RoHS

READ THE INSTRUCTION MANUAL BEFORE USING

INSTRUCTION MANUAL

Intrinsically Safe Explosion-proof Structure

Type Examination Certification No. TC22339X

MANOSTAR SWITCH

MS99S

No. TR-MS99S-E00

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Manostar

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INTRODUCTION

Thank you very much for purchasing of "MANOSTAR SWITCH MS99S". The instrument is a micro differential pressure switch wherein our manostar switch type MS99 is improved to ensure the intrinsic safe explosion-proof structure. It features, explosion-proof performance that prevents the instrument from being the ignition source even it is used in a hazardous area where flammable gas is generated.

⚠ Caution	For using the instrument safely: – Be sure to carefully read the operating instruction manual before using the instrument and use it in a correct and safe manner within the rated specifications. Improper use may cause instrument failure, which may induce damage, accidents, etc. – Keep this manual handy in a safe place.

Ⅰ. PRECAUTIONS

The instrument features the intrinsic safe explosion-proof structure. Although the structure has higher reliability compared to other explosion-proof structures, the reliability will deteriorate significantly unless the prerequisites for explosion-proof structures are observed and the intended explosion-proof performance cannot be maintained. Before using the instrument, the following precautions must be observed. For details related to explosion protection, refer to the references shown below:

References:

- JNIOSH-TR-NO.46-1～10
- JNIOSH-TR-NO.44

⚠ Warning

・**Do not use the instrument in dangerous places, excluding the target gas atmosphere.**
Use of the instrument in the non-target flammable gas atmosphere may cause an explosion because the instrument becomes the ignition source.

・**Do not use the instrument at the place where corrosive gas is present.**
The instrument is not corrosion resistance construction. Measuring corrosive gas may corrode the receiving element and housing material of the instrument. It is expected that corrosive gas leaked out of the instrument will harm a person.

・**Do not apply the pressure to the instrument more than it can withstand.**
The diaphragm and the retainer are broken and cause of injury or accident, etc. disaster if the pressure exceeding withstanding pressure of the pressure receiving element is applied to the instrument. The case body and the transparent cover of the instrument are broken and cause of injury or accident, etc. disaster if the pressure exceeding withstanding pressure of the instrument body is applied to the instrument.

・**Use the instrument with the cover, cable clamp and DIN rail mounting plate installed.**
The intrinsic safety cannot be guaranteed with the cover, cable clamp and DIN rail mounting plate detached, and the instrument cannot be used in hazardous areas.,

・**Use a wet cloth with water for cleaning.**
Charging of static electricity may cause sparks that could be ignition sources, resulting in an explosion hazard.

・**Do not use the instrument in places where significant vibrations or shocks exist.**
Use of the instrument in places where significant vibrations or shocks exist may induce deterioration in performance or failures, which may cause damage and disasters.

・**Do not exceed rated surrounding temperature, humidity and altitude in use.**
Using the instrument by exceeding rated surrounding temperature and humidity and altitude it may be damaged and cause the accident.

・**Do not disassemble or reconstruct the instrument.**
Disassembling or modification of the instrument not only voids the warranty, but also induces deterioration in performance or failures, which may cause damage and disaster.

・**Do not exceed rated voltage in using**
Using the instrument by exceeding rated voltage may cause fire or electric shock.

・**Wire correctly.**
Incorrect wiring may cause fire.

⚠ Caution

- As to where to install and how to install this instrument, be sure to follow the instruction manual provided so as to ensure a proper method.
- Use the instrument indoors.
- In case of not being installed in dry and well-kept clean locations, the instrument must be enclosed in box.
- Do not use organic solvent for cleaning.
  Use a cloth soaked with water-diluted neutral detergent to wipe the surface of a product. Using of organic solvent causes damage on the surface.
- Dropping the product.
  Product is a precision instrument. If you drop the product, there is a possibility that the exterior, also the interior mechanism damage.
- Removal of the piping
  Please do not pull the pipe with a strong force. There is a possibility that the pipe cap is broken.

