

# Air Combination

## F.R.L. Units AC Series



### Mounting

#### Step ①



- Mount the product by lining up the mating surface of the new spacer with bracket.
- Insert the retainer into the spacer bolt and tighten the nut. (temporary assembling)

#### Step ②



- Tighten the nut with the hexagon wrench.

#### Interchangeable with current model

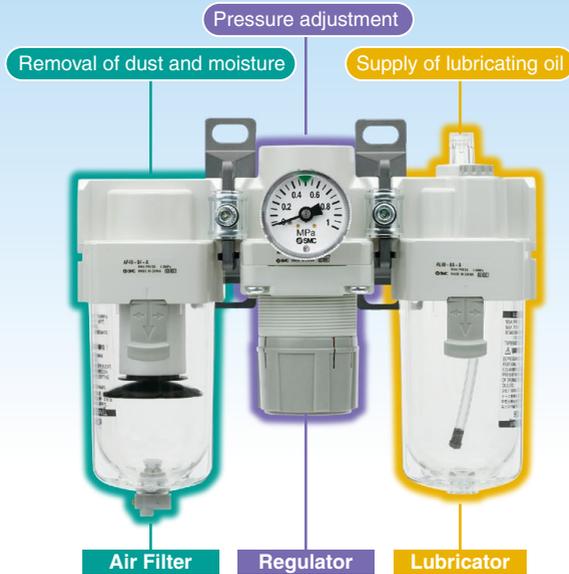
- New spacer can be connected to current AF, AR, AL, AW series.
- Current spacer cannot be used for new AR□A, AW□A series.

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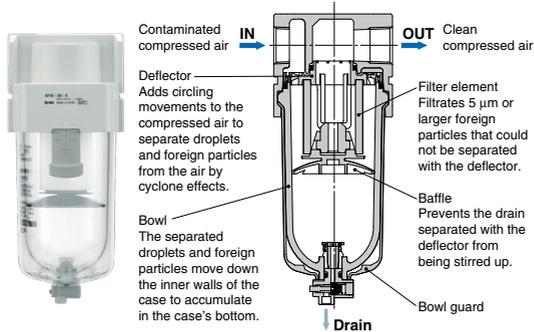


In general, moisture, oil content and solid foreign matter contained in compressed air from compressors used in general industrial machinery are removed using air preparation equipment before the air reaches an operating line. The compressed air experiences a temperature drop on the way to the operating line and oversaturated moisture due to condensation or rust inside the piping may mix into the compressed air, possibly causing problems to pneumatic equipment. In addition, proper pressure levels must be set at the operating line according to the type of equipment. In most applications, the Air Combination is installed in the operating line and used for the purpose of preventing the above-mentioned problems and setting required pressures. The Air Combination basically consists of an air filter, a regulator and a lubricator and has the following functions.



## Air Filter

The air filter is installed at the inlet to prevent moisture and dust contained in compressed air from entering the pneumatic control circuit.

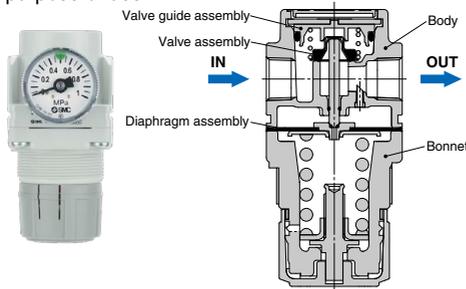


A 5 μm element has been employed as a standard for the air filter's nominal filtration rating and this nominal filtration rating is compatible with most general-purpose pneumatic equipment. If a filtration rating other than 5 μm are required, select an air filter that uses an element with a different filtration rating. If the Air Combination is used in, for example, precision instruments and even finer foreign particles need to be removed, select a mist separator (0.3 μm) or a micromist separator (0.01 μm).

Refer to the "Air Preparation Equipment" catalog no. NCAT.E30-1.

## Regulator

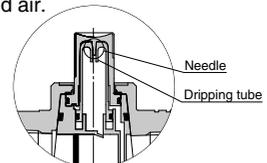
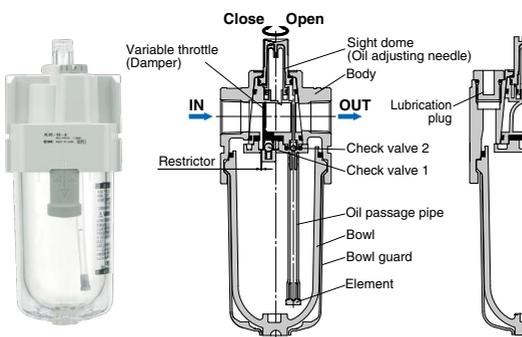
In pneumatic control equipment, a regulator or other pressure control valves are used since the pressure of air from an air compressor need to be reduced to a specific level according to the purpose of use.



Regulators come in general-purpose and precision models are selectively used according to their setting accuracy. In most cases, the setting accuracy levels of general-purpose and precision regulators are approximately ±0.05 MPa and ±0.01 MPa, respectively. In general industrial machinery, general-purpose regulators are commonly used, while precision regulators are used only when high pressure accuracy levels are required.

