FTES

FukudaTestEnvironmentSolution

Proposal to Fukuda Test Environment Solution

- *Fukuda proposes using standard test circuits that adapt to client measurement conditions for the air leak tester in order to operate under optimal conditions.*

FukudaTestEnvironmentSolution

Work Property	Work Condition	Seal Device	Measurement Method	Equipment Condition	Operation Process	Temperature Setting	Equipment Setting	Plant Environment
Material, Structure, Temperature, Resisting Pressure, Pressure Property, Dispersion	Moisture, Oil, Germs, Corrosion, Dirt, Environmental Pollution	Seal Material, Seal Structure, Stability, Reproducibility, Performance	Pressure, Flow, Direct Pressure, Differential Pressure, Hydrogen, Helium, Sealed Product	Piping Material, Manual, Automatic, Original Pressure Control, Lock	Preceding Process, Subsequent Process, Transporting Device	Work Temperature, Air Temperature, Sounding Temperature	Air Control, Management Equipment, Vibration, Noise, Exhaust Disposal	Air Conditioning, Lighting, Misting, Soot, Dust

FUKUDA

Proposal to Fukuda Test Environment Solution

The air leak test has been widely used in a variety of production lines as an economically efficient and automatic seal test method. However, increased quality and shorter production time are now under serious consideration as a result of changing needs by the customer, direct environmental issues, escalating costs and competition.
This state of affairs is common in the seal test process field, and it is implausible to expect an improvement in test specifications or decrease in tact time using the conventional system. One possible solution involves preparing 2 seal testers; however, this approach will not show any real benefit to the customer. As a result, FUKUDA proposed to accommodate for this by creating a more favorable set of environmental and measurement conditions for the air leak tester.

The air leak test is a simple test method performed by pressurizing (or evacuating) the inside of test objects with air before sealing the container. It then detects the pressure variation inside the test object to confirm if a leak is present. However, as the pressure changes due to temperature and volume variation, this testing method is not always 100% accurate. Moreover, if test specifications become unstable, precise measurement cannot be guaranteed if conditions are not sufficient to suppress any variations. In addition, only experienced Engineers can identify factors that can cause pressure to vary (not including leaks) within the measurement environment.
FUKUDA has manufactured standard test circuits that can be applied to various measurement conditions, and the customer can use them in alliance with FUKUDA's technologies that have been refined for over 50 years.

Contents

Selection of the Measurement System

To construct a seal test system that fits the test object product to be seal tested (hereafter referred to as the 'work'), it is necessary to examine the work characteristics in order to select the measurement system and item (consisting in the system) fitting the condition.

■ Selection by Work Volume and Test Pressure

Select the basic items according to the test pressure and the work volume. The pressure and flow rate ranges (capability of pressurization and exhaust) of the selected items are determined according to the following condition: The first process in the leak test is to fill (exhaust) the test pressure inside the work. It is recommended to use large flow rates to pressurize large volumes of work, and also necessary to select pneumatic equipment suitable to the work volume. Also, the pressurization process must be considered to factor in the pressure inside the work to accomplish stable measurement.

Points to be Considered:

- Pipe diameter ensuring the pressurization and evacuation flow rate is suitable for the work volume.
- Test pressure regulator suitable for the work volume, and the evacuation capability of the primary regulator.
- Assurance of the repeatability of the pressurization characteristics.
  Sensitivity and precision of the test pressure regulator.
- Air source stability to support the instantaneous flow rate during pressurization.
  Pipe diameter of the air pressure source with or without the accumulator tank.

■ Selection According to Work Characteristics and Environment Conditions

It is necessary to select a proper measurement system and items according to individual work characteristics and measurement environment.
The air leak test method is used to test for leaks by measuring the pressure variation inside the sealed work. If pressure variation occurs for reasons other than a leak, correct testing cannot be accomplished. Also, if any factors vary inside the work pressure due to environmental conditions, or changes within the work itself, it becomes necessary to select countermeasures against those factors.
Depending on the condition, it may be necessary to determine the system by observing effects showing from or put to the work.

Points to be Considered:

- **Will the temperature vary?**
  In the preceding process (cleaning with warm water)/In the measurement (air conditioner etc.)/ In system (electromagnetic valve etc.)
- **Will the volume vary?**
  Work expansion by heating (soft material)/Seal sink down/O-ring displacement
- **Work structure.**
  Inside work is complex, and the path is narrow/Existing check valve/Existing porous material (filter etc.).
- **With or without residual material of the preceding process.**
  Use the same cleaning agent as in the preceding process
- **Effect to the work.**
  Pressure should not exceed a certain value and should not be exposed to humidity.

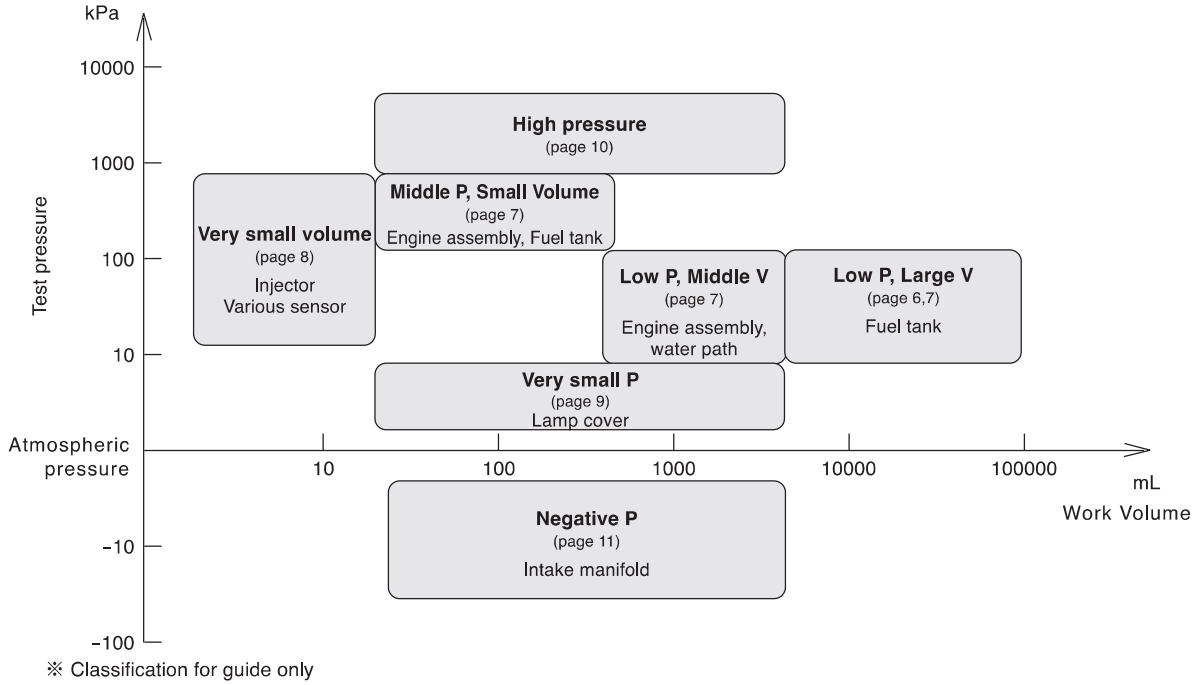
■ System examples

System and Item Selection Examples

Work Name	Basic Requirement	Additional Requirement	Page	Similar Work
Automobile fuel tank	Test pressure low and work volume very large	Work is soft. Measurement pipe is long	**6**	Pail can, resin intake manifold, gas meter etc.
Engine assembly	Complex test where test pressure and volume differ between works.	Inner path is complex.	**7**	Engine bear etc.
Injector	Work inner volume is very small.	Small leak specification	**8**	Sensor parts, pressure regulator etc.
Lamp cover	Test with small pressure	Work is soft	**9**	Gas meter, gas cooking appliance
Hydraulic Control System Product	Test with high pressure		**10**	Radiator, heater, compressor, common rail etc.
Resin intake manifold	Test with negative pressure	Work is soft	**11**	Canister, fuel tank, resin made sanitary part etc.
Water proof portable telephone	No pressurization port of work		**12**	Sensor, water proof watch, bath room products, camera on board etc.
Tail lamp cover	No pressurization port of work	Work inner volume is relatively large.	**13**	Water closet float, seal type sensor etc.
Rubber hose	Work is very soft		**14**	Evaporator, delivery pipe, warm water pipe etc
Oil filter	Large amounts of porous materials inside work.		**15**	Valve, canister, hollow filament filter etc.

Example Systems Portfolio

(The system is configured according to the work characteristics as main factors for water proof portable telephones, tail lamp covers, rubber hoses, and oil filters)



※ Classification for guide only

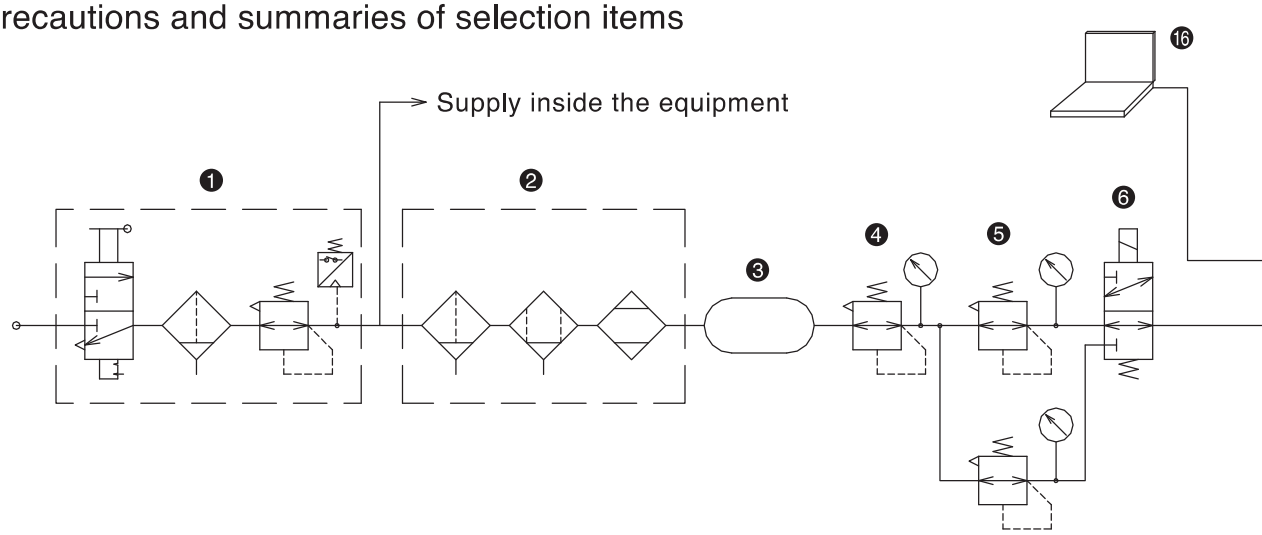
Selection item according to measurement conditions other than shown above

Measurement Condition	Item	Measurement System	Page
The residual cleaning agent or work oil may remain inside work.	Exhaust bypass	Common chapter No.11	**35**
Plurality of measurement point and measure by switching exists.	Work switching unit	Common chapter No.10	**34**

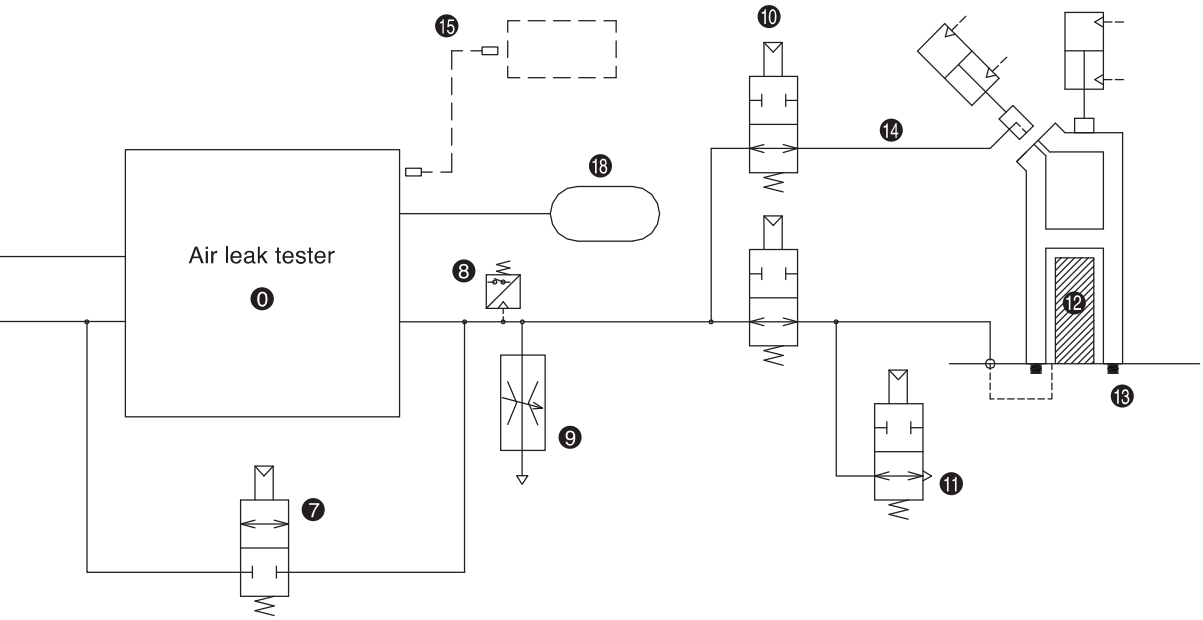
When the measurement cannot be correctly performed, the necessary countermeasure is shown at the end of this document. Also, refer to the countermeasure at the time of system construction for advanced preparation.

Common Seal Test circuit

● Common precautions and summaries of selection items



No.	Item	Purpose	Comment
0	**Leak tester**	Main body	–
1	**Air source to equipment supply filter**	Filter regulator of the air source to supply the equipment	–
2	**Tester Filter**	Filter to supply correct air to tester	Recommend JIS B 8392-1:2000 Compressed air quality class 1.3.1
3	**Air P stability tank**	Accumulator to stabilize test air to improve measurement precision	Large work volume is effective in general, but is also effective for small work depending on the air source situation.
4	**Primary regulator**	Primary regulator to stabilize test air pressure	Set to test pressure + 100kPa as the guide line. It is necessary to for the evacuation flow rate to exceed the test pressure regulator.
5	**Test P regulator**	Precision regulator supplying test pressure	Repeatability should be excellent against the exhaust flow rate variation by the work pressurization
6	**Test P switch valve**	Switching valve to switch a plurality of test pressures	–
7	**Charge bypass**	Supply test pressure in a short time to large work volumes	Large diameter valve that can flow with large flow rate. Structure to prevent the effect on the measurement as it enters into the measurement circuit at the OUT side.
8	**Work P confirmation**	Monitor the inner work pressure	Structure to prevent the effect on the measurement as it enters the measurement circuit. It is indispensable against the inner pressure loss at the large leak measurement using very small pressure.
9	**Confirmation gauge**	Confirm system operates by generating a false leak	Can be used at periodical maintenance and work start check, as well as at set up time.
10	**Switch measurement point**	Switching unit to measure a plurality of works (measuring point)	Structure to prevent the effect on the measurement as it enters the measurement circuit.
11	**Exhaust bypass**	Prevent foreign material from entering the work	Periodical maintenance is required because foreign materials from the work focus on this valve. Structure to prevent effect on the measurement as it enters into the measurement circuit.
12	**Core**	Decrease work inner volume to increase detection sensitivity	–
13	**Seal**	Seal the work	–
14	**Piping material**	Piping material of the leak test measurement circuit	Joint structure which is difficult to create leaks. Pipe that is difficult to change shape through pressurization.Heat insulation effect to prevent wind effects (depending on wall thickness and protective material)
15	**Model conversion**	Convert to new tester	May require some change in the equipment side depending on the model difference.
16	**Analysis tool**	Tool to analyze measurement status and problem	–
17	**Check tool**	Tool to check the tester	–
18	**Stability standard container**	–	–

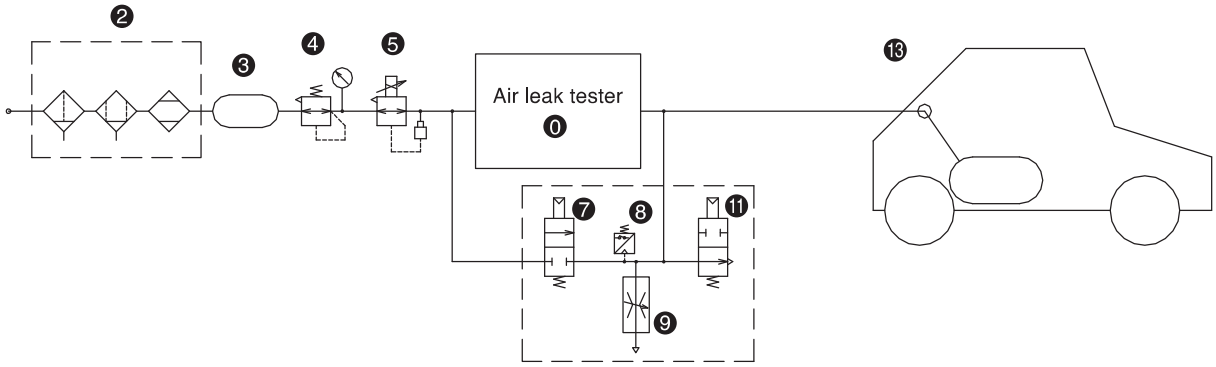


	Product Name	Selection category (guide line)	Model	Page	No.
	–	–	–	–	0
	Drain catcher **Main line filter** **Source pressure regulator**	General part that can be obtained at air pressure equipment manufacturer	–	–	1
	Air filter **Mist separator** **Dryer**	Select process flow rate according to work volume	**KF-101** **KF-201, 202, 203** **KF-901, 902**	**16 ～ 19**	2
	Air tank	Work volume ～2L	**KT-201**	**20**	3
		Work volume 2～10L			
		Work volume 10L～			
	Primary regulator	Select evacuation flow rate according to work volume	**KR-101** **KR-201** **KR-901, 902**	**20 ～ 22**	4
	Precision regulator	Select evacuation flow rate according to work volume	**R5, P-200, APU-X005** **KRZ-0205, 0905** **KR-202, 204, 903, 904**	**22 ～ 27**	5
	Test pressure switching valve	Select valve according to test pressure Select diameter according to work volume	**KV-201, 202**	**28**	6
	Charge bypass unit	Select valve according to test pressure Select diameter according to work volume	**CBU-600**	**30**	7
	Digital pressure gauge	Select according to test pressure	**KM-901, 904**	**30 ～ 31**	8
	Flow standard	Leak 0.2～20 mL/min	**FFM-100**	**32**	9
	Float type flow rate meter	Leak 20～200 mL/min	**KM-903**	**33**	
	Calibrator ※Some testers include	Work volume ～0.1L	**CAL**	**32**	
		Work volume ～1.0L			
		Work volume ～ 5.0L			
	Work switching unit	–	**ESV**	**34**	10
	Exhaust bypass unit	FL-600, 601 system	**EBU-600**	**35**	11
	External exhaust bypass unit	FL-3700, 294, 296 system	**FE-20**	**35**	
	Molded core, worked core	–	–	–	12
	O-ring, Seal material	–	–	–	13
	Coupler	Prepare according to necessary conditions	–	–	
	Piping material **Joint**	Select material according to test pressure Select diameter according to work volume	**KP-901** **KJ-901**	**36**	14
	Conversion cable	FL-600 for FL-3700 equipment	Contact us	–	15
		FL-600 for FL-294 equipment			
		Others			
	Application software	FL-600, 601 (distribute sample software)	–	–	16
		FL-3700 (distribute sample software)	–	–	
	Super penguin	For calibration of test pressure difference pressure	**CL-100**	**37**	17
	Precision very small pressure difference gauge	For calibration of difference pressure	**DG-72-X002**	**38**	
	Stability tank	–	**M-100**	**39**	18

On Board Fuel Tank Seal Test　Low Pressure Large Volume Test　SET-001

The large diameter pipe, large accumulator tank, and large flow rate regulator are required for the low pressure and large volume test. Also, the APU must be prepared to ensure turbo functionality and repeatability of the pressurization characteristics when considering the following factors:

- **Piping length extends beyond the work**
- **Work expands through pressurization**



Set Type No.