II. INTRINSICALLY SAFE EXPLOSION-PROOF STRUCTURE

1. Certification as explosion-proof instrument

In Japan, only the explosion-proof instruments that passed the type examination for electric machines and instrument of explosion-proof construction can be used. The type examination of explosion-proof includes the guidelines according to the explosion-proof design standards for electrical and mechanical equipment (popular name: the structure standards) and the guidelines that are harmonized with international standards (popular name: the technical standards). The micro differential pressure transmitter described herein (MS99S type) passed the examination of the certification authority and is certified as the explosion-proof design electrical and mechanical instrument featuring an intrinsically safe explosion-proof structure that conforms to the International harmonization explosion-proof Guideline Ex2015.
(Type examination certification No. 22339X)

2. Concept of intrinsically safe explosion-proof structure

The explosion-proof structures include the following:

Explosion-proof structure	Explosion-proof method	Brief Summary
Pressurized instrument	Isolation of ignition source	Explosion-proof performance is secured by isolating the parts of electric instrument that could be ignition sources from the surrounding explosive atmosphere.
Oil-immersion		
Equipment protection by resin immersion		
Encapsulation		Although an explosion occurs inside the electric instrument, explosion-proof performance is secured by isolating the flame so that it will not ignite the surrounding explosive atmosphere.
Increased safey	Enhancement of safety degree	Regarding electric instruments wherein no spark-generating part or high-temperature part that could be an ignition source exists, explosion-proof performance is secured by further enhancing safety.
Intrinsic safety	Inhibition of ignition ability	Explosion-proof performance is secured by inhibiting occurrence of energy that could be an ignition source even in the regular condition or in the stipulated failure condition with the use of intrinsically safe circuits.

(1) Inhibiting energy

For flammable gas to catch fire, energy exceeding a certain quantity is required. Should a spark occur, the gas will not catch fire if the energy of spark does not reach the afore-said energy. Therefore, energy is inhibited with the relay barrier that is installed in the non-hazardous area to prevent feeding excessive energy to the micro differential pressure switch.

(2) Not accumulating energy

Even if the feeding of energy is inhibited externally, it is meaningless when energy is accumulated in hazardous areas. Our instrument is designed in a manner that the energy to be accumulated in circuits can be inhibited to prevent the instrument will not be the ignition source.

(3) Inhibiting increase in temperature

Flammable gases catch fire due to temperature. Our instrument is designed in a manner that the increase in temperature is inhibited to the level that any target gas will not catch fire within the range of operating ambient temperatures.

3. List of laws and regulation related to explosion-proof electric instruments

(1) Industrial Safety and Health Act
June 8, 1972 Law No. 57
(2) Enforcement ordinance of Industrial Safety and Health Act
August 19, 1972 Cabinet Order No. 318
(3) Ordinance on Industrial Safety and Hygiene
September 30, 1972 Ministry of Labour Ordinance No. 32
(4) Ordinance on Examination of Machines and Other Equipment
September 30, 1972 Ministry of Labour Ordinance No. 45
(5) Explosion-proof design standards for electrical and mechanical equipment
April 1, 1969 Ministerial Notification No. 16 of the Ministry of Labour
(6) Explosion-proof Guide
August 31, 2015 Labor Standards Bureau Notification 0831 No. 2, etc.
(International harmonization explosion-proof guideline Ex2015)

5. Explosion-proof performance of the instrument (Ex ia IIC T6 Ga)

Ex	ia	IIC	T6	Ga
(i)	(ii)	(iii)	(iv)	(v)

(i) The code shows the explosion-proof structure conforming to the International harmonization explosion-proof guideline.

(ii) The code "**i**" shows the intrinsically safe explosion-proof structure and it is further classified into "**ia**", "**ib**" and "**ic**."
For the intrinsic safety, "**ia**" shows the highest level and it can also be used as "**ib**" or "**ic**".

(iii) The code shows the group of instrument and it is further classified into "**I**", "II" and "III".
In addition, regarding "**II**" and "**III**", they are further segmentalized by adding either one of "**A**", "**B**" or "**C**".

Group **I**: Usable in mines that are likely to be affected by mine air.

Group **II**: Usable in areas, excluding mines that are likely to be affected by mine air, where explosive gas atmosphere exists.

＊"**IIC**" can also be used as "**IIB**" or "**IIA**".

Group **III**: Usable in the explosive-dust atmosphere, excluding mines that are likely to be affected by mine air.

(iv) The code shows the temperature classes and is further classified according to the maximum surface temperatures to which the instrument reaches within the range of operating temperatures.

