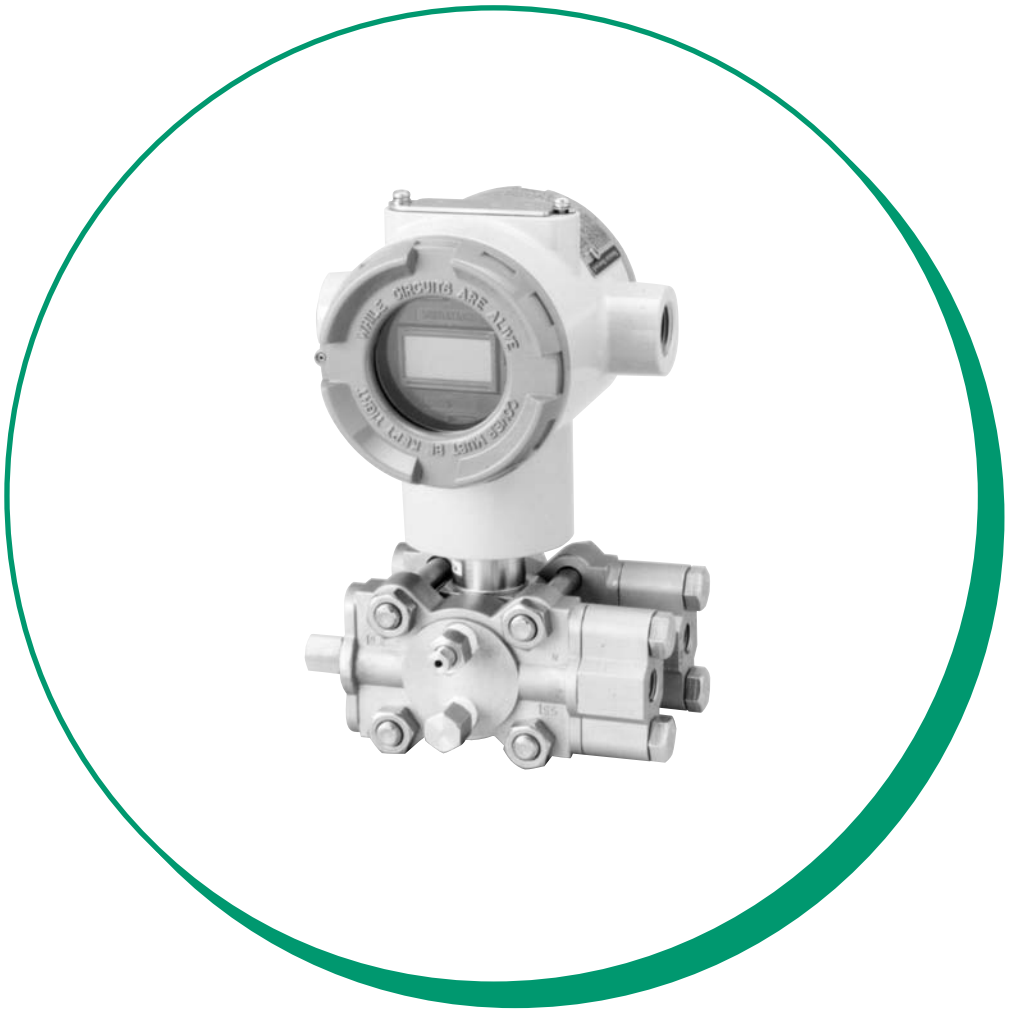
YAMATAKE

ST3000 Smart Transmitter Series900 Electronic Differential Pressure/ Pressure Transmitter Model : STD, STG, STA, STC, STE, STR, STH and STU

User's Manual



Yamatake Corporation

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Safety

Instructions

Preface

Correct installation and periodic maintenance are essential to the safe use of your differential pressure transmitters.

Read the safety instructions provided in this manual carefully and understand them fully before starting installation, operation, and maintenance work.

Inspection

On delivery, make sure that the specifications are correct and check for any damage that may have occurred during transportation. This equipment was tested under a strict quality control program before shipment. If you find any problem in the quality specifications, please contact your Yamatake Corporation representative immediately, providing the model name and serial number.

The name plate is mounted on the top of the enclosure.

Precautions

The following symbols are used in this manual to ensure user safety.

⚠ WARNING

This symbol is used to warn of hazards where failure to observe a safety instruction may result in death or serious injury.

⚠ CAUTION

This symbol is used to warn of hazards where failure to observe a safety instruction may result in injury or physical damage.

To ensure safe operation, be sure to observe the safety instructions provided on the next page.

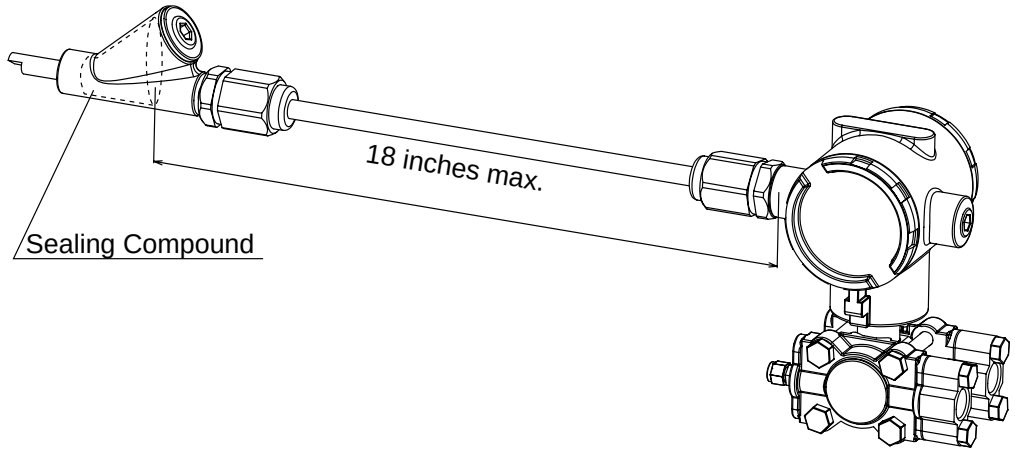
Yamatake Corporation will assume no responsibility, or offer any guarantee for any failure resulting from violation of these safety instructions.

Explosion protected Models

FM Explosionproof/Dust -ignitionproof Apparatus (in accordance with NEC)

⚠ CAUTION

- Install the apparatus only in areas for which the apparatus has been approved.
- Seal each conduit entering the apparatus enclosure within 18 in.(457mm) from the enclosure.
- Do not open the apparatus enclosure when an explosive atmosphere is present.



1. Class I, Division 1 locations

1.1 **Wiring methods**

- **Threaded rigid metal conduit, threaded steel intermediate metal conduit, or Type MI cable with termination fittings approved for the location**, can be employed
- **Threaded joints** must be made up with at least five threads fully engaged.

1.2 **Sealing**

- **Each conduit entering the apparatus enclosure is required to be sealed within 18 in. (457 mm) from the enclosure.**
- The sealing of each conduit can be provided with **a sealing fitting approved for class I locations.**
- **Sealing compound must be approved** and must not have a melting point of less than 93 ° (200 °F).
- The minimum thickness of the sealing compound should not be less than the trade size of the conduit and, in no case, less than 5/8 in.(16 mm).
- Splices and taps cannot be made in the fittings.

2. Class I, Division 2 locations

2.1 **Wiring methods**

- **Threaded rigid metal conduit, threaded steel intermediate metal conduit, enclosed gasketed busways**, or **Type PLTC cable** in accordance with the provisions of remote-control, signaling, and power-limited circuits (see NEC, Article 725), or **Type ITC cable** in cable trays, in raceways, supported by messenger wire, or directly buried where the cable is listed for this use; **Type MI, MC, MV, or TC cable with approved termination fittings** can be employed.

2.2 **Sealing**

- Each conduit entering the apparatus enclosure is required to be sealed as shown in 1.1.2.

3. Class II, Division 1 locations

3.1 **Wiring methods**

- **Threaded rigid metal conduit, threaded steel intermediate metal conduit, or Type MI cable with termination fittings approved for the location**, can be employed.

3.2 **Sealing**

- Where **a raceway** provides communication between the apparatus enclosure and an enclosure that is not required to be dust-ignitionproof, suitable means must be provided to prevent the entrance of dust into the former enclosure through this raceway. One of the following means can be used: (1) a permanent and effective seal; (2) a horizontal raceway not less than 10 ft (3.05 m) long; or (3) a vertical raceway not less than 5 ft (1.52 m) long and extending downward from the dust-ignitionproof enclosure.
- **Seals are not required to be explosionproof.**

4. Class II, Division 2 locations

4.1 **Wiring methods**

- **Rigid metal conduit, intermediate metal conduit, electrical metallic tubing, dust-tight wireways, or Type MC or MI cable with approved termination fittings, or Type PLTC in cable trays, or Type ITC in cable trays, or Type MC or TC cable installed in ladder, ventilated trough, or ventilated channel cable trays in a single layer, with a space not less than the larger cable diameter between the two adjacent cables**, can be employed.

4.2 **Sealing**

- Sealing means must be provided as shown in 1.3.2.

5. Class III, Division 1 locations

5.1 **Wiring methods**

- **Rigid metal conduit, rigid non-metallic conduit, intermediate metal conduit, electrical metallic tubing, dust-tight wireways**, or **Type MC or MI cable with approved termination fittings**, can be employed.

5.2 **Sealing**

- Sealing means are not required.

6. Class III, Division 2 locations

6.1 **Wiring methods**

- Wiring methods must comply with 5.1.

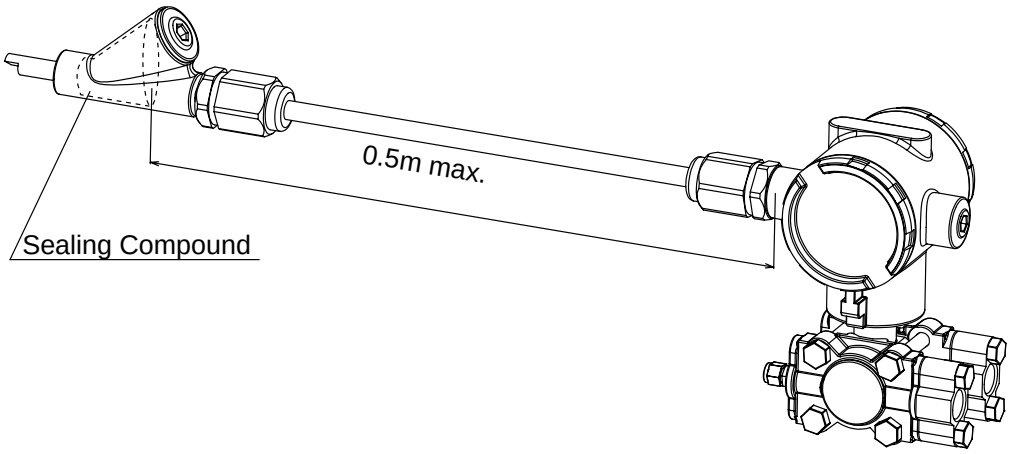
6.2 **Sealing**

- Sealing means are not required.

CSA Explosionproof / Dust-ignitionproof Apparatus (in accordance with CEC)

⚠ CAUTION

- Install the apparatus only in any hazardous (classified) locations for which the apparatus has been approved.
- Seal each conduit entering the apparatus enclosure within 500 mm of the enclosure according to the test report.
- Do not open the apparatus enclosure when an explosive atmosphere is present.



1. Class I, Division 1 locations

1.1 (a) **Threaded rigid metal conduit or** (b) **cables approved for hazardous locations with associated cable glands approved for the particular hazardous locations**, can be used.

1.2 **Threaded joints** must have **at least five full threads** fully engaged.

1.3 **Seals must be provided in conduit or cable systems** to prevent passage of gases, vapours or flames.

1.3.1 **The seal is located in each run of conduit entering the apparatus enclosure** as close as practicable to and **in no case more than 500 mm from the enclosure.**

1.3.2 The seal can be made in **a sealing fitting** approved for the location.

- **Sealing compound** must be approved for the purpose.
- The melting point of the sealing compound should not be less than 93°C (200°F).
- The minimum thickness of the sealing compound should not be less than the trade size of the conduit and in no case, less than 5/8 in. (16 mm).
- Splices and taps are not made in the fittings.

2. Class I, Division 2 locations

2.1 (a) **Threaded metal conduit**, or (b) **cables approved for hazardous locations with associated cable glands approved for the particular location**, or (c) **Type TC cable** installed in cable tray, or (d) **Type ACWU cable with associated cable glands approved for the particular location**, can be used.

2.2 **Seals must be provided in conduit or cable systems** to prevent passage of gases, vapours or flames.

2.2.1 **The seal is located** in each run of **conduit** entering **the apparatus enclosure** as close as practicable to and **in no case more than 450 mm from the enclosure**;

2.2.2 **The sealing in Class I, Division 2 locations** conforms to **1.3.2.**

3. Class II, Division 1 locations

3.1 (a) **Threaded rigid metal conduit**, or (b) **cables approved for hazardous locations with associated cable glands approved for the particular hazardous location**, can be used.

3.2 Where **a raceway** provides communication between the apparatus enclosure and an enclosure that is not required to be dust-tight, the entrance of dust into the former enclosure through this raceway must be prevented by (a) a permanent and effective seal, or (b) a horizontal section not less than 3 m long in the raceway, or (c) a vertical section of raceway not less than 1.5 m long and extending downward from the dust-tight enclosure.

4. Class II, Division 2 locations

4.1 (a) **Threaded metal conduit**, or (b) **cables approved for hazardous locations with associated cable glands approved for the particular location**, or (c) **Type TC cable** installed in cable tray, or (d) **Type ACWU cable with associated cable glands approved for the particular location**, can be used.

4.2 **Sealing of raceways** conforms to **3.2.**

5. Class III, Division 1 locations

5.1 **Wiring methods**

(a) **Threaded rigid metal conduit** or (b) **cables approved for hazardous locations with associated cable glands approved for the particular hazardous locations**, can be used.

5.2 **Sealing**

Sealing means are not required.

6. Class III, Division 2 locations

6.1 **Wiring methods**

The wiring methods in Class III, Division 2 locations conform to 5.1 except that in sections, compartments, or areas used solely for storage and containing no machinery. (In such sections, compartments, or areas, open wiring methods conforming to the rules for non-hazardous locations may be used.)

6.2 **Sealing**

Sealing means are not required.

FM /CSA Nonincendive Apparatus

⚠ CAUTION

- **The nonincendive apparatus** can be installed only in **Division 2** hazardous (classified) locations for which the apparatus has been approved.
- **Tampering and replacement of any components within the nonincendive apparatus** may impair safe use of the apparatus.

Installation requirements

1. Wiring of the nonincendive circuit is permitted using **any of the methods suitable for wiring in ordinary (unclassified) locations.**

~Note *Nonincendive apparatus is composed of all nonincendive circuits in which any arc or thermal effect produced **under normal operating conditions of the apparatus** is not capable of igniting the explosive atmospheres. This protection technique is permitted for apparatus in those **Class I, Division 2, Class II, Division 2**, and **Class III locations**. Nonincendive apparatus looks like intrinsically safe apparatus but are not, require associated apparatus (ex. shunt diode barriers).*

2. **In any raceway, junction box, or similar fitting**, the conductors of the nonincendive circuit cannot be placed with the conductors of any other system, unless (1) the conductors of the two systems are separated by a suitable mechanical partition, or (2) all of the conductors of either system are segregated by a grounded metal shield.

3. **It is recommended that separate nonincendive circuit conductors** to be in separate cables, unless (1) the conductors of each circuit are within a grounded metal shield, or (2) the conductors of each circuit have insulation with a minimum thickness of 0.01 in. (0.254mm)

4. **If a raceway (including conduit) and cable for a nonincendive circuit in Class I, Division 2 or Class II, Division 2 locations is capable of transmitting flammable atmosphere through the raceway and cable from the Division 2 location to a non-hazardous location**, it must be properly sealed at the boundary by using of non-approved sealing fittings.

ATEX Flameproof Apparatus

1. General

1.1 **The apparatus protected by the flameproof enclosure** in accordance with EN 50018 can be installed in such hazardous areas, for which the apparatus has been certified, as an explosive atmosphere containing flammable substances in the form of **gas, vapour, mist** or **dust** may be present.

~Note *The apparatus has been certified to comply with EN 50281-1-1(dust ignition protection).*

1.2 **The apparatus enclosure must be kept closed in hazardous areas when the apparatus is energized** because the internal circuit of the apparatus is capable of igniting in the explosive atmosphere. (Never connect any hand-held communicator to the apparatus terminals by opening the cover, except while no explosive atmosphere is present.)

1.3 It is required to connect **the external earthing terminal of the apparatus to the equipotential bonding system** which includes protective conductors, metal conduits, metal cable sheaths, steel wire armouring and metallic parts of structures, but does not include the neutral conductors of the power systems.

~Note *The protective conductor to which exposed conductive parts of equipment (machines, apparatus, devices, components and instrumentation thereof) are connected, must be separated in the hazardous area from the neutral conductor, and must be connected to the power system earth point in the non-hazardous area, if the power system is directory earthed.*

For external earthing and bonding of the apparatus it is recommended to use a **cable lug** so that the conductor is secured against loosening and twisting, and so that the contact pressure is permanently secured.

1.4 Either **cable systems** (cable entry systems) or **conduit systems** can be employed for wiring of the apparatus in the hazardous areas (see 2 or 3).

1.5 **Non-sheathed single core cables are not permitted for live conductors** unless they are installed inside enclosures or conduit systems.

1.6 **Conduits** and, **in special cases, cables** (for example, where there is a pressure difference) **must be sealed** so as to prevent the passage of the explosive atmosphere.

1.7 **Further information concerning installation and maintenance of apparatus** is given by relevant clauses in the following documents.

EN 60079-14 Electrical apparatus for explosive gas atmospheres
Part 14: **Electrical installations in hazardous areas**
EN 60079-17 Part 17: **Inspection and maintenance of electrical installations in hazardous areas.**
EN 60079-19 Part 19: **Repair and overhaul for apparatus used in explosive atmospheres**
EN 50281-1-2 Electrical apparatus for use in the presence of combustible dust
Part 1-2: Electrical apparatus protected by enclosures
-- **Selection, installation and maintenance**

2.Cable systems

2.1 **Thermoplastic sheathed cables, thermosetting sheathed cables**, or **elastomeric sheathed cables** can be selected for fixed wiring in the hazardous areas.

2.2 Flameproof cable entry devices (cable glands) certified to comply with EN 50018 and appropriate to the type of cable employed, must be used for the connection of cables to the apparatus.

3. Conduit systems

For conduit systems, relevant national standards or codes of practice should be followed prior to the following recommendations.

3.1 **Screwed heavy gauge steel, solid drawn or seam welded conduit, or flexible conduit for protection of cables in explosive atmospheres** (see ISO 10807) can be selected for fixed wiring in the hazardous areas.

3.2 **Conduit must be threaded for connection** to permit the full engagement of five threads.

3.3 Either **conduit entry devices** or **sealing devices such as stopping boxes** should be provided at the wall of the apparatus enclosure to limit the pressure piling effect and to prevent hot gases from entering the conduit system from the enclosure containing a source of ignition. **Each type of both the devices must be certified** to comply with EN 50018.

3.4 **The stopping boxes**, if used, **should be filled with a compound** which does not shrink on setting and is impervious to, and unaffected by, chemicals found in the hazardous area. **The depth of the compound in the stopping box** should be at least equal to the internal diameter of the conduit, but in no case less than 10 mm.

3.5 When the conduit contains three or more **non-sheathed single or multi-core cables**, the total cross-sectional areas of cables, including insulation, should not be more than 40% of the cross-sectional area of the conduit.

4. Installation in explosive atmospheres caused by air/dust mixtures

4.1 **Conduit** or **cable glands**, if employed to connect cables to the apparatus, must be selected and used in such a way that an IP6X protection (dust-tight) is guaranteed.

4.2 It is recommended to maintain the apparatus so that **the dust layer will not exceed a thickness of 5mm**.

~Note *Where **the ignition temperature of a dust layer up to 5mm thickness** is equal to, or higher than, the value that is obtained by adding 75K to the maximum surface temperature of the enclosure "T …°C" as marked on the apparatus, the apparatus is incapable of causing ignition of the dust layer. (T…°C is based on the maximum ambient temperature.)*

Instruction for Safety

1. Introduction

Explosion protected models

Smart Pressure Transmitters **ST3000 series 900** has been constructed and certified to comply with the CENELEC standards EN 50014, EN 50018,

EN 50281-1-1 and EN1127-1. Be sure to read all applicable laws of your country and local regulations for the installation of equipment for explosive atmospheres.

EN 50014, Electrical apparatus for potentially explosive atmospheres - General requirements

EN 50018, Electrical apparatus for potentially explosive atmospheres - Flameproof enclosure “d”

EN 50281-1-1, Electrical apparatus for use in the presence of combustible dust - Part1-1: Electrical apparatus protected by enclosures

EN 1127-1, Explosive atmospheres-Explosion prevention and protection- Part 1: Basic concepts and methodology

2. Smart Pressure Transmitters ST3000 series 900

Safety information marked on the transmitter

“  **II 2 G D EEx d II C T6”** is a full marking in accordance with the Directive 94/9/EC.

“II” indicates “equipment - group II” for use in places other than mines.

“2” indicates “equipment - category 2” for use in areas in which explosive atmospheres are likely to occur (**Zone 1**).

“**G”** is the symbol of the equipment - group and the equipment - category concerning explosive atmospheres caused by gases, vapors or mists.

“D” is the symbol of the equipment - group and the equipment - category concerning explosive atmospheres caused by dust (“Dust ignition protection”).

“d” is the symbol for the type of protection d (flameproof enclosure).

“IIC” indicates that the group equipment is suitable for use in the explosive gas group “C” which contains hydrogen, acetylene and carbon disulfide (Annex A to EN 50014).

“**T6**” indicates that the maximum surface temperature of the transmitter is in the temperature class T6, i. e. the maximum surface temperature never exceeds 85°C at the maximum ambient temperature of 60°C.

For particular use in the presence of combustible dust only,

“  **II 2 D”** can be abstracted from the full marking.

“IP67” indicates a protection class provided by enclosures (known as **IP code** specified in EN 60529), i. e. the first numeral “6” means that the transmitter is protected by a dust - tight enclosure as prescribed in EN 50281-1-1. The second

numeral **“7”** means that the transmitter is protected against the effects of temporary immersion in water.

“**CE**” (CE marking) indicates that, in accordance with the relevant European Directives: **Directive 94/9/EC** (ATEX Directive) and **Directive 89/336/EEC** (EMC Directive), the transmitter complies with the protection requirements relating to the design and construction of the transmitter. In addition, the CE marking is followed by the identification number **0344** of the notified body (KEMA) responsible of the production quality assurance notification under Directive 94/9/EC.

“**INERIS 99ATEX0010 X”:** The certificate number of EC-type examination carried out by INERIS responsible of the examination under Directive 94/9/EC.

“**DATE”**: The year of construction of Smart Pressure Transmitter ST3000 series 900 is printed with the last two figures, together with the name of the month.

3. Installation

3.1 Operating condition

⚠ WARNING

Never open the enclosure while the internal circuit is alive.

3.2 Mounting and wiring

For use in explosive atmospheres of gase, fluid or vapor:

The cable and conduit entry devices must be of a certified flameproof type, suitable for the conditions of use and correctly installed.

With the use of conduit entries a sealing device must be provided either in the flameproof enclosure or immediately on the entrance thereto.

For use in the presence of combustible dust:

The cable and conduit entry devices must be of a certified flameproof type of E - or ATEX - Generation, suitable for the conditions of use and correctly installed. Those devices must satisfy the requirements for IP6X (dust - tight) as specified in EN 60529.

For external earthing and bonding:

A cable lug must be used so that the conductor is secured against loosening and twisting and so that the contact pressure is permanently secured.

Special condition for safe use:

The fastening screws of this apparatus are made of stainless steel and have a yield stress of 500N/mm^2

4. Operation

Precautions

⚠ WARNING

Do not open the enclosure when energized.

5. Maintenance

⚠ WARNING

Unauthorized modifications of any part of the enclosure or the internal circuit may invalidate the verified explosion protection of Smart Pressure Transmitter ST3000 series 900.

The integrity of enclosure must always be maintained.

6. Troubleshooting

⚠ WARNING

Do not open the enclosure when energized.

7. Specifications

Item	Description
Enclosure rating	IP67
Explosion protection	Flameproof **II 2 D EEx d IIC T6;** Dust ignition protection **II 2 D;** for ambient temperature - 20 to 60°C (Note 1)

~Note *The cable and conduit entry devices must be of a certified flameproof type (see 3.2 Mounting and wiring)*

FM Intrinsically Safe System (in accordance with NEC and ANSI/ISA RP 12.6)

⚠ CAUTION

- Only suitable **associated apparatus separately approved by FM (FMRC)** shall be connected to the intrinsically safe apparatus.
- Electrical equipment connected to the associated apparatus in non-hazardous locations shall not use or generate more than 250 Vrms.
- Tampering and replacement of any components within the intrinsically safe apparatus with non-factory components may adversely affect the safe use of the system.

Installation requirements

1. The intrinsically safe and associated apparatus shall be installed in accordance with **the control drawing(s)** attached.

   Especially, the control drawing(s) provides guidance on determining **the maximum allowed capacitance and inductance of the interconnecting cables**.

2. The intrinsically safe and associated apparatus is permitted to be installed in any hazardous (classified) location for which they have been approved, **by using any of the wiring methods suitable for ordinary (unclassified) locations**, including wiring methods for communication systems.

3. **Conductors of the intrinsically safe circuit shall not be placed in raceways, cable trays, and cables with conductors of any non-intrinsically safe circuit, unless** (1) the conductors of the intrinsically safe circuit are separated from these of the non-intrinsically safe circuits by a distance of at least 50 mm, and secured or separated by a grounded partition or an approved insulating partition; or (2) either all of the intrinsically safe circuit conductors or all of the non-intrinsically safe circuit conductors are in grounded metal-sheathed or metal-clad cables where the sheathing or cladding is capable of carrying fault current to ground.

4. **Different intrinsically safe circuits shall be in separate cables, unless** (1) the conductors of each circuit are within a grounded metal shield, or (2) the conductors of each circuit have insulation with a minimum thickness of 0.01 inch (0.25 mm).

5. Intrinsically safe apparatus, associated apparatus, shields of conductors or cables, enclosures and raceways, if of metal, shall be grounded.

6. **If the associated apparatus is a type of shunt diode barriers**, supplementary bonding to the grounding electrode is needed. And the grounding path resistance from the farthest barrier to the grounding electrode shall not exceed 1Ω.

   In practice, the bonding to the grounding electrode is achieved by connecting the grounding terminals of the barriers to the intrinsically safe ground bus which is connected to the grounding electrode with an insulated conductor not smaller than No.12 AWG (2.05 mm in dia.).

7. **In hazardous locations, non-current-carrying metal parts** of the apparatus, raceways, and other enclosures of the intrinsically safe system shall be bonded to ensure **the electrical continuity**.

8. **In non-hazardous locations, where metal raceways are used for the intrinsically safe system wiring in hazardous locations, all intervening raceways, fittings, boxes, enclosures, etc**. between the hazardous locations and the point of grounding for the power supply system or point of grounding of a separately derived system, shall be grounded by using bonding jumpers with proper fittings or other approved means of bonding.

9. Where **conduits and cables** are used to protect the intrinsically safe wiring against environments, the conduits and cables **must be sealed** so that they do not transmit gases, vapors, or dust from a hazardous location to a non-hazardous location. **Sealing fittings** should be installed in each conduit run leaving the hazardous location, on either side of the boundary within 10 ft (3.05 m) of the boundary. Such seals need not be explosionproof.

10. **The grounding electrode** usually available on premises is specified in a), b), c) or d):

    a) **Metal underground water pipe** in direct contact with the earth for 10 ft (3.05 m) or more.

    b) **Metal frame of the building**, where effectively grounded.

    c) Concrete-encased electrode. An electrode encased by at least 2 in. (50.8 mm) of concrete, located within and near the bottom of a concrete foundation or footing that is in direct contact with the earth, consisting of at least 20 ft (6.1m) of one or more bare or zinc galvanized or other electrically conductive coated steel reinforcing bars or rods not less than 1/2 in. (12.7 mm) diameter, or consisting of at least 20 ft (6.1 m) of bare copper conductor not smaller than No.2 AWG (6.54 mm in dia.).

    d) **Ground ring**. A ground ring encircling the building or structure, in direct contact with the earth at a depth below earth surface not less than 2 1/2 ft (762 mm), consisting of at least 20 ft (6.1 m) of bare copper conductor not smaller than No.2 AWG.

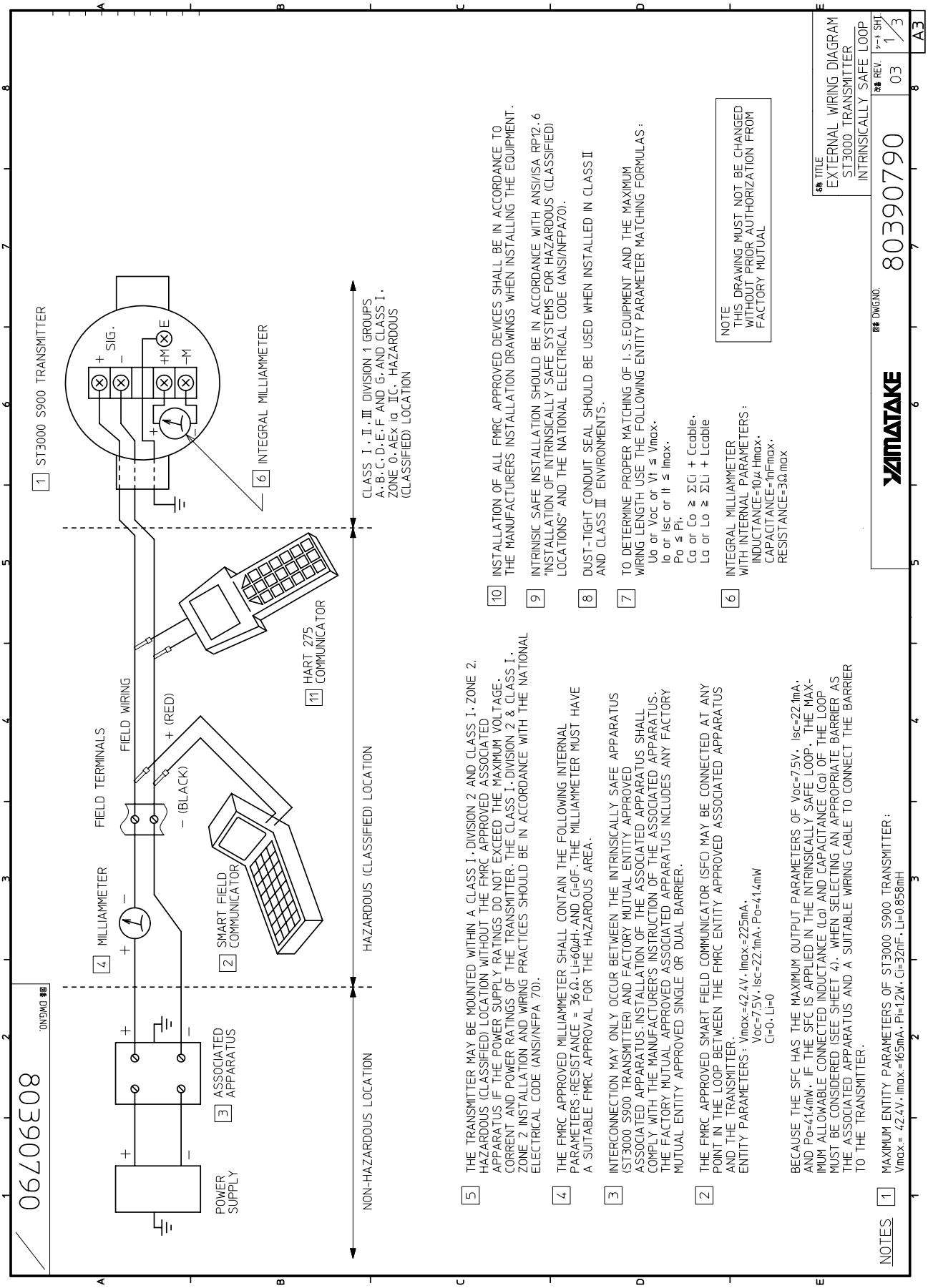
    Where none of the above electrodes is available, made electrodes should be used:

e) Rod and pipe electrodes. Not less than 8 ft (2.44 m) in length, consisting of the following materials, and being installed in the following manner:

- Electrodes of pipe or conduit shall not be smaller than 3/4 in. trade size and, where of iron or steel, shall have the outer surface galvanized or otherwise metalcoated for corrosion protection.
- Electrodes of rods of iron or steel shall be at least 5/8 in. (15.87 mm) in diameter. Stainless steel rods less than 5/8 in. (15.87 mm) in diameter, non-ferrous rods, or their equivalent shall not be less than 1/2 in. (12.7 mm) in diameter.
- The electrode shall be installed such that at least 8 ft (2.44 m) of length is in contact with the soil. It shall be driven to a depth of not less than 8 ft (2.44 m).

f) **Plate electrodes.** Each plate electrode shall expose not less than 2 sq ft (0.186 sq m) of surface to exterior soil. Electrodes of iron or steel plates shall be at least 1/4 in. (6.35 mm) in thickness. Electrodes of non-ferrous metal shall be at least 0.06 in. (1.52 mm) in thickness.

