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.

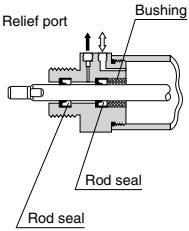
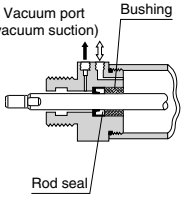
Dust is kept from the clean room.

- **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.**

10-/11-/12-/13- (Clean Series)	Product assembled in clean room (Special Clean Series)
Assembly and inspection in a standard workshop ↓ Clean room ISO Class 8 equivalent Surface wiped with alcohol (to remove oil) ↓ Clean room ISO Class 8 equivalent Clean booth ISO Class 5 equivalent Interior packed after blowing surface with clean air (anti-static electricity measures) ↓ Clean room ISO Class 8 equivalent Exterior packed (Double packing) ↓ Shipping	Clean booth ISO Class 5 equivalent Parts washed ↓ Assembly/Inspection ↓ Clean bench ISO Class 5 equivalent in Clean room ISO Class 7 equivalent Double packing ↓ Shipping

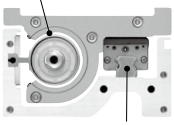
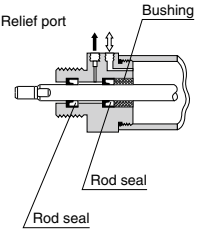
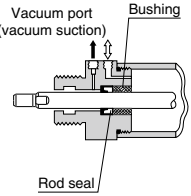
The 21- and 22- series are given standard packaging (assembly, inspection, packing, and shipping carried out in a standard workshop.) Please contact SMC for clean packaging.

Basic Specifications of Actuators

	Series 10-	Series 11-	Series 12-	
Construction	• **Double seal type/ release to atmosphere** 	• **Single seal type/ vacuum suction** 	• **Compact guide cylinder** P.839 • **Dual rod cylinder** From P.848 Double seal type/release to atmosphere (10- series equivalent) and specially treated guide  Ball bushing guide Linear guide	• **Rodless cylinder** P.766-1 Specially treated cylinder tube exterior  Cylinder tube
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	• **Directional control valve** P.36  Main valve and pilot valve common exhaust Fittings, speed controllers, pressure switches, etc. have the same structure as those of standard.	• **Compressed air cleaning filter series** P.958 • **Modular F.R.** P.1068 	• **Clean regulator** P.1114 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. 	• **Clean One-touch fittings (for blowing)** P.1221  Polypropylene resin • **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-
	• **Compact guide cylinder** P.839 • **Air slide table** From P.778 Single seal type/ vacuum suction (11- series equivalent) and specially treated guide  Ball bushing guide Linear guide	• **Clean rodless cylinder** P.773 No contact between the cylinder tube exterior and the slider interior  Linear guide Special treatment	• **Double seal type/ release to atmosphere** 	• **Single seal type/ vacuum suction** 
		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.

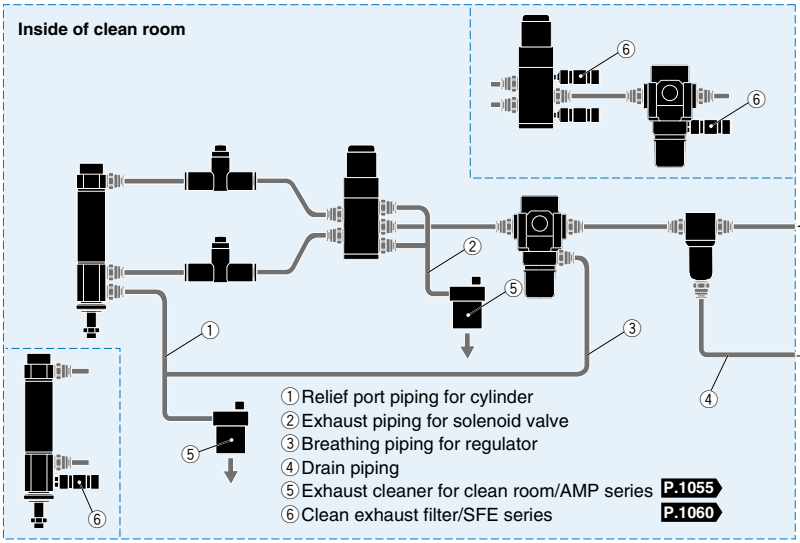
	Clean Series			Series 21-	
	• **Clean One-touch fittings (for driving air piping)** P.1225 • **Clean speed controller** P.1291 Polypropylene resin  Metal parts Brass (Electroless nickel plated) or Stainless steel 304	• **Exhaust cleaner for clean room** P.1055  • **Clean gas filter** From P.1011 PTFE membrane element  • **Clean air filter** Polyolefin hollow fiber membrane element From P.1031 	• **Clean exhaust filter** P.1060 	• **Directional control valve** P.36 • **Modular F.R.** P.1068 The same construction as the 10- series	• **Clean One-touch fittings (for driving air piping)** P.1225 • **Clean speed controller** P.1291 No sealant on thread parts ∗ UNI thread is also applicable. (Made to Order)
	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.