＊For Group **II**, the range of usable gas atmosphere is determined according to combinations of (iii) and (iv) as shown below:

Table II-(1): Typical Explosive Gas Groups and Temperature Classes

Temperature Class (Ignition Temperature) \ Group		Low ← Hazard Ratio → High		
		IIA	IIB	**IIC**
Low ↑ Hazard Ratio ↓ High	T1 (Exceeding 450° C)	Acetone Ammonia Ethane Acetic acid Ethyl acetate Toluene Benzene Methane	Carbon monoxide	Water gas Hydrogen
	T2 (Exceeding 300° C and 450° C or below)	Isopentyl acetate Butane Propane Methanol Acetic acid anhydride	Ethanol Ethylene Ethylene oxide	Acetylene
	T3 (Exceeding 200° C and 300° C or below)	Hexane		
	T4 (Exceeding 135 and 200° C or below)	Acetaldehyde	Diethyl ether	
	T5 (Exceeding 100° C and 135° C or below)			
	T6 (Exceeding 85° C and 100° C or below)			Carbon bisulfide

＊The content of the table is quoted from JNIOSH-TR-44.

Shows the scope where the instrument can be used.

(v) The code indicates the equipment protection level (EPL) and shows the hazardous area where installation is possible.
The intrinsically safe explosion-proof structure Group II is classified into either of "**Ga**", "**Gb**" or "**Gc**".

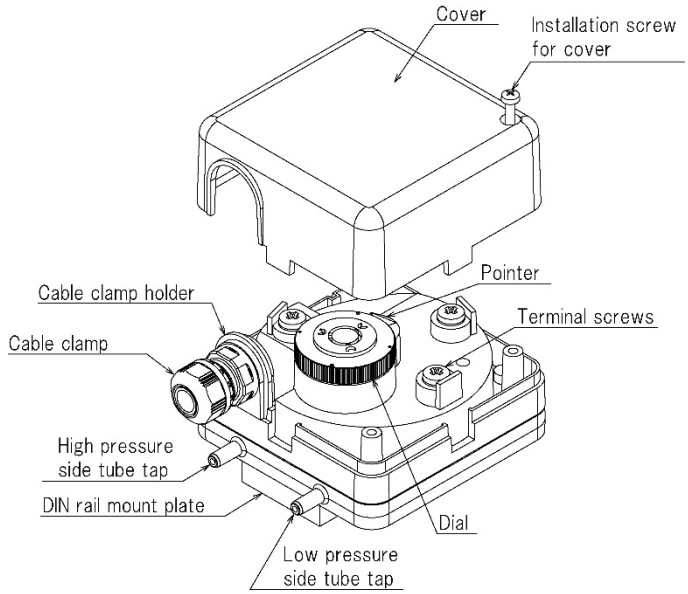
"**Ga**": Installation is possible in Class 2 hazardous area, Class 1 hazardous area and special hazardous area.

"**Gb**": Installation is possible in Class 2 hazardous area and Class 1 hazardous area.

"**Gc**": Installation is possible in Class 2 hazardous area.

⚠ CAUTION	The instrument is not the corrosion-proof type. Even for gases that are classified in the above-stated scope, the instrument cannot be used in the corrosive-gas atmosphere.

Ⅲ. THE NAME OF EACH PART



Ⅳ. INSTALLATION

Before using this instrument, make sure if it is the type that you requested and meets the demand of the environment, pressure and piping conditions where it is used, by specification.

1. Places where the instrument can be used

a) The instrument can be used in the special hazardous area, Class 1 hazardous area and Class 2 hazardous area.
b) The instrument should be installed and used in the area where all of the following conditions are satisfied.

Target gas atmosphere	Refer to Table II-(1) "Typical Explosive Gas Groups and Temperature Classes" on Page 4. * The instrument cannot be used for corrosive gas.
Ambient temperature	-10° C to +60° C (No freezing) * Avoid installation in areas where ambient temperatures change suddenly.
Ambient humidity	90%RH or below (No condensing)

c) The instrument is not waterproof. Do not use it in a place subjected to rain, or other splashing water.
d) Do not use the instrument in a place subjected to direct sunlight, vibration or shock, or excessive moisture. In particular, vibration and shock to the instrument should shorten its life.
e) In installing the instrument, select the place where the ground is smooth and flat.

