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|-----------|---|
| CLASS No. | — |
| SUB. No. | — |

| | | | |
|-------|----------|-------------|--------------|
| MODEL | MD-SX II | DRAWING No. | C981 74111A0 |
|-------|----------|-------------|--------------|

SENSOR FOR THE OIL MIST DETECTOR

センサ * オイルミストディテクタ

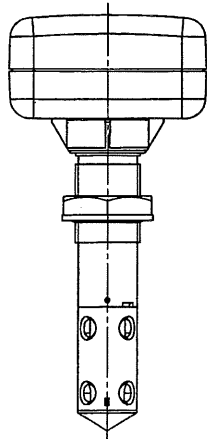
POWER SOURCE : DC24V
 ALARMING : HI-ALARM, PRE-ALARM, SYSTEM FAILURE
 SCREW SIZE : G3/4
 PROTECTION CLASS : IP55

| | | | | | |
|---|----------|----------|----------|-------------------|------|
| | | | | | |
| MARK | REVISION | APPROVED | PASSED | DRAWN | DATE |
| <p>Niigata Power Systems Co., Ltd. ENGINEERING & TECHNOLOGY CENTER</p> | | | APPROVED | <i>H.Nagasawa</i> | |
| | | | PASSED | <i>H.Nagasawa</i> | |
| | | | CHECKED | <i>M. Ikeda</i> | |
| | | | DRAWN | <i>M. Ikeda</i> | |
| | | | DATE | 20-Aug-12 | |

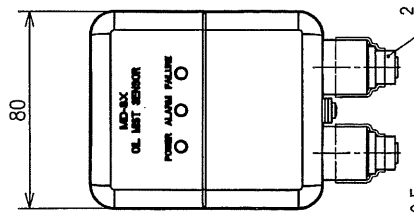
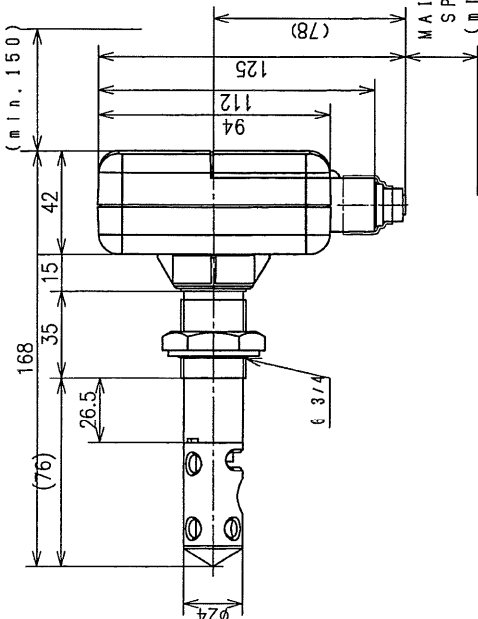
1 2 3 4 5 6 7

Model MD-SX Sensor Unit

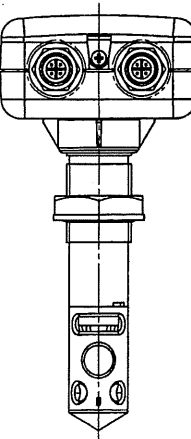
| | | |
|-----|---|--|
| No. | FUNCTION | Oil mist concentration detection and the mist level signal conversion & output |
| 1 | DETECTION POINT | 1 point/1 unit |
| 2 | MIST DETECTION | Natural diffusion system |
| 3 | DETECTION SYSTEM | Optical system (Optical dispersion system) |
| 4 | DETECTION INTERVAL | Continuous |
| 5 | DISPLAY | 3 color LEDs *POWER (Green) : State of operation (Lighting) *ALARM (Red) : "PRE ALARM" (Blink) *HIGH ALARM (Lighting) *FAILURE (Orange) : Equipment failure (Lighting) |
| 6 | DATA COMMUNICATIONS | Serial Interface:RS-485(Half Duplex) conformity (Sensor unit & Controller) |
| 7 | INITIAL-SETTING OPERATION | Rotary switch:Communication(CH) "1" ~ "16" Dip switch:Terminator(Terminus) "ON"/"OFF" Power supply (Line and Communication line (Sensor unit & Controller)) |
| 8 | EXTERNAL CONNECTION | Wiring:Use the special cable with connector Connection method:Connector |
| 9 | POWER SUPPLY | 24V DC(+30% to -25%) (supply from controller) |
| 10 | POWER CONSUMPTION | 60 mA(max./1 unit) |
| 11 | OUTLINE DIMENSIONS | 80WX124HX168D mm |
| 12 | INSTALLATION | Screw size : 6/32 (with a seal washer) Vertical direction:level and less than 15° of facing data |
| 13 | PROTECTION AGAINST DUST AND WATERPROOFING | Retain direction:less than 45° Protection class:IP 55 |
| 14 | WEIGHT | 500g |
| 15 | PAINT COLOR | Matte MIL-D (Black) (Case part) |
| 16 | ENVIRONMENTAL CONDITIONS | Ambient temp. : (for operation) : 5~55°C : 5~80°C (insertion parts in a crank case) (for storage) : -20~80°C Humidity :Max.80%RH (without dew condensation) Atmosphere :No corrosive gas Vibration :1G or less |
| 17 | | |