SET-001

No.	Item	Product Name	Remarks	Model	Page
0	**Tester**	Master less air leak tester	–	**FL-600L-2**	–
2	**Tester Filter**	Filter	Air filter, mist separator, dryer	**KF-101**	**16**
3	**Air pressure stability tank**	Air tank	38 L	**KT-201**	**20**
4	**Primary regulator**	Large flow rate regulator	–	**KR-101**	**20**
5	**Test pressure regulator**	Large flow rate precision regulator	–	**APU-130WP-X005**	**24**
7	**Charge bypass**	Charge bypass unit	–	**CBU-600-X001**	–
8	**Work pressure confirmation**	Digital pressure gauge	Pressure is abnormal at more than 25 kPa		
9	**Confirmation gauge**	Area type flow meter	300 mL/min F.S.		
11	**Exhaust bypass**	Exhaust bypass unit	–		
13	**Seal tool**	Air picker	–	Contact us	–
		Screw type seal tool	–	Contact us	–

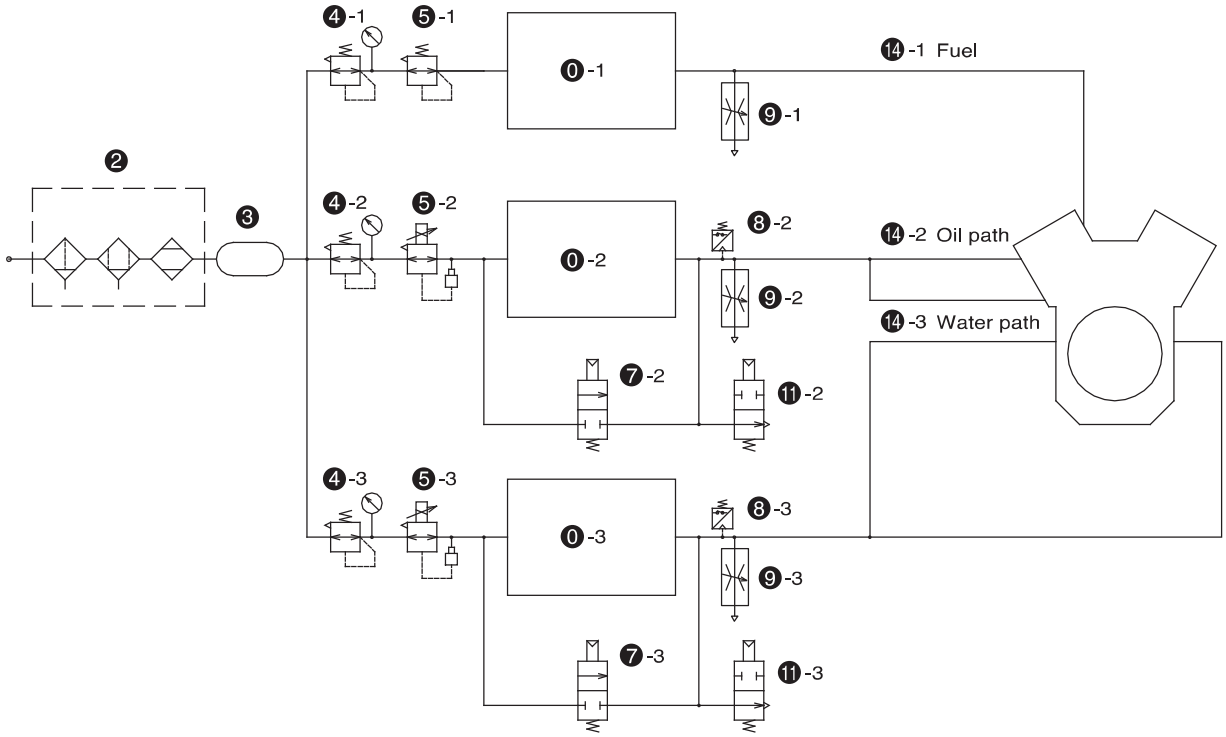
This system can also be adapted for the following seal tests:

- Lamp oil tank for heater seal test
- Pail can system
- Resin intake manifold
- Reserve tank
- Wet area product (bath)
- Gas meter

※ Model GR-001 assembly dedicated leak tester is provided.

Engine Assembly Seal Test Complex Test SET-002

The test pressure and inner volume differ according to the measurement part in the engine assembly seal test. In this condition, select the peripheral equipment adapted for each condition.
It may become difficult to achieve performance even if the peripheral is prepared exclusively for the inner volume, because the work inner path is complicated and a plurality of room is connected by a narrow path.



Set Type No.

SET-002

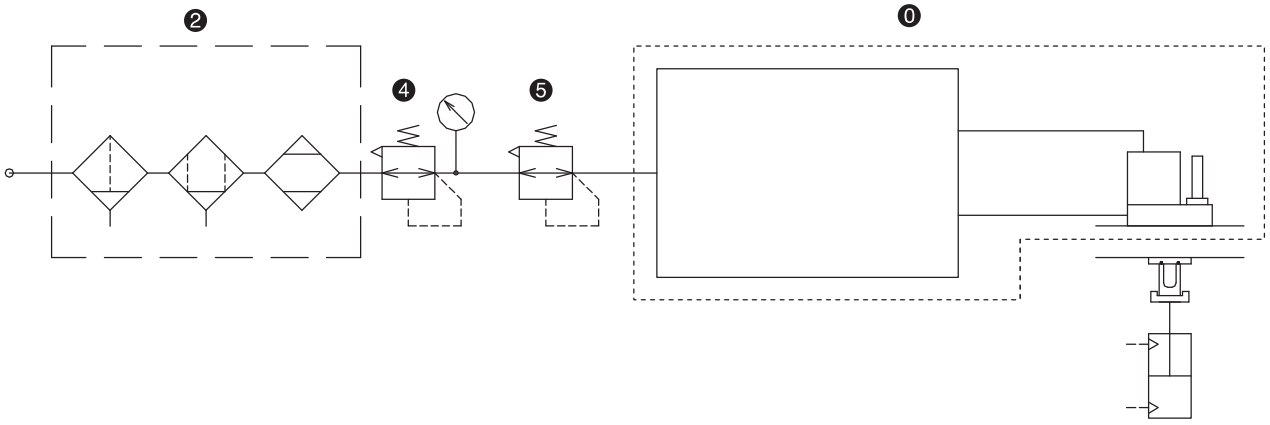
No.	Item	Product Name	Remarks	Model	Page
0-1	**Teste**	Master less air leak tester	Test P* 400kPa	**FL-600M-2**	–
0-2			Test P* 30kPa	**FL-600L-2**	–
0-3			Test P* 80kPa		
2	**Test Filter**	Filter	Air filter + Mist separator + Polymer membrane dryer	**KF-101**	**16**
3	**Air pressure stability tank**	Air tank	38L	**KT-201**	**20**
4-1	**Primary regulator**	Regulator	–	**KR-201**	**21**
4-2		Large flow regulator	–		–
4-3		Dial air regulator	–	**KR-101**	**20**
5-1	**Test pressure regulator**	Precision regulator	–	**KR-202**	**26**
5-2		Precision electro pneumatic regulator	–	**APU-120WP-X005**	**24**
5-3		Precision electro pneumatic regulator		**APU-90W-X005**	**24**
7-2	**Charge bypass**	Charge, evacuation bypass unit	Includes evacuation bypass function of 11-2 and 11-3	**CBU-600**	**30**
7-3					
8-2	**Work pressure confirmation**	Digital pressure gauge	Monitors over pressure	**KM-901**	**30 ～ 31**
8-3					
9-1	**Confirmation gauge**	Flow standard	–	**FFM-100**	**32**
9-2					
9-3					
14-1	**Piping material**	Nylon tube for high pressure	Interlocking piping with sleeve	**KP-901, KJ-901**	**36**
14-2		Nylon tube	General tube with more than ϕ12	–	–
14-3					

*Ideal test pressure.

※ For oil path, Model GR-001assembly dedicated leak tester is provided.

Injector Seal Test Very Small Volume test SET-003

The peripheral equipment load becomes small for test work of very small volume. However, if the configuration is the same as for other test work volumes, the ratio of the work volume/piping volume approaches one (or less than one), and therefore, it becomes impossible to determine which is the measurement target. As a result, the measurement is performed without piping by attaching the measurement unit to the tool (FUKUDA patent). By using this method, the highly sensitive and highly stable leak test becomes possible.



Set Type No.

SET-003

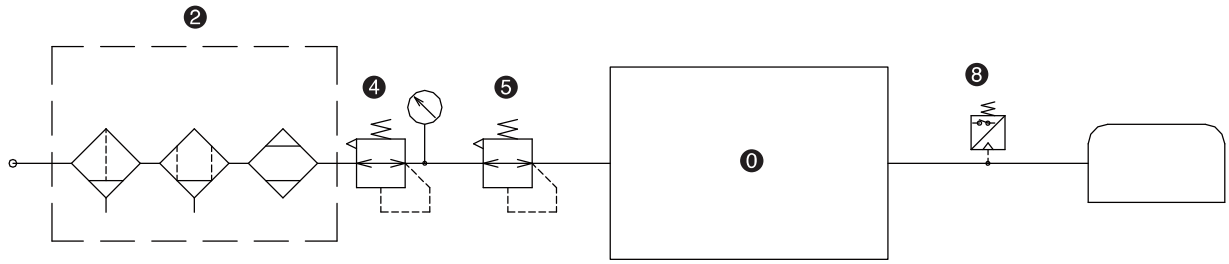
No.	Item	Product Name	Remarks	Model	Page
0	**Tester**	Separate type leak tester	High function type	**FL-601+LPU-300-X004**	**16**
			General type	**FL-2710+LPU-300-X020**	**16**
			Simple type	**FL-294+LPU-300-X020**	**16**
2	**Tester filter**	Filter	Air filter, mist separator, dryer	**KF-101**	**16**
4	**Primary regulator**	General purpose regulator	–	**KR-201**	**21**
5	**Test pressure regulator**	Precision regulator	–	**KR-202**	**26**

This system can also be used for the following seal tests:

- Various sensor part seal test
- Pressure regulator
- Sensor device
- Meter system
- Very small work

Lamp Cover Seal Test Ultra low pressure test SET-004

It is not easy for pneumatic equipment to control ultra low pressure. Generally, work that requires ultra low test pressure consists of very soft materials, and therefore, precision at ultra low pressures, and repeatability of pressurization characteristics are required for the regulator.
Also, due to low test pressure, if there is a large leak, the test pressure cannot be kept until the detection process, and the possibility of making a miss judgment occurs. As a result, it is essential to ensure a work inner pressure monitor is provided.



Set Type No.

SET-004

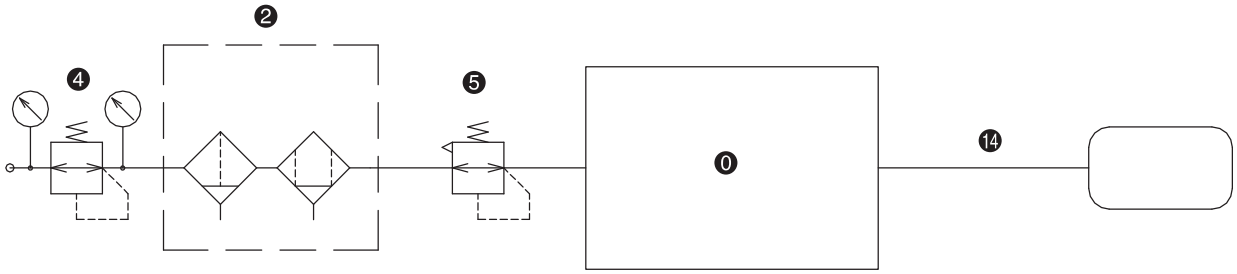
No.	Item	Product Name	Remarks	Model	Page
0	**Tester**	Master less air leak tester	High function type	**FL-600UL**	–
2	**Tester filter**	Filter	Air filter, mist separator, dryer	**KF-101**	**16**
4	**Primary regulator**	General purpose regulator	–	**KR-201**	**21**
5	**Test pressure regulator**	Precision small pressure regulator	5 ~ 20kPa	**P-200**	**23**
		Ultra low pressure regulator	5 ~ 10kPa	**R5**	**22**
8	**Work pressure confirmation**	Digital pressure gauge	Air loss monitor for large leak	**KM-904**	**31**

This system can also be applied to the following seal test.

- Gas meter
- Gas cooking unit
- Product with wet resin area

Hydraulic Control System Product Seal Test High Pressure Test SET-005

In high pressure ranges, the type of the air pressure equipment is limited thereby making it difficult to locate equipment with high-quality performance. In this condition, it is essential to think about the basics and consider all variables from a total point of view. Moreover, it is necessary to select equipment that does not generate heat, come equipped with pipes that do not expand with pressure, and layout that does not increase redundant volume.



Set Type No.

SET-005

No.	Item	Product Name	Remarks	Model	Page
0	**Tester**	Leak tester for each volume	0.8 ~1.5MPa	**FL-3710H1-1**	–
			1.0 ~ 3.5MPa	**FL-3710H2-1**	–
		Fitting leak tester	0.5 ~ 2.0MPa	**FL-601H1-2**	–
2	**Tester filter**	Air filter	~ 2.0MPa	**KF-901**	**18**
		Mist separator	~ 4.0MPa	**KF-903**	**19**
			~ 2.0MPa	**KF-902**	**19**
4	**Primary regulator**	Regulator for cylinder	~ 4.0MPa	**KR-902**	**22**
5	**Test pressure regulator**	Regulator ※included in tester of FL-3700 series	~ 3.4MPa	**KR-904**	**27**
14	**Piping material**	Copper pipe	–	–	–
		Stainless pipe	–	–	–

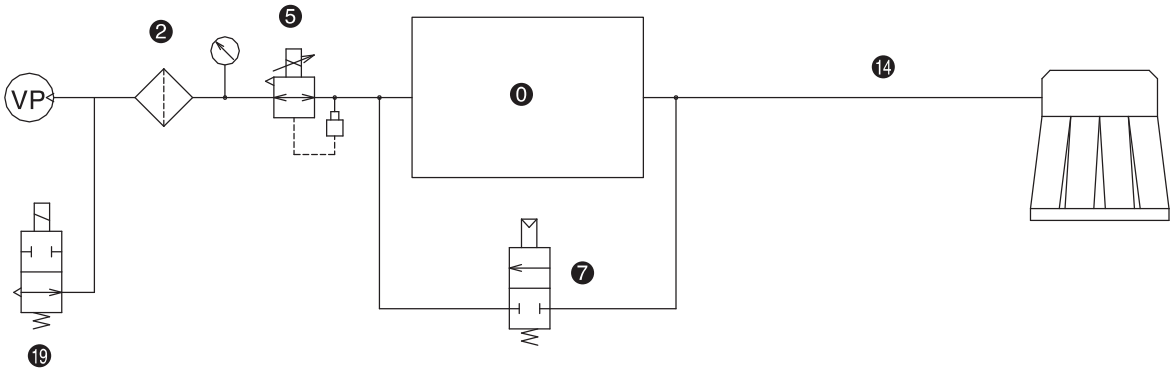
※ The above selected equipment may not satisfy High Pressure Gas Safety Laws.

The system can also be applied to the following seal tests:

- Radiator (0.8 - 3.0MPa)
- Heater
- Compressor
- Common rail
- Diesel injector
- Pressure regulator
- Other diesel system products
- Break system products
- Hydraulic system products

Resin Intake Manifold Seal Test Negative Pressure Test SET-006

Evacuation flow becomes very small in vacuum measurements. Also, the effect on measurement performance gets affected if the capability of the evacuation equipment, which takes advantage of the regulator, as well as the assurance of the piping diameter are not considered. In the vacuum measurement, there are several cases where the air source accumulator tank cannot improve, and therefore, selecting this equipment becomes important in the planning stage.
The resin intake manifold varies the volume using the vacuum, and flow rare assurance and repeatability with the APU and bypass shall be considered.



Set Type No.

SET-006

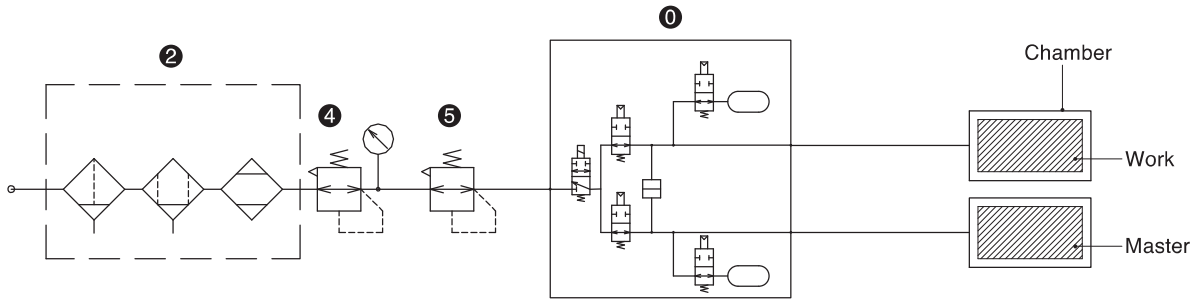
No.	Item	Product Name	Remarks	Model	Page
0	**Tester**	Master less air leak tester	–	**FL-600V-2**	–
2	**Filter**	Suction filter	–	**KF-203**	**18**
5	**Test pressure regulator**	Precision electro pneumatic regulator	–	**APU-120WV-X005**	**24**
7	**Exhaust bypass**	Exhaust bypass unit	–	**EBU-600V**	**35**
14	**Piping material**	Nylon tube	–	**KP-901, KJ-901**	**36**
19	**Vent valve**	Two port connection valve	–	**KV-101**	**28 ~ 29**

The system can also be applied to the following seal tests:

- Canister
- Product with wet resin area
- Fuel tank

Water Proofed Portable Telephone Seal Test Hermetic Product Test SET-501

If the work does not have a port to pressure, the work is put inside a capsule and the capsule is pressurized outside the work. As a result, the leak is detected by measuring the drop in pressure due to gas entering inside the work (hermetic product seal test). However if there is a large leak, the inside work also gets pressurized when the capsule is pressurized, and therefore, the correct test cannot be performed because there is no leak at the detection process. To avoid miss judgment of a large leak work, a special circuit (provided a class of the tester) is attached.
For the general large leak detection method (after pressurization), the pressure is split with the tank that is integrated in the tester. The pressure difference is measured between the work side and master side, and as a result, the large leak is confirmed.



Set Type No.

SET-501

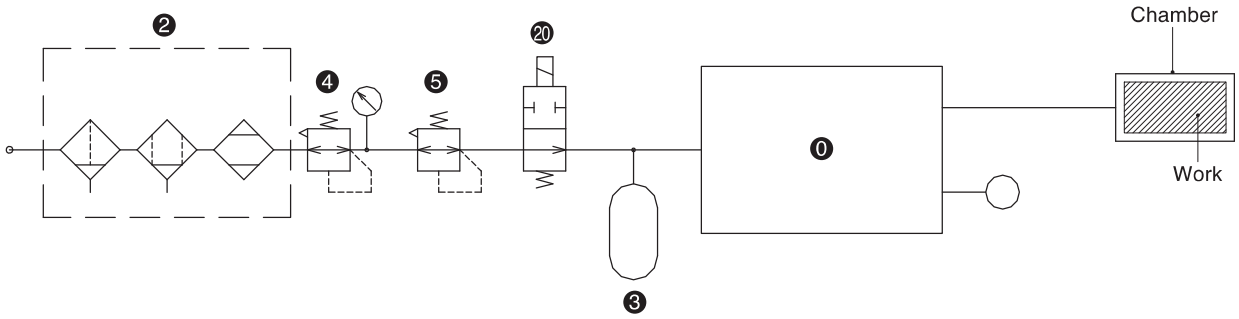
No.	Item	Product Name	Remarks	Model	Page
0	**Tester**	Hermetic type air leak tester	Transient submerge test level	**MS-531+FL-512**	–
2	**Tester filter**	Filter	Air filter + Mist separator + Polymer membrane type dryer	**KF-101**	**16**
4	**Primary regulator**	Regulator	–	**KR-201**	**21**
5	**Test pressure regulator**	Precision regulator	–	**KR-202**	**26**

The system can also be applied to the following seal tests:

- Water proof watch seal test
- Hermetic sensor seal test
- Bath area products
- On board camera

Hermetic Type Lamp Cover Seal Test Simple Hermetic product Test SET-007

For cases of work with relatively large inner volumes where the work inner volume is almost the same as the residual volume, and equal to the capsule volume minus the work outside volume, the simple system can be constructed. The capsule with the work inside gets pressurized using compressed air stored (in advance) in the tank, and the test pressure is measured to detect a large leak. It is possible to use only one capsule to reduce equipment costs.