A single electrode consisting of a rod, pipe, or plate that does not have a resistance to ground of 25Ω or less shall be augmented by one additional electrode of any of the types specified in a) to f). Where multiple rod, pipe, or plate electrodes are installed, they shall not be less than 6 ft (1.83 m) apart.


DWG.NO 80390790
1 ST3000 S900 TRANSMITTER
2 SMART FIELD COMMUNICATOR
3 ASSOCIATED APPARATUS
4 MILLIAMMETER
6 INTEGRAL MILLIAMMETER
11 HART 275 COMMUNICATOR
FIELD TERMINALS
FIELD WIRING
+ (RED)
– (BLACK)
SIG.
+M
–M
E
POWER SUPPLY
NON-HAZARDOUS LOCATION
HAZARDOUS (CLASSIFIED) LOCATION
CLASS Ⅰ, Ⅱ, Ⅲ DIVISION 1 GROUPS A.B.C.D.E.F AND G. AND CLASS Ⅰ. ZONE 0, AEx ia ⅡC, HAZARDOUS (CLASSIFIED) LOCATION
NOTES
1 MAXIMUM ENTITY PARAMETERS OF ST3000 S900 TRANSMITTER:
Vmax = 42.4V. Imax=165mA. Pi=1.2W. Ci=32nF. Li=0.858mH
BECAUSE THE SFC HAS THE MAXIMUM OUTPUT PARAMETERS OF Voc=7.5V. Isc=22.1mA. AND Po=41.4mW. IF THE SFC IS APPLIED IN THE INTRINSICALLY SAFE LOOP, THE MAXIMUM ALLOWABLE CONNECTED INDUCTANCE (La) AND CAPACITANCE (Ca) OF THE LOOP MUST BE CONSIDERED (SEE SHEET 4). WHEN SELECTING AN APPROPRIATE BARRIER AS THE ASSOCIATED APPARATUS AND A SUITABLE WIRING CABLE TO CONNECT THE BARRIER TO THE TRANSMITTER.
2 THE FMRC APPROVED SMART FIELD COMMUNICATOR (SFC) MAY BE CONNECTED AT ANY POINT IN THE LOOP BETWEEN THE FMRC ENTITY APPROVED ASSOCIATED APPARATUS AND THE TRANSMITTER.
ENTITY PARAMETERS: Vmax=42.4V. Imax=225mA.
Voc=7.5V. Isc=22.1mA. Po=41.4mW
Ci=0. Li=0
3 INTERCONNECTION MAY ONLY OCCUR BETWEEN THE INTRINSICALLY SAFE APPARATUS (ST3000 S900 TRANSMITTER) AND FACTORY MUTUAL ENTITY APPROVED ASSOCIATED APPARATUS. INSTALLATION OF THE ASSOCIATED APPARATUS SHALL COMPLY WITH THE MANUFACTURER'S INSTRUCTION OF THE ASSOCIATED APPARATUS, THE FACTORY MUTUAL APPROVED ASSOCIATED APPARATUS INCLUDES ANY FACTORY MUTUAL ENTITY APPROVED SINGLE OR DUAL BARRIER.
4 THE FMRC APPROVED MILLIAMMETER SHALL CONTAIN THE FOLLOWING INTERNAL PARAMETERS: RESISTANCE = 36Ω. Li=60μH. AND Ci=0F. THE MILLIAMMETER MUST HAVE A SUITABLE FMRC APPROVAL FOR THE HAZARDOUS AREA.
5 THE TRANSMITTER MAY BE MOUNTED WITHIN A CLASS Ⅰ. DIVISION 2 AND CLASS Ⅰ. ZONE 2. HAZARDOUS (CLASSIFIED) LOCATION WITHOUT THE FMRC APPROVED ASSOCIATED APPARATUS IF THE POWER SUPPLY RATINGS DO NOT EXCEED THE MAXIMUM VOLTAGE, CURRENT AND POWER RATINGS OF THE TRANSMITTER. THE CLASS Ⅰ. DIVISION 2 & CLASS Ⅰ. ZONE 2 INSTALLATION AND WIRING PRACTICES SHOULD BE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE (ANSI/NFPA 70).
6 INTEGRAL MILLIAMMETER WITH INTERNAL PARAMETERS: INDUCTANCE=10μ Hmax. CAPACITANCE=1nFmax. RESISTANCE=30Ω max
7 TO DETERMINE PROPER MATCHING OF I.S. EQUIPMENT AND THE MAXIMUM WIRING LENGTH USE THE FOLLOWING ENTITY PARAMETER MATCHING FORMULAS:
Uo or Voc or Vt ≤ Vmax.
Io or Isc or It ≤ Imax.
Po ≤ Pi.
Ca or Co ≥ ΣCi + Ccable.
La or Lo ≥ ΣLi + Lcable
8 DUST-TIGHT CONDUIT SEAL SHOULD BE USED WHEN INSTALLED IN CLASS Ⅱ AND CLASS Ⅲ ENVIRONMENTS.
9 INTRINSIC SAFE INSTALLATION SHOULD BE IN ACCORDANCE WITH ANSI/ISA RP12.6 "INSTALLATION OF INTRINSICALLY SAFE SYSTEMS FOR HAZARDOUS (CLASSIFIED) LOCATIONS" AND THE NATIONAL ELECTRICAL CODE (ANSI/NFPA70).
10 INSTALLATION OF ALL FMRC APPROVED DEVICES SHALL BE IN ACCORDANCE TO THE MANUFACTURERS INSTALLATION DRAWINGS WHEN INSTALLING THE EQUIPMENT.
NOTE
THIS DRAWING MUST NOT BE CHANGED WITHOUT PRIOR AUTHORIZATION FROM FACTORY MUTUAL
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11 THE FMRC APPROVED HART 275 COMMUNICATOR (HHT) MAY BE CONNECTED AT ANY POINT IN THE LOOP BETWEEN THE FMRC ENTITY APPROVED ASSOCIATED APPARATUS AND THE TRANSMITTER.
EXAMPLE ENTITY PARAMETERS,SEE HHT CONTROL DRAWING FOR ACTUAL ENTITY PARAMETERS: Vmax.=30V, Imax.=300mA.
Voc=1.7V, Isc=32mA
Ci=0.07μF, Li=0

BECAUSE THE HHT HAS THE MAXIMUM OUTPUT PARAMETERS OF Voc=1.7V AND Isc=32mA. IF THE HHT IS APPLIED IN THE INTRINSICALLY SAFE LOOP, THE MAXIMUM ALLOWABLE CONNECTED INDUCTANCE (La) AND CAPACITANCE (Ca) OF THE LOOP MUST BE CONSIDERED (SEE SHEET 5). WHEN SELECTING AN APPROPRIATE BARRIER AS THE ASSOCIATED APPARATUS AND A SUITABLE WIRING CABLE TO CONNECT THE BARRIER TO THE TRANSMITTER.

12 SMART FIELD COMMUNICATOR (SFC) AND HART 275 COMMUNICATOR (HHT) SHALL NOT BE CONNECTED IN THE LOOP AT THE SAME TIME.

13 AEx ib IS SUITABLE ONLY FOR CLASS I, ZONE 1 HAZARDOUS (CLASSIFIED) LOCATIONS AND IS NOT SUITABLE FOR CLASS I, ZONE 0, OR CLASS I, DIVISION 1 HAZARDOUS (CLASSIFIED) LOCATIONS.

14 THE POWER SUPPLY CONNECTED TO THE ASSOCIATED APPARATUS MUST NOT USE OR GENERATE MORE THAN 250 Vrms OR Vdc.

CONSIDERATION OF AN INTRINSICALLY SAFE LOOP BASED ON ENTITY PARAMETERS

THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS TO ASSOCIATED APPARATUS NOT SPECIFICALLY EXAMINED IN SUCH COMBINATION.

BASICALLY, THE MAXIMUM UNPROTECTED CAPACITANCE (Ci) AND INDUCTANCE (Li) OF THE INTRINSICALLY SAFE APPARATUS, INCLUDING INTERCONNECTING WIRING PARAMETERS (Lcable, Ccable), MUST BE EQUAL OR LESS THAN THE CAPACITANCE (Ca) AND INDUCTANCE (La) WHICH CAN BE SAFELY CONNECTED TO THE ASSOCIATED APPARATUS. ALSO, THE MAXIMUM OUTPUT PARAMETERS (Voc, Isc, Po) OF THE ASSOCIATED APPARATUS MUST BE EQUAL OR LESS THAN THE MAXIMUM ENTITY PARAMETERS (Vmax, Imax, Pmax) OF THE INTRINSICALLY SAFE APPARATUS.

IF THE SFC IS CONNECTED TO THE INTRINSICALLY SAFE LOOP, FURTHER CONSIDERATION MUST BE TAKEN AS SHOWN BY THE FOLLOWING EXAMPLES.

EXAMPLE 1. La

MAXIMUM OUTPUT CURRENT (Isum) TO THE LOOP IN THE WORST SITUATION IS THE SUM OF THE DELIVERED CURRENT (Isc) BY THE BARRIER AND THAT (Isc) BY THE SFC. IF Isc OF THE BARRIER IS 93mA,

Isum = 93mA + 22.1mA = 115.1mA.

THEN, BY APPLYING 120mA (THE NEXT HIGHER VALUE OF THE RESULTING Isum) TO THE TABLE OF NEXT PAGE, La FOR GROUP A/B IS DETERMINED : La=2.50mH.

THE ABOVE OBTAINED La VALUE MUST SATISFY THE BELOW RELATIONSHIP.

La ≧ Li (TRANSMITTER) + Lcable + Li (SFC).

ACCORDINGLY, THE WIRING INDUCTANCE NEVER EXCEEDS THE VALUE La - Li (TRANSMITTER) - Li (SFC), i.e. IF Li OF TRANSMITTER IS 11μH,

Lcable ≦ 2.50mH - 11μH - 0 = 2.489mH.

NOTE: IF THE ABOVE Lcable VALUE IS SMALLER THAN THE INDUCTANCE OF A CABLE, ANOTHER BARRIER WITH A SMALLER Isc VALUE SHOULD BE SELECTED.

EXAMPLE 2. Ca

MAXIMUM OUTPUT VOLTAGE (Vsum) TO THE LOOP IN THE WORST SITUATION IS THE SUM OF THE DELIVERED VOLTAGE (Voc) BY THE BARRIER AND THAT (Voc) BY THE SFC. IF Voc OF THE BARRIER IS 28V.

Vsum = 28V + 7.5V = 35.5V.

THEN, BY APPLYING 36V (THE NEXT HIGHER VALUE OF THE RESULTING Vsum) TO THE TABLE OF NEXT PAGE, Ca FOR GROUP A/B IS DETERMINED : Ca=0.08 μF.

THE ABOVE OBTAINED Ca VALUE MUST SATISFY THE BELOW RELATIONSHIP.

Ca ≧ Ci (TRANSMITTER) + Ccable + Ci (SFC).

ACCORDINGLY, THE WIRING CAPACITANCE NEVER EXCEEDS THE VALUE Ca - Ci (TRANSMITTER) - Ci (SFC), i.e. IF Ci OF TRANSMITTER IS 0.032 μF

Ccable ≦ 0.08 μF - 0.032 μF - 0 = 0.048 μF.

NOTE: IF THE ABOVE Ccable VALUE IS SMALLER THAN THE CAPACITANCE OF A CABLE, ANOTHER BARRIER WITH A SMALLER Voc VALUE SHOULD BE SELECTED.

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IF THE HHT IS CONNECTED TO THE INTRINSICALLY SAFE LOOP, FURTHER CONSIDERATION MUST BE TAKEN AS SHOWN BY THE FOLLOWING EXAMPLES.

EXAMPLE 3. La

MAXIMUM OUTPUT CURRENT (Isum) TO THE LOOP IN THE WORST SITUATION IS THE SUM OF THE DELIVERED CURRENT (Isc) BY THE BARRIER AND THAT (Isc) BY THE HHT. IF Isc OF THE BARRIER IS 93mA.

Isum = 93mA + 32mA = 125mA.

THEN, BY APPLYING 130mA (THE NEXT HIGHER VALUE OF THE RESULTING Isum) TO THE RIGHT TABLE, La FOR GROUP A/B IS DETERMINED : La=2.00mH.

THE ABOVE OBTAINED La VALUE MUST SATISFY THE BELOW RELATIONSHIP.

La ≧ Li (TRANSMITTER) + Lcable + Li (HHT).

ACCORDINGLY, THE WIRING INDUCTANCE NEVER EXCEEDS THE VALUE La - Li (TRANSMITTER) - Li (HHT), i.e. IF Li OF TRANSMITTER IS 11μH,

Lcable ≦ 2.00mH - 11μH - 0 = 1.989mH

NOTE : IF THE ABOVE Lcable VALUE IS SMALLER THAN THE INDUCTANCE OF A CABLE, ANOTHER BARRIER WITH A SMALLER Isc VALUE SHOULD BE SELECTED.

EXAMPLE 4. Ca

MAXIMUM OUTPUT VOLTAGE (Vsum) TO THE LOOP IN THE WORST SITUATION IS THE SUM OF THE DELIVERED VOLTAGE (Voc) BY THE BARRIER AND THAT (Voc) BY THE HHT. IF Voc OF THE BARRIER IS 28V.

Vsum = 28V + 1.7V = 29.7V.

THEN, BY APPLYING 30V (THE NEXT HIGHER VALUE OF THE RESULTING Vsum) TO THE RIGHT TABLE, Ca FOR GROUP A/B IS DETERMINED : Ca=0.12μF.
THE ABOVE OBTAINED Ca VALUE MUST SATISFY THE BELOW RELATIONSHIP.

Ca ≧ Ci (TRANSMITTER) + Ccable + Ci (HHT).

ACCORDINGLY, THE WIRING CAPACITANCE NEVER EXCEEDS THE VALUE Ca - Ci (TRANSMITTER) - Ci (HHT), i.e. IF Ci OF TRANSMITTER IS 0.032μF,

Ccable ≦ 0.12μF - 0.032μF - 0 = 0.088μF.

NOTE : IF THE ABOVE Ccable VALUE IS SMALLER THAN THE CAPACITANCE OF A CABLE, ANOTHER BARRIER WITH A SMALLER Voc VALUE SHOULD BE SELECTED.

Isum = Isc (ASSOCIATED APPARATUS) + Isc(SMART COMMUNICATOR OR HART COMMUNICATOR)
Vsum = Voc (ASSOCIATED APPARATUS) + Voc (SMART COMMUNICATOR OR HART COMMUNICATOR)

Isum (MILLI AMPERES)	La (MILLI HENRYS)		
	A/B	C	D
20	90.00	330.00	700.00
21	82.00	300.00	635.30
23	68.00	250.00	530.10
25	58.00	210.00	449.00
28	46.00	170.00	358.40
30	40.00	150.00	312.40
32	36.00	135.00	274.80
35	31.00	110.00	229.90
40	23.00	87.00	176.30
45	19.00	70.00	139.40
50	15.00	56.00	113.10
55	12.00	48.00	93.50
57	11.00	43.00	87.10
60	10.00	40.00	78.70
62	9.50	37.00	73.70
65	8.80	34.00	67.10
70	7.50	28.00	57.90
75	6.70	25.00	50.50
80	6.00	22.00	44.40
85	5.50	20.00	39.30
90	5.00	18.00	35.10
100	4.00	15.00	28.50
110	3.00	12.00	23.60
120	2.50	10.00	19.80
130	2.00	9.00	16.90
140	1.60	8.00	14.60
150	1.30	7.00	12.70
160	1.00	6.20	11.20
170	0.80	5.50	9.90
180	0.60	5.00	8.80
200	0.50	4.00	7.20
220	0.40	3.20	5.90

Vsum (VOLTS)	Ca (MICROFARADS)		
	A/B	C	D
5	91.97	275.91	735.77
10	3.21	9.64	25.69
15	0.78	2.35	6.26
20	0.34	1.01	2.7
22	0.26	0.78	2.09
24	0.21	0.63	1.67
26	0.17	0.51	1.37
28	0.14	0.43	1.14
30	0.12	0.36	0.97
32	0.11	0.32	0.84
34	0.09	0.28	0.73
36	0.08	0.24	0.65
38	0.08	0.22	0.58
40	0.06	0.19	0.52
42	0.06	0.18	0.47

名称 TITLE
EXTERNAL WIRING DIAGRAM
ST3000 TRANSMITTER
INTRINSICALLY SAFE LOOP

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図番 DWG.NO. 80390790
改番 REV. 03
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About This Publication

This manual is intended as a detailed “how to” reference for installing, piping wiring, configuring, starting up, operating, maintaining, calibrating, and servicing Yamatake’s family of ST3000 Smart Transmitters. It is based on using a model SFC160/260 Smart Field Communicator as the operator interface for the ST3000 Smart Transmitter. Be aware that some data in this manual overlaps information in the field Communicator Model SFC160/260 Operating Guide.

While this manual provides detailed procedures to assist first time users, it also includes keystroke summaries for most procedures as a quick reference for experienced users.

Precautions

General Precautions

1. Checking the Product

When you accept the ST3000 Smart Transmitter, check its appearance to make sure that it is not damaged.

A Smart Transmitter with semi-standard or special specifications may have different accessories.

2. Check the specifications

The specifications are marked on the name plate on the outside of the transmitter case. Make sure that the specifications match your order by referring to the specifications.

In making an inquiry, identify the model No. and the product No.

3. Transportation

We recommend to transport the transmitter to the installation site in the packaged state in order to prevent damages from occurring during transportation.

4. Storage Environment

(1) Storage location

During storage, protect the transmitter from rain water as well as from heavy vibration and shock. Store it at normal temperature and humidity (about 25°C, 65%RH) as much as possible.

(2) Store the transmitter in original packaging if possible.

(3) If a used transmitter must be stored for some period, wash it thoroughly after making sure that no fluid remains in the pressure receiving section.

5. Installation Environment

In order to maintain the original performance and reliability for a long time, install the transmitter in the following environment:

(1) Ambient temperature

(a) The temperature gradient and temperature changes in installation environment should be as small as possible.

(b) If a transmitter is exposed to heat radiated from the process side, lower its ambient temperature as much as possible by insulating it or by selecting a well-ventilated location for installation.

(c) If a process fluid can freeze, prevent freezing by means of heat insulation.

(2) Emvironment

Avoid corrosive emvironment as much as possible.

Install in explosion proof and intrinsically safe conditions.

(3) Shock and vibration

Install the transmitter where shocks and vibrations will be as small as possible.

(4) Installation of explosion proof type transmitter.

Refer to “Instructions for Explosion proof Transmitter“.

6. Application of Pressure to transmitter

In applying pressure to this transmitter, observe the following rules.

(1) The locking bolts of the adapter flange are loose when shipped. Tighten them to the specified torque.

(2) Do not apply a pressure that exceeds the specified level.

(3) Do not tighten or loosen bolts while pressure is being applied to the transmitter.

(4) When a transmitter is used for measuring a poisonous substance, handle it carefully even after the pressure is released.

7. Electronic Parts

(1) This transmitter has several CMOS electronic components. Since static electricity can easily cause the functional destruction of a CMOS component, never directly touch them or touch a circuit with your hands.

(2) Is components must be touched, equalize the potential of the components before doing so.

(3) When the printed wiring board (PWB) is removed, protect it in a non-conductive bag.

8. Using a Transceiver

(1) When a transceiver is used very near a transmitter, its transmission frequency (in the form of high frequency noise) may cause radio interference.

(2) When using a transceiver, determine the distance that will be necessary for avoiding any interference, and ensure that the distance between the transceiver and the transmitter is greater.

(3) When using a transceiver, be sure to close the cover of the transmitter

9. Welding in Proximity

(1) When welding is to be carried out near the transmitter, the welding current may affect the operation of the transmitter depending on the grounding method.

(2) Directly ground the welding equipment and power transformer. Do not ground to the stanchion pipe of the transmitter.

(3) Turn off the power supply to the transmitter.

Technical Assistance

If you encounter a problem with your ST3000 Smart Transmitter, check to see how your transmitter is currently configured, and verify that all selections are consistent with your application.

If the problem persists, please call Yamatake group representatives.

An engineer will discuss your problem with you. Please have your complete model number, serial number, and software revision number on hand for reference, You can find the model and serial numbers on the transmitter nameplates. You can also view the software version number using the SFC.

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Chapter 1 : Overview-First Time Users Only

1-1 : Introduction

This section is intended for users who have never worked with our ST3000 Smart Transmitter and its companion operator interface device, the hand-held Smart Field Communicator (SFC). It provides some general information to acquaint you with the ST3000 Smart Transmitter and the SFC.

1-2 : ST3000 Smart Transmitters

Yamatake's ST3000 Smart Transmitter includes model variations of these basic pressure measurement types.

- Differential Pressure
- Gauge Pressure
- Absolute Pressure

Transmitter adjustments

Except for optional zero and span adjustments available with ST3000 Smart Transmitters only, the ST3000 Smart Transmitter has no physical adjustments.

You need an SFC to make adjustments to a ST 3000 Smart Transmitter.

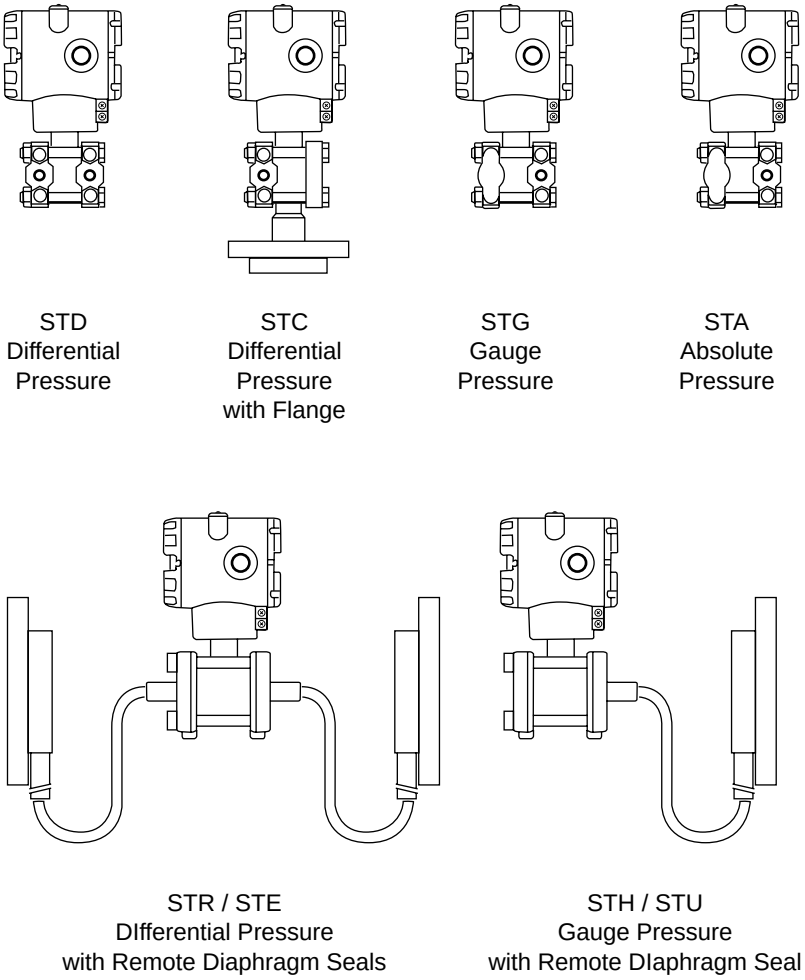


Figure 1-1 ST3000 Smart Transmitter Family.

1-3 : Smart Field Communicator

About SFC communications

The portable, battery-powered SFC serves as the common communication interface device for Yamateke's family of Smartline Transmitters. It communicates with a transmitter through serial digital signals over the 4 to 20 mA line used to power the transmitter. A request/response format is the basis for the communication operation. The transmitter's microprocessor receives a communication signal from the SFC, identifies the request, and sends a response message.

Figure 1-2 shows a simplified view of the communication interface provided by an SFC.

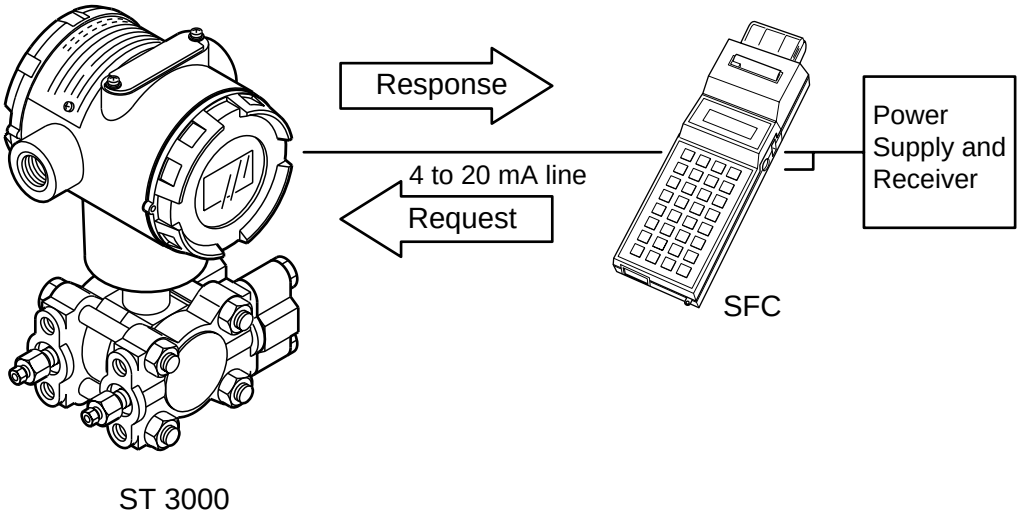


Figure 1-2 Typical SFC Communication Interface.

Purpose of SFC

The SFC allows you to adjust transmitter values, or diagnose potential problems from a remote location such as the control room. You can use the SFC to

- Configure: Define and enter the transmitter's operating parameters including
  - range values,
  - output conformity,
  - damping time,
  - tag number (ID), and more
- Monitor: Read the input pressure to the transmitter in engineering units and the transmitter's output in percent.
- Display: Retrieve and display data from the transmitter or SFC memory.
- Change Mode of Operation: Tell transmitter to operate in either its analog (4-20mA) mode or its digital enhanced (DE) mode.
- Check Current Output: Use the transmitter to supply the output current desired for verifying analog loop operation, troubleshooting, or calibrating other components in the analog loop.
- Troubleshoot: Check status of transmitter operation and display diagnostic messages to identify transmitter, communication, or operator error problems.

SFC model differences

As Yamatake's family of Smartline Transmitters has evolved, the SFC has been changed to meet new model and functionality requirements.

Now there are two following types of SFC:

- SFC160..... Without Printer
- SFC260..... With Printer

1-4 : Transmitter/SFC Order

Order components

Figure 1-3 shown the components that are shipped and should be received for a typical ST3000 Smart Transmitter and SFC order.

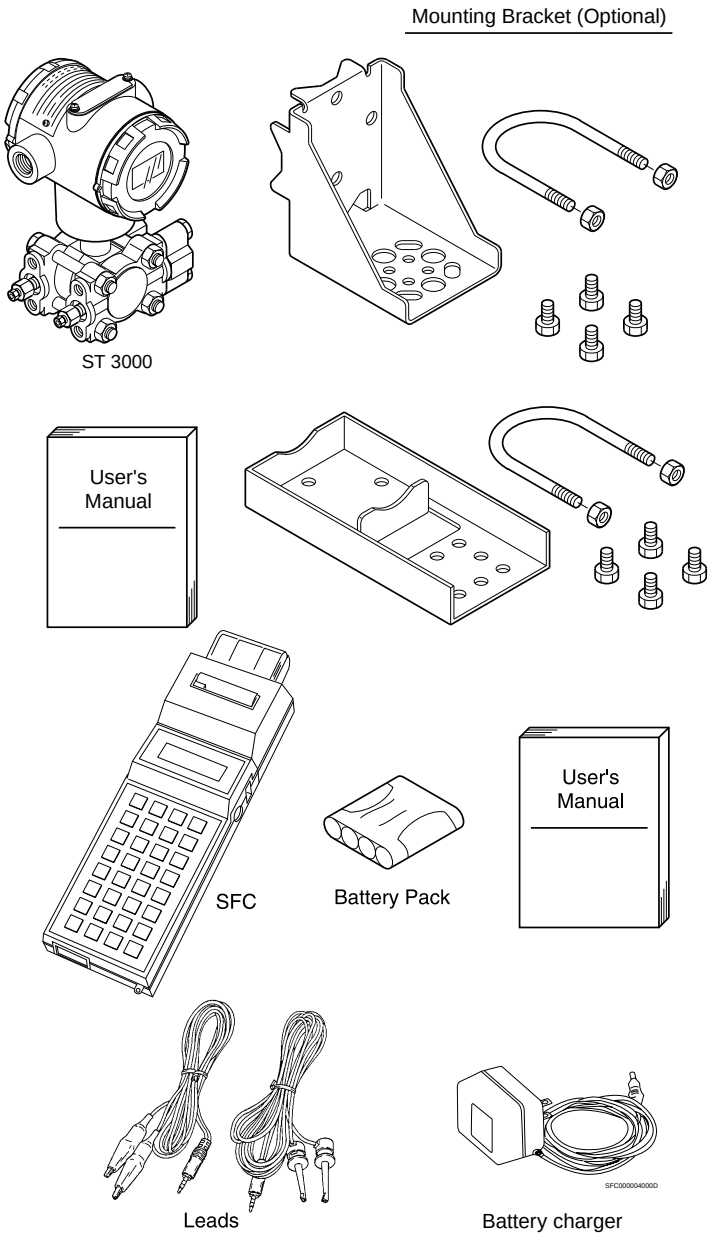


Figure 1-3 Typical ST3000 Smart Transmitter and SFC Order Components.