MAINTENANCE SPACE (min. 150)



| PIN NO. | CABLE | TERMINAL NO. |
|---------|--------------------|--------------|
| 1 | +24V | 1, 5 |
| 2 | 0V | 2, 6 |
| 3 | S+ | 3, 7 |
| 4 | S- | 4, 8 |
| 5 | Shield/Shield Line | Terminal |



PIN ASSIGNMENTS, SOCKET

| | | | | | |
|----------|------------------|-----------|------------------------------------|-------|-------------|
| LIST NO. | NIN00465 | MATERIAL | KUMI | GROUP | O SCALE:1:2 |
| BEFORE | | MASS. | 420 g | QTY. | 1 |
| REF. | | TYPE | | | A3 |
| CHECKED | CHUJYOU JYUNYA | NAME | ヨウコニス:MD-SX:センサユニット (コネクタタイプ) | | |
| DRAWN | NAKAMITSU TOSHIO | APPROVAL: | MD-SX:SENSOR UNIT (CONNECTOR TYPE) | | |
| DATE | 2009/02/04 | PARTS NO. | NN00465K001 B * | | |

| | | | |
|--|------------------|------|------------|
| APPROVED | UCHIYUKI MASARU | DATE | 2009/02/04 |
| CHECKED | CHUJYOU JYUNYA | | |
| DRAWN | NAKAMITSU TOSHIO | | |
| DATE | 2009/02/04 | | |
| (E006244) 2007/12/20 1/1 本図は、本製品の仕様書に基づき作成されたものであり、製品の改良等により、本図と実物の形状が異なる場合があります。 | | | |
| 本図は、本製品の仕様書に基づき作成されたものであり、製品の改良等により、本図と実物の形状が異なる場合があります。 | | | |

5. SPECIFICATIONS

5.1 Sensor unit

| No. | MODEL MD-SX SENSOR UNIT | |
|------|---|---|
| (1) | Function | Oil mist concentration detection Mist level signal conversion and output |
| (2) | Detection point | 1 point/1 unit |
| (3) | Mist detection | Natural diffusion system |
| (4) | Detection system | Optical system (Optical dispersion system) |
| (5) | Detection interval | Continuous |
| (6) | Display | 3 LEDs "POWER" (Green) : Power status (Lighting) "ALARM" (Red) : PRE ALARM (Blink) HIGH ALARM (Lighting) "FAILURE" (Yellow) : Comm. and Sensor failure (Lighting) |
| (7) | Data communications | Serial interface: RS-485 (Half Duplex) conformity (Sensor unit - controller) |
| (8) | Initial-setting operation | Rotary switch: Communication node (16CH) "0" - "F" Dip switch : Terminator "ON"/"OFF" |
| (9) | External connection (Sensor unit - Controller) | Sensor line : MD-SX option cables (Daisy chain) Total length: 150 m max. Connection method : Connector (Standard type) Clamp-type terminal (Cable gland type) |
| (10) | Power supply | 24 V DC (+30% to -25%) (supply from controller) |
| (11) | Power consumption | 60 mA (max.)/1 unit |
| (12) | Outline dimensions | 80 W × 124 H × 168 D mm (Standard: connector type) 80 W × 135 H × 168 D mm (Cable gland type) |
| (13) | Installation | Screw size: G 3/4 (with a seal washer) Vertical direction : Level or less than 15° of facing down Rotation direction : Less than ±5° |
| (14) | Protection against dust and waterproofing | Protection class: IP 55 |
| (15) | Weight | Approx. 450 g (Standard connector type, Cable gland type) Approx. 500 g (Fling - lead type) |
| (16) | Paint color | Munsell N1.0 (Black) (Case part) |
| (17) | Environmental conditions | Ambient temperature: (For operation) 5 - 55°C 5 - 80°C (Engine insertion part) (For storage) -20 - 80°C Humidity : Max. 80%RH (without dew condensation) Atmosphere : No corrosive gas Vibration : Amplitude: ±1.6 mm or less (2 to 25 Hz), 4 G or less (25 to 2 kHz) |