Set Type No.

SET-007

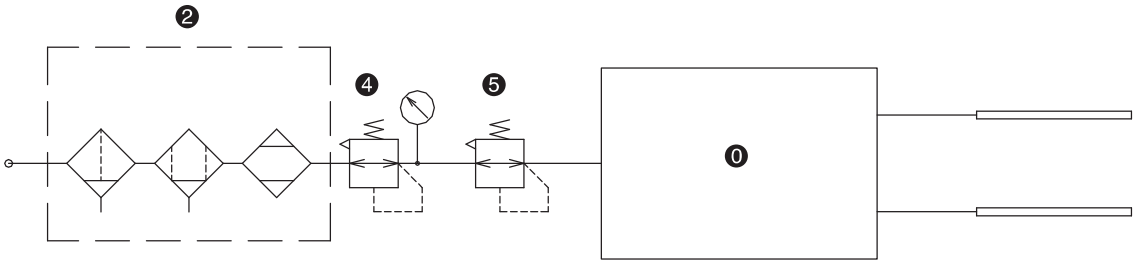
No.	Item	Product Name	Remarks	Model	Page
0	**Tester**	Tank pressurization type air leak tester	Drip-proof level	**FL294L-X022**	–
2	**Tester filter**	Filter	Air filter, mist separator, dryer	**KF-101**	**16**
3	**Air pressure tank**	–	–	Design according to the measurement condition	–
4	**Primary regulator**	General regulator	–	**KR-201**	**21**
5	**Test pressure regulator**	Precision regulator	–	**KR-202**	**26**
20	**Cutoff valve**	Two port connection valve	–	**KV-101**	**28 ~ 29**

The system can also be applied to the following seal tests:

- Float for the water closet seal test
- Hermetic sensor

Rubber Hose Seal Test Work to Work Comparison Test SET-008

The soft rubber hose expands with pressurization and the inner pressure varies during the detection process, and therefore, it cannot be tested correctly using the conventional method. The turbo pressurization is effective against the inner volume change by expansion, however, it cannot be applied to work with large expansion coefficients such as rubber. In this condition, the work to work comparison method can be applied.
When two NG works are compared, there is a possible risk of overlooking the NG work. In order to prevent this from happening, a special tester is used which has a function to detect simultaneous leaks by comparing two separate works within the reference container.
The piping for both equipments should be set equivalent as much as possible to cancel work noise when using this measurement method.



Set Type No.

SET-008

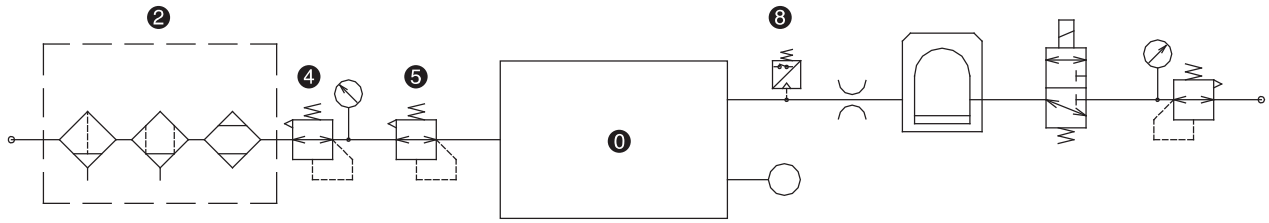
No.	Item	Product Name	Remarks	Model	Page
0	**Tester**	Work to work comparison type leak tester	With simultaneous leak detection function	**FL-601M-2-X001**	–
2	**Tester filter**	filter	Air filter + Mist separator + Polymer membrane type dryer	**KF-101**	**16**
4	**Primary regulator**	Regulator	–	**KR-201**	**21**
5	**Test pressure regulator**	Precision regulator	–	**KR-202**	**26**

The system can also be applied to the following seal tests:

- Delivery pipe seal test
  This system is applied to the delivery pipe seal test not because of the work expansion, but is used to cancel the wind effect on equipment as the delivery pipe test is sensitive to humidity and environmental temperature change. This is effective to prepare the cover to protect the tester from wind, or to avoid direct hand contact with the work to eliminate any thermal effects.
- Warm water pipe
- Fuel pump
- Fuel tank

Oil Filter Seal Test Leak Side Measurement Test SET-009

When there is a porous filter element inside the work such as an oil filter, the air slowly enters the porous element (virtual leak) during the detection process, even after compression of the pressurization. This causes a drop in pressure which ultimately leads to a miss judgment.
If the virtual leak is very small, it can be converged in a short period using turbo pressurization. However, this process cannot cover work where this phenomenon covers the entire work such as a filter element. In this condition, a chamber surrounding the work is prepared, and the test is performed by measuring the chamber inner pressure increase by the leak. However, if the chamber is not sealed correctly, the chamber inner pressure does not increase even if there is a leak, and as a result, small pressure is applied for the measurement. If the work has a leak, the inner pressure increases and a work leak is detected. Conversely, if the chamber has a leak, the inner pressure decreases and a chamber seal abnormality is detected.
The circuit restrictor prevents the application of high pressure to the tester side by utilizing the phenomenon where the tester measurement circuit opens to the atmosphere when the tester is in pause status.



Set Type No.

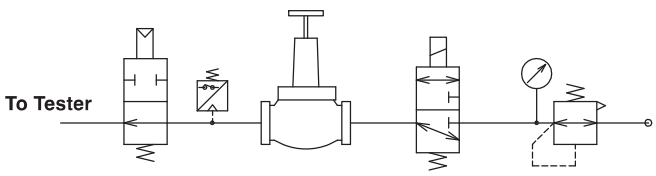
SET-009

No.	Item	Product Name	Remarks	Model	Page
0	**Tester**	–	Compact type	**FL-296UL-1**	–
			General type	**FL-3700UL-1**	–
			High function type	**FL-601UL-2**	–
2	**Tester filter**	Filter	Air filter, mist separator, dryer	**KF-101**	**16**
4	**Primary regulator**	General regulator	–	**KR-201**	**21**
5	**Regulator to check chamber abnormality**	Ultra low pressure regulator	–	**R5**	**22**
8	**Chamber inner pressure confirmation**	Digital pressure gauge	Monitor the large leak by chamber seal abnormality	**KM-901**	**30 ～ 31**

The system can also be applied to the following seal tests:

- Valve leak seal test

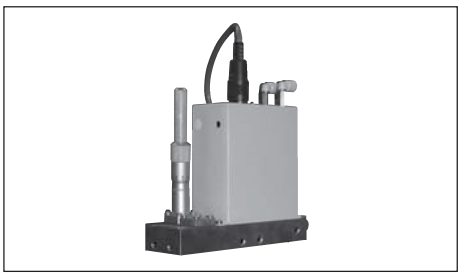
  For cases of the valve leak test, the test pressure is applied to the input side, and the tester is connected to the port of the output side, and therefore, the chamber need not be prepared. The pressure may be very high in the case of the valve. In this condition, it is necessary to arrange the valve between the tester and the work as shown in the figure to the right, and confirm large leak generation using the pressure switch before performing the leak test.



- Canister
- Core filter

Air Leak Tester

Separate Type Leak Tester



■ Model

LPU-300❶-❷

❶Pressure range

Sign	Pressure range
V	-10 ～ -90kPa
H	10 ～ 1000kPa

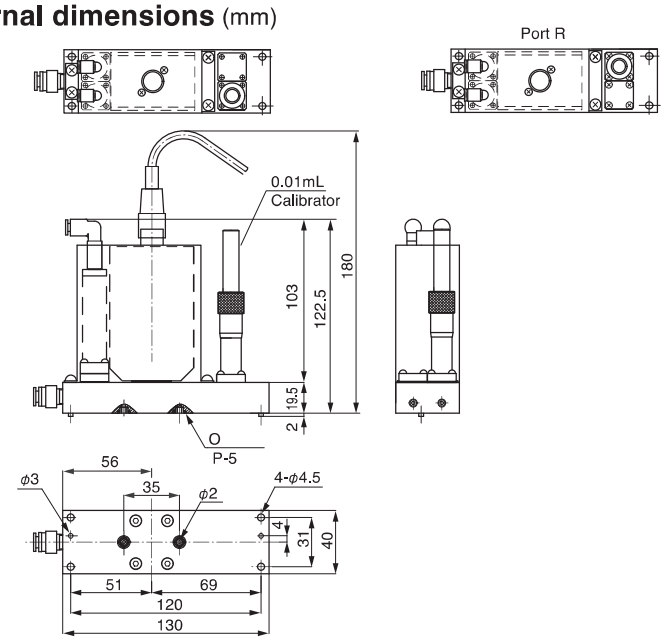
❷Port

Sign	Contents
No sign	Standard
R	Work, master port inverse position

■ Specifications

Item	LPU-300
Operation temperature	5～40℃
Operation humidity	45～85%RH
Storage temperature	–20～70℃
Supply air quality	Compressed air quality 1.3.1 (JIS B 8392-1) recommended
Pressure measurement range	±1000Pa, ±1999Pa
Pressure precision	±5% of F.S. (including hysteresis)
Pilot pressure	0.3～0.5MPa
Measurement system inner volume	0.7mL
Calibrator	0～0.01mL
Power source	DC±15V 0.2A

■ External dimensions (mm)



Filter for Tester

Dryer Unit

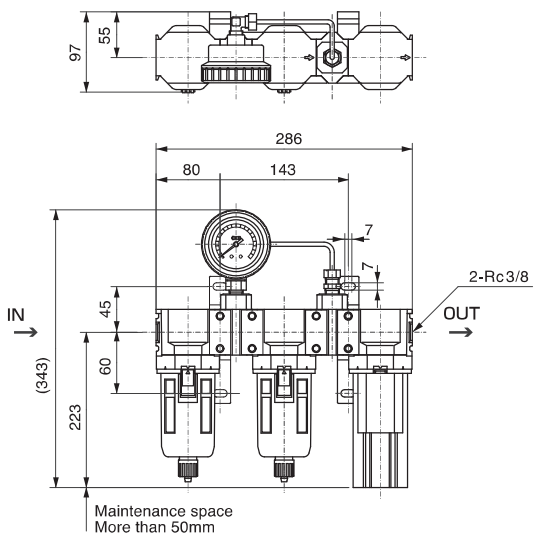
■ Model

KF-101

■ Specifications

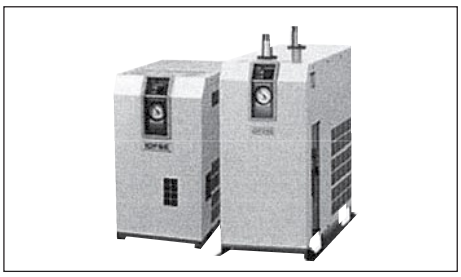
	Item	KF-101
Working Condition	Used fluid	Compressed air
	Input air pressure	0.4～1.0MPa
	Guaranteed pressure	1.5MPa
	Input air temperature	5～50℃
	Environment temperature	5～50℃
Standard Rating	Output air atmospheric dew point	–20℃
	Input air flow rate	250L/min
	Output air flow rate	200L/min
	Purge flow rate	50L/min
	Input air pressure dew point	25℃
	Input air pressure	0.7MPa
	Input air temperature	25℃
	Environment temperature	25℃
Air filter	Rated filtration	5μm

■ External dimensions (mm)



Filter for Tester

Freezing Type Air Dryer



■ Model

KF-201-❶❷

❶Dimension

Sign	Power of air compressor
1	0.75kW
2	1.5kW

❷Option

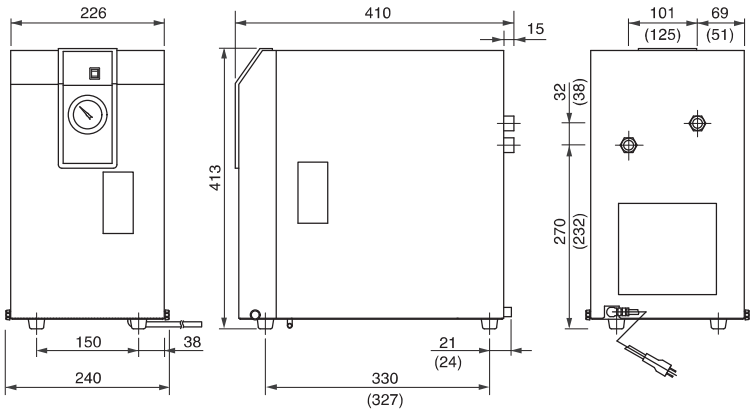
Sign	Contents
No sign	No
A	For cooling compressed air
C	Cupper pipe preserved
S	Power terminal block connection

■ Specifications

Item			Compressor size ❶ 1:0.75kW	Compressor size ❶ 2:1.5kW
Processed air quantity m^3/min	Standard condition (ANR)	50Hz	0.10	0.20
		60Hz	0.12	0.235
	Air compressor in suction status	50Hz	0.10	0.21
		60Hz	0.12	0.24
Input air pressure			0.7MPa	
Input air temperature			35℃	
Ambient temperature			32℃	
Output air pressure dew point			10℃	
Used fluid			Compressed air	
Input air temperature			5~50℃	
Input air pressure			0.15~1.0MPa	
Ambient temperature/ Humidity			2~40℃ (less than 85%RH)	
Power source voltage			AC100V	
Power consumption (W) 50Hz/60Hz			180/ 202	
Operating current (A) 50Hz/60Hz			2.4/ 2.5	

■ External dimensions (mm)

The figure inside ( ) is the dimension of KF-201-2.



Filter for Tester

Air Filter

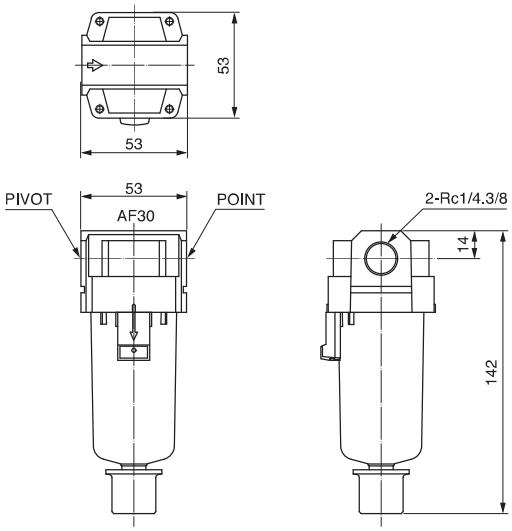
■ Model

KF-202

■ Specifications

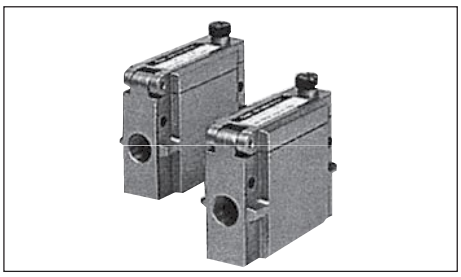
Item	KF-202
Guaranteed pressure endurance	3.0MPa
Maximum operating pressure	2.0MPa
Ambient temperature and used fluid temperature	–5~60℃ (without condensation)
Rated filtration	5μm
Connection diameter	Rc1/4

■ External dimensions (mm)



Filter for Tester

Air Suction Filter



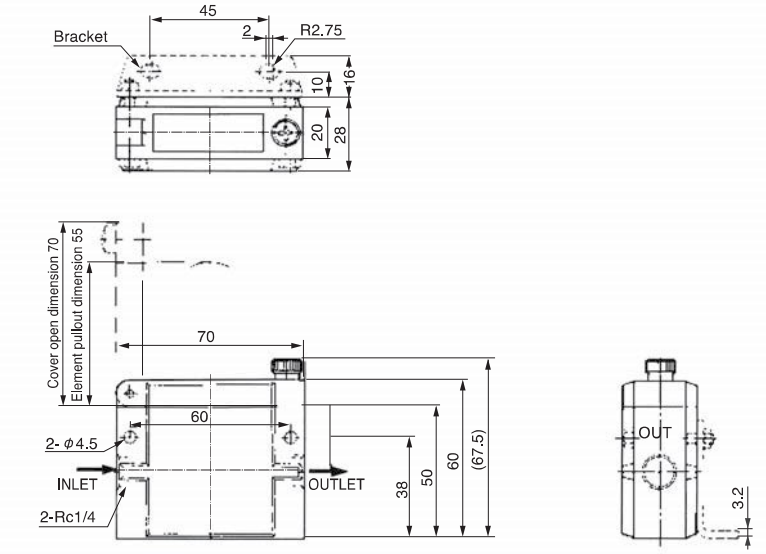
■ Model

KF-203

■ Specifications

Item	KF-203
Used fluid	Air, Nitrogen
Used pressure	–100～0kPa
Pressure endurance	0.5MPa
Operation temperature range	5～60℃
Rated filtration	30μm
Pressure difference and endurance of element	0.15MPa
Recommended flow rate	200L/min
Pipe connection diameter	Rc1/4

■ External dimensions (mm)



Filter for Tester

Air Filter

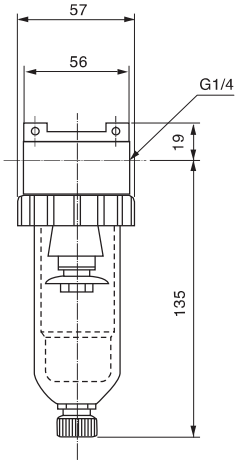
■ Model

KF-901

■ Specifications

Item	KF-901
Nominal flow rate	1050NL/min
Maximum usage pressure	2.5MPa
Operating temperature	0～90℃
Filter element	40μm

■ External dimensions (mm)



Tester Filter

Oil mist separator

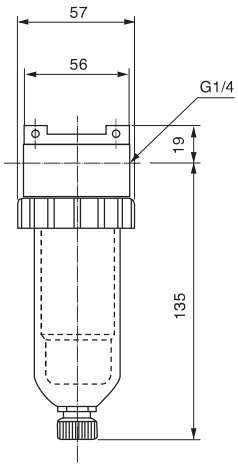
■ Model

KF-902

■ Specifications

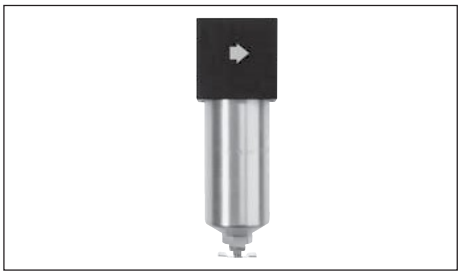
Item	KF-902
Nominal flow rate	560NL/min
Maximum operation pressure	2.5MPa
Operation temperature	0～90℃
Filter element	0.01μm

■ External dimensions (mm)



Tester Filter

Oil mist separator



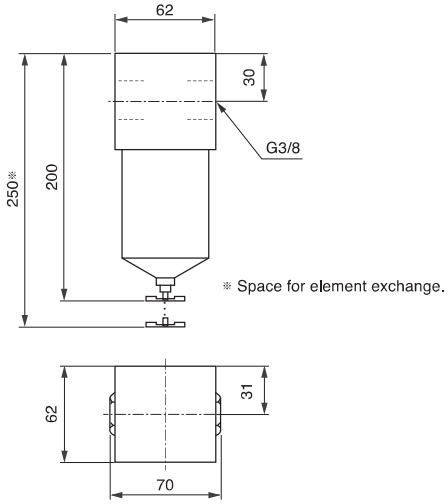
■ Model

KF-903

■ Specifications

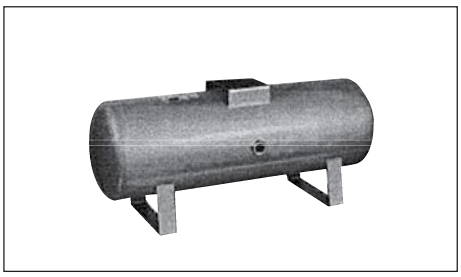
Item	KF-903
Nominal flow rate	2600NL/min
Maximum operation pressure	4MPa
Operation temperature	0～90℃
Filter element	40μm

■ External dimensions (mm)



Air Pressure Stabilization Tank

Air Tank



■ Model

KT-201-❶

❶Tank capacity

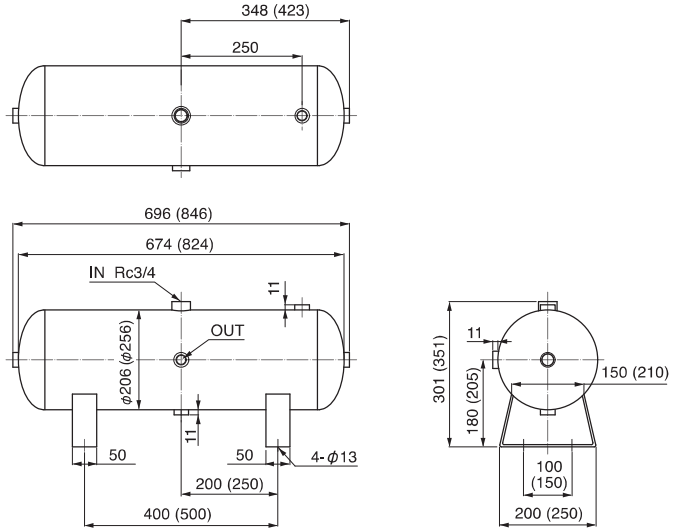
Sign	Capacity
20L	20 L
38L	38 L

■ Specifications

Item		KT-201-20L	KT-201-38L
Maximum operation Pressure		1.0MPa	
Ambient temperature and operation fluid temperature		0～75℃	
Steel material tensile strength		400N/mm^2	
Material		SS400	
Connection diameter	IN	Rc3/4	Rc3/4
	OUT	Rc1/2	Rc3/4
Weight		14kg	21kg

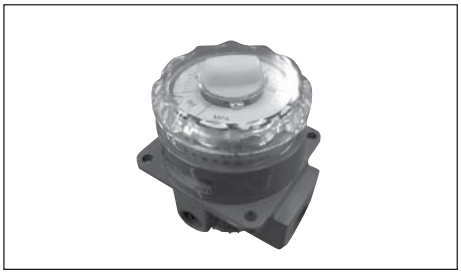
■ External dimensions (mm)

The figure in ( ) shows the dimension of KT-201-38L.



