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# **KITZ**

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## **Operation Manual**

For

**KITZ FBS Pneumatic Actuators**

Thank you for choosing KITZ products.

For safe and trouble-free function and performance of the product, ensure to read and understand all items of this manual before valve mounting and operation.

Keep this manual in a convenient place for your valve operators' easy access.

## NOTES TO USERS

This manual applies to the KITZ FBS Series Pneumatic Valve Actuators.

For actuators of automatically operated value, refer to the operation manual of relevant actuators prepared by the manufacturers.

### SAFETY CAUTIONS

This manual calls users' careful attention to the dangers and hazards that may be caused to personnel or properties during handling, storage, installation, operation or maintenance of the product. Such dangers and hazards are specifically highlighted in the operation manual with either one of the following marks.



**WARNING**

A warning indicates a potentially hazardous condition that may result in serious injury or death of personnel, if such a warning is ignored.



**CAUTION**

A caution indicates a potentially hazardous condition that may result in minor injury to personnel or damage to properties, if such a caution is ignored.



Indicate to call attention of an action.



Indicates prohibition of an action.



Indicates mandatory implementation of an action.

This manual provides users with the instructions on correct use of KITZ FBS pneumatic valve actuators. Ensure to carefully read all the items of this manual before handling, storage, installation, operation and maintenance of the product.

This manual covers the normal use of the product as a general guide to users, but does not necessarily cover every condition or situation that may be caused to users while using the product. If technical assistance beyond the scope of this manual is required, users are recommended to contact KITZ Corporation or the distributors in their locations.

Numerical limits given in this manual such as operating pressures and service temperatures are specified in consideration of safe and trouble-free operation of the products. It is forbidden to use the product in any condition that may exceed such numerical limits.

Drawings and illustrations of the product in this manual provide users with only the basic information.

Ask KITZ Corporation or the distributors for detailed assembly drawings of the products, if needed.






Any information provided in this manual is subject to from-time-to-time change without notice for error rectification, product discontinuation, design modification, or any other causes that KITZ Corporation considers necessary.

If any item of this manual is not strictly followed by users, KITZ Corporation shall have no responsibility for any resulting accident or failure of the product.

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**1. Attention for user's system**

 <b>WARNING</b>	
	<p>Holding valve position KITZ pneumatic actuators Do not assure no leakage. Actuators do not hold valve positions long time without continuous air supply. If you need to hold valve position long time without continuous air supply, contact KITZ Corporation or its distributors.</p> <p>Internal air residue of spring return type actuators Out put torques of spring return type actuators indicate values without internal air residue remains inside their cylinders. Please design your systems to be able to exhaust internal air residue at spring return action. If internal air residue remains in the cylinders, out put torque will be small and valves do not open or close by spring return action.</p>
 <b>WARNING</b>	
	Do not pressurize spring return type actuator's breathing port.
	Prevent entering dust, rainwater or waste into actuators through the breathing port.

**2. Product Features**

- 2-1. KITZ FBS pneumatic valve actuator is provided with output torque characteristics suitable for operation of KITZ smaller size ball valves.
  
- 2-2. KITZ FBS pneumatic valve actuator is designed for direct modular mounting of KITZ optional accessories on the actuator housing.

**3. Product Codes**

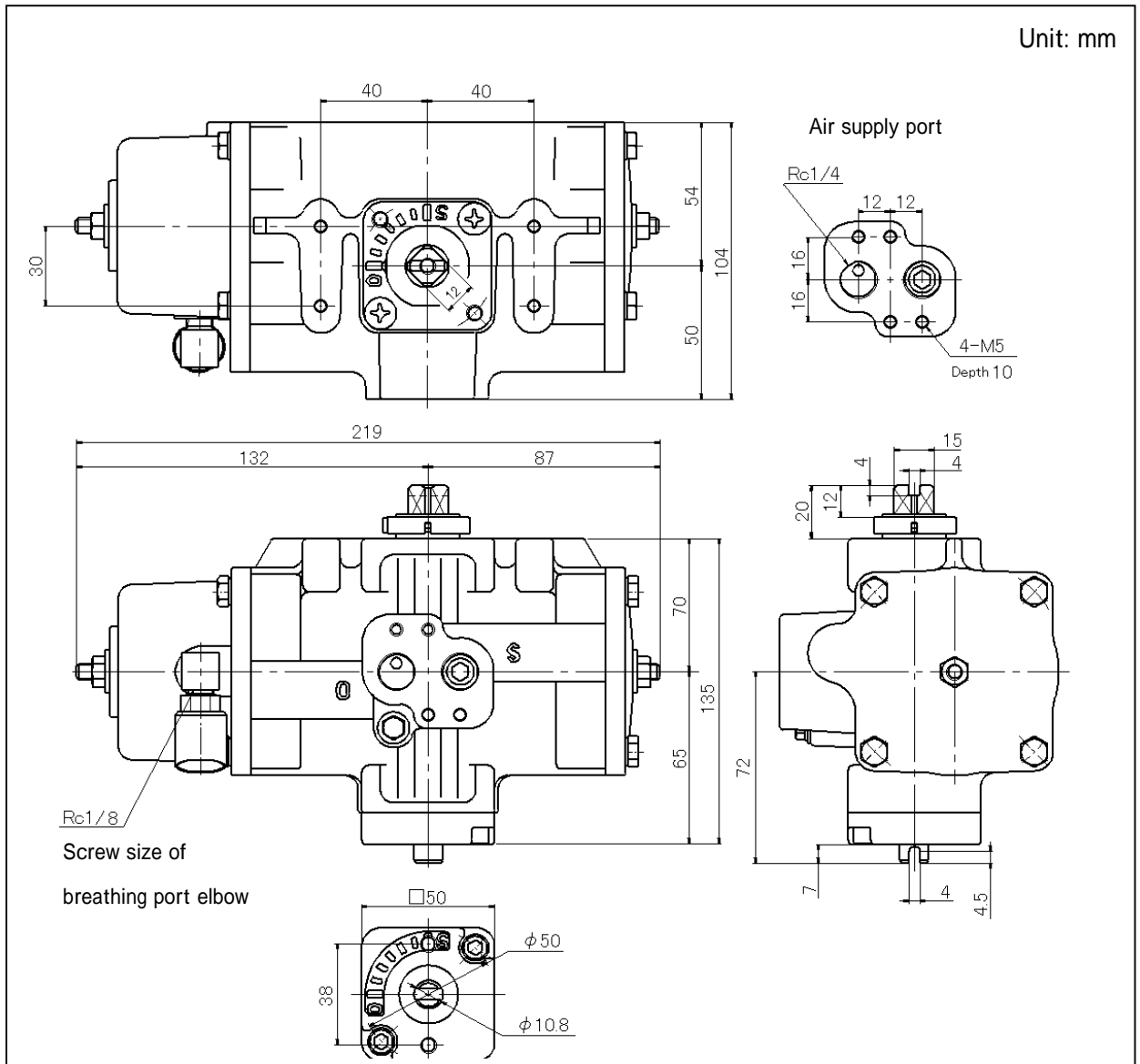
**F B S 1**

Type of valves to operate	Type of operation	Actuator size
B...Smaller size ball valves	S.....Spring return	1...Size 1

**4. Mounting of Actuators on Valves**

KITZ FBS pneumatic valve actuator is mounted on KITZ smaller size ball valves directly with male shape driving shaft.

**5. Dimensions and Mass**



	Mass
FBS-1	2.1kg

### 6. Design Specifications

	FBS-1
Shaft rotating range	90 ° ± 7 °
Cylinder volume ( L )	0.15
Standard operation pressure	0.39 MPa
Operation pressure range *1	0.29 ~ 0.69 MPa
Housing shell test pressure	0.97 MPa
Valve opening position indicator	90 ° with 7 division marks including [O] and[S]
Service temperature range *2	- 20 ~ + 80
Bottom pad for mounting on valves	ISO5211

\*1. Contact KITZ for technical advice, if the operating pressure is lower than 0.39MPa.

\*2. The air supply must not be frozen.

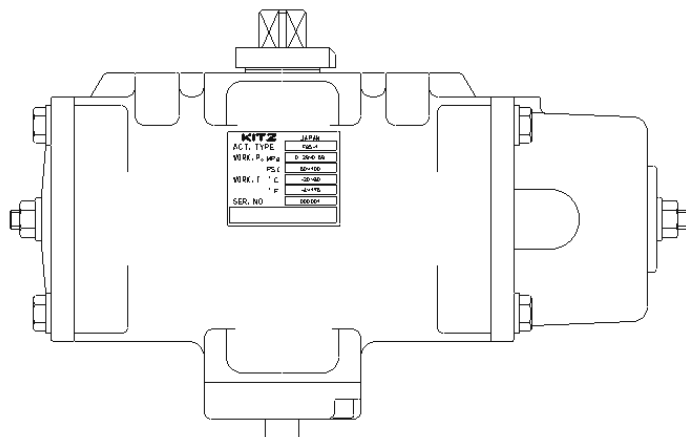
### 7. Product Identification Plate

For the identification of the product code and service conditions, a metal plate is attached to the actuator housing.

