

SMC Pneumatic Clean Room Equipment

Clean Series **Series 10-/11-/12-/13-**

**Suitable for clean environment.
Prevents particle generation in clean room.**

Applicable equipment

Actuators (Cylinders, Rotary actuators, Air grippers), Directional control equipment, Flow control equipment, Filters, Pressure control equipment, Fittings/Tubing, Air preparation equipment, Pressure switches
Note) The 11-, 12-, and 13- series are only applicable to actuators.

Special Clean Series

**Adheres to an even higher standard of cleanliness than the Clean Series.
The development of this line of products, from structure and materials to assembly environment, are all determined for clean environment use.**

Applicable equipment

Clean rodless cylinders, Clean regulators, Clean One-touch fittings, Clean tubing, Clean gas filters, Clean air filters, Normal close high vacuum solenoid valve

Copper, Fluorine, Silicone-free, Low-particle Generation **Series 21-/22-**

Suitable for environments where the presence of copper, fluorine or silicone materials is restricted.

Structures are identical to the Clean Series. (Grease and packaging are different from the Clean Series.)

Applicable equipment

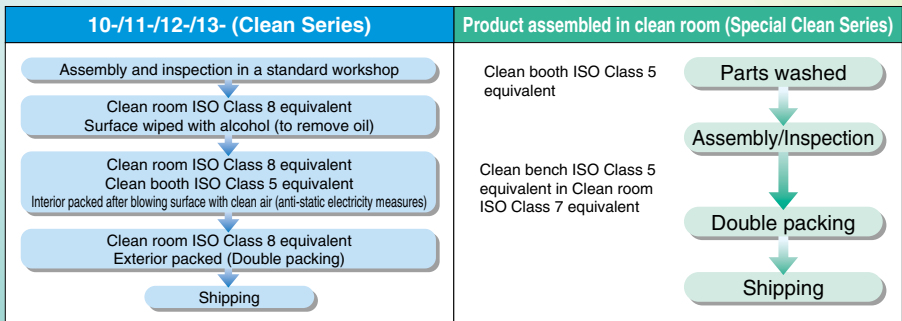
Actuators (Cylinders, Rotary actuators, Air grippers), Directional control valves, Flow control equipment, Pressure control equipment, Fittings

Note) The 22- series is only applicable to actuators.



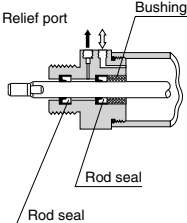
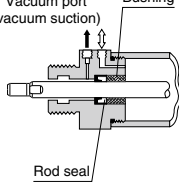

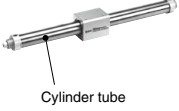
Dust is kept from the clean room.

- After inspection, the product is blown with high purity air (of ISO Class 5 equivalent clean bench) in a clean environment.
- Products are sealed and shipped in antistatic double bags.








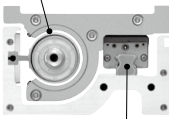
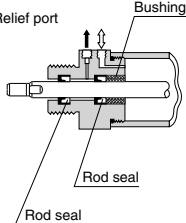
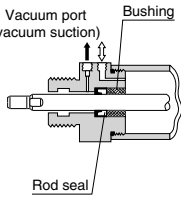
The 21- and 22- series are given standard packaging (assembly, inspection, packing, and shipping carried out in a standard workshop.) Please contact SMC for clean packaging.

Basic Specifications of Actuators

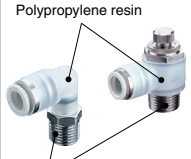


	Series 10-	Series 11-	Series 12-	
Construction	<ul style="list-style-type: none"> • Double seal type/ release to atmosphere 	<ul style="list-style-type: none"> • Single seal type/ vacuum suction 	<ul style="list-style-type: none"> • Compact guide cylinder P.839 • Dual rod cylinder From P.848 <p>Double seal type/release to atmosphere (10- series equivalent) and specially treated guide</p> 	<ul style="list-style-type: none"> • Rodless cylinder From P.787 <p>Specially treated cylinder tube exterior</p> 
Restricted material	None			
Grease	Fluorine grease			
Assembly environment	General environments (assembly and inspection in a workshop)			
Packaging	Clean packaging: Products are sealed in antistatic double bags after			

Basic Specifications of Other Equipment

	Series 10-	Special		
Construction	<ul style="list-style-type: none"> • Directional control valve P.36  <p>Main valve and pilot valve common exhaust</p> <p>Fittings, speed controllers, pressure switches, etc. have the same structure as those of standard.</p>	<ul style="list-style-type: none"> • Compressed air cleaning filter series P.958 • Modular F.R. P.1068  <p>Drain guide With female thread</p> <p>Relief port With fitting in bleed port</p>	<ul style="list-style-type: none"> • Clean regulator P.1114 <p>All wetted parts are made of stainless steel, FPM and PTFE, and exterior metal parts are made of anodized aluminum, which provides high corrosion resistance.</p> 	<ul style="list-style-type: none"> • Clean One-touch fittings (for blowing) P.1221  <p>Wetted parts non-metal</p> <p>Polypropylene resin</p> <ul style="list-style-type: none"> • Clean tubing Polyolefin-based resin P.1235
Restricted material	None			
Grease	Fluorine grease	—		
Assembly environment	General environments (assembly and inspection in a workshop)	Parts are		
Packaging	Clean packaging: Products are sealed in antistatic double bags			

Series 13-	Special Clean Series	Series 21-	Series 22-
<ul style="list-style-type: none"> • Compact guide cylinder P.839 • Air slide table From P.778 <p>Single seal type/ vacuum suction (11- series equivalent) and specially treated guide</p>  <p>Ball bushing guide Linear guide</p>	<ul style="list-style-type: none"> • Clean rodless cylinder P.773 <p>No contact between the cylinder tube exterior and the slider interior</p>  <p>Linear guide Special treatment</p>	<ul style="list-style-type: none"> • Double seal type/ release to atmosphere  <p>Relief port Bushing Rod seal Rod seal</p>	<ul style="list-style-type: none"> • Single seal type/ vacuum suction  <p>Vacuum port (vacuum suction) Bushing Rod seal</p>
	None	Copper, fluorine and silicone-free	
	Fluorine grease	Lithium soap based grease	
	Parts are washed and assembled in a clean room.	General environments (assembly and inspection in a workshop)	
blow to the surface with clean air.		Standard packaging ^(Note)	

(Note) Please contact SMC for clean packaging.

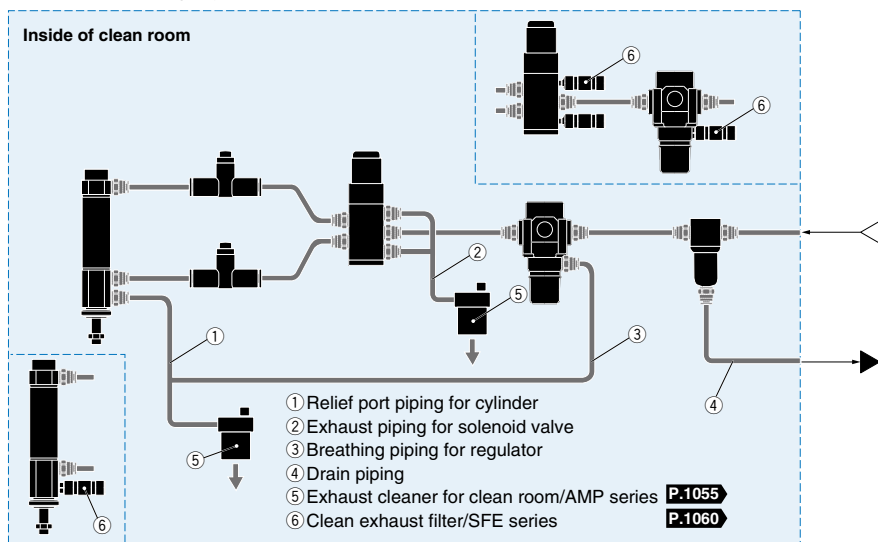
Clean Series		Series 21-		
<ul style="list-style-type: none"> • Clean One-touch fittings (for driving air piping) P.1225 • Clean speed controller P.1291 <p>Polypropylene resin</p>  <p>Metal parts Brass (Electroless nickel plated) or Stainless steel 304</p>	<ul style="list-style-type: none"> • Exhaust cleaner for clean room P.1055 • Clean gas filter From P.1011 PTFE membrane element • Clean air filter Polyolefin hollow fiber membrane element From P.1031 	<ul style="list-style-type: none"> • Clean exhaust filter P.1060 	<ul style="list-style-type: none"> • Directional control valve P.36 • Modular F.R. P.1068 <p>The same construction as the 10- series</p>	<ul style="list-style-type: none"> • Clean One-touch fittings (for driving air piping) P.1225 • Clean speed controller P.1291 <p>No sealant on thread parts</p> <p>* UNI thread is also applicable. (Made to Order)</p>
None		Copper, fluorine and silicone-free		
Fluorine grease		Lithium soap based grease		
washed and assembled in a clean room.		General environments (assembly and inspection in a workshop)	Parts are washed and assembled in a clean room.	
after blow to the surface with clean air.		Standard packaging ^(Note)		

(Note) Please contact SMC for clean packaging.