Regulator

Dial Air Regulator



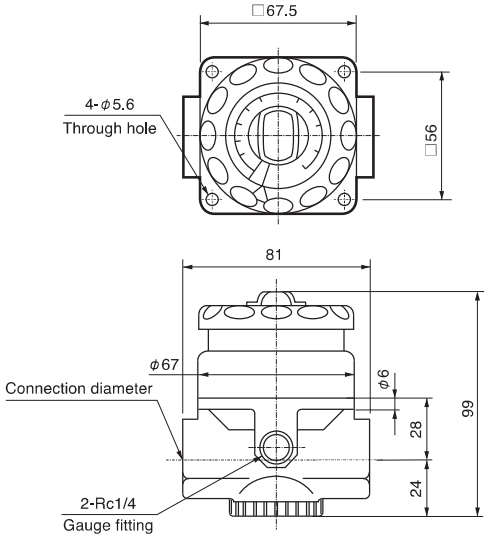
■ Model

KR-101

■ Specifications

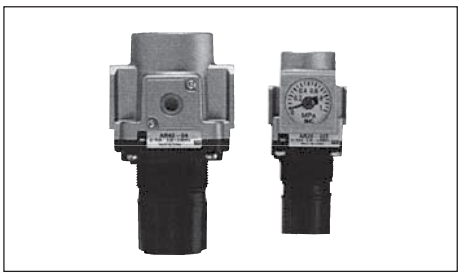
Item	KR-101
Operation fluid	Compressed air
Maximum operation pressure	2.06MPa
Assured pressure endurance	3.09MPa
Fluid temperature (environment)	5～65℃
Set pressure range	0.05～0.27MPa
Relief	With relief function
Connection diameter	Rc 3/8
Weight	1kg

■ External dimensions (mm)



Regulator

General Purpose Regulator



■ Model

KR-201-❶❷

❶Fitting option

Sign	Contents
N	No
B	with bracket

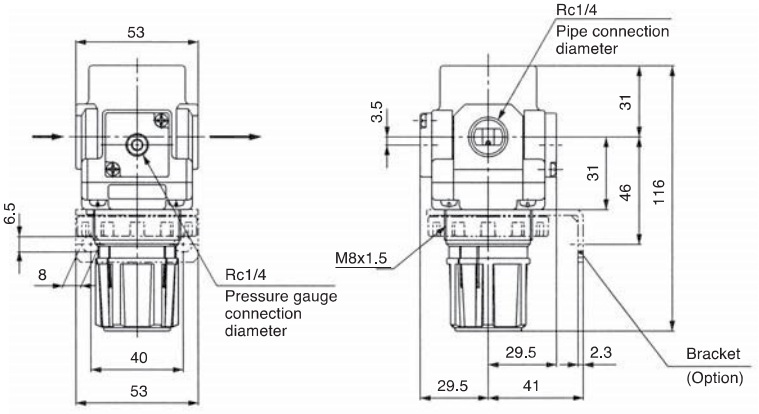
❷Pressure gauge

Sign	Contents
N	No
G	Round type pressure gauge

■ Specifications

Item	KR-201
Pipe connection diameter	Rc1/4
Pressure gauge connection diameter	Rc1/4
Operation fluid	Air
Ambient temperature and operation fluid temperature	–5～60℃ (without condensation)
Assured pressure endurance	1.5MPa
Maximum operation pressure	1.0MPa
Set pressure range	0.05～0.85MPa
Relief pressure	Set pressure +0.05MPa (At relief flow rate 0.1L/min ANR)
Structure	Relief type
Weight	0.29kg

■ External dimensions (mm)



Regulator

Regulator for Cylinder

■ Model

KR-901-❶❷

❶Pressure gauge at low pressure side

Sign	Pressure (MPa)
03	0.3
06	0.6
10	1
16	1.6

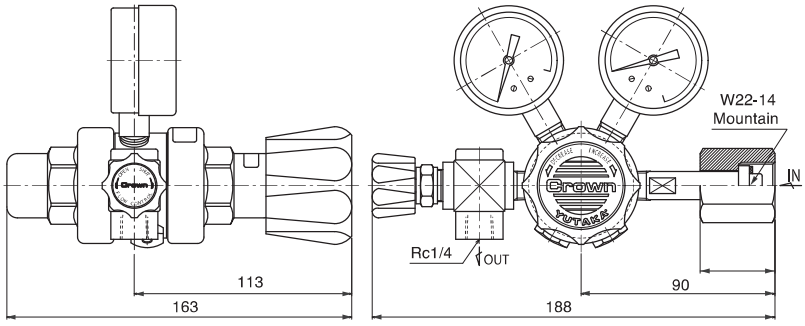
❷Input shape

Sign	Shape
R	Right nut
L	Left nut

■ Specifications

Item	KR-901
Regulator main body	SUS316
Regulator cover	ZDC
Valve seat	SUS316
Valve sheet	PCTFE (Daifron) or Teflon
Diaphragm	PTFE (Teflon) + SUS316
Relief valve seat	FKM (fluorocarbon rubber)
Output shape	Rc1/4
High pressure side pressure gauge	25MPa
Flow rate range	25L/min

■ External dimensions (mm)



Regulator

Regulator for Cylinder

■ Model

KR-902-❶❷❸

❶Entrance connection

Sign	Entrance connection	Remarks
A	Rc1/4	Primary regulator not selectable
B	W22-14 Mountain (Right) Box nut (P)	Test pressure regulator not selectable
C	W22-14 Mountain (Left) Box nut (P)	Test pressure regulator not selectable

❷Primary side pressure gauge

Sign	Pressure range Value in ( ) is maximum used pressure	Remarks
10	10(6) MPa	Test pressure regulator not selectable
15	15(10) MPa	
25	25(15) MPa	Test pressure regulator not selectable

❸Secondary side pressure gauge

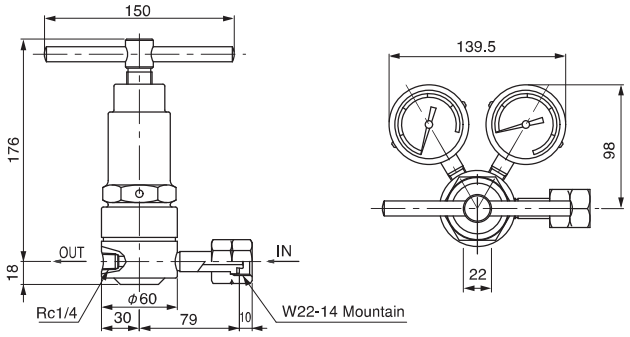
Sign	Pressure range Value in ( ) is maximum used pressure	Remarks
10	10(6) MPa	
15	15(10) MPa	Test pressure regulator not selectable
25	25(15) MPa	Test pressure regulator not selectable

※For primary side pressure gauge, please choose higher pressure range than secondary pressure gauge.

■ Specifications

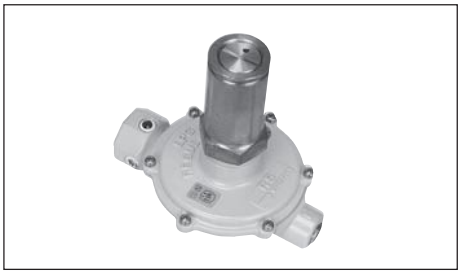
Item	KR-902
Operation gas	N_2, Air
Weight	3kg
Standard flow rate	180m³/h
Maximum flow rate	220m³/h
Exit connect diameter	Rc 1/4

■ External dimensions (mm)



Test Pressure Regulator

Ultra Low Pressure Regulator



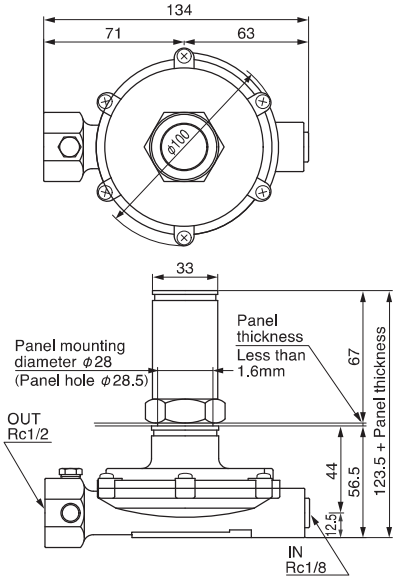
■ Model

R5

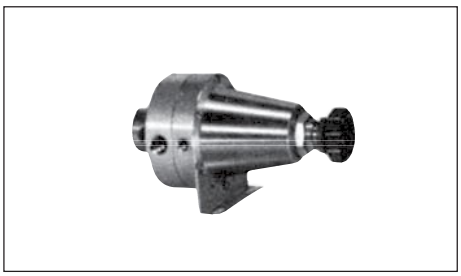
■ Specifications

Item	R5
Operation fluid	Air
Maximum supply pressure	500kPa
Minimum supply pressure	Set pressure +100kPa
Set pressure range	0.5～10kPa
Ambient temperature and air temperature	–5～50℃ (Without condensation)
Weight	0.7kg

■ External dimensions (mm)



Pilot Regulator



■ Model

P-200-❶

❶Pressure range

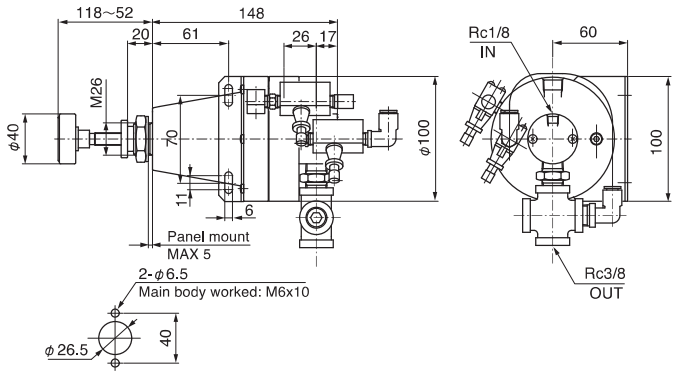
Sign	Output pressure	Supply Pressure
1	0.1～1.0kPa	20～400kPa (set pressure + more than 10 kPa)
2	1.0～10.0kPa	
3	10.0～50.0kPa	
4	10.0～80.0kPa	
5	-0.1～-1.0kPa	-30～-100kPa (set pressure + less than -1.5 kPa)
6	-1.0～-10.0kPa	
7	-10.0～-50.0kPa	
8	-10.0～-80.0kPa	

■ Specifications

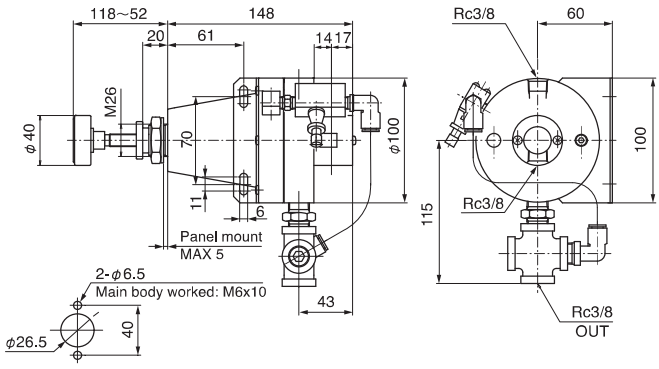
Item	Pressure range		
	1 , 5	2 , 6	3, 4, 7, 8
Ambient temperature	5～60℃		
Regulated Flow Rate	0.5L/min	15L/min	30L/min
Pressure change when changing from zero flow rate to the regulated flow rate	Less than 0.1 kPa	Less than 0.5 kPa	Less than 1 kPa
Set pressure change when returning from the regulated flow rate to zero flow rate	Less than 0.05 kPa	Less than 0.25 kPa	Less than 0.5 kPa

■ External dimensions (mm)

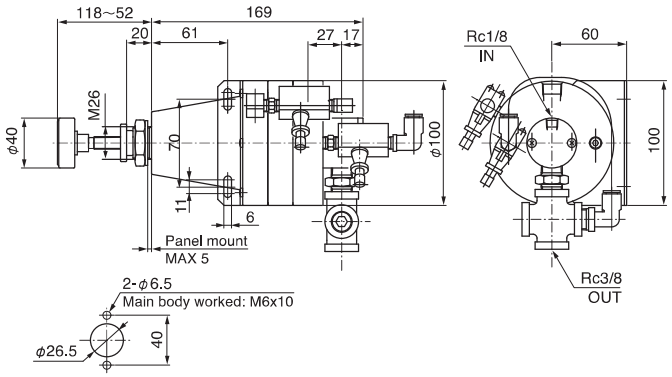
▼ In case of less than positive pressure 10kPa



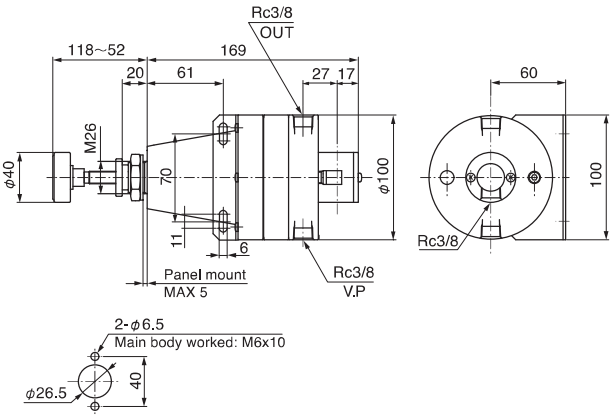
▼ In case of less than negative pressure 10kPa



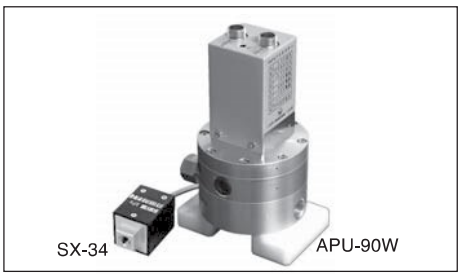
▼ In case of less than positive pressure 80kPa



▼ In case of less than negative pressure 80kPa



Electro Pneumatic Regulator



■ Specifications

Item	APU
Repeatability	±0.15% of F.S.
Power source	DC ± 15V
Power consumption	0.2A
Operation air	Clean air

■ Model

APU-❶❷-(❸)-❹-❺-❻

❶Shape

Sign	Remarks
70W	ϕ70 mm
90W	ϕ90 mm
120W	ϕ120 mm
130W	ϕ130 mm

❷Pressure control range

Sign	Remarks
P	Positive pressure control
V	Negative pressure control

Air leak tester is automatically controlled when the cable is connected.

❹APU dedicated to leak tester

Sign	X005

❺Sensor model, precision

Sign	Remarks
C	SX-100D: ±0.15% of F.S. (LF Range 0.3% of F.S.)
E	SX-34: ±1.0% of F.S. +990 unable to achieve (LF Range 2.0% of F.S.)