ID plate for FA-1 actuator

<b>KITZ</b>		JAPAN
ACT. TYPE		FBS-1
WORK. P MPa		0.39~0.69
	PSI	60~100
WORK. T °C		-20~80
	°F	-4~176
SER. NO		000001

ID plate location



### 8. Actuator Driving Mechanism

#### Type FBS spring return actuator

- (1) The Air pressure supplied into the chamber A through the inlet pushes the piston-gear rack assembly toward the left, compresses the spring and discharges the air residue left in the chamber B through the outlet (Fig 1).
- (2) At the same time the gear rack rotates the pinion gear and the shaft counter-clockwise, to drive the valve.
- (3) At the moment the air in A is discharged through the solenoid valve, the spring force pushes the piston and the gear rack to the reverse direction, and the gear rack activates rotation of the shaft clockwise to reversely operate the valve.

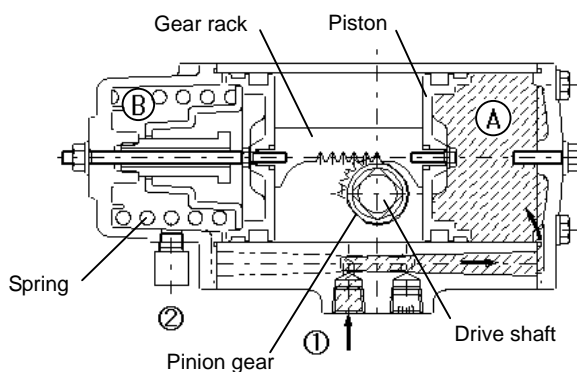


Fig1

### 9. Output Torques

#### Type FBS spring-return actuator

Unit: N-m

Actuator type-size	Spring rating	Operating pressure (air)						Operating force (spring)	
		0.29 MPa		0.39 MPa		0.49 MPa			
		0 ° *1	90 ° *2	0 ° *1	90 ° *2	0 ° *1	90 ° *2	0 ° *3	90 ° *4
FBS-1	3	9.25	6.51	14.06	11.32	18.87	16.12	5.18	7.92
	4	-	-	11.66	7.64	16.47	12.45	7.58	11.6
	5	-	-	-	-	14.6	9.6	9.44	14.45

\*1. For starting an actuator travel to open a fully closed valve:

\*2. For ending an actuator travel to open a fully closed valve.

\*3. For ending an actuator travel to close a fully open valve.

\*4. For starting an actuator travel to close a fully open valve.

**10. Supply of Air Operation Pressure**

- 10.1 For the actuator factory-assembled with a solenoid valve, provide the air tubing between the air compressor and the solenoid valve. Air inlets are Rc 1/4.
- 10.2 Use copper, coated copper or plastic tubes of an adequate diameter and wall thickness. Clean tube bores to remove all foreign residues and tightly seal all connections to avoid leakage of air during a travel from the compressor.
- 10.3 If you want to mount your own solenoid valves other than those factory-assembled, select the following type. For FBS actuators, 3-way or 4-way solenoid valves with plug up just one port are used.
- 10.4 Air inlets are Rc1/4. Use hexagonal fittings of 19mm and smaller width of flat . Contact KITZ Corporation for technical advice, if you want to use larger tubes for faster operation of actuators.
- 10.5 Keep the air always free from dust and moisture ( -15 or lower dew point under the atmospheric pressure ), using air-filters and air-dryers.
- 10.6 Choose the capacities of your own accessories and the sizes of auxiliary air tubing, in consideration of possible loss of air pressure during a travel from the compressor.
- 10.7 The exact volume (Q) of air supply required per minute for actuators must be known before the air tubing installation so that the provided operation pressure may be sufficient to properly drive actuators and valves. Calculate your air supply requirement with the following equation.
- 10.8 The required air pressure must be kept constant at the air inlet of an actuator. Insufficient air supply causes intermittent piston drive and results in malfunction of actuators.

$$Q = V(P + 0.1013) / 0.1013 \times 60/t \text{ [L /min.(ANR)]}$$

V: Volume of actuator housing [L] ( V1 or V2 in Section 10 )

P: Air operation pressure [MPaG]

t: Time required per stroke [second] under 0.39MPa operation pressure, where no valve nor accessory is provided. ( Refer to **Table 1** )

ANR: Air supply volume under the standard condition of 20 ( 68 ° F ), 760mmHg absolute pressure and 65% relative humidity

**Table 1.**  
Time [t] required per stroke under 0.39MPa

Actuator type	Time[sec]
FBS-1	0.2

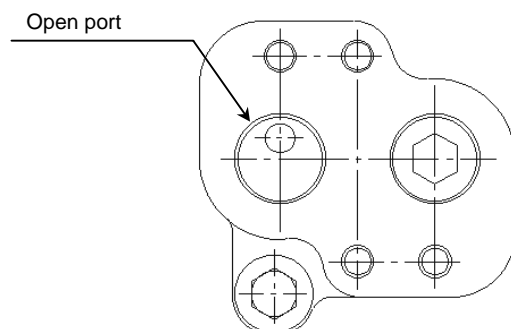


Fig2. Design of solenoid valve mounting pad( air inlet/outlet ports )



### 11. Air Consumption

Air consumption means the volume (Q) of the air released to the atmosphere from an actuator operating [n] times forward and backward per hour as converted to the average volume per minute. Decide the capacity of an air compressor using the result of the following calculation. We recommend to use an air reservoir of an adequate size to constantly operate an actuator at the preset time.

Air consumption of FBS actuator:

$$Q = V (P + 0.1013) / 0.1013 \times n / 60 \quad [\text{L/min. (ANR)}]$$

V: Volume of actuator housing [L]

Refer to **Table 2** and the illustration shown below.

P: Air operation pressure [MPaG]

n: Number of operation cycles per hour

**Table 2** Volume of actuator housing

Actuator type	V [L]
FBS - 1	0.15

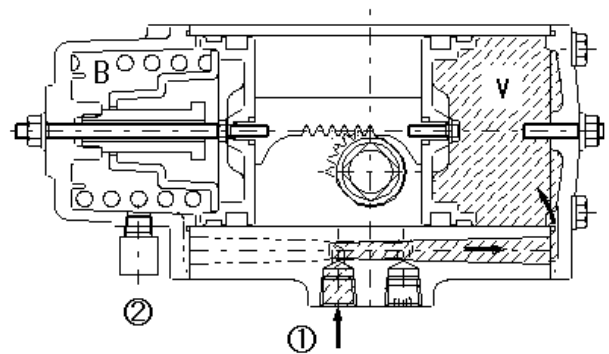





Fig3




 <b>CAUTION</b>	
	<ul style="list-style-type: none"> <li>● The required capacity of an air compressor depends on the availability and the volume of an air reservoir, the number of hourly operations, the time required for valve stroke and whether the air compressor is used exclusively or otherwise for the actuator.</li> </ul>
	<ul style="list-style-type: none"> <li>● To decide the practical capacity of air compressors and reservoirs, adding some extra 30% to the calculated air consumption volume is recommended to absorb possible loss of air caused during a travel through air tubing and accessories.</li> <li>● Use an air-filter to continually supply clean, dry air to an actuator.</li> <li>● Use plastic tapes for tightly sealing piping connection, ensuring that tape ends do not enter into the tube bore and block the port.</li> <li>● Also ensure that there is no leakage of air through all tubing connections. Insufficient supply of air pressure causes malfunction or failure of an actuator.</li> <li>● Appropriately design the total length of air tubing. Too long air tubing causes pressure loss or insufficient flow rate of the air, and results in malfunction or failure of an actuator.</li> </ul>

**12. Handling and Storage of Actuators and Actuated Valves**

12.1 Store actuators and valves in cool, dry, corrosion-free environment to keep them rust-free and prevent their malfunction, although surfaces are appropriately finished for primary protection.

12.2 Actuators and actuated valves are provided with dust protectors and packed individually for damage prevention. Don't unpack them and don't remove protectors until you are ready to install them on pipes.

12.3 Overloading actuators and valves must be prevented. Don't fall them on the ground. Don't place any other objects on them. Don't step on them.

 <b>CAUTION</b>	
	<ul style="list-style-type: none"> <li>● Actuators or actuated valves are individually packed and all openings and connections are sealed for dust prevention. Don't unpack them and don't remove protectors until you are ready to install them on pipes.</li> <li>● Modification of actuators or actuated valves is forbidden, unless accepted by KITZ Corporation or the authorized modification shops in advance.</li> </ul>
	<ul style="list-style-type: none"> <li>● Carefully handle actuators packed particularly in cardboard cases, since the cases might have become very fragile due to moisture and other causes.</li> <li>● Care must be taken to handle actuators equipped with solenoid valves and other accessories during storage or transportation.</li> <li>● Store actuators or actuated valves in cool, dry, corrosion-free environment to keep them rust-free and prevent their malfunction or failure.</li> </ul>

**13. Valve Opening Positions Set for Shipment**

KITZ ball valves equipped with FBS actuators are all shipped in the de-energized condition.

