CKD

SM-10806-A/1

INSTRUCTION MANUAL

EXPLOSION PROOF VALVE

AB41E4 · AG4 $\begin{matrix}1\\3\\4\end{matrix}$ E4−Z

- Please read this instruction manual carefully before using this product, particularly the section describing safety.
- Retain this instruction manual with the product for further consultation whenever necessary.

CKD Corporation

Thank you very much for purchasing the CKD's explosion proof type MULTILEX VALVE "Direct drive series AB41E4-Z, AG4 $\frac{1}{3}$ E4-Z.
4

This explosion proof type MULTILEX VALVE is so designed to operate at such places usually not allowed to use due to existence of combustible gas or vapor of flammable liquid (explosive gas).

This INSTRUCTION MANUAL deals with the basic items regarding the installation, operation, maintenance, etc. required for bringing the efficiency of the MULTILEX VALVE into full play.

You are requested to thoroughly read through this INSTRUCTION MANUAL before using the valve, and to perform correct operation and maintenance.

CONTENTS

1. OUTLINE

This explosion proof type MULTILEX VALVE (hereinafter called as solenoid valve) is a direct drive type 2 - and 3- port solenoid valve used under such dangerous places as classified as 1st grade (*1) and 2nd grade(*2) danger.
This kind of explosion proof construction is considered as a withstanding pressure type explosion proof construction of grade 2 explosion and degree 4 ignition.
The symbol for this type is d2G4.
Since this solenoid valve is of an explosion proof construction, this has received the certificate from TECHNICAL INSTITUTION of INDUSTRIAL SAFETY; JAPAN.
The approval No. is marked on the cap of terminal box.

Note : Refer to 4-3 on page 21 for *1, *2.

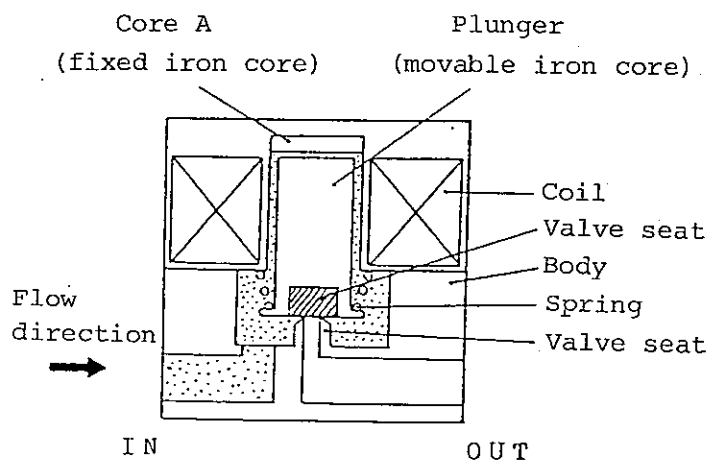
2. CONSTRUCTION OF SOLENOID VALVE AND PRECAUTIONS

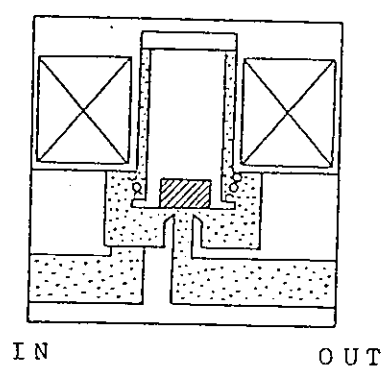
2-1 Construction

The solenoid valve is composed roughly of the actuator section (the section applied explosion proof construction) and the body section (a section where contacts with fluid.). The actuator section is composed of the solenoid and the bonnet case and terminal case which protect the solenoid, and the body section is composed of the core assembly, the plunger (movable iron core) and the body. As to the control of fluid, the coil excited makes the plunger activate and the valve seat incorporated directly in the plunger controls the fluid.

- Principles of Operation

(1) 2-way valve (Open when energized)