❻APU dedicated cable

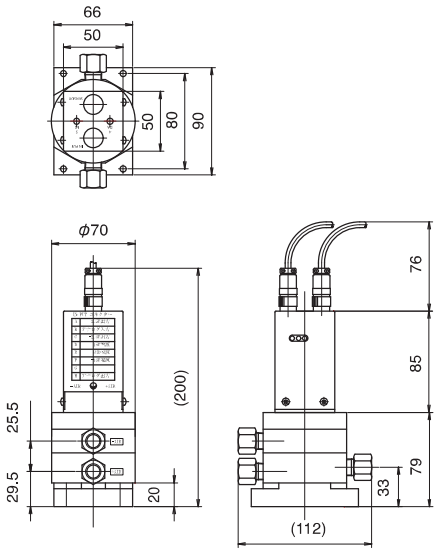
Sign	Remarks
1.5	Cable length 1.5m
3	Cable length 3.0m

❸Pressure range

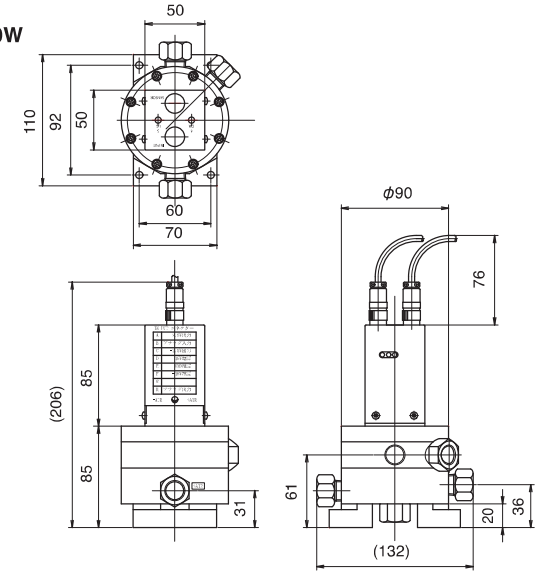
Sign	FL-600、FL-601				FM-1061		FL-610、FL-611			
	70W	90W	120W	130W	90W	120W	70W	90W	120W	130W
-100	V	V	V	V		V	VB	VB	VB	VB
+50						UL				
+20		UL	UL	UL				LC	LC	LC
+100	L	L	L	L		L	LD, LE	LD, LE	LD, LE	LD, LE
+300							LF	LF	LF	
+500					M					
+700	M	M	M				MC	MC	MC	
+990	H	H					HC	HC		

■ External dimensions (mm)

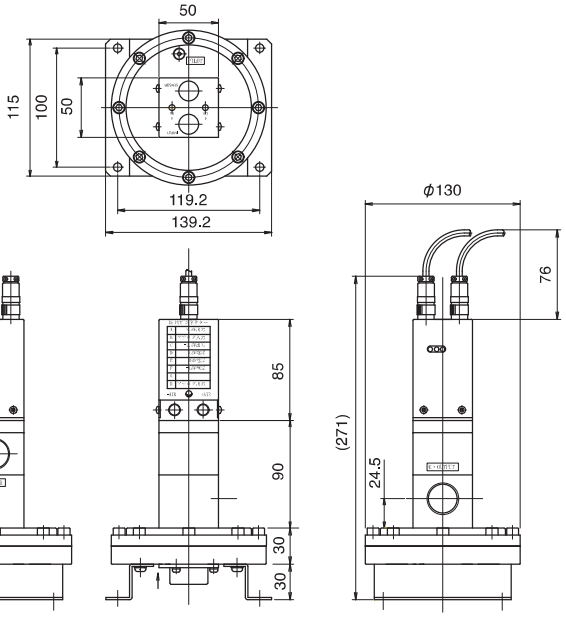
APU-70W



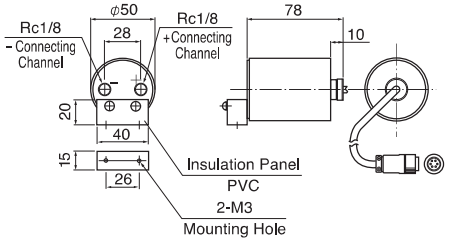
APU-90W



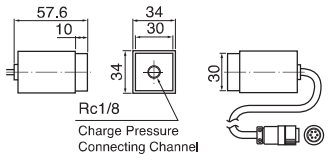
APU-130W



Pressure Sensor
SX-100D



Pressure Sensor
SX-34



Electro Pneumatic Regulator

■ Specifications

Item	KRZ
Power source voltage	DC12～15V
Power consumption	Less than 0.18A
Input signal	DC 0～10V
Input impedance	About 6.5 kΩ
Output Signal	DC1～5V (Output impedance: About 1 kΩ) Output accuracy: less than ±6%(F.S.)
Linearity	Less than ±1% (F.S.)
Hysteresis	Less than 0.5% (F.S.)
Repeatability	Less than ±0.5% (F.S.)
Sensitivity	Less than 0.2% (F.S.)
Temperature characteristics	Less than ±0.12%(F.S./°C)
Output pressure display	Accuracy: ±2%F.S. ±1 digit Minimum unit: kPa: 1
Ambient temperature and operation fluid temperature	0～50°C (without condensation)
Protective structure	IP65
Weight	Approx. 350g (without option)

■ Model

KRZ-0205❶❷❸❹

❶Pressure range

Sign	Pressure range	Set pressure range	Air leak tester correspond range					ALT F.S.
			FL-600	FL-601	FL-610	FL-611	FLZ-0210	
1	−80 kPa	1.3～−80 kPa※1			VB※3	VB※3		−90 kPa
2	100 kPa	5～100 kPa	L	L	LD	LD	LD	99.9 kPa
					LE	LE		100 kPa
3	300 kPa	5～300 kPa※4			LF	LF		300 kPa
4	700 kPa	5～700 kPa※5	M	M	MC	MC		700 kPa
5	900 kPa	5～900 kPa※2					HJ	900 kPa
			H	H	HC	HC		990 kPa

Caution 1: Cannot be used within the range under -80kPa.
Caution 2: Cannot be used within the range over 900kPa.
Caution 3: It is necessary to change the set value of the air leak tester (APU F.S. and APU polarities) for use in the VB range.
Caution 4: The maximum setting of the electro-pneumatic regulator has been changed from F.S. 500kPa to F.S. 300kPa.
Caution 5: The maximum setting of the electro-pneumatic regulator has been changed from F.S. 900kPa to F.S. 700kPa.

❷ Bracket

Sign	Content
N	No brackets
F	2x FR unit mounting brackets (FR unit connection fittings)
B	Flat bracket (For installation onto flat panels)
C	L shaped bracket (For installation onto vertical panels)

Caution: The flat bracket or the L bracket cannot be used when using the FR unit mounting bracket to connect to the FR unit.

❸ Air leak tester connection cable connector

Sign	Content	
1	Straight type connector cable length	0.6 m
2		1.5 m
3		3.0 m
4		5.0 m
5	Right angle type (L shape) connector cable length	0.6 m
6		1.5 m
7		3.0 m
8		5.0 m

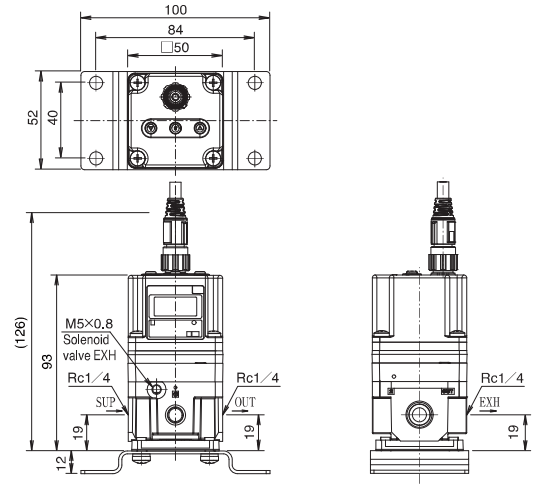
❹ CE Marking

Sign	Content
N	Not supported (standard)
Q	Supported

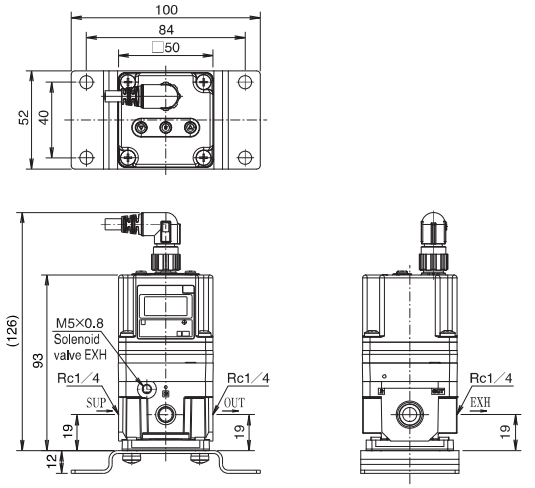
Caution: The shape of the connector is the connector on the electro-pneumatic regulator side.

■ External dimensions (mm)

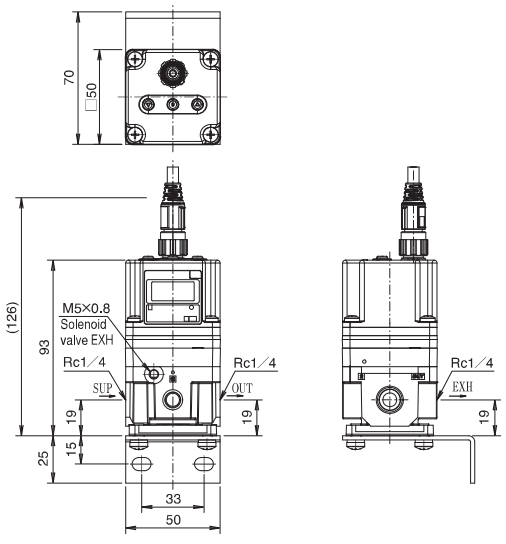
Flat bracket, Straight type connector



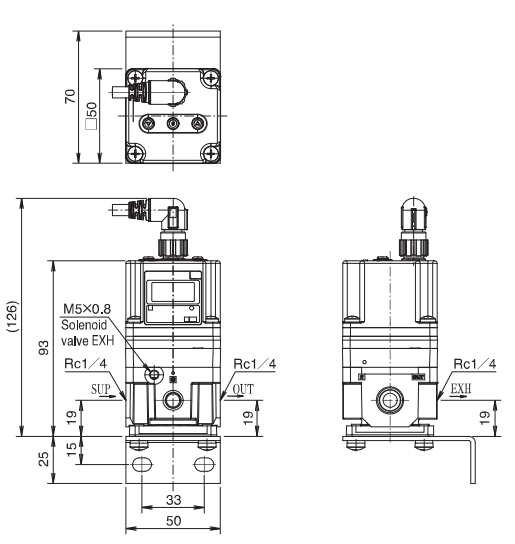
Flat bracket, Right angle type connector



L shaped bracket, Straight type connector



L shaped bracket, Right angle type connector



Test Pressure Regulator

High pressure electro pneumatic regulator

■ Model

KRZ-0906-❶❷

❶ Pressure range

Sign	Set pressure range
1	5MPa (0~50bar)

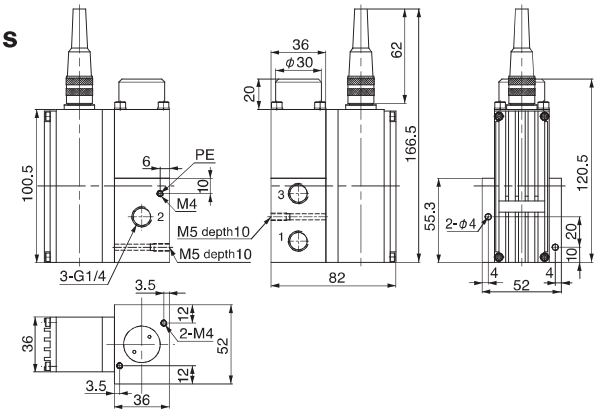
❷ Cable state

Sign	Content
1	The cable supplied with this product is not modified
2	Cable is not modified for FL-6 XX Refer to the A127185-D-001 cable wiring manual

■ Specifications

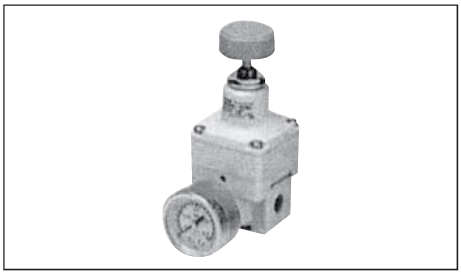
Item	KRZ-0906
Set pressure range	5MPa (0～50bar)
Power source voltage	DC24V
Maximum current value	1200mA
Output signal	DC0～10V (Sensitivity＞50mV Impedance 100kΩ)
Linearity	Less than 0.5 % of the maximum control pressure
Hysteresis	Less than 1 % of the maximum control pressure
Repeatability	Less than 0.5 % of the maximum control pressure
Ambient temperature	0～40°C (without condensation)
Operation fluid temperature	0～60°C (without condensation)
Protective structure	IP65
Weight	Approx. 950g (no option)

■ External dimensions (mm)



Test Pressure Regulator

Precision Regulator



■ Model

KR-202-❶❷

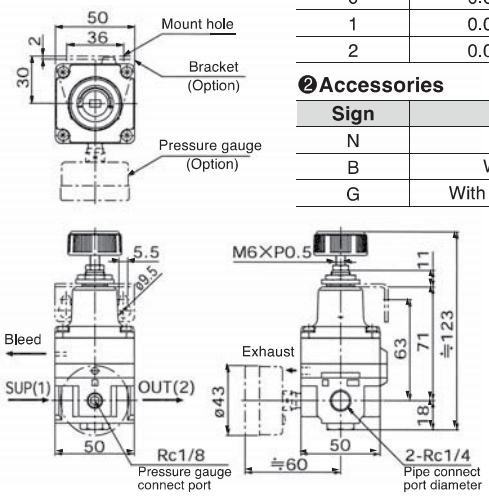
❶Setting pressure range

Sign	Setting Pressure range
0	0.005～0.2 MPa
1	0.01 ～0.4 MPa
2	0.01 ～0.8 MPa

❷Accessories

Sign	Contents
N	No
B	With bracket
G	With pressure gauge

■ External dimensions (mm)

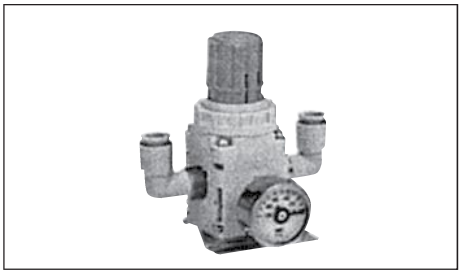


■ Specifications

Item	KR-202
Maximum supply pressure	1.0MPa
Minimum supply pressure	Set pressure + 0.05MPa
Sensitivity	Less than 0.2% of F.S.
Repeatability	Less than 0.5% of F.S.
Connection diameter	Rc1/4
Connection diameter of pressure gauge	Rc1/8 (2 points)
Ambient temperature	−5～60°C (without condensation)
Weight	0.3kg

Test Pressure Regulator

Vacuum Regulator



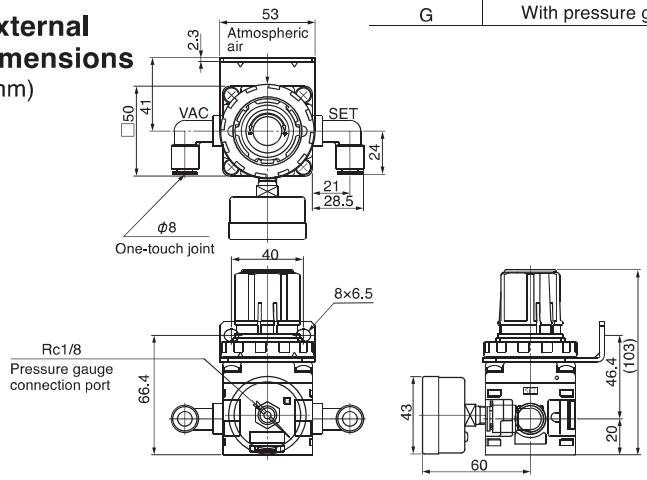
■ Model

KR-204-❶

❶Accessories

Sign	Contents
N	No
B	With bracket
G	With pressure gauge

■ External dimensions (mm)



■ Specifications

Item	KR-204
Operation fluid	Air
Set pressure range (Caution: 1)	−100～−1.3kPa
Atmospheric air intake consumption (Caution: 2)	Less than 0.6L/min (ANR)
Handle resolution	Less than 0.13kPa
Ambient temperature	5～60°C (without condensation)
VAC. side tubing external dimensions	φ8
SET. side tubing external dimensions	φ8
Weight (Standard piping specifications)	250g (without accessories)

Caution 1: Changes are possible due to pressure supplied from the vacuum pump.
Caution 2: Air is supplied from the atmosphere at all times.

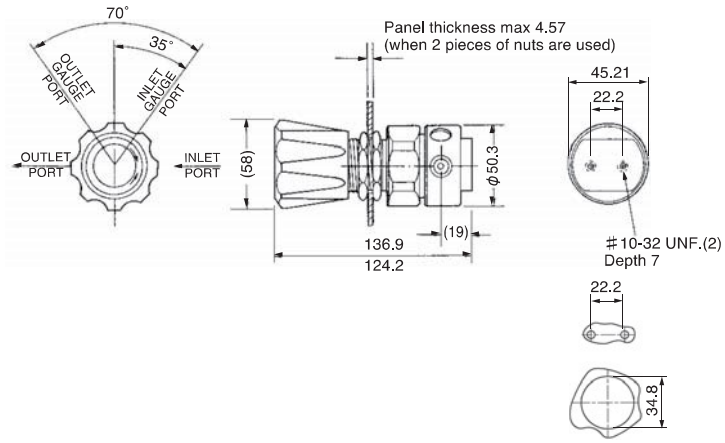
Test Pressure Regulator

High Pressure Regulator

■ Model

KR-903

■ External dimensions (mm)



■ Specifications

Item	KR-903
Maximum input pressure	24.1MPa
Regulation pressure range	0.01～3.44MPa
CV value	0.06 (High pressure type)
Leak rate	2×10^{-9}Pa・m³/sec
Input pressure endurance	27.0MPa
Output pressure endurance	150% of regulated pressure
Designed destruction pressure	400% of regulated pressure
Operating temperature	-40～74℃
Main body material	Brass
Main body weight	Approx. 0.9kg
Inlet/Outlet connection diameter	NPT 1/4

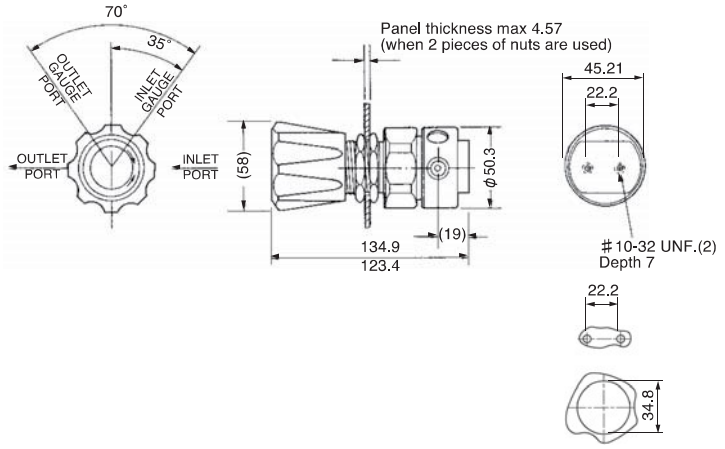
Test Pressure Regulator

High Pressure Regulator

■ Model

KR-904

■ External dimensions (mm)



■ Specifications

Item	KR-904
Maximum input pressure	24.13MPa
Output pressure endurance	0.03～3.45MPa
Design pressure endurance	150% of maximum pressure
Operating temperature	-26～93℃
CV value	0.06
Body material	Brass
Structure	Includes exhaust mechanism
Inlet/Outlet gauge port	NPT 1/4
Body weight	0.91kg (no gauge)

Test Pressure Regulator

High Pressure Regulator

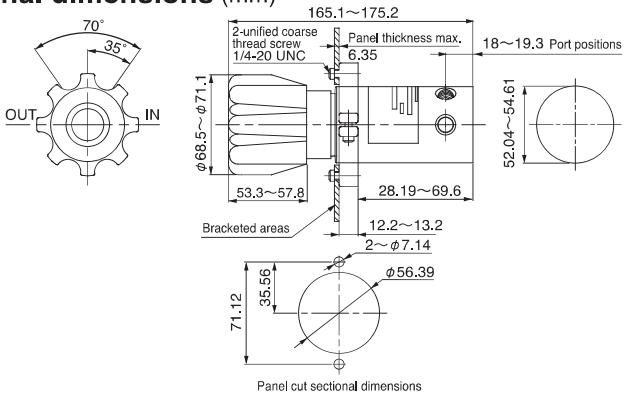
■ Model

KRZ-0905-❶

❶ Pressure range

Sign	Set pressure range
1	Max. 5.5MPa

■ External dimensions (mm)

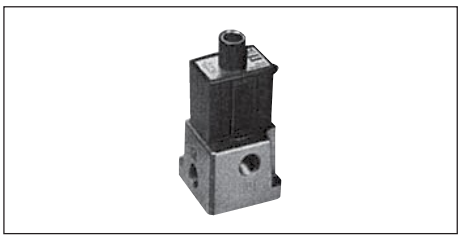


■ Specifications

Item	KRZ-0905-1
Set pressure range	Max. 5.5MPa
Regulation pressure range	0～5.5MPa (0～800PSI)
CV value	0.06
Operating temperature	-40～74°C (without condensation)
Weight	Approx. 2.2kg

Test Pressure Switching Valve

Three Port Connection Valve



■ Model

KV-201-❶❷

❶Valve

Sign	Content
N	Standard
V	Vacuum specification

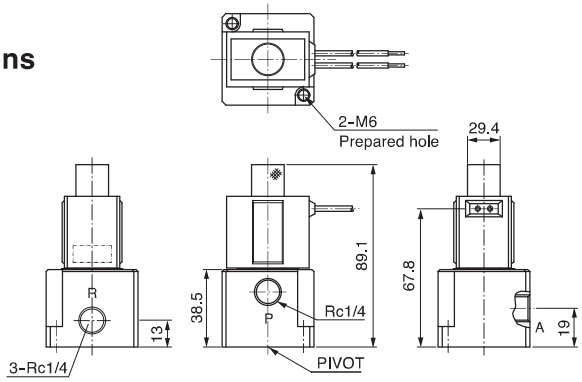
❷Rated voltage

Sign	Rated voltage
1	AC100V
2	AC110V
3	DC24V

■ Specifications

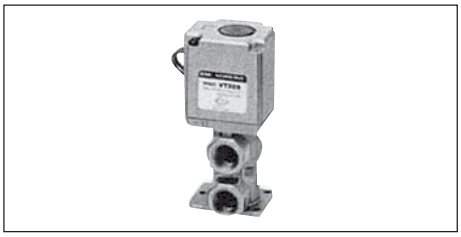
Item	KV-201
Switching method	Direct acting double position single solenoid
Operation fluid	Air
Operation pressure range	0～0.9MPa
Ambient temperature and operation fluid temperature	-10～50℃ (without condensation)
Response time	Less than 30ms (at 0.5MPa)
Maximum operating frequency	10Hz
Manual operation	Non lock push type
Body type	Direct piping type
Lead wire removal method	Grommet, Lead wire length 300mm
Connection diameter	Rc1/4
Surge voltage countermeasure	With protection circuit