### 14. Adjusting Valve Opening Range

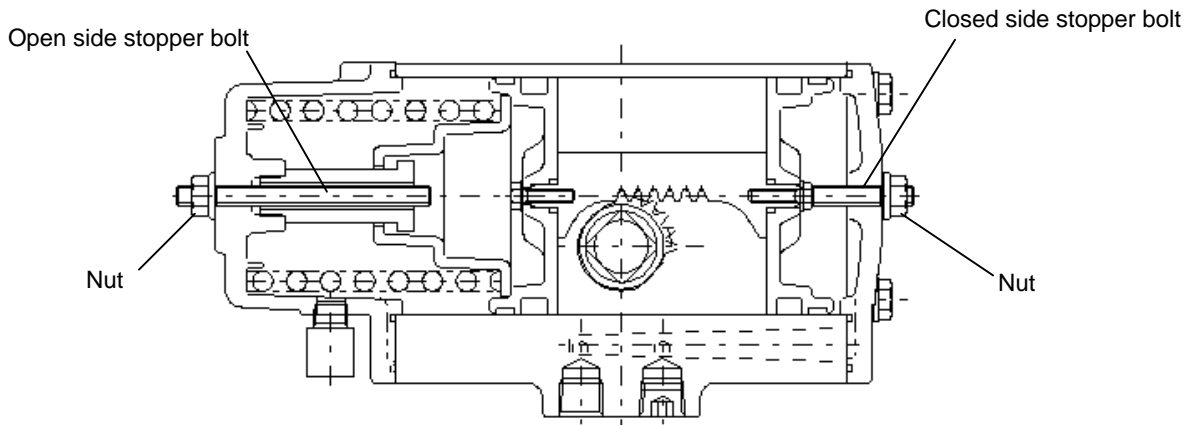


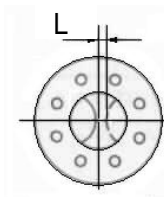
Fig 4

14.1 Release the compressed air from the actuator housing. Loosen a hexagon nut and adjust the position of either one of two stopper bolts illustrated above for your desired valve opening position. The dimensional requirements of ball valve balls ([L] in **Table 3**) must be satisfied. Refer to **Table 4** on the sizes of stopper bolts.

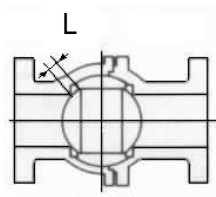
14.2 Clockwise rotation of the stopper bolt makes the valve operation range smaller, and counter-clockwise rotation makes it larger.

14.3 After having tightened the nuts, supply the compressed air to the port and check the valve opening range. Repeat this work until you have a satisfactory result

**Table 3: Adjustment for KITZ Class 150/300 full-bored floating ball valves (\*5)**



Half open from the fully closed position



Fully closed

Valve size (full-bore)		L [mm]
NPS	DN	
3/8 ~ 3/4	10 ~ 20	5.0
1 ~ 1 1/2	25 ~ 40	5.5
2	50	6.0

(\*5) In the case of 3-way ball valves, adjust the center of the ball bore so that it may align with the center of the valve end flange bore. During adjustment, you can monitor the work through either side opening of the valve end flanges.

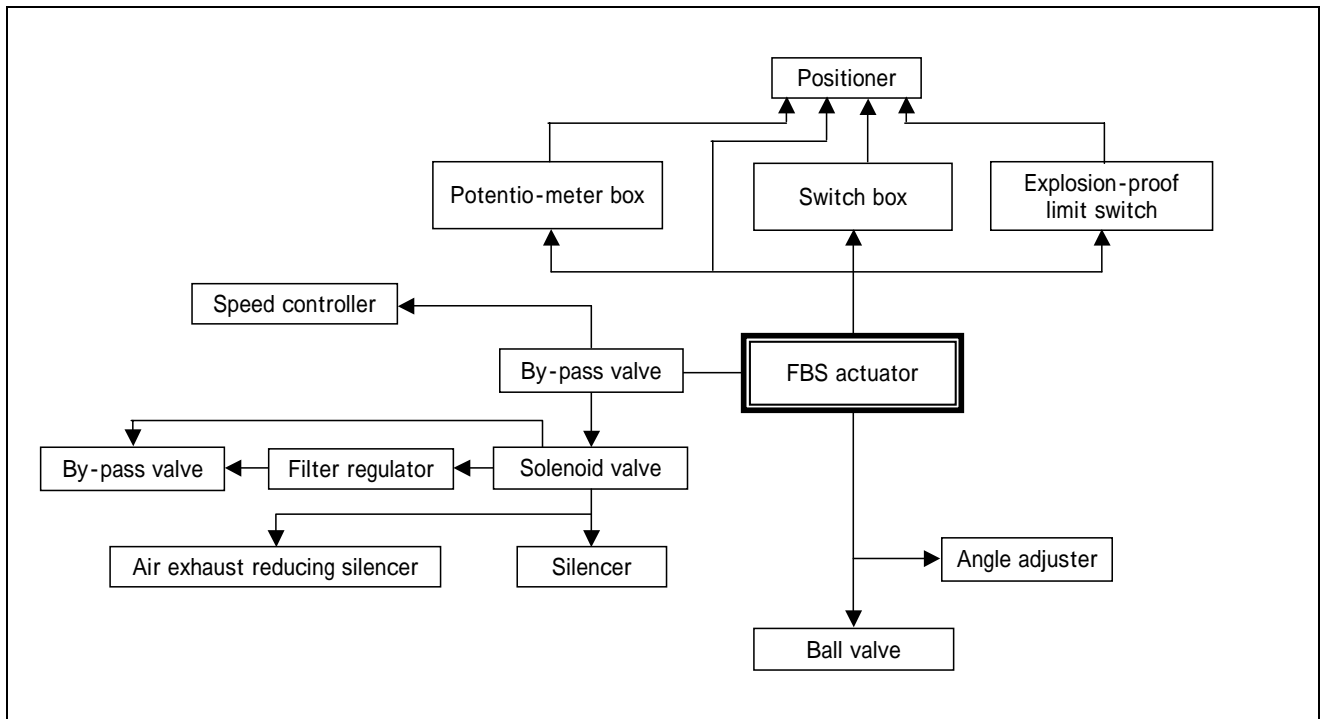
**Table 4: Size of stopper bolts (Hexagon socket set screws)**

Actuator type	Bolt size
FBS - 1	M6

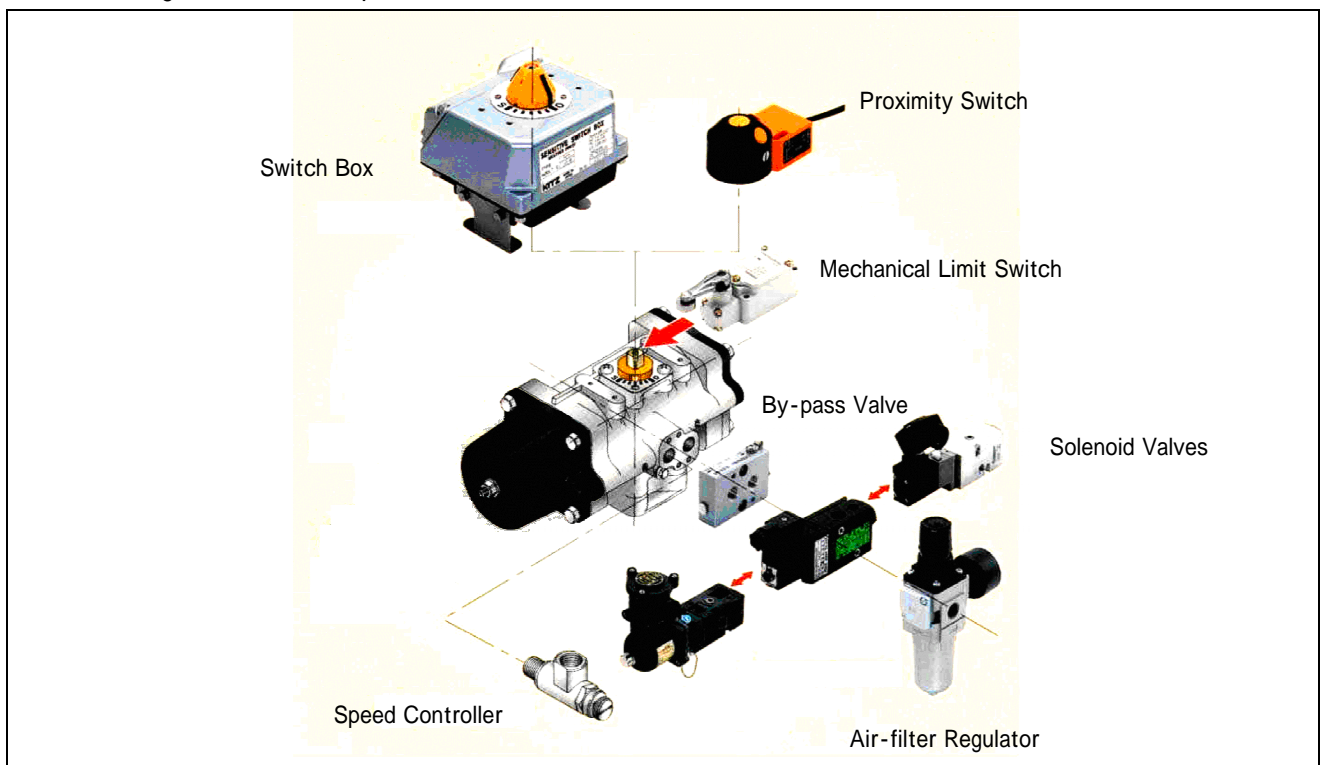
### 15. Mounting KITZ Optional Accessories on Actuators

KITZ FBS pneumatic valve actuator employs NAMUR dimensions for an accessory mounting pad on the top. Any NAMUR dimensioned solenoid valve can be directly mounted on the actuator without tubing. For detailed information on mounting KITZ optional accessories on FBS actuator, refer to the operating instructions provided for each optional accessory.