- De-energized

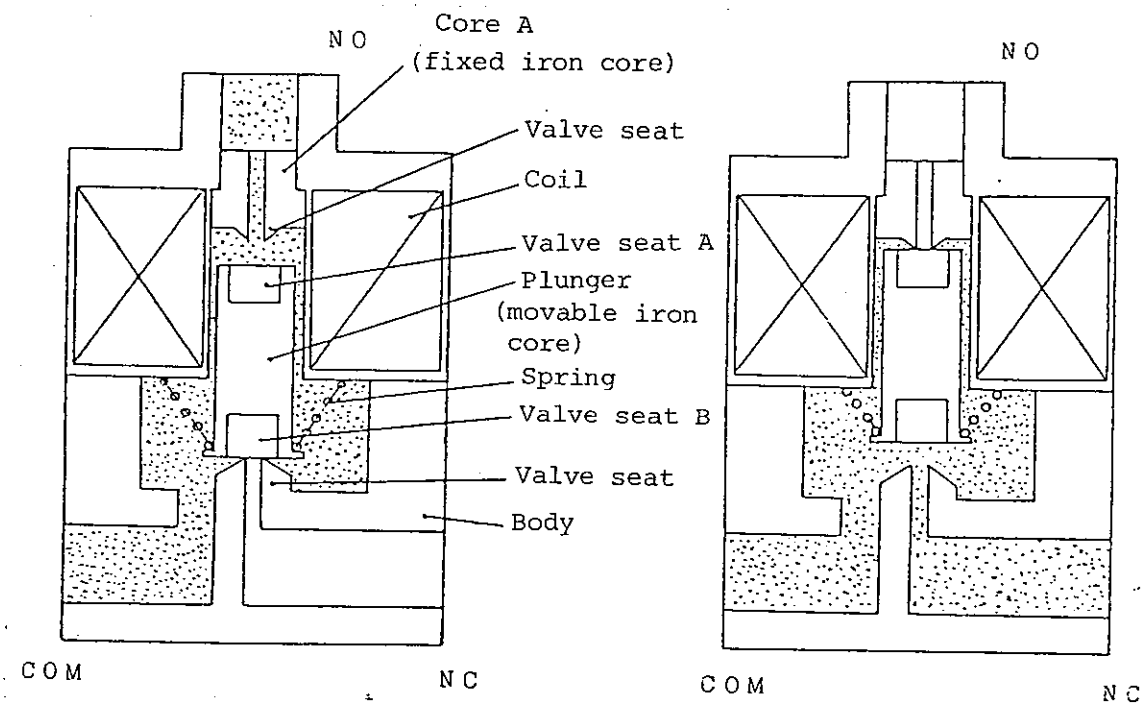
The plunger (movable iron core), under the condition that the coil for solenoid valve being not energized, is pushed down to the valve seat of the body due to the spring force. So the fluid pressurized from the IN port does not flow into the OUT port.

- Energized

As the coil for solenoid valve is energized, the plunger (movable iron core) is absorbed by the core A (fixed iron core), and thus the fluid pressurized by the IN port flows into the OUT port.

(2) 3-way valve (Open when energized)

There are three types of 3-way valve; namely universal type, normally closed type and normally open type. Here described is an universal type.



- De-energized

  The plunger (movable iron core) is pushed against the body side due to the spring force, to close the valve seat on the body side. Therefore the fluid flows out to NO when COM is pressurized, flows out to COM when NO is pressurized, or stops at the valve seat when NC is pressurized.

- Energized

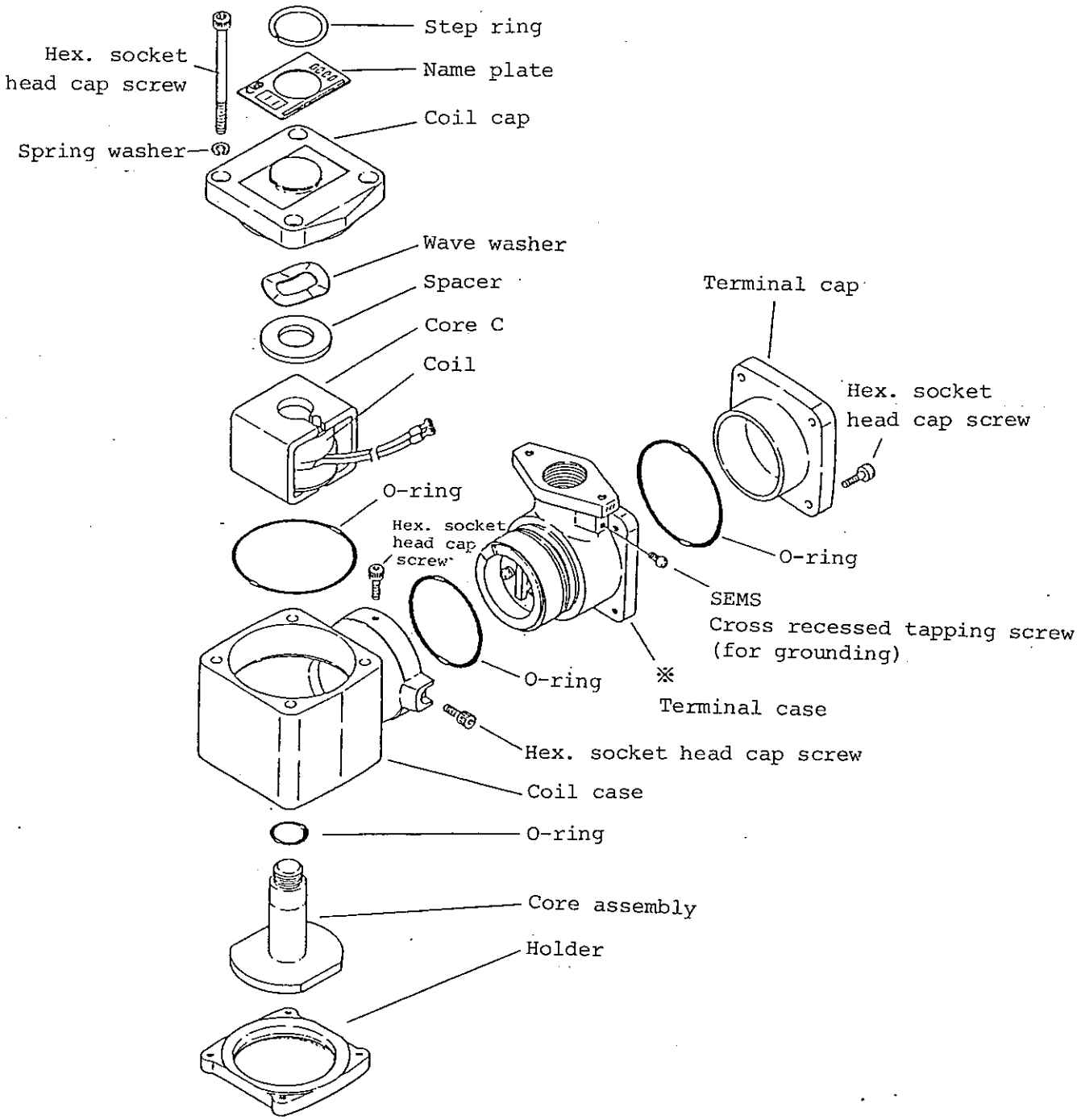
  As the coil is energized, the plunger (movable iron core) is absorbed to the core A (fixed iron core). Then the valve seat on NO side closes and the valve seat on body side opens. Therefore the fluid flows out to NC when COM is pressurized, stops at the valve seat when NO is pressurized, or flows out to COM when NC is pressurized.