## Lubricator

Portions of pneumatic equipment in need of lubrication include control valve spools and the sliding surfaces of, for example, cylinder pistons and pneumatic motor vanes. Since compressed air is commonly applied to these pieces of equipment, they cannot be easily lubricated from the outside. The method employed to solve this problem is to install a specially-constructed lubricator in the pipe line to mix lubricating oil into the compressed air.



Detailed view of the sight dome

## Air Combination Basic Specifications

Air Filter



Regulator



Lubricator

### [Application]

Applicable to remove solid foreign objects sized 5 μm or more and oversaturated water contained in the compressed air, prevent malfunction of actuators and solenoid valves, control (regulate) the outlet pressure, suppress fluctuations of the outlet pressure affected by fluctuations of the inlet pressure, and apply oil to pneumatic equipments at the outlet side.



AC20



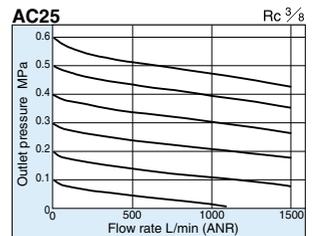
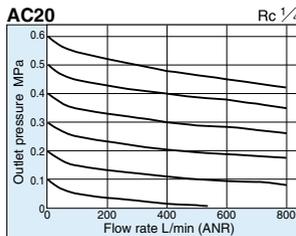
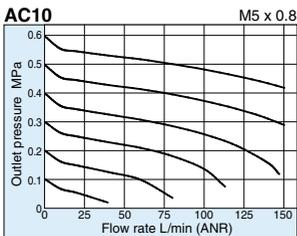
AC40

### Standard Specifications

Model	AC10	AC20	AC25	AC30	AC40	AC40-06	AC50	AC55	AC60	
Component	Air Filter	AF10	AF20	AF30	AF30	AF40	AF40-06	AF50	AF60	AF60
	Regulator	AR10	AR20	AR25	AR30	AR40	AR40-06	AR50	AR50	AR60
	Lubricator	AL10	AL20	AL30	AL30	AL40	AL40-06	AL50	AL60	AL60
Port size	M5	1/8, 1/4	1/4, 3/8	1/4, 3/8	1/4, 3/8, 1/2	3/4	3/4, 1	1	1	1
Fluid	Air									
Proof pressure (MPa)	1.5									
Max. operating pressure (MPa)	1.0									
Set pressure range (MPa)	0.05 to 0.7									0.05 to 0.85
Ambient and fluid temperature (°C)	-5 to 60 (No freezing)									
Nominal filtration rating (μm)	5									
Bowl material	Polycarbonate									
Bowl guard	—	Semi-standard								Standard
Regulator construction	Relieving type									
Weight (kg)	0.27	0.46	0.91	1	1.74	1.95	4.17	4.25	4.34	

### Flow Rate Characteristics (Representative value)

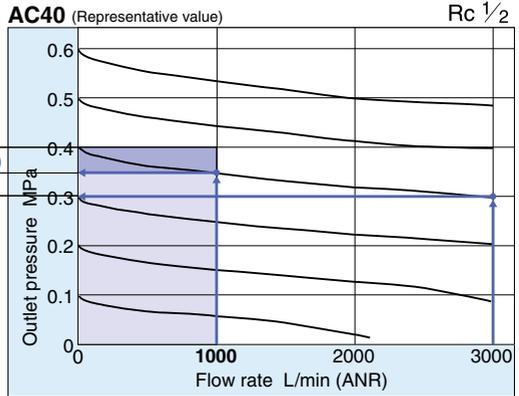
Condition: Inlet pressure 0.7 MPa



## Selecting a body size applicable to service conditions according to the flow rate and flow rate characteristics

### (Example) Selecting the AC40

The flow rate characteristics are presented by characteristic charts indicating the variation of set pressure (amount of pressure drop) corresponding to the consumption air flow at the outlet side. When the outlet pressure is set to 0.4 MPa and the air flow of 1000 L/min (ANR) is supplied, the set pressure drops to 0.35 MPa. If the required pressure range of a device is between 0.3 and 0.4 MPa and the set pressure of AC40 is set to 0.4 MPa, the corresponding air flow rate to the outlet pressure of 0.3 MPa is indicated to be 3000 L/min (ANR) in the chart, therefore the air flow is allowed to be provided up to this flow rate. If the air flow rate is required more than this, select a larger size.



### The approx. characteristic value when the air combination inlet pressure is different from the flow rate characteristic conditions (0.7 MPa) in the catalog

Generally, the approx. value can be guessed using the flow rate characteristics chart in the catalog.