Mounting diagram of KITZ optional accessories



Mounting view of KITZ optional accessories



**Design specifications of KITZ optional accessories**

Accessories	Specification
NAMUR solenoid valves Explosion proof Weather proof indoor use Weather proof outdoor use	Power supply : AC100V / 110V 50 / 60Hz : AC200V / 220V 50 / 60Hz : DC24V Air inlets : Rc1/4 Maximum working pressure : 0.69MPa
Switch boxes With built-in sensitive switches  With built-in proximity switches	Switch boxes with built-in sensitive switches Resistive load : 11A AC125V / 250V : 0.5A DC125V : 0.25A DC250V Inductive load : 7A AC125/250V  Switch boxes with built-in proximity switches Power supply : DC10 ~ 36V Maximum output current ( instantaneous and continuous ): 200mA
Limit switches Weather proof Explosion proof	Weather proof : 10A - 125V / 250V / 480V AC : 0.8A - 125V / 0.4A - 250V DC Explosion proof : 5A - 125V / 250V / 480V AC : 0.8A - 125V / 0.4A - 250V DC
Proximity switch	Power supply : 20-250V AC / DC Switching current : AC350mA / DC100mA
Air filter-regulator	Working pressure : Inlet Max0.97MPa : Outlet Max0.39 ~ 0.69MPa Connection : Rc1/4
Speed controller	Connection : Rc1/4 Maximum working pressure : 0.97MPa
Silencer	Connection : Rc1/4 Maximum working pressure : 0.90MPa
Positioner	Connection : Rc1/4 ( Pressure gauge : Rc1/8 ) Supply pressure : 0.29 ~ 0.69MPa Signal pressure : 0.02 ~ 0.10MPa Signal current : 4 ~ 20mA Air consumption : 20NL/min.(Max.) [Supply pressure : 0.49MPa]
By-pass valve	Connection : Rc1/4 Maximum working pressure : 0.69MPa



## 16. Automated Operation of Actuators

16.1 KITZ FBS pneumatic valve actuator is operated with the standard air pressure of 0.39MPa , however, can be set for operation with minimum 0.29MPa and maximum 0.69MPa air pressure. Actuators equipped with air filter-regulators are set for operation with 0.39MPa.

16.2 Compressed instrumentation air ( or nitrogen gas ) is the standard operation medium. Use of air filters and air dryers are recommended to keep the air in the housing dry and clean for trouble-free operation of actuators.

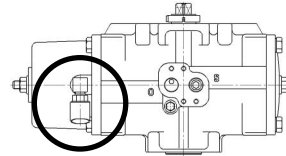
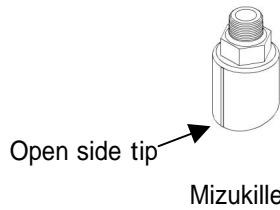
16.3 Check the following points during pilot operation of your actuators.

- (1) Check trouble-free function of an actuator by manually or automatically operating it a few cycles.
- (2) Check air leakage from the air tubing through a travel from a compressor to the actuator. If the operation mode of the equipped solenoid valve is changed from AIR-TO-OPEN to AIR-TO-CLOSE or vice versa, the gasket connection between the solenoid valve and its adaptor must be also checked for air leakage.
- (3) Check if a solenoid valve is provided with your required specifications.
- (4) Check if the operating pressure has been set with your required specification.
- (5) Check if an equipped air regulator has been set for your required operation pressure.
- (6) If a speed controller is equipped, adjust the flow rate of the exhaust air to match your required operation speed.

 <b>CAUTION</b>	
	<ul style="list-style-type: none"> <li>● Use either compressed instrumentation air or nitrogen gas for operation of actuators. Use of any other operating medium may affect the function of actuators.</li> <li>● Use of operation pressure exceeding 0.69MPa may damage actuators or accessories.</li> <li>● Keep the operation medium completely dry. High humidity causes rust and may result in malfunction or failure of actuators or accessories.</li> <li>● A part to avoid entering water into a spring case (“Mizukiller”) is installed on spring return type actuator’s breathing port. And The Mizukiller is sealed with a sticker. Remove the sticker before running automated operation. (For products shipped before December 2009, a cap is installed on spring return type actuator’s breathing port instead of the Mizukiller. Remove the cap before running automated operation. If the cap remains, actuator speed may become slow.)</li> </ul>

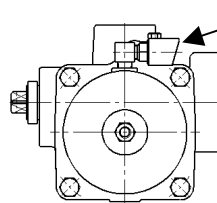
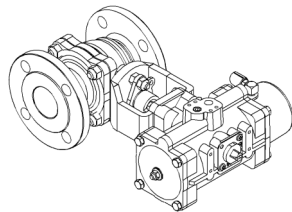
**⚠ CAUTION**

When Type FBS spring return actuator is used outside or wet condition, water may enter into a spring unit in some actuator orientation. Rotate a part avoiding entering water (“Mizukiller”) clockwise and set it adequate position that open side tip of Mizukiller shall be upward.



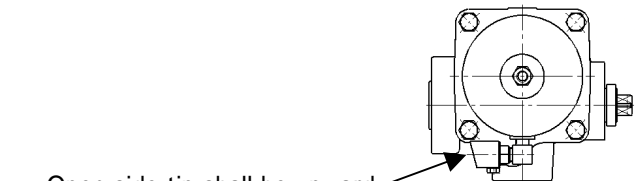
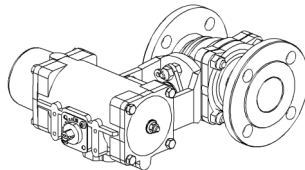
Nomal position of Mizukiller

(1) Actuator supply port faces upward.



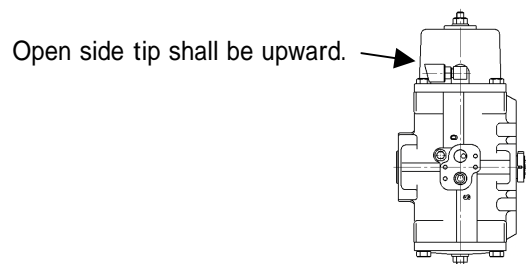
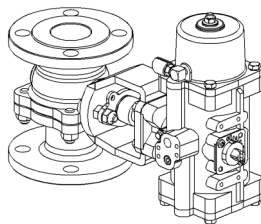
Open side tip shall be upward.

(2) Actuator supply port faces ground.



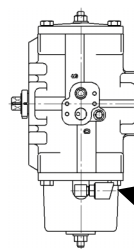
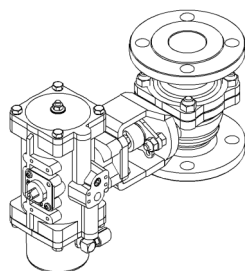
Open side tip shall be upward.

(3) Actuator supply port faces side and spring case is upward.



Open side tip shall be upward.

(4) Actuator supply port faces side and spring case is downward.



Open side tip shall be upward.



## 17. Manual Operation of Actuators

All KITZ optional solenoid valves are provided with a manual switch. Choose any one of the following solenoid valves for manual operation of the actuators being energized.

### **KOGANEI Model A180**

Keep pressing a switch with the tip of a screwdriver for manual operation. Removal of the screwdriver returns the actuator to the original automated operation mode.

### **CKD Model 4F310**

Rotate a knob for manual operation.

### **KANEKO Model MK15G**

Pull out a switch for manual operation.

### **ASCO SCXD551**

Set the position of a manual operation thread, with a screwdriver, to Position [O] of the indicator for manual operation. Set it to Position [1] to energize the actuator for automated operation mode.

## 18. Inspection and Maintenance of Actuators and Actuated Valves

- 18.1 Both actuators and actuated valves are designed for lubrication-free operation, and maintenance or replacement of parts and components is not usually needed, except consumable sealing materials.
- 18.2 If aging or highly frequent use has caused malfunction or failure of actuators or actuated valves, use KITZ genuine parts for replacement.
- 18.3 If actuators are equipped with air filter-regulators, periodically clean the bore of drain cocks to remove all internal residues.
- 18.4 Replace sealing materials such as O-rings and gaskets, if any leakage is detected through sealed connections of actuators and accessories.
- 18.5 If a lubricator is used, the quality of the lubricant must be appropriately controlled. We recommend use of Turbine Oil Class 1 ISO VG32, or the equivalent for refill.
- 18.6 Seal washers are used for cylinder's stopper bolts. Leakage may occur from the seal washers after long-term use. Then retighten nuts or replace seal washers.