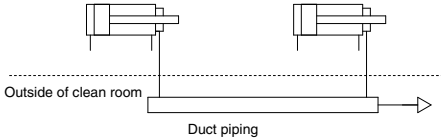
●Actuator Driving System



●Cylinder Relief Port Piping

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

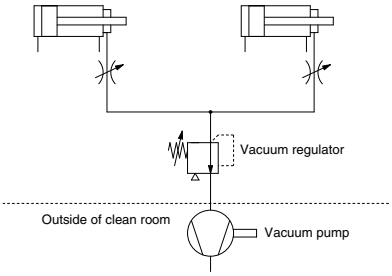
Connect the relief port piping with the dedicated duct piping installed outside the clean room or with the exhaust cleaner for clean room/AMP series, or connect the clean exhaust filter SFE series to relief port piping.



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

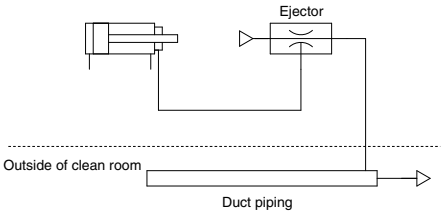
With a vacuum pump

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.

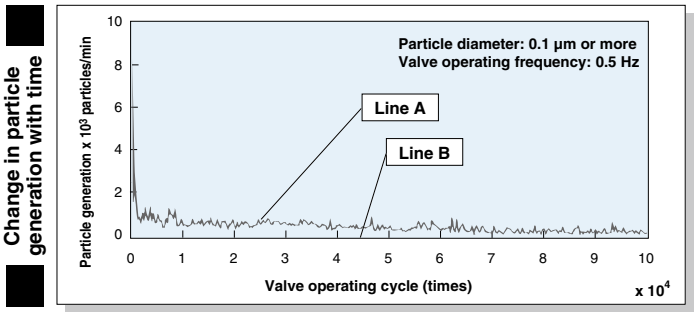


∗ The symbol for the cylinder is an original SMC symbol.

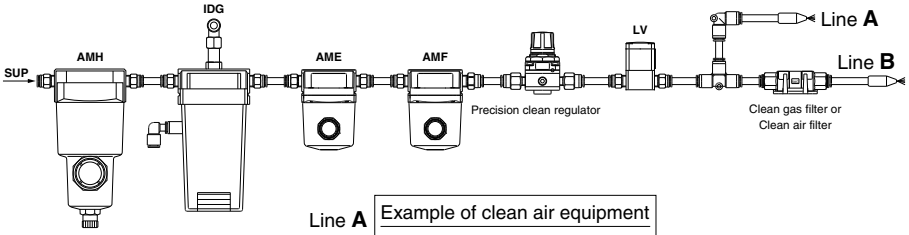
Clean Blow System

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 N_2 blow



Example of Air Line Equipment

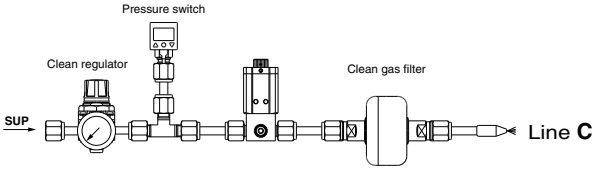


Line **A**
Line **B**

Example of clean air equipment

Fittings: Clean One-touch fittings
Piping : Polyolefine tubing
Clean: Oil-free, Assembled in clean room

Example of N_2 Equipment



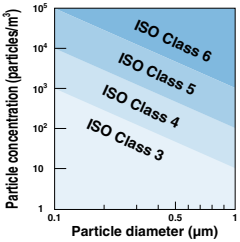
Feature (Line C)

Excellent corrosion resistance
(Body: Stainless steel 316L)
Integrated fitting
Seal material: Fluoropolymer or Stainless steel
Precision cleaning, Assembled in clean room

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

Particle generation grade no. of pneumatic equipment ≤ 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

① Required clean room cleanliness? ····· ISO Class 4 or ISO Class 5 or ISO Class 6?