Calculation method: Calculate the flow rate in relation to the actual inlet pressure from the absolute pressure ratio

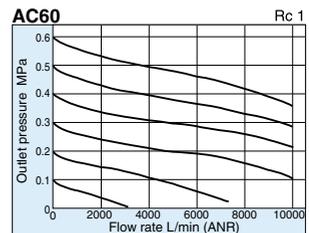
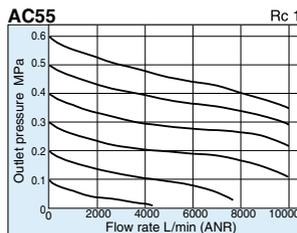
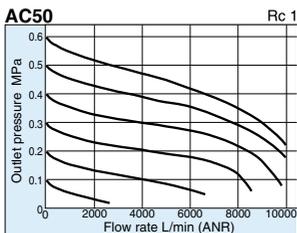
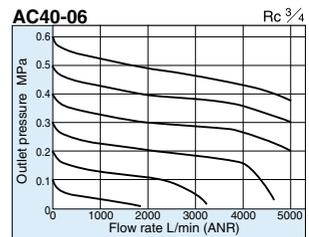
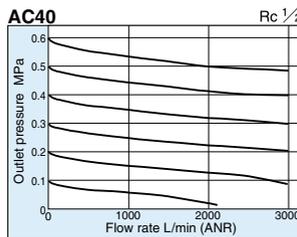
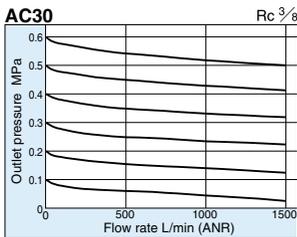
$$\text{Absolute pressure ratio} = \frac{\text{Actual inlet pressure}}{\text{Flow rate characteristic inlet pressure}}$$

Ex.) When the inlet pressure is 0.5 MPa  $\frac{0.5 + 0.1}{0.7 + 0.1} = 0.75$  Correct to: Flow rate value x 0.75

Ex.) When the inlet pressure is 1.0 MPa  $\frac{1.0 + 0.1}{0.7 + 0.1} = 1.375$  Correct to: Flow rate value x 1.375

## Flow Rate Characteristics (Representative value)

Condition: Inlet pressure 0.7 MPa



# Variation of Combination

## Foreign matter and moisture removal + Pressure control + Lubrication

(Nominal filtration rating: 5  $\mu\text{m}$ ) (0.05 to 0.85 MPa)



Air Filter + Regulator + Lubricator

Filter Regulator + Lubricator

## Foreign matter and moisture removal + Pressure control

(Nominal filtration rating: 5  $\mu\text{m}$ ) (0.05 to 0.85 MPa)



Air Filter + Regulator

## Foreign matter and moisture removal + Oil mist removal + Pressure control

(Nominal filtration rating: 5  $\mu\text{m}$ ) (Nominal filtration rating: 0.3  $\mu\text{m}$ ) (0.05 to 0.85 MPa)



Air Filter + Mist Separator + Regulator



Filter Regulator + Mist Separator

AC-A 6 P.395	AF-A 6 P.429	AR-A 6 P.449	AL-A 6 P.459	AW-A 6 P.467	AFM-A 6 P.440
AC-B 6 P.481	AF-A 6 P.523	AR-B 6 P.543	AL-A 6 P.559	AW-B 6 P.567	AFM-A 6 P.534

Appearance	Model	Port size	Component				
			Air Filter AF	Regulator AR	Lubricator AL	Filter Regulator AW	Mist Separator AFM
<b>AF + AR + AL</b> 	AC10	M5 x 0.8	AF10	AR10	AL10	—	—
	AC20	1/8, 1/4	AF20	AR20	AL20		
	AC25	1/4, 3/8	AF30	AR25	AL30		
	AC30	1/4, 3/8	AF30	AR30	AL30		
	AC40	1/4, 3/8, 1/2	AF40	AR40	AL40		
	AC40-06	3/4	AF40-06	AR40-06	AL40-06		
	AC50	3/4, 1	AF50	AR50	AL50		
	AC55	1	AF60	AR50	AL60		
AC60	1	AF60	AR60	AL60			
<b>AW + AL</b> 	AC10A	M5 x 0.8	—	—	AL10	AW10	—
	AC20A	1/8, 1/4			AL20	AW20	
	AC30A	1/4, 3/8			AL30	AW30	
	AC40A	1/4, 3/8, 1/2			AL40	AW40	
	AC40A-06	3/4			AL40-06	AW40-06	
	AC50A	3/4, 1			AL50	AW60	
	AC60A	1			AL60	AW60	
	<b>AF + AR</b> 	AC10B			M5 x 0.8	AF10	
AC20B		1/8, 1/4	AF20	AR20			
AC25B		1/4, 3/8	AF30	AR25			
AC30B		1/4, 3/8	AF30	AR30			
AC40B		1/4, 3/8, 1/2	AF40	AR40			
AC40B-06		3/4	AF40-06	AR40-06			
AC50B		3/4, 1	AF50	AR50			
AC55B		1	AF60	AR50			
AC60B	1	AF60	AR60				
<b>AF + AFM + AR</b> 	AC20C	1/8, 1/4	AF20	AR20	—	—	AFM20
	AC25C	1/4, 3/8	AF30	AR25			AFM30
	AC30C	1/4, 3/8	AF30	AR30			AFM30
	AC40C	1/4, 3/8, 1/2	AF40	AR40			AFM40
	AC40C-06	3/4	AF40-06	AR40-06			AFM40-06
	<b>AW + AFM</b> 	AC20D	1/4, 3/8	—			—
AC30D		1/4, 3/8	AW30		AFM30		
AC40D		1/4, 3/8, 1/2	AW40		AFM40		
AC40D-06		3/4	AW40-06		AFM40-06		