System Circuit in Clean Room

The following are the actuator driving system and circuit configuration of the blow system employed to reduce particle generation when using pneumatic equipment in a clean room.

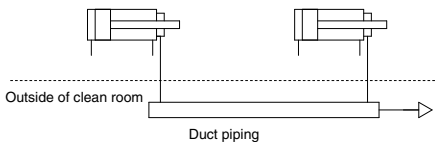
● Actuator Driving System



● Cylinder Relief Port Piping

Series 10-/12-/21- (Atmospheric release type)

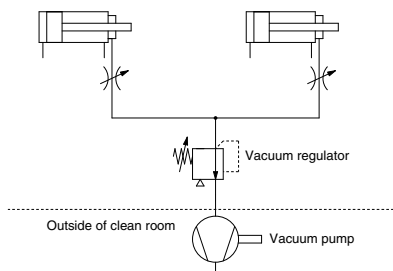
Connect the relief port piping with the dedicated duct piping installed outside the clean room or with the exhaust cleaner for clean room/AMP series, or connect the clean exhaust filter SFE series to relief port piping.



Series 11-/13-/22- (Vacuum suction type)

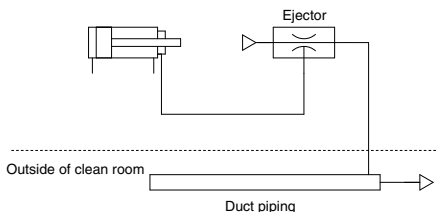
With a vacuum pump

When several air cylinders are used together or a model with high vacuum suction flow is used.



With an ejector

When a few air cylinders are used locally.



* The symbol for the cylinder is an original SMC symbol.

System Circuit in Clean Room

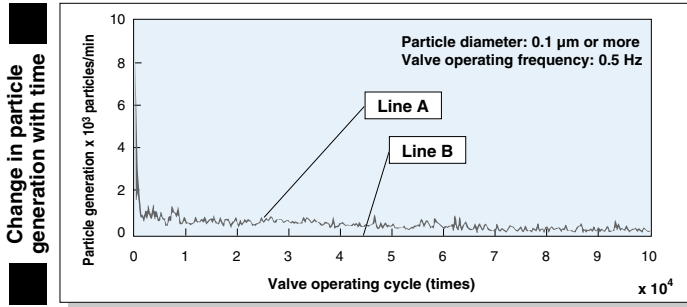
● Clean Blow System

Example of equipment to suit each clean blow grade

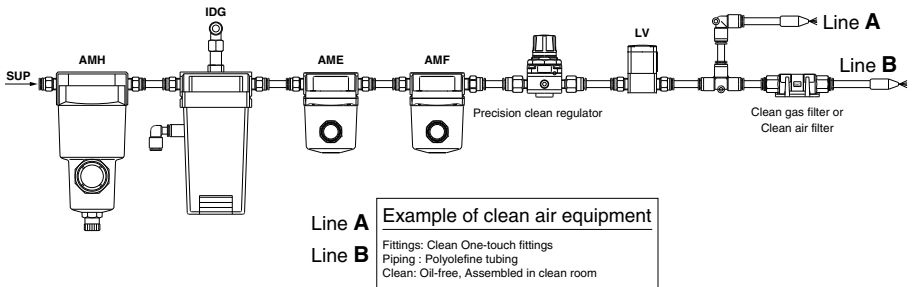
Line A: For clean blow

Line B: For clean blow (with clean gas filter or with clean air filter)

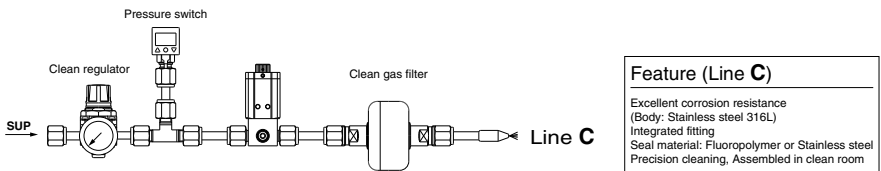
Line C: For N₂ blow



● Example of Air Line Equipment



● Example of N₂ Equipment

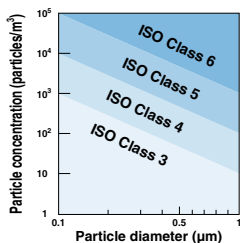


How to Use Clean Series

The position of the pneumatic equipment to the workpiece is determined by the degree of particle generation.

$$\boxed{\text{Particle generation grade no. of pneumatic equipment}} \leq \boxed{\text{Particle concentration grade no. around workpiece}}$$

Particle Generation Classification



Cleanliness Class (Reference)

ISO 14644-1	JIS B 9920	Fed.Std.209E ^(Note)
		SI unit
ISO Class 3	JIS Class 3	M1.5
ISO Class 4	JIS Class 4	M2.5
ISO Class 5	JIS Class 5	M3.5
ISO Class 6	JIS Class 6	M4.5
ISO Class 7	JIS Class 7	M5.5
ISO Class 8	JIS Class 8	M6.5

Note) Fed.Std.209E was abolished in Nov. 2001, so these figures are for reference only.

Selection Procedure

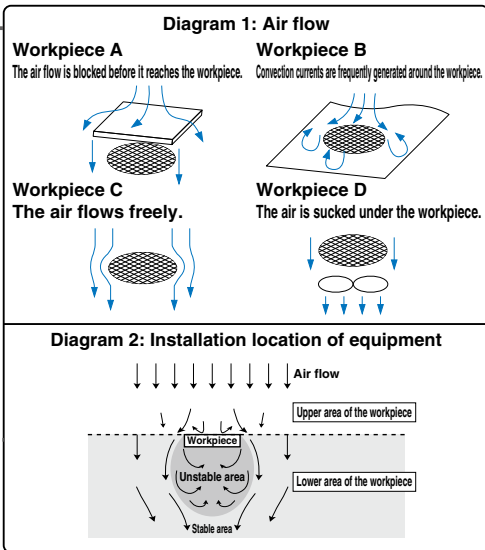
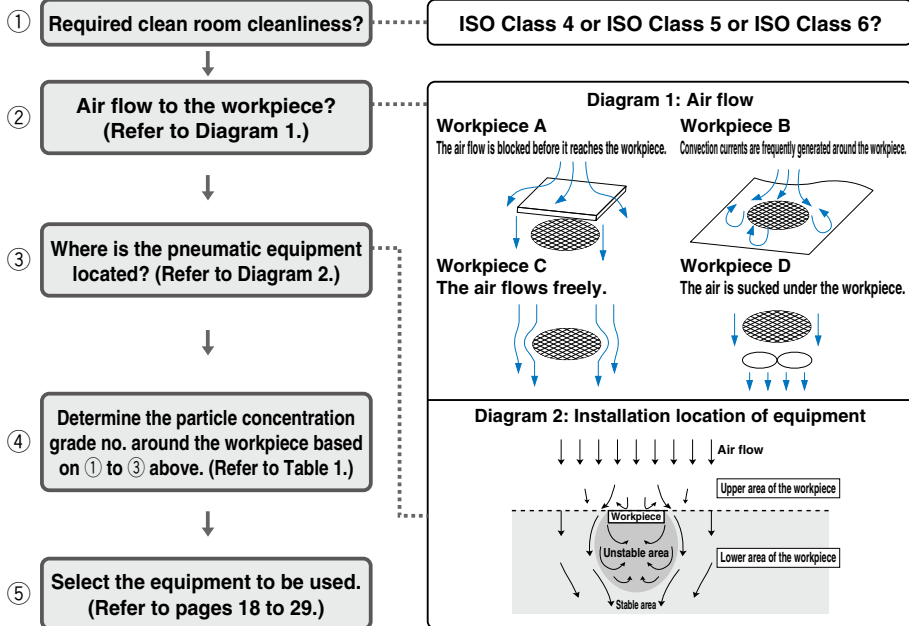










