air-bearing airflow effect around the piston.

So, with as little as 5 psi of air applied to the cylinder, the same air that drives the piston also produces a stiff circumferential buffer of air. It is this air-powered cushion that supports the piston and prevents it from contacting the cylinder wall. The result is a frictionless air cylinder that delivers virtually unlimited piston life, super clean operation, with no need for lubrication—just the kind of advantages we figured you'd want.

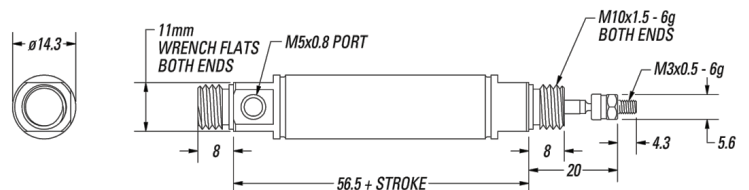
Because the output force of this zero-friction air cylinder is reduced only infinitesimally by movement of the ultra-low friction ball joint used to connect the rod, the force can be

controlled to exceedingly high levels of accuracy and resolution.

These unique air cylinders provide the ultimate in accurate force pneumatic control for applications such as tensioning, counterbalancing linear actuator motor driven loads, and applying squeezing or holding forces to within 0.5 gm resolution.

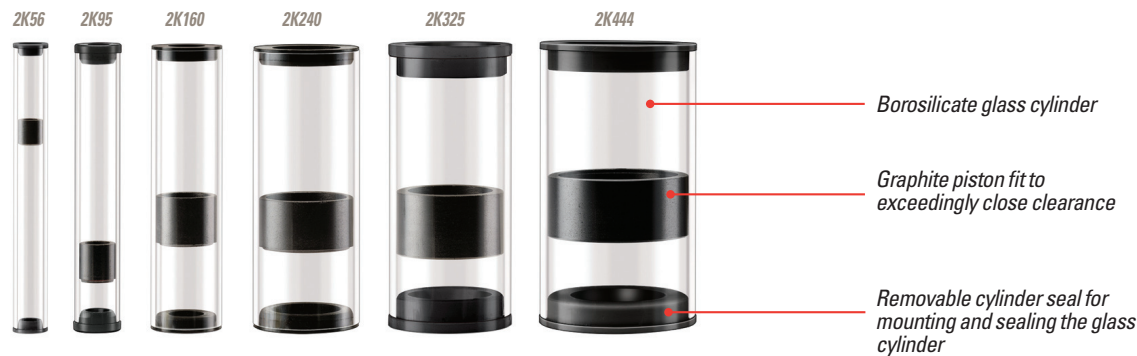
You'll find Airpel-AB air bearing actuators are available in metric models with four bore diameters and ten standard strokes to provide precisely repeatable driving or supporting forces from 2 grams to 58 kg. Operating temperatures range from -20°C to $+90^{\circ}\text{C}$.

What more could an enterprising engineer ask for?



Piston/Cylinder Set Specifications

	2K56	2K95	2K160	2K240	2K325	2K444
Dimensional Specifications						
Bore (in)	.220	.366	.627	.945	1.281	1.75
Piston area (in²)	.038	.105	.309	.701	1.289	2.405
Strokes (in)	0.5–8.0 depending on model (custom strokes and rod lengths available upon request)					
Outside diameter (maximum)	.311	.462	.746	1.088	1.456	1.925
Piston length	.225	.375	.505	.505	.750	.750
Cylinder length = desired stroke (in) plus	.325	.475	.605	.605	.850	.850
Performance Specifications						
Friction coefficient	.2	.2	.2	.2	.2	.2
Operating temperature range (°C/°F)	–55 to +260 –67 to +500	–55 to +260 –67 to +500	–55 to +260 –67 to +500	–55 to +260 –67 to +500	–55 to +260 –67 to +500	–55 to +260 –67 to +500
Pressure range: full vacuum to (psi)	125	100	100	100	100	100
Force output at maximum pressure (lb)	4.75	10.5	30.9	70.1	128.8	240.1
Minimum pressure differential required for actuation (psi)	.05	.05	.05	.05	.05	.05
Component Weights						
Maximum cylinder weight (gram/in)	1.39	2.29	4.71	8.39	13.82	18.56
Piston weight (gram)	.20	.77	2.37	4.66	17.75	34.60



Each piston and cylinder set is an individually matched pair, sized with an extremely high degree of accuracy. (Don't even think of switching parts!)