■ External dimensions (mm)



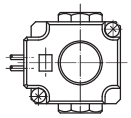
Test Pressure Switching Valve

Three Port Connection Valve

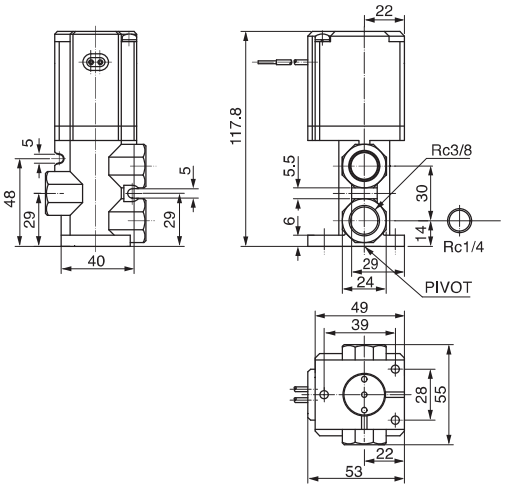


■ Model

KV-202



■ External dimensions (mm)

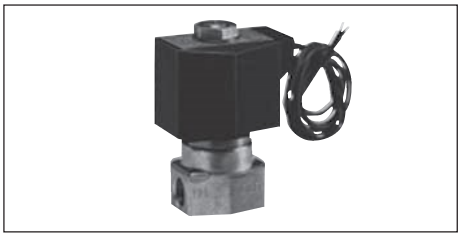


■ Specifications

Item	KV-202
Switching method	Direct acting double type, position single solenoid
Operation fluid	Air
Operation pressure range	0～1.0MPa
Ambient temperature and operation fluid temperature	-10～50℃ (without condensation)
Response time	Less than 30ms (at 0.5MPa)
Maximum operating frequency	5Hz
Rated voltage	AC100V 50/60Hz
Lead wire take out method	Grommet, lead wire length 300mm
Connection diameter	Rc3/8
Surge voltage countermeasure	With protection circuit

Test Pressure Switching Valve

Two Port Connection Valve



■ Model

KV-101-❶-❷❸-❹

❶Model shape

Sign	Function
31	NC (normally closed) type
41	NC (normally closed) type
42	NC (normally closed) type

❷Connection diameter

Sign	Specifications	❶-31	❶-41	❶-42
A	Rc1/8	○	–	–
B	Rc1/4	○	○	○
C	Rc3/8	–	○	○

❸Orifice

Sign	Specifications	❶-31	❶-41	❶-42
1	φ1.5	○	○	○
2	φ2	○	○	○
3	φ3	○	○	○
4	φ3.5	○	○	○
5	φ4	○	○	○
6	φ5	○	○	○
7	φ7	–	○	○

❹Power source voltage

Sign	Specifications
100	AC100V
200	AC200V
024	DC24V

■ Specifications

Item	KV-101
Operation fluid	Air, Water, lamp oil, oil (less than 50mm³/sec)
Pressure endurance (with water pressure)	25MPa
Fluid temperature	-10～60℃ (Without condensation)
Ambient temperature	-20～60℃
Body seal material	Nitrile rubber

※ Refer to model specifications on the next page.

Two Port Connection Valve

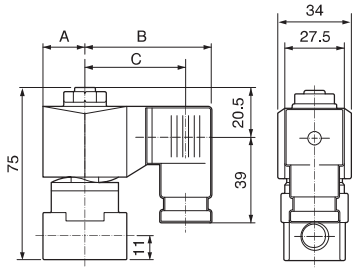
■ KV-101 Specifications by Model

	Shape	Connection	Orifice		Maximum operable Pressure (MPa)							Maximum usage pressure (MPa)
					Air		Water, hot water, lamp oil		Oil		Vapor	
					AC	DC	AC	DC	AC	DC	AC	
KV-101	31	A、B	1	φ1.5	2.5	2.5	2.5	2.5	2.5	2.5	1.0	5 (1: in case of liquid and vapor)
			2	φ2	1.5	1.5	1.5	1.5	1.5	1.5	1.0	
			3	φ3	1.0	0.5	0.7	0.5	0.5	0.5	0.7	
			4	φ3.5	0.6	0.4	0.5	0.4	0.4	0.4	0.5	
			5	φ4	0.4	0.25	0.3	0.25	0.25	0.25	0.3	
			6	φ5	0.2	0.15	0.15	0.15	0.15	0.15	0.15	
	41	B、C	1	φ1.5	5.0	4.0	4.5	4.0	4.0	0.4	1.0	
			2	φ2	3.0	2.5	2.7	2.5	2.5	2.5	1.0	
			3	φ3	1.5	0.9	1.3	0.9	0.9	0.9	1.0	
			4	φ3.5	1.2	0.6	0.9	0.6	0.6	0.6	0.9	
			5	φ4	1.0	0.5	0.7	0.5	0.5	0.5	0.7	
			6	φ5	0.6	0.25	0.4	0.25	0.25	0.25	0.4	
			7	φ7	0.25	0.1	0.2	0.1	0.15	0.1	0.2	
	42	B、C	1	φ1.5	2.0	2.0	2.0	2.0	2.0	2.0	1.0	2 (1: in case of liquid and vapor)
			2	φ2	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
			3	φ3	0.7	0.7	0.7	0.7	0.7	0.7	0.7	
			4	φ3.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
			5	φ4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	
			6	φ5	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
			7	φ7	0.15	0.15	0.15	0.15	0.15	0.15	0.15	

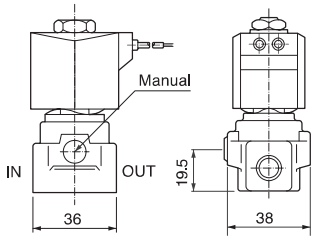
■ External dimensions (mm)

KV-101-31

▼ With DIN terminal box



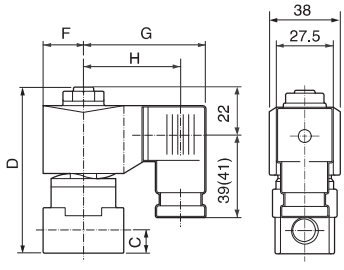
▼ Manual (lock type)



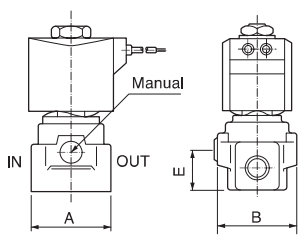
Voltage	A	B	C
AC	20	62	50.5
DC	21	63.5	52

KV-101-41

▼ With DIN terminal box



▼ Manual (lock type)

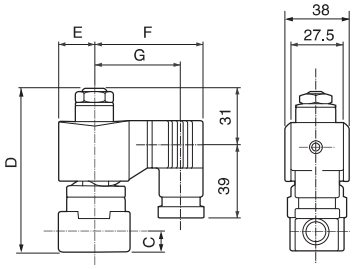


Type No.	A	B	C	D	E
KV-101-41-B1～B6	36	38	11	80.5	19.5
KV-101-41-B7 KV-101-41-C1～C7	40	40	12	83.5	22.5

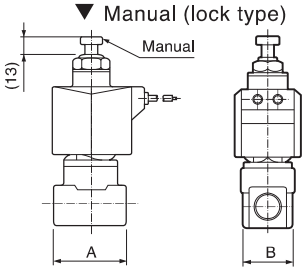
Voltage	F	G	H
AC	23.5	65.5	54
DC	23.5	66	54

KV-101-42

▼ With DIN terminal box



▼ Manual (lock type)



Type No.	A	B	C	D
KV-101-41-B1～B6	36	28	11	94
KV-101-41-B7 KV-101-41-C1～C7	40	28	12	97

Voltage	E	F	G
AC	23.5	65.5	54
DC	28	72	60

Charge Bypass

Charge Bypass Unit

■ Specifications

Item	CBU-600
Pilot valve drive pressure	300～700kPa
Pilot valve rated voltage	DC24V
Operation temperature range	0～40℃
Operation humidity range	35～85%RH% (without condensation)

■ Model

❶-600❷-❸-❹

❶Model

Sign	Function
CBU	Charge bypass unit

❷Range

Sign	Operation pressure range
C	10～700 kPa

❸Bypass unit control cable

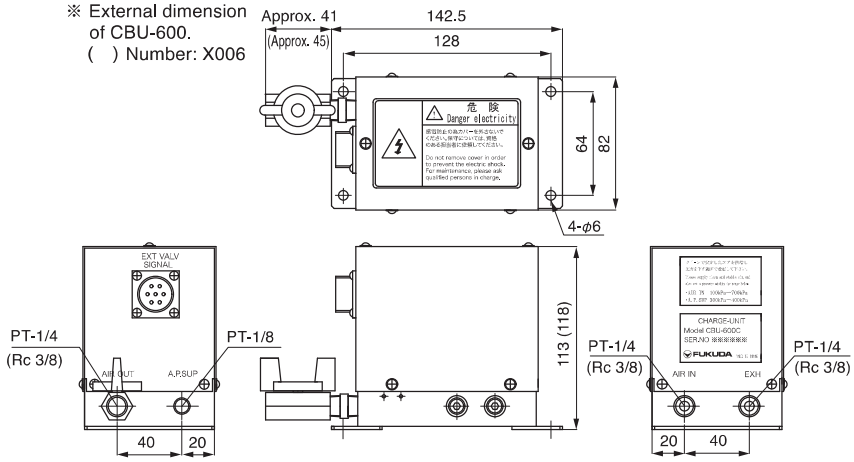
Sign	Content	Remarks
1.5	1.5m	Standard accessory
3	3m	Option

❹Exhalation flow rate

Sign	Content
No sign	Standard
X006	Large flow rate

■ External dimensions (mm)

※ External dimension of CBU-600.
( ) Number: X006



Work Pressure Confirmation

Digital Pressure Gauge

■ Specifications

Item	KM-901
Pressure range (maximum display digit)	±100kPa: -0.1～2MPa 0～500kPa: 0～50MPa
Operation fluid	Air, water, oil (Gas or fluid that will not corrode the liquid contact part)
Material of liquid contact part	SUS630(17-4PH)、SUS304
Acceptable maximum pressure	2 times the operation pressure range (1.5 times for 35MPa and 50MPa)
Display precision	±(1.0% F.S. + 1 digit)
Temperature characteristics	±0.1% F.S./℃ (For zero point and span)
Display method	3½ digit, LED display (Character height 10mm)
Display period	0.2sec
Power source/ Current consumption	12～24V DC±10% Less than 30mA DC
Cable length	2m
Operation temperature range	-10～50℃
Operation humidity range	35～85% RH (without condensation)
Weight	Approximately 100g (including cable)

■ Model

KM-901-❶-❷❸❹

❶Mount

Sign	Mount
1	Vertical mount
3	Horizontal mount

❷Connection screw

Sign	Joint standard	Operation maximum pressure range
2	G1/4B	50 MPa
6	R1/8(M5 Female type included)	1 MPa
7	R1/4	50 MPa

❸Pressure range

Sign	Pressure range
A	-100～100 kPa
B	-100～500 kPa
C	-0.1～ 1 MPa
D	-0.1～ 2 MPa
G	0～500 kPa
H	0～ 1 MPa
J	0～ 2 MPa
K	0～ 3.5 MPa
L	0～ 5 MPa
M	0～ 10 MPa
N	0～ 20 MPa
P	0～ 35 MPa
Q	0～ 50 MPa

❹Comparator output

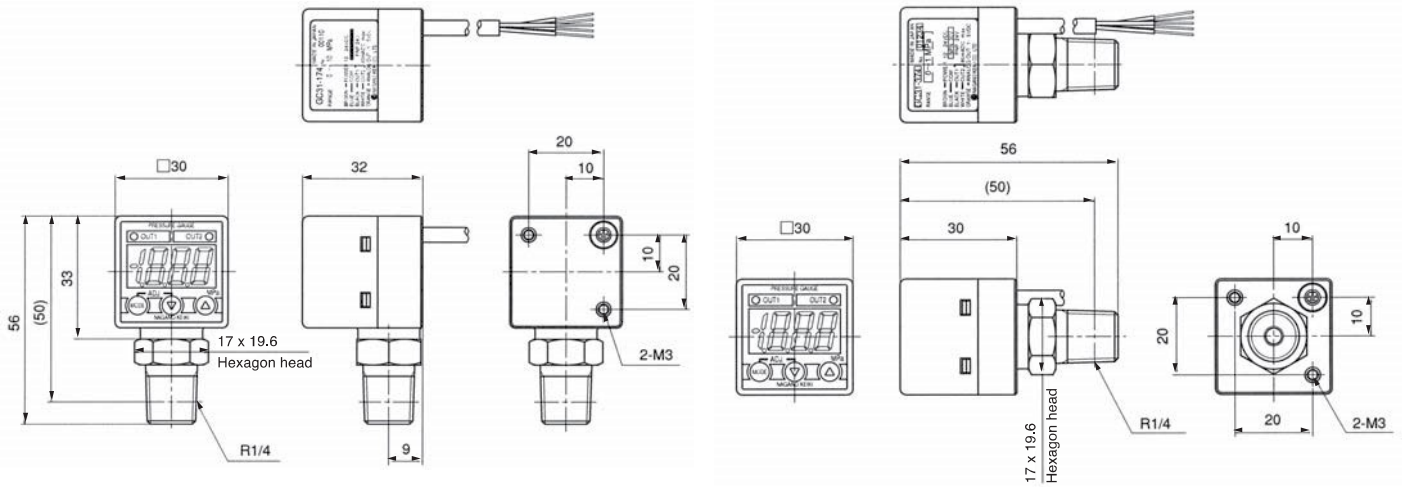
Sign	Specifications
1	PNP open corrector ×2 output (80mA max.)
3	NPN open corrector ×2 output (30VDC、80mA max.)

※ Refer to external dimensions on the next page.

Work Pressure Confirmation

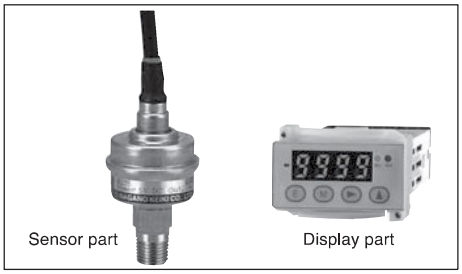
Digital Pressure Gauge

■ KM-901 External dimensions (mm)



Work Pressure Confirmation

Micro-pressure transmitter



■ Model

KM-904-❶

❶Tolerable pressure range

Sign	Pressure range	Tolerable pressure range
1	0～10 kPa	-10～50 kPa
2	0～20 kPa	-20～100 kPa
3	0～50 kPa	-50～250 kPa
4	0～0.1 MPa	-0.1～0.5 MPa
5	0～0.2 MPa	-0.1～1 MPa
6	-0.1～0.2 MPa	
7	0～0.3 MPa	
8	-0.1～0.3 MPa	
9	0～0.5 MPa	

■ Specifications

Sensor part

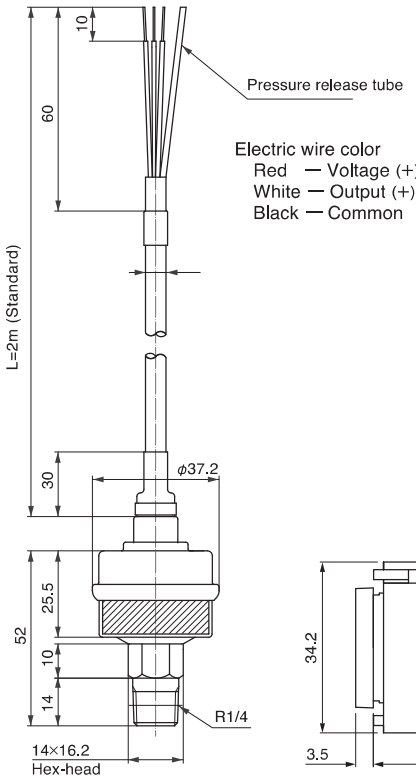
Item	Specifications
Measuring fluid	Dry gas
Connecting type	R1/4
Material at gas connecting part	Elementos:Alumina 96% Connector:SUS316 Packing: Fluorosilicone
Voltage	5V±0.25VDC
Accuracy	±0.5%F.S. (at 23±3℃ includes linearity and hysteresis)

Display part

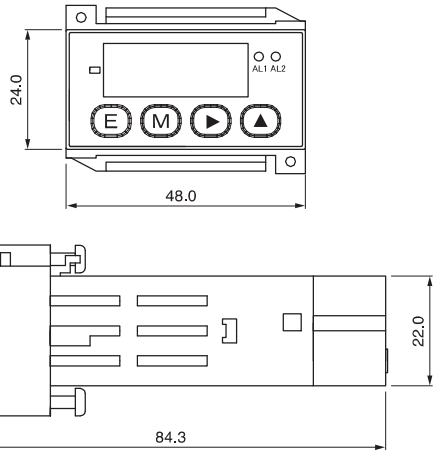
Item	Specifications
Sampling speed	Max. 25 times/sec
Max. display	±9999 (Full 4-digit)
Output	Photocoupler output
Power source voltage	DC24V±20%

■ External dimensions (mm)

● Sensor part



● Display part



Confirmation gauge

Flow standard

■ Model

FFM-100-❶-❷

❶Pressure indication

Content	Pressure range
Positive pressure	10～50 kPa
	50～100 kPa
	100～800 kPa
Negative pressure	−10～−80 kPa

❷Flow indication

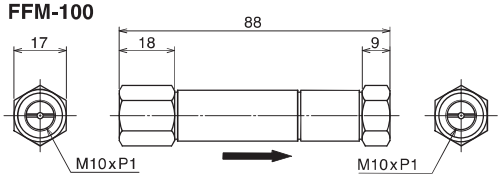
Content	Pressure range
Positive pressure	0.1～50 mL/min
	0.1～100 mL/min
	0.1～200 mL/min
Negative pressure	0.1～50 mL/min

■ Specifications

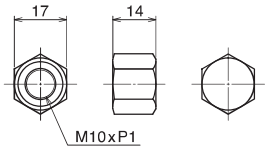
Item	FFM-100
Operation medium	Clean air (Corresponds to compressed air quality 1.3.1)
Operation temperature	23 ±3℃
Repeatability	±5% of measured flow rate (with ambient temperature 23 ℃) ±0.05mL/min in case measured flow rate less than 1mL/min
Accessories	Coupling 2pcs Seal plug 1pc Instruction manual, certification, test results

■ External dimensions (mm)

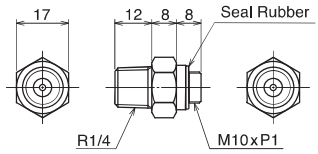
FFM-100



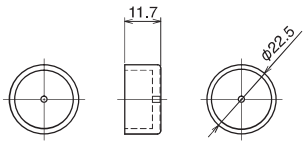
Plug



Coupling



Resin cap



Confirmation Gauge

Calibrator

■ Model

CAL-❶-❷

❶Volume change indication

Sign	Content
0.1	0.1 mL F.S.
1.0	1.0 mL F.S.
5.0	5.0 mL F.S.