18.8 Ensure to carry out the following inspections periodically. Do it as frequently as possible for safe and trouble-free operation of actuators and actuated valves.

Check the fully open or closed position of a valve.




Ensure that the valve opening or closing range is correctly maintained in accurate response to a signal currency or a signal pressure of actuators and accessories.

Check the air leakage through all air tubing connections and valves.

Check an abnormal noise generated from the air tubing or valves.

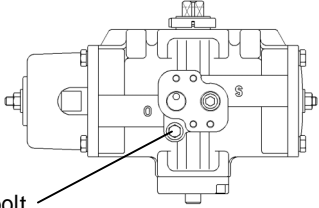
Check vibration of actuators and valves.

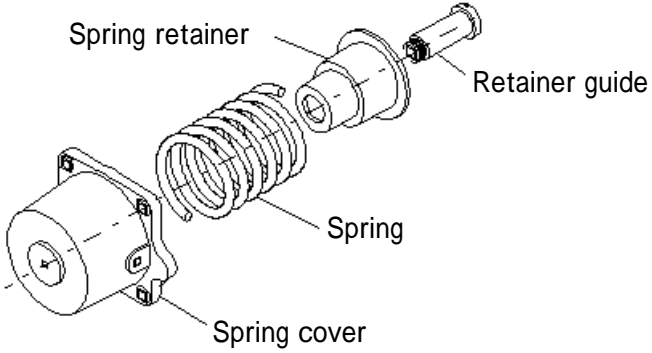
Ensure that all bolts and nuts are securely tightened.

 <b>CAUTION</b>	
	<ul style="list-style-type: none"> <li>● Don't use any spindle oil or gear oil for lubrication of actuators and accessories</li> </ul>
	<ul style="list-style-type: none"> <li>● An abnormal noise may be generated due to valve seat galling ( valve seats getting stuck with foreign objects ) or blockage of actuator air tubing caused by internal residues. Take corrective measures immediately, since damage of valve seats and malfunction of actuators and valves may be caused by negligence of such problems.</li> <li>● Ensure to replace terminals of electric devices, if needed, with those designed with the same specifications. Different design specifications could be a cause of technical troubles.</li> <li>● Leaving an abnormal vibration of actuators and valves also causes equipment failure. Support the piping system securely.</li> </ul>

### 19. Disassembly and Reassembly of Actuators

19.1 When you disassemble or reassemble these actuators for inspection or maintenance, the utmost care must be taken to respect the warnings and cautions mentioned here.

<b>⚠ WARNING</b>	
<b>!</b>	<ul style="list-style-type: none"> <li>● Before disassembly of spring cartridges from FBS actuator, evenly loosen all of 4 spring cover bolts ( but don't completely remove them from the cover ) and check if the spring has been released from the compression force and bolts can be rotated by hand.</li> <li>● If the spring cover bolts are found too tight to be rotated by hand, the spring still remains energized, possibly due to damage of the spring cartridge or the housing pressure remaining higher than the atmospheric level. In such a case, disassembly work must be immediately discontinued to prevent the spring cartridge from jumping out.</li> <li>● If you have a concern of damage of a spring cartridge, securely retighten spring cover bolts, and replace the actuator itself without removal of the spring cartridge.</li> <li>● Before disassembling, loosen the hexagon headed bolt under air port to depressurize the housing.</li> </ul> <div style="text-align: center;">  <p>Hexagon headed bolt</p> </div>

<b>⚠ WARNING</b>	
<b>⊘</b>	<div style="text-align: center;">  </div> <ul style="list-style-type: none"> <li>● A compressed heavy-duty spring is packed in a spring cartridge of FBS spring return actuator. Careless disassembly of the cartridge may cause the spring to jump out and result in damage of properties or injury of personnel. Don't loosen a retainer guide from the spring retainer.</li> <li>● Don't fall or step on a spring cartridge. Careless or rude handling may cause an unintended separation of the highly energized spring from the cartridge.</li> <li>● Don't remove an end cover from a pressurized actuator housing. Disassembly of any energized actuator is forbidden.</li> <li>● Don't use compressed air as the measure of disassembly of an actuator. A piston may hazardously jump out.</li> </ul>

## 19.2 Disassembly of KITZ FBS pneumatic valve actuator

- (1) Make the air pressure the same as the atmospheric level.
- (2) Gradually loosen all air tubing fittings and ensure that the housing pressure has been equalized with the atmospheric level. Dismantle an actuated valve from the pipeline and disassemble an actuator from the valve.
- (3) Unthread a hexagon headed bolt and a seal washer near the solenoid valve mounting pad. It is possible that piston O-rings are worn and cause air leakage and pressurize the interior of the housing. Therefore, before working on disassembly of an actuator, gradually loosen the hexagon headed bolt and check that the housing pressure has been equalized with the atmospheric level ( Fig.5 ).

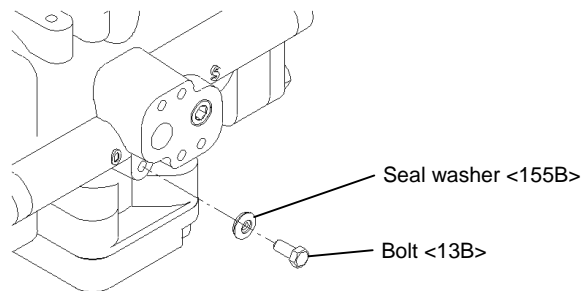


Fig.5

- (4) Remove a snap ring (with snap ring pliers), a position indicator, headed screws and an indicator plate (Fig.6).

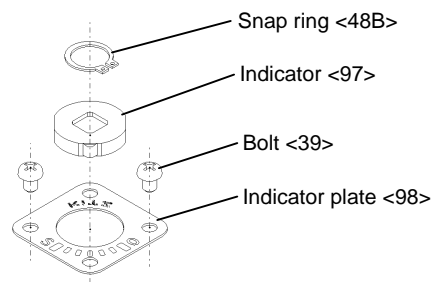


Fig.6

(5) Remove the cover from the housing (Fig.7).

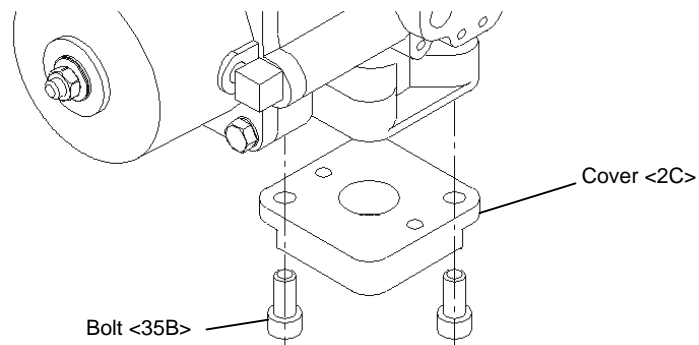


Fig.7

(6) Loosen bolts and remove the end cover and the spring unit. O-rings are placed inside the end cover and the spring unit (Fig.8).

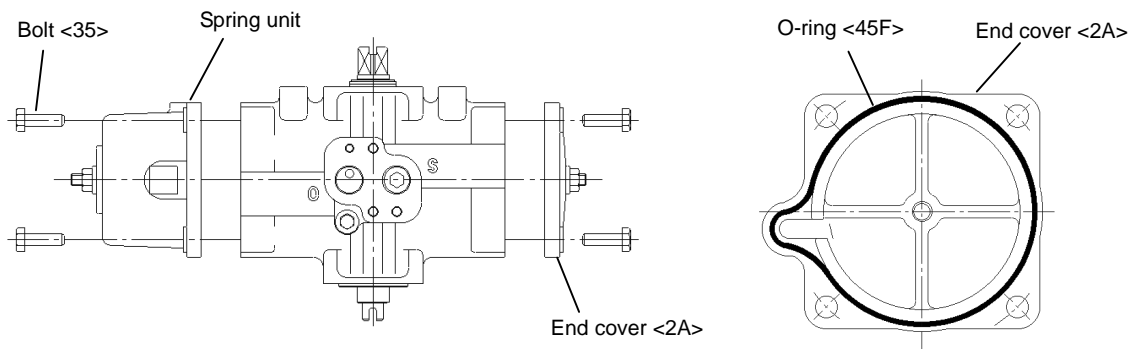


Fig.8

(7) Loosen a hexagon headed bolt and remove a piston from the housing, by picking an outside rib with pliers (Fig.9).

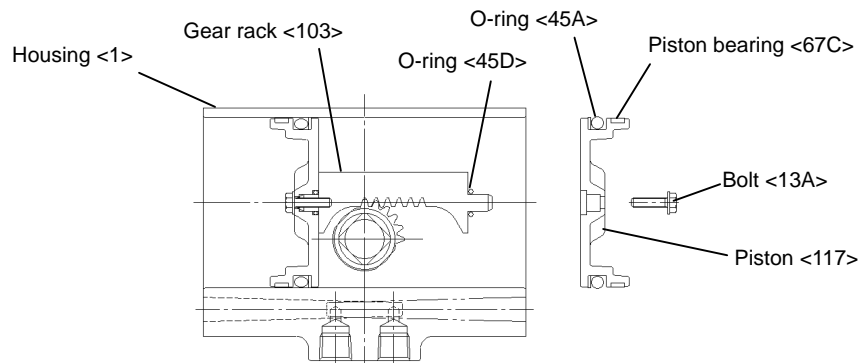


Fig.9

- (8) Rotate the shaft and move another piston toward the end cover opening. Loosen a hexagon headed bolt and remove the second piston from the housing. Also remove a gear rack (Fig.10).