Innovative engineers have enhanced their designs by adapting part or all of a standard purchased component to provide a non-traditional function. Our precisely matched graphite piston and Pyrex® glass cylinder sets are often chosen to support such ingenuity due to the special properties of our basic components.

Over the years, Airpot P/C sets have been used as bearings, vacuum pickups, Stirling engine power pistons, rate of climb indicators, earthquake sensors, spool valves, flow meters, pumps, pressure sensors, and other unexpected customer-generated designs. You name it! Quite often, we are asked to assemble or modify these parts to fabricate special subassemblies.

If you are an engineer or technical student interested in seeing first hand the useful characteristics of our P/C sets, we'd be very pleased to send you one as a free sample.



Miniature I/P, E/P Transducer Specifications

	Standard Range		High Output Range		
	AFPT 1	AFPT 2	AFPT 3	AFPT 4	AFPT 5
Functional Specifications					
Inputs (when ordering, choose one by letter designation)	(A) 4–20 mA ■ (C) 0–5 VDC ■ (E) 0–10 VDC ■ (F) 1–5 VDC ■ (D) 1–9 VDC				
Outputs (psig)	0–15*	0–30*	0–60*	2–60	2–100
Outputs (bar)	(0.00–1.00)	(0.00–2.00)	(0.00–4.00)	(0.14–4.00)	(0.14–6.90)
Supply pressure (psig)	25–65	40–70	70–80	65–130	105–130
Supply pressure (bar)	1.72–4.50	2.75–4.82	4.82–5.50	4.50–9.00	7.20–9.00
Air consumption at mid-range typical*	1.5 scfh (0.04 m³/hr)		4.5 scfh (0.13 m³/hr)		
Operating temperature limits	–40°F to +158°F (–40°C to +70°C)				
Storage temperature range	–40°F to +200°F (–40°C to +93°C)				
Loop load, I/P transducer	9.5 VDC @ 20 mA				
Supply voltage, E/P transducer	7–30 VDC, less than 3 mA				
Signal impedance E/P transducer	10 kilohms				

■ * Zero-based units have slightly higher air consumption.

Performance Specifications	
Accuracy, Hysteresis, and Repeatability	±0.10% of span guaranteed
Deadband	.02% of span
Position effect	No measurable effect
Vibration effect	Less than ±1.0% of span under the following conditions: 5–15 Hz @ 0.8 inches constant displacement; 1–500 Hz @ 10 g's
Supply pressure effect	No measurable effect
Temperature effect	±0.045%/°F (0.07%/°C) of span
Reverse polarity effect	No damage from reversal of normal supply current (4–20 mA) or from misapplication of up to 60 mA
RFI/EMI effect	< 0.5% of span change in output pressure per En 61000–4–3:1998, Amendment 1, Performance Criterion A

Physical Specifications	
Port size, pneumatic	1/4" NPT
Port size, electric	1/2" NPT
Media	Clean, dry, oil-free, air filtered to 40 microns
Mounting	Wall, panel, 1.5" or 2" pipe (optional) or DIN rail (optional)
Housing material	Chromate-treated aluminum with epoxy paint, NEMA 4X (IP65)
Elastomers	Buna-N
Trim material	Stainless steel; brass; zinc-plated steel
Weight	13 oz (0.4 kg)

Other Important Information

- A bimorph piezo actuator encapsulated in a protective skin provides constant defense against humidity and contaminants.
- Unique control and feedback circuitry provide precise, stable output with Airpot's AFP optimized systems.