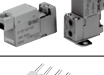




Table 1: Particle Concentration Grade around the Workpiece (Guide)

② Air flow	A: Air flow is blocked/B: Convection currents are frequently generated			C: Air flows freely			D: Air is sucked under the workpiece			
	Upper area of the workpiece	Lower area of the workpiece		Upper area of the workpiece	Lower area of the workpiece		Upper area of the workpiece	Lower area of the workpiece		
③ Installation location of equipment		Unstable area	Stable area	Upper area of the workpiece	Unstable area	Stable area	Upper area of the workpiece	Unstable area	Stable area	
① Cleanliness required on the workpiece	Class 3	/			Series 11- (Series 13-, 22-)	Series 10- (Series 12-, 21-)		Series 11- (Series 13-, 22-)	Series 10- (Series 12-, 21-)	
	Class 4					Series 10- (Series 12-, 21-)			Series 10- (Series 12-, 21-)	
	Class 5				Standard product		Standard product		Standard product	
	Class 6				Series 11- (Series 13-, 22-)	Series 10- (Series 12-, 21-)	Standard product	Series 10- (Series 12-, 21-)	Standard product	Series 10- (Series 12-, 21-)

: ISO Class 4 and 5 levels of cleanliness cannot be achieved in the area due to accumulated or airborne dust












Directional Control Valves

Description	Series	Cleanliness class (ISO class) ^{Note)}			Page	
		Standard	10-	21-		
	Note 2) Note 2) 10-SY3000/5000/7000/9000	5	3		P.38	
	10-SV1000/2000/3000/4000	5	3		P.179	
	10-SYJ3000/5000/7000	5	3		P.279	
	10-SZ3000	5	3		P.377	
4/5 Port Solenoid Valve		5	3	3	P.417	
		5	3	3	P.514	
		5	3		P.578	
		10-VQD1000	5	3		P.597
		10-V100	5	3		
3 Port Solenoid Valve		5	3		P.602	
		5	3		P.648	
		10-S070	5	3	3	P.658
	XSA Normal Close High Vacuum Solenoid Valve	3				

Note 1) ISO classes apply to threaded port connection type.
 Different classes apply to the One-touch fittings. For details, refer to page 1385.
 Note 2) Please consult with SMC separately for SY connector type.





Values in show ISO classes.
 No class applies to blanks.

Air Cylinders

Description			Series	Cleanliness class (ISO class)							Page
				Standard	10-	11-	12-	13-	21-	22-	
	Air Cylinder	Standard	10-/11- 21-/22- CJ2	5	4	3			4	3	From P.685
			10-/11- 21-/22- CJ2-Z								
		Direct mount type	10-/11- 21-/22- CJ2W-Z								
		Direct mount type	10-/11- 21-/22- CJ2RA-Z								
	Air Cylinder	Standard	10-/11- 21-/22- CM2-Z	5	4	3			5	3	From P.700
			10-/11- 21-/22- CM2W-Z								
		Direct mount type	10-/11- 21-/22- CM2R-Z								
		End lock (Except rod side)	10-/11- 21-/22- CBM2								
	Air Cylinder	Standard	10-/11- 21-/22- CG1-Z	5	4	3			5	3	From P.722
			10- 11- CG1W-Z								
		Direct mount type	10- 11- CG1R-Z								
	Air Cylinder: Standard		10-/11- 21-/22- CA2	5	4	3			5	3	P.736
	Mini Free Mount Cylinder		10- 11- CUJ	5	4	3					P.740
	Free Mount Cylinder		10-/11- 21-/22- CDU	5	4	3			5	3	P.746
	Compact Cylinder: Standard		10-/11- 21-/22- CQS	5	4	3			4	3	P.749
			10-/11- 21-/22- CQ2-Z	5	4	3			4	3	P.758
	Magnetically Coupled Rodless Cylinder: Basic Type		12-CY3B	6			5				P.767
	Magnetically Coupled Rodless Cylinder: Direct Mount Type		12-CY3R	6			5				P.769
	Clean Rodless Cylinder		CYP	4							P.773

Values in show ISO classes.
 No class applies to blanks.


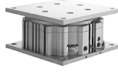


Air Cylinders

Description		Series	Cleanliness class (ISO class)						Page
			Standard	10-	11-	12-	13-	21-	
	Air Slide Table	13- 22: MXS (Without adjuster)	6				5	5	P.778
		13- 22: MXS (Rubber stopper)	6				5	5	
	Air Slide Table	13- 22: MXQ (Without adjuster)	6				5	5	P.799
		13- 22: MXQ (Rubber stopper)	6				5	5	
		13- 22: MXQ (Metal stopper)					6	6	
	Air Slide Table	11-MXJ (Without adjuster)	6		5				P.825
		11-MXJ (Metal stopper)			6				
	Air Slide Table ^{Note 1)}	11- 22: MXP ^{Note 2)} (Without adjuster)	5		3			3	P.831
		11- 22: MXP (Rubber stopper)	5		4			4	
		11- 22: MXP (Metal stopper)			6			6	
		11- 22: MXPJ6	5		3			3	






Note 1) Clean room specifications are not available for MXP8.
 Note 2) MXP6 without adjuster is not available.

Values in show ISO classes.
 No class applies to blanks.

Air Cylinders




Description		Series	Cleanliness class (ISO class)						Page		
			Standard	10-	11-	12-	13-	21-		22-	
	Compact Guide Cylinder	¹² / ₁₃ :MGPL-Z	6			5	4			P.839	
		²¹ / ₂₂ :MGPL	6					6	5		
	Guide Table Cylinder	10-MGF	6	4						P.844	
	Dual Rod Cylinder	Ball bushing bearing	¹¹ / ₂₁ - ¹² / ₂₂ :CXSJL	5		3	4		5	3	P.848
		Slide bearing	11-CXSJM	6		3					
	Dual Rod Cylinder	Ball bushing bearing	¹⁰ / ₂₁ - ¹¹ / ₂₁ - ¹² / ₂₂ :CXSL	5	4	3	4		5	3	P.852
		Slide bearing	¹⁰ / ₁₁ :CXSM	6	4	3					

Values in show ISO classes.
 No class applies to blanks.





Description		Series	Cleanliness class (ISO class)						Page	
			Standard	10-	11-	12-	13-	21-		22-
	Sine Rodless Cylinder	12-REA	6			5				P.861
	Sine Cylinder	¹⁰ / ₁₁ :REC	5	4	3					P.864
	Low Speed Cylinder	¹⁰ / ₁₁ :CM2X-Z	5	4	3					P.868
		¹⁰ / ₁₁ :CQSX	5	4	3					P.870
		¹⁰ / ₁₁ :CQ2X	5	4	3					P.872

Values in show ISO classes.
 No class applies to blanks.

Rotary Actuators


Description			Series	Cleanliness class (ISO class)							Page	
				Standard	10-	11-	12-	13-	21-	22-		
	Rotary Actuator	Vane	10- 21-CRB1	6	4					4	P.893	
		Rack & Pinion	11-CRA1-Z	5		4						P.905
	Rotary Table		11- 22-MSQ	5		3					3	P.909

Air Grippers

Description			Series	Cleanliness class (ISO class)							Page	
				Standard	10-	11-	12-	13-	21-	22-		
	2 Finger Air Gripper		11- 22-MHZ2	6		4					4	P.923
	2 Finger Parallel Type Wide Opening Air Gripper		11- 22-MHL2	6		4					4	P.927
	Rotary Actuated Air Gripper	2 finger	11- 22-MHR2	6		3					3	P.932
		3 finger	11- 22-MHR3	6		3					3	P.938







Values in show ISO classes.
 No class applies to blanks.