6. DISPLAY AND FUNCTIONS OF SENSOR UNIT

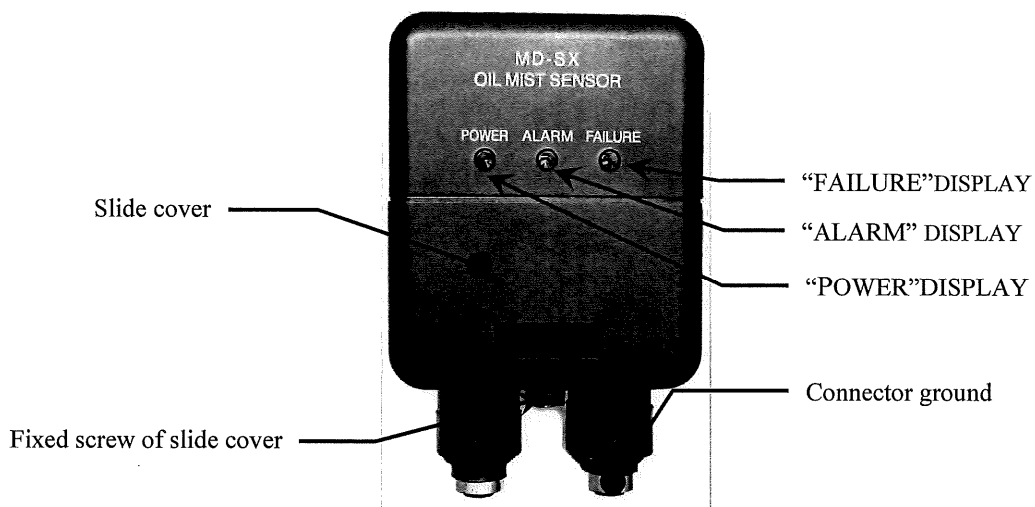


Fig. 6 Sensor unit

Each sensor unit has three status indicating lamps (LEDs); POWER (green), ALARM (red), and FAILURE (yellow).

6.1 Description of function

The light emitted from the LED of the sensor unit is diffused and reflected by the oil mist in the sensor hood, and then received by the photoreceiver diode (PD). After amplification and A-D conversion, the output from the photoreceiver is input to the CPU for arithmetic operation, and then transferred to the controller as the oil mist density data.

6.2 "POWER" LED

This lamp is located on the left of the surface of the sensor unit case. When the green LED is on, this means that power is being supplied from the controller and the CPU is working normally.

6.3 "ALARM" LED

The controller detects the alarm status based on the oil mist density detected by the sensor unit. There are two alarm statuses, "PRE ALARM" and "HIGH ALARM". Upon occurrence of any alarm, the red LED in the center of the case surface flashes (PRE ALARM) or lights (HIGH ALARM) according to the signal from the controller.

6.4 "FAILURE" LED

The sensor unit has a self-diagnosis function. If any trouble is found, the yellow LED on the right of the case surface will turn on.

Upon occurrence of a light receiving or emitting element output trouble, a CPU trouble, a thermistor trouble or a circuit trouble, the LED lights.

In addition, when the controller is set in the test mode, the LED of all sensor units becomes blinking.

8. INSTALLATION

8.1 Sensor unit

- (1) Use the sensor unit under environmental conditions meeting the following specifications

When mounting the sensor unit, select a place where vibration can be 4 G or less (2 Hz to 2 kHz).
When selecting the sensor mounting place, also check that the mist suction port of the sensor hood cannot be continuously blocked by a large quantity of oil.

By rotatory direction of a crankshaft and structure of the engine inside, the heavy splash of lubrication oil occurs, and there may be the case that the oil mist is hard to come in to a detecting element.
Please install it by a recommended method.

The recommended installation position of the MD-SX sensors is upper place from clank shaft and side of figure below.