⚠ WARNING	- Do not use the instrument for measuring pressure of corrosive gases or toxic gases.

⚠ CAUTION	- Pay careful attention to handling in the environment where static electricity is likely to be charged.

2. Installation

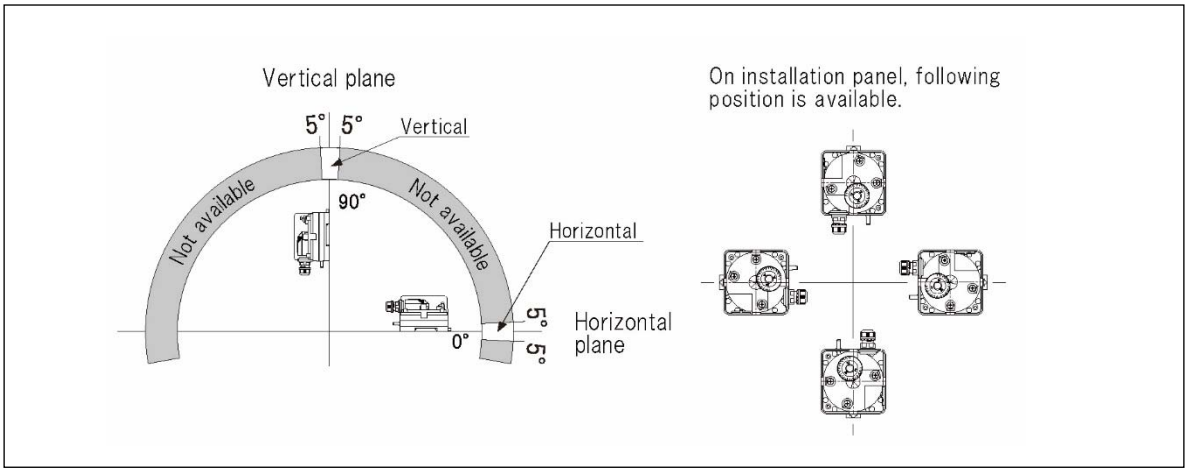
DIN rail (35mm width) mounting

⚠ CAUTION	The "ADPL99-01" mounting plate, the "ADPL99-02" and "ADPL99-03" compatible mounting plates, which are MS99-specific accessories, cannot be used.

3. Installation position

Must be specified at time of order.

After inspection and adjustment in accordance with the specified installation position and shipped.

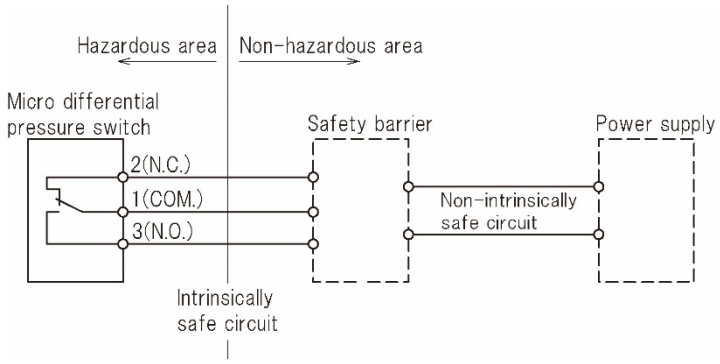


⚠ Caution	Use of in a position other than the specified is out of accuracy warranty.

4. Wiring/connection

(1) Connection Diagram

Figure Ⅳ-(1) Terminal Connection Diagram



・ The safety retainer that can be connected to this unit must be a stand-alone device that has passed type approval and meets the following conditions.

Performance Class	:	ia
Group	:	IIC
Uo	≦	14.4V
Io	≦	30mA
Po	≦	0.11W

・Use external wiring for intrinsically safe circuits that meets the wiring requirements for safety circuit.

Lo ≧ Lc Lc：Inductance of the wiring outside the main safety circuit

Co ≧ Cc Cc：Capacitance of the external wiring of the main safety circuit

※The internal inductance and internal capacitance of this unit are ″negligible values″ and therefore not considered.

・The wiring of the main safety circuit should be arranged so that voltages and currents that impair the safety of the main safety circuit are not induced in the main safety circuit due to electromagnetic induction and electrostatic induction.