Directional  
Control Valves

Actuators

Air Preparation  
Equipment

Air Combination

Pressure Control  
Equipment

Pressure Detection  
Equipment

Flow Rate Detection  
Equipment

# Variation of Combination

Product classification					Specifications and			
Appearance	Function	Application	Connection	Model	Set pressure range MPa	Max. flow rate *1 L/min (ANR)	Pressure characteristics (Air supply pressure characteristics) %	
<b>AF + AR + AL</b> ① Air Filter + ② Regulator + ③ Lubricator 	Foreign matter and moisture removal + Pressure control + Lubrication	General industrial equipment air tool (lubrication equipment)	Modular connection	AC10	0.05 to 0.7	180	17	
				AC10A				
				AC20	0.05 to 0.85	1,900	2	
				AC20A		1,700		
				AC25	0.05 to 0.85	2,400	2	
				AC30		3,500		
				AC30A	0.05 to 0.85	2,300	2	
				AC40		5,800		
				AC40A	0.05 to 0.85	4,600	2	
				AC40-06		5,800		
				AC40A-06	0.05 to 0.85	4,600	2	
				AC50		10,000		
				AC50A	0.05 to 0.85	13,000	2	
				AC55		14,000		
AC60	0.05 to 0.85		2					
AC60A								
<b>AF + AR</b> ① Air Filter + ② Regulator 	Foreign matter and moisture removal + Pressure control	General industrial equipment (non-lube equipment)	Modular connection	AC10B	0.05 to 0.7	180	17	
				AC20B				
				AC25B	0.05 to 0.85	1,900	2	
				AC30B		2,400		
				AC40B	0.05 to 0.85	3,500	2	
				AC40B-06		5,800		
				AC50B	0.05 to 0.85	5,800	2	
				AC55B		10,000		
				AC60B	0.05 to 0.85	13,000	2	
						14,000		
<b>AF + AFM + AR</b> ① Air Filter + ② Mist Separator + ③ Regulator  <b>AW + AFM</b> ① Filter Regulator + ② Mist Separator 	Foreign matter and moisture removal + Oil mist removal + Pressure control	Instrumentation and control air (non-lube air)	Modular connection	AC20C	0.05 to 0.85	200*2	2	
				AC20D				
				AC25C	0.05 to 0.85	450*2	2	
				AC30C		450*2		
				AC30D	0.05 to 0.85		2	
				AC40C				
				AC40D	0.05 to 0.85	1,100*2	2	
				AC40C-06				
				AC40D-06	0.05 to 0.85	1,100*2	2	

\*1: Indicates the maximum flow rate at inlet pressure 0.7 MPa or the maximum flow rate at inlet pressure 0.7 MPa and set pressure 0.5 MPa.  
 \*2: Indicates the rated flow of inlet pressure 0.7 MPa.

AC-A 6 P.395	AF-A 6 P.429	AR-A 6 P.449	AL-A 6 P.459	AW-A 6 P.467	AFM-A 6 P.440
AC-B 6 P.481	AF-A 6 P.523	AR-B 6 P.543	AL-A 6 P.559	AW-B 6 P.567	AFM-A 6 P.534

\* Select with particular attention to the maximum flow rate and the port size.

Characteristics		Piping	Product combination				
Nominal filtration rating $\mu\text{m}$	Oil mist concentration $\text{mg}/\text{m}^3$ (ANR)	Port size	Air Filter AF	Regulator AR	Lubricator AL	Filter Regulator AW	Mist Separator AFM
5	—	M5	① AF10	② AR10	③ AL10	—	—
			—	—	② AL10	① AW10	—
5	—	1/8, 1/4	① AF20	② AR20	③ AL20	—	—
			—	—	② AL20	① AW20	—
5	—	1/4, 3/8	① AF30	② AR25	③ AL30	—	—
5	—	1/4, 3/8	① AF30	② AR30	③ AL30	—	—
			—	—	② AL30	① AW30	—
5	—	1/4, 3/8, 1/2	① AF40	② AR40	③ AL40	—	—
			—	—	② AL40	① AW40	—
5	—	3/4	① AF40-06	② AR40-06	③ AL40-06	—	—
			—	—	② AL40-06	① AW40-06	—
5	—	3/4, 1	① AF50	② AR50	③ AL50	—	—
			—	—	② AL50	① AW60	—
5	—	1	① AF60	② AR50	③ AL60	—	—
5	—	1	① AF60	② AR60	③ AL60	—	—
			—	—	② AL60	① AW60	—
5	—	M5	① AF10	② AR10	—	—	—
5	—	1/8, 1/4	① AF20	② AR20	—	—	—
5	—	1/4, 3/8	① AF30	② AR25	—	—	—
5	—	1/4, 3/8	① AF30	② AR30	—	—	—
5	—	1/4, 3/8, 1/2	① AF40	② AR40	—	—	—
5	—	3/4	① AF40-06	② AR40-06	—	—	—
5	—	3/4, 1	① AF50	② AR50	—	—	—
5	—	1	① AF60	② AR50	—	—	—
5	—	1	① AF60	② AR60	—	—	—
0.3	1	1/8, 1/4	① AF20	③ AR20	—	—	② AFM20
			—	—	—	① AW20	② AFM20
0.3	1	1/4, 3/8	① AF30	④ AR25	—	—	② AFM30
			① AF30	③ AR30	—	—	② AFM30
0.3	1	1/4, 3/8	—	—	—	① AW30	② AFM30
			① AF40	③ AR40	—	—	② AFM40
0.3	1	1/4, 3/8, 1/2	—	—	—	① AW40	② AFM40
			① AF40-06	③ AR40-06	—	—	② AFM40-06
0.3	1	3/4	—	—	—	① AW40-06	② AFM40-06