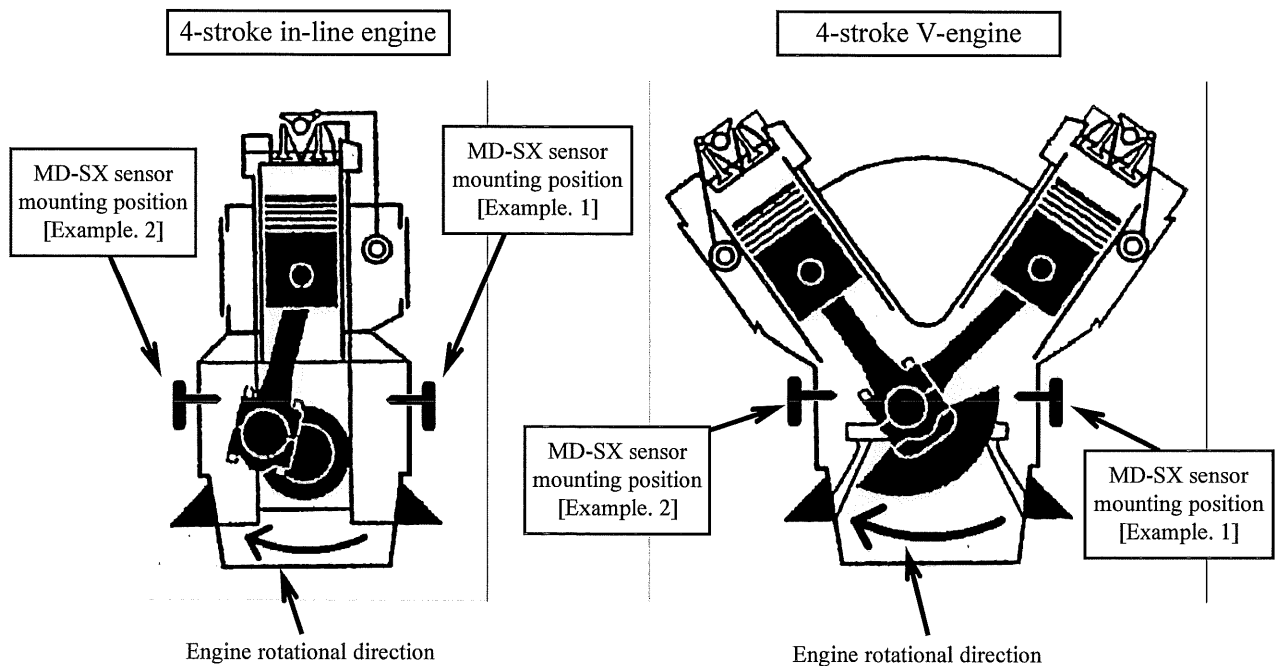


Fig. 8 Recommended attachment position of the sensor unit

(2) Mounting conditions

- 1) Horizontal or downward (front declined) within 15°

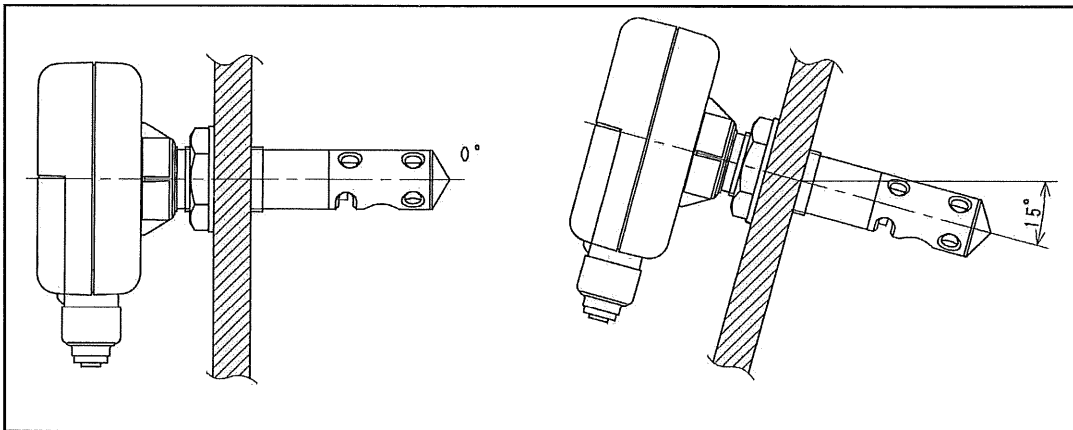


Fig. 9 Tilt tolerance for horizontal direction

- 2) Rotation direction within ±5°

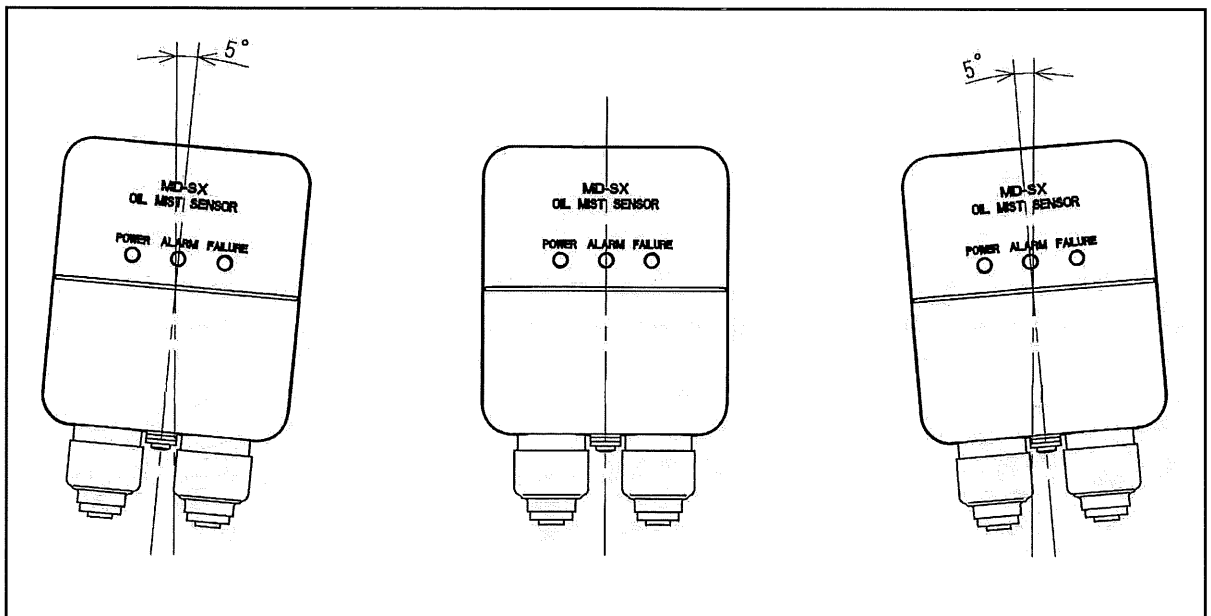


Fig. 10 Tilt tolerance for the rotation direction

- (3) Insert the hood of the sensor unit into the crankcase through the threaded portion (thread size: G3/4) of the engine frame, screw in the hood to the specified length (threaded portion length of 15 mm: 10 turns or more) after winding a sealing tape, and secure the hood with the lock nut through the supplied sealing washer.

Note: • If the screw part is not rolled up by seal tape, Oil leak will be occurred from screw part to engine outside.

- If you use the special sealing washer (optional), it is not necessary to wind the sealing tape. If you need this special sealing washer, please contact us

- (4) Although the threaded portion is made of stainless steel and has sufficient strength, the case and the front hood are made of plastics. When handling them, take care not to give undue force to them.
- (5) Please do not install an obstacle to a radius of less than 100 mm from an installation hole of a sensor. On sensor installation work, a sensor hits the obstacle, and there is the case that cannot screw.

(6) When MD-SX sensor unit install on engine with the following condition, MD-SX sensor should be avoided to install on these place.



- Oil comes from upper part like a waterfall continuously.
- Oil comes from lower part like a fountain continuously.
- Oil comes from the inside structure to reflect oil heavily.
- There is the structure like oil pool, and the sensor hood sinks.

In case the sensor is installed such a place, mist inlet holes of the hood may be blocked by oil and MD-SX may not detect mist density surely. Then, oil comes into mist detection area in hood from the mist inlet holes. As a result it may cause sensitivity abnormal or miss-alarms (HIGH and/or PRE- ALARM).

When MD-SX sensor unit can not install on the recommended place by the limit of engine design, Daihatsu recommend using the cover structure or the protection pipe to cover the hood part of MD-SX sensor from heavy scattering oil. Please refer to the below drawings for protection method or ask Daihatsu in the details.