❷Option

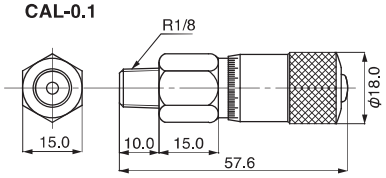
Sign	Content
No sign	No
A ※	R1/4 Conversion fitting attachment
B ※	M10 Conversion fitting attachment

■ Specifications

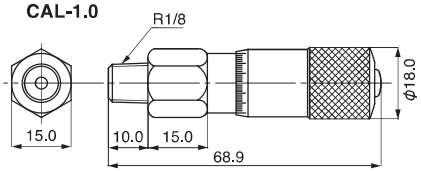
Item	Type		
	CAL-0.1	CAL-1.0	CAL-5.0
Stroke	5	10	5
Rotation number	5	10	5
Volume change per rotation mL	0.02	0.1	1.0
Volume change per minimum division mL	0.0004	0.002	0.02
Precision	5% F.S.		
Connection	R1/8		
Leak	0.02 mL/min at 300 kPa		
Operation pressure	Under atmospheric pressure		
Operation temperature/ humidity	0～40℃、45～85%RH (without condensation)		

■ External dimensions (mm)

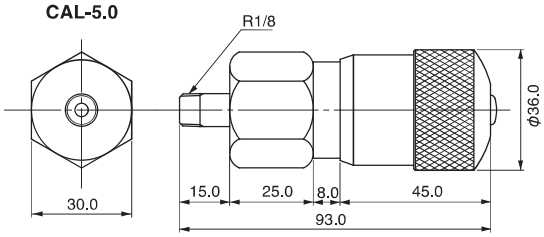
CAL-0.1



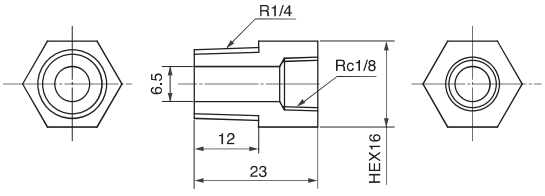
CAL-1.0



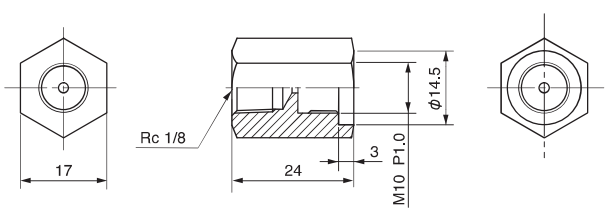
CAL-5.0



※**Option A** (Conversion fitting)



※**Option B** (Conversion fitting)



Float type Flow Meter

■ Specifications

Item	KM-903
Precision	F.S. 2% (Measurement point)
Pressure endurance	Less than 100mL/min: 1.0MPa
	Less than 5L/min: 0.7MPa
	Less than 10L/min: 0.5MPa
Effective division	10 : 1

■ Model

KM-903-❶❷(❸)❹-(❺)-(❻)

❶Total length

Sign	Total length
12	126 mm
15	156 mm
20	206 mm
25	256 mm

❷Material

Sign	Material
SS	SUS 316
B	Brass

❸Flow rate

Total length \ Flow rate	5 mL/min	10 mL/min	20 mL/min	30 mL/min	50 mL/min	100 mL/min	150 mL/min	200 mL/min	300 mL/min
12	○	○	○	○	○	○	○	○	○
15	–	○	○	○	○	○	○	○	○
20	–	–	–	–	○	○	○	○	○
25	–	–	–	–	–	○	○	○	○

Total length \ Flow rate	500 mL/min	1 L/min	2 L/min	3 L/min	5 L/min	10 L/min	15 L/min	20 L/min	30 L/min
12	○	○	○	○	○	○	○	○	○
15	○	○	○	○	○	○	○	○	○
20	○	○	○	○	○	○	○	○	○
25	○	○	○	○	○	○	○	○	○

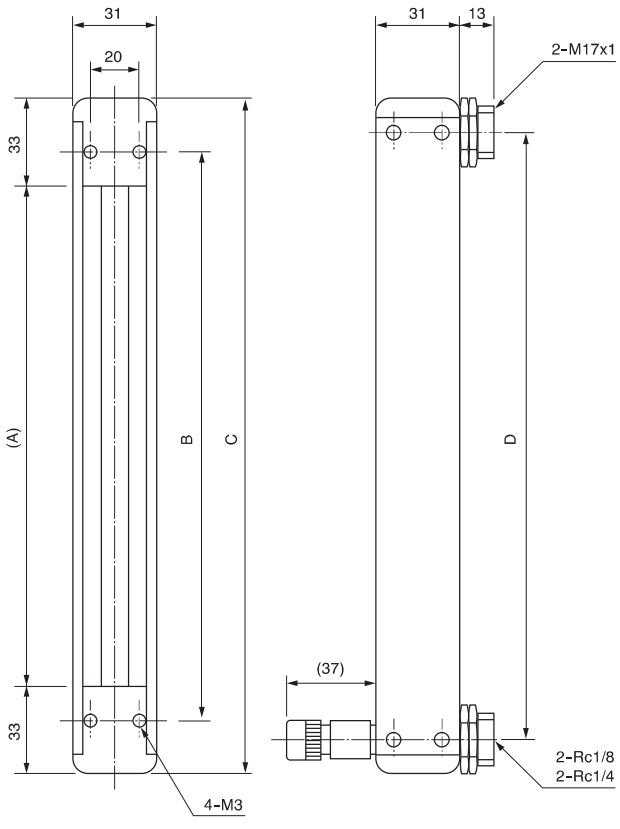
❹Needle position

Sign	Position
U	Upper part needle
D	Lower par needle

❺Supply pressure

❻Output pressure

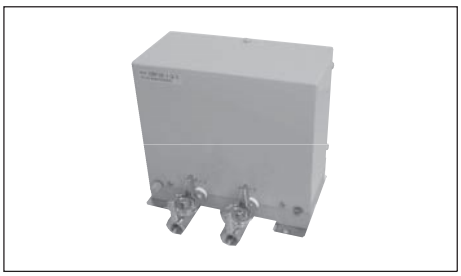
■ External dimensions (mm)



Dimensions of each part

Part	12	15	20	25
A	60	90	140	190
B	86	116	166	216
C	126	156	206	256
D	100	130	180	230

Switching Valve Unit



■ Specifications

Item	ESV
Port number	2 ports
Operation pressure range	-90～700kPa
Leak standard	0.08mL/min (Test pressure 700kPa, One measurement circuit open, and one closed
Air pilot supply pressure	300～400kPa
Inner volume measurement system	12.5mL
Operation fluid	Clean air and non corrosive fluid against C3604, A2017, and NBR
Operation temperature/humidity	0～40℃、45～85%RH (without condensation)

■ Model

ESV❶-❷-❸-❹

❶Used tester

Sign	Content
100	FL-600, FL-601 series
110	Series by each volume

※ Please discuss your requirements with nearest sales office as testers are designed for specific operations.

❷With/without exhaust valve

Sign	Content
0	Without valve
1	With valve

❸Exhaust valve indication

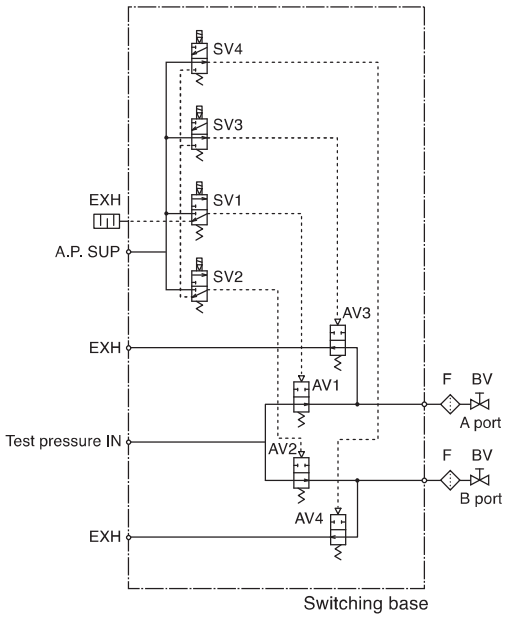
Sign	Content	Remarks
1	Interlock with switching valve A	When 1 switching unit is used by 1 tester
2	Interlock with switching valve B	When 2 switching units are used by 1 tester
3	Single operation indication	Air pilot valve: all normal closed type.
4	Exhaust bypass specification	When used as external evacuation valve

❹Cable indication

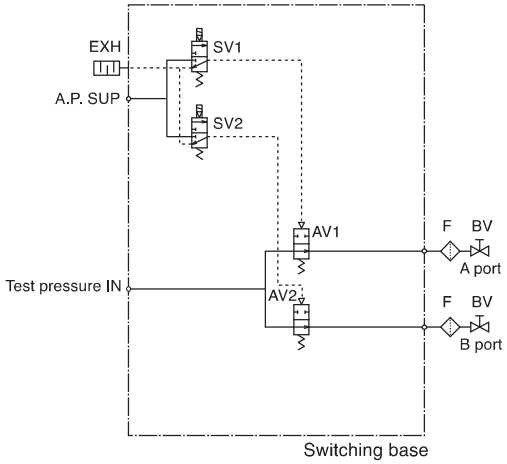
Sign	Cable	Remarks
0	No cable	
1	1.5m	
2	5m	
3	1.5m×2	When interlocked switching valve A and B are used
4	5m×2	When interlocked switching valve A and B are used
5	1.5m + with CBU cable	
6	1.5m + with EBU cable	
7	Specified single cable	
8	Exhaust bypass specification cable	

■ Exhaust valve circuit diagram

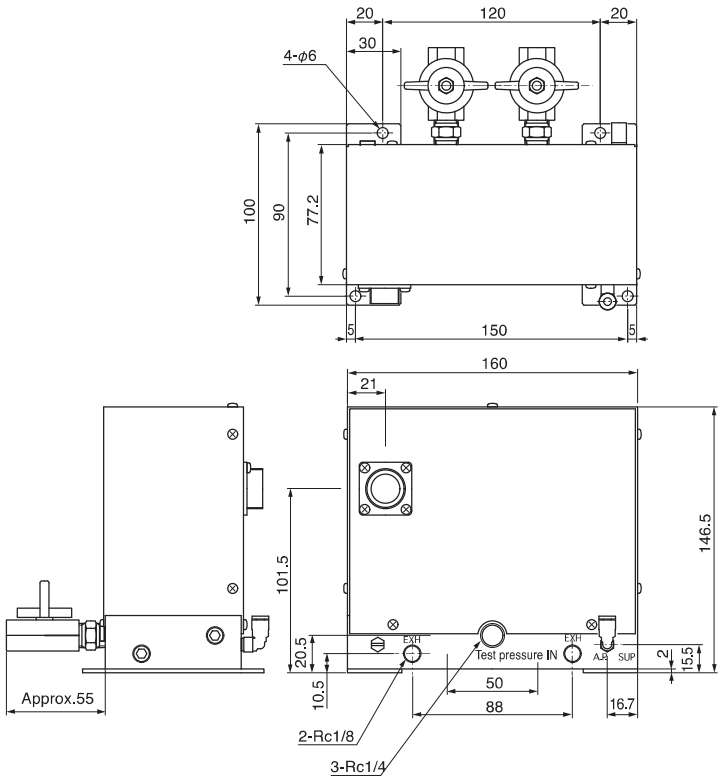
● With exhaust valve



● Without exhaust valve



■ External dimensions (mm)



Exhaust Bypass

Exhaust Bypass Unit

■ Model

❶-600❷-❸

❶Model

Sign	Function
EBU	Exhaust bypass unit

❷Range

Sign	Operation pressure range
C	10～700 kPa
V	-5～-90 kPa

※The leak tester gets modified for V specifications.

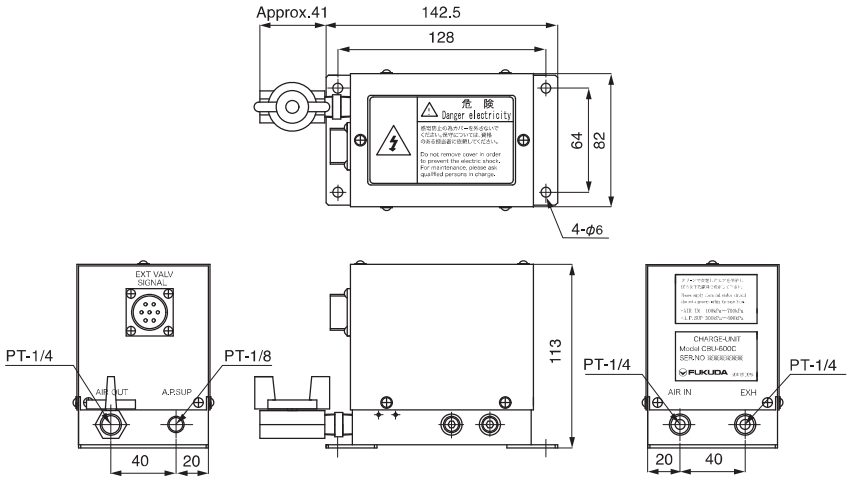
❸Bypass unit control cable

Sign	Content	Remarks
1.5	1.5m	Standard accessory
3	3m	Option

■ Specifications

Item	EBU-600
Pilot valve driving pressure	300～700kPa
Pilot valve rated voltage	DC24V
Operation temperature range	0～40℃
Operation humidity range	35～85%RH (without condensation)

■ External dimensions (mm)



Exhaust Bypass

External Exhaust Bypass Unit

■ Model

FE-20❶

❶Model

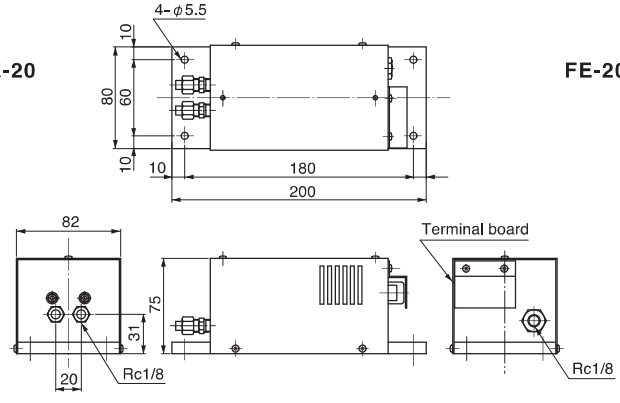
Sign	Pressure range		Function
No	1～990 kPa	AC100V	For positive pressure without drain
C	1～800 kPa	AC100V	For positive pressure with drain
V	-5～-90 kPa	AC100V	For negative pressure
X003	1～1.5MPa	AC100V	For high pressure
X005	1～1.5MPa	DC24V	For high pressure

■ Specifications

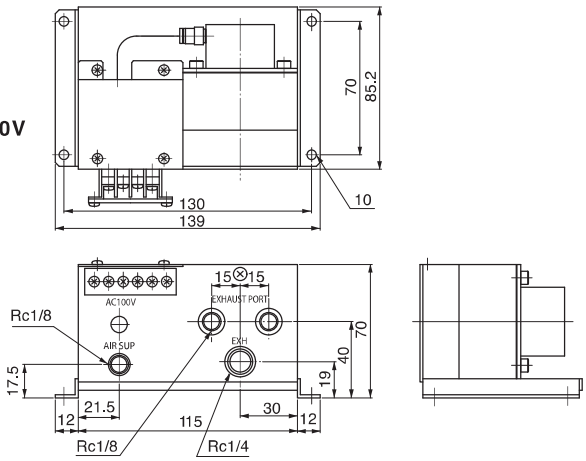
Item	FE-20
Cylinder driving pressure	400～700kPa
Power source voltage	AC100V±10%　50/60Hz
Operation temperature range	0～40℃
Operation humidity range	35～85%RH (without condensation)

■ External dimensions (mm)

FE-20



FE-20V



Piping Material

Nylon Tube

■ Model

KP-901-❶-(❷)-(❸)-(❹)

❶Model

Sign	External diameter (mm)	Internal diameter (mm)
1/8	3.18	1.6
3/16	4.76	2.42
1/4	6.35	3.21
5/16	7.94	4.02
3/8	9.53	4.81
1/2	12.7	6.4

❷Tube color

Sign	Color
B	Black
W	Opal

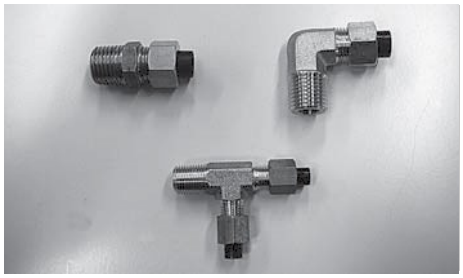
❸Length

Sign	Length
20	20 m

❹Quantity

Piping Material

Insert Type Joint



■ Model

KJ-901-❶ ❷-(❸)

❶Shape

Sign	Content
C	Connector
E	90° elbow
S	Service T

❸Number

Sign	Number
10	10 pieces

❷Size

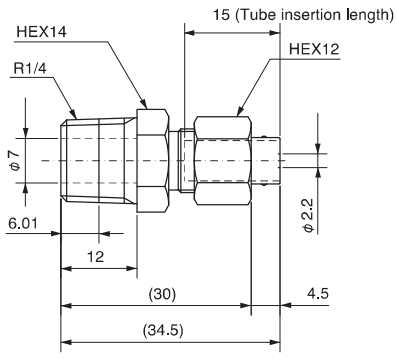
Sign	Applied tube external diameter	T screw size	Connector	90° elbow	Service T	Tube insertion length
01	1/8	R1/8	○	○	○	21 mm
02	3/16	R1/8	○	○	○	15 mm
03	3/16	R1/4	○	–	–	15 mm
04	1/4	R1/8	○	○	○	15 mm
05	1/4	R1/4	○	○	○	15 mm
06	5/16	R1/8	○	○	○	16 mm
07	5/16	R1/4	○	○	○	16 mm
08	3/8	R1/8	○	–	–	18 mm
09	3/8	R1/4	○	○	○	18 mm
10	3/8	R3/8	○	○	○	18 mm
11	1/2	R1/4	○	○	–	19 mm
12	1/2	R3/8	○	○	○	19 mm
13	1/2	R1/2	○	○	–	19 mm

■ Specifications

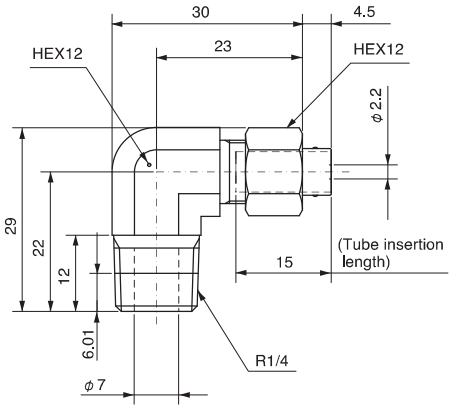
Item	KJ-901
Operation fluid	Air, water, general hydraulic oil, chemicals
Maximum operation pressure	Depending on maximum operation pressure of operation tube
Operation temperature range	Air, general hydraulic oil : -40～+80℃ Water : 0～+70℃
Negative performance	0.1 Torr (-759.9 mmHG)
Material	Brass

■ External dimensions (mm)

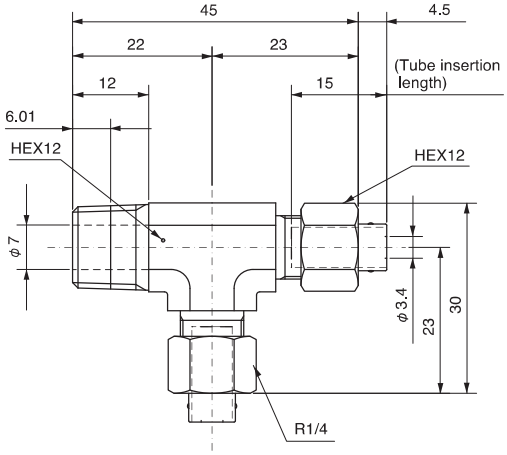
● Connector



● 90° elbow

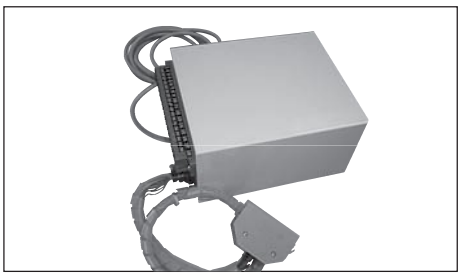


● Service T



Leak tester switching unit

Conversion BOX



■ Specifications

This conversion BOX with terminals allows FL-3700 series equipments connected to terminals are used for FL-600 series.

●Note:
Please refer to the FL-600 series operation manual for connecting method to sequencer, working voltage range, contact point volume, and other specifications.

※FL-600 series corresponds to models FL-600, FL-601, and FL-610.