Chapter 2 : Quick Start Reference

2-1 : Introduction

This section assumes that the ST3000 Smart Transmitter has been installed and wired correctly, and is ready to be put into operation. It also assumes that you are somewhat familiar with using the SFC and that the transmitter has been configured correctly for your application. If the transmitter has not been installed and wired, you are not familiar with SFC operation, and/or you do not know if the transmitter is configured correctly, please read the other sections of this manual before operating your transmitter.

This section provides a list of typical start-up tasks and tells you where you can find detailed information about performing the task.

2-2 : Getting ST3000 Smart Transmitter On-Line Quickly

Quick start-up tasks

Table 2-1 lists common start-up tasks for an ST3000 Smart Transmitter using an SFC and gives an appropriate section in this manual to reference for more information about how to do the task. The start-up tasks are listed in the order they are commonly completed.

Table 2-1: Start-up Tasks Reference

Task	Description	Reference Section
1	Connecting SFC	5-1-1
2	Setting Tag No. and Checking Specifications	5-2
3	Starting Communications	5-2-1
4	Setting Tag No.	5-2-2
5	Checking Output Format	5-2-3
6	Checking Display Setting	5-2-4
7	Checking Engineering Unit of Measured Pressure	5-2-5
8	Checking Low and High Limits of Setting Range	5-2-6
9	Checking Damping Time Constant	5-2-7
10	Checking Sealed Liquid Temperature Correction Function Setting	5-2-8

Chapter 3 : Considerations before installation

3-1 : Introduction

This section reviews things you should take into consideration before you install the transmitter and start using the SFC. Of course, if you are replacing an existing ST3000 Smart Transmitter and you did not order a new SFC; you can skip this section.

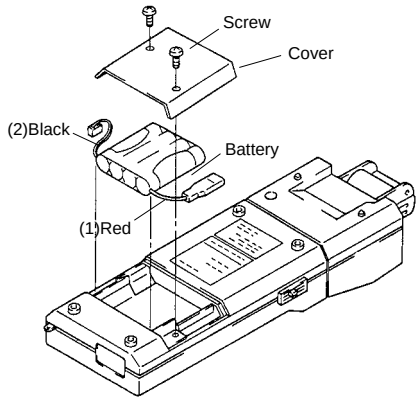
3-2 : Considerations for SFC

Install SFC battery pack

If the SFC battery pack was removed for shipping and/or storage, you will have to install the battery pack and charge the batteries before you can operate the SFC.

The procedure in Table 3-1 outlines the steps for installing and charging the battery pack.

Table 3-1: Installing and Charging SFC Battery Pack

Step	Action
1	Turn SFC face down on working surface. Use metric hex wrench (2.5mm) to remove screw in battery compartment cover and remove cover.
2	Insert battery pack in compartment and connect plug in compartment to pin on battery pack. Example-Battery pack installation. 
3	Replace cover and tighten hex screws.
4	Connect lead from battery charger to recessed connector on left side of SFC **⚠ WARNING** The SFC battery charger is not intrinsically safe. Always recharge the SFC battery pack in a nonhazardous location.

Temperature Limits

The ambient operating temperature limits for the SFC are -10° to 50°C (14° to 122°F) with relative humidity in the range of 10 to 90% RH.

Usage guidelines

- Be sure to put an analog control loop into its manual mode before initiating SFC communications with an ST3000 Smart Transmitter operating in its analog mode. Communication superimposes digital signals on the loop wiring that could affect the analog control signal. This is not necessary when the transmitter is operating in its digital (DE) mode.
- Be sure the power supply voltage does not exceed 45V DC. The ST3000 Smart Transmitter and SFC were designed to operate with voltages below 45V DC.
- Be sure there is at least 250 ohms of resistance between the SFC and the power supply for proper communications.

Chapter 4 : Installation

4-1 : Introduction

This section Provides information about installing the ST3000 Smart Transmitter.

It includes procedures for mounting, piping and wiring the transmitter for operation.

4-2 : Mounting ST3000 Smart Transmitter

Summary

You can mount all transmitter models except those with integral flanges to a 2-inch (50 mm) vertical or horizontal pipe using our optional angle or flat mounting bracket or a bracket of your own. Those models with integral flanges are supported by the flange connection.

Figure 4-1 shows typical bracket mounted and flange mounted transmitter installations for comparison.

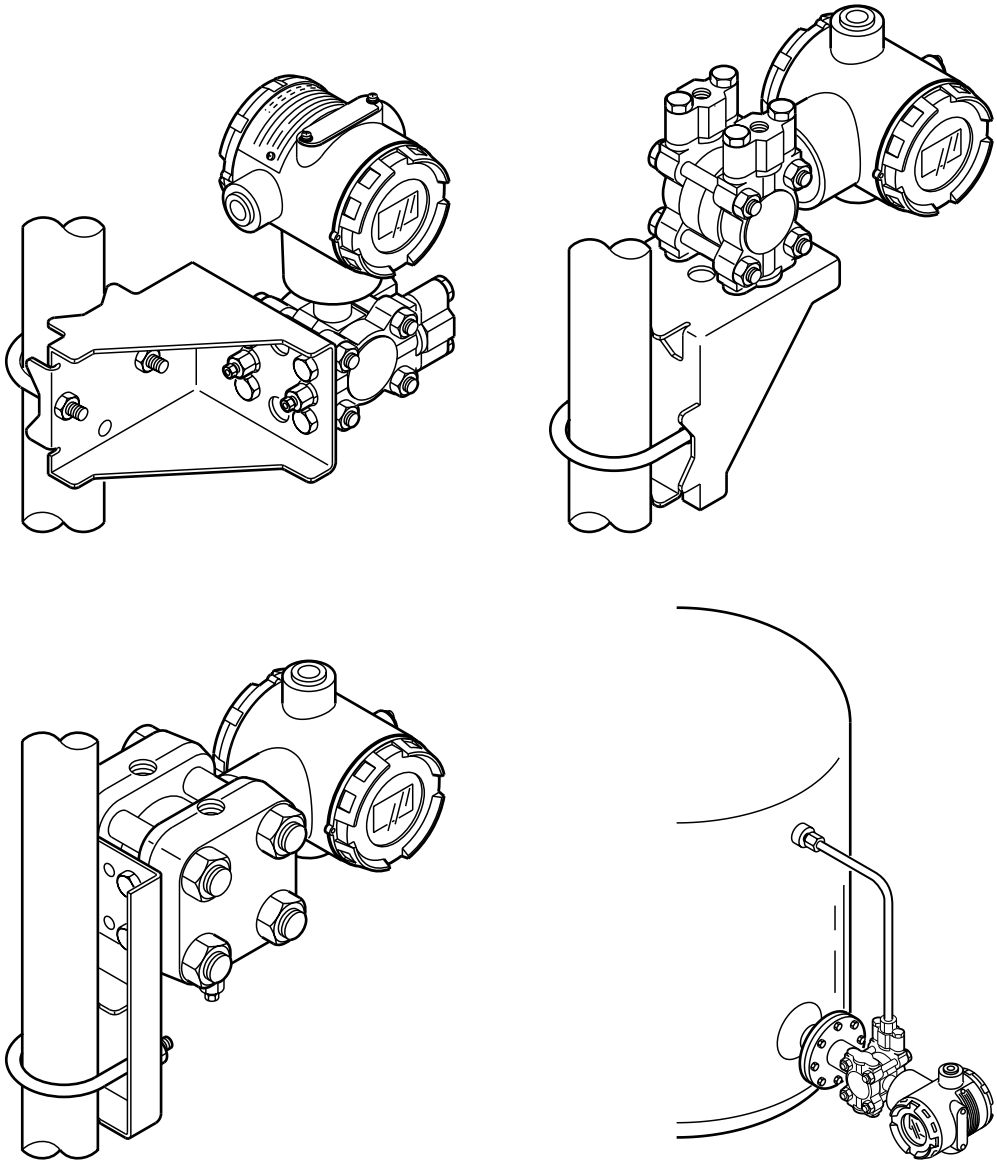


Figure 4-1 Typical Bracket Mounted and Flange Mounted Installations.

Methods of changing direction of indicator after mounted are shown below.

a) Rotate electronics housing 90° horizontally.

Loosen 3 mm set screw on outside neck of transmitter. Rotate electronics housing in a maximum of 90 degree increments (left or right) from the center to a position you require and tighten the set screw.

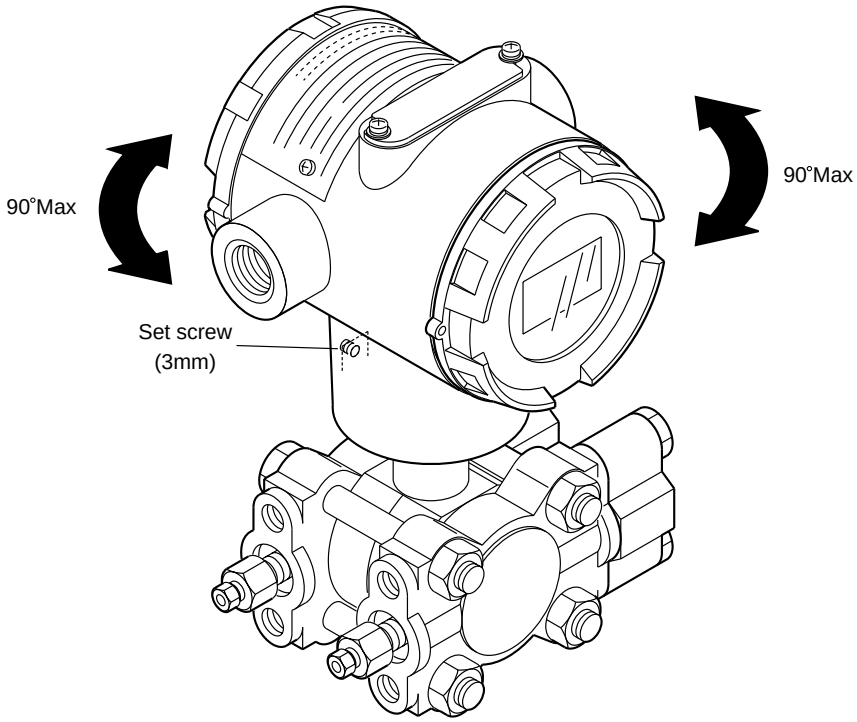


Figure 4-2

b) Rotate digital display module

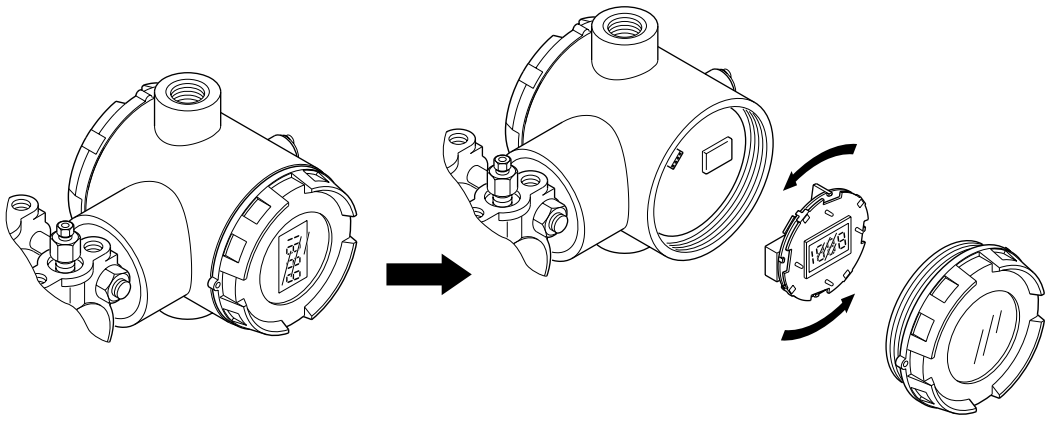


Figure 4-3

Flange mounting

To mount a flange mounted transmitter model, bolt the transmitter's flange to the flange pipe on the wall of the tank. Tighten the bolts to a torque of

SNB : $20 \pm 1\ N \bullet m$

SUS304 : $10 \pm 1\ N \bullet m$

ATTENTION

On insulated tanks, remove enough insulation to accommodate the flange extension.

Figure 4-4 shows a typical installation for a transmitter with the flange on the high pressure (HP) side so the HP diaphragm is in direct contact with the process fluid. The low pressure (LP) side of the transmitter is vented to atmosphere (no connection).

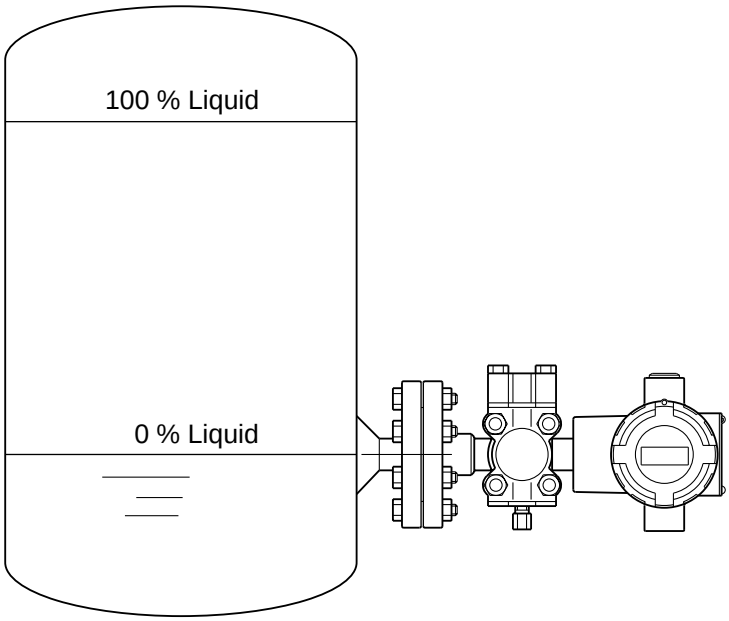


Figure 4-4 Typical Flange Mounted Transmitter Installation.

Remote seal mounting

Use the procedure in "Table 4-1:Mounting Remote Diaphragm Seal Transmitter" to mount a remote diaphragm seal transmitter model. Figure 4-5 shows a typical installation for a remote diaphragm seal transmitter for reference.

ATTENTION

Mount the transmitter flanges within the limits stated here for the given fill-fluid in the capillary tubes with a tank at one atmosphere.

Table 4-1: Mounting Remote Diaphragm Seal Transmitter

Step	Action
1	Mount transmitter at a remote distance determined by length of capillary tubing.
2	**If Transmitter Model Number Is...** STR929, STR930 STE929, STE930 **Then Connect Remote Seal on...** H mark side of transmitter to upper flange mounting on tank wall. ATTENTION On insulated tanks, remove enough insulation to accommodate the flange extension.
3	**If Transmitter Model Number is...** STR929, STR930 STE929, STE930 **Then Connect Remote Seal on...** Opposite side of transmitter to lower flange mounting on tank wall. ATTENTION On insulated tanks, remove enough insulation to accommodate the flange extension.
4	Tighten bolts to torque of SNB7: $20 \pm 1\ N \bullet m$, SUS304: $10 \pm 1\ N \bullet m$.

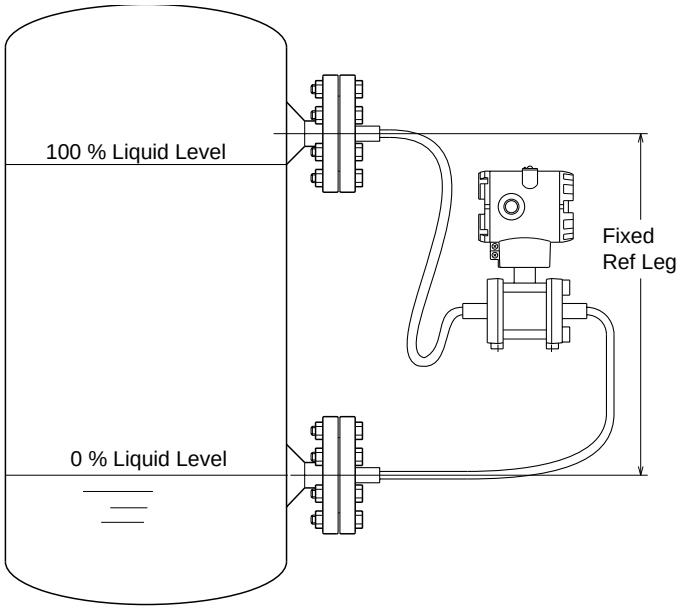


Figure 4-5 Typical Remote DIaphragm Seal Transmitter Installation

ATTENTION

Calculation of Allowable Transmitter Installation Location in Remote Seal Type Differential Pressure Transmitter.

When installing a remote seal type differential pressure transmitter on an enclosed tank, we recommend the installation of the main unit below the lower flange. However, it is sometimes necessary to install the transmitter main unit between the upper and lower flanges due to piping restrictions.

The condition that must be satisfied to ensure normal transmitter operations is specified here.

If a transmitter is installed in the position shown in Figure 4-6, the inner pressure of the tank (P_0) and the head pressure of the liquid sealed in the capillary can be applied to its main unit (low limit flange side).

The transmitter functions normally as long as the pressure applied to its diaphragm surface is equal to or higher than the low limit P (kPa abs.) of the allowable pressure of its main unit.

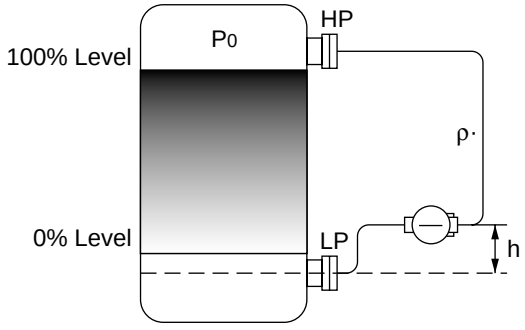


Figure 4-6

This condition can be expressed with the following formula;

$P_0 + ((\rho' h) / 102) \geq P(1kPa = 102mmH_2O)$

Therefore, $h \leq (P_0 - P) \times 102 / (\rho')$

Table 4-2:

	Specific gravity of sealed liquid ρ'	**Low limit of allowable pressure P (kPa abs.)**	**Liquid contacting temperature range (°C)**
General application (*1)	0.935	2	-40 - 40
High temperature application (-*2)	1.07	2	-5 - 90
High temperature & vacuum application (*3)	1.07	0.1333	-5 - 50
High temperature & high vacuum application (*4)	1.09	0.1333	-10 - 250
Oxygen application, chlorine application (*5)	1.87	53	-10 - 40

Remarks

1. An application where the pressure in the tank P_0 becomes a vacuum requires special caution.
2. If the above condition is not met, the pulling force applied to the diaphragm surface will exceed the specified range.

   Foaming occurs because the pressure of sealed liquid exceeds the saturated vapour pressure and can cause zero point shifting. Negative pressure applied to the diaphragm can cause buckling and destroy the diaphragm.
3. When the liquid contacting temperature exceeds the levels shown in the table, the low limit of the allowable pressure also changes. Check the specifications.
4. *1. STR9□□-1, STE9□□ -1

   *2. STR9□□-3, STE9□□ -3

   *3. STR9□□-4, STE9□□ -4

   *4. STR9□□-7, STE9□□ -7

   *5. STR9□□-2 & -5 STE9□□ -2 & -5

<Example of calculation>

Let's take up an example in which a remote seal type transmitter of the of the general specifications is used for a vacuum application (3kPa abs.)

- Liquid contacting pressure :Normal pressure (24°C)
- Low limit of allowable pressure (ρ) :2 kPa abs. (15mmHg abs.)
- Specific gravity of sealed liquid (ρ') :0.935
- Inner pressure of tank (ρ_0) :3kPa abs.

The condition that must be met to satisfy the transmitter specifications is as follows:

$$h \leq (P_0 - P) \times 102 / (\rho')$$

$$h \leq (3 - 2) \times 102 / 0.935 \ = \ 109mm$$

Therefore, the high limit of the transmitter position is 109mm.

4-3 : Piping ST3000 Smart Transmitter

Summary

The actual piping arrangement will vary depending upon the process measurement requirements and the transmitter model. Except for flanged and remote diaphragm seal connections, process connections are made to 1/4 inch or 1/2 inch NPT female connections in the process head of the transmitter's meter body. For example, a differential pressure transmitter comes with double ended process heads with 1/4 inch NPT connections but they can be modified to accept 1/2 inch NPT through optional flange adapters.

The most common type of pipe used is 1/2 inch schedule 80 steel pipe.

Many piping arrangements use a three-valve manifold to connect the process piping to the transmitter. A manifold makes it easy to install and remove a transmitter without interrupting the process. It also accommodates the installation of blow-down valves to clear debris from pressure lines to the transmitter.

Figure 4-7 shows a diagram of a typical piping arrangement using a three-valve manifold and blow-down lines for a differential pressure transmitter being used to measure flow.

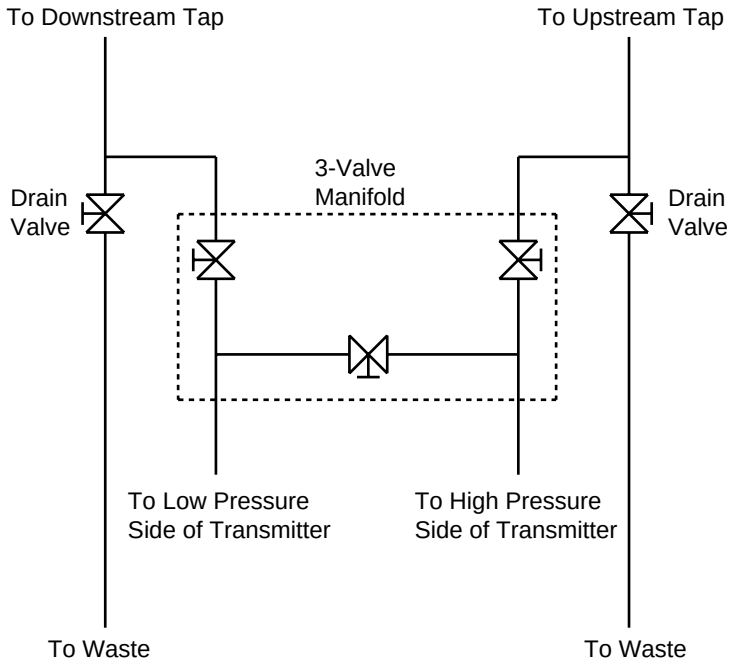


Figure 4-7 Typical 3-Valve Manifold and Blow-Down Piping Arrangement.

Process connections

Table describes typical process connections for a given type of transmitter.

Table 4-3: Process Connections

Transmitter type	Process Connection
Differential Pressure	Process heads with 1/4in. NPT internal thread connection. Flange adapters and manifolds with 1/2in. internal thread connections are optional.
Gauge Pressure	Process head with 1/2in. NPT internal thread connection. Process heads with 1/4in. NPT internal thread connection. (STG9□0) Flange adapters and manifolds with 1/2in. internal thread connections are optional (STG9□0)
Absolute Pressure	Process heads with 1/2in. NPT internal thread connection (STA923, 940)
Flange Mounted Liquid Level	1.5. 2 or 3in. flange with flush or 2, 3 or 4in. extended diaphragm on high pressure side*. Reference side has standard differential pressure process head.
Remote Diaphragm Seals	See Model Selection Guide for description of available Flanged, Button-diaphragm (G1·1/2), and Wafer type process connections.

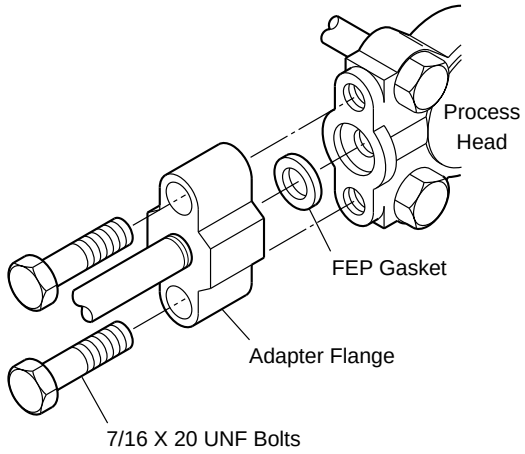
Installing flange Adapter

Table 4-4: gives the steps for installing an optional flange adapter on the process head.

Slightly deforming the gasket supplied with the adapter before you insert it into the adapter may aid in retaining the gasket in the groove while you align the adapter to the process head. To deform the gasket, submerse it in hot water for a few minutes then firmly press it into its recessed mounting groove in the adapter.

Table 4-4: Installing Adapter Flange

Step	Action
1	Carefully seat FEP (white) gasket into adapter groove.
2	Thread adapter onto 1/2in. process pipe and align mounting holes in adapter with holes in end of process head as required.

Step	Action
3	Secure adapter to process head by hand tightening 7/16-20 UNF hexhead bolts. Example-Installing adapter on process head **ATTENTION** Apply an anti-seize compound on the stainless steel bolts prior to threading them into the process head. 
4	Evenly tighten adapter bolts to a torque of 47.5 to 54 $N \bullet m$ (35 to 40 ftlb)

4-3-1 :Piping for Liquid, Gas or Steam Flow Rate Measurement

Recommended Piping -- Example 1

The illustration shows a typical example for liquid Flow Rate Measurement. This Differential pressure transmitter is located below the differential pressure output port of the process pipe.This minimizes the static head effect of the condensate.

The following apply:

Grade the pipe at the differential pressure output part.

Inclination symbol ◿ in illustration: Low level ◿ High level

After piping work, ensure that the connecting pipe, the 3-way manifold valve, and the transmitter have no pressure leak.

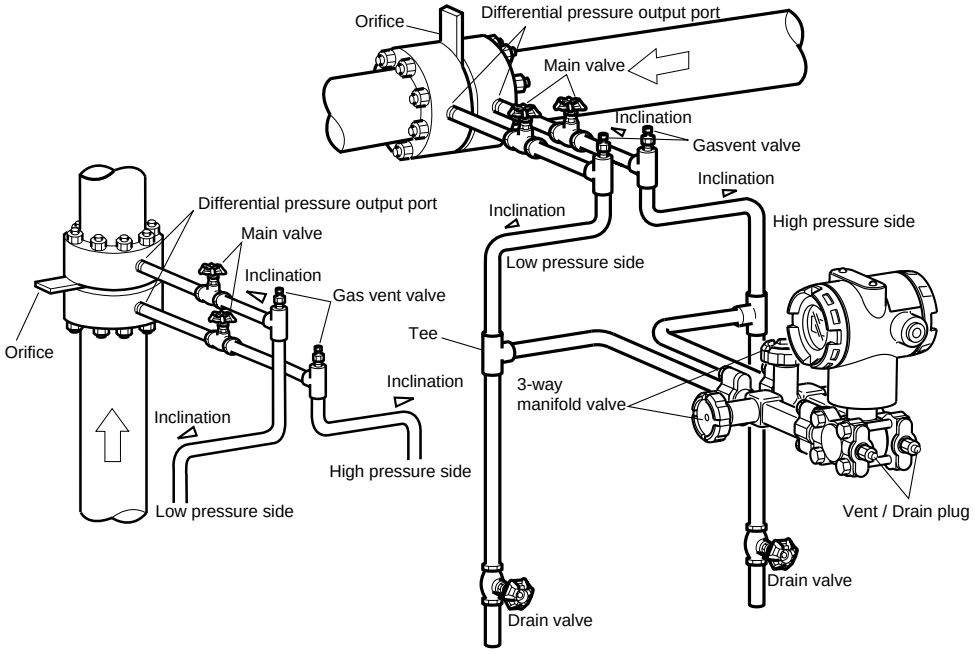


Figure 4-8 Piping for Liquid Flow Rate Measurement (Example)

This transmitter is located underneath the differential pressure output port of the process pipe.

Recommended Piping -- Example 2

The illustration shows a typical example for Gas Flow Rate Measurement. This Differential pressure transmitter is located above the differential pressure output port of the process pipe.The condensate drains away from the transmitter.

The following apply:

Grade the pipe at the differential pressure output part.

Inclination symbol in illustration: Low level High level

After piping work, ensure that the connecting pipe, check for pressure leaks around the 3-way manifold valve, and the transmitter.

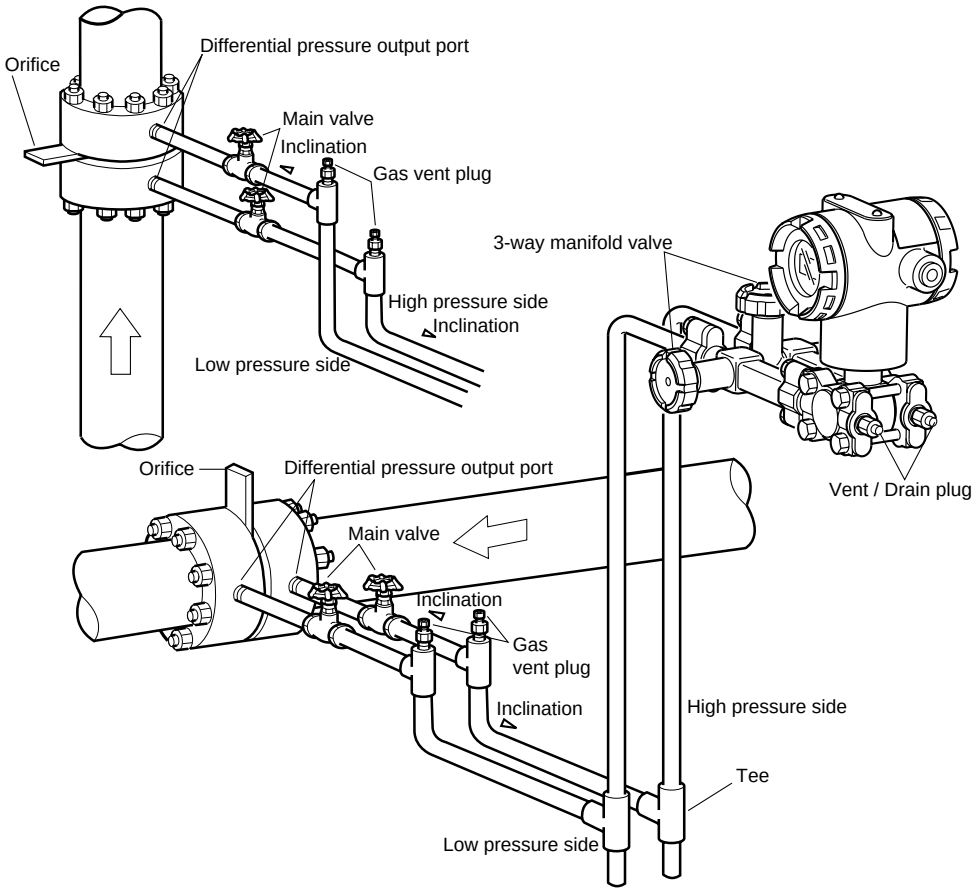


Figure 4-9 Piping for Gas Flow Rate Measurement -- Example

This transmitter is located above the differential pressure output port of the process pipe.