Mechanism of this valve is nothing different than ordinary direct drive type solenoid valve.
But this type is of explosion proof type, the protection of solenoid in the actuator section is more rigid.

o Major parts

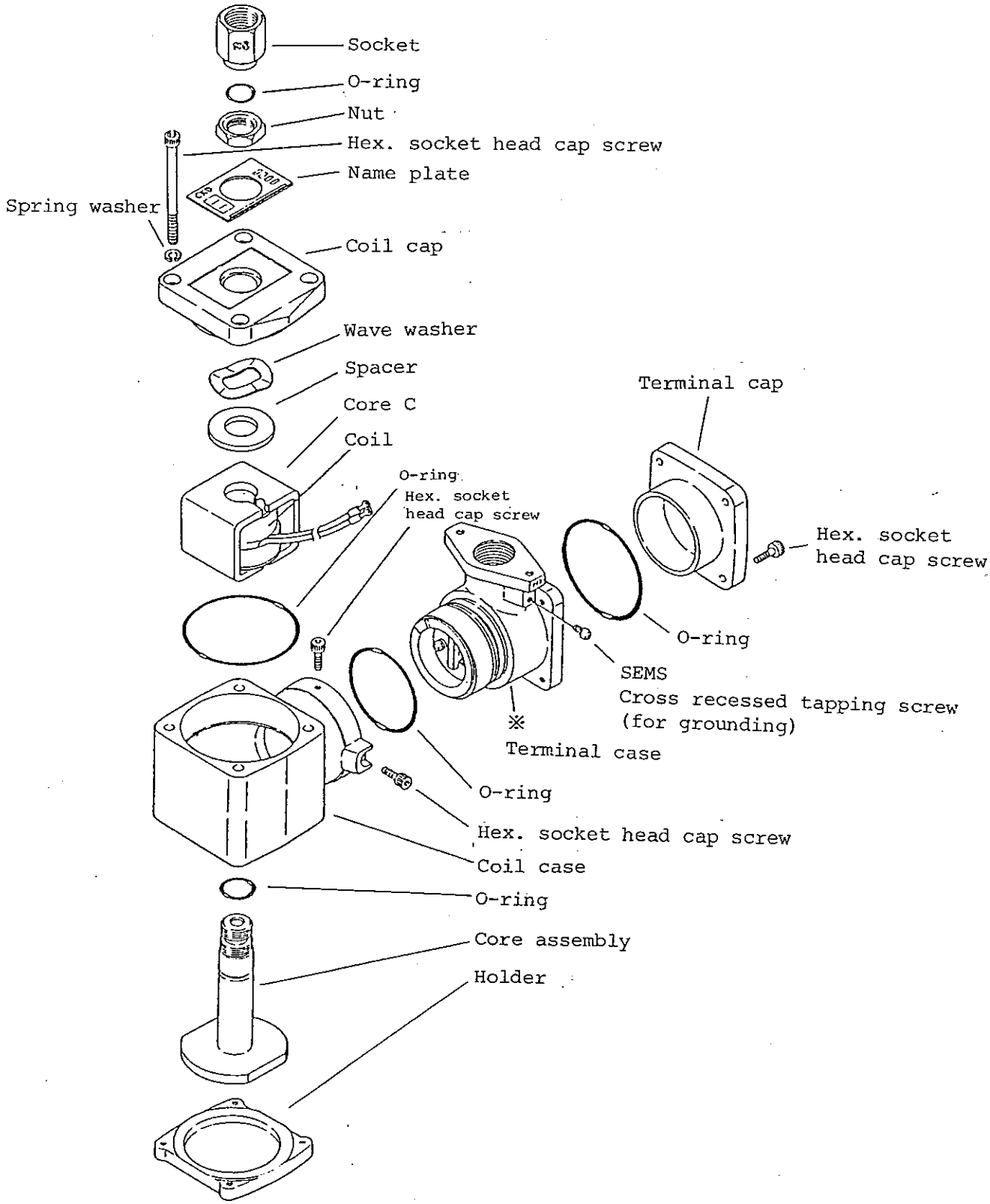
(1) 2T type (2-way valve)