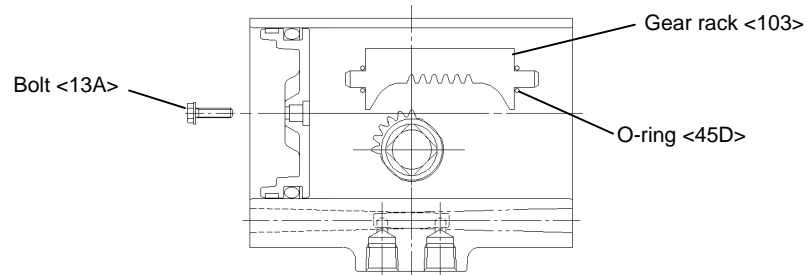


Fig.10

- (9) Remove a snap ring (with snap ring pliers), a thrust washer and a thrust bearing from the shaft (Fig.11).

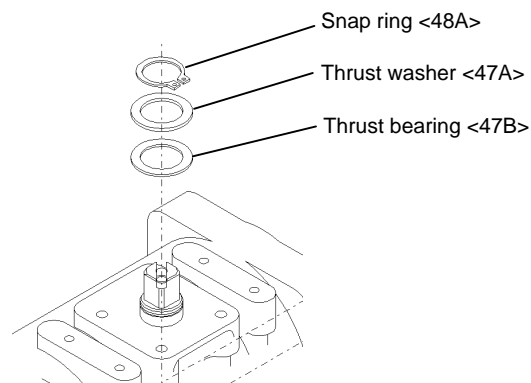


Fig.11

- (10) Remove the shaft slowly through the bottom of the housing, holding a pinion gear and a bearing by hand. Another bearing is removed together with the shaft (Fig.12) to complete disassembly of the actuator.

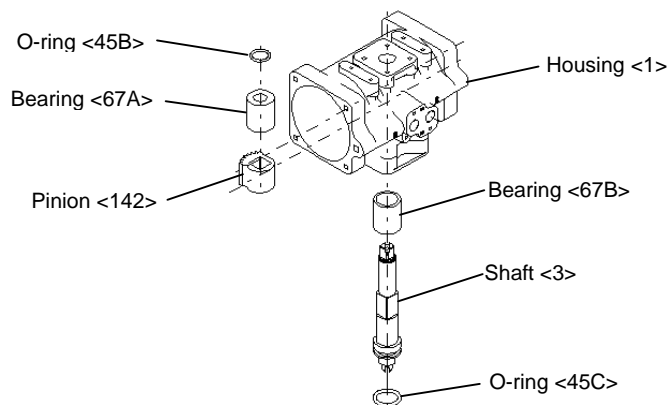


Fig.12

FBS spring return actuator is provided with a spring cartridge, in place of an end cover. Don't disassemble the cartridge unit internally holding a compressed heavy-duty spring.

19.3 Reassembly of KITZ FBS pneumatic valve actuator

- (1) Lubricate a larger O-ring, a smaller O-ring, a bearing, and a back-up ring with Kyodo Oil MULTEMP AC-J lubricant or the equivalent, and assemble them with the piston (Fig.13). Contact KITZ Corporation for advice, if this lubricant is not available.

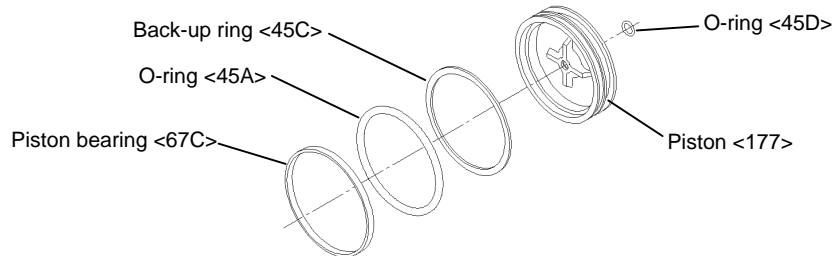


Fig.13

- (2) Lubricate an O-ring and a bearing, and assemble them with the shaft (Fig.14).

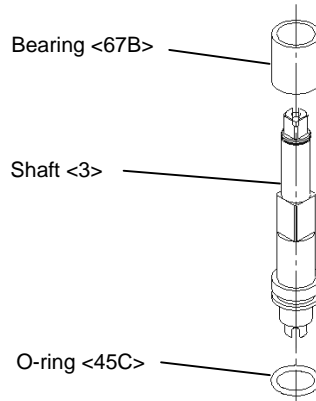


Fig.14

- (3) Lubricate an O-ring, a bearing, a pinion gear and the shaft, and assemble them with the housing (Fig.15). The pinion teeth and the NAMUR groove on top of the shaft must be positioned each other as shown in Fig.16.

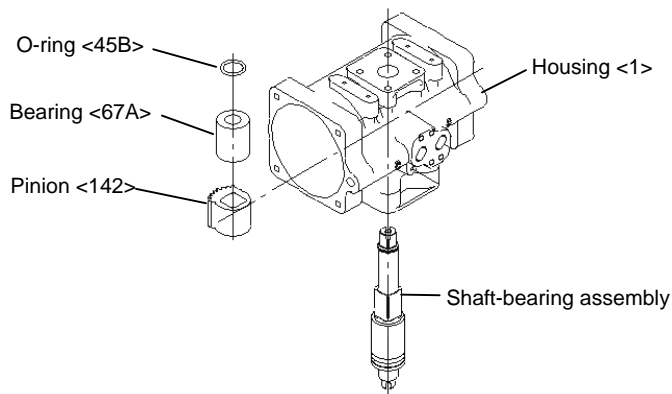


Fig.15

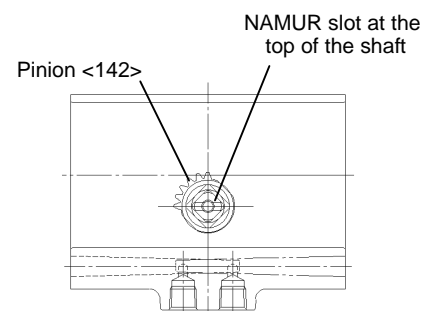


Fig.16

- (4) Lubricate the shaft assembled with the housing. Mount a thrust washer and a thrust bearing on the shaft securely with a snap ring (Fig.16).

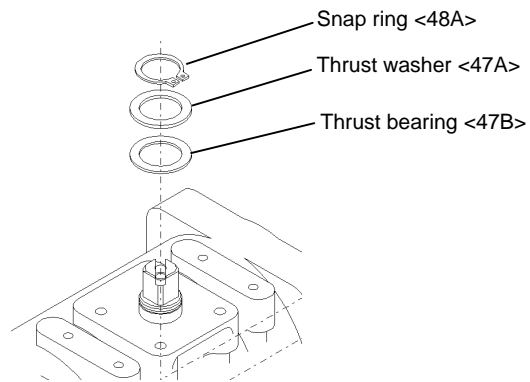


Fig.16

- (5) Assemble the cover with the housing (Fig.17).

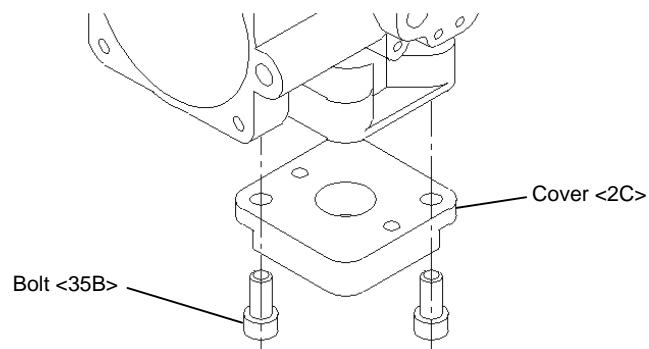


Fig.17

- (6) Lubricate the internal surface of the housing and assemble the piston ( complete with O-rings, a bearing and a back-up ring ) with the housing (Fig.18).

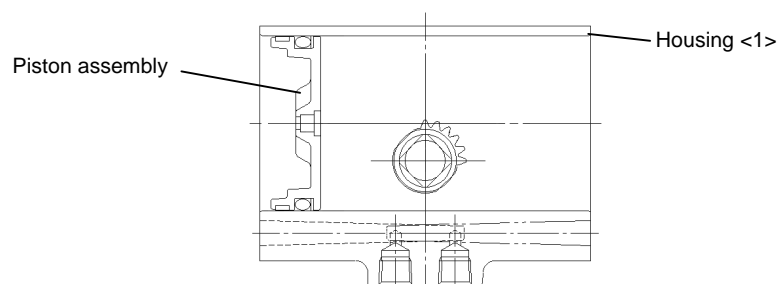


Fig.18

- (7) Lubricate the gear rack teeth and assemble it with the piston as follows: Mesh the first tooth of the pinion with the first space (bottom of tooth) of the rack, and insert the projection of the rack into the center hole of the piston. Temporarily assemble the piston and the rack with a hexagon headed bolt. Apply LOCKTITE No.262 or the equivalent to the bolt beforehand for secured assembly (Fig.19).