Air Preparation Equipment

Description		Series	Cleanliness class (ISO class)		Page
			Standard	10-	
	Membrane Air Dryer	10-IDG□A	5	3	P.949
		10-IDG	5	3	P.950
	Main Line Filter	10-AFF2C to 22C 10-AFF37B, 75B	5	3	P.959
	Mist Separator	10-AM150C to 550C 10-AM650, 850	5	3	P.966
	Micro Mist Separator	10-AMD150C to 550C 10-AMD650, 850	5	3	P.973
	Micro Mist Separator with Pre-filter	10-AMH150C to 550C 10-AMH650, 850	5	3	P.980
	Super Mist Separator	10-AME150C to 550C 10-AME650, 850	5	3	P.987
	Odor Removal Filter	10-AMF150C to 550C 10-AMF650, 850	5	3	P.994
	Clean Gas Filter: Cartridge Type	SFA100/200/300	3		P.1011
	Clean Gas Filter: Cartridge Type	SFB100	3		P.1014
	Clean Gas Strainer: Cartridge Type	SFB200	3		P.1015
	Clean Gas Filter: Disposable Type	SFB300	3		P.1018
	Clean Gas Filter: Disposable Type	SFC100	3		P.1021



















Values in show ISO classes.
 No class applies to blanks.

Air Preparation Equipment

Description		Series	Cleanliness class (ISO class)	Page
			Standard	
	Clean Air Filter: Disposable Type	SFD100	3	P.1031
	Clean Air Filter: Cartridge Type	SFD101/102	3	P.1031
	Clean Air Filter: Cartridge Type	SFD200	3	P.1031
	Clean Air Module	LLB	3	P.1039
	Exhaust Cleaner for Clean Room	AMP220 to 420	3 Exhaust air: 5	P.1055
	Clean Exhaust Filter	Male thread type	3 Exhaust air: 4	P.1060
		Plug-in type		








Values in show ISO classes.

Modular F.R.

Description		Series	Cleanliness class (ISO class)			Page
			Standard	10-	21-	
	Air Filter	10- 21- AF20-D to AF60-D	5	3	3	P.1068-1
	Mist Separator	10- 21- AFM20-D to AFM40-D	5	3	3	P.1068-4
	Micro Mist Separator	10- 21- AFD20-D to AFD40-D	5	3	3	P.1068-7
	Regulator	10- 21- AR20-D to AR60-D	5	3	3	P.1068-10
	Regulator with Backflow Function	10- 21- AR20K-D to AR60K-D	5	3	3	P.1068-10
	Filter Regulator	10- 21- AW20-D to AW60-D	5	3	3	P.1068-14
	Filter Regulator with Backflow Function	10- 21- AW20K-D to AW60K-D	5	3	3	P.1068-14
	Mist Separator Regulator	10- 21- AWM20-D to AWM40-D	5	3	3	P.1068-18
	Micro Mist Separator Regulator	10- 21- AWD20-D to AWD40-D	5	3	3	P.1068-18
	Air Filter	10- 21- AF20-A to AF60-A	5	3	3	P.1069
	Mist Separator	10- 21- AFM20-A to AFM40-A	5	3	3	P.1071
	Micro Mist Separator	10- 21- AFD20-A to AFD40-A	5	3	3	P.1073
	Regulator	10- 21- AR20-B to AR60-B	5	3	3	P.1075
	Regulator with Backflow Function	10- 21- AR20K-B to AR60K-B	5	3	3	P.1075
	Filter Regulator	10- 21- AW20-B to AW60-B	5	3	3	P.1079
	Filter Regulator with Backflow Function	10- 21- AW20K-B to AW60K-B	5	3	3	P.1079
	Mist Separator Regulator	10- 21- AWM20 to AWM40	5	3	3	P.1083
	Micro Mist Separator Regulator	10- 21- AWD20 to AWD40	5	3	3	P.1083












Values in show ISO classes.

Pressure Control Equipment

Image	Description	Series	Cleanliness class (ISO class)			Page
			Standard	10-	21-	
	Direct Operated Precision Regulator	10- 21- ARP20 to 40	5	3	3	P.1093
	Direct Operated Precision Regulator with Backflow Function	10- 21- ARP20K to 40K	5	3	3	P.1093
	Precision Regulator	10-IR1000-A to 3000-A		3		P.1100-1
	Regulator	10-IR1200-A to 3200-A		3		P.1100-9
	Precision Regulator	10-IR1000 to 3000		3		P.1101
	Vacuum Regulator	10-IRV10/20		3		P.1106
	Clean Regulator	SRH3000/4000	3			P.1114
	Precision Clean Regulator	SRP	5			P.1118















Values in show ISO classes.
 No class applies to blanks.

Fittings & Tubing

Description		Series	Cleanliness class (ISO class)			Page
			Standard	10-	21-	
	One-touch Fittings	10-KQ2	6	5		P.1124
	Insert Fittings	10-KF	5	3		P.1190
	Miniature Fittings	10-M	5	3		P.1196
	Rectangular Multi-connector	10-KDM	6	5		P.1202
	Stainless Steel One-touch Fittings	10-KG	6	5		P.1206
	Stainless Steel Miniature Fittings	10-MS	5	3		P.1217
	Clean One-touch Fittings	For blowing	KP	3		P.1221
		For driving air piping	KPQ	3	3	P.1225
			KPG	3	3	P.1225
	Polyurethane Tubing	10-TU	5	3		P.1232
	Polyurethane Coil Tubing	10-TCU	5	3		P.1233
	Polyurethane Flat Tubing	10-TFU	5	3		P.1234
	Clean Tubing	Polyolefin	TPH	3		P.1235
		Soft polyolefin	TPS	3		P.1236



Values in show ISO classes.
 No class applies to blanks.

Flow Control Equipment











Description	Series	Cleanliness class (ISO class)			Page
		Standard	10-	21-	
 Push-lock: Elbow Type/Universal Type	10-AS-F	6	5		P.1243
 With Indicator: Elbow Type/Universal Type	10-AS-FS	6	5		P.1249
 Speed Controller: Elbow Type/Universal Type	10-AS-F	6	5		P.1253
 Speed Controller: In-line Type	10-AS	6	5		P.1257
 Dual Speed Controller	10-ASD	6	5		P.1261
 Push-lock (Stainless steel): Elbow Type/Universal Type	10-AS-FG	6	5		P.1265
 With Indicator (Stainless steel): Elbow Type/Universal Type	10-AS-FSG	6	5		P.1271
 Stainless Steel Speed Controller: Elbow Type/Universal Type	10-AS-FG	6	5		P.1275
 Stainless Steel Speed Controller: In-line Type	10-AS-FG	6	5		P.1279
 Stainless Steel Dual Speed Controller	10-ASD-FG	6	5		P.1282
 Speed Controller: Metal Elbow Type	10-AS1200 to 4200	5	3		P.1286
 Speed Controller: In-line Type	10-AS1000 to 5000	5	3		P.1288
 Clean Speed Controller	(21-)AS-FPQ	3		3	P.1291
	(21-)AS-FPG	3		3	P.1291
 Speed Controller for Low Speed Operation: Elbow Type/Universal Type	10-AS-FM	6	5		P.1294

Values in show ISO classes.
 No class applies to blanks.