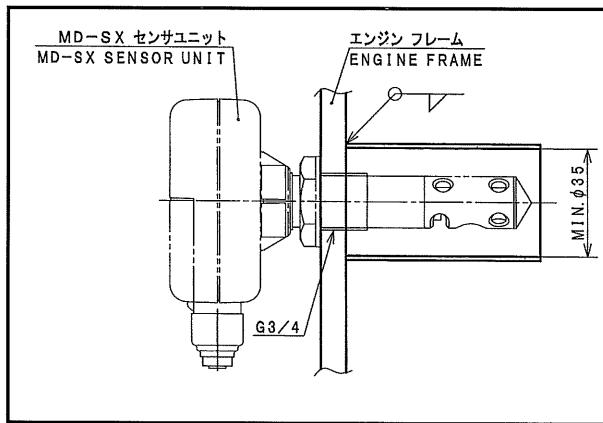


Fig.11 (Sample 1) Protection pipe

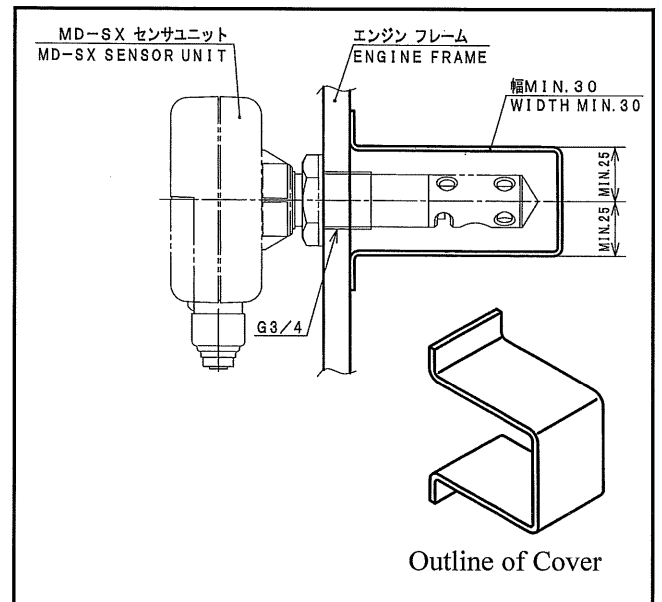


Fig.12 (Sample 2) Cover structure

(7) In case of fitting sensor to a gear case except the engine crankcase, a chain case, the part of fuel oil supply unit, please measure the vibration value of the sensor fitting part up to frequency 2KHz beforehand, then please fit the sensor after confirmed the specification is satisfied.

In case of exceeding the vibration value from the specified value of sensor, please fit the sensor after executed the anti-vibration measures.



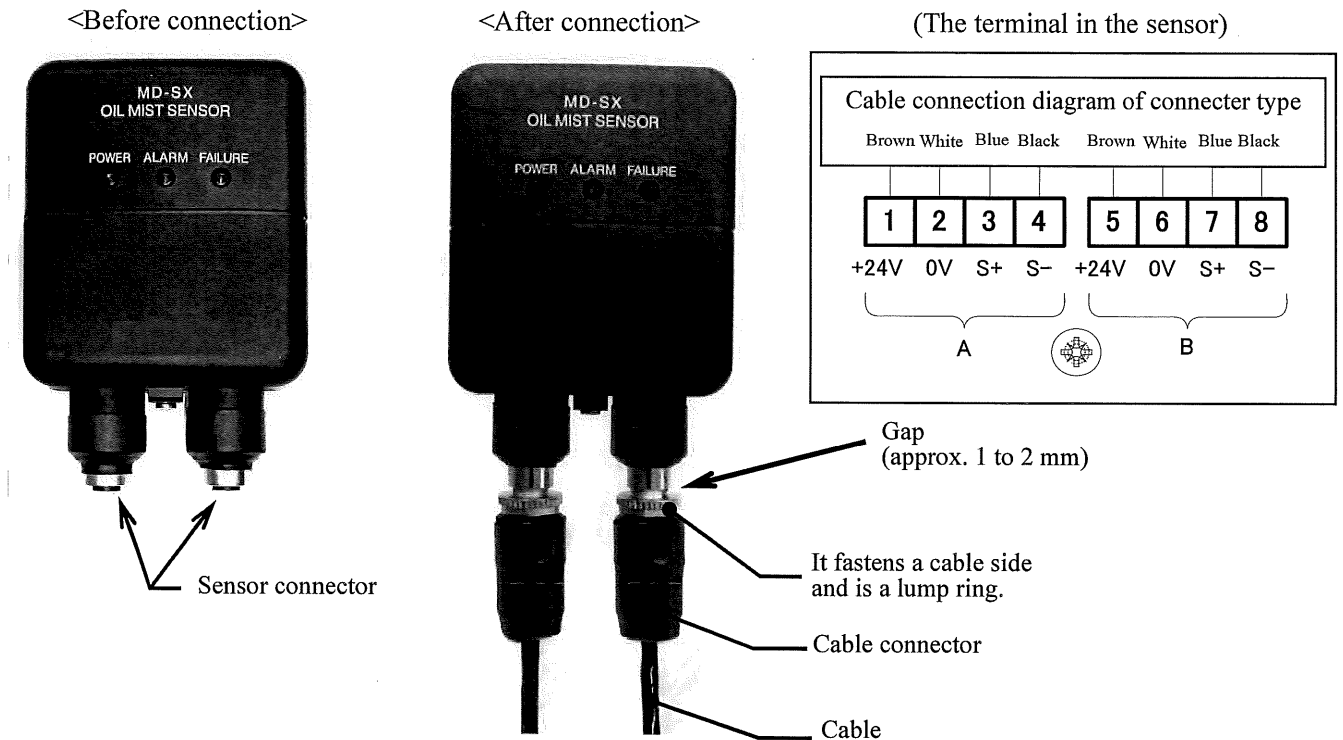
If the sensor is fitted to the place the vibration value is large, or the space the engine outside is narrow where the external force seems to suffer from the sensor connector,