(Note) Numerical value 1 to 3 of the product combination shows the order of arrangement of the equipment from the upstream.

Directional Control Valves

Actuators

Air Preparation Equipment

Air Combination

Pressure Control Equipment

Pressure Detection Equipment

Flow Rate Detection Equipment

# Basic Specifications for Other F.R.L. Units

## Filter Regulator



## Lubricator

**Application:** Applicable to remove solid foreign objects seized 5 μm or more and oversaturated water contained in the compressed air, prevent malfunction of actuators and solenoid valves, control (regulate) the outlet pressure, suppress fluctuations of the outlet pressure affected by fluctuations of the inlet pressure, and apply a lubricant to pneumatic equipments at the outlet side.



### Standard Specifications

Model	AC10A	AC20A	AC30A	AC40A	AC40A-06	AC50A	AC60A
Component	Filter Regulator	AW10	AW20	AW30	AW40	AW40-06	AW60
	Lubricator	AL10	AL20	AL30	AL40	AL40-06	AL50
Port size	M5	1/8,1/4	1/4,3/8	1/4, 3/8, 1/2	3/4	3/4,1	1
Fluid	Air						
Proof pressure (MPa)	1.5						
Max. operating pressure (MPa)	1.0						
Set pressure range (MPa)	0.05 to 0.7		0.05 to 0.85				
Ambient and fluid temperature (°C)	-5 to 60 (No freezing)						
Nominal filtration rating (μm)	5						
Bowl material	Polycarbonate						
Bowl guard	—	Semi-standard	Standard				
Regulator construction	Relieving type						
Weight (kg)	0.20	0.38	0.75	1.41	1.46	3.33	3.40

## Air Filter



## Regulator

**Application:** Applicable to remove solid foreign objects seized 5 μm or more and oversaturated water contained in the compressed air, prevent malfunction of actuators and solenoid valves, control (regulate) the outlet pressure, and suppress fluctuations of the outlet pressure affected by fluctuations of the inlet pressure.



### Standard Specifications

Model	AC10B	AC20B	AC25B	AC30B	AC40B	AC40B-06	AC50B	AC55B	AC60B
Component	Filter Regulator	AF10	AF20	AF30	AF30	AF40	AF40-06	AF50	AF60
	Regulator	AR10	AR20	AR25	AR30	AR40	AR40-06	AR50	AR60
Port size	M5	1/8,1/4	1/4,3/8	1/4,3/8	1/4, 3/8, 1/2	3/4	3/4,1	1	1
Fluid	Air								
Proof pressure (MPa)	1.5								
Max. operating pressure (MPa)	1.0								
Set pressure range (MPa)	0.05 to 0.7		0.05 to 0.85						
Ambient and fluid temperature (°C)	-5 to 60 (No freezing)								
Nominal filtration rating (μm)	5								
Bowl material	Polycarbonate								
Bowl guard	—	Semi-standard	Standard						
Regulator construction	Relieving type								
Weight (kg)	0.16	0.33	0.55	0.63	1.12	1.16	2.44	2.45	2.54

## Attachment

### Piping adapter

A piping adapter allows installation/removal of the component without removing the piping.



Port size M5 x 0.8, 1/8, 1/4, 3/8, 1/2, 3/4, 1

### T-interface

Redirection of air flow is possible.



Port size M5 x 0.8, 1/8, 1/4, 3/8, 1/2

### Pressure switch with piping adapter

Compact reed switch integrated with the piping adapter



Port size 1/8, 1/4, 3/8, 1/2, 3/4

### Check valve

Can be used to prevent a back flow of lubricant from lubricator.



Port size 1/8, 1/4, 3/8

## Air Filter



## Mist Separator



## Regulator

**Application:** Applicable to remove minute solid foreign objects and oil mist contained in the compressed air, control (regulate) the outlet pressure, and control pulsations of the outlet pressure affected by pulsations of the inlet pressure.