Recommended Piping -- Example 3

The illustration shows a typical example for Steam Flow Rate Measurement. Recommended for a Differential pressure transmitter located below the differential pressure output port of the process pipe.

The following apply:

Grade the pipe at the differential pressure output part.

Inclination symbol ⊿ in illustration: Low level ⊿ High level

After piping work, ensure that the connecting pipe, the 3-way manifold valve, and the transmitter have no pressure leaks.

If the process pipe is vertically mounted, mount seal pots at different levels to prevent zero drift. But in this case, you cannot apply the previously-used zero adjustment procedure (using a 3-way manifold valve). For zero shift occurring at different levels, use an SFC.

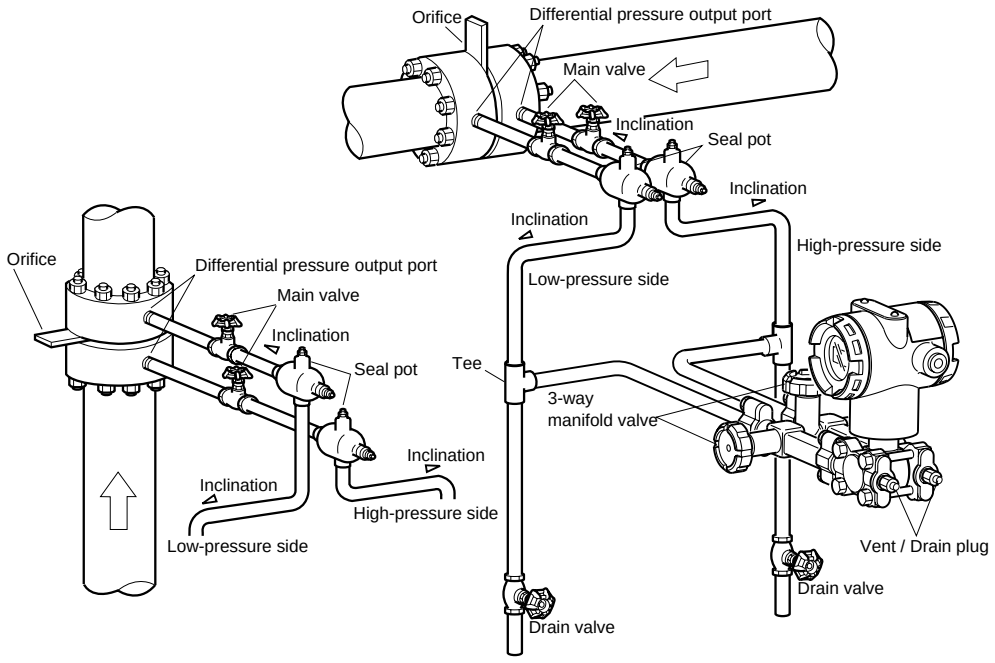


Figure 4-10 Piping for Steam Flow Rate Measurement -- Example

This transmitter is located under the differential pressure output port of the process pipe.

4-3-2 :Pressure Measurement - Piping

Recommended piping - Example

For gas-pressure measurement, piping should be performed following the typical example shown here. Always observe these points:

At the differential pressure output, make pipe vertical.

After completing piping work, check for pressure leaks around connecting pipe and transmitter.

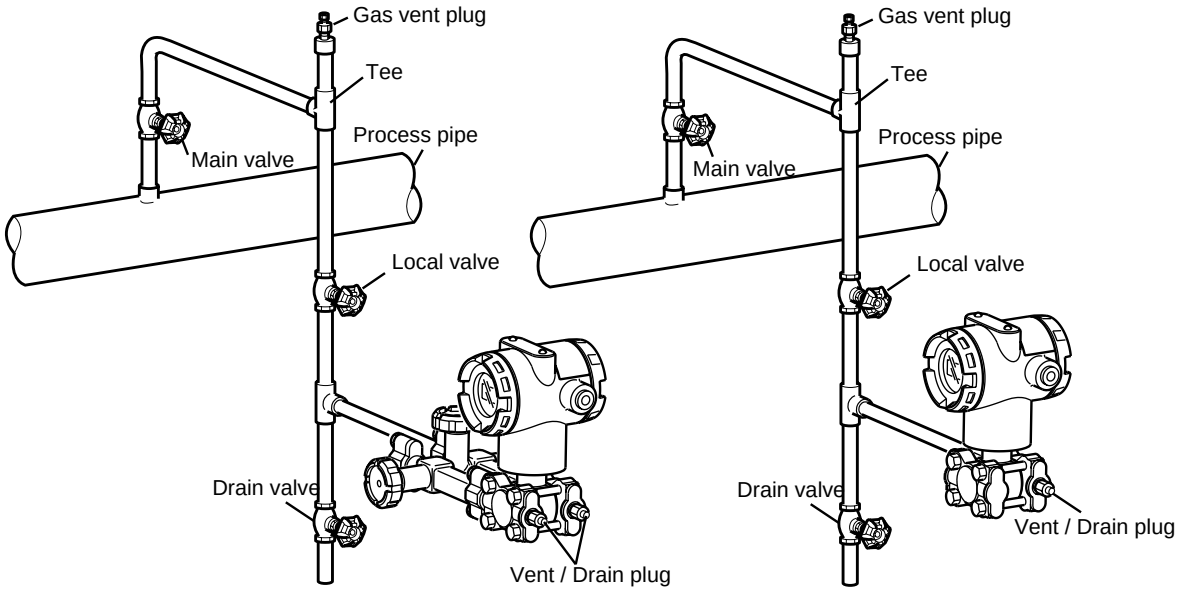


Figure 4-11 Gas Pressure Measurement - Piping

Piping method

The piping method for the fluid to be measured depends on the meter installation position and the pipe line state. Typical examples of piping are shown in Figure 4-12.

Connect pipes by the following procedure:

(1) Use a T-shaped joint for the connecting pipeline.

(2) Install a main valve between the entrance of the connecting pipe and the T-shaped joint.

(3) If the process is a horizontal line, tilt the pipe to allow draining from the pressure line.

~Note *In case of a high pressure process, select a joint of appropriate specifications and shape and a pipe of appropriate shape and material with care.*

(4) Determine the connecting pipe schedule number and the nominal thickness of the connecting pipe from the process based on conditions such as the process pressure.

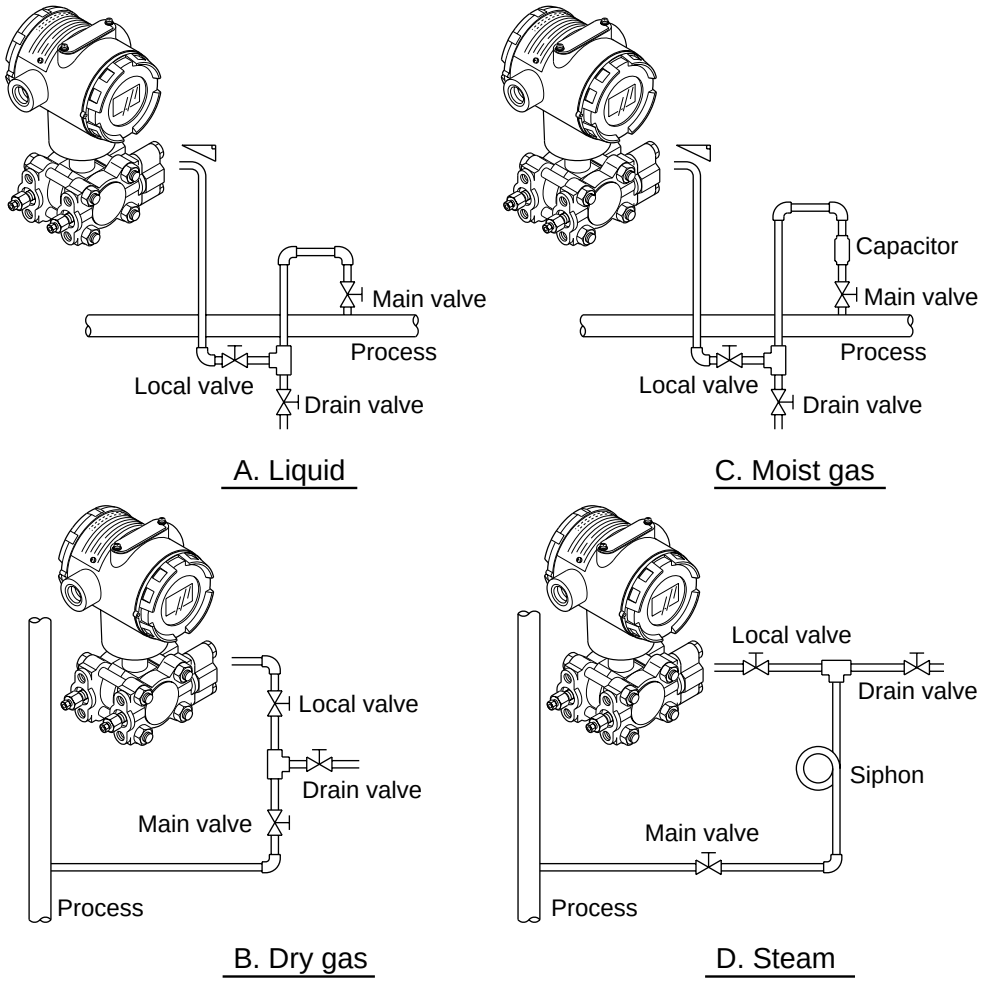


Figure 4-12 Example of Piping

Auxiliary equipment

(1) Oil sealing and air purging

If the pressure medium (such as suspension, high viscosity, and corrosive fluid) should not be led directly to the element, avoid it by means of sealing or purging. Various sealing and purging methods are available. Consult us for each case.

(2) Preventing pulsations

If the process has serious pulsations or great pressure fluctuations, provide a throttle valve in the middle of the connecting pipe to prevent pulsations.

4-3-3 :Liquid Level Measurement -- Piping (STD/STG)

4-3-3-1 Piping

Introduction

For measurement by STD type of liquid level in a tank, the piping method depends on whether the tank is open or enclosed. For enclosed tanks, piping is modified according to whether you use the gas sealing method (dry leg) or the liquid sealing method (wet leg).

H mark

H indicating high pressure is marked on the center body of this transmitter. Check the mark during piping work. The low-pressure side has no mark.

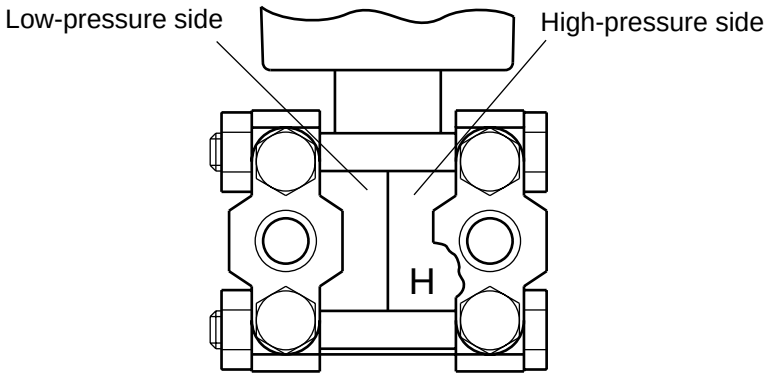


Figure 4-13 H mark on center body

Before your start

The following parts are requirements for piping work. Refer to illustration.

- 3-way manifold valve
- Pipe
- Main valve
- Union or flange
- Tee
- Drain valve
- Drain plug
- Seal pot (for enclosed tank and wet-leg only)

4-3-3-2 Open Tank - Piping

Recommended piping - Example

For open tanks, connect the high-pressure side of this transmitter to the lower part of the tank. Open the low-pressure side to the air.

After completing piping work, check for pressure leaks around the connecting pipe, the transmitter, and the 3-way manifold valve. The illustration shows a typical installation.

Connect the high-pressure side of this transmitter to the lower part of the tank.

Install this transmitter below the lowest liquid level to be measured.

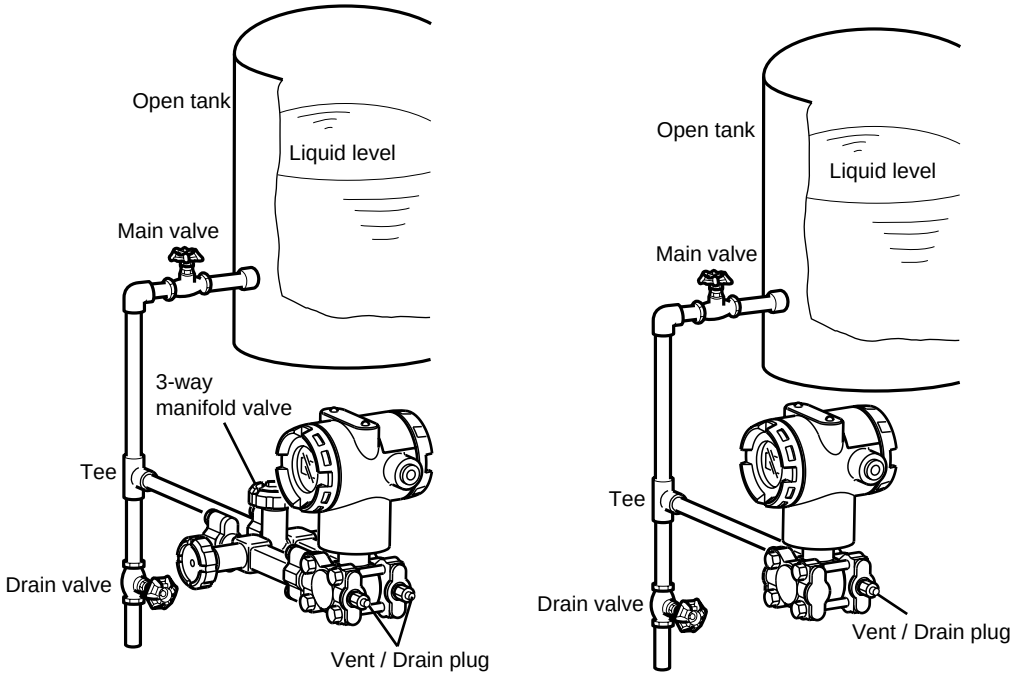


Figure 4-14 Open Tank -- Piping Example

4-3-3-3 Closed Tank - Piping

Recommended piping for dry leg - Example

When using the dry-leg method, connect the high-pressure side of the transmitter to the lower part of the tank. Connect the low-pressure side to the gas-sealing pipe of the tank.

After completing piping work, check for pressure leaks around the connecting pipe, the transmitter, and the 3-way manifold valve. The following shows a typical installation.

Always connect the high-pressure side of this transmitter to the lower part of the tank.

Install this transmitter below the lowest liquid level to be measured.

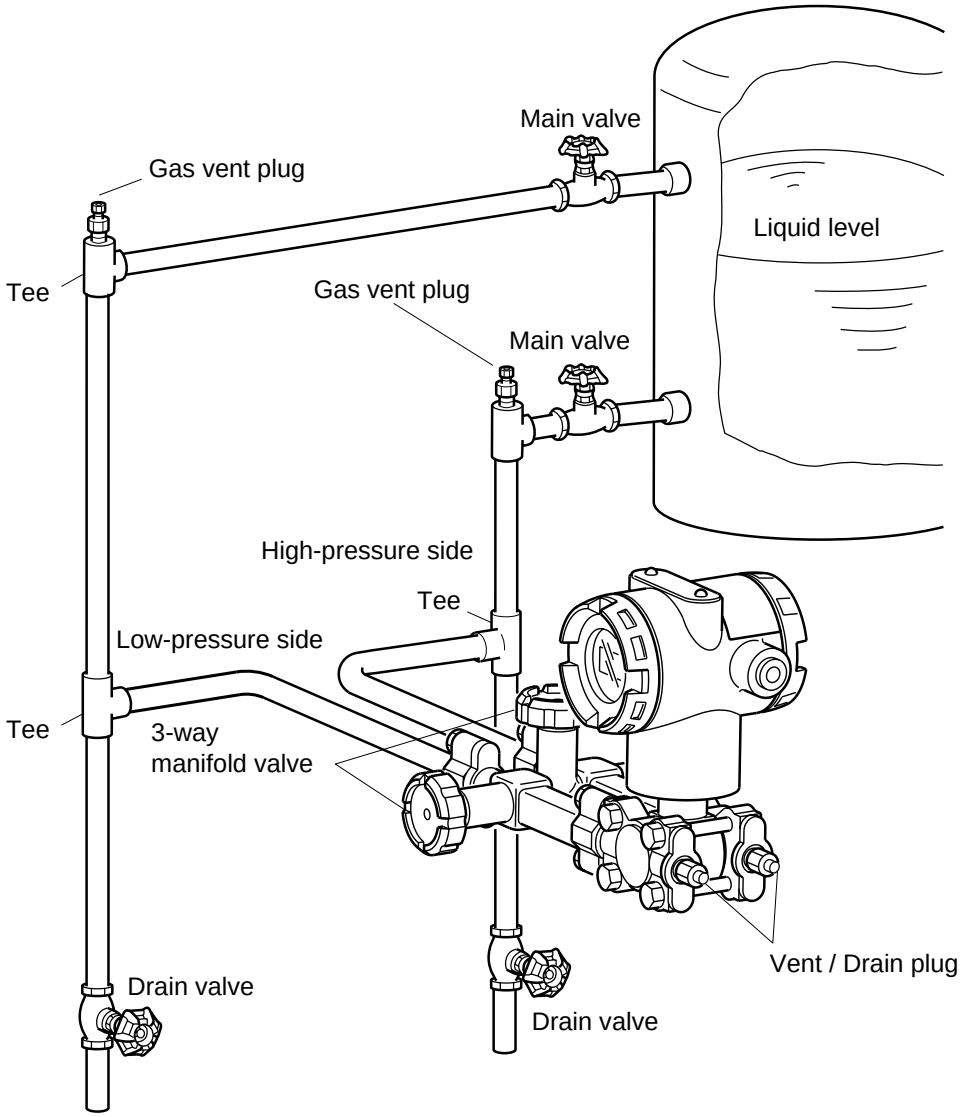


Figure 4-15 Closed Tank -- Piping (Dry-leg Sealing Example)

Recommended piping for wet leg - Example

When using the wet-leg method, connect the high-pressure side of the transmitter to the sealing pipe of the tank. Connect the low-pressure side to the lower part of the tank.

After completing piping work, check for pressure leaks around the connecting pipe, the transmitter, and the 3-way manifold valve. The illustration shows a typical installation.

Be sure to connect the low-pressure side of this transmitter to the lower part of the tank.

Install this transmitter below the lowest liquid level to be measured.

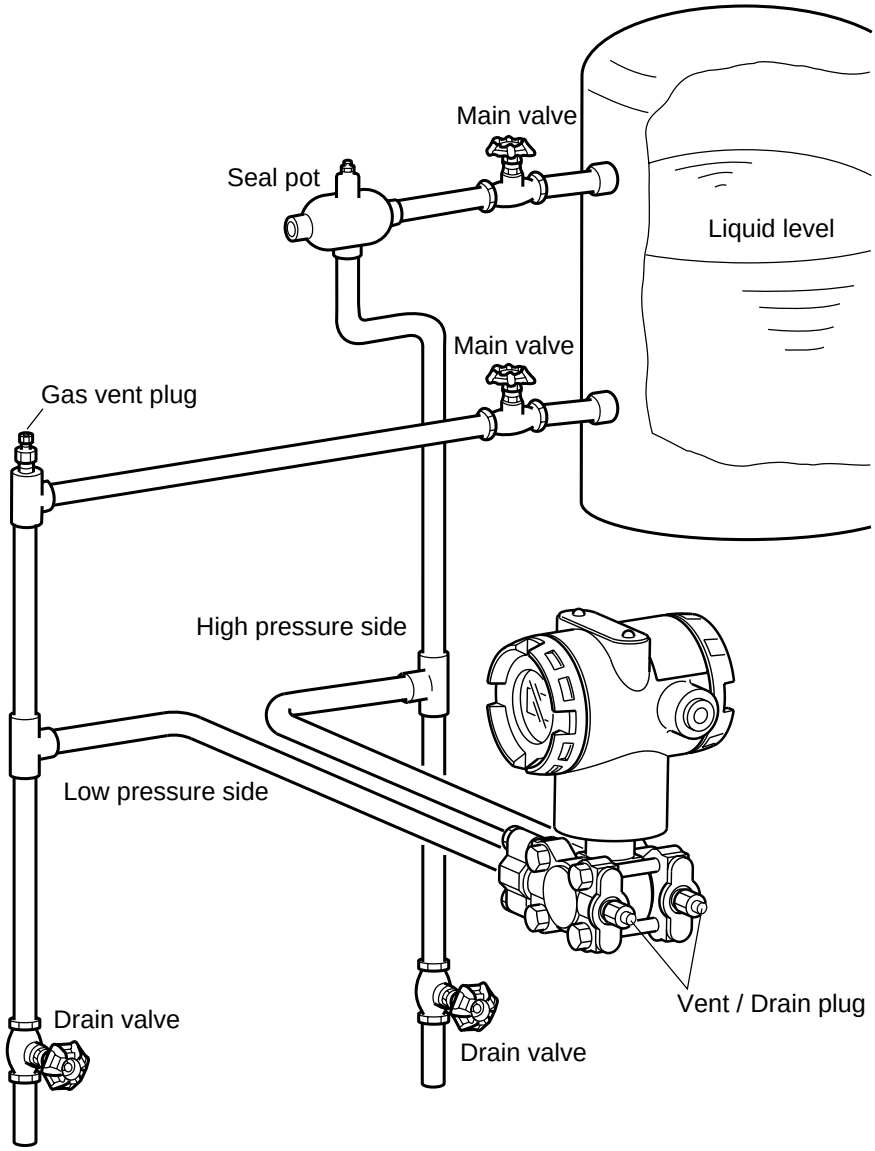


Figure 4-16 Closed Tank -- Piping (Wet-leg Sealing Example)

ATTENTION

For liquid or steam, the piping should slope a minimum of 25.4 mm (1 inch) per 305 mm (1 foot). Slope the piping down towards the transmitter if the transmitter is below the process connection so the bubbles may rise back into the piping through the liquid. If the transmitter is located above the process connection, the piping should rise vertically above the transmitter, then slope down towards the flowline with a vent valve at the high point. For gas measurement, use a condensate leg and drain at the low point (freeze protection may be required here).

4-4 : Wiring ST 3000 Smart Transmitter

4-4-1 :Wiring for Transmitter -- Regular Model

Introduction

Following wiring instructions when no explosion-proof standards apply.

As well as the following, during wiring and cabling of an explosion-proof transmitter, refer to the instructions for flameproof special explosion-proof and intrinsically-safe transmitters (provided later).

Wire and cable this transmitter as shown in the illustrations.

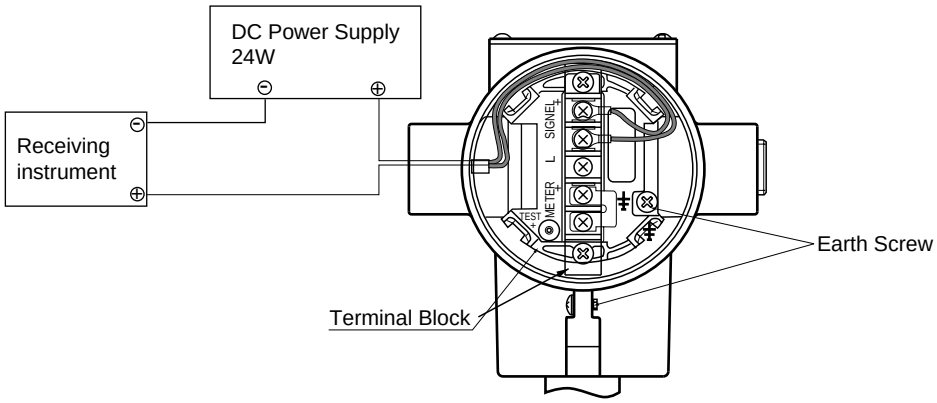


Figure 4-17 Wiring

~Note *1. External load resistance of at least 250Ω required for communications with an SFC. If total load resistance of the receiving instrument is less than 250Ω, insert the necessary resistance to the loop.*

~Note *2. In using Yamateke's field type indicator (Model NWS300, Model NWA300), please consult us.*

Conduit pipe for cables

Lead cables into the transmitter case, as follows:

Mount a conduit pipe in the conduit hole (1/2NPT female thread) provided on the side of a transmitter, and lead cables through the pipe.

Seal the part that contacts with the conduit pipe. Use a sealing agent or a seal plug to prevent entry of water.

Install transmitter so that the cables lead into it, from the bottom.

Grounding

If a shielded cable is used, earth (ground) the shield at the receiver only (single point ground). Connecting the shield to signal ground is recommended to make the electric potential difference lower.

If the transmitter is not grounded through a pipe stanchion, ground the transmitter using an earth terminal in the transmitter.

To ground the transmitter, the ground resistance must be 100Ω or lower.

Supply power and external load resistance

Confirm the relationship between the external load resistance and the supply voltage. As shown in the illustration, the relationship should be inside the shaded area.

External resistance: the total resistance connected to the output terminals of a transmitter (includes resistances of all cables in the loop plus the internal resistance of the instruments).

The horizontal axis represents the supply voltage of a transmitter, and vertical axis represents the external load resistance

.

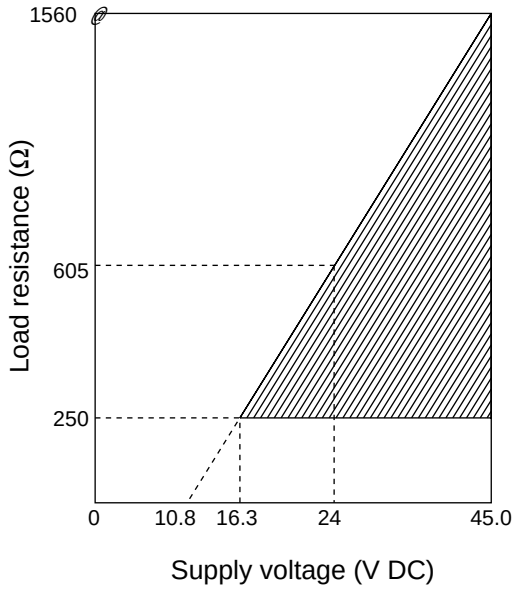


Figure 4-18 Supply Voltage and External Load Resistance - Relationship

~Note *1: 45 volt operation is permitted.*

~Note *2: For communication with SFC, a load resistance of 250 ohms or more is needed.*

Summary

For wiring the transmitter, you simply connect the positive (+) and negative (-) loop wires to the positive (+) and negative (-) signal terminals on the terminal block in the transmitter's electronics housing as shown in Figure 4-19.

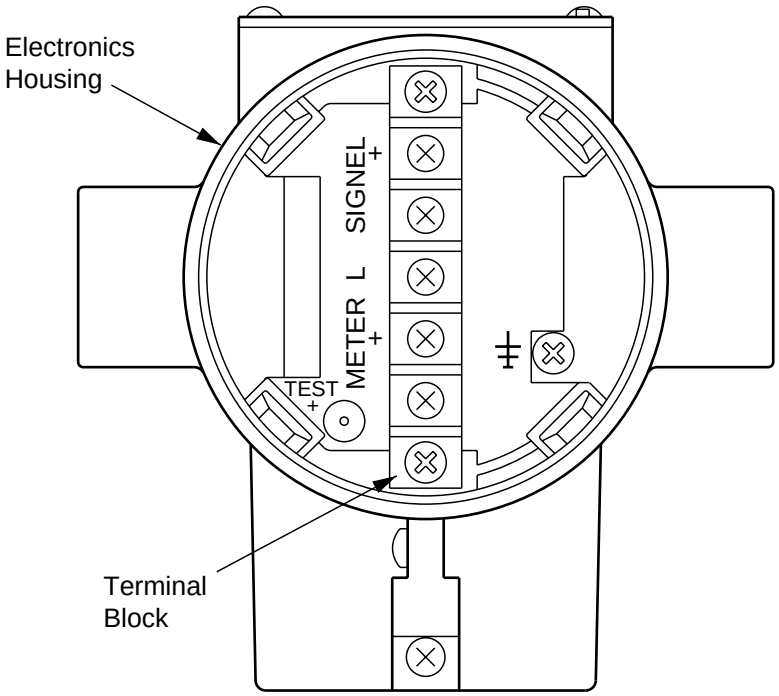


Figure 4-19 ST3000 Smart Transmitter Terminal Block.

4-4-2 :Wiring for Transmitter-- Explosion-Proof

Guidelines

Explosion-proof requires special precautions and installation methods. Refer also to "4-4-1 :Wiring for Transmitter -- Regular Model".

⚠ WARNING

- Tighten the case cover fully, to the end, and lock.
- Clearly delineate safety responsibilities in operating procedures. Especially, for an explosion-proof transmitter, specify locking of the cover of the transmitter case.

Locking

Before cabling can be performed. Use a 3mm hexagonal wrench to open the locking structure.

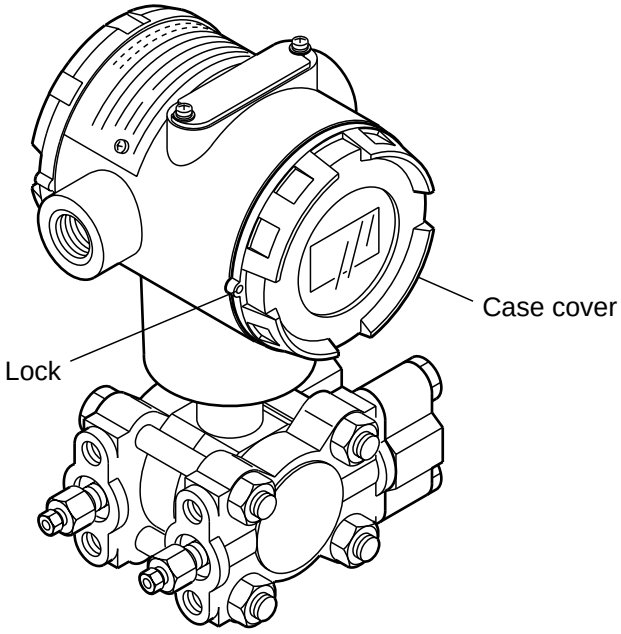


Figure 4-20 Unlock Transmitter Case

Leading-in external cables

Leading in cables to the equipment

Refer to the instructions in the chapter of About Explosion-Proof(“Explosion protected Models” on page Safety-ii) in the front of this manual.

4-4-3 :Wiring Transmitter -- Intrinsically-safe

Guidelines

Intrinsically safe requires special wiring precautions and installation methods. Refer to "4-4-1 :Wiring for Transmitter -- Regular Model".