Please adopt the flying lead type sensor or the ground type sensor.

- ※ When the connection is not enough between the sensor connector and cable connector by the large Vibration or external force to the sensor, it may cause communication abnormal and/or the breakdown of sensors. Please fix the cable within 200mm from a sensor connection to avoid the above troubles.

9.2 Wiring of the sensor

- (1) Cable for connection : option cables
 [Cable with both-ends connector] or [Cable with single-sided connector]
- (2) Connection topology : Daisy chain
- (3) Connection method : Connector - Connector



Cable connection diagram of connector type

Fig. 19 Connection of sensor and wiring (Connector)

- (4) Connection method of connectors
The connectors have polarity.
The sensor side is female connector.
The wiring side is male connector.

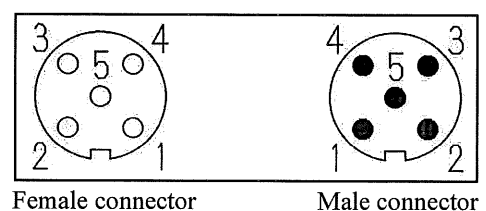


Fig. 20 CONNECTOR FORM

- 1) The connectors have a position to fit.
Connect the cable connector to the sensor connector while checking that the inner pins of the cable connector can be inserted into the holes of the sensor connector.

Notes) Please do not look for the fit position after putting connectors together.
The connector pins may be broken, and the broken pins may cause imperfect contact.

- 2) Tighten a cable side fixing ring with your hand enough.
After tightening, there will be a gap of approximately 1 to 2 mm between the sensor connector and the cable connector. This gap will not cause any problems.

Notes) Please set the termination and node settings to the sensors necessarily after wiring work was over. And attach a dust cover (option) to an unused connector of a sensor unit of end.

9.5 Wiring of the gland type sensors

Using the sensor of “gland type”, connection work for “Terminal Block” is necessary. The connection and method of wiring work for Terminal Block, please refer to [9.6 Cautions in wiring].

- (1) Loose screw fastening the slide cover and slide the slide cover to reveal the terminal block.
- (2) Wiring connection refer to Figure 26 [SENSOR TERMINAL BLOCK LAYOUT].
- (3) Set the termination and node settings to the sensors necessarily after wiring work was over.

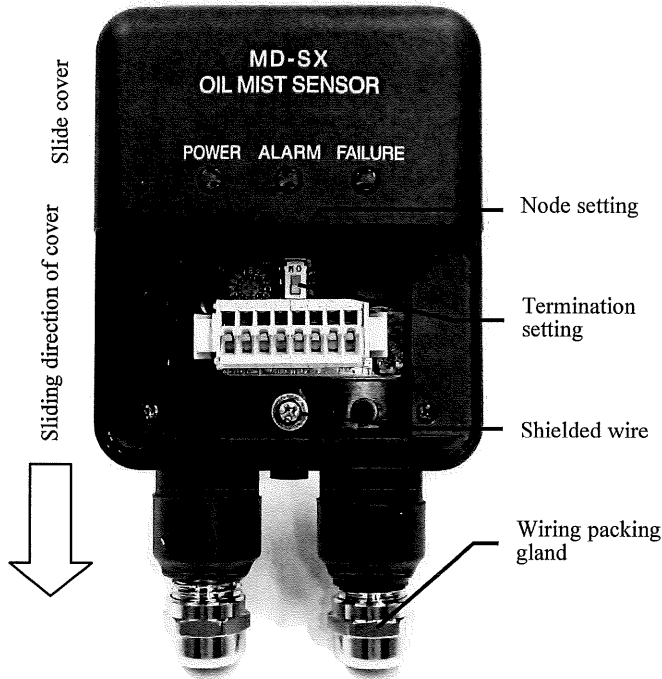


Fig. 26 Cable connection diagram (gland type)