↓

② Air flow to the workpiece? (Refer to Diagram 1.)

↓

③ Where is the pneumatic equipment located? (Refer to Diagram 2.)

↓

④ Determine the particle concentration grade no. around the workpiece based on ① to ③ above. (Refer to Table 1.)

↓

⑤ Select the equipment to be used. (Refer to pages 18 to 29.)

Diagram 1: Air flow

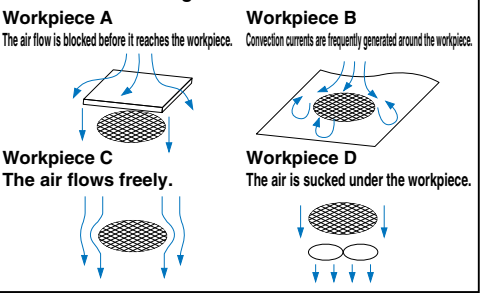


Diagram 2: Installation location of equipment

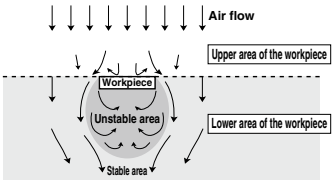


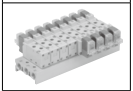
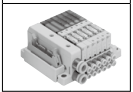
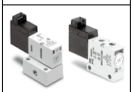
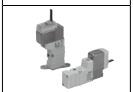
Table 1: Particle Concentration Grade around the Workpiece (Guide)

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		
③ Installation location of equipment		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	
			Unstable area	Stable area		Unstable area	Stable area		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									
	Class 5					Series 10- (Series 12-, 21-)	Standard product			Standard product
	Class 6	Series 11- (Series 13-, 22-)	Series 10- (Series 12-, 21-)	Standard product	Series 10- (Series 12-, 21-)			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

Cleanliness Class

Directional Control Valves

Description		Series	Cleanliness class (ISO class) Note)			Page
			Standard	10-	21-	
	4/5 Port Solenoid Valve	**10-SY3000/5000/7000/9000** Note 2) Note 2)	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
		**10-S0700**	5	3	3	P.417
		**10-/21-VQ1000/2000**	5	3	3	P.514
		**10-SQ1000/2000**	5	3		P.578
		**10-VQD1000**	5	3		P.597
	3 Port Solenoid Valve	**10-V100**	5	3		
		**10-SYJ300/500/700**	5	3		P.602
		**10-SY100**	5	3		P.648
		**10-S070**	5	3	3	P.658
	Normal Close High Vacuum Solenoid Valve	**XSA**	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.

Cleanliness Class

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								
			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-Z	6			5				P.766-1
			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.

Cleanliness Class

Air Cylinders

Description		Series	Cleanliness class (ISO class)							Page
			Standard	10-	11-	12-	13-	21-	22-	
	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.

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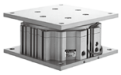
Cleanliness Class

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-Z	6					6	5	
	Guide Table Cylinder		10-MGF	6	4						P.844
	Dual Rod Cylinder	Ball bushing bearing	11-/12-/21-/22- CXSJL	5		3	4		5	3	P.848
		Slide bearing	11-CXSJM	6		3					
		Ball bushing bearing	10-/11-/12-/21-/22- CXSL	5	4	3	4		5	3	P.852
		Slide bearing	10-/11- CXSM	6	4	3					

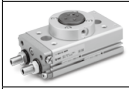
Values in ☐ show ISO classes.
☐ No class applies to blanks.

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.

Cleanliness Class

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-MSQ**	**5**		**3**				**3**	P.908-1
			11-22- **MSQA, MSQB**	**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.

Cleanliness Class

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.

Cleanliness Class

Air Preparation Equipment

Description			Series	Cleanliness class (ISO class) Standard	Page
	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 Plug-in type	**SFE1/3/4/5/7**	**3** **Exhaust air: 4**	P.1060

Values in ☐ show ISO classes.

Cleanliness Class

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.

Cleanliness Class

Pressure Control Equipment

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.

Cleanliness Class

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.

Cleanliness Class

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.