The * marked parts shall be changed for G type.



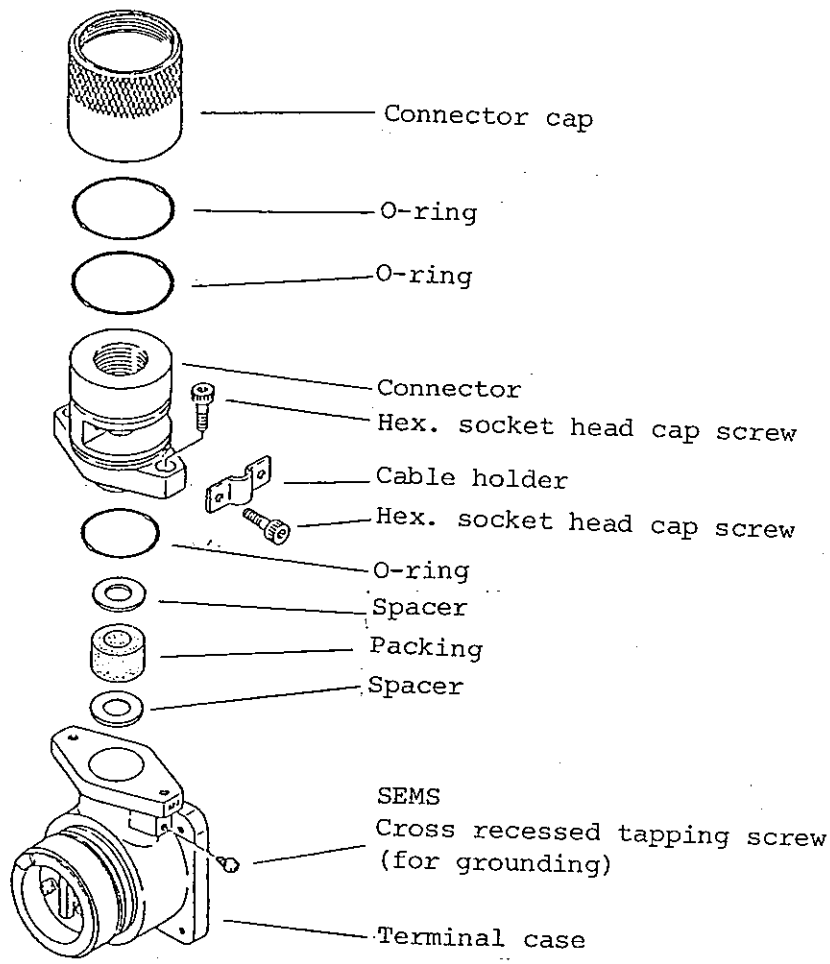
(2) 3T type (3-way valve)

The * marked parts shall be changed for G type.



(3) G type

The construction of G type is common to both 2-way valve and 3-way valve. The terminal case section is different from T type.