⚠ WARNING

- Protect transmitter from electrical or magnetic influence (such as mixing and induction) from other electrical circuits.
- Use a Zener barrier approved by an approval body such as FM and NEPSI.

Wiring

- Follow the instructions in the installation drawing (80390790) for FM intrinsically safe loops.
- In case of NEPSI, combine with a NEPSI approved Zener barrier; Z787,MTL787S or LB987S.

  Following parameters must be taken.

  Maximum allowed cable capacitance = 0.1μF

  Maximum allowed cable inductance = 2mH

  See instruction manual of Zener barrier.

Intrinsically-safe system - Configuration

System configuration

The system configuration is shown below. The diagram also shows the layout of an intrinsically-safe system consisting of a transmitter, a portable setting display, a field type current indicator, and a Zener barrier. The system components must be designated as having conformance that is proved by relevant public organizations.

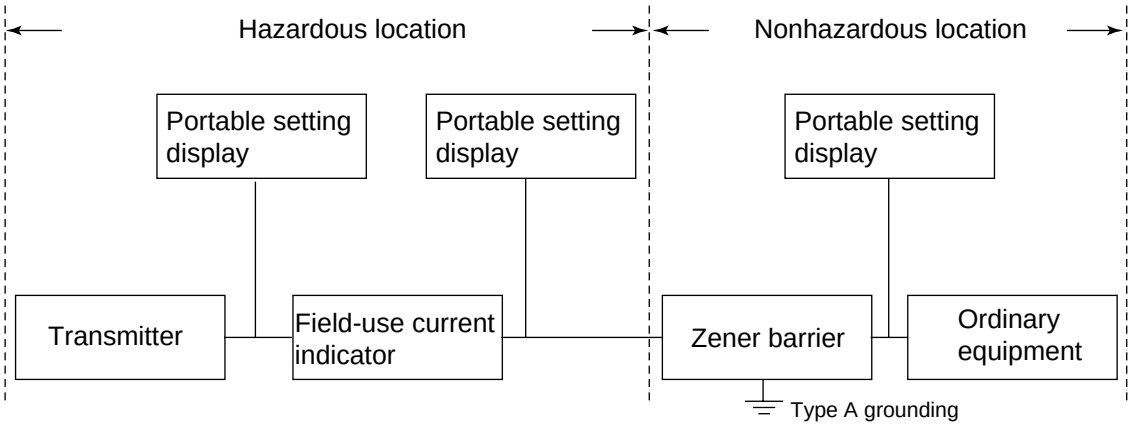
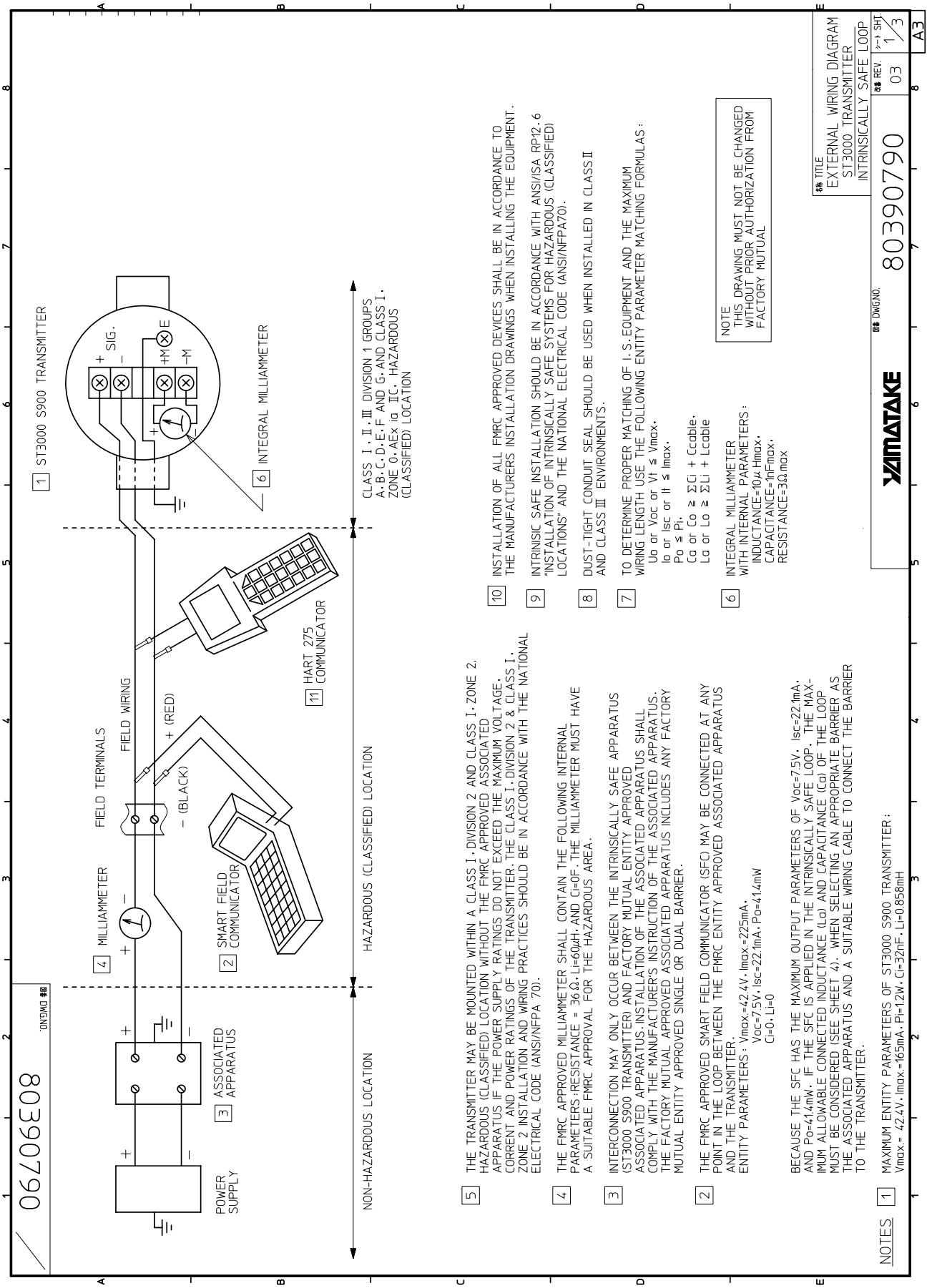


Figure 4-21 System Configuration of Intrinsically-safe Transmitter


80390790
DWG.NO.
1 ST3000 S900 TRANSMITTER
SIG.
+M
-M
E
6 INTEGRAL MILLIAMMETER
4 MILLIAMMETER
FIELD TERMINALS
FIELD WIRING
+ (RED)
- (BLACK)
2 SMART FIELD COMMUNICATOR
11 HART 275 COMMUNICATOR
3 ASSOCIATED APPARATUS
POWER SUPPLY
NON-HAZARDOUS LOCATION
HAZARDOUS (CLASSIFIED) LOCATION
CLASS Ⅰ, Ⅱ, Ⅲ DIVISION 1 GROUPS A, B, C, D, E, F AND G. AND CLASS Ⅰ, ZONE 0, AEx ia ⅡC, HAZARDOUS (CLASSIFIED) LOCATION
NOTE
THIS DRAWING MUST NOT BE CHANGED WITHOUT PRIOR AUTHORIZATION FROM FACTORY MUTUAL
TITLE
EXTERNAL WIRING DIAGRAM
ST3000 TRANSMITTER
INTRINSICALLY SAFE LOOP
YAMATAKE
80390790
REV.
03
SHT
1/3
A3
NOTES
1 MAXIMUM ENTITY PARAMETERS OF ST3000 S900 TRANSMITTER:
Vmax.= 42.4V. Imax.=165mA. Pi=1.2W. Ci=32nF. Li=0.858mH
2 THE FMRC APPROVED SMART FIELD COMMUNICATOR (SFC) MAY BE CONNECTED AT ANY POINT IN THE LOOP BETWEEN THE FMRC ENTITY APPROVED ASSOCIATED APPARATUS AND THE TRANSMITTER.
ENTITY PARAMETERS: Vmax=42.4V. Imax=225mA.
Voc=7.5V. Isc=22.1mA. Po=41.4mW
Ci=0. Li=0
BECAUSE THE SFC HAS THE MAXIMUM OUTPUT PARAMETERS OF Voc=7.5V. Isc=22.1mA. AND Po=41.4mW. IF THE SFC IS APPLIED IN THE INTRINSICALLY SAFE LOOP, THE MAXIMUM ALLOWABLE CONNECTED INDUCTANCE (La) AND CAPACITANCE (Ca) OF THE LOOP MUST BE CONSIDERED (SEE SHEET 4). WHEN SELECTING AN APPROPRIATE BARRIER AS THE ASSOCIATED APPARATUS AND A SUITABLE WIRING CABLE TO CONNECT THE BARRIER TO THE TRANSMITTER.
3 INTERCONNECTION MAY ONLY OCCUR BETWEEN THE INTRINSICALLY SAFE APPARATUS (ST3000 S900 TRANSMITTER) AND FACTORY MUTUAL ENTITY APPROVED ASSOCIATED APPARATUS. INSTALLATION OF THE ASSOCIATED APPARATUS SHALL COMPLY WITH THE MANUFACTURER'S INSTRUCTION OF THE ASSOCIATED APPARATUS. THE FACTORY MUTUAL APPROVED ASSOCIATED APPARATUS INCLUDES ANY FACTORY MUTUAL ENTITY APPROVED SINGLE OR DUAL BARRIER.
4 THE FMRC APPROVED MILLIAMMETER SHALL CONTAIN THE FOLLOWING INTERNAL PARAMETERS: RESISTANCE = 36Ω. Li=60μH. AND Ci=0F. THE MILLIAMMETER MUST HAVE A SUITABLE FMRC APPROVAL FOR THE HAZARDOUS AREA.
5 THE TRANSMITTER MAY BE MOUNTED WITHIN A CLASS I, DIVISION 2 AND CLASS I, ZONE 2, HAZARDOUS (CLASSIFIED) LOCATION WITHOUT THE FMRC APPROVED ASSOCIATED APPARATUS IF THE POWER SUPPLY RATINGS DO NOT EXCEED THE MAXIMUM VOLTAGE, CURRENT AND POWER RATINGS OF THE TRANSMITTER. THE CLASS I, DIVISION 2 & CLASS I, ZONE 2 INSTALLATION AND WIRING PRACTICES SHOULD BE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE (ANSI/NFPA 70).
6 INTEGRAL MILLIAMMETER
WITH INTERNAL PARAMETERS:
INDUCTANCE=10μ Hmax.
CAPACITANCE=1nFmax.
RESISTANCE=3Ω max
7 TO DETERMINE PROPER MATCHING OF I.S.EQUIPMENT AND THE MAXIMUM WIRING LENGTH USE THE FOLLOWING ENTITY PARAMETER MATCHING FORMULAS:
Uo or Voc or Vt ≤ Vmax.
Io or Isc or It ≤ Imax.
Po ≤ Pi.
Ca or Co ≥ ΣCi + Ccable.
La or Lo ≥ ΣLi + Lcable
8 DUST-TIGHT CONDUIT SEAL SHOULD BE USED WHEN INSTALLED IN CLASS Ⅱ AND CLASS Ⅲ ENVIRONMENTS.
9 INTRINSIC SAFE INSTALLATION SHOULD BE IN ACCORDANCE WITH ANSI/ISA RP12.6 "INSTALLATION OF INTRINSICALLY SAFE SYSTEMS FOR HAZARDOUS (CLASSIFIED) LOCATIONS" AND THE NATIONAL ELECTRICAL CODE (ANSI/NFPA70).
10 INSTALLATION OF ALL FMRC APPROVED DEVICES SHALL BE IN ACCORDANCE TO THE MANUFACTURERS INSTALLATION DRAWINGS WHEN INSTALLING THE EQUIPMENT.

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11 THE FMRC APPROVED HART 275 COMMUNICATOR (HHT) MAY BE CONNECTED AT ANY POINT IN THE LOOP BETWEEN THE FMRC ENTITY APPROVED ASSOCIATED APPARATUS AND THE TRANSMITTER.
EXAMPLE ENTITY PARAMETERS,SEE HHT CONTROL DRAWING FOR ACTUAL ENTITY PARAMETERS: Vmax.=30V, Imax.=300mA,
Voc=1.7V, Isc=32mA
Ci=0.07μF, Li=0

BECAUSE THE HHT HAS THE MAXIMUM OUTPUT PARAMETERS OF Voc=1.7V AND Isc=32mA. IF THE HHT IS APPLIED IN THE INTRINSICALLY SAFE LOOP, THE MAXIMUM ALLOWABLE CONNECTED INDUCTANCE (La) AND CAPACITANCE (Ca) OF THE LOOP MUST BE CONSIDERED (SEE SHEET 5). WHEN SELECTING AN APPROPRIATE BARRIER AS THE ASSOCIATED APPARATUS AND A SUITABLE WIRING CABLE TO CONNECT THE BARRIER TO THE TRANSMITTER.

12 SMART FIELD COMMUNICATOR (SFC) AND HART 275 COMMUNICATOR (HHT) SHALL NOT BE CONNECTED IN THE LOOP AT THE SAME TIME.

13 AEx ib IS SUITABLE ONLY FOR CLASS I, ZONE 1 HAZARDOUS (CLASSIFIED) LOCATIONS AND IS NOT SUITABLE FOR CLASS I, ZONE 0, OR CLASS I, DIVISION 1 HAZARDOUS (CLASSIFIED) LOCATIONS.

14 THE POWER SUPPLY CONNECTED TO THE ASSOCIATED APPARATUS MUST NOT USE OR GENERATE MORE THAN 250 Vrms OR Vdc.

CONSIDERATION OF AN INTRINSICALLY SAFE LOOP BASED ON ENTITY PARAMETERS

THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS TO ASSOCIATED APPARATUS NOT SPECIFICALLY EXAMINED IN SUCH COMBINATION.

BASICALLY, THE MAXIMUM UNPROTECTED CAPACITANCE (Ci) AND INDUCTANCE (Li) OF THE INTRINSICALLY SAFE APPARATUS, INCLUDING INTERCONNECTING WIRING PARAMETERS (Lcable, Ccable), MUST BE EQUAL OR LESS THAN THE CAPACITANCE (Ca) AND INDUCTANCE (La) WHICH CAN BE SAFELY CONNECTED TO THE ASSOCIATED APPARATUS. ALSO, THE MAXIMUM OUTPUT PARAMETERS (Voc, Isc, Po) OF THE ASSOCIATED APPARATUS MUST BE EQUAL OR LESS THAN THE MAXIMUM ENTITY PARAMETERS (Vmax, Imax, Pmax) OF THE INTRINSICALLY SAFE APPARATUS.

IF THE SFC IS CONNECTED TO THE INTRINSICALLY SAFE LOOP, FURTHER CONSIDERATION MUST BE TAKEN AS SHOWN BY THE FOLLOWING EXAMPLES.

EXAMPLE 1. La

MAXIMUM OUTPUT CURRENT (Isum) TO THE LOOP IN THE WORST SITUATION IS THE SUM OF THE DELIVERED CURRENT (Isc) BY THE BARRIER AND THAT (Isc) BY THE SFC. IF Isc OF THE BARRIER IS 93mA,

Isum = 93mA + 22.1mA = 115.1mA.

THEN, BY APPLYING 120mA (THE NEXT HIGHER VALUE OF THE RESULTING Isum) TO THE TABLE OF NEXT PAGE, La FOR GROUP A/B IS DETERMINED : La=2.50mH.

THE ABOVE OBTAINED La VALUE MUST SATISFY THE BELOW RELATIONSHIP.

La ≧ Li (TRANSMITTER) + Lcable + Li (SFC).

ACCORDINGLY, THE WIRING INDUCTANCE NEVER EXCEEDS THE VALUE La - Li (TRANSMITTER) - Li (SFC), i.e. IF Li OF TRANSMITTER IS 11μH,

Lcable ≦ 2.50mH - 11μH - 0 = 2.489mH.

NOTE: IF THE ABOVE Lcable VALUE IS SMALLER THAN THE INDUCTANCE OF A CABLE, ANOTHER BARRIER WITH A SMALLER Isc VALUE SHOULD BE SELECTED.

EXAMPLE 2. Ca

MAXIMUM OUTPUT VOLTAGE (Vsum) TO THE LOOP IN THE WORST SITUATION IS THE SUM OF THE DELIVERED VOLTAGE (Voc) BY THE BARRIER AND THAT (Voc) BY THE SFC. IF Voc OF THE BARRIER IS 28V.

Vsum = 28V + 7.5V = 35.5V.

THEN, BY APPLYING 36V (THE NEXT HIGHER VALUE OF THE RESULTING Vsum) TO THE TABLE OF NEXT PAGE, Ca FOR GROUP A/B IS DETERMINED : Ca=0.08 μF.

THE ABOVE OBTAINED Ca VALUE MUST SATISFY THE BELOW RELATIONSHIP.

Ca ≧ Ci (TRANSMITTER) + Ccable + Ci (SFC).

ACCORDINGLY, THE WIRING CAPACITANCE NEVER EXCEEDS THE VALUE Ca - Ci (TRANSMITTER) - Ci (SFC), i.e. IF Ci OF TRANSMITTER IS 0.032 μF

Ccable ≦ 0.08 μF - 0.032 μF - 0 = 0.048 μF.

NOTE: IF THE ABOVE Ccable VALUE IS SMALLER THAN THE CAPACITANCE OF A CABLE, ANOTHER BARRIER WITH A SMALLER Voc VALUE SHOULD BE SELECTED.

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EXTERNAL WIRING DIAGRAM
ST3000 TRANSMITTER
INTRINSICALLY SAFE LOOP

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IF THE HHT IS CONNECTED TO THE INTRINSICALLY SAFE LOOP, FURTHER CONSIDERATION MUST BE TAKEN AS SHOWN BY THE FOLLOWING EXAMPLES.

EXAMPLE 3. La

MAXIMUM OUTPUT CURRENT (Isum) TO THE LOOP IN THE WORST SITUATION IS THE SUM OF THE DELIVERED CURRENT (Isc) BY THE BARRIER AND THAT (Isc) BY THE HHT. IF Isc OF THE BARRIER IS 93mA,

Isum = 93mA + 32mA = 125mA.

THEN, BY APPLYING 130mA (THE NEXT HIGHER VALUE OF THE RESULTING Isum) TO THE RIGHT TABLE, La FOR GROUP A/B IS DETERMINED : La=2.00mH.

THE ABOVE OBTAINED La VALUE MUST SATISFY THE BELOW RELATIONSHIP.

La ≧ Li (TRANSMITTER) + Lcable + Li (HHT).

ACCORDINGLY, THE WIRING INDUCTANCE NEVER EXCEEDS THE VALUE La - Li (TRANSMITTER) - Li (HHT), i.e. IF Li OF TRANSMITTER IS 11μH,

Lcable ≦ 2.00mH - 11μH - 0 = 1.989mH

NOTE: IF THE ABOVE Lcable VALUE IS SMALLER THAN THE INDUCTANCE OF A CABLE, ANOTHER BARRIER WITH A SMALLER Isc VALUE SHOULD BE SELECTED.

EXAMPLE 4. Ca

MAXIMUM OUTPUT VOLTAGE (Vsum) TO THE LOOP IN THE WORST SITUATION IS THE SUM OF THE DELIVERED VOLTAGE (Voc) BY THE BARRIER AND THAT (Voc) BY THE HHT. IF Voc OF THE BARRIER IS 28V,

Vsum = 28V + 1.7V = 29.7V.

THEN, BY APPLYING 30V (THE NEXT HIGHER VALUE OF THE RESULTING Vsum) TO THE RIGHT TABLE, Ca FOR GROUP A/B IS DETERMINED : Ca=0.12μF.
THE ABOVE OBTAINED Ca VALUE MUST SATISFY THE BELOW RELATIONSHIP.

Ca ≧ Ci (TRANSMITTER) + Ccable + Ci (HHT).

ACCORDINGLY, THE WIRING CAPACITANCE NEVER EXCEEDS THE VALUE Ca - Ci (TRANSMITTER) - Ci (HHT), i.e. IF Ci OF TRANSMITTER IS 0.032μF,

Ccable ≦ 0.12μF - 0.032μF - 0 = 0.088μF.

NOTE: IF THE ABOVE Ccable VALUE IS SMALLER THAN THE CAPACITANCE OF A CABLE, ANOTHER BARRIER WITH A SMALLER Voc VALUE SHOULD BE SELECTED.

Isum = Isc (ASSOCIATED APPARATUS) + Isc(SMART COMMUNICATOR OR HART COMMUNICATOR)
Vsum = Voc (ASSOCIATED APPARATUS) + Voc (SMART COMMUNICATOR OR HART COMMUNICATOR)

Isum (MILLI AMPERES)	La (MILLI HENRYS)		
	A/B	C	D
20	90.00	330.00	700.00
21	82.00	300.00	635.30
23	68.00	250.00	530.10
25	58.00	210.00	449.00
28	46.00	170.00	358.40
30	40.00	150.00	312.40
32	36.00	135.00	274.80
35	31.00	110.00	229.90
40	23.00	87.00	176.30
45	19.00	70.00	139.40
50	15.00	56.00	113.10
55	12.00	48.00	93.50
57	11.00	43.00	87.10
60	10.00	40.00	78.70
62	9.50	37.00	73.70
65	8.80	34.00	67.10
70	7.50	28.00	57.90
75	6.70	25.00	50.50
80	6.00	22.00	44.40
85	5.50	20.00	39.30
90	5.00	18.00	35.10
100	4.00	15.00	28.50
110	3.00	12.00	23.60
120	2.50	10.00	19.80
130	2.00	9.00	16.90
140	1.60	8.00	14.60
150	1.30	7.00	12.70
160	1.00	6.20	11.20
170	0.80	5.50	9.90
180	0.60	5.00	8.80
200	0.50	4.00	7.20
220	0.40	3.20	5.90

Vsum (VOLTS)	Ca (MICROFARADS)		
	A/B	C	D
5	91.97	275.91	735.77
10	3.21	9.64	25.69
15	0.78	2.35	6.26
20	0.34	1.01	2.7
22	0.26	0.78	2.09
24	0.21	0.63	1.67
26	0.17	0.51	1.37
28	0.14	0.43	1.14
30	0.12	0.36	0.97
32	0.11	0.32	0.84
34	0.09	0.28	0.73
36	0.08	0.24	0.65
38	0.08	0.22	0.58
40	0.06	0.19	0.52
42	0.06	0.18	0.47

名称 TITLE
EXTERNAL WIRING DIAGRAM
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INTRINSICALLY SAFE LOOP

YAMATAKE

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改番 REV. 03

シート SHT. 3

A3

Power supply and load resistance

- The load resistance of the intrinsically safe circuit and the supply voltage must be determined in such a way that the following formula holds:

  $$250 \leq R \leq (Supply \cdot voltage - 10.8) / 0.0218$$

  R: Loop resistance (Ω)
  Vz: Voltage drop of Approved Zener Barrier
- Load resistance is the sum of the resistance that is connected to the output terminals of the equipment such as the resistance of the cable loop and the internal resistance of the connected instruments.

Lightning protection

When your transmitter is equipped with optional lightning protection, you must connect a wire form the transmitter to ground as shown in Figure 4-22 to make the protection effective.

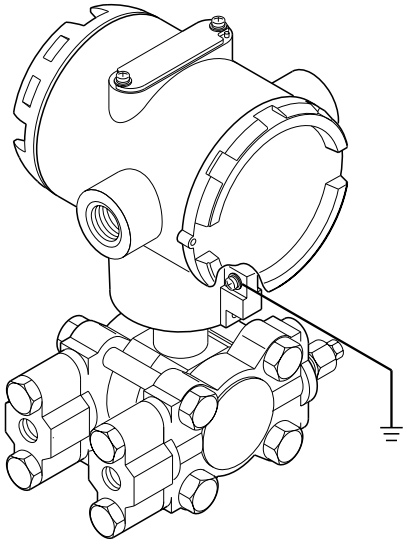


Figure 4-22 Ground Connection for Lightning Protection

Conduit seal

For an explosion proof installation in Class 1,Division 1, Group A locations only, you must seal the conduit entrances in the electronics housing. However, you can skip the conduit seal requirement for installations in Groups B,C, and D locations.

If a seal is required, use a conduit seal on the wiring outlet of the housing or junction box.

⚠ WARNING

In explosive atmospheres and non-intrinsically safe loops, do not apply power to the transmitter with the electronics housing end-cap removed, and do not remove the end-cap with power applied to the transmitter.
Install the conduit seal according to the instructions packaged with the product.

Chapter 5 : Operation of the Transmitter

5-1 : Preparation

5-1-1 :Connecting SFC

SFC connection

The illustration shows how to connect an SFC to the transmitter.

Remarks:

Connect the SFC communication cables to the transmitter terminals, as follows.

Red cable: Supply + terminal

Black cable: Supply - terminal

~Note *External load resistance must be at least 250Ω for communications with an SFC. If total load resistance of the receiving instrument is below 250Ω, add the difference to the loops resistance.*

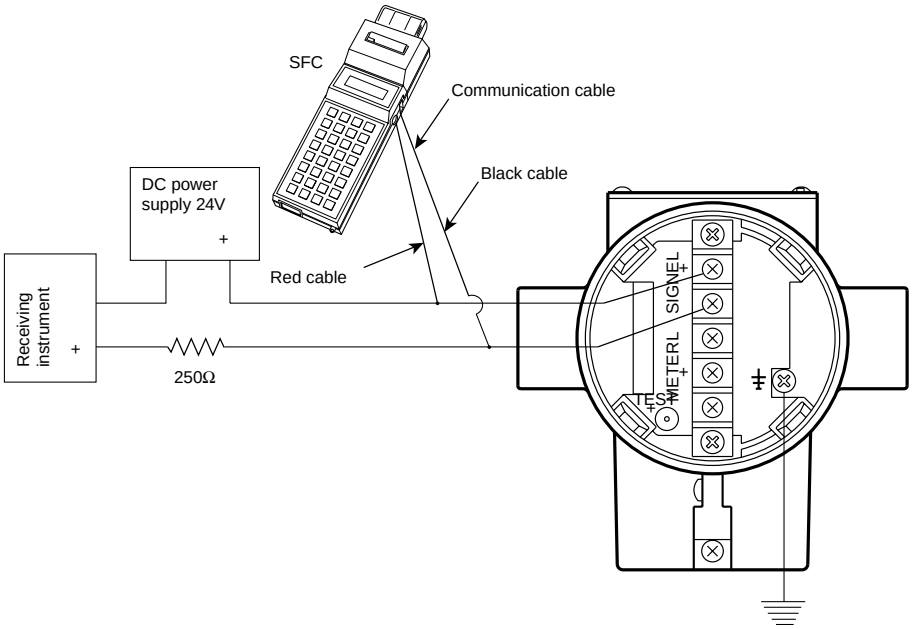


Figure 5-1 Connecting SFC

General key-pad operations

Operate SFC keys with these points in mind:

- Press keys firmly and slowly. No response on the screen indicates input failure. In such a case, press the key again, slowly.
- If a key-press makes no change on the screen, it may mean that the key is not supported by the connected transmitter. You should find the correct key using the manual.

5-2 : Setting Tag No. and Checking Specifications

5-2-1 :Starting Communications

⚠ WARNING

In some cases, communications between the transmitter and the SFC in the automatic mode cause a sudden change in the output. Although this change is only temporary, it may result in a hazardous situation. Switch the process control loop to manual before starting communications between the transmitter and the SFC.

Procedure

This procedure starts communications between this transmitter and the SFC:

Step	Description	SFC screen
1	Place in manual mode, the process	No display
2	Refer to Figure 5-1 and connect the SFC to the transmitter.	
3	Turn ON the SFC power switch. Press the key	LOOP IN MANUAL? PRESS ID
4	Press the key	DSTJ TAG NO. LIN DP XXXXXXXX The default tag number is xxxxxxxx

5-2-2 :Setting Tag No.

Procedure

Start communications with the transmitter. Use this procedure, to set a tag No.:

The tag No. is displayed on the name plate of this transmitter.

The procedure for setting FIT-1234 for the tag No. is included, below.

Step	Description	SFC screen
1	Press the [ALPHA], [URV 100%], [DE CONF. MENU ITEM], and [6] keys in that order	DSTJ TAG NO. LIN DP FIT-
2	Press the [ALPHA] and [TIME +/-] keys in that order.	DSTJ TAG NO. LIN DP FIT-
3	Press the [1], [2], [SW VER 3], and [4] keys in that order.	DSTJ TAG NO. LIN DP FIT-1234
4	Press the [NON-VOL ENTER (Yes)] key. Tag No. FIT-1234 is set.	DSTJ TAG NO. WORKING... DSTJ TAG NO. LIN DP FIT-1234

Correct an input

Correct keying errors, using this procedure:

Press the [ALPHA] key to release alphabet mode. Press the [A DE ←Q] key to shift the cursor back by one column and press the [ALPHA] key again. Input correct character.

Correct keying errors using this procedure:

Press the [A DE ←Q] key to shift the cursor back by one column. Input a correct number.

5-2-3 :Checking Output Format

Procedure

Check the output format (linear/square root) of the transmitter, using this procedure.

To change the output format, refer to "6-7-3 : Display or Change Output Format".

Step	Description	SFC screen
1	Press the B CONF key.	DSTJ CONFIG CONFORM?
2	Press the NON-VOL ENTER (Yes) key.	Square root output CONFORM SQUARE ROOT Linear output CONFORM LINEAR
3	Press the CLR (No) key twice.	DSTJ FIT-1234 READY...

5-2-4 :Checking Display Setting

Procedure

Check the display setting (flow rate/linear/display flow rate) of the transmitter, using this procedure.

To change the setting, refer to "6-7-4 : Display or Change Indicator Display Format (Flow Rate /Linear/ Display Flow Rate)".

Step	Description	SFC screen
1	Press the B CONF key.	DSTJ CONFIG CONFORM?
2	Press the ▲ H NEXT key.	DSTJ CONFIG DISPLAY?
3	Press the NON-VOL ENTER (Yes) key.	Square root output DISPLAY CONF FLOW Linear output and linear display DISPLAY CONF LINEAR Linear output and flow rate display DISPLAY CONF DISP FLOW
4	Press the CLR (No) key twice.	DSTJ FIT-1234 READY...

5-2-5 :Checking Engineering Unit of Measured Pressure

Procedure

Check the engineering unit of measured pressure, using this procedure.

Here, it is assumed that [kPa] is selected.

To change the engineering unit, refer to "6-7-5 : Display or Change Indicator Display Format (Engineering Unit /%)".

Step	Description	SFC screen
1	Press the D UNITS key.	UNIT FIT-1234 kPa

5-2-6 :Checking Low and High Limits of Setting Range

Procedure

Check the low and high limits of the setting range, using this procedure.

It is assumed that the following values are set:

- Low limit (LRV): 0.0000 kPa
- High limit (URV): 50 kPa

To change the setting, refer to "6-7-8 : Display or Change Low/High Limits and Span of Set Range".

Step	Description	SFC screen
1	Press the E LRV 0% key.	LRV FIT-1234 0.0000 kPa
2	Press the F URV 100% key.	URV FIT-1234 50.00 kPa

5-2-7 :Checking Damping Time Constant

Procedure

Check the damping time constant using the following procedure.