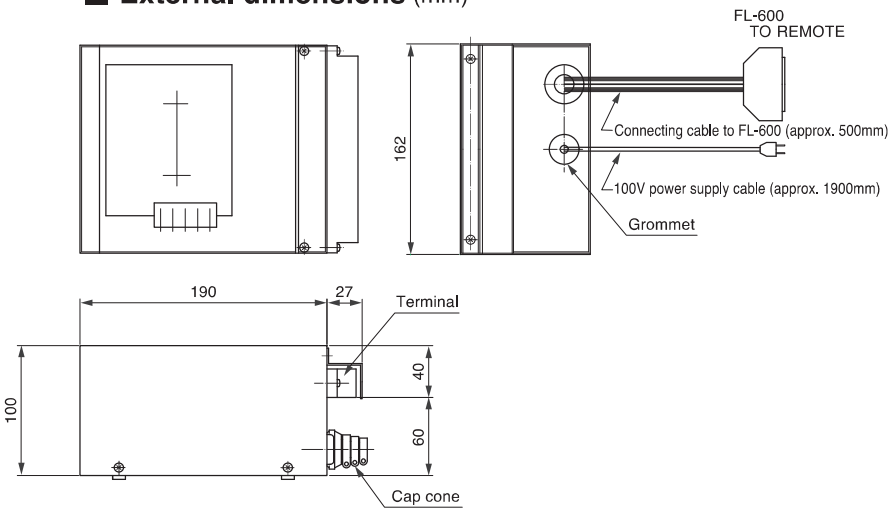
■ Model

D4-001-❶

❶Conversion signal

Sign	Remarks	
01	FL-3700 → FL-600 selection	(ERR, INT / EXT signal logic change)
02	FL-296→FL-600 selection	(ERR, PSW signal logic change)
03	FL-3700 → FL-600 selection	(No signal logic change)
04	FL-296→FL-600 selection	(No signal logic change)

■ External dimensions (mm)



Check Tool

Pressure Standard Container

■ Model

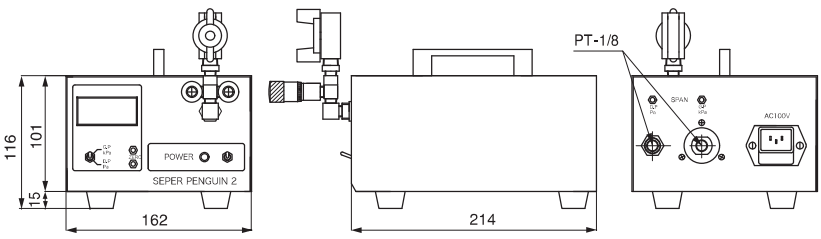
CL-100

■ Specifications

Item	CL-100
Ambient conditions	Temperature: 0～40℃ No temperature change during measurement.
	Humidity: 40～80%RH (without condensation)
Power source voltage	Standard specification: AC90～110V
	Special specification: AC200～240V
Insulating resistance	More than 50MΩ at DC500V
Dimension	160(W)×100(H)×210(D) mm
Weight	Approximately 3.3kg
Operation sensor	Pressure difference sensor: ±0.5% F.S.
	Direct pressure sensor: ±0.3% F.S.
Pressure range※	Pressure difference: -2000～2000Pa
	Direct pressure : 0～1000kPa (gauge pressure)

※ Note specifications may differ from standard specifications.

■ External dimensions (mm)



Digital Manometer

■ Specifications

Item	DG-72	
Measurement medium	SX-34	Air, Nitrogen, Non corrosive gas
	SX-100D	
	PI-100C	Gas and liquid that will not corrode SUS630, SUS316, NBR
	PA-860	
	PA-830	
Sensor linearity	L : ±1% of F.S.	
	H : ±0.3% of F.S.	
Thermal zero span	L、H : ±0.05%/℃ of F.S.	
Excess pressure	2 times of range F.S.	
Destruction pressure	3 times of range F.S.	
Pressure input port	Rc 1/8	
Power source voltage	AC90～132V	
Current consumption	200mA	
Voltage endurance	AC1500V 1 minute (AC line to case)	
Insulating resistance	More than 50MΩ at DC500V (AC line to case)	
Operation temperature and humidity	0～40℃, 35～85%RH (without condensation)	

■ Model

DG-72-❶ ❷ ❸ ❹-X002

❶Sensor Precision (Precision for sensors that can not be prepared depending on the pressure range)

Sign	Precision	Mounted Sensor	
L	± 1 % F.S.	SX-34	Air pressure
		PA-860	Oil and air pressure
H	± 0.3 % F.S.	SX-100D	Air pressure
		PI-100C	Oil and air pressure
		PA-830	Oil and air pressure
		PA-860-006	Oil and air pressure

❷Pressure range configuration

Sign	Measurement Pressure range	Precision L		Precision H	
		Preparation	Sensor	Preparation	Sensor
-100 kPa	0～-100 kPaG	○	SX-34	○	PA-830
±1000 Pa	-1000～1000 PaG	×	-	○	SX-100D
2 kPa	0～2.00 kPaG	×	-	○	SX-100D
50 kPa	0～50 kPaG	○	SX-34	○	PA-830
100 kPa	0～100 kPaG				
200 kPa	0～200 kPaG				
500 kPa	0～500 kPaG				
1 MPa	0～1.00 MPaG	×	-		
2 MPa	0～2.00 MPaG	×	-	○	PI-100C
5 MPa	0～5.00 MPaG	○	PA-860	○	PA-860-006
10 MPa	0～10.0 MPaG				
20 MPa	0～20.0 MPaG				

※ X in the column is not manufactured.

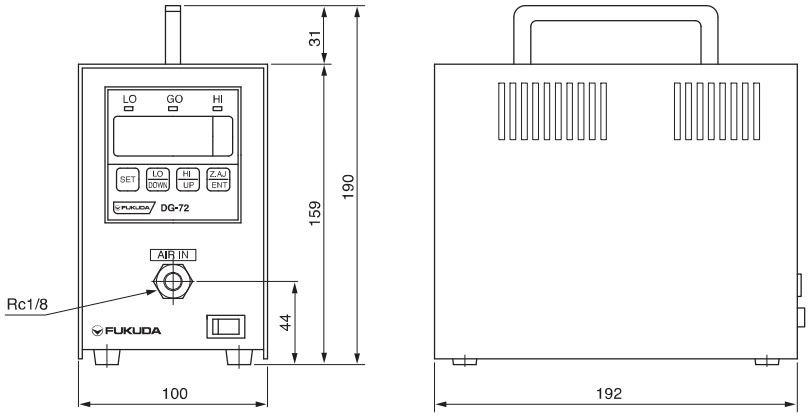
❸Input/Output specification

Sign	Content	Remarks
No	No input/output signal	
R	Relay output	
T	Transistor output	NPN open collector

❹ Calibrator

Sign	Content	Remarks
No	No calibrator	
A	1.0mL Calibrator	
B	0.1mL Calibrator	

■ External dimensions (mm)



Stability Standard Container

Stability Tank

■ Model

M-100-❶

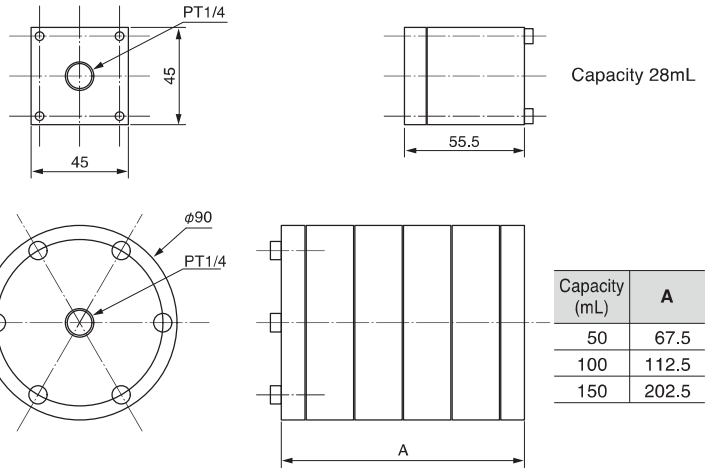
❶Tank capacity

Sign	Content
028ML	28mL
050ML	50mL
100ML	100mL
150ML	150mL

■ Specification

Item	M-100
Allowable pressure	990kPa

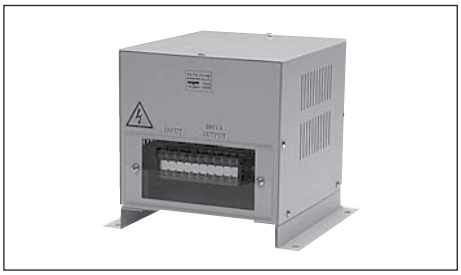
■ External dimensions (mm)



Capacity (mL)	A
50	67.5
100	112.5
150	202.5

Stability Standard Container

Transformer



■ Model

D1-901-❶

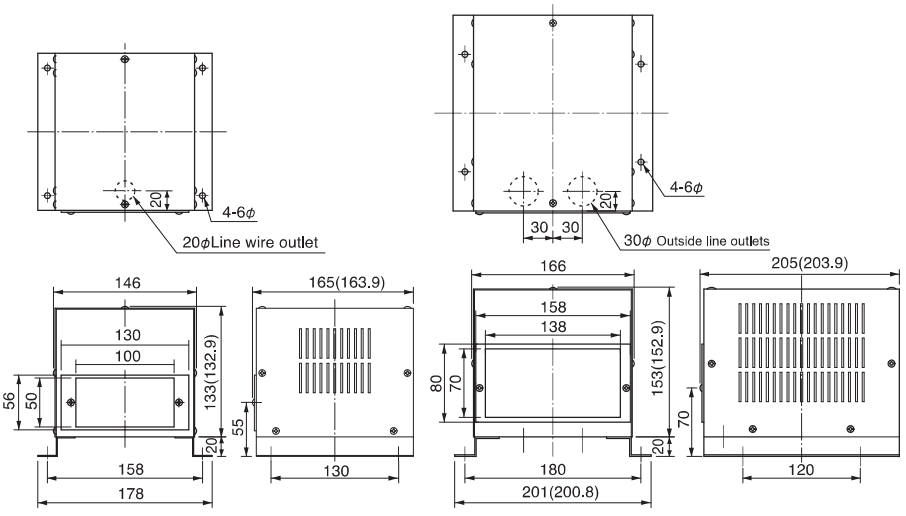
❶Capacity

Sign	Capacity
300	300VA
500	500VA

■ Specification

Item	Capacity: 300VA	Capacity: 500VA
Phase numbers	Single phase double-winding	
Frequency	50Hz/ 60Hz	
Primary voltage	200/ 220/ 240V	
Secondary voltage	100/ 110/ 115V	
Secondary current	3A	
Weight	Approx. 5.8kg	Approx. 9kg

■ External dimensions (mm)



D1-901-300 D1-901-500

Observation sheet

※Tester failure or apparent abnormality of equipment are not included.

Segment	Phenomenon	Observation	Cause
1. Work	Measurement unstable (Result varies randomly)	· Ratio between inner volume and leak criteria is large. Leak criteria (mL/sec): work volume (mL)=1:10000	Work is large Leak criteria is small
2. Work	Measurement unstable	· Work expands with pressurization. Resin or rubber. · Detected pressure difference is large even with increased pressure time. · Detected pressure difference becomes small when pressure time increases (10 times) with good work. Becomes stable with repeated measurement.	Shape variation is large
3. Work	Measurement unstable	· Pressure difference wave form shifts suddenly · O-ring present for side sealed in work.	Work inner seal moves
4. Work	Measurement unstable	· Work includes porous material (filter etc) · Continuous measurement by atmospheric pressure after measurement shows large minus swing.	Inner leak present
5. Work	Measurement unstable	· Work is sensitive to temperature. · Pressure difference wave form with long detection time snakes.	Effect of external temperature
6. Work	Measurement sensitivity low (Real leak and tester display do not coincide)	· Work shape variation large.	Work shrinks
7. Work	Measurement sensitivity low (Real leak and tester display do not coincide)	· Work inner structure is complex. · Work (measurement circuit) includes check valve.	Filling pressure does not circulate well
8. Work	Measurement sensitivity is low (NG good is judged to be good)	· Work is wet. · Work includes liquid such as oil.	Leak hole is closed by liquid
9. Work	Measurement sensitivity is high	· Several B.NG. Pressure difference swings out at small leak.	Criteria is large compared to inner volume
10. Setting	Measurement unstable	· Pressure difference swing at balance is large with good work. · Pressure drop of the work inner pressure graph is large after pressurization finish with good work. (more than -5% drop)	Pressurization insufficient
11. Setting	Measurement value of good work does not become zero	· Mastering pressure difference wave form is not stable after M.DET completion. (Easy to observe the wave form by making M.DET time long).	Mastering time insufficient
12. Equipment	Measurement unstable	· Work is large (more than 5L) · Distance between work and tester piping is long). · Pressurizing port diameter is small compared to work size.	Pressuring flow insufficient
13. Equipment	Measurement unstable	· Work is large (more than 5L) · Test pressure increase is slow at pressurization	Pressuring flow insufficient
14. Equipment	Measurement unstable	· Work is large (more than 5L) · Supply pressure drops momentary at pressurization.	Supply flow insufficient
15. Equipment	Measurement unstable	· No pre-regulator in front of the pressure regulator.	Effect of supply pressure variation
16. Equipment	Tester is frequently destroyed	· Tool submerged and performs bubble test after NG decision. · Cleaning water of precedent process remains	Foreign material (water) is sucked
17. Equipment	Tester is frequently destroyed	· Water or oil remains in filter of equipment or tester. · Water comes out when air gun is operated.	Foreign material entered
18. Equipment	Measurement unstable	· Pressure difference varies when clamp tool is pushed by hand during detection. (Be careful as this operation is dangerous. Make sure to assure safety by manual confirmation or extension of detection time) · Seal face is wide (Especially Betaseal) · Seal material is soft	Seal is unstable
19. Equipment	Measurement unstable	· A plurality of measurement points is switched by electromagnetic valve.	Effect of temperature
20. Equipment	Measurement unstable	· A plurality of measurement points is switched by spool type valve (such as 3 way valve).	Inner leak Seal moves
21. Equipment	Measurement unstable	· Piping material is soft	Shape variation is large
22. Equipment	Measurement unstable (at special timing)	· Multi axis measurement is performed. · Multi room measurement is performed. · Occurs at NG (evacuation) timing of neighbor axis.	Interference
23. Equipment	Measurement unstable (at special time range)	· Many miss judgments in the morning, or after long breaks or pauses. · Average value of good work varies gradually. · There is the master.	Initial swing (master)
24. Equipment	Measurement unstable (at special time range)	· Many miss judgments in the morning, or after long breaks or pauses. · Average value of good work varies gradually. · Master less.	Initial swing (tool variation)
25. Equipment	Measurement unstable (at special time range)	· Impossible to measure in the morning during winter. It becomes possible at noontime. · Work in winter morning is too cold	Condensation
26. Equipment	Measurement value of good work does not become zero	· Detection pressure difference occurs even with long pressure and balance time (5 - 10 times of normal value). (Pressure difference becomes long in proportion to time)	Leak
27. Equipment	Large leak work is judged to be good	· Measurement at very small pressure (less than 10kPa)	Test pressure loss
28. Environment	Measurement is unstable	· Average value of good part measurement result shifts gradually. · Stable from 12:00 to 16:00.	Effect of ambient temperature
29. Environment	Measurement unstable	· Leak test equipment near entrance. · There is a window near tester and tester receives direct sunshine. · Air conditioner directly affects testers	Effect of ambient temperature
30. Environment	Measurement unstable	· Work is warm · External process that changes the temperature of work such as welding or hot water cleaning.	Effect of work temperature
31. Environment	Measurement unstable	· Storage place of test waiting work and test place is different. · Test waiting work is place near the floor.	Effect of work temperature
32. Environment	Measurement unstable (at special timing)	· Detecting pipe vibrates. · Vibration during detection (other operation is done in parallel). · Work moves during detection.	Vibration
33. Environment	Measurement unstable	· Pressure difference value varies up and down during detection. · Varies if measurement opened in atmospheric pressure.	Electrical noise

	Counter measure	Item	Example	Remarks
	◎ Decrease core volume			
	※ Study other test methods	H2 leak, He leak		
	※ Study all variable such as conditions, tools, environment	LPU-300	Injector Sensor parts	
	○ Use turbo pressurization	Turbo model such as FL-3700		
	○ Increase pressurization repeatability by precision regulator	APU series	Resin intake manifold	
	△ Increase pressurization time			
	※ Study and propose work/work comparison method for the work with more variation.	FL-601M-2-X001	Rubber hose	
	○ Perform turbo pressurization	Turbo model such as FL-3700	Injector Engine assembly	
	△ Increase pressurization time			
	◎ Measure leak side △ Perform turbo pressurization △ Increase pressurization time		Oil filter	
	○ Propose work/ work comparison method (Study complete symmetry)	FL-601M-2-X001	Delivery pipe Evaporator	
	○ Protect work with cover			
	○ Adopt measured volume by flow standard	FFM-100	Gasoline tank	Equivalent inner volume becomes larger than the real inner volume because of the work shape change.
	◎ Pressurize work from a plurality position (other side)			
	△ Increase pressurization time			
	◎ Dry work and measure		Mission assembly	
	※ Study other method	FL-273		Measure direct pressure
	○ Change tester measurement range	FL-283		Measure pressure difference of 10kPa
	△ Decrease detection time			
	△ Increase measurement inner volume	MH master chamber		Measurement time may rise if increased volume is not stable.
	◎ Increase pressurization time			
	◎ Set appropriate M.DET time			
	◎ Pressurize work from a plurality position		Engine bear	
	○ Perform turbo pressurization	Turbo model such as FL-3700		
	○ Make pipe diameter large			
	△ Increase pressurization time			
	◎ Prepare pressurization bypass	CBU-600	Gasoline tank	
	◎ Perform APU pressurization	APU-90W, 130W series		
	○ Increase the pressure reduce valve. Pre-regulator may need more flow rate.			
	◎ Attach surge tank at tester air source.	VBAT38	Gasoline tank	
	◎ Provide pre-regulator and set test pressure + 100kPa.	AR series		
	◎ Provide evacuation bypass.	FE-20、EBU-600		
	◎ Provide filter at pressure air source. Open drain at daily check and change filter element periodically.	AF + AFD		
	△ Replace to high performance filter(Lemans made)			
	◎ Provide O-ring type and make metal touch.			
	○ Surround seal material to stop shape change			
	△ Attach stopper to seal cylinder			
	△ Study hardness of seal material			
	△ Review seal force (including clamp force)			
	※ Review totally work and tool (from design)			
	○ Use air operation type switching valve	ESV		
	○ Use poppet type valve	ESV		
	○ Use high pressure pipe. Use N2 pipe even for low pressure. Shape change effect occurs at 500kPa even with N2 pipe. Study metal pipe when the pressure is high and effect is large.	N2 pipe		One touch joint is not allowed (Use only products correctly selected from conditions such as low pressure, large volume, large leak criteria etc.)
	◎ Synchronize measurement and evacuation timing.			
	○ Strengthen tool base or make it independent			
	○ Provide pressure reduce valve for each pressure air source of clamp cylinder and make them independent.			
	○ Introduce master less	FL-600	Engine bear	
	△ Use highly stable container.	MH master chambe		
	△ Repeat idle measurement to warm up.			
	○ Review tool stability(seal structure)			
	△ Repeat idle measurement to warm up.			
	◎ Provide dryer Make guide line of dew point of -20℃ under pressure.			One touch joint is not allowed. Use only products correctly selected from conditions such as low pressure, large volume, and large leak criteria etc.)
	◎ Stop leak of equipment and tool.			
	◎ Provide pressure gauge to monitor the work pressure.		Lamp cover	
	○ Perform ambient (drift) compensation.	FL-600, FL-3700 with drift compensation series	Engine bear	
	◎ Study installation place.			
	○ Provide cover on equipment and protect work during measurement.			
	○ Attach cover on pipe to protect.			
	◎ Study process order.			
	○ Measure after cooling.			
	○ Store test waiting work near tester and at the same height.			
	◎ Remove vibration cause(Remove transportation vibration, study operation timing)			
	○ Fix pipe to stop vibration			
	○ Change earth wiring.			More effective to attach the filter if cause of noise is detected.
	△ Provide noise filter			

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