Cleanliness Class

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
		For compact pneumatics	**10-PSE540**	**5**	**4**	P.1355
		For low differential pressure	**10-PSE550**	**5**	**4**	P.1357
		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 x 10^{-3} m^3/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

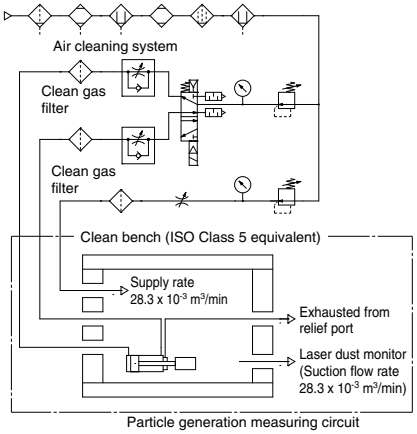
Chamber	Internal volume	28.3 x 10^{-3} m^3
	Supply air quality	Same quality as the supply air
Measuring instrument	Description	Automatic particle counter using light-scattering method
	Minimum measurable particle diameter	0.1 μm
	Suction flow rate	28.3 x 10^{-3} m^3/min
Setting conditions	Sampling time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

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.



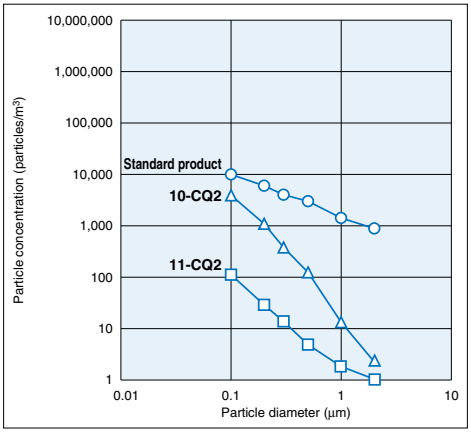
Particle generation measuring circuit

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

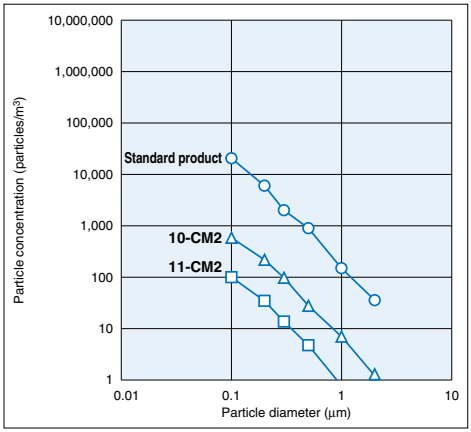
Note 1) Sampling air flow rate: Number of particles contained in 850 x 10^{-3} m^3 of air
Note 2) Actuator: 1 million cycles
Solenoid valve: 10 million cycles