Here, it is assumed that [1.0 second] is set for the damping time constant.

To change the damping time constant, refer to "6-7-10 : Display or Change Damping Time Constant".

Step	Description	SFC screen
1	Press the C DAMP key.	DAMP FIT-1234 1.0 s

5-2-8 :Checking Sealed Liquid Temperature Correction Function Setting

Procedure

Check that the sealed liquid temperature correction function is set by the following procedure.

This function is not set when the height display on the SFC screen is “0 m.”

For the procedure for changing the setting, refer to "6-7-15 : Displaying and changing the sealed liquid temperature correction function".

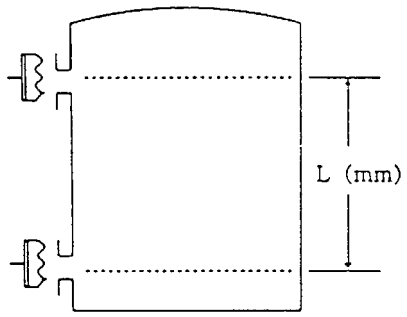
Step	Description	SFC screen
1	Press the B CONF key.	DSTJ CONFIG CONFORM?
2	Press the ▲ H NEXT key. Or else, press the ▼ L PREV key four times.	DSTJ CONFIG SAVE/RESTORE?
3	Press the NON-VOL ENTER (Yes) key.	SAVE DATA WORKING...

Step	Description	SFC screen
4	Press the CLR (No) key twice.	DSTJ FIT-1234 READY...

Sealed liquid temperature correction function

When the liquid level of a tank is measured using a remote sealing type differential pressure transmitter, the density of the sealed liquid in the capillary tube changes as the ambient temperature changes. This ordinarily causes about 4~5% zero shifting.

The STR/STE has a composite semiconductor sensor with a function for correcting sealed liquid temperature by means of temperature measurement and arithmetic operation with a microprocessor. This assures accurate level measurements. (The zero shift is reduced to 1/5 from the previous level.)



Example of zero shift

L (Difference between flanges): 2500 mm (2.5 m)

R (Measurement span): 2500 mm (2.5 m)

A (Temperature coefficient of sealed liquid):0.001/°C

T (Ambient temperature change): 55°C

$$Zero\ shift = \frac{A \times T \times L}{R} \times 100 \ldots (1)$$

From (1)

Zero shift of a model without temperature correction:

$$\frac{0.001 \times 55 \times 2500}{2500} \times 100 = 5.5\,\%$$

(Conventional transmitter)

Zero shift of a model with temperature correction

function DSTJ3000: 1%

5-3 : Measurement with STD type

5-3-1 :Flow Rate Measurement

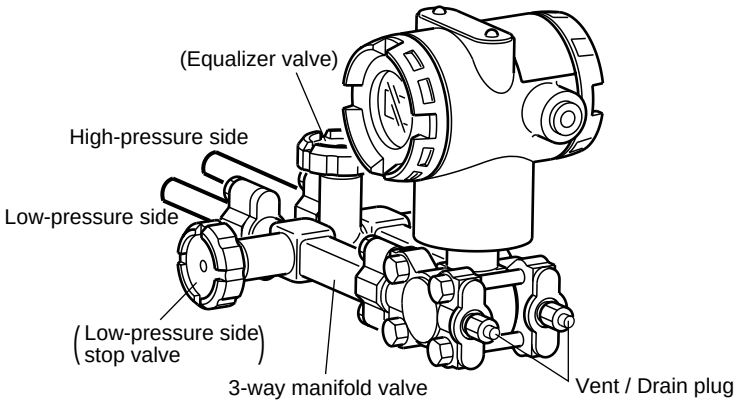
5-3-1-1 Preparation for Measurement

⚠ WARNING

- Make sure that the process is in the manual control mode.
  If in automatic control mode, switch to manual control before starting the following procedures.
- Drain poisonous fluids with care, making provisions to protect personnel.
- Always close the differential pressure output valve (main valve), the drain valve, the gas vent plug (refer to figures 4-8 and 4-9) and the high pressure side and low pressure side stop valves of the 3-way manifold valve. Also, open the equalizer valve of the 3-way manifold valve.

Procedure 1

Lead process pressure into the pressure receiving part of the transmitter, using this procedure:

Step	Description
1	Gradually open the main valves of both the high-pressure side and the low-pressure side (Refer to Figure 4-8 and Figure 4-9). Lead process fluid into the connecting pipe.1
2	Fill with process fluid, the pressure-receiving part of the transmitter. 1. Gradually open the high pressure side stop valve. Close, after the pressure receiving part has completely filled with process fluid. 2. Gradually open the low pressure side stop valve. Close, after the pressure receiving part has completely filled with process fluid. 

Step	Description
3	Decrease to zero, the differential pressure applied to the transmitter. • Gradually open the high-pressure side stop valve to lead process pressure into the pressure receiving part of the transmitter. • In this state, equal pressure is applied to the high-pressure side and the low-pressure side of the transmitter (equal pressure state).
4	Check for pressure leaks in the connecting pipe, the 3-way manifold valve, and the transmitter.

Procedure 2

Perform zero-point calibration, using this procedure:

Zero point calibration by SFC operation

Check that the transmitters input is 0 kPa and its output is 0%.

Step	Description	SFC screen
1	Turn ON the power switch of the SFC. After making sure that the process is in the manual control mode, press the NON-VOL ENTER (Yes) key.	LOOP IN MANUAL? PRESS ID
2	Press the DE READ ID A key.	DSTJ TAG NO. LIN DP FIT-1234
3	Press the SHIFT ^ and INPUT OUT- J PUT keys in that order.	SHIFT- INPUT FIT-1234 WORKING... ↓ INPUT FIT-1234 0.0000 kPa

Step	Description	SFC screen
4	Press the INPUT / OUT- J PUT key.	OUTPUT FIT-1234 WORKING... ↓ OUTPUT FIT-1234 0.00 %

If the screen display is not 0 kPa in step 3 or 0% in step 4, proceed to step 5 to perform zero-point calibration.

Assuming that 0.005 kPa was displayed in step 3, perform zero point calibration, using this procedure:

Step	Description	SFC screen
5	Press the SHIFT ^ and INPUT / OUT- J PUT keys, in that order	SHIFT- INPUT FIT-1234 WORKING... ↓ INPUT FIT-1234 0.0000 kPa
6	Press the RESET / COR- K RECT key.	INPUT FIT-1234 ZERO INPUT?
7	Press the NON-VOL / ENTER (Yes) key.	INPUT ARE YOU SURE?

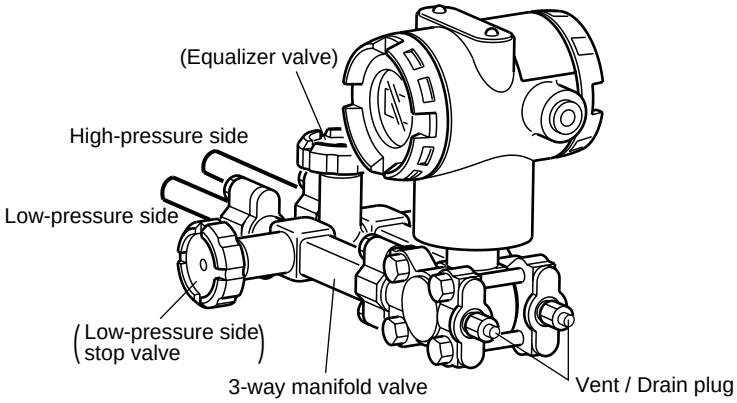
Step	Description	SFC screen
8	Press the NON-VOL ENTER (Yes) key.	INPUT FIT-1234 WORKING... ↓ INPUT FIT-1234 INPUT ZEROED
9	Repeat steps 3 and 4 and make sure that 0.00 is displayed. Zero-point calibration is completed.	

5-3-1-2 Starting Measurement

Procedure 3

Apply the differential pressure of the process by operating valves, using this procedure. Display the measured value using the SFC.

How to apply process pressure

Step	Description
1	Ensure that the 3-way manifold valve is in the following state: 1. High-pressure side stop valve: Fully open 2. Low-pressure side stop valve: Fully closed 3. Equalizer valve: Fully open
2	1. Close the equalizer valve. 2. Open the low-pressure side stop valve gradually. 

How to display measured value

The following conditions are assumed:

Low limit of setting range: 0 kPa

High limit of setting range: 50 kPa

Input differential pressure of transmitter: 25 kPa

In this case, the output is 50%. (Linear output)

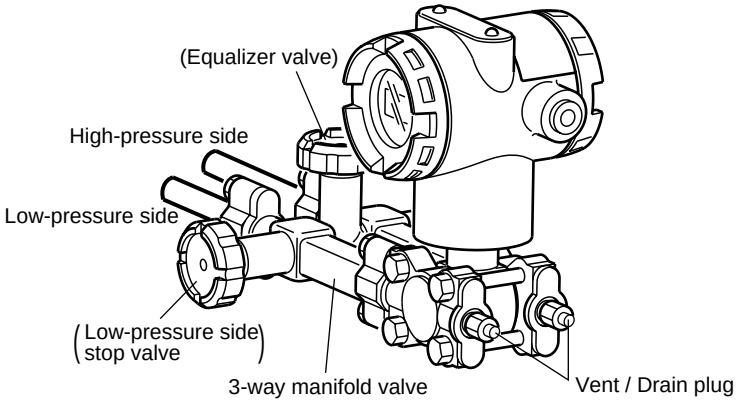
Step	Description	SFC screen
3	Press the SHIFT and INPUT OUTPUT keys, in that order	SHIFT- INPUT FIT-1234 WORKING... ↓ INPUT FIT-1234 25.00 kPa
4	Press the INPUT OUTPUT key.	OUTPUT FIT-1234 50.00 %
5	At the completion measurement, remove the clip from the communication cable. Switch the process to normal operation **⚠ CAUTION** Securely close the cover of the transmitter case. Imperfect closure allows entry of water, and may damage internal terminals as well as the electronics module. Such damage may require parts replacement, possibly of the entire module.	

- If input and output values do not match, check the range and recalibrate. If after recalibration, they remain inconsistent, troubleshot the transmitter as described in "Chapter 7 : Maintenance and Troubleshooting".
- If the displayed data value is unstable, adjust the damping time constant Refer to "6-7-10 : Display or Change Damping Time Constant".

5-3-1-3 Stopping Measurement

Procedure

Stop the transmitter, using this procedure:

Step	Description
1	Turn off the transmitter
2	Operate the 3-way manifold valve by the following procedure: 1. Close the low-pressure side stop valve. 2. Open the equalizer valve. 3. Close the high-pressure side stop valve 
3	Close the main valves on the high and low pressure sides. Refer to Figure 4-8 and Figure 4-9.

⚠ CAUTION

- If you plan to leave the transmitter OFF for a long period of time, always drain process fluid from the connecting pipe and the pressure-receiving part.
- Leave the equalizer valve open.

5-3-2 :Gas Pressure Measurement

5-3-2-1 Preparation for Measurement

⚠ WARNING

- Ensure that the process is in the manual control mode.

  If the process is in automatic control mode, switch to manual before starting the procedure.
- Drain poisonous fluids with care, making provisions to protect personnel.
- Close the differential pressure output valve (main valve), the local valve, the drain valve, and the gas vent plug. Refer to "Figure 4-11 Gas Pressure Measurement - Piping".

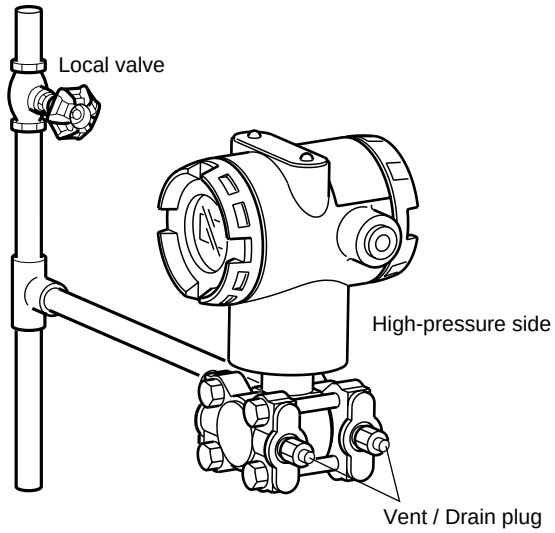
How to measure gas pressure

Perform zero-point adjustment and introduce process pressure into the transmitter, using this procedure:

- Zero-point adjustment

Step	Description
1	Open both the high-pressure side and low-pressure side vent plugs and open the pressure receiving part to the air.
2	Refer to procedure 2 on page 5-10. Perform zero-point calibration.
3	After completing zero-point calibration, close the high-pressure side vent plug.

Introducing process pressure and venting air

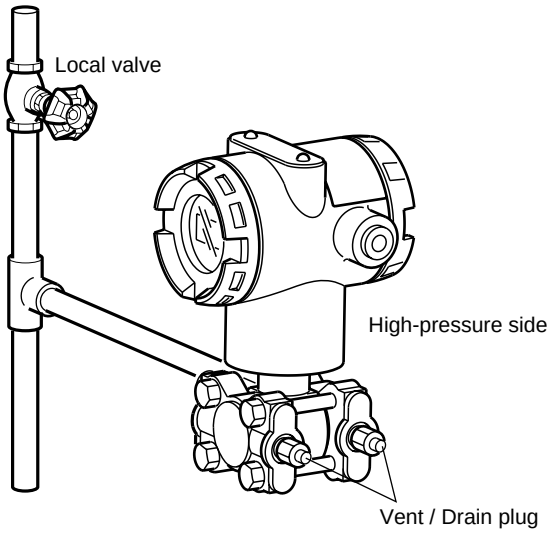
Step	Description
1	1. Open the main valve (refer to "Figure 4-11 Gas Pressure Measurement - Piping".) to introduce process pressure into the connecting pipe. 2. Open the local valve gradually, to introduce process pressure into the pressure-receiving part of the transmitter.
2	1. Open the high-pressure side vent plug gradually, to vent air from the center body. 2. After vent air, close the vent plug and the local valve. 
3	Check for pressure leaks in the connecting pipe and the transmitter.

5-3-2-2 Starting Measurement

Procedure

Operate the valves using this procedure, to apply process pressure to the transmitter and display the measured value by operating the SFC.

- How to apply process pressure

Step	Description
1	Open the local valve gradually. 

How to display measured value

These conditions are assumed here:

- Low limit of setting range :0 kPa
- High limit of setting range :50 kPa
- Input differential pressure of transmitter :25 kPa

In this case, the output is 50%.

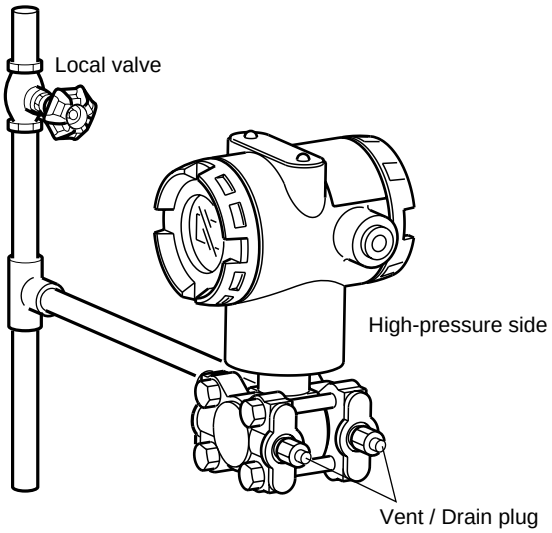
Step	Description	SFC screen
2	Press the SHIFT key and INPUT OUTPUT key in that order.	SHIFT- INPUT FIT-1234 WORKING... ↓ INPUT FIT-1234 25.00 kPa
3	Press the INPUT OUTPUT key.	OUTPUT FIT-1234 50.00 %
4	At the end of measurement, remove the clip of the communication cable and switch the process to ordinary operation. **⚠ CAUTION** Securely close the cover of the transmitter case. Failure to do so will result in entry of water, and cause damage to internal terminals and the electronics module.	

- If input and output values fail to match, check the range and recalibrate. If after recalibration, they remain inconsistent, troubleshoot the transmitter as described in "Chapter 7 : Maintenance and Troubleshooting".
- If the displayed data value is unstable, adjust the damping time constant by referring to "6-7-10 : Display or Change Damping Time Constant".

5-3-2-3 Stopping Measurement

Procedure

How to stop the transmitter

Step	Description
1	Turn off the transmitter.
2	Close the local valve. 
3	Close the main valve. (Refer to "Figure 4-11 Gas Pressure Measurement - Piping".)

⚠ CAUTION

If you plan to leave the transmitter OFF for a long period of time, completely drain process fluid from the connecting pipe, and from the pressure receiving part.

5-3-3 :Liquid Level Measurement of Open Tank and Closed Tank (Dry Leg)

5-3-3-1 Preparation for Measurement

⚠ WARNING

- Place the process in the manual control mode.

  If the process is in the automatic control mode, switch to manual before performing work.
- Drain poisonous fluids carefully, taking provisions to protect workers.
- Check that the differential pressure output valve (main valve), the drain valve, the gas vent plug (refer to "Figure 4-12 Example of Piping".) are closed, as well as the high pressure side and low pressure side stop valves of the 3-way manifold valve. Also, make sure that the equalizer valve of the 3-way manifold valve is open.

Calculating setting range

Calculate the setting range. Refer to "5-10 : Set Range Calculation for Liquid Level Measurement".

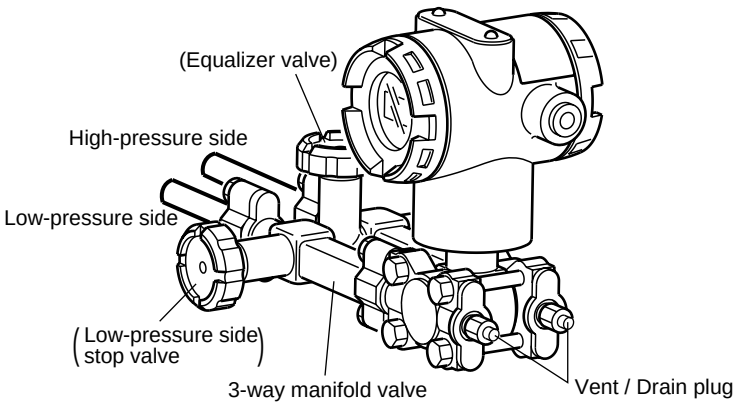
Procedure

Perform zero-point adjustment and introduce process pressure into the transmitter by this procedure:

Zero-point calibration

Step	Description
1	Open the drain plugs and the stop valves of both the high-pressure side and the low-pressure side. Open the pressure receiving part to the air. If fluid remains in the pressure receiving part, blow it to drain.
2	Refer to procedure 2 in page 5-10 and perform zero-point calibration.
3	After completing zero-point calibration, close the high-pressure side drain plug and the high-pressure side stop valve.

Introducing process pressure

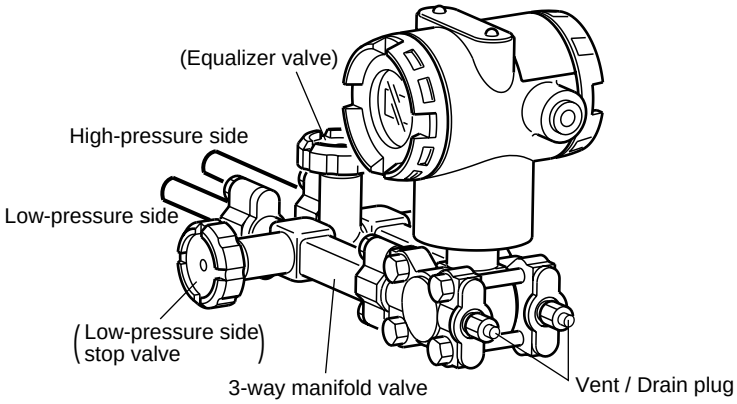
Step	Description
1	1. Open the main valve (refer to "Figure 4-14 Open Tank -- Piping Example".) to introduce process pressure into the connecting pipe. 2. Open the high-pressure side stop valve gradually to introduce process pressure. After introducing process pressure into the pressure receiving part of the transmitter, close the high-pressure side stop valve. 
2	Check for pressure leaks in the connecting pipe, the 3-way manifold valve, and the transmitter.

5-3-3-2 Starting Measurement

Procedure

Operate the valves with this procedure, to apply the differential pressure of the process to the transmitter. Display the measured value using operating the SFC.

How to apply process pressure

Step	Description
1	Check that the 3-way manifold valve is in the following state: 1. High-pressure side stop valve: Fully closed 2. Low-pressure side stop valve: Fully open 3. Equalizer valve: Fully closed 
2	1. Open the high-pressure side stop valve gradually.

Zero-point adjustment during measurement

Refer to "5-8 : Zero-point Adjustment -- Based on Actual Liquid Level" to adjust the zero point during measurement.

How to display measured value

These conditions are assumed here:

- Low limit of setting range :0 kPa
  High limit of setting range :50 kPa
- Input differential pressure of transmitter :25 kPa

In this case, the output is 50%. (Linear output)

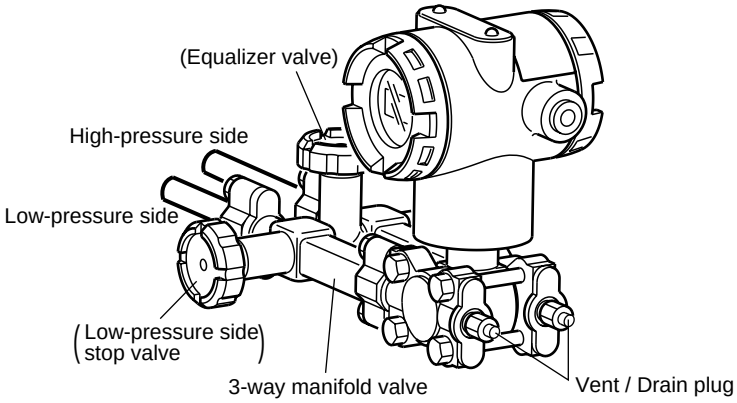
Step	Description	SFC screen
2	Press the SHIFT ^ and INPUT OUT- PUT J keys in that order.	SHIFT- INPUT FIT-1234 WORKING... ↓ INPUT FIT-1234 25.00 kPa
3	Press the INPUT OUT- PUT J key.	OUTPUT FIT-1234 50.00 %
4	At the end of measurement, remove the clip of the communication cable and switch the process to ordinary operation. **⚠ CAUTION** Securely close the cover of the transmitter case. Failure to do so will result in entry of water, and cause damage to internal terminals and the electronics module.	

- If the input and output values do not match, check the range and recalibrate. If they remain inconsistent, troubleshoot the transmitter as described in "Chapter 7 : Maintenance and Troubleshooting".
- If the displayed data value is unstable, adjust the damping time constant. Refer to "6-7-10 : Display or Change Damping Time Constant".

5-3-3-3 Stopping Measurement

Procedure

How to stop the transmitter

Step	Description
1	Turn off the transmitter.
2	Operate the 3-way manifold valve using this procedure: 1. Close the low-pressure side stop valve. 2. Open the equalizer valve. 3. Close the high-pressure side stop valve. 
3	Close the main valve. Refer to "Figure 4-14 Open Tank -- Piping Example".

⚠ CAUTION

- If you plan to leave the transmitter OFF for a long period, drain process fluid from the connecting pipe and the pressure receiving part.
- Leave the equalizer valve open.

5-3-4 :Liquid Level Measurement of Closed Tank (Wet Leg)

5-3-4-1 Preparation for Measurement

⚠ WARNING

- Place the process in manual control mode.

  If the process is in automatic control mode, change it to the manual control mode before performing this work.
- Drain poisonous fluids with care, making provisions for protecting workers.
- Make sure that the differential pressure output valve (main valve), the drain valve, the gas vent plug (refer to "Figure 4-16 Closed Tank -- Piping (Wet-leg Sealing Example)".) and the high pressure side and low pressure side stop valves of the 3-way manifold valve are closed. Also, make sure that the equalizer valve of the 3-way manifold valve is open.

Calculating setting range

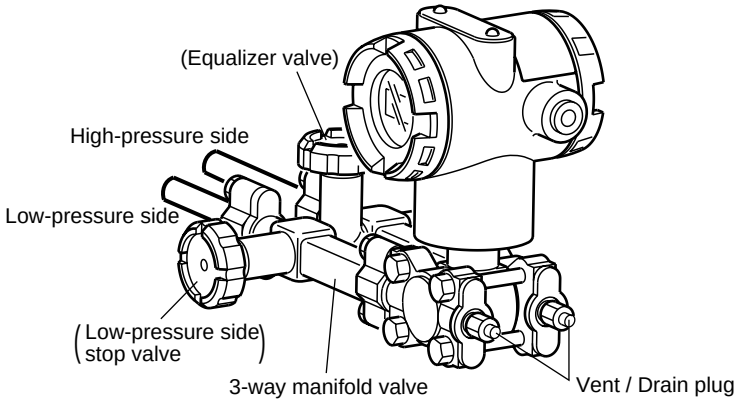
For the procedure for obtaining the setting range by calculation, refer to "5-10 : Set Range Calculation for Liquid Level Measurement".

Procedure

Perform zero-point adjustment and introduce process pressure into the transmitter using this procedure:

Zero-point calibration

Step	Description
1	Feed sealing liquid from the seal pot to fill the connecting pipe with sealing liquid.
2	Gradually open the stop valves of both the high-pressure side and the low-pressure side, and the drain plugs, to fill the pressure receiving part of the transmitter with sealing liquid.
3	When sealing liquid flows out from the drain plugs, close the stop valves of both the high pressure side and the low pressure side and the drain plugs. In this state, the same pressure is applied to the high pressure side and the low pressure side of the transmitter (equal pressure state).
4	Referring to procedure 2 in page 5-10, perform zero point calibration.
5	After completing zero-point calibration, close the equalizer valve. Open the stop valve and the drain plug of the low-pressure side to drain sealing liquid. Close the stop valve and the drain plug of the low-pressure side.



Introducing process pressure

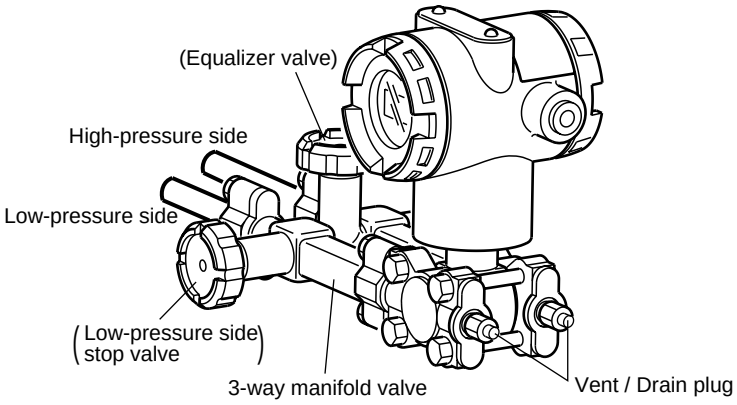
Step	Description
1	Open the main valve (Refer to "Figure 4-16 Closed Tank -- Piping (Wet-leg Sealing Example)".) to introduce process fluid into the connecting pipe.
2	Gradually open the low pressure side stop valve to introduce process fluid. After introducing process fluid into the pressure receiving part of the transmitter, close the low pressure side stop valve.
3	Make sure that the connecting pipe, the 3-way manifold valve, and the transmitter have no pressure leaks.

5-3-4-2 Starting Measurement

Procedure

Operate the valves by the following procedure to apply the differential pressure of the process to the transmitter and display the measured value by operating the SFC.

How to apply process pressure

Step	Description
1	Make sure that the 3-way manifold valve is in this state: 1. High-pressure side stop valve: Fully closed 2. Low-pressure side stop valve: Fully closed 3. Equalizer valve: Fully closed
2	Fill the liquid sealing pipe with sealing liquid.
3	1. Gradually open the high-pressure side stop valve. 2. Gradually open the low-pressure side stop valve. 

Zero-point adjustment during measurement

Refer to "5-9 : Zero-span Adjustment with Input Pressure Equivalent to Range" to adjust the zero point during measurement.

How to display measured value

The following conditions are assumed here:

- Low limit of setting range : 50 kPa
  High limit of setting range : 0 kPa
- Input differential pressure of transmitter : 25 kPa

In this case, the output is 50%.

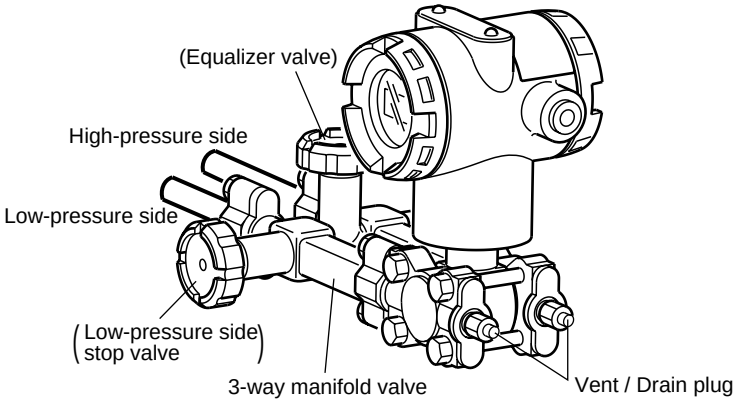
Step	Description	SFC screen
4	Press the SHIFT and INPUT OUTPUT keys in that order.	SHIFT- INPUT FIT-1234 WORKING... ↓ INPUT FIT-1234 25.00 kPa
5	Press the INPUT OUTPUT key.	OUTPUT FIT-1234 50.00 %
6	After completing measurements, remove the clip from the communication cable and switch the process to regular operation. **⚠ CAUTION** Close the cover of the transmitter case securely. Imperfect closure allows entry of water, damaging internal terminals and the electronics module.	

- If the input and output values are inconsistent, check the range and perform calibration again. If they are still inconsistent, use the troubleshooting procedure explained in "Chapter 7 : Maintenance and Troubleshooting".
- If the displayed data value is unstable, adjust the damping time constant by referring to "6-7-10 : Display or Change Damping Time Constant".

5-3-4-3 Stopping Measurement

Procedure

How to stop the transmitter

Step	Description
1	Turn off the transmitter.
2	Operate the 3-way manifold valve by the following procedure: 1. Close the low pressure side stop valve. 2. Open the equalizer valve. 3. Close the high pressure side stop valve. 
3	Close the main valve. (Refer to Figure 4-16.)

⚠ CAUTION

- If the transmitter is to be left off for a long period of time, drain process fluid from the connecting pipe and the pressure receiving part.
- Leave the equalizer valve open.

5-4 : Measurement with Model STG/STA

5-4-1 :Pressure Measurement

5-4-1-1 Preparation for Measurement

⚠ WARNING

- Make sure that the process is in the manual control mode.
  If the process is in the automatic control mode, switch it to manual mode.
- For hazardous fluids (poisons etc.) take any necessary actions to prevent physical hazard and ensure that work proceeds with adequate care.
- Before starting a measurement procedure, ensure closure of the pressure valve (main valve), the local valve, the drain valve, and the gas vent plug (Refer to Figure 4-12).