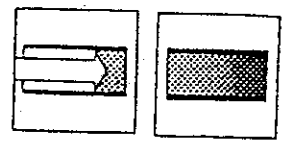


The construction of this valve adopts the high reliability withstanding pressure type explosion proof construction in accordance with the guide to factory electrical facility explosion proof.
This construction prevents ignition to the explosive gas entered from outside, in case spark is produced by short circuit during operation of solenoid, terminal connections, etc.
Also coil cap for maintenance and inspection, terminal cap for ease of wiring work, etc. can be loosened from outside. And yet necessary parts for keeping the explosion proof performance such as bolts are tightened with spring washers to prevent it from rotating. Those can not be loosened by a driver, a spanner, or a plier since special clamping mechanism is adopted. To loosen this bolt, it means that the explosion proof performance will also be lost. Do not anyone touch these clamped bolts but authorized person.
Also the method for conductor lead in is very important, we at CKD adopts the withstanding pressure stud type lead in system for leading in the conductor to the body from the terminal box.
The connection terminals are stored in the terminal box with sufficient explosion proof. In addition, a lead in system to the terminal box of external conductor is of conduit tube screw connection system.
Name plate attached on the terminal cap of the terminal box shows d2G4. This shows the range of explosive gas contained in the air and that this is for factory use. This can not be used at the coal mine or on the ship.

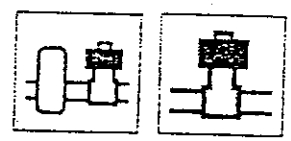
2-2. Precautions

Be careful of the following points before using the solenoid valves.

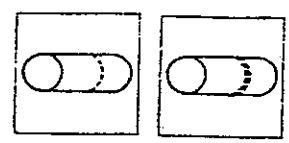
- Before piping, carry out flushing with 3kgf/cm^2 air pressure to remove dusts, metal chips, seal tapes, rusts completely.



- Quality of the fluid, and dusts, foreign materials included in the fluid greatly affect the function of the solenoid valve. So install a filter for air.



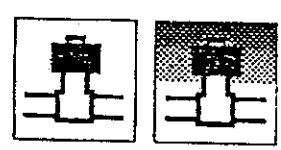
- Excessive use of sealing material for piping (seal tape, jelly type sealing material,etc.) may cause inclusion inside the solenoid valve, which may interfere normal function of the valve.



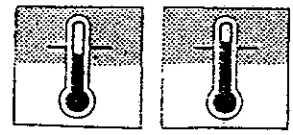
- Installation of bypass circuit will ease maintenance and repairing work.

- Adoption of switching circuit with no contact point chattering prolongs the life of solenoid valve.

- Do not use the valve in the place where corrosive gas is included in the air. However the corrosive gas can be shut out depending upon the material used. So consult us for it.

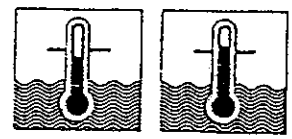


- Use on condition that surrounding temperature is below 45°C.

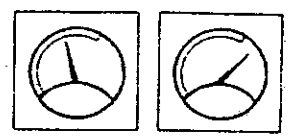


- The use of a valve under the condition that it may freeze, protect it with an insulating material or install a heater to the piping.

- Fluid temperature should be below 45°C.



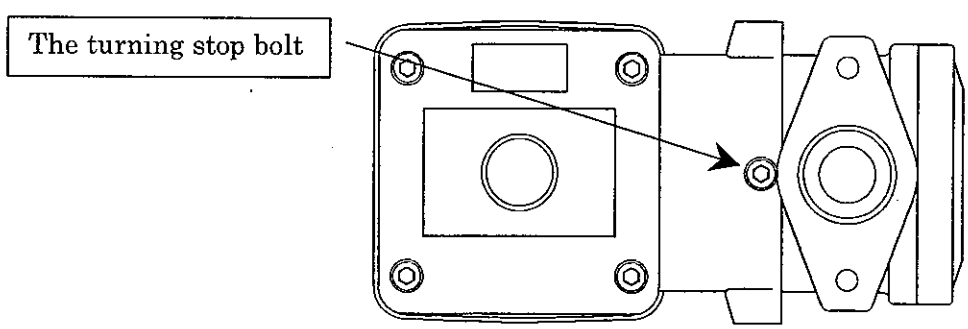
- Use below the rated pressure.
  If used above the rated pressure, it may cause malfunction. And it may extremely shortens its life.



- Use Within the voltage fluctuation range.
  If used beyond the range, it may cause defective movement or coil burning.

- The solenoid coil used here is a continuous rating. So the solenoid valve can be continuously energized. In that case, surface temperature of coil becomes high and if touched, you can feel it. But it is nothing wrong with the solenoid valve.

- The turning stop bolt used should be tightened to the torque of 0.6 to 0.8 Nm.
  The turning stop bolt, if loose, may fall off during operation.
  Also, terminal box turning may cause damage to the rotating portion and lead to internal wiring disconnection.
  Avoid loosening other bolts than the turning stop bolt; otherwise the explosion protecting performance may be unable to be guaranteed.



3. MAINTENANCE AND INSPECTION

3-1 Periodic Inspection

Execution of periodic inspection once or twice a year is the best way to prolong the life of the solenoid valve. Following cases may disturb smooth operation and shorten its life.

(1) change in quality of fluid under use,
(2) rust in the pipe,
(3) oxidized oil, carbon, tar in the compressor, and
(4) adhesion of dusts, foreign materials in the valve.