Recommended Safety Retainers
- ・EB3C Relay barriers（IDEC Corporation）
- ・Barrier Relay System TBR-100 Series（TAKENAKA ENGINEERING CO., LTD.）

5. Wiring material

Choose the wiring material depending on the load. Terminal screw of the product is M4. Wire by performing the termination of the crimping terminal (O.D. less than ϕ8 which matches the general M4 screws.) The wiring direction can be changed by changing the direction of the cover.
Further, an attachment point of the cable clamp receipt can be chosen from 2 points.

The wiring direction

(When cable clamp, which is sold separately, is installed.)

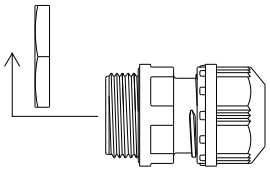
6. Common accessory for MS99 series

Cable Clamp Holder Made of Polycarbonate [installed]	
	Product code ADPA-MS99

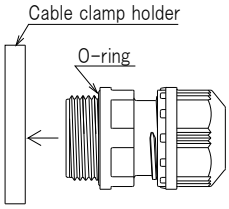
Cable clamp (produced by OHM ELECTRIC CO., LTD.) Made of Nylon66, Polypropylene, NBR		
	Product code	Suitable wire diameter
	OA-W15M-04	ϕ2～4
	OA-W15M-05	ϕ3～5
	OA-W15M-07	ϕ5～7

Model MS99S comes standard with "OA-W15M-05" and is supplied with one each of "OA-W15M-04" and "OA-W15M-07" rubber bushings.

＜Installation＞



1.Remove the locknut. The locknut is not necessary to install the instrument.



2.The cable clamp screwed to it, by hand. At that time, O-ring of the cable clamp is compressed, and, parts are in contact (without a gap). Caution, parts may be damaged if too much tightening.

7. Accessory for type S

DIN rail set Made of Aluminum, Steel [option]	
	Product code DIN-99S

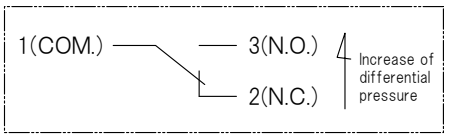
DIN rail mounting plate Made of Polyacetal, Steel made [installed]	
	Product code ADPL99S-DIN

⚠ Caution	About the Cover of Model MS99S This product has a seal with an acceptance mark affixed to the cover. Since confirmation of the actual product is required to affix the Seal of Approval, the cover is not sold as a stand-alone item. If the cover is damaged or lost and needs to be replaced, please contact us separately.

Ⅴ. SETTING OF PRESSURE

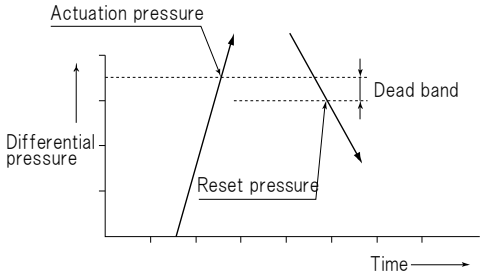
1. Switch contact configuration

- Composition of contact of this instrument is as shown on the right.
- If the instrument is not applied by differential pressure we call such "normal condition".
- At normal condition, the contact between 1(COM.) and 2(N.C.) is closed, and between 1(COM.) and 3(N.O.) is open.
- With increase of differential pressure and reaching the actuation pressure, the contact will be changed over ; between 1(COM.) and 2(N.C.) is opened and between 1(COM.) and 3(N.O.) is closed.



2. Setting of upper limit/ lower limit

- When differential pressure applied to the instrument is increased starting from zero and changes over the electric contact from N.C. (normal close) to N.O. (normal open), the pressure at this moment is called "**actuation pressure**".
- When this differential pressure decreases from the pressure higher than this actuation pressure activating electrical contact and returning the contact from N.O. (normal open) to N.C. (normal close), the pressure at this moment is called "**reset pressure**".



- There is certain difference between actuation pressure and reset pressure and this is called "**dead band**".
- There are two types of the instrument. One is called "**upper limit setting type**"type (H) whose scale of setting knob is adjusted on actuation pressure, the other is called "**lower limit setting type**"type (L) which is adjusted on reset pressure.
- Depending on the purpose of use, choose the instrument either "upper limit setting type" or "lower limit setting type"

Please confirm the following table about the respective movement.