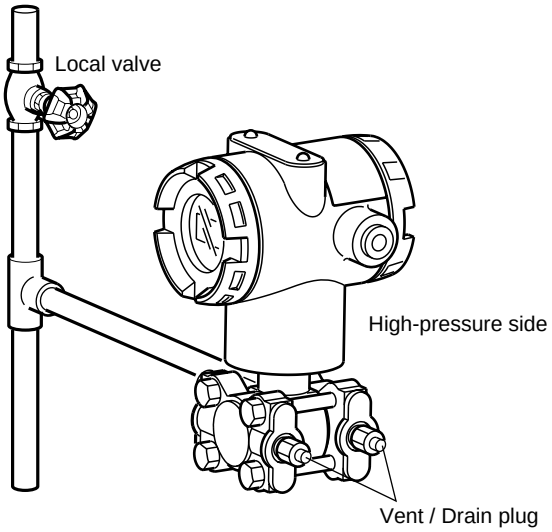
Gas pressure measurement

Perform zero-point calibration and introduce process pressure, with this procedure:

- Zero point calibration

Step	Description
1	Open the vent plug to release the pressure receiving part to the open air.
2	Referring to procedure2 in page 5-10, perform zero-point calibration.
3	When calibration is complete, close the vent plug.

- Introducing process pressure and venting air

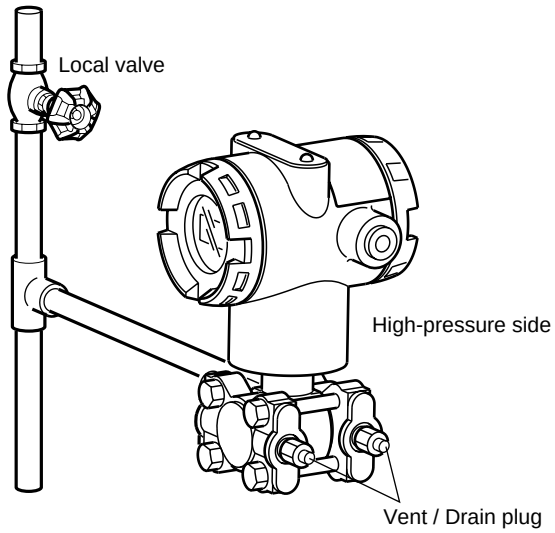
Step	Description
1	1. Introduce the process pressure into the connecting pipe by opening the main valve (Refer to "Figure 4-12 Example of Piping"). If the process temperature is high, allow cooling time so that the connecting pipe is stable at a safe temperature, before starting work. 2. Open the local valve gradually to introduce the process pressure into the pressure receiving part of transmitter.
2	1. Vent air from the center body by gradually opening the vent plug. 2. After venting air completely, close the plug and the local valve. 
3	Ensure zero leakage exists at the connecting pipe and transmitter.

5-4-1-2 Starting Measurement

Procedure

Operate the valve with the following procedure and apply the process pressure to transmitter. Display the measured value by operating the SFC keys.

Process pressure applying operation

Step	Description
1	open gradually the local valve. 

Measured value displaying operation

The following case is explained here:

- Low limit of setting range : 0KPA
  High limit : 50 kPa
- Input pressure to the transmitter : 25 kPa

In this case, the output is 50%.

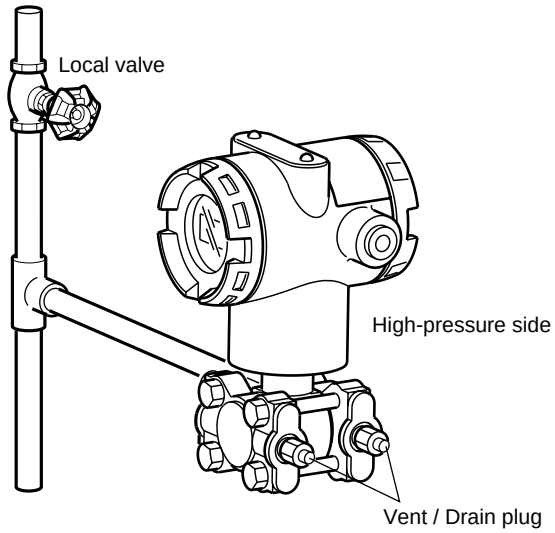
Step	Description	SFC screen
4	Press the SHIFT ^ and INPUT OUT- PUT J keys in that order.	
5	Press the INPUT OUT- PUT J key.	
6	After completing measurement, remove the clip of the communication cable and then switch the process to normal operation. **⚠ CAUTION** Securely close the case cover of the transmitter. Take precautions against moisture ingress into the transmitter body. Water entering the transmitter will damage the internal terminals and the electronics module.	

- If the output value does not correctly reflect the input value, check again the range and calibrate the transmitter. If inappropriate output value persists for the input value, apply troubleshooting procedures ("Chapter 7 : Maintenance and Troubleshooting").
- If the displayed data value is unstable, adjust the damping time constant ("6-7-10 : Display or Change Damping Time Constant").

5-4-1-3 Stopping Measurement

Procedure

Stop the operation of the transmitter by this procedure:

Step	Description
1	Turn OFF the transmitter.
2	Close the local valve. 
3	Close the main valve. (Refer to Figure 4-12)

⚠ CAUTION

When a long-term shutdown is planned, completely drain all process fluid from the connecting pipe and from the pressure receiving part of transmitter.

5-4-2 :Liquid Level Measurement

5-4-2-1 Preparation for Measurement

⚠ WARNING

- Make sure that the process is in the manual control mode.
  If the process is in the automatic control mode, make sure that it has been changed to the manual mode.
- For hazardous fluids (poisons etc.) take any necessary actions to prevent physical hazard and ensure that work proceeds with adequate care.
- Ensure closure of the main valve, the drain valve, and the gas vent plug on the pipe (Refer to Figure 4-12).

Setting range calculation:

In determining the setting range by calculation, refer to Item "5-10 : Set Range Calculation for Liquid Level Measurement"

Gas pressure measurement

Perform zero-point calibration and introduce process pressure, by this procedure:

- Zero point calibration

Step	Description
1	Open the drain plug to release the pressure receiving part to the open air. If fluid remains in the pressure receiving part, blow out fluid.
2	Referring to procedure2 in page 5-10, perform zero-point calibration.
3	When calibration is complete, close the vent plug.

- Introducing process pressure and venting air

Step	Description
1	1. Gradually open the main valve (Refer to Figure 4-12) to introduce the process pressure into the connecting pipe. 2. After introducing the process pressure into the pressure receiving part of the transmitter, close the main valve.
2	Ensure zero leakage exists at the connecting pipe and transmitter.

5-4-2-2 Starting Measurement

Procedure

Operate the valve with the following procedure and apply the process pressure to transmitter. Display the measured value by operating the SFC keys.

Process pressure applying operation

Step	Description
1	Gradually open the main valve (Refer to Figure 4-12).

Zero-point adjustment during measurement

When adjusting the zero point during measurement, refer to Item "5-8 : Zero-point Adjustment -- Based on Actual Liquid Level".

Measured value displaying operation

The following case is explained here:

- Low limit of setting range : 0 kPa
  High limit : 50 kPa
- Input pressure to the transmitter : 25 kPa

In this case, the output is 50%.

Step	Description	SFC screen
4	Press the SHIFT and keys INPUT OUT- PUT in that order.	
5	Press the INPUT OUT- PUT key.	
6	After completing measurement, remove the clip of the communication cable and then switch the process to normal operation. **⚠ CAUTION** Securely close the case cover of the transmitter. Take precautions against moisture ingress into the transmitter body. Water entering the transmitter will damage the internal terminals and the electronics module.	

- If the output value does not correctly reflect the input value, check again the range and calibrate the transmitter. If inappropriate output value persists for the input value, apply troubleshooting procedures ("Chapter 7 : Maintenance and Troubleshooting").
- If the displayed data value is unstable, adjust the damping time constant ("6-7-10 : Display or Change Damping Time Constant").

5-4-2-3 Stopping Measurement

Procedure

Stop the operation of the transmitter by this procedure:

Step	Description
1	Turn OFF the transmitter.
2	Close the main valve. (Refer to Figure 4-12)

⚠ CAUTION

When a long-term shutdown is planned, completely drain all process fluid from the connecting pipe and from the pressure receiving part of transmitter.

5-5 : Measurement with Model STC

5-5-1 :Pressure Measurement

5-5-1-1 Preparation for Measurement

When setting the zero point, set all the diaphragm surface area to be wet with the measured liquid for high accuracy. Even when the diaphragm surface area is not completely wet, make sure that the zero point is set at a level higher than the center of the diaphragm.

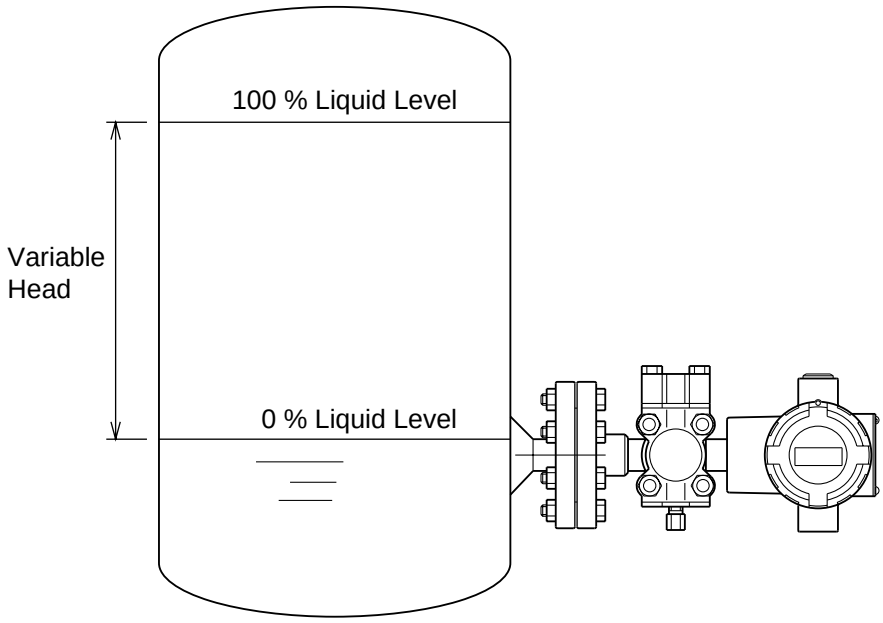


Figure 5-2

5-5-1-2 Starting Measurement

The transmitter is ready for operation when zero-point adjustment is completed. This procedure is described in the previous section. Before starting, always check the following:

(1) Check the correspondence between input and output values.

- If the output does not correctly reflect the input, check the range, check the flange position on the process, and calibrate the transmitter again. If an inappropriate output value persists for the input value, apply troubleshooting procedures ("Chapter 7 : Maintenance and Troubleshooting").

(2) Check the displayed data.

- If unstable value is displayed, adjust the damping time constant ("6-7-10 : Display or Change Damping Time Constant").

(3) Perform the following items carefully:

- Disconnect the SFC from the transmitter terminal. Ensure that the terminal is sufficiently tight, and not loose.
- Close the case cover. Screw in the cover firmly until it can no longer be turned.
- This transmitter has a locking structure. After closing the cover, tighten the lock using a hexagon wrench.

5-5-1-3 Stopping Measurement

Procedure

Turn off the transmitter.

⚠ CAUTION

When a long-term shutdown is planned, completely drain all process fluid from the connecting pipe and from the pressure receiving part of transmitter.

5-6 : Measurement with Model STE/STR

When starting operation, adjust the transmitter in its actual process state. The specific gravity of the sealed-in liquid is stated in the specifications in Appendix A. Specific gravity changes with temperature at the rate of 0.0008/°C. Use the temperature of the capillary tube for items related to specific gravity, in this section.

5-6-1 :Pressure Measurement

5-6-1-1 Preparation for Measurement

When setting the zero point, set all the diaphragm surface area to be wet with the measured liquid for high accuracy. Even when the diaphragm surface area is not completely wet, make sure that the zero point is set at a level higher than the center of the diaphragm.

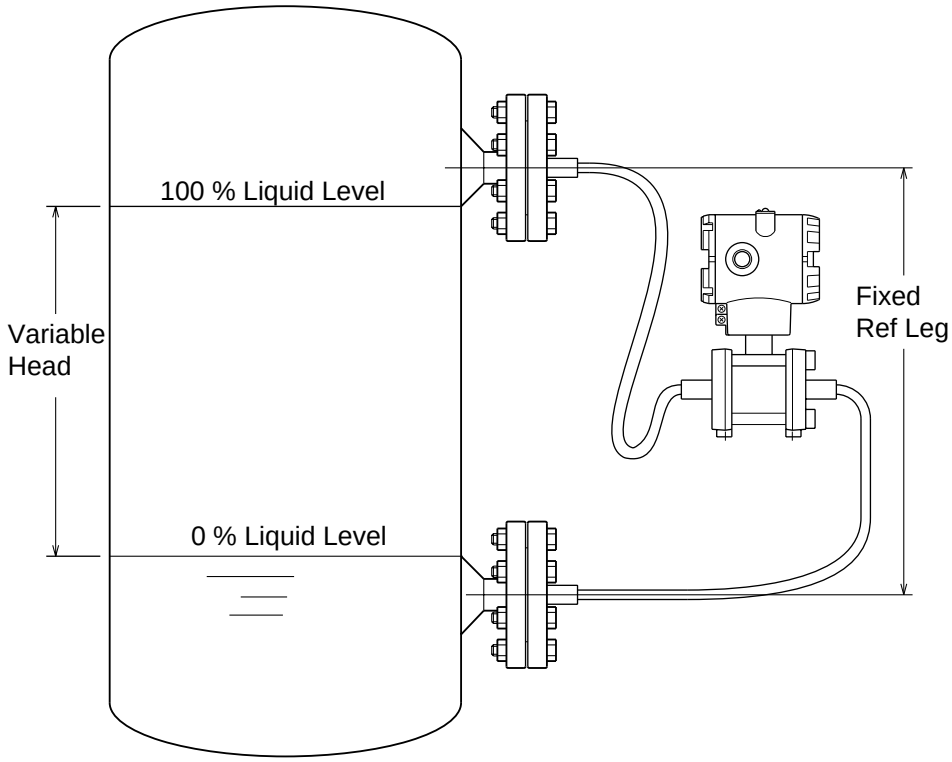


Figure 5-3

5-6-1-2 Starting Measurement

The transmitter is ready for operation when zero-point adjustment is completed. This procedure is described in the previous section. Before starting, always check the following:

(1) Check the correspondence between input and output values.

- If the output does not correctly reflect the input, check the range, check the flange position on the process, and calibrate the transmitter again. If an inappropriate output value persists for the input value, apply troubleshooting procedures ("Chapter 7 : Maintenance and Troubleshooting").

(2) Check the displayed data.

- If unstable value is displayed, adjust the damping time constant ("6-7-10 : Display or Change Damping Time Constant").

(3) Perform the following items carefully:

- Disconnect the SFC from the transmitter terminal. Ensure that the terminal is sufficiently tight, and not loose.
- Close the case cover. Screw in the cover firmly until it can no longer be turned.
- This transmitter has a locking structure. After closing the cover, tighten the lock using a hexagon wrench.

5-6-1-3 Stopping Measurement

Procedure

Turn OFF the transmitter.

⚠ CAUTION

When long-term shutdown is planned, always dismount the transmitter flange from the tank, clean diaphragms with a soft brush, wash using a solvent, and store. Take care not to deform or damage the diaphragms.

5-6-2 :Cautions Related to Flow Rate Measurement

Refer to the instructions on flange mounting for flow-rate measurement, to operate the transmitter for flow rate measurement.

Always complete zero-point checking before introducing fluid to the pipe. This precaution is warranted since the STR/STE has a structural characteristic that prevents mounting of an equalizing valve or stop valve.

For vertical pipes with differential-pressure take-out flange port, the high-pressure side flange and the low-pressure side flange exhibit a level difference. In this case, determine the zero point by setting LRV.

5-7 : Measurement with Model STH/STU

When starting operation, adjust the transmitter in its actual process state. The specific gravity of the sealed-in liquid is stated in the specifications in Appendix A. Specific gravity changes with temperature at the rate of 0.0008/°C. Use the temperature of the capillary tube for items related to specific gravity, in this section.

5-7-1 :Pressure Measurement

5-7-1-1 Preparation for Measurement

When setting the zero point, set all the diaphragm surface area to be wet with the measured liquid for high accuracy. Even when the diaphragm surface area is not completely wet, make sure that the zero point is set at a level higher than the center of the diaphragm.

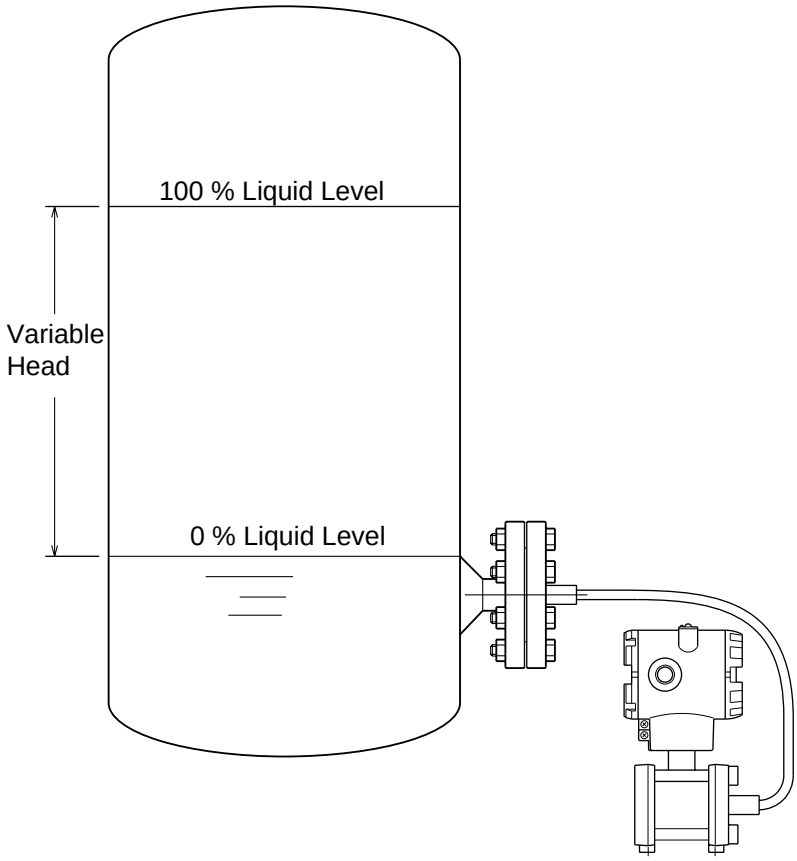


Figure 5-4

5-7-1-2 Starting Measurement

The transmitter is ready for operation when zero-point adjustment is completed. This procedure is described in the previous section. Before starting, always check the following:

(1) Check the correspondence between input and output values.

- If the output does not correctly reflect the input, check the range, check the flange position on the process, and calibrate the transmitter again. If an inappropriate output value persists for the input value, apply troubleshooting procedures ("Chapter 7 : Maintenance and Troubleshooting").

(2) Check the displayed data.

- If unstable value is displayed, adjust the damping time constant ("6-7-10 : Display or Change Damping Time Constant").

(3) Perform the following items carefully:

- Disconnect the SFC from the transmitter terminal. Ensure that the terminal is sufficiently tight, and not loose.
- Close the case cover. Screw in the cover firmly until it can no longer be turned.
- This transmitter has a locking structure. After closing the cover, tighten the lock using a hexagon wrench.

5-7-1-3 Stopping Measurement

Procedure

Turn OFF the transmitter.

⚠ CAUTION

When long-term shutdown is planned, always dismount the transmitter flange from the tank, clean diaphragms with a soft brush, wash using a solvent, and store. Take care not to deform or damage the diaphragms.

5-8 : Zero-point Adjustment -- Based on Actual Liquid Level

Zero point can be adjusted during liquid level measurement without actually lowering to zero the liquid level. The transmitter output can be adjusted to the actual level, based on the actual liquid level measured with a level gauge.

An example of liquid level measurement in a closed tank (by the wet leg method) is show, below.

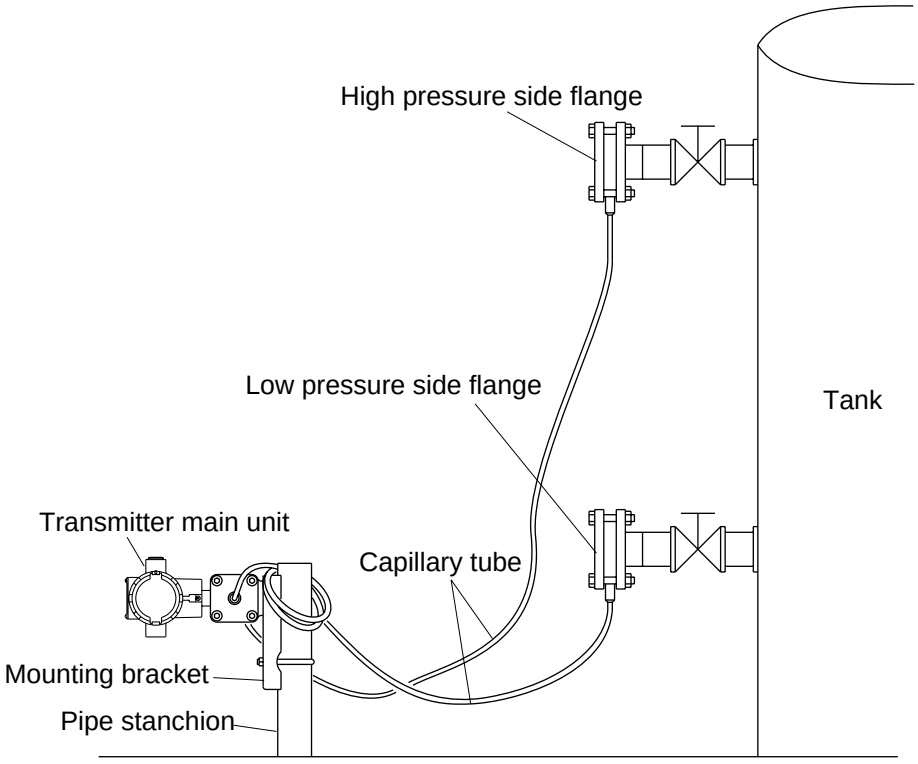


Figure 5-5 Zero Adjustment during Liquid Level Measurement

Procedure

Use these procedures to adjust the transmitter output value to the actual level during liquid-level measurement, based on the actual liquid level.

It is assumed that the zero point is adjusted under the following conditions:

- Low limit : 1000 mm (0%)
- High limit : 0 mm (100%)
- Liquid level measured with level gauge: 500 mm (50%)
- Display on SFC : 45%

Step	Description	SFC screen
1	Press the INPUT OUT- PUT J key The current output of the transmitter will be displayed. Change the displayed value to 50% by the following steps.	OUTPUT FIT-1234 WORKING... ↓ OUTPUT FIT-1234 45.00 %
2	Press the 5 S and ACT PR 0 Z keys in that order.	OUTPUT FIT-1234 50.00 %
3	Press the SET G key. The SFC asks whether or not to execute zero adjustment for 50% output.	OUTPUT FIT-1234 SET LRV?
4	Press the NON-VOL ENTER (Yes) key. Zero adjustment has been completed.	OUTPUT FIT-1234 50.00 %

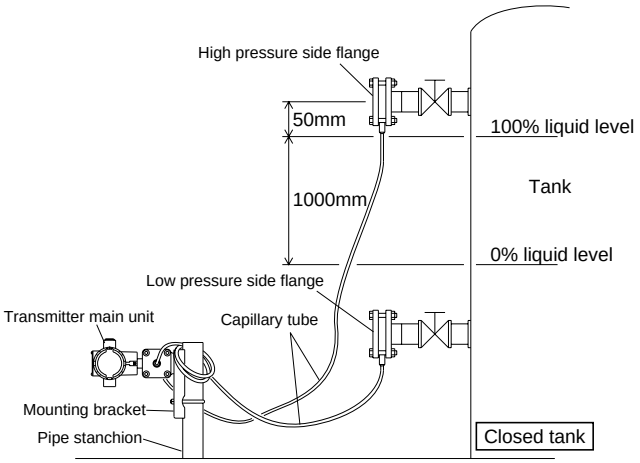
5-9 : Zero-span Adjustment with Input Pressure Equivalent to Range

The LRV (input pressure for 0% output) and the URV (input pressure for 100% output) can be set based on the actual pressure by applying the pressure equivalent to the desired range. The LRV and URV are set automatically based on the desired liquid level or input pressure. Zero span adjustment is completed by this operation.

Procedure

Zero span adjustment procedure under the following conditions is explained below.

- Desired LRV value: 1050 mm (0%)
- Desired URV value: 50 mm (100%)



Procedure for setting LRV (input differential pressure at 0% output)

Step	Description	SFC screen
1	Press the LRV E 0% key. The current set value for LRV will be displayed.	LRV FIT-1234 1050 mmH2O
2	Press the SET G key. The SFC asks whether or not to set the LRV based on the current pressure.	LRV FIT-1234 SET LRV?
3	Press the NON-VOL ENTER (Yes) key. The data will be loaded to the memory of the transmitter and the SFC and the new LRV value will be displayed.	LRV FIT-1234 WORKING... ↓ LRV FIT-1234 1050 mmH2O

Procedure for setting URV (input differential pressure at 100% output)

Step	Description	SFC screen
1	Press the URV F 100% key. The current set value for URV will be displayed.	URV FIT-1234 50 mmH2O
2	Press the SET G key. The SFC asks whether or not to set the URV based on the current pressure.	URV FIT-1234 SET URV?
3	Press the NON-VOL ENTER (Yes) key. The data will be loaded to the memory of the transmitter and the SFC and the new LRV value will be displayed.	URV FIT-1234 WORKING... ↓ URV FIT-1234 50 mmH2O

5-10 : Set Range Calculation for Liquid Level Measurement

5-10-1 :Open Tank or Closed Tank (Dry Leg) or Remote Seal Set Range Calculation

Set range calculation Ex. STD Type

Calculate the set range using these procedures:

The following symbols are used to express density and distance.

It is assumed that the density is fixed, during liquid level measurement.

ρ : Specific gravity of liquid in tank

ρ_0 : Specific gravity of liquid in high pressure side connecting pipe

l : Distance between 100% liquid level and 0% liquid level (measurement range)

h : Distance between 0% liquid level and high-pressure outlet port

d : Distance between high-pressure outlet port and transmitter

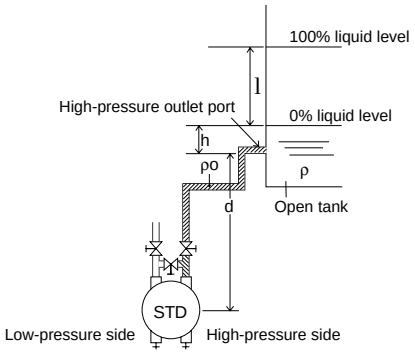


Figure 5-6 Open Tank

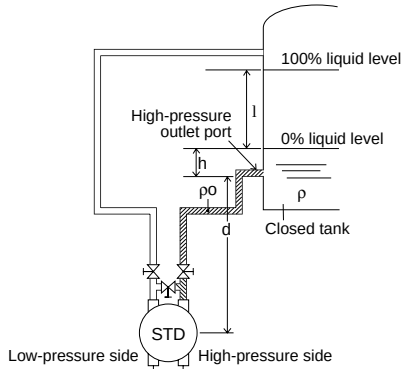


Figure 5-7 Closed Tank

Differential pressure at 0% liquid level (Pressure on high-pressure side - Pressure on low-pressure side) = $h\rho + d\rho_0$ = LRV

Differential pressure at 100% liquid level (Pressure on high-pressure side - Pressure on low-pressure side) = $l\rho + h\rho + d\rho_0 = (l+h)\rho + d\rho_0$ = URV

Therefore, set the range as follows:

Low limit (LRV): $h\rho + d\rho_0$; High limit (URV): (l+h) r+ dr0

Example of calculation: l = 1500 mm, h = 250 mm, d = 500 mm ρ = 0.9, ρ_0 = 1.0

If the above conditions are assumed, the following results are obtained:

Differential pressure at 0% liquid level = (250 x 0.9) + (500 x 1.0) = 725 mmH2O = 7.110 kPa

Differential pressure at 100% liquid level = {(1500 + 250) x 0.9) + (500 x 1.0) = 2075 mmH_2O = 20.35 kPa

Therefore, set the range as follows:

Low limit (LRV): 7.110 kPa{725 mmH_2O}, High limit (URV): 20.35 kPa{2075 mmH_2O}

Set range calculation Ex. STG Type

Calculate the set range using these procedures:

The following symbols are used to express density and distance.

It is assumed that the density is fixed, during liquid level measurement.

ρ :Specific gravity of liquid in tank

ρ_0 :Specific gravity of liquid in connecting pipe

l :Distance between 100% liquid level and 0% liquid level (measurement range)

h :Distance between 0% liquid level and high-pressure outlet port

d :Distance between high-pressure outlet port and transmitter

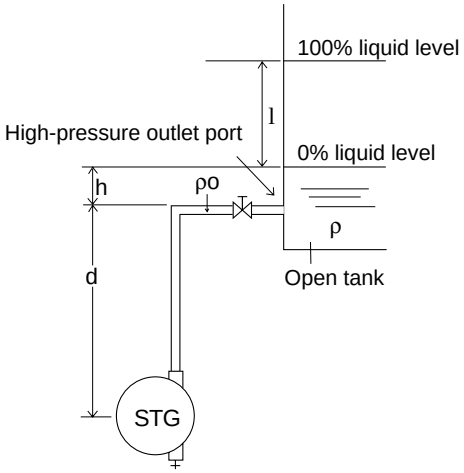


Figure 5-8

Pressure at 0% liquid level = $h\rho + d\rho_0$ = LRV

Pressure at 100% liquid level = $l\rho + h\rho + d\rho_0 = (l+h)r + d\rho_0$ = URV

Therefore, set the range as follows:

Low limit (LRV): $h\rho + d\rho_0$; High limit (URV): $(l+h)\ \rho + d\rho_0$

Example of calculation:

$l = 1500$ mm, $h = 250$ mm, $d = 500$ mm

$\rho = 0.9$, $\rho_0 = 1.0$

If the above conditions are assumed, the following results are obtained:

Differential pressure at 0% liquid level = (250 x 0.9) + (500 x 1.0) = 725 mmH_2O = 7.110 kPa

Differential pressure at 100% liquid level = {(1500 + 250) x 0.9) + (500 x 1.0) = 2075 mmH_2O = 20.35 kPa

Therefore, set the range as follows:

Low limit (LRV): 7.110 kPa{725 mmH_2O}, High limit (URV): 20.35 kPa{2075 mmH_2O}

Set range calculation Ex. STC Type

Calculate the set range using these procedures:

The following symbols are used to express density and distance.

It is assumed that the density is fixed, during liquid level measurement.