3-2 Cautions for Maintenance and Inspection

ALWAYS keep the following in mind when carrying out maintenance and inspection works.

(1) To dismantle or disassemble the solenoid valve from the line, be sure to turn the power off and purge fluid and pressure.
(2) In case of disassembly of the explosion proof construction solenoid valve, the clamping section of coil case has to be loosened. If such necessity arises, disassemble the valve with a CKD engineer attended.

However "maintenance of explosion proof construction electrical facility" stipulated by the Guide to factory electrical facility explosion proof is attached. Please refer to it.

4. REFERENCE INFORMATION

4-1 5000 Maintenance of Explosion Proof Electrical Facility

5100 General items

5110 Applicable range

This section is applied to the maintenance of the electrical facilities described below and the environment such facilities are used.

(1) The electrical equipment and wirings used at a danger place.

(2) Electrical wiring for related equipment and circuit used at non danger place.

(3) The protective devices essential for keeping the explosion proof ability of the electrical facilities used at a danger place.

However even if a work to be carried out is a general type of maintenance, this section is applied if the work is related to the explosion proof of electrical facilities in some way.

(Explanation)

(1) This section stipulates the maintenance related to explosion proof of electrical facilities. This does not include mere inspection, service and repair for maintaining the function of electrical facilities. As for maintenance of oil explosion proof construction electrical equipment, there is not much information available.

(2) A word "environment" here includes dust, corrosive gas, fluid, temperature, humidity, vibration, etc. in regard to the explosion proof of electrical facility.

(3) As a protective device, an internal pressure protective device, a temperature protective device and an overload protective device, etc. are available.

5120 Definitions of key terms used

Definitions of key terms used in this manual are as follow.

(1) Maintenance

Inspection and maintenance or repair based on inspection which are carried out to the electrical facility and the environment that such facility is

used to maintain explosion proof of electrical facility. Remodeling of electrical equipment is not considered as maintenance.

(2) Inspection

Checking existence of abnormality of electrical facility, or the environment that the facility is used by means of visual, auditory, touching, or using an instrument.

(3) Servicing

The work carried out for recovering to the original state by replacing the consumable parts for maintaining explosion proof performance of the electrical facility without replacing the durable parts.

(Explanation)

The work for recovering to the original state without replacing the durable parts includes cleaning, replacement of consumable part, and servicing by opening the inspection cover or terminal box.

The packing, lamp, brush, lubricating oil, contact point, brake shoe, etc. are considered as consumable parts.

(4) Repair

The work carried out for the purpose of maintaining explosion proof performance of the electrical facility by disassembling the electrical facility and recovering the damaged or worn durable parts as close to the original state as possible within the specified restriction.

(Explanation)

(1) The specified restriction means that the range that the recovering of the explosion proof performance is possible and the recovered state can be confirmed with a reliable manner.
However if the specified restriction is exceeded, it is considered as remodeling.

(2) The concrete example of repair is replacement of bearing for motor, lamp protective cover for lighting equipment, etc.

5130 Classification of Maintenance and Basic Items for Execution

5131 Classification of maintenance

Frequency of maintenance shall be determined by taking the kind of electric equipment and explosion construction, wiring method, using condition, environment condition, and past result into consideration.

Generally accepted maintenance is as shown below.

(1) Daily maintenance

A maintenance work carried out to the electrical facility every day, placing importance on inspection.

(2) Periodic maintenance

A maintenance work carried out to the electrical facility periodically, placing importance on servicing and repairing.

(3) Non regular maintenance

Besides daily maintenance and periodic maintenance, a maintenance work carried out to the electrical facility any time the necessity for maintenance arises. The contents of work are the same as above (1) and (2).

(Explanation)

(1) Here the maintenance work is divided into three - daily, periodic and non regular maintenance. Execute the daily and periodic maintenance sufficiently to lessen the non regular maintenance.

(2) Determine the maintenance frequency by taking the life of consumable part, damage and wear of durable part, environment condition, using condition, past result, etc. into consideration.

5132 Basic items for maintenance

As for maintenance of electrical facility, take each of the following items as a basis holding the user himself subjectivity to carry out the maintenance work independently.

(1) Carry out the maintenance work totally by taking not only the remarkable point of view on explosion proof construction, but also the function of electrical facility into consideration.

(2) Execute the maintenance work by taking the type of electrical equipment and explosion proof construction, wiring method, environmental condition, etc. under proper plan.

(3) Execute the maintenance work by whom sufficient knowledge about the electrical facility is obtained.

(4) Understand that there is a limit for maintaining the explosion proof performance only by the maintenance work. If judged hard to maintain the explosion proof performance, replace the electrical facility promptly.