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

Series CQ2-Z



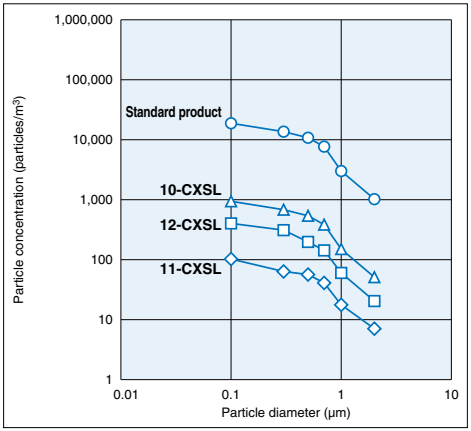
Series CM2-Z



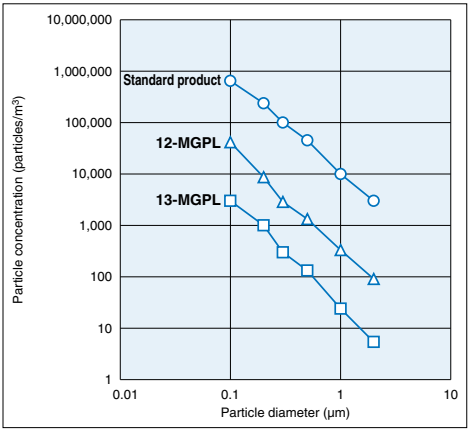
Particle Generation Measuring Method

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

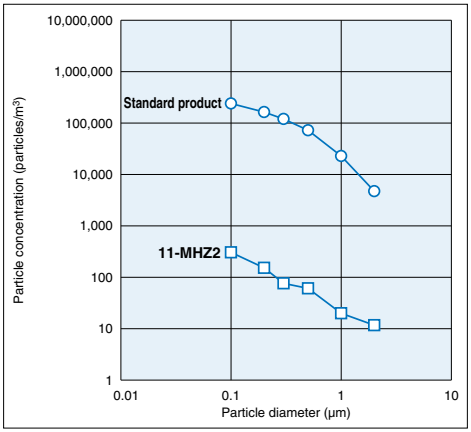
Series CXSL



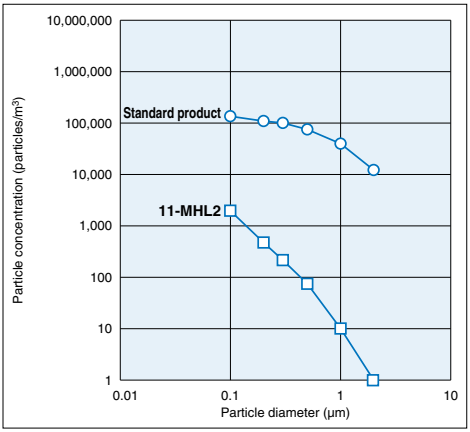
Series MGPL-Z



Series MHZ2



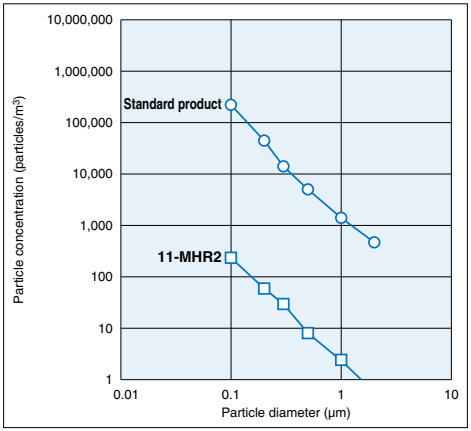
Series MHL2



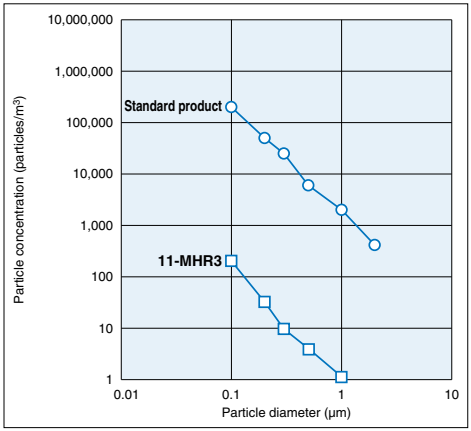
Particle Generation Measuring Method

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

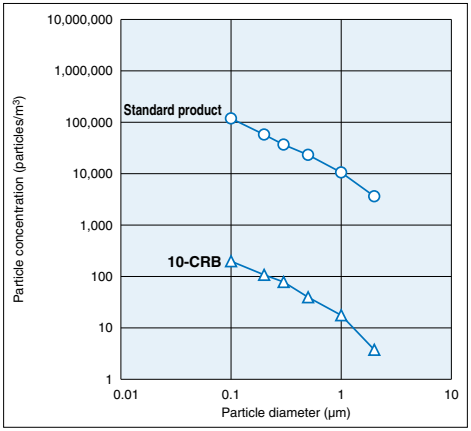
Series MHR2



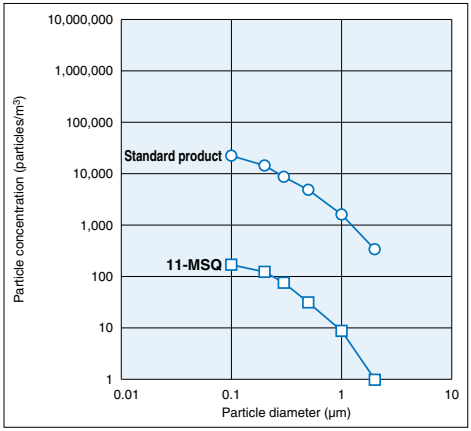
Series MHR3



Series CRB1



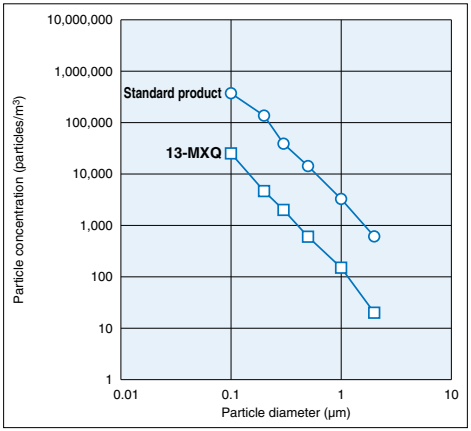
Series MSQ



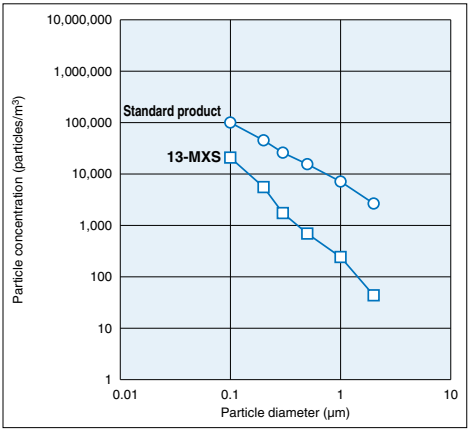
Particle Generation Measuring Method

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

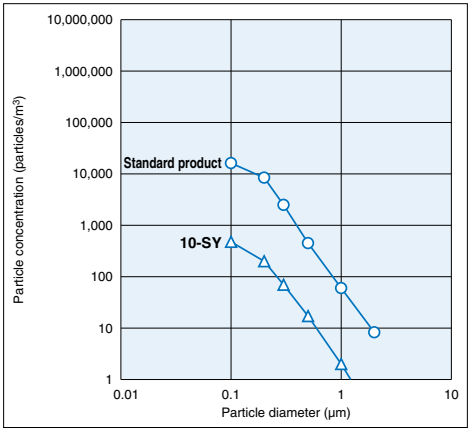
Series MXQ



Series MXS



Series SY

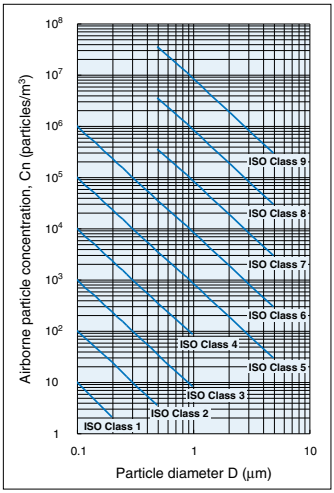


Comparison of Cleanliness Standards (Reference)

<table>
<tr><th colspan="2">Standard</th><th>ISO 14644-1</th><th>JIS B 9920</th><th colspan="2">Fed.Std.209E Note)</th></tr>
<tr><td colspan="2" rowspan="2">Cleanliness class</td><td colspan="2">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</td><td colspan="2">British unit: Class 1 to 100.000
SI unit: Class M1 to M7
U descriptor: Particle diameter less than 0.1 μm</td></tr>
<tr><td>Corresponding class</td><td>(British unit)</td><td>(SI unit)</td></tr>
<tr><td colspan="2"></td><td>ISO Class 1</td><td>JIS Class 1</td><td></td><td></td></tr>
<tr><td colspan="2"></td><td>ISO Class 2</td><td>JIS Class 2</td><td></td><td></td></tr>
<tr><td colspan="2"></td><td>ISO Class 3</td><td>JIS Class 3</td><td>1</td><td>M1.5</td></tr>
<tr><td colspan="2"></td><td>ISO Class 4</td><td>JIS Class 4</td><td>10</td><td>M2.5</td></tr>
<tr><td colspan="2"></td><td>ISO Class 5</td><td>JIS Class 5</td><td>100</td><td>M3.5</td></tr>
<tr><td colspan="2"></td><td>ISO Class 6</td><td>JIS Class 6</td><td>1000</td><td>M4.5</td></tr>