### Standard Specifications

Model	AC20C	AC25C	AC30C	AC40C	AC40C-06	
Component	Air Filter	AF20	AF30	AF30	AF40	AF40-06
	Mist Separator	AFM20	AFM30	AFM30	AFM40	AFM40-06
	Regulator	AR20	AR25	AR30	AR40	AR40-06
Port size	1/8, 1/4	1/4, 3/8	1/4, 3/8	1/4, 3/8, 1/2	3/4	
Fluid	Air					
Proof pressure (MPa)	1.5					
Max. operating pressure (MPa)	1.0					
Set pressure range (MPa)	0.05 to 0.85					
Nominal filtration rating (µm)	0.3 (95% filtered particle size)					
Outlet side oil mist concentration	Maximum 1.0 mg/m <sup>3</sup> (ANR) standard unit (=0.8 ppm)					
Rated flow rate L/min (ANR)	200	450	450	1,100	1,100	
Ambient and fluid temperature (°C)	-5 to 60 (No freezing)					
Bowl material	Polycarbonate					
Bowl guard	Semi-standard	Standard				
Regulator construction	Relieving type					
Weight (kg)	0.48	0.88	0.95	1.76	1.83	

## Filter Regulator



## Mist Separator

**Application:** Applicable to remove minute solid foreign objects and oil mist contained in the compressed air, control (regulate) the outlet pressure, and control pulsations of the outlet pressure affected by pulsations of the inlet pressure.



### Standard Specifications

Model	AC20D	AC30D	AC40D	AC40D-06	
Component	Filter Regulator	AW20	AW30	AW40	AW40-06
	Mist Separator	AFM20	AFM30	AFM40	AFM40-06
Port size	1/8, 1/4	1/4, 3/8	1/4, 3/8, 1/2	3/4	
Fluid	Air				
Proof pressure (MPa)	1.5				
Max. operating pressure (MPa)	1.0				
Set pressure range (MPa)	0.05 to 0.85				
Nominal filtration rating (µm)	0.3 (95% filtered particle size)				
Outlet side oil mist concentration	Maximum 1.0 mg/m <sup>3</sup> (ANR) standard unit (=0.8 ppm)				
Rated flow rate L/min (ANR)	150	330	800	800	
Ambient and fluid temperature (°C)	-5 to 60 (No freezing)				
Bowl material	Polycarbonate				
Bowl guard	Semi-standard	Standard			
Regulator construction	Relieving type				
Weight (kg)	0.37	0.74	1.38	1.43	

### Pressure switch

Compact reed switch



### Cross interface

Branch piping is possible in all 4 directions.



Port size M5 x 0.8, 1/8, 1/4, 3/8, 1/2

### 3-port valve for residual pressure release

Residual pressure in the line can be exhausted.



Port size 1/8, 1/4, 3/8, 1/2, 3/4, 1

# Option/Semi-standard/Made to Order

Model	Option					Attachment				Filter /		
	Auto drain		Pressure gauge		Digital pressure switch	Check valve	Pressure switch	T-interface	3-port valve for residual pressure release	Metal bowl	Nylon bowl	Metal bowl with level gauge
	N.C.	N.O.	Square embedded type	Round type								
AC10	●	—	—	●	—	—	—	●	—	●	●	—
AC10A	●	—	—	●	—	—	—	—	—	●	●	—
AC20	●	—	●	●	●	●	●	●	●	●	●	—
AC20A	●	—	●	●	●	●	●	—	●	●	●	—
AC25	●	●	●	●	●	●	●	●	●	●	●	●
AC30	●	●	●	●	●	●	●	●	●	●	●	●
AC30A	●	●	●	●	●	●	●	—	●	●	●	●
AC40	●	●	●	●	●	●	●	●	●	●	●	●
AC40A	●	●	●	●	●	●	●	—	●	●	●	●
AC40-06	●	●	●	●	●	—	●	●	●	●	●	●
AC40A-06	●	●	●	●	●	—	●	—	●	●	●	●
AC50	●	●	●	●	●	—	●	●	●	●	●	●
AC50A	●	●	●	●	●	—	●	—	●	●	●	●
AC55	●	●	●	●	●	—	●	●	—	●	●	●
AC60	●	●	●	●	●	—	●	●	—	●	●	●
AC60A	●	●	●	●	●	—	●	—	—	●	●	●
AC10B	●	—	—	●	—	—	—	●	—	●	●	—
AC20B	●	—	●	●	●	—	●	●	●	●	●	—
AC25B	●	●	●	●	●	—	●	●	●	●	●	●
AC30B	●	●	●	●	●	—	●	●	●	●	●	●
AC40B	●	●	●	●	●	—	●	●	●	●	●	●
AC40B-06	●	●	●	●	●	—	●	●	●	●	●	●
AC50B	●	●	●	●	●	—	●	●	●	●	●	●
AC55B	●	●	●	●	●	—	●	●	—	●	●	●
AC60B	●	●	●	●	●	—	●	●	—	●	●	●
AC20C	●	—	●	●	●	—	●	●	●	●	●	—
AC20D	●	—	●	●	●	—	●	—	●	●	●	—
AC25C	●	●	●	●	●	—	●	●	●	●	●	●
AC30C	●	●	●	●	●	—	●	●	●	●	●	●
AC30D	●	●	●	●	●	—	●	—	●	●	●	●
AC40C	●	●	●	●	●	—	●	●	●	●	●	●
AC40D	●	●	●	●	●	—	●	—	●	●	●	●
AC40C-06	●	●	●	●	●	—	●	●	●	●	●	●
AC40D-06	●	●	●	●	●	—	●	—	●	●	●	●