Flow Control Equipment

Description	Series	Cleanliness class (ISO class)			Page
		Standard	10-	21-	
 Speed Controller for Low Speed Operation: In-line Type	10-AS-FM	6	5		P.1298
 Dual Speed Controller for Low Speed Operation	10-ASD-FM	6	5		P.1301

Pressure Switches/Pressure Sensors

Description	Series	Cleanliness class (ISO class)		Page
		Standard	10-	
 3-Screen Display High-Precision Digital Pressure Switch	10-ZSE20(F)/ ISE20	5	4	P.1311
 3-Screen Display High-Precision Digital Pressure Switch	10-ZSE20A(F)/ ISE20A	5	4	P.1311-2
 3-Screen Display High-Precision Digital Pressure Switch	10-ZSE20B(F)/ ISE20B	5	4	P.1311-4
 3-Screen Display High-Precision Digital Pressure Switch for General Fluids	10-ZSE20C/ ISE20C	5	4	P.1311-13
 Remote Type Pressure Sensor	For compact pneumatics 10-PSE530	5	4	P.1353
 Remote Type Pressure Sensor	For compact pneumatics 10-PSE540	5	4	P.1355
 Remote Type Pressure Sensor	For low differential pressure 10-PSE550	5	4	P.1357
 Remote Type Pressure Sensor	For general fluids 10-PSE560	5	4	P.1359
 3-Screen Display Multi-channel Digital Sensor Monitor	10-PSE200A	3	3	P.1361
 Remote Type 2-Color Display Digital Pressure Sensor Controller	10-PSE300	3	3	P.1366

Flow Switches

Description	Series	Cleanliness class (ISO class)	Page
 2-Color Display Digital Flow Switch	PFM7-X300 PFMB7-X300	4	Web Catalog

Values in show ISO classes. No class applies to blanks.

Particle Generation Measuring Method

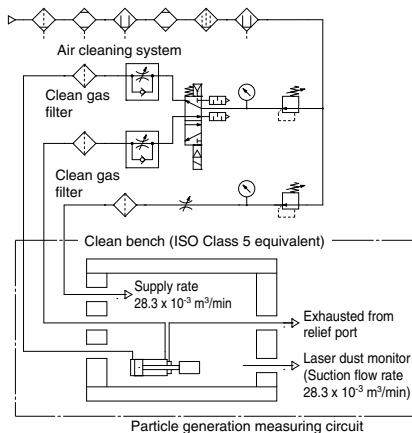
The particle generation data for SMC Clean Series is measured with the following test method.

Test Method (Example)

Place the test sample in the acrylic resin chamber and operate it while supplying the same flow rate of clean air as the suction flow rate of the measuring instrument ($28.3 \times 10^{-3} \text{ m}^3/\text{min}$). Measure the changes in the particle concentration over time until the number of cycles reaches the specified point. The chamber is placed in an ISO Class 5 equivalent clean bench.

Measuring Conditions

Chamber	Internal volume	$28.3 \times 10^{-3} \text{ m}^3$
	Supply air quality	Same quality as the supply air
Measuring instrument	Description	Automatic particle counter using light-scattering method
	Minimum measurable particle diameter	$0.1 \mu\text{m}$
	Suction flow rate	$28.3 \times 10^{-3} \text{ m}^3/\text{min}$
Setting conditions	Sampling time	30 min
	Interval time	30 min
	Sampling air flow	$850 \times 10^{-3} \text{ m}^3$



* The symbol for the cylinder is an original SMC symbol.

Evaluation Method

To obtain the measured values of particle concentration, the accumulated value ^{Note 1)} of particles captured every 30 minutes by the laser dust monitor, is converted into the particle concentration every 1 m^3 .

When determining particle generation classes, the 95% upper confidence limit of the average particle concentration (average value) when each test sample is operated at a specified number of cycles ^{Note 2)} is considered.

The plots in the graphs indicate the 95% upper confidence limit of the average particle concentration of particles with a diameter within the horizontal axis range.

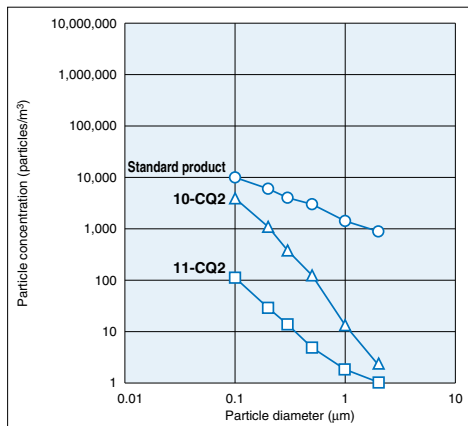
Note 1) Sampling air flow rate: Number of particles contained in $850 \times 10^{-3} \text{ m}^3$ of air

Note 2) Actuator: 1 million cycles

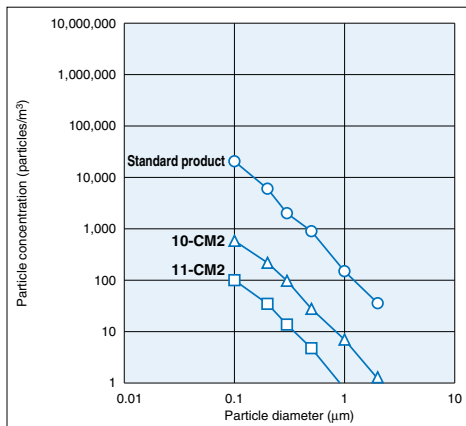
Solenoid valve: 10 million cycles

Particle Generation Characteristics (The particle generation data is representative and not guaranteed.)

Series CQ2-Z



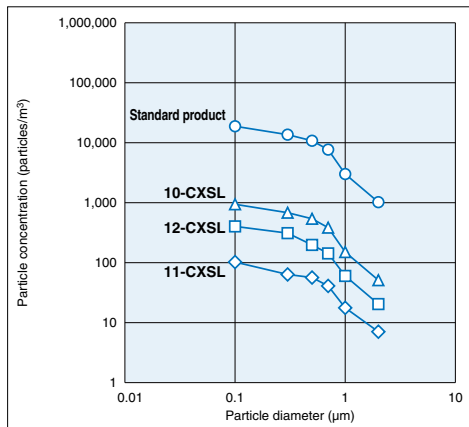
Series CM2-Z



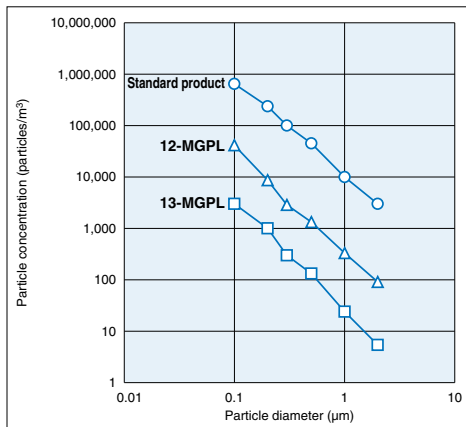
Particle Generation Measuring Method

■ Particle Generation Characteristics (The particle generation data is representative and not guaranteed.)

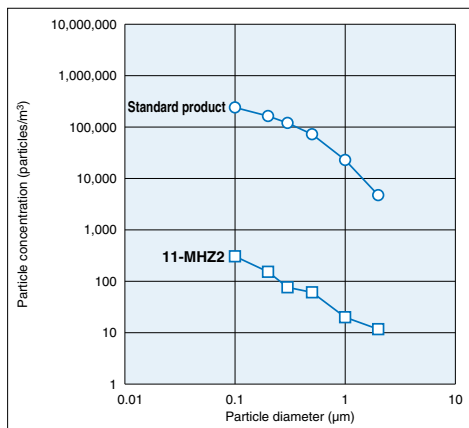
Series CXSL



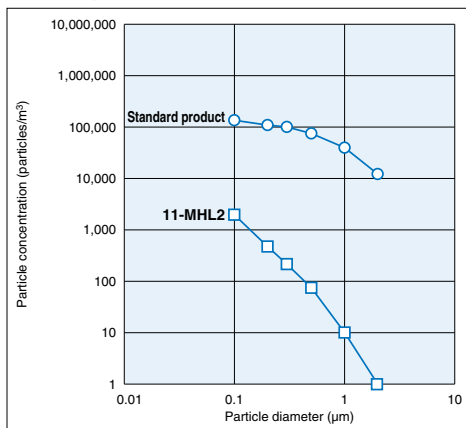
Series MGPL-Z



Series MHZ2



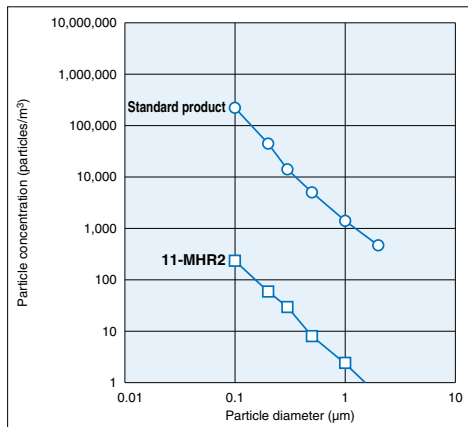
Series MHL2



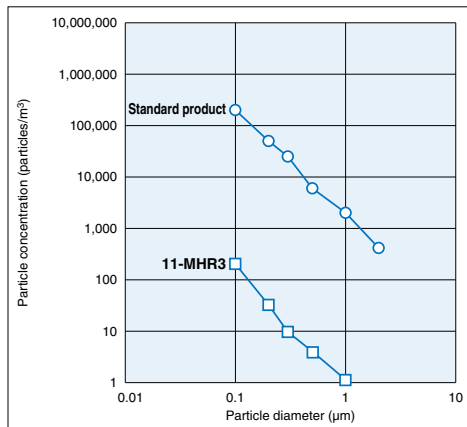
Particle Generation Measuring Method

■ Particle Generation Characteristics (The particle generation data is representative and not guaranteed.)

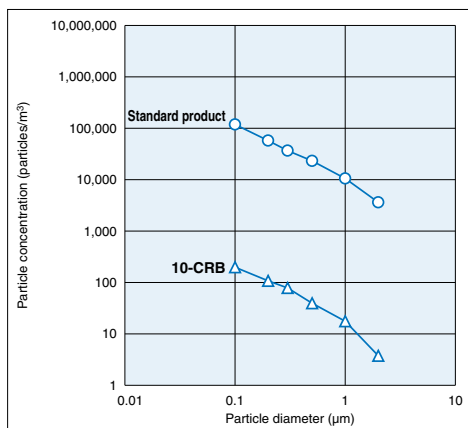
Series MHR2



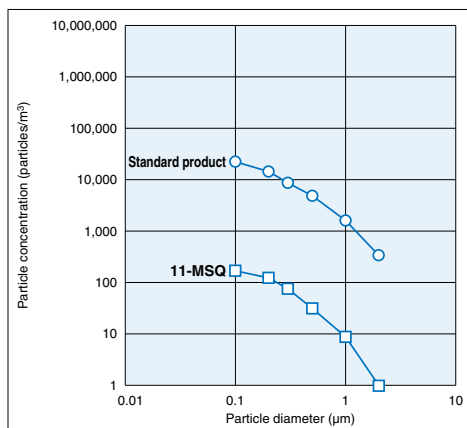
Series MHR3



Series CRB1



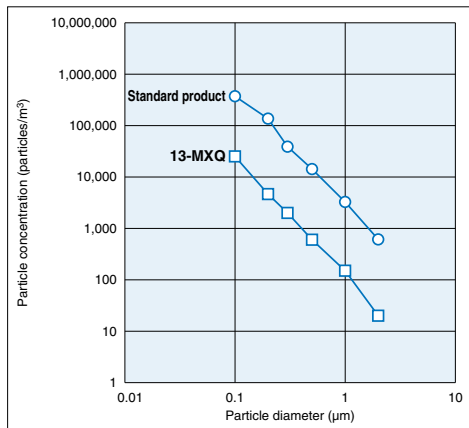
Series MSQ



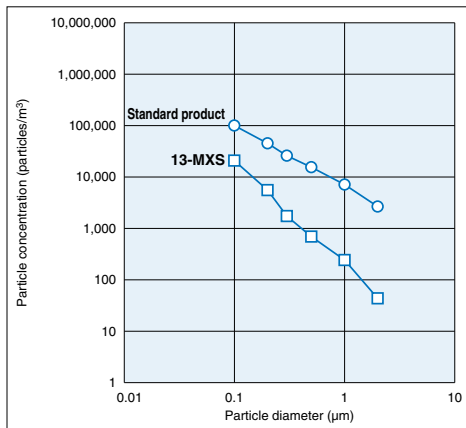
Particle Generation Measuring Method

■ Particle Generation Characteristics (The particle generation data is representative and not guaranteed.)

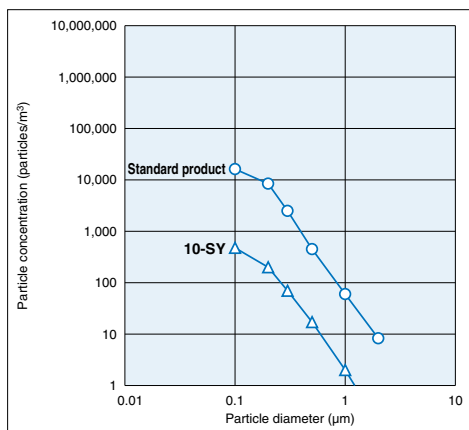
Series MXQ



Series MXS



Series SY

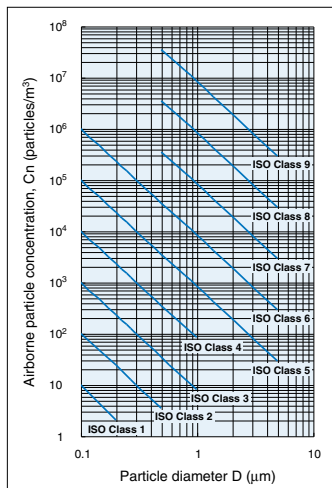


Comparison of Cleanliness Standards (Reference)

Standard	ISO 14644-1	JIS B 9920	Fed.Std.209E <small>Note)</small>		
Cleanliness class	ISO Class 1 to 9 Intermediate class available U descriptor: Particle diameter less than 0.1 μm M descriptor: Particle diameter exceeding 5.0 μm		British unit: Class 1 to 100.000 SI unit: Class M1 to M7 U descriptor: Particle diameter less than 0.1 μm		
			(British unit)	(SI unit)	
	Corresponding class	ISO Class 1	JIS Class 1		
		ISO Class 2	JIS Class 2		
		ISO Class 3	JIS Class 3	1	M1.5
		ISO Class 4	JIS Class 4	10	M2.5
		ISO Class 5	JIS Class 5	100	M3.5
		ISO Class 6	JIS Class 6	1000	M4.5
		ISO Class 7	JIS Class 7	10000	M5.5
		ISO Class 8	JIS Class 8	100000	M6.5
ISO Class 9		JIS Class 9			
Cleanliness class definition	The number of particles diameter 0.1 μm or larger in an air volume of 1 m ³ is expressed as 10 ^N . ISO Class N: Occupancy state: Sampling particle diameter		The number of particles diameter 0.5 μm or larger in an air volume of 1 m ³ is expressed as 10 M or coefficient Nc. Cleanliness class: Nc or M		
Calculation of max permitted concentration of particulates for cleanliness classes	$C_n = 10^N \times (0.1/D)^{2.08}$		British unit: Number of particles/ft ³ = Nc x (0.5/D) ^{2.2} SI unit: Number of particles/m ³ = 10 M x (0.5/D) ^{2.2}		
Evaluation method using simple sampling	① Number of sampling locations: 2 to 9 95% UCL of the mean and the mean of the averages ② Number of sampling locations: 1, or 10 or more The mean		① Number of sampling locations: 2 to 9 95% UCL of the mean and the mean of the averages ② Number of sampling locations: 10 or more The mean		
Number of sampling locations	Derive from the area of the clean room or clean air controlled space. Number of sampling locations N _L = (A) ^{0.5} At least one location		① Non-unidirectional air flow: at least two locations N _L = A x 64/(10 M) ^{0.5} ② Unidirectional air flow: at least two locations Smaller value between N _L = A/2.32, N _L = A x 64/(10 M) ^{0.5}		
Min. sampling air flow volume	2 liters or a sufficient volume of air that a minimum of 20 particles can be counted if the particle concentration were at the class limit. Min. sampling time: 1 minute		2 liters or a sufficient volume of air that a minimum of 20 particles can be counted if the particle concentration were at the class limit.		
Number of samplings	Where only one sampling location is required, take a minimum of three single sample volumes at that location.		Total number of samplings in each clean zone: 5 times or more		
Sampling method	Suction in the same direction as the air flow If the direction of the air flow is not predictable, the inlet of the sampling probe shall be directed vertically upward.		5.0 μm or larger: Constant velocity and suction in the same direction of the air flow 0.5 to 5 μm: Correction possible when it is sucked at a nonconstant velocity		

Note) Fed.Std.209E was abolished in Nov. 2001, so these figures are for reference only.

Comparison of Cleanliness Standards (Reference)



$$C_n = 10^N \times (0.1/D)^{2.08}$$

C_n: The maximum permitted concentration of airborne particles that are equal to or larger than the sampling particle diameter (D). C_n is rounded down to the nearest whole number, using no more than three significant figures.

N: Class No. (1 to 9), Intermediate class (1.1 to 8.9)

D: Sampling particle diameter (µm)

0.1: Constant number (µm)

Note) Concentration data with no more than three significant figures used in determining the classification level.

ISO Standard (ISO 14644-1)/JIS Standard (JIS B 9920)

Cleanliness class	Maximum concentration limit (particles/m ³)						Fed.Std.209E equivalent	
	Sampling particle diameter (µm)						(British unit)	(SI unit)
	0.1 µm	0.2 µm	0.3 µm	0.5 µm	1 µm	5 µm		
Class 1	10	2	—	—	—	—		
Class 2	100	24	10	4	—	—		
Class 3	1,000	237	102	35	8	—	Class 1	Class M1.5
Class 4	10,000	2,370	1,020	352	83	—	Class 10	Class M2.5
Class 5	100,000	23,700	10,200	3,520	832	29	Class 100	Class M3.5
Class 6	1,000,000	237,000	102,000	35,200	8,320	293	Class 1,000	Class M4.5
Class 7	—	—	—	352,000	83,200	2,930	Class 10,000	Class M5.5
Class 8	—	—	—	3,520,000	832,000	29,300	Class 100,000	Class M6.5
Class 9	—	—	—	35,200,000	8,320,000	293,000		

□ : Number of particles 0.1 µm or larger contained in 1 m³ (particles/m³)

U.S. Federal Standard (Fed.Std.209E: British unit)

Cleanliness class	Maximum concentration limit (particles/ft ³)				
	Sampling particle diameter (µm)				
	0.1 µm	0.2 µm	0.3 µm	0.5 µm	5 µm
Class 1	35	8	3	1	—
Class 10	350	75	30	10	—
Class 100	3,500	750	300	100	—
Class 1,000	35,000	7,500	3,000	1,000	7
Class 10,000	—	—	—	10,000	70
Class 100,000	—	—	—	100,000	700

□ : Number of particles 0.5 µm or larger contained in 1 ft³ (particles/ft³)

U.S. Federal Standard (Fed.Std.209E: SI unit)

Cleanliness class	Maximum concentration limit (particles/m ³)				
	Sampling particle diameter (µm)				
	0.1 µm	0.2 µm	0.3 µm	0.5 µm	5 µm
Class M1	350	76	31	10	—
Class M1.5	1,240	265	106	35	—
Class M2	3,500	757	309	100	—
Class M2.5	12,400	2,650	1,060	353	—
Class M3	35,000	7,570	3,090	1,000	—
Class M3.5	—	26,500	10,600	3,530	—
Class M4	—	75,700	30,900	10,000	—
Class M4.5	—	—	—	35,300	247
Class M5	—	—	—	100,000	618
Class M5.5	—	—	—	353,000	2,470
Class M6	—	—	—	1,000,000	6,180
Class M6.5	—	—	—	3,530,000	24,700

□ : Number of particles 0.5 µm or larger contained in 1 m³ (particles/m³)



Clean Series Precautions 1

Be sure to read this before handling products.
Refer to the main text for detailed precautions for every series.

Air Supply

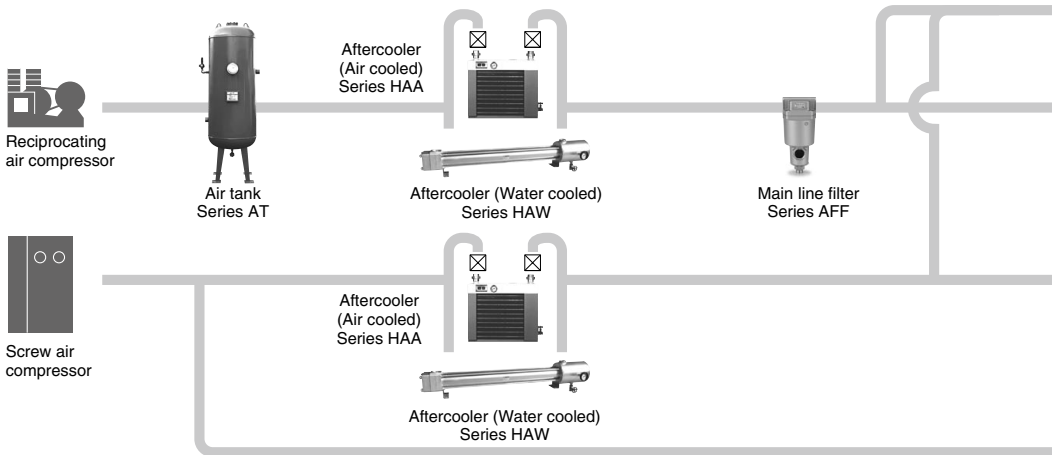
⚠ Caution

System Configuration

Refer to the "Air Preparation System" below for the quality of compressed air before configuring the system.

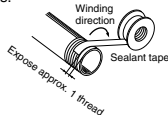
Main line

Sub-line



Piping

1. Provide an inclination of 1 cm per meter in the direction of the air flow to the main piping.
2. If there is a line branching from the main piping, provide an outlet of compressed air on top using a tee so that drainage accumulated in the piping will not flow out.
3. Provide a drainage mechanism at every recessed point or dead end to prevent drain accumulation.
4. For future piping extensions, plug the end of the piping with a tee.
5. Before piping
Before piping, the piping should be thoroughly flushed out with air or washed to remove chips, cutting oil and other debris from inside the pipe.
6. Winding of sealant tape
When screwing piping or fittings into ports, ensure that chips from the pipe threads or sealing material do not get inside the valve. Also, when sealant tape is used, leave approx. 1 thread ridge exposed at the end of the threads.



7. After piping
After piping, the piping should be thoroughly flushed out with air, and dust generated when piping should be removed.

8. If air with a low dew point (-40°C or less) is required, do not use nylon tubes or resin fittings (except for fluorine resin) for the outlet side of the membrane air dryer or heatless air dryer. Nylon tubing could be affected by the ambient air and thus may not be able to achieve the prescribed low dew point at the end of the tube. Therefore, for low dew point air, use stainless steel or fluorine tubes and fittings.

Maintenance

1. If the heatless air dryer Series ID is left unused for a long period, the absorbent may become moist. Prior to use, close the valve on the outlet side of the dryer for regeneration and drying.

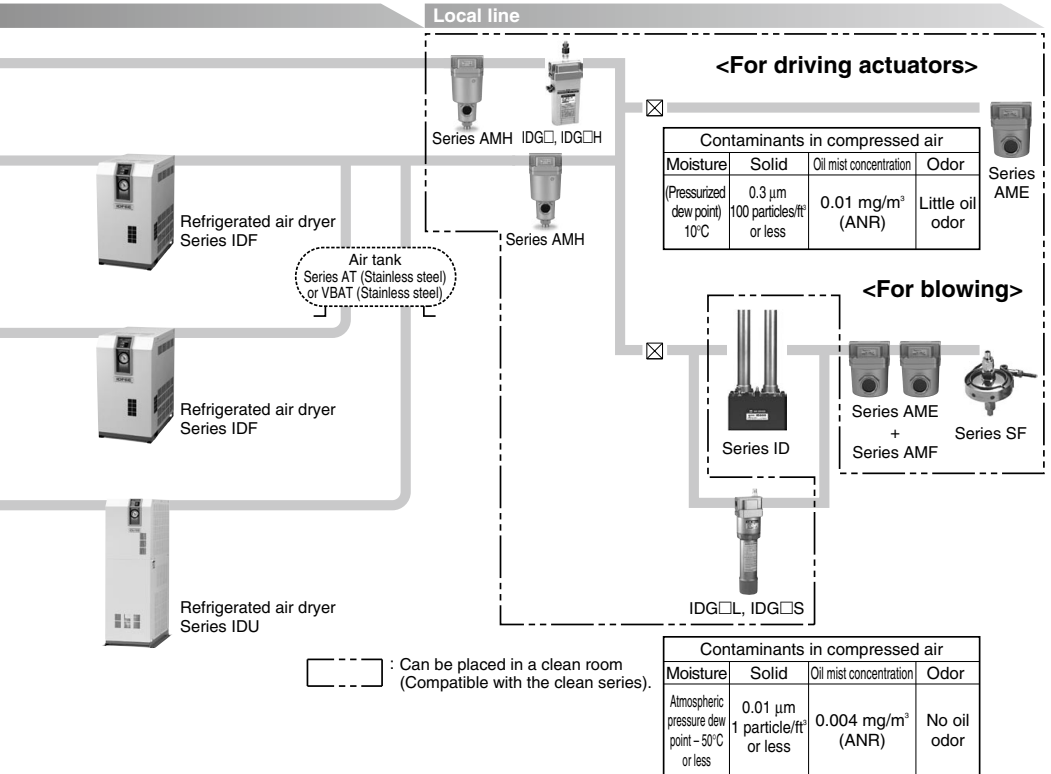
Design

Employ a safe design, so that the following unexpected conditions will not occur.

⚠ Warning

1. Provide a design that prevents high-temperature compressed air from flowing into the outlet side of the cooling equipment.
If the flow of the coolant water in a water-cooled aftercooler is stopped or if the fan motor of an air cooled aftercooler is stopped, the high-temperature compressed air will flow to the outlet side of the cooling equipment, causing the equipment on the outlet side (such as the AFF, AM, AD, or IDF series) to be damaged or to malfunction.

Air Supply



2. Provide a design in which interruptions in the supply of compressed air are taken into consideration.

There are cases in which compressed air cannot flow due to freezing of the refrigerated air dryer or a malfunction (heatless dryer) in the switching valve.

⚠ Caution

3. Design a layout in which the leakage of the coolant water and the dripping of condensation are taken into consideration.

A water-cooled aftercooler that uses coolant water could lead to water leakage due to freezing. Depending on the operating conditions, the refrigerated air dryer and its downstream pipes could create water droplets due to condensation formed by supercooling.

4. Provide a design that prevents back pressure and backflow.

The generation of back pressure and backflow could lead to equipment damage.

Take appropriate safety measures, including the proper installation methods.

5. When super dry air is used as the fluid, equipment reliability (service life) may be adversely affected due to deteriorating lubrication properties inside the equipment.

Please consult SMC in such cases.

6. Blowing system

Even a small amount of dust can be a problem for blowing systems.

Install Clean Gas Filter or Clean Air Filter Series SF to the end of the blowing line.



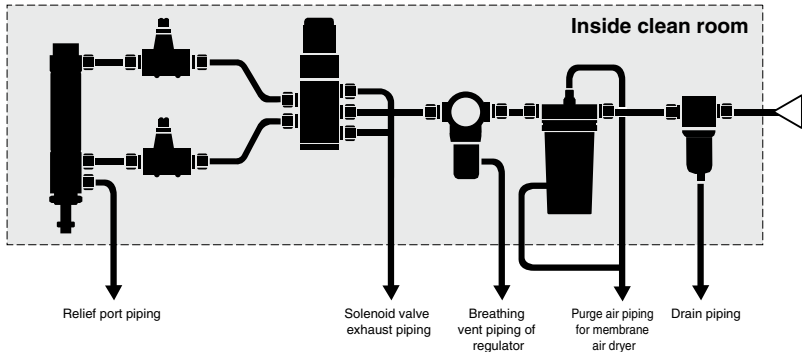
Clean Series Precautions 2

Be sure to read this before handling products.
Refer to the main text for detailed precautions for every series.

Piping: Inside of Clean Room

⚠ Caution

1. Do not make the piping for the air cylinder relief port and regulator breathing tube common with solenoid valve exhaust piping.
This can cause malfunctions in the air cylinder or regulator pressure change.
Do not apply pressure to the air cylinder relief port.
2. Arrange the piping so that the exhaust air of the solenoid valves is exhausted outside of the clean room.
3. Air filter drain piping
Exhaust drainage outside the clean room through piping from the drain guide of the air filter.
4. Arrange the membrane dryer air purge piping using standard size tubing so that air is exhausted outside the clean room.
5. Take precautions so that the threaded portion of the piping connection or the tubing connection will not be loosened.
Take sufficient precautions against piping shaking along with vibration of the equipment.
6. Use polyurethane tubing containing no plasticizer.
7. In case of the One-touch fitting 10-KQ (that includes built-in One-touch fitting solenoid valve manifolds, and speed controllers with One-touch fittings), changes in internal pressure may cause the collet chuck to slide very slightly. This may result in particle generation, so please avoid using this item in ISO Class 3 or ISO Class 4 areas.
However, there is no need for similar caution in the case of insert fittings (KF), miniature fittings (M/MS), clean One-touch fittings (KP/KPQ/KPG), or speed controllers with clean One-touch fittings (AS-FPQ/FPG).



Handling

⚠ Caution

1. The inner bag of a double-packed clean series package should be opened in a clean room or clean environment.
2. When standard pneumatic equipment is brought into a clean room, spray high-purity air onto it and remove dust thoroughly by wiping the external surfaces of the cylinder tube, solenoid valves and air line equipment with alcohol.
3. To replace parts or disassemble the product in a clean room, first exhaust the compressed air inside the piping to the outside of the clean room before the work.
4. Do not use rotation type mounting brackets such as clevises, trunnions, etc. They will generate a considerable amount of particulate matter due to the sliding friction between the metal parts.

Lubrication for Actuators

⚠ Warning

Be sure to wash your hands after handling fluoresces grease.
The grease itself is not hazardous but it can produce a hazardous gas at temperatures exceeding 260°C.



Clean Series Precautions 3

Be sure to read this before handling products.
Refer to the main text for detailed precautions for every series.

Lubrication for Actuators

⚠ Caution

- Do not use any greases but those specified by SMC.
Use of greases not specified will cause malfunctions or particle generation.
- Do not lubricate the products since they are of a non-lubricant type.
As the clean series actuators are lubricated at the factory with fluororesin grease, the product specifications may not be satisfied if turbine oil or other such lubricants are applied.

Piston Speed

⚠ Caution

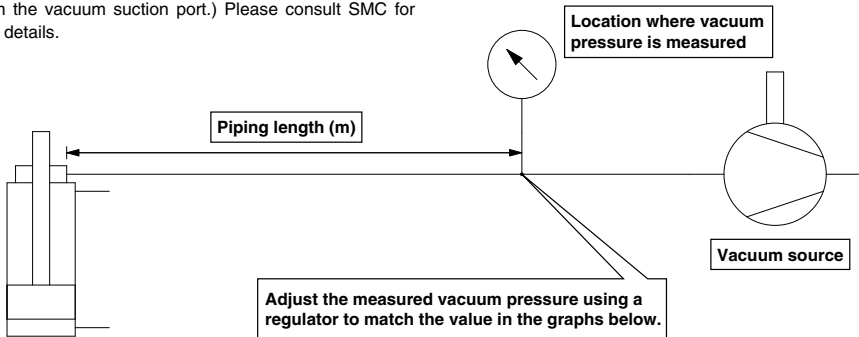
The air cylinder speed upper limit that retains the particle generation grade is 400 mm/s. When the maximum operating speed for the standard type is 400 mm/s or slower, operate the series within the operating speed range.

Suction Flow Rate of Vacuum Suction Types

⚠ Caution

For vacuum suction types (11-/13-/22-Series), perform vacuum suction at the vacuum port to retain the particle generation grade.

The optimum suction flow rate varies depending on the series and size. Refer to "Suction flow rate of vacuum suction type (Reference values)" for each series. (The vacuum pressure will be approximately -27 kPa at around 1 m from the vacuum suction port.) Please consult SMC for further details.



* The symbol for the cylinder is an SMC original symbol.