ControlAir 900 X
miniature transducer



Airpel® FFR Specifications Compact System

Compact System Specifications	System Components				
	High Precision Regulator (60 psi / 0.4 MPa)	High Precision Regulator (100 psi / 0.7 MPa)	Standard Regulator (120 psi / 0.85 MPa)	5 micron Filter	0.01 micron Coalescing Filter
System # PFRN1-1 (NPT ports)	PRN1-1	—	—	F5N1-1	FCN1-1
System # PFRG1-1 (G ports)	PRG1-1	—	—	F5G1-1	FCG1-1
System # PFRN1-2 (NPT ports)	—	PRN1-2	—	F5N1-1	FCN1-1
System # PFRG1-2 (G ports)	—	PRG1-2	—	F5G1-1	FCG1-1
System # SFRN1-1 (NPT ports)	—	—	SRN1-1	F5N1-1	FCN1-1
System # SFRG1-1 (G ports)	—	—	SRG1-1	F5G1-1	FCG1-1
Working fluid	Clean compressed air	Clean compressed air	Compressed air	Compressed air	Compressed air
Maximum working pressure	150 psi / 1 MPa	150 psi / 1 MPa	150 psi / 1 MPa	150 psi / 1 MPa	15 to 150 psi / 0.1 to 1.0 MPa
Minimum working pressure	Set Pressure + 15 psi / 0.1 MPa	Set Pressure + 15 psi / 0.1 MPa	—	—	—
Withstanding pressure	220 psi / 1.5 MPa	220 psi / 1.5 MPa	220 psi / 1.5 MPa	220 psi / 1.5 MPa	220 psi / 1.5 MPa
Ambient temperature range/ fluid temperature (°C)	-5 to +60 (to be unfrozen)	-5 to +60 (to be unfrozen)	+5 to +60	+5 to +60	+5 to +60
Set pressure range	.7 psi to 60 psi / 0.005 to 0.4 MPa	.7 psi to 100 psi / 0.005 to 0.7 MPa	7 psi to 120 psi / 0.05 to 0.85 MPa	—	—
Sensitivity	.06 psi / 0.0004 MPa	.06 psi / 0.0004 MPa	—	—	—
Repeatability	.3 psi / 0.002 MPa	.3 psi / 0.002 MPa	—	—	—
Air consumption	≤ 1.3 std L/min	≤ 1.3 std L/min	—	—	—
Filtration rating	—	—	—	5 micron	0.01 micron
Relief mechanism	Included	Included	Included	—	—
Drain capacity	—	—	—	12 cm³	3 cm³
Port size NPT or G	1/4	1/4	1/4	1/4	1/4
Product weight (gram)	250	250	160	87	96
Standard accessories	—	—	Pressure gauge, nut for panel mount	Bowl guard	Bowl guard
Maximum flow rate with 0.7 MPa input pressure and 0.01 MPa pressure drop	—	—	—	150 std L/min	150 std L/min
Secondary side oil concentration	—	—	—	—	≤ 0.01 mg/m³

HIGH FLOW 



PFRN1-1
Precision Filter-Filter-Regulator



SFRN1-1
Standard Filter-Filter-Regulator



Precise control and optimal air
quality in a compact size



Airpel® FFR Specifications High Flow System

High Flow System Specifications	System Components			
	High Precision Regulator	Standard Regulator	5 micron Filter	0.01 micron Coalescing Filter
System # PFRN3-1 (NPT ports)	PRN3-1	—	F5N3-1	FCN3-1
System # PFRG3-1 (G ports)	PRG3-1	—	F5G3-1	FCG3-1
System # SFRN3-1 (NPT ports)	—	SRN3-1	F5N3-1	FCN3-1
System # SFRG3-1 (G ports)	—	SRG3-1	F5G3-1	FCG3-1
Working fluid	Clean compressed air	Compressed air	Compressed air	Compressed air
Maximum working pressure	150 psi / 1 MPa	150 psi / 1 MPa	150 psi / 1 MPa	15 to 150 psi / 0.1 to 1.0 MPa
Minimum working pressure	Set pressure +14.5 psi / 0.1 MPa	—	—	—
Withstanding pressure	220 psi / 1.5 MPa	220 psi / 1.5 MPa	220 psi / 1.5 MPa	220 psi / 1.5 MPa
Ambient temperature range/fluid temperature (°C)	-5 to +60 (to be unfrozen)	+5 to +60	+5 to +60	+5 to +60
Set pressure range	5 to 120 psi / 0.03 to 0.85 MPa	7 to 120 psi / 0.05 to 0.85 MPa	—	—
Sensitivity	.25 psi / 0.0017 MPa	—	—	—
Repeatability	.63 psi / 0.0043 MPa	—	—	—
Air consumption	≤ 5 std L/min	—	—	—
Filtration rating	—	—	5 micron	0.01 micron
Relief mechanism	Included	Included	—	—
Drain capacity	—	—	45 cm ³	45 cm ³
Port size NPT or G	3/8	3/8	3/8	3/8
Product weight (gram)	470	450	250	280
Standard accessories	—	Pressure gauge, nut for panel mount	Bowl guard	Bowl guard
Maximum flow rate with 0.7 MPa input pressure and 0.01 MPa pressure drop	—	—	360 std L/min	360 std L/min
Secondary side oil concentration	—	—	—	≤ 0.01 mg/m ³

COMPACT 



PFRN3-1
Precision Filter-Filter-Regulator



SFRN3-1
Standard Filter-Filter-Regulator