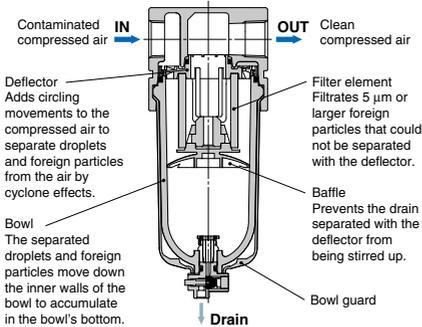
●: Available    ▲: Not available at the moment, but available from engineering viewpoints (special order)    —: Not available



## Air Filter

### Construction

Moisture and dust are contained in compressed air. The air filter is installed at the inlet to prevent such moisture and dust from entering the pneumatic control circuit.



The compressed air introduced from the inlet is given circling movements by the deflector. The resulting cyclone effects forcibly push comparatively large free droplets and foreign particles toward the inner walls of the bowl, causing them to move down the wall surfaces and accumulate in the bowl's bottom.

The compressed air from which most foreign particles have been removed passes through the centrally-placed filter element made of synthetic resin or sintered metal and having numerous micropores. At the filter element, even finer dust particles are removed and the compressed air flows out to the outlet side.

On the other hand, the separated moisture, dust and other foreign particles are discharged out of the air filter by a manually-operated drain valve, such as a cock valve or a push valve, or an automatic drain valve mounted in the bowl's bottom.

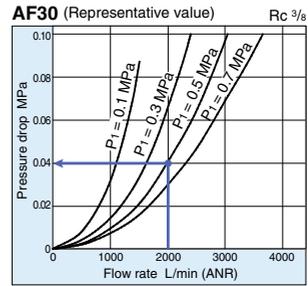
In most applications, filter elements with a 5 μm filtration rating are used.

### Characteristics and Selection

#### Flow Rate Characteristics

As one of the characteristics inherent in air filters, there is a flow rate characteristics. The flow rate characteristics refers to the relationship between the volume of air passing through the air filter and the resulting pressure drop. This relationship is represented by the curve illustrated below.

#### Flow Rate Characteristics



**Example: How to read the AF30's flow rate and pressure drop**  
 The pressure drop when the inlet pressure is 0.5 MPa and air is flowed at a rate of 2000 L/min (ANR), is 0.04 MPa. Select a model so that the pressure thus determined is no greater than 0.1 MPa.

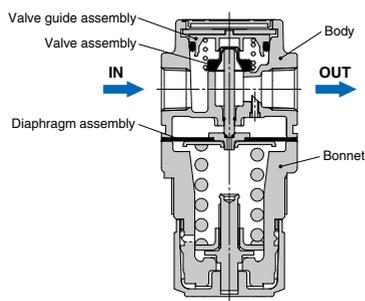
## Regulator

### Construction

In a pneumatic system used for general industrial equipment, the pressure of compressed air to be supplied must be controlled to a level appropriate for the purpose of use of each piece of equipment. For this purpose, regulators are commonly used.

The regulator is used to reduce the inlet pressure and thereby regulate the outlet pressure to a given set point. It is also used when variations in the set pressure need to be kept to a minimum also against changes in the inlet pressure or in the volume of air consumed under the outlet pressure.

The following figure shows the construction of a direct-operated regulator with a release function.



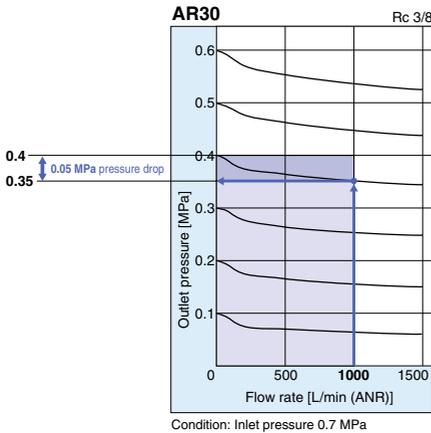
When the knob is rotated to compress the adjusting spring, the valve is pushed downward by way of the stem and the inlet pressure is transmitted to the outlet. This pressure acts upon the diaphragm and produces a downward force to conflict with the force produced by the adjusting spring. The inlet pressure continues to transmit as long as the outlet pressure is lower than the set point. The diaphragm goes down as the difference between these pressures decreases and, when the two forces counterbalance, the valve closes and the required pressure is established. If the outlet pressure rises above the set point or if the compressive load of the adjusting spring is reduced by rotating the knob, the diaphragm goes down and the relieving valve moves away from the stem. As a result, the outlet pressure is relieved to the atmosphere and therefore reduces.