In case of 1-10 kPa range with set value 1 kPa. (dead band is 0.7 kPa)

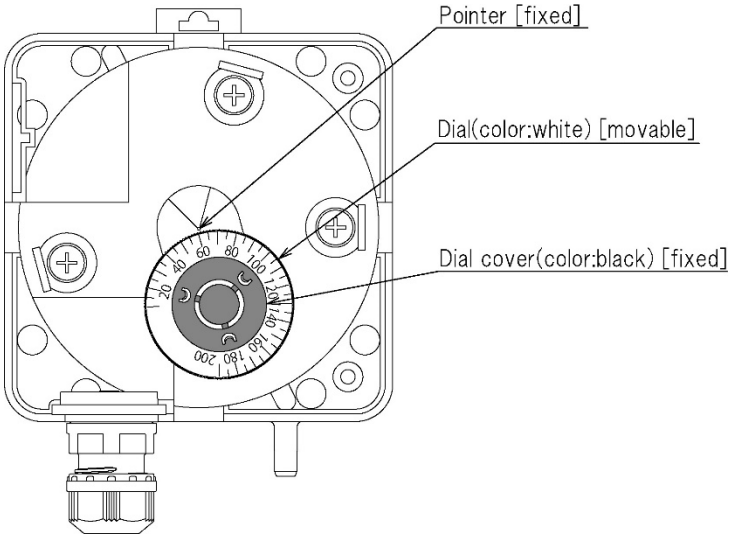
Setting of scale	Adjusting of scale	Movement of contact
Upper limit setting type	Adjusted in activating pressure	When the differential pressure increases, the circuit is closed between N.O. and COM. at 1 kPa. Then as the differential pressure decreases, the circuit is opened between N.O. and COM. at 0.3 kPa.
Lower limit setting type	Adjusted in reset pressure	When the differential pressure increases, the circuit is closed between N.O. and COM. at 1.6 kPa. Then as the differential pressure decreases, the circuit is opened between N.O. and COM. at 1 kPa.

⚠ Caution	It can't be changed from the lower limit setting to the upper limit setting or vice versa.

3. Setting the dial

Use the dial and pointer, when you set the “Activating pressure” or “Reset pressure”.

Set the ″Activating pressure″ for the upper limit setting.
Set the ″Reset pressure″ for the lower limit setting.



Set the tip of the pointer to the pressure you desire by knobbing the outer periphery of the dial to rotate the dial. Turning the pointer from the lower side (anti-clockwise) is recommended to set accurately with good reproducibility. Turning the pointer from the lower side (anti-clockwise) is recommended to set accurately with good reproducibility.

⚠ Caution	Do not turn the dial too much exceeding the upper bound or the lower bound of the scale. It causes performance deterioration and the failure. Removal of the cover and dial operation may cause static electricity to be charged. Do not perform these operations in explosive atmospheres.

4. Reset time

The reset time means the time needed for the differential pressure to decline to the reset pressure from the activating pressure (i.e., the electrical contact is reset) when the differential pressure is sharply reduced to zero. It is about three seconds at 20 Pa, and one second at more than 50 Pa for Manostar switches. (This value is only for the instrument itself and does not include the effect of piping.) Therefore, a response quicker than this value is not possible.

Ⅵ. ABOUT BUILT-IN SWITCH

1. About measured gas and contact failure

a) Corrosive gas

If the gas to be measured contains corrosive gases (nitric acid, hydrogen sulfide, sulfurous acid, ammonia, chlorine, and so on), they may cause electrical contact failure or corrosion of internal mechanism, which leads to malfunction of the switch. Do not use the switch for the gases containing high humid air because in such gases, the arc generated by opening/ closing the contact produces nitric acid, and it may also cause electrical contact failure or malfunction of switches.

b) Silicone gas

If the gas to be measured contains silicon produced from silicon (contained in oil, grease, filling agent, and so on), the gas produced by arc, generates by opening/ closing the contact, accumulates on the contact surface and causes contact failure. Take corrective measures such as the removal of the gas source or arc suppression.

c) Dust and organic gas

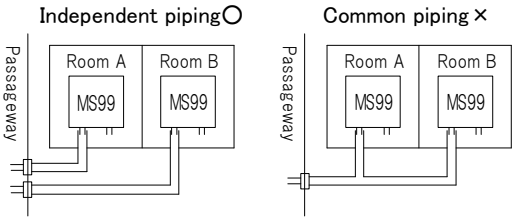
The film can be made to the switch part by the composition of the gas. In addition, the dust contained in the gas to be measured can adhere to the contact surface and be changed into carbide caused the contact failure by the arc generated when the contact is opened or closed. Therefore, pay attention to the measurement environment as well.
(Even with gold alloy contact, be careful about the dust.)