(Explanation)

Maintenance of the electrical equipment shall be done by the person who uses. Particularly if recovery of explosion proof performance by disassembly and reassembly, consult the manufacturer in advance to determine concretely a maintenance worker, contents and method of maintenance, method for confirmation of recovered explosion proof performance.

5140 Preparation for maintenance and its execution

5141 Preparation of maintenance documents

Select the documents thought to be necessary for maintenance in an appropriate manner from the following items, taking the type of electrical facility and explosion proof construction, and other conditions into consideration.

(1) Drawings which show hazardous location.

(2) Electrical wiring diagram

(3) Structural diagram of the device

(4) External dimension diagram of the device

(5) Information regarding characteristics of protective device

(6) Information regarding spare parts

(7) Operating instructions

(8) Test results

(9) Maintenance record

(10) Other necessary information

5142 Important matter for maintenance worker

The worker who carries out the maintenance work shall have sufficient knowledge about the following items.

(1) Principle and function of explosion proof construction
(2) Knowledge about explosion proof in regard to electrical wiring
(3) Methods for control, operation, disassembly, reassembly, etc. of the device.
(4) Precautions for maintenance
(5) Items and methods for maintenance
(6) Related regulations

5143 Maintenance and energization

Determine whether the valve shall be kept energized or not at maintenance in accordance with the following items.

(1) Ordinary periodic maintenance is mainly for inspection purpose, so the valve can be energized.
(2) Periodic and non regular maintenance are mainly for service and repair purposes, so the valve should not be energized.

However the maintenance work can be carried out with the valve being energized, under the following conditions.

(a) If it is obvious that the electrical facility does not become a source for ignition without de-energizing.
(b) It is confirmed that there is no chance that the work to be carried out does not produce any dangerous atmosphere at the site that the maintenance work of electrical facility are to be carried out.

In that case, the site is handled as non hazardous location temporarily.

5144 Precautions for maintenance

Precautions for maintenance vary depending upon type of electrical facility and explosion proof construction, etc.

(c) Determination and confirmation of necessity of de-energizing and the range of power failure

(d) Existence of explosive gas and handling of non hazardous location

(e) Knowledge and skill of worker

(2) Things to be noted during work

(a) In case of inspection work during energizing, do not open the body of the electrical equipment, terminal box, transparent window, etc. However this rule does not apply to the device meeting the safety explosion proof construction.

(b) It is desirable that the service or repair work be carried out at the non hazardous location. In case the work can not be carried out such a place, apply item 51453 (2).

(c) In case of execution of maintenance work at hazardous location, do not produce any impact spark.

(d) In case of service and repair, they accompany disassembly and reassembly in connection with explosion proof performance of the device. So be careful not to deteriorate the explosion proof performance of other parts.

(e) The electrical measuring instruments used for maintenance at hazardous location shall be of explosion proof construction.

(3) Things to be noted after work

(a) Reconstruct the explosion proof performance of the device as a whole.

(b) Confirm that the device conforms with the corresponding items stipulated by 2700.

5150 Maintenance in regard to atmosphere

As for dusts, corrosive gas, temperature, humidity which affect explosion proof performance of the device, refer to the table 51.1 and properly execute the periodic or non regular maintenace.

However this table is applicable to 5200 and 5300 commonly.

Table 51.1 Inspection items in regard to atmosphere

Item	Method	Inspection	Remark
Ambient temp.	Touch, thermometer	Should not exceed the specified value.	
Moisture humidity	Visual, touching	No wetting, nor immersion of water	
Dust	Visual	No contamination, accumulation	
Corrosive gas	Visual, smell	No leakage	Gas detection if necessary
Explosive gas	Visual, smell	No leakage	Gas detection if necessary
Vibration	Visual, touching	No particular vibration	

5200 Maintenance of Electrical Equipment

5210 Withstanding pressure type explosion proof construction electrical equipment

5211 Maintenance of withstanding pressure type explosion proof performance

Withstanding pressure type explosion proof construction of electrical equipment has been ensured by each item of 3200. Therefore in order to maintain withstanding pressure type explosion proof performance, refer to table 52.1 and carry out the periodic and non regular maintenance particularly on strength of vessel, clearance of bonded section, temperature rise of external surface of vessel.

Table 52.1 Inspection items of withstanding pressure type explosion proof construction electrical equipment

Item	Method	Inspection	Remark
Vessel	Visual	No rust, damage	Clean, anticorrosive treatment
Transparent window	Visual	No damage	Replace
Bonded section	Visual	No damage, rough surface due to corrosion	Clean
Clamp screw	Visual, touching	No looseness, adhesion of dust, rust	Retighten & clean
Packings	Visual	No crack nor deformation	Replace
Bearing	Visual	No leakage nor deterioration of oil, grease.	Replace
Conductor lead-in section	Visual,	No damage, nor deterioration	Replace
Movable wire lead-in section	Visual, touching	No damage, deterioration, nor looseness	Retighten & replace
Terminal	Visual, touching	No looseness on connection, or stain on insulation	Retighten, tape, & clean

Item	Method	Inspection	Remark
Gounding terminal	Visual, touching	No looseness nor damage	Retighten & replace
Temperature rise	Thermometer, touching	Temperature rise of vessel outer surface shall be below the specified value.	Find the cause.