Non-relieving type regulators have no relief ports on their relieving valves and are used when air is constantly consumed at the outlet or when the evacuation of air to the outside must be avoided.

## Regulator

### Characteristics and Selection

The main characteristics of a regulator are the flow and pressure characteristics. As a rule, select a size of the regulator body suited to the conditions of use by judging from the flow rate characteristics.

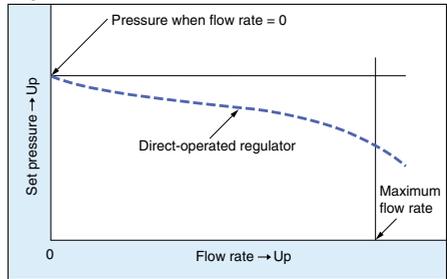


**Example: How to read the AR30's flow rate characteristics**  
 When the outlet pressure is set to 0.4 MPa and the air flow of 1000 L/min (ANR) is supplied, the set pressure drops to 0.35 MPa. It is desirable to use the regulator with a reference pressure drop from the set pressure no greater than 0.08 MPa. Since the pressure drop in this example is 0.05 MPa, smaller than the reference value 0.08 MPa, the pressure value 0.35 MPa is tolerable.

### Flow Rate Characteristics

Under normal conditions, the outlet pressure is adjusted without flowing air. If the outlet is gradually opened to increase the flow rate after pressure setting, the set pressure decreases consequently. It can be said that the smaller the pressure drop is, the better the flow rate characteristic is. Ideally, the pressure should be kept at a constant level even if the flow rate changes.

### Regulator's Flow Rate Characteristics

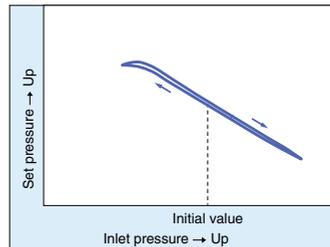


### Pressure Characteristics

The characteristics in which the set pressure changes as the inlet pressure varies is referred to as the pressure characteristics.

A typical example is shown below:

### Regulator's Pressure Characteristics



# Lubricator

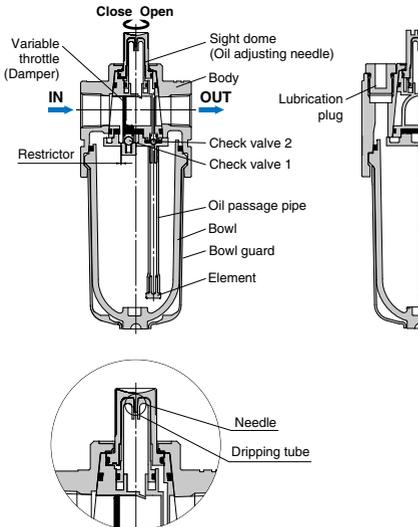
## Construction

The compressed air introduced from the inlet passes through a variable throttle (damper) and flows out to the outlet. At this point, a pressure difference is produced between the inlet and the outlet by the variable throttle.

The inlet pressure is introduced into the bowl through the restrictor.

On the other hand, the pressure within the sight dome is equivalent to the outlet pressure. The lubricating oil within the bowl is driven by the inlet pressure into the oil passage pipe. Thus, the oil passes through the sight dome and reaches the drip regulating needle built in the sight dome.

The lubricating oil adjusted to a specified drip rate by the drip regulating needle drips from the dripping tube and is carried on the stream of compressed air on the outlet side to reach equipment (e.g., cylinder) to be lubricated.



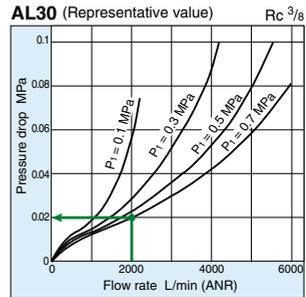
Detailed view of the sight dome

## Characteristics and Selection

### Flow Rate Characteristics

The flow rate characteristics refers to the relationship between the volume of air passing through the lubricator and the resulting pressure drop. This relationship is represented by the curve illustrated below.

### Flow Rate Characteristics



### Example: How to read the AL30's flow rate characteristics

The pressure drop when the inlet pressure is 0.7 MPa and air is flowed at a rate of 2000 L/min (ANR), is 0.02 MPa. Select a model so that the pressure drop is no greater than 0.1 MPa.

### Minimum Flow Rate for Charging

The minimum flow rate for charging refers to the rate of air flow for producing a pressure difference necessary for the lubricating oil to drip.

Although this minimum flow rate for charging varies depending on the inlet pressure, it is based on the air flow rate at which five droplets of oil drip every minute when the inlet pressure is 0.5 MPa. Since the correct drip rate of oil depends on the conditions of use, it is difficult to universally prescribe a standard rate. As a guide however, the rate should be considered as one droplet (approximately 0.02 mL) for a flow rate of 10 L under pressure. An excessively large amount of oil results in an increase in the amount of oil mixed into the exhaust air of a directional control valve and thus emitted outside. Care must be taken since this is not only wasteful but also likely to lead to environmental pollution.