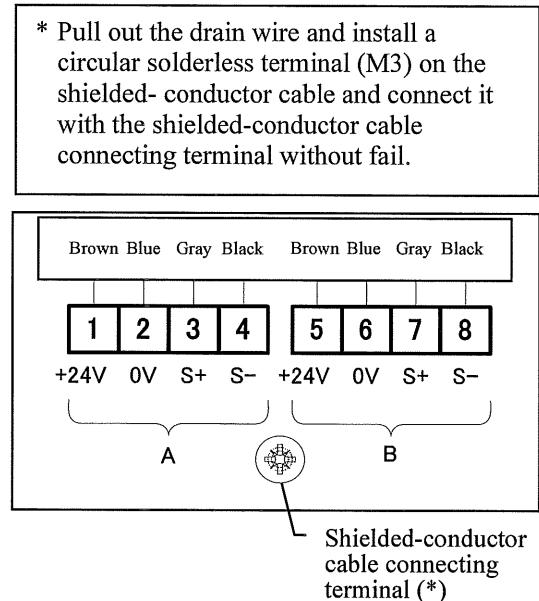


Fig. 27 Sensor terminal block layout

9.6 Cautions in wiring

The solderless terminal is not required for other connection terminal blocks as the clamp type (no screw) terminal blocks are used for them. See the wiring instruction for correct wiring as follows.

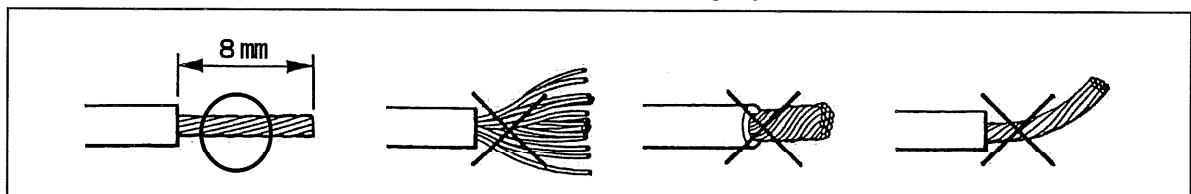
As connectors are equipped with the sensor unit terminal blocks, remove the connectors by pinching the locking devices on both ends of the connector and pulling the connector out if they make wiring difficult.

Connect the shielding wire to a “shielded-conductor cable connecting terminal” in a sensor unit with circle solderless terminal.

- (1) Wire end treatment for cables to be connected with the control unit and sensor terminal block:

Always bare wiring cable ends in correct length.

Bare the wiring cable end again if the core wires loosen, too tightly twisted, or bent.



- Wire size to be used
 - Sensor cable: $4 \times 0.5 \text{ mm}^2$

Fig. 28 Wire terminal treatment

10. INITIAL SETUP

10.1 Initial setup of sensor units

After fitting the sensor units on the engine, initialize the units while the controller power is off. Remove the lid of the sensor unit case, and operate the internal setting switches.

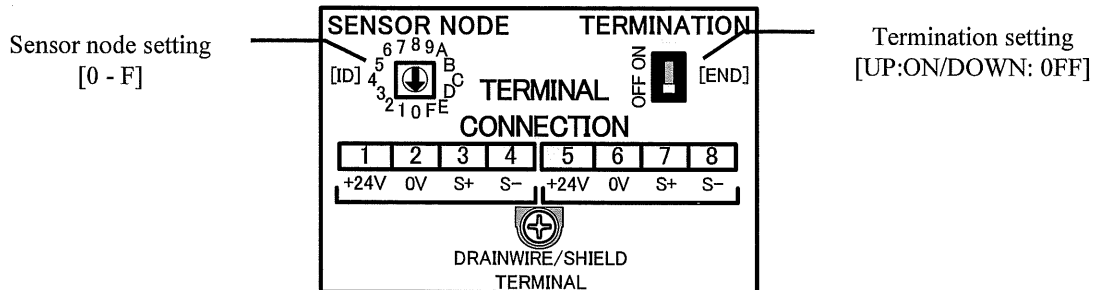


Fig. 30 Sensor terminal outline

- (1) Sensor (communication) node setting:
Setting necessary for the controller to recognize each sensor unit.
Set the rotary switch (16 channels) in the sensor unit to the specified position ("0" to "F").
Please set the node number from "0" sequentially from a No. 1 cylinder not to overlap.

When one engine is connected

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Controller channel | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Rotary switch setting position (Node No.) | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

- (2) Termination (terminator) [ON/OFF] setting:
Set the DIP switch in the sensor unit at the end to ON.

* After the completion of setting of the internal switches, fit the slide cover to the sensor unit case.