<tr><td colspan="2"></td><td>ISO Class 7</td><td>JIS Class 7</td><td>10000</td><td>M5.5</td></tr>
<tr><td colspan="2"></td><td>ISO Class 8</td><td>JIS Class 8</td><td>100000</td><td>M6.5</td></tr>
<tr><td colspan="2"></td><td>ISO Class 9</td><td>JIS Class 9</td><td></td><td></td></tr>
<tr><td colspan="2">Cleanliness class definition</td><td colspan="2">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</td><td colspan="2">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</td></tr>
<tr><td colspan="2">Calculation of max permitted concentration of particulates for cleanliness classes</td><td colspan="2">$C_n = 10^N \times (0.1/D)^{2.08}$</td><td colspan="2">British unit: Number of particles/ft^3 = $N_c \times (0.5/D)^{2.2}$
SI unit: Number of particles/m^3 = 10 M x $(0.5/D)^{2.2}$</td></tr>
<tr><td colspan="2">Evaluation method using simple sampling</td><td colspan="2">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</td><td colspan="2">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</td></tr>
<tr><td colspan="2">Number of sampling locations</td><td colspan="2">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</td><td colspan="2">① Non-unidirectional air flow: at least two locations
$N_L = A \times 64/(10\ M)^{0.5}$
② Unidirectional air flow: at least two locations
Smaller value between $N_L = A/2.32$, $N_L = A \times 64/(10\ M)^{0.5}$</td></tr>
<tr><td colspan="2">Min. sampling air flow volume</td><td colspan="2">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</td><td colspan="2">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.</td></tr>
<tr><td colspan="2">Number of samplings</td><td colspan="2">Where only one sampling location is required, take a minimum of three single sample volumes at that location.</td><td colspan="2">Total number of samplings in each clean zone: 5 times or more</td></tr>
<tr><td colspan="2">Sampling method</td><td colspan="2">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.</td><td colspan="2">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</td></tr>
</table>