⚠ Caution	As the opening/ closing frequency of the contact increases, wear dust from the contact increases. This wear dust accumulates between the contacts to increase the contact resistance and causes the malfunction in the load circuit. In particular, the surrounding where there exists continuous vibration and impact will be most likely to cause contact failure due to worn powder.

Ⅶ. Precautions regarding pipe

1. Prohibition of common piping

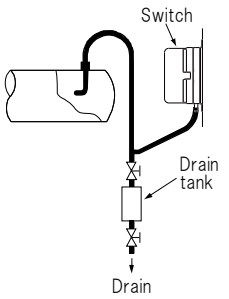
The pipes from the pressure detector and the instrument shall be independent pipes for each line as shown in the right-hand figure, and never allow common pipes with neighboring lines. If common pipes are employed, errors will occur because the pressures from the independent lines interfere with each other.



2. Prevention of clogged piping due to drain

Because measurement error for pressure occurs when drainage accumulates in the pipes, the instrument should be installed above the pressure pick-up port of the pressure detector to prevent accumulation of drainage at the sagging part generated on the pipe. If unavoidable, install the drain tank on the way of the pipe as shown in the right-hand figure and execute cleaning on a regular basis. After completing the cleaning work, check that airtightness is ensured.

Installation diagram of drain tank

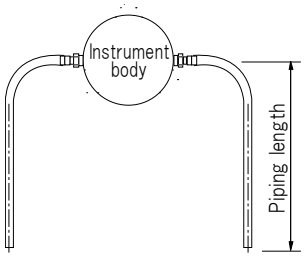


3. Pressure setting of high-temperature gas

For the pressure setting of high-temperature gas, use a refractory metal (stainless steel pipe, for example) for the pressure detector (pitot tube), and use metal pipes having the length that is required for cooling the high-temperature gas between the detector and the instrument body.

4. Errors caused by long-distance piping

If piping of instrument is done for a long distance, the response speed will become slower. Employ thicker pipes on the way as much as possible. In addition, because the pipe resistance differs at the higher-pressure and lower-pressure sides if piping conditions significantly differ for the higher and the lower sides, a time lag in pressure transmission occurs and accurate differential pressure cannot be measured.



Ⅷ. SPECIFICATIONS

1. General specifications

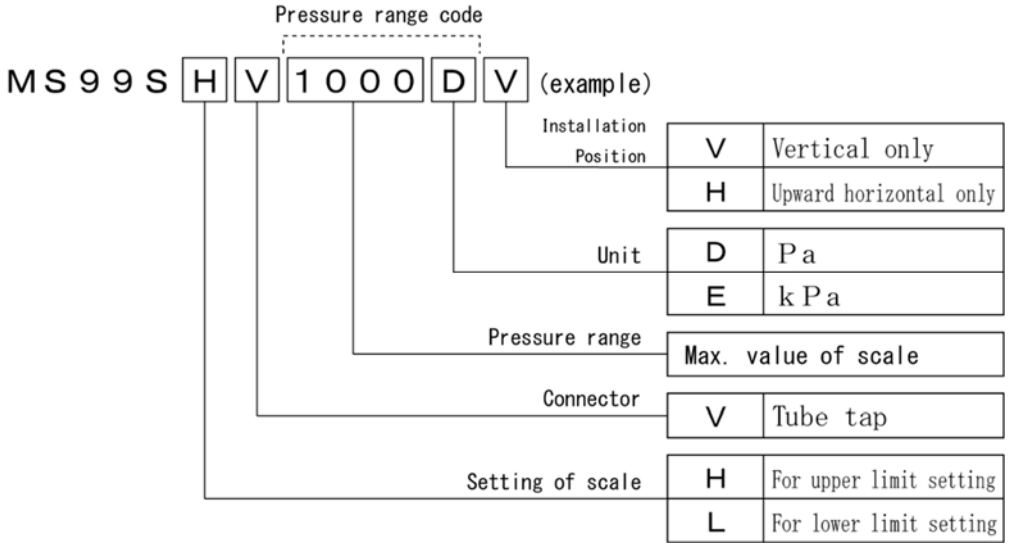
Product name	Micro differential pressure switch
Type	MS99S type
Pressure measurement system	Diffrential pressure type
Atmosphere to be measured	Air and non-corrosive gas (Liquids cannot be measured)
Rated voltage	12 VDC - 30 mA RES
Withstand voltage	Across terminals and grounding terminal 1500V AC 50/60 Hz, 1 min., 1 mA or below
Operating ambient temperature	-10～+60 ℃ (No freezing)
Operating ambient humidity	90% RH or below (No condensing)
Mechanical durability vibration	5 to 10 Hz Amplitude 10 mm; 10 to 50 Hz Acceleration 39 m/s^2 (3 axial directions; 2 hours each)
Impact resistance	100 m/s^2 (3 axial directions; 6 times each)
Weight	Approx. 190 g