ρ : Specific gravity of liquid in tank
l : Distance between 100% liquid level and 0% liquid level (measurement range)
h : Distance between 0% liquid level and high-pressure outlet port
d : Distance between high-pressure outlet port and transmitter

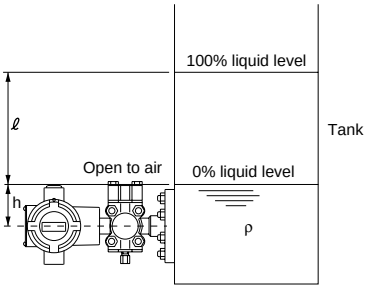


Figure 5-9 Open Tank

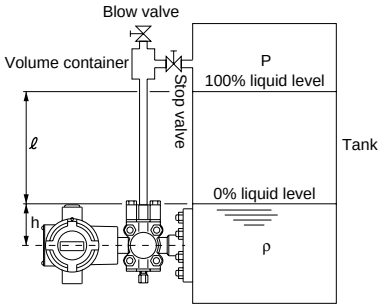


Figure 5-10 Closed Tank

Differential pressure at 0% liquid level (Pressure on high-pressure side - Pressure on low-pressure side) = $h\rho$ = LRV

Differential pressure at 100% liquid level (Pressure on high-pressure side - Pressure on low-pressure side) = $l\rho + h\rho = (l+h)\rho$ = URV

Therefore, set the range as follows:

Low limit (LRV): $h\rho$; High limit (URV): (l+h) r

Example of calculation:

$l = 1500\ mm, h = 250\ mm$

$\rho = 0.9, \rho_0 = 1.0$

If the above conditions are assumed, the following results are obtained:

Differential pressure at 0% liquid level = (250 x 0.9) = 725 mmH_2O = 7.110 kPa

Differential pressure at 100% liquid level = {(1500 + 250) x 0.9) = 2075 mmH_2O = 20.35 kPa

Therefore, set the range as follows:

Low limit (LRV): 7.110 kPa{725 mmH_2O}, High limit (URV): 20.35 kPa{2075 mmH_2O}

Set range calculation Ex. STE/STR Type

Calculate the set range using these procedures:

The following symbols are used to express density and distance.

It is assumed that the density is fixed, during liquid level measurement.

ρ : Specific gravity of liquid in tank

ρ_0 : Specific gravity of sealed liquid

l : Distance between 100% liquid level and 0% liquid level (measurement range)

h : Distance between 0% liquid level and high-pressure outlet port

d : Distance between high-pressure outlet port and transmitter

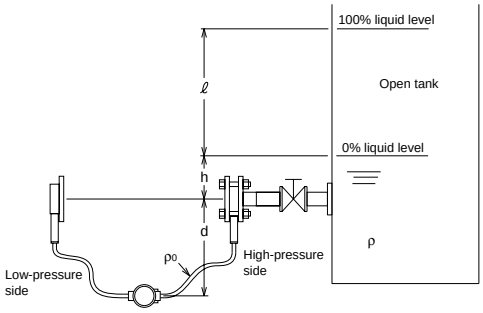


Figure 5-11 Open Tank

Differential pressure at 0% liquid level (Pressure on high-pressure side - Pressure on low-pressure side) = hr = LRV

Differential pressure at 100% liquid level (Pressure on high-pressure side - Pressure on low-pressure side) = $l\rho + h\rho = (l+h)\rho$ = URV

Therefore, set the range as follows:

Low limit (LRV): $h\rho$; High limit (URV): (l+h) r

Example of calculation:

$l = 1500$ mm, $h = 250$ mm, $d = 500$ mm, $\rho = 0.9$, $\rho_0 = 0.935$

If the above conditions are assumed, the following results are obtained:

Differential pressure at 0% liquid level = 250 x 0.9= 225 mmH_2O = 2.206 kPa

Differential pressure at 100% liquid level = (1500 + 250) x 0.9 = 1575 mmH_2O = 15.45 kPa

Therefore, set the range as follows:

Low limit (LRV): 2.206 kPa, High limit (URV): 15.45 kPa

Set range calculation Ex. STH/STU Type

Calculate the set range using these procedures:

The following symbols are used to express density and distance.

It is assumed that the density is fixed, during liquid level measurement.

ρ : Specific gravity of liquid in tank

ρ_0 : Specific gravity of sealed liquid

l : Distance between 100% liquid level and 0% liquid level (measurement range)

h : Distance between 0% liquid level and high-pressure outlet port

d : Distance between high-pressure outlet port and transmitter

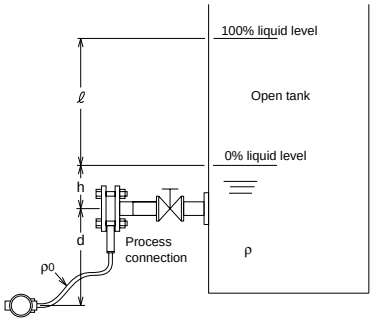


Figure 5-12 Open Tank

Differential pressure at 0% liquid level = $h\rho + d\rho_0$ = LRV

Differential pressure at 100% liquid level = $l\rho + h\rho + d\rho_0 = (l+h)\rho + d\rho_0$ = URV

Therefore, set the range as follows:

Low limit (LRV): $h\rho + d\rho_0$; High limit (URV): $(l+h)\rho + d\rho_0$

Example of calculation:

$l = 1500$ mm, $h = 250$ mm, $d = 500$ mm, $\rho = 0.9$, $\rho_0 = 1.0$

If the above conditions are assumed, the following results are obtained:

Differential pressure at 0% liquid level = (250 x 0.9) + (500 x 1.0) = 725 mmH_2O = 7.110 kPa

Differential pressure at 100% liquid level = {(1500 + 250) x 0.9) + (500 x 1.0) = 2075 mmH_2O = 20.35 kPa

Therefore, set the range as follows:

Low limit (LRV): 7.110 kPa, High limit (URV): 20.35 kPa

5-10-2 :Closed Tank (Wet Leg or Remote Seal) -- Set Range

Set range calculation Ex. STD Type

Calculate the set range using these procedure:

The following symbols are used to express density and distance.

It is assumed that the density is fixed during liquid level measurement.

ρ : Specific gravity of liquid in tank

ρ_0 : Specific gravity of sealing liquid

l : Distance between 100% liquid level and 0% liquid level (measurement range)

h : Distance between 0% liquid level and high-pressure outlet port

d : Distance between high-pressure outlet port and transmitter

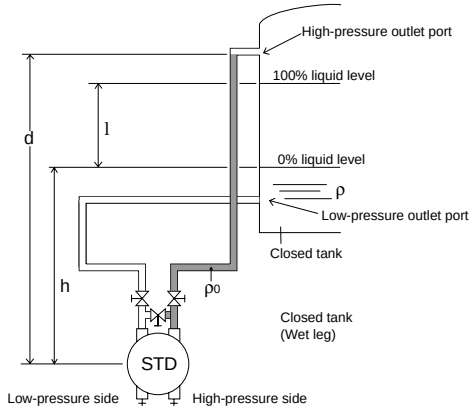


Figure 5-13 Closed Tank (Wet Leg)

Differential pressure at 0% liquid level (Pressure on high-pressure side - Pressure on low-pressure side) = $d\rho_0 - h\,r$ = LRV

Differential pressure at 100% liquid level (Pressure on high-pressure side - Pressure on low-pressure side) = $d\rho_0 - (l+h)\,\rho$ = URV

Therefore, set the range as follows:

Low limit (LRV): $d\rho_0 - h\rho\,r$, High limit (URV): $d\rho_0 - (l+h)\,\rho$

Example of calculation:

$l = 1500$ mm, $h = 250$ mm, $d = 2000$ mm, $\rho = 0.9$, $\rho_0 = 1.0$

If the above conditions are assumed, the following results are obtained:

Differential pressure at 0% liquid level = (2000 x 1.0) + (250 x 0.9) = 1775 mmH_2O = 17.41 kPa

Differential pressure at 100% liquid level = (2000 x 1.0) + (1500 x 250) x 0.9 = 425 mmH_2O = 4.168 kPa

Therefore, set the range as follows:

Low limit (LRV): 17.41 kPa{1775 mmH_2O}, High limit (URV): 4.168 kPa {425 mmH_2O}

Set range calculation Ex. STC Type

Calculate the set range using these procedure:

The following symbols are used to express density and distance.
It is assumed that the density is fixed during liquid level measurement.

ρ : Specific gravity of liquid in tank
ρ_0 : Specific gravity of sealing liquid
l : Distance between 100% liquid level and 0% liquid level (measurement range)
h : Distance between 0% liquid level and high-pressure outlet port
d : Distance between high-pressure outlet port and transmitter

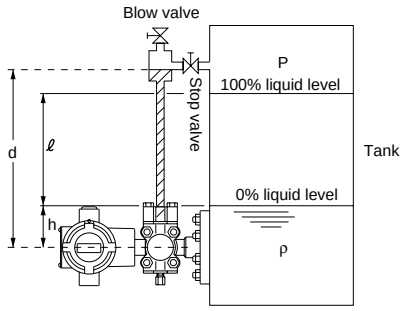


Figure 5-14 Closed Tank (Wet Leg)

Differential pressure at 0% liquid level (Pressure on high-pressure side - Pressure on low-pressure side) = $d\rho_0 - h\rho$ = LRV

Differential pressure at 100% liquid level (Pressure on high-pressure side - Pressure on low-pressure side) = $d\rho_0 - (l+h)\ \rho$ = URV

Therefore, set the range as follows:

Low limit (LRV): $d\rho_0 - h\rho$, *High limit (URV):* $d\rho_0 - (l+h)\ \rho$

Example of calculation:

$l = 1500$ mm, $h = 250$ mm, $d = 2000$ mm, $\rho = 0.9$, $\rho_0 = 1.0$

If the above conditions are assumed, the following results are obtained:

Differential pressure at 0% liquid level = (2000 x 1.0) + (250 x 0.9) = 1775 mmH_2O = 17.41 kPa

Differential pressure at 100% liquid level = (2000 x 1.0) + (1500 x 250) x 0.9 = 425 mmH_2O = 4.168 kPa

Therefore, set the range as follows:

Low limit (LRV): 17.41 kPa{1775 mmH_2O}, High limit (URV): 4.168 kPa {425 mmH_2O}

Set range calculation Ex. STE/STR Type

Calculate the set range using these procedure:

The following symbols are used to express density and distance.
It is assumed that the density is fixed during liquid level measurement.

ρ : Specific gravity of liquid in tank
ρ_0 : Specific gravity of sealed liquid
l : Distance between 100% liquid level and 0% liquid level (measurement range)
h : Distance between 0% liquid level and lower flange of tank
d : Distance between upper flange of tank and lower flange of tank

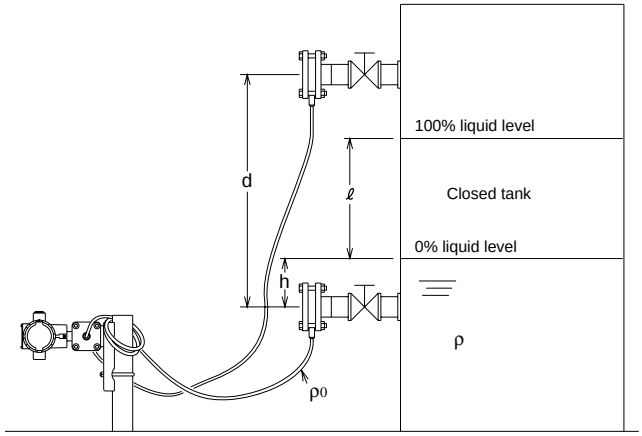


Figure 5-15 Closed Tank (Wet Leg)

Differential pressure at 0% liquid level (Pressure on high-pressure side - Pressure on low-pressure side) = $d\rho_0 - h\rho$ = LRV

Differential pressure at 100% liquid level (Pressure on high-pressure side - Pressure on low-pressure side) = $d\rho_0 - (l+h)\rho$ = URV

Therefore, set the range as follows:

Low limit (LRV): $d\rho_0 - h\rho$, High limit (URV): $d\rho_0 - (l+h)\rho$

Example of calculation:

$l = 1500$ mm, $h = 250$ mm, $d = 2000$ mm, $\rho = 0.9$, $\rho_0 = 0.935$

If the above conditions are assumed, the following results are obtained:

Differential pressure at 0% liquid level = (2000 x 0.935) - (250 x 0.9) = 1645 mmH_2O = 16.13 kPa

Differential pressure at 100% liquid level = (2000 x 0.935) + (1500 x 250) x 0.9 = 295 mmH_2O = 2.893 kPa

Therefore, set the range as follows:

Low limit (LRV): 16.13 kPa{1645 mmH_2O}, High limit (URV): 2.893 kPa {295 mmH_2O}

5-11 : Indicator (Option)

5-11-1 :Display Unit of Indicator

The display unit of an indicator consists of the following:

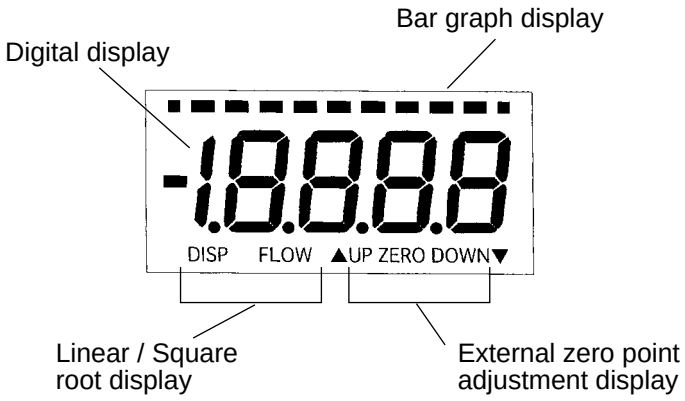


Figure 5-16 Display Unit of Indicator

5-11-2 :Digital Display

The indicator displays the output value of a transmitter in% or any engineering unit in the digital mode. The display unit is a 4.5-digit 7-segment LCD. Indicates a value outside the display range by flashing as shown below.

- When the display value is within either of the following ranges, the limit value flashes.

Range of display value	Display
Display value < -19999	-1999
Display value > 19999	1999

- In some cases, a transmitter failure is indicated by the following display.

The response action is outlined in "7-6-4 : Self-Diagnostic by Indicator (option)".

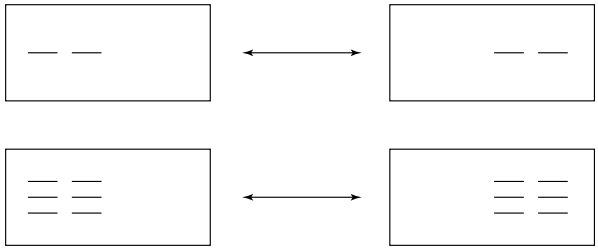


Figure 5-17 Failure Display on Indicator

5-11-3 :Analogue Bar Graph Display

The output value of a transmitter is displayed in a 11-segment analogue bar graph. The relationship between the output value and the segment display status (on and blinking) is as shown, below.

Output (OUT)	Segment status	
OUT<0%	Blink	■
0%≤OUT<5%	On	□
5%≤OUT<15%		□□
15%≤OUT<25%		□□□
25%≤OUT<35%		□□□□
35%≤OUT<45%		□□□□□
45%≤OUT<55%		□□□□□□
55%≤OUT<65%		□□□□□□□
65%≤OUT<75%		□□□□□□□□
75%≤OUT<85%		□□□□□□□□□
85%≤OUT<95%		□□□□□□□□□□
95%≤OUT<100%		□□□□□□□□□□□
100%<OUT	Only the far most segment blinks.	□□□□□□□□□□ ■

In the constant current mode, the entire bar graph blinks.

In this case, the bar graph and digital display blink alternately.

5-11-4 :Linear/Square Root Display

Read the display to judge whether the transmitter output and the indicator display are linear (differential pressure) or the result of extracting the square root (flow rate).

The judgement criteria based on the display are shown below:

Table 5-1: Linear/Square Root Display Status

Display	Output	Display status	Category
Linear (Differential pressure)	Linear (Differential pressure)	None	Linear
Square root (Flow rate)	Linear (Differential pressure)	DISP FLOW	Display flow rate (Display square root)
Square root (Flow rate)	Square root (Flow rate)	FLOW	Flow rate (Square root)

5-11-5 :External Zero Adjustment Display

The operation status of the external zero adjustment function (option) is displayed.

The judgement criteria based on the display are shown below:

ZERO stays on for a transmitter with the external zero adjustment function.

Table 5-2: External Zero Adjustment Display Status

Adjustment status	Display
Running	ZERO
Output is increasing	▲UP ZERO
Output is decreasing	ZERO DOWN▼
Error	ZERO (flashing)

In the event of an error, take the necessary action, referring to "7-6-4 : Self-Diagnostic by Indicator (option)".

For the adjustment procedure, refer to "5-12 : External Zero and Span Adjustment (Option)".

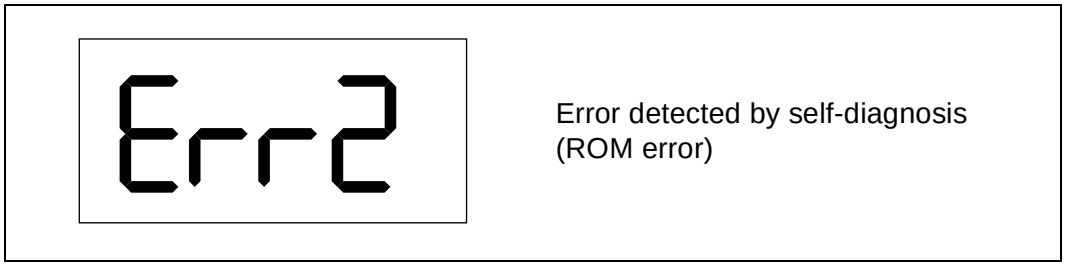
5-11-6 :Self-Diagnosis Display on Indicator

Turn on the power and check that the indicator is in the normal status.

If the cable has an abnormality, the indicator does not light up.

If the indicator has an error, Error No. corresponding to the error type is displayed.

Figure 5-18 Self-Diagnosis Result Display on Indicator



- When the transmitter itself is not functioning properly, the indicator display will be as shown in "5-11-2 : Digital Display".

In the event of an error, take the necessary action, referring to "7-6-4 : Self-Diagnostic by Indicator (option)".

5-11-7 :Engineering Unit Label

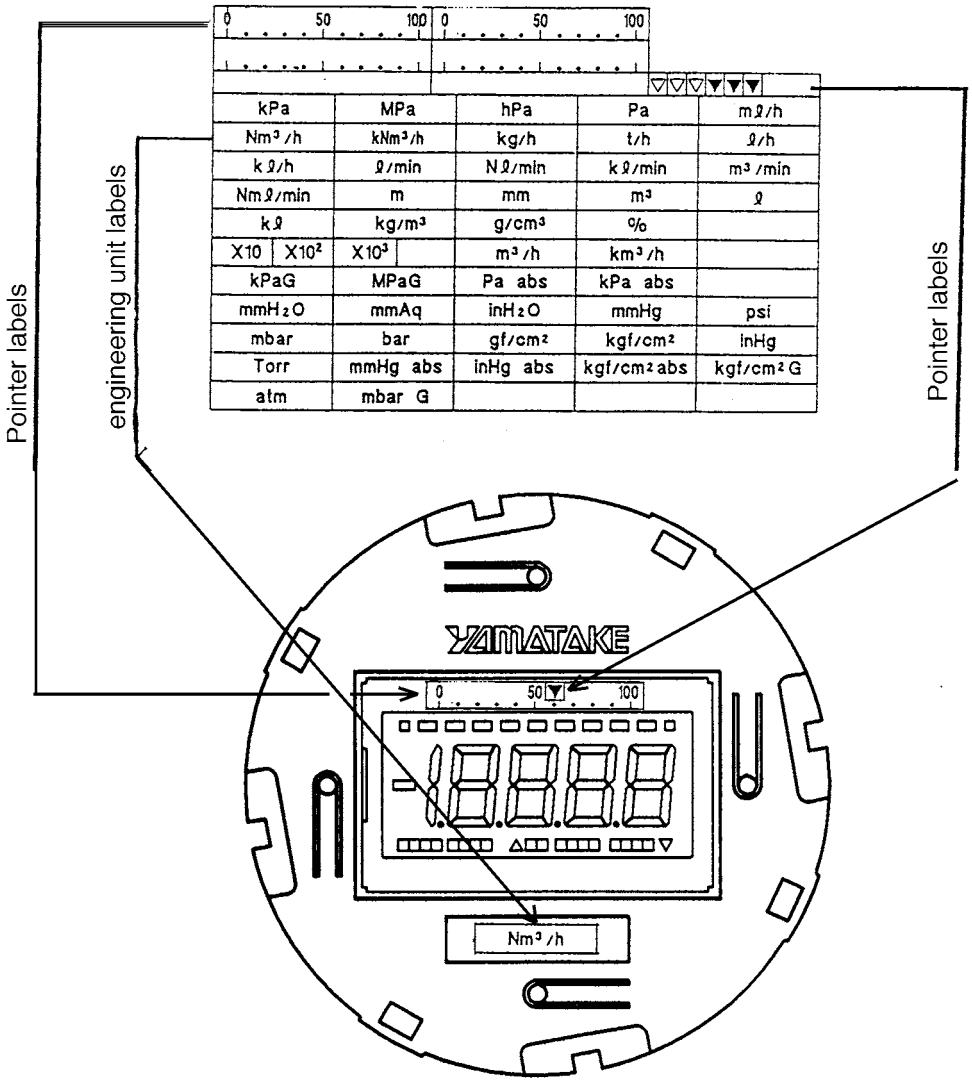
Use the engineering unit label sheet (included) to indicate the display area on the engineering unit.

* If you specify an engineering unit at the time of ordering, the equipment will be shipped with the specified label already attached. Change the engineering unit label using the following procedure when necessary.

* Pointer labels for analogue bar graphs are provided on the engineering unit label sheet. Use them for monitoring in the field.

1.Select a unit label or a pointer label and remove it from the sheet.

2. Attach the label to the designated position as illustrated below.



5-12 : External Zero and Span Adjustment (Option)

5-12-1 :External zero and span adjustment

A transmitter with external zero and span adjustment function enables on-site zero/ span point adjustment work without using an SFC.

A transmitter with both a digital meter and external zero and span adjustment function displays ZERO in the display unit.

Adjustment range

Set to any value an output corresponding to the current input. Set within the range of -1.25% (3.8 mA) and +105% (20.8 mA).

Procedure

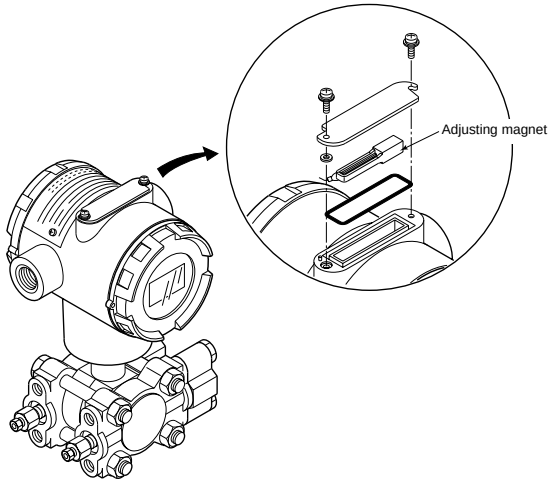


Figure 5-19 External Zero and span Adjustment

How to adjust zero point.

Step	Description
1	Make sure that the zero pressure is applied to the transmitter.
2	Insert adjusting magnet into ZERO(+) or (-) cavity in housing and remove it when ammeter reading equals 4mA.

How to adjust span point.

Step	Description
1	Make sure that the desired upper range value pressure is applied to the transmitter.
2	Insert adjusting magnet into SPAN SET cavity wait until ammeter reading equals 20mA and remove the magnet from cavity.

Error diagnostics

Adjustment function, ZERO blinks on the indicator.

An error will result if the adjusting operation continues for about 50 seconds.

And, the set value is restored to its original value.

5-13 : DE Mode Configuration

Procedure

Table 5-3: defines the information that can be transferred with the communication protocol used in the transmitter digital mode. This section describes how to check and change the amount of data to be transferred.

Table 5-3: Data element for digital transmission

<table>
<tr><th>Data element</th><th colspan="3">Selection</th></tr>
<tr><td>Output signal mode for digital transmission</td><td colspan="3">One of the following can be selected:
Single Range: This mode is used to display the PV value for the range that is set in the transmitter on the TDCS.
Dual Range (STDC): This mode is used to display on the TDCS the PV value in two different units of measurement, one for full range and another for working range.
Single Range w/SV: This mode is used to display on the TDCS the single range and the sensor temperature of the transmitter.</td></tr>
<tr><td>Message format for digital transmission</td><td colspan="3">One of two modes can be selected:
4 bytes:
Byte 1 2 3 4
FLAG PV PV PV
Byte 1: Identification of output signal mode
Byte 2-4: PVs

6 bytes:
Byte 1 2 3 4 5 6
FLAG PV PV PV ID DB
Byte 1: Identification of output signal mode
Byte 2-4: PVs
Byte 5: Identification of database being transmitted (LRV, URV, SPAN, etc.)
Byte 6: Data being transmitted.

Note
Transfer rate: 4 bytes 6 bytes
PV value Approx. 3times/sec. Approx 2.5times/sec.
Sensor temp Approx. once every 2.5 sec. Approx. once every 3 sec.</td></tr>
<tr><td rowspan="8">Fail-safe mode for digital transmission</td><td colspan="3">This fail-safe mode applies to STDC card operations, not to the transmitter.
The two types of fail-safe mode are the STDC card input setting and output setting.
The three directions of burn-out are lower limit, upper limit, and hold.</td></tr>
<tr><td></td><td>SFC display</td><td>Type of fail-safe</td></tr>
<tr><td rowspan="3">STDC input</td><td>F/S=B/O Lo</td><td>Lower limit</td></tr>
<tr><td>F/S=B/O Hi</td><td>Upper limit</td></tr>
<tr><td>F/S=LKG</td><td>(The STDC output signal holds the PV value displayed immediately before the transmitter error)</td></tr>
<tr><td rowspan="3">STDC output setting</td><td>F/S=B/O Lo</td><td>Lower limit</td></tr>
<tr><td>F/S==B/O Hi</td><td>Upper limit</td></tr>
<tr><td>F/S=LKG</td><td>(The STDC output signal holds the PV value displayed immediately before the transmitter error.)</td></tr>
<tr><td colspan="3">F/S: Fail Safe
B/O: Burn Out
LKG: Last Known Good Value
FSO: Freeze Slot Output</td></tr>
</table>

5-13-1 :Changing Mode of Operation

Procedure

If you need to change your transmitter's mode of operation, use the steps in the following table to change the mode from analog to digital or digital to analog.

Step	Description	SFC screen
1	Make sure that the transmitter is in the ready state.	DSTJ PT001 READY...
2	Press the SHIFT key and then press the A DE ← Q key. When the message to the right is displayed, press the NON-VOL ENTER (Yes) key.	SHIFT- DSTJ PT001 CHANGE TO DIGITAL?
3	Press the NON-VOL ENTER (Yes) key for verification purposes.	DSTJ PT001 ARE YOU SURE?
4	The procedure is completed when these messages are displayed.	DSTJ PT001 WORKING... DSTJDE PT001 DEXMTR DSTJ PT001 READY...

5-13-2 :Selecting the Output Signal Mode

Procedure

The following procedure can be used to check and set the output signal mode shown in Table 5-3:, such as “Single Range“, “Dual Range“, and “Single Range w/SV“:

Step	Description	SFC screen
1	Make sure that the transmitter is in the ready state.	DSTJ PT001 READY...
2	Press the SHIFT key and then press the DE CONF. MENU ITEM key.	SHIFT- DECONFIG Single Range
3	Press the DE CONF. MENU ITEM key to display a desired output signal mode.	DECONFIG Single Range w/SV DECONFIG DUAL RANGE
4	Press the NON-VOL ENTER (Yes) key	DECONFIG ENTERED IN SFC
5	Press the ▲ H NEXT key or ▼ L PREV key until the message to the right is displayed.	DECONFIG DOWNLOAD DATA?
6	Press the NON-VOL ENTER (Yes) key.	DECONFIG WORKING...
7	When this message displayed, the SFC can be disconnected from the transmitter.	DSTJ PIC001 READY...

5-13-3 :Setting message Format

Procedure

The following procedure can be used to check and set the message format “4-byte output” or “6-byte output“ shown in Table 5-3:

Step	Description	SFC screen
1	Make sure that the transmitter is in the ready state.	DSTJ PIC001 READY...
2	Press the SHIFT key and then press the DE CONF. MENU ITEM key.	SHIFT- DECONFIG DOWNLOAD DATA?
3	Press the ▲H NEXT key or ▼L PREV key to display next DE CONFIG menu item-Message format selection.	DECONFIG DE-6 Byte
4	Alternately press the DE CONF. MENU ITEM key until a desired message format appears.	DECONF DE-4 Byte
5	Press the NON-VOL ENTER (Yes) key.	DECONFIG ENTERED IN SFC
6	Press the ▲H NEXT key or ▼L PREV key until the message to the right is displayed.	DECONFIG DOWNLOAD DATA?
7	Press the NON-VOL ENTER (Yes) key.	DECONFIG WORKING...
8	When this message displayed, the SFC can be disconnected from the transmitter.	DSTJ PIC001 READY...

5-13-4 :Selecting the Fail-Safe Mode

Procedure

The following procedure can be used to check and set the fail safe mode shown in Table 5-3::

Step	Description	SFC screen
1	Make sure that the transmitter is in the ready state.	DSTJ PIC001 READY...
2	Press the SHIFT key and then press the DE CONF. MENU / ITEM key.	SHIFT- DECONFIG Single Range
3	Press the ▲ H NEXT key or ▼ L PREV key to display Failsafe setting menu appears	DECONFIG F/S = B/O Hi
4	Alternately press the DE CONF. MENU / ITEM key until a desired message format appears.	DECONFIG F/S = B/O LKG
5	Press the NON-VOL ENTER (Yes) key.	DECONFIG ENTERED IN SFC
6	Press the ▲ H NEXT key or ▼ L PREV key until the message to the right is displayed.	DECONFIG DOWNLOAD DATA?
7	Press the NON-VOL ENTER (Yes) key.	DECONFIG WORKING...
8	When this message displayed, the SFC can be disconnected from the transmitter.	DSTJ PIC001 READY...

Chapter 6 : Operation Using SFC

⚠ CAUTION

When communication with the transmitter is started using the SFC in a system with analog output, be sure to change the control loop of the process to “manual” (manual control).

Be sure to use the SFC with software version 7.0 or newer. Using earlier versions may result in problems such as the absence of some setting functions.

The SFC may only be changed or recharged in the non-hazardous area with the associated battery charger.

~Note *Do not overcharge or over discharge (leave with the switch on) the built-in battery of the SFC. This may shorten the life of the battery.*

6-1 : Introduction

Connect the SFC to this transmitter in order to perform checks on measured data and to change setting data.

This section deals with basic operating procedures for an SFC, such as communications with the transmitter.

For detailed information on an SFC, refer to SFC User's Manual (CM2-SFC100-2001).

6-1-1 :SFC key operations

Each of the SFC keys is assigned to two or more functions. To distinguish between these functions, this manual uses the following notations for key operations.

- Press xxxx key: Press the xxxx key only.

- Press SHIFT + xxxx keys: Press the SHIFT key first then press the xxxx key when “SHIFT-” appears on the SFC screen.

6-1-2 :Names of components

Figure 6-1 shows the structure and names of components for the Smart Field Communicator (SFC).