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)

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

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

Cleanliness class	Maximum concentration limit (particles/m³) Sampling particle diameter (μm)							Fed.Std.209E equivalent	
	0.1 μm		0.2 μm	0.3 μm	0.5 μm	1 μm	5 μm	(British unit)	(SI unit)
Class 1	10	10^1	2	—	—	—	—		
Class 2	100	10^2	24	10	4	—	—		
Class 3	1,000	10^3	237	102	35	8	—	Class 1	Class M1.5
Class 4	10,000	10^4	2,370	1,020	352	83	—	Class 10	Class M2.5
Class 5	100,000	10^5	23,700	10,200	3,520	832	29	Class 100	Class M3.5
Class 6	1,000,000	10^6	237,000	102,000	35,200	8,320	293	Class 1,000	Class M4.5
Class 7	—	10^7	—	—	352,000	83,200	2,930	Class 10,000	Class M5.5
Class 8	—	10^8	—	—	3,520,000	832,000	29,300	Class 100,000	Class M6.5
Class 9	—	10^9	—	—	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/ft³) 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/m³) 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.

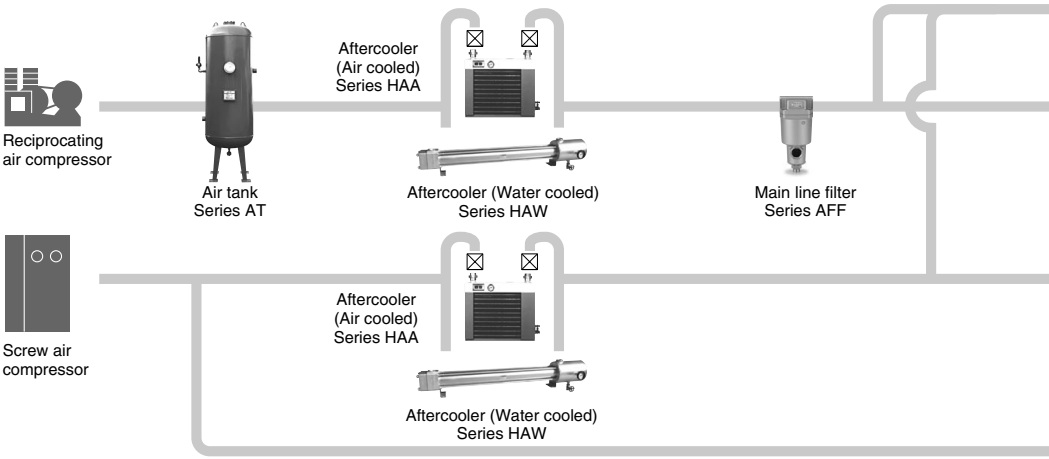
Air Supply

⚠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.

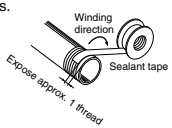
2. If there is a line branching from the main piping, provide an outlet of compressed air on top using a tee so that drainage accumulated in the piping will not flow out.