5212 Confirmation of recovered withstanding pressure type explosion proof performance

Confirm mainly the following points for recovery of withstanding pressure type explosion proof performance.

(1) No damage on bonded section of the vessel.

(2) Gap and length of flamepass shall ensure necessary figures for explosion proof construction.

(3) No damage nor crack on outer surface of vessel and transparent plate.

(4) See if the clamping screws are tightened uniformly and properly.

(5) See if anticorrosive treatment is sufficiently performed.

4-2 Classification of explosive gas

The table 1 classifies the grade of explosion and degree of ignition of explosive gas.

Table 1 Classification of explosive gas

Easy to ignite →

Explosive energy becomes greater ↓

Degree of ignition	Classification by ignition temperature				
	450 °C or over	450 - 300 °C	300 - 200 °C	200 - 135 °C	135 - 100
	G1	G2	G3	G4	G5
1	Acrylonitrile Acetonitrile Acetone Ammonia Isoputyl ketone Carbon monoxide Etane Ethyl methyl ketone *Isopropyl chloride O-xylene m-xylene p-xylene Chlorobenzene Acetic acid * Ethyl acetate * Methyl acetate Hydrogen cyanide Ethyl bromide 1,1-Dichloro ethylene Stylene 1,2,4-trimethyl benzene Triene Propane Benzene Benzotrifloride Methanol	Methyl acrylate Ethyl acrylate Acethyl acetone Iso octane Isobutanol Isobutane Ethanol Epichlorohydrin Vinyl chloride * Isobontyl acetate * Vinyl acetate * Butyl acetate * Propyl acetate * Bentyl acetate Cyclohexanone Di isoproyl ether 1,4-dioxyson 1,2-dichloro ethane Thiophene Furan 1-butanol Butan 2-propanol Propylene Acetic anhydride Methyl metha-crylate	* Butyl chloride Octane Cyclohexene Dimetyl ether Tetrahydrofuran Decan Butyraldehyde 1-hexanol Hexane Hebutane 1-pentanol Pentane 2-Methylhexane 3-Methylhexane Gasoline	Acetaldehyde Ethyl ether Dibutyl ether Dibutyl ether	
2	1,2-dichloro ethylene Coal gas	Ethylene Eth Ethylene oxide 1,3-butadiene Propylene oxide	Isopulene * Hydrogen sulfide		
3	Hydrogen Water gas	Acetylene			Carbon disulfide

(Note 1) The explosive gas with * mark is also a corrosive gas, so avoid using it as much as possible.

(Note 2) The material of explosion proof construction of Multi explosion proof type solenoid valve is made of aluminum die cast (ADC12). The corrosive gas may corrode O-ring (NBRetc), body material, etc. So it can not be used.

4-3 Classification of Hazardous Location

The hazardous location is a place that there is a chance to produce dangerous atmosphere by mixing the explosive gas and air, which may either explode or burn.

The locations can be classified into three, as shown below depending upon the period of dangerous atmosphere and frequency

Table 2 Classification of hazardous location

Type	Atmosphere	Example
0 grade	Density of explosive gas is beyond the lower limit continuously or for a long period of time at the place where produces dangerous atmosphere continuously or there is a chance to produce such an atmosphere.	1. A vessel for flammable solution or an empty space on top of solution in the tank. 2. Inside of vessel, tank, etc. of flammable gas. 3. Near solution surface of flammable solution of opened vessel.
1 grade	A place where there is a chance of producing dangerous atmosphere under normal condition.	1. An explosive gas accumulates at the lid when opening and closing it for taking the products out, or operation of safety valve, etc. 2. A place where there is a chance of accumulation of explosive gas due to repair, maintenance, or leakage.
2 grade	A place where there is a chance of producing dangerous atmosphere under abnormal condition.	1. An explosive gas or flammable liquid has been handled regularly. But those are sealed in the vessel of facility. Such vessel or facility is damaged due to accident or mis-handling, and therefore the place is possible to be filled with such a gas or liquid. 2. Though a place is well ventilated by a ventilator, there is a chance that eplosive gas may accumulate due to break down of ventilator.

Table cont'd

Type	Atmosphere	Example
		3. In the room near or adjacent to the 1 grade location, an explosive gas may enter and fill upto the dangerous density.

(Note 1) The Multi explosion proof type solenoid valve (withstanding pressure type explosion proof construction) can be used at grades 1 and 2 locations in the table 2.