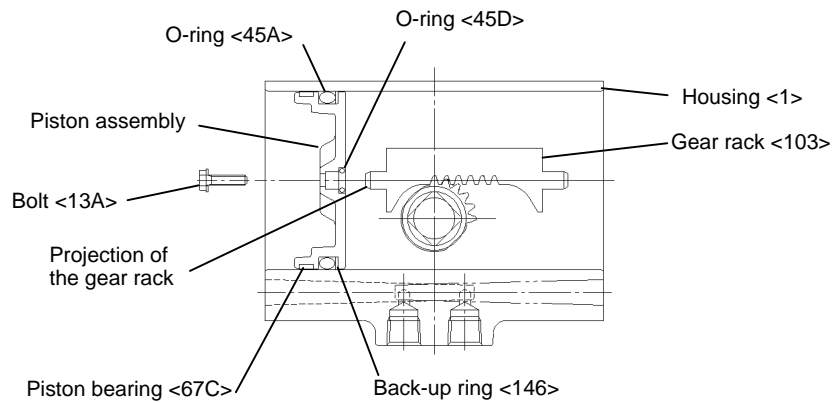


Fig.19

- (8) Assemble another piston with another projection of the rack. Securely tighten it with a hexagon headed bolt and a flat washer. Also at this time tighten the first piston and the first rack projection securely (Fig.20).

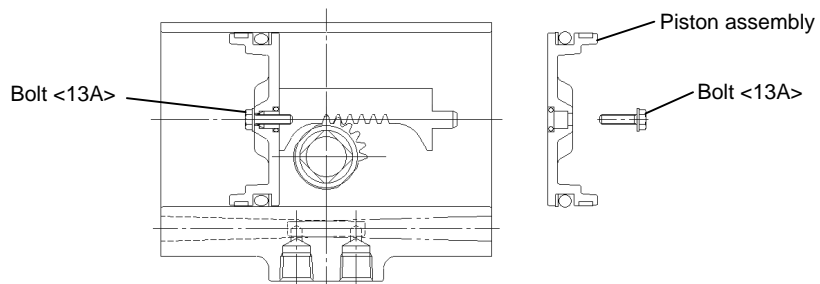


Fig.20



- (9) Mount the O-ring, stopper bolts, seal washers and nuts into the end cover and spring unit. Assemble the end cover and spring unit assembly into the housing (Fig.21). The threading torque values are provided in Table 3.

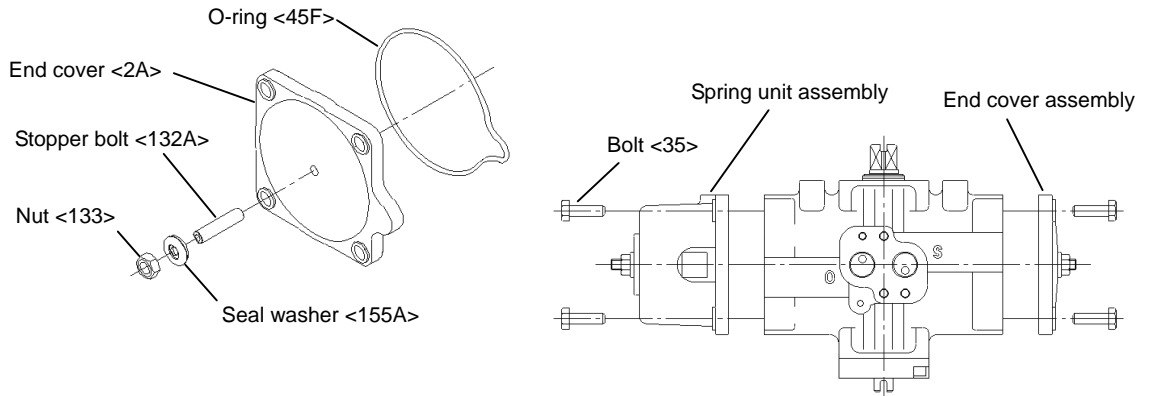


Fig.21

- (10) Adjust the shaft rotating angle (valve opening range), according to Section 14 of this manual.

- (11) Check the leakage of air from an actuator with soap solution, according to the following procedures:

Apply the operating pressure to Port [O] and check if any external air leakage is detected through the contact of the housing with the end cover, the stopper bolt and the seal washer in the right-hand side ( Fig.22 ).

Cover the leak detecting hole below the solenoid valve mounting pad with a soap film, and check if any air leakage is detected there during a travel of the piston. Don't apply the soap film directly to the opening, since the soap may penetrate inside the housing and cause malfunction of an actuator.

Leak test should be done after 15minuits to 30minuits past since pressurizing actuators.

If not, internal air residue remains and the leak test cannot be done with accuracy.

Wipe off all soap solution afterwards.

If any leakage has been detected, disassemble the actuator again to check if any part or component is scratched, deformed or worn, and replace them, if necessary, with KITZ genuine parts.

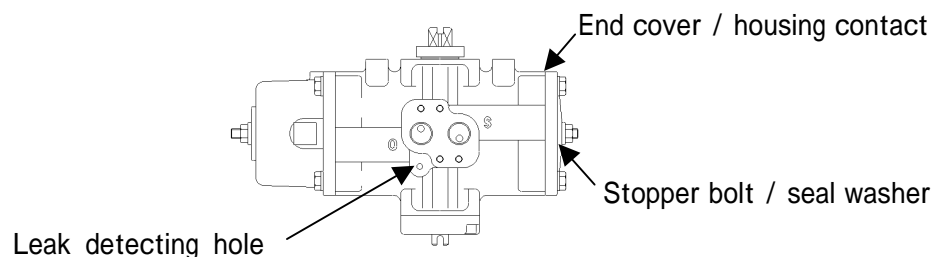
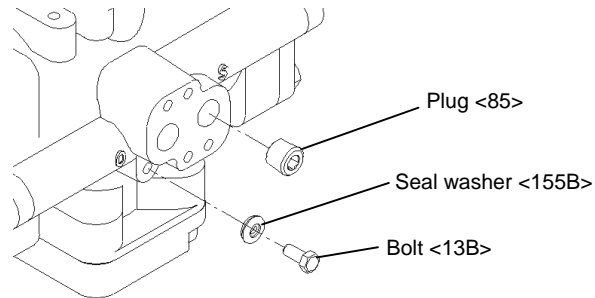


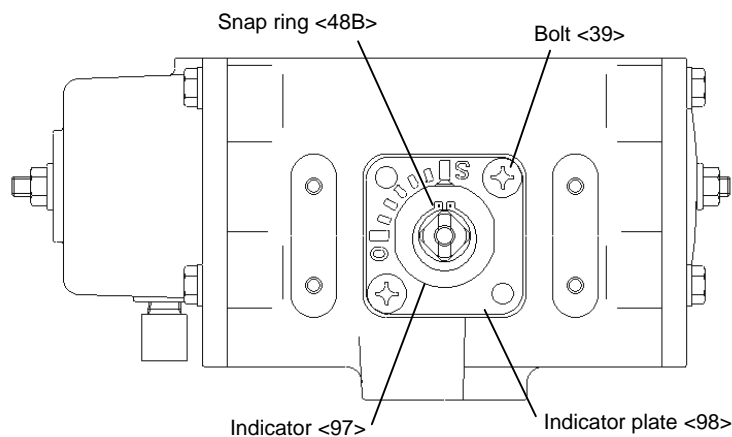
Fig.22

- (12) Plug the leak detector hole with a seal washer and a hexagon headed bolt, to complete reassembly of an actuator ( Fig.23 ).



**Fig.23**

- (13) Mount an indicator plate on top of the housing with two headed screws so that Mark [O] may point (a) the left-hand of the housing for ball valves, or (b) the air inlet/outlet ports for butterfly valves as shown in Fig.24. After checking correct mounting of the indicator plate, assemble a position indicator through the shaft securely with a snap ring.



**Fig.24**

- (14) Check trouble-free operation of reassembled actuators and mount them on valves.

- (15) Insert Mizukiller on a breathing port of a spring case.