2. Specifications concerning explosion-proof

Explosion-proof performance	Intrinsically Safe Explosion-proof Structure (Ex ia ⅡC T6 Ga)
Applicable guidelines	International harmonization explosion-proof guideline Ex2015 JNIOSH-TR-46-1:2015 JNIOSH-TR-46-6:2015
Allowable voltage of intrinsically safe circuit (Ui)	14.4V
Allowable current of intrinsically safe circuit (Ii)	30mA
Allowable electric power of intrinsically safe circuit (Pi)	0.11W
Internal inductance (Li)	Ignorable value
Internal capacitance (Ci)	Ignorable value
Target gas atmosphere	Refer to Table II-(1) “Typical Explosive Gas Groups and Temperature Classes” on page 3.
Equipment protection level (EPL)	Ga
Hazardous areas where the instrument can be installed	Special hazardous area Class 1 hazardous area Class 2 hazardous area
Degree of protection	IP20

※ In the special hazardous area, robustly prevent generation of sparks that could be the ignition source caused by shocks or friction on the container.

3. Product code



※Pressure Range Code List

Pressure Range Code	Pressure Range
120 D	20 ～ 120 Pa
200 D	20 ～ 200 Pa
300 D	30 ～ 300 Pa
500 D	50 ～ 500 Pa
1000 D	100 ～ 1000 Pa
3 E	0.3 ～ 3.0 kPa
5 E	0.5 ～ 5.0 kPa
10 E	1 ～ 100. kPa
30 E	3 ～ 300. kPa

Ⅸ. DISPOSAL

Disposal of the apparatus must be done according to related ordinances, laws, and regulations.

Ⅹ. REGULAR CALIBRATION

To maintain the service life and reliability of an instrument in general, it is important not to apply any stress caused by external factors to the apparatus. With the apparatus, no special maintenance service is required when it is adequately used according to the operating instructions manual. However, it is recommended to execute the regular calibration once a year. For the regular calibration, contact our distributor or Yamamoto Electric Works Co., Ltd.

Ⅺ. PRODUCT WARRANTY

Warranty Period

This product warranty is valid for one year from the date of delivery to a place specified by an ordering party who has transacted directly with Yamamoto Electric Works Co., Ltd.

Coverage

If a product breaks down due to a reason for which we are responsible during the warranty period and you return the product to us, we will either repair or replace the product free of charge.
This warranty does not cover:

(1) Usage of the product under any inappropriate conditions or environment contrary to what is described in our product catalog, specifications or manual.
Handling or usage of the product other than as described in our product catalog, specifications or manual.
(2) Breakdown due to a reason other than a fault within our product.
(3) Any product that has been modified or repaired by a party other than us.
(4) Any breakdown due to a reason that was not foreseeable based on scientific and technical standards applied at the time of shipment.
(5) Any breakdown due to a reason not attributable to us such as a natural calamity or other disaster.

These terms of warranty represent our entire liability with respect to the product, and we shall have no liability for any other loss arising in connection with a breakdown of the product.

*This product warranty is only valid within Japan.

This document is a translation from the original Japanese version, and the original Japanese version has priority over this translation.
Be sure to refer to the original Japanese for the details of this warranty.

< Note >

The specifications and contents of the product described in the operating instruction manual may subject to change without notice for further improvement.