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

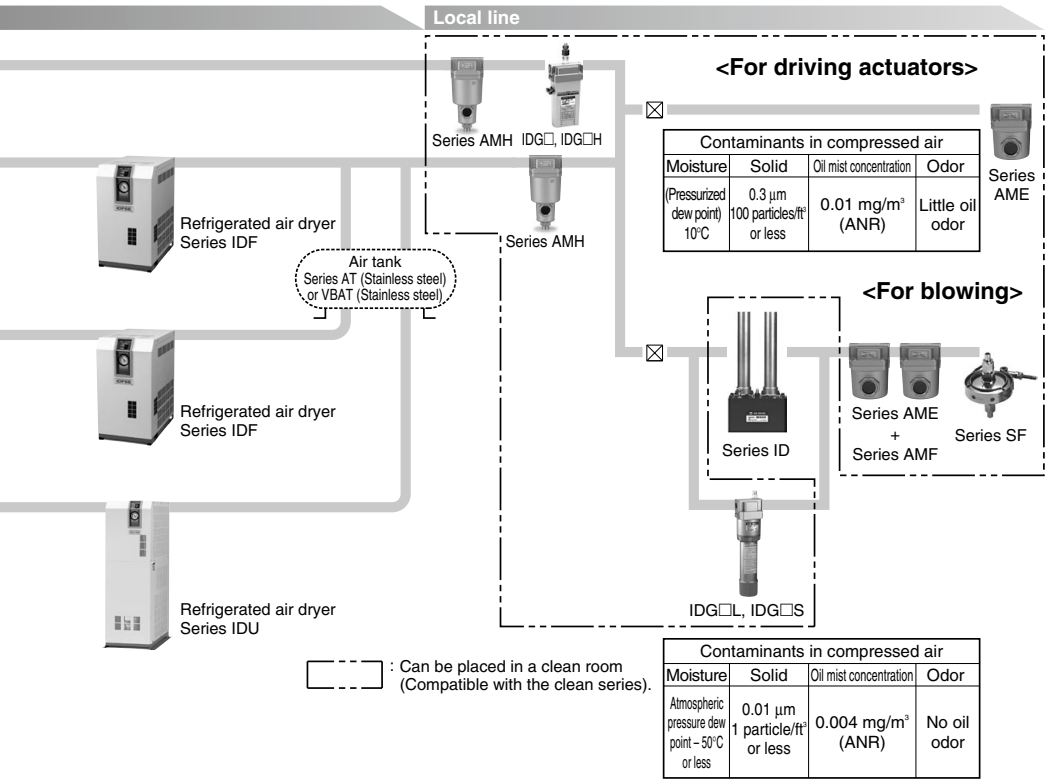
1. If the heatless air dryer Series ID is left unused for a long period, the absorbent may become moist. Prior to use, close the valve on the outlet side of the dryer for regeneration and drying.

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.



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 air with a low dew point is used as the fluid, equipment reliability (service life) may be adversely affected due to the deterioration of the lubrication properties inside the equipment. Consider using a 25A- series low dew point compatible product.

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.

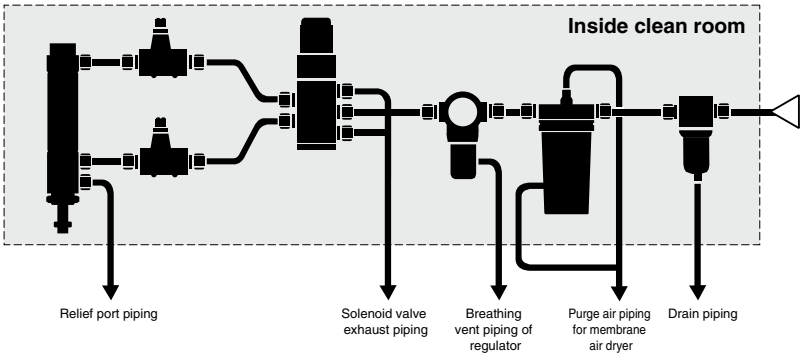
3. Air filter drain piping
Exhaust drainage outside the clean room through piping from the drain guide of the air filter.

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 fluororesin 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

1. Do not use any greases but those specified by SMC.
Use of greases not specified will cause malfunctions or particle generation.

2. 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

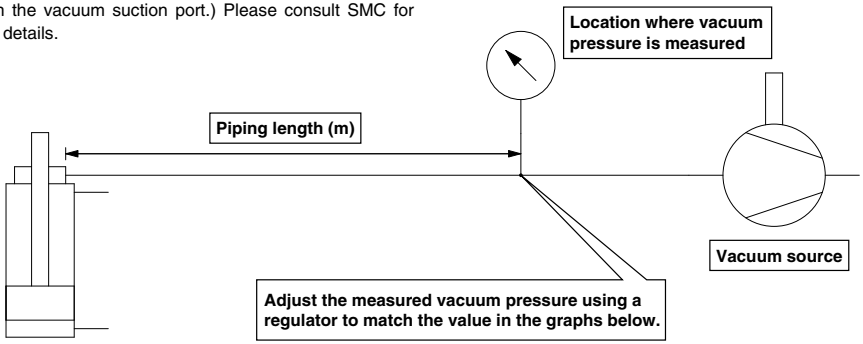
⚠Caution

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.