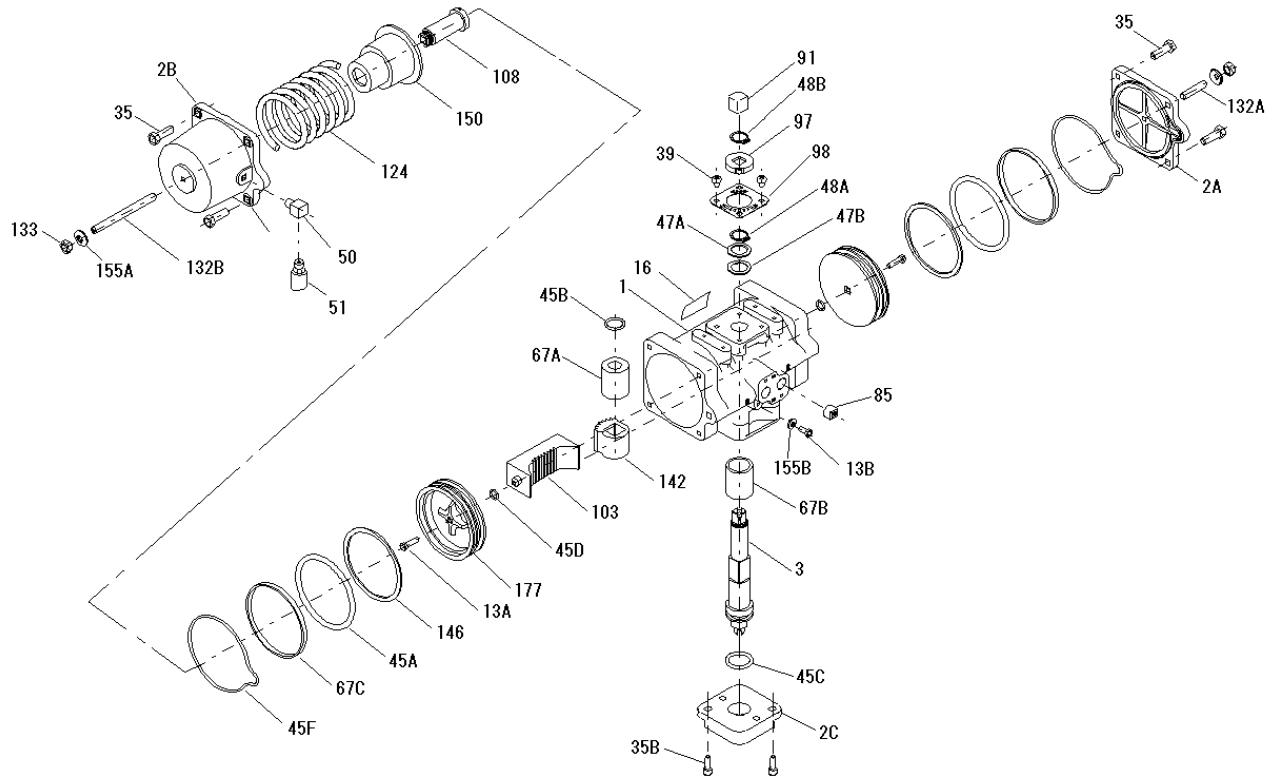
**19.4 Bolt tightening torque**

All bolts and screws shall be securely tightened with the torques recommended below:

**Table.5 Recommended bolt tightening torques**

		Thread size	Threading torque values [N·m]
Piston / rack assembly	Bolt <13A>	M5	4 ~ 5
End cover / spring cover mounting	Bolt <35>	M6	10 ~ 12
Opening range adjuster bolt	Nut <133>	M6	3 ~ 5
Leak detector hole plugging	Bolt <13B>	M5	2 ~ 5

19.5 Construction details and list of parts  
FBS-1



**Materials**

Part No.	Description	Material	ASTM
1	Housing	Aluminum die-cast	B85-84-383.0
2A	End cover	Aluminum die-cast	B85-84-383.0
2B	Spring cover	Aluminum die-cast	B85-84-383.0
2C	Cover	Aluminum die-cast	B85-84-383.0
3	Shaft	Carbon steel	A181 Gr.1
13A	Bolt	Stainless steel	A193 Gr. B8
13B	Bolt	Stainless steel	A193 Gr. B8
16	Name Plate	Polyethylene	—
35	Bolt	Stainless steel	A193 Gr. B8
35B	Bolt	Stainless steel	A193 Gr. B8
39	Bolt	Stainless steel	A193 Gr. B8
45A -D, F	O-ring	NBR	—
47A	Thrust washer	Stainless steel	A276 Type 430
47B	Thrust bearing	PTFE	—
48A	Snap ring	Stainless steel	A167 Type 304
48B	Snap ring	Stainless steel	A167 Type 304
50	Breathing plug	Brass	B16
51	Mizukiller	Resin (POM)	—
67A	Stem bearing	Bronze	B62 or B584 No.C83600

Part No.	Description	Material	ASTM
67B	Stem bearing	Bronze	B62 or B584 No.C83600
67C	Piston bearing	PTFE	—
85	Plug	Carbon steel	A307 Gr. B
91	Shaft cap	PVC	—
97	Indicator	Nylon	—
98	Indicator plate	Aluminum	B209 Gr. 1060
103	Gear rack	Aluminum die-cast	B85-84-383.0
108	Retainer guide	Brass	B16
124	Spring	Carbon steel	A228 or ANSI 9260
132A	Stopper bolt	Stainless steel	A193 Gr. B8
132B	Stopper bolt	Stainless steel	A194 Gr. 8
133	Nut	Stainless steel	A194 Gr. 8
142	Pinion	Sintered metal	—
146	Back-up ring	PTFE	—
150	Spring retainer	Aluminum die-cast	B85-84-383.0
155A	Seal washer	NBR + Stainless steel	—
155B	Seal washer	NBR + Stainless steel	—
177	Piston	Aluminum die-cast	B85-84-383.0

**20. KITZ Standard Spare Parts for KITZ FBS Actuators**

## FBS actuator standard spare parts

Description		Part No.	FBS-1		
			Part number	Size	Quantity
O RING	Piston	45A	8710-0060-00	P60	2
	Shaft	45B	8710-0016-00	P16	1
	Shaft	45C	8710-0021-00	P21	1
	Gear rack	45D	8710-0009-00	P9	2
	End cover	45F	87B0-0075-00	S75	2
Thrust bearing		47B	8620-1612-40	—	1
Piston bearing		67C	8632-1101-40	—	2
Back-up ring		146	8730-0060-80	P60	2
Seal washer		155A	6360-9811-01	M6*16	2
Seal washer		155B	6360-9811-02	M5	1

## 21. Trouble Shooting

Detected Troubles		Causes of Troubles	Remedial Measures
Troubles with Actuators	Disturbed supply of air pressure	Malfunction or insufficient capacity of compressors	Check/repair of compressors; check/repair of tubing systems
		Air leakage from tubing between compressors and actuators	
		Air flow disturbed by foreign objects within tubes; Too small tubing sizes; Pipe damage or freezing	Check/repair of tubes
		Defective regulators	Repair/replacement of regulators
	No activation of actuators under full air pressure	Foreign objects stuck with valve seats	Disassembly/maintenance/repair of valves
		Excessive raise of valve operating torque	Disassembly/maintenance/repair of valves; Increase of operating pressure (Max 0.69 MPa, 100 psi)
		Excessively throttled speed controllers	Readjustment of speed controllers
		Rejective actuators	Repair/replacement of actuators
Troubles with Solenoid Valves	No Activation of energized solenoid valves;	Breaks of electric circuits	Check/repair of electric circuits
		Defective electromagnets	Check/adjustment of voltage; replacement of coils
	Unusual noise	Water intrusion into electromagnets or terminals	Water prevention; replacement of coils
		Inadequate voltage	Check/adjustment of voltage; Check of solenoid valve specs; replacement of coils
	Excessive temperature raise	Foreign objects stuck in solenoid valve interior	Disassembly/cleaning/replacement of solenoid valves
	Excessive leak from exhaust ports of solenoid valves	Worn piston O-ring; Foreign objects stuck to piston O-rings	Disassembly/cleaning of actuators; Replacement of O-rings
		Worn seating parts of solenoid valves ; Foreign objects stuck to sealing parts of solenoid valves	Check/replacement of solenoid valves

## 22. Notes to users

This manual covers the normal use of the product as a general guide to users, but does not necessarily cover every condition or situation that may be caused to users while they use the product. If technical assistance beyond the scope of this manual is required, users are recommended to contact KITZ Corporation or the distributors in their locations.

Numerical limits given in this manual such as operating pressures and service temperatures are specified in consideration of safe and trouble-free operation of the product. It is forbidden to use the product in any condition that may exceed such numerical limits.

Drawings and illustrations of the product in this manual provide users with only the basic information. Ask KITZ Corporation or the distributors for detailed assembly drawings of the products, if needed.

## 23. Product Warranty

Failed or damaged products shall be repaired or replaced at no cost to users, if the failure or damage occurred within 12 months after pilot operation, but not exceeding 18 months after shipment from KITZ factories, and the following conditions are satisfied:

- (1) The product has been correctly handled, stored, installed, operated and maintained according to this manual within the scope of design specifications and service conditions of the product.
- (2) The product has not been modified by any party other than KITZ Corporation or its authorized modification shops.
- (3) The product function and performance has not been deteriorated by aging.
- (4) The product has not been damaged due to an act of God or a natural disaster.

## 24. Emergency Call for Technical Assistance

Should users need to contact KITZ Corporation, its distributors or its authorized service shops on technical problems of the products, they are recommended to inform the following:

KITZ product code and size

In-site service conditions such as the kind and conditions of the fluid, the line pressure range and cycles, and the line temperature range and cycles

Frequency of operation and any other functional conditions

Environmental conditions for piping installation

Source of supply

Arrival date of shipment and date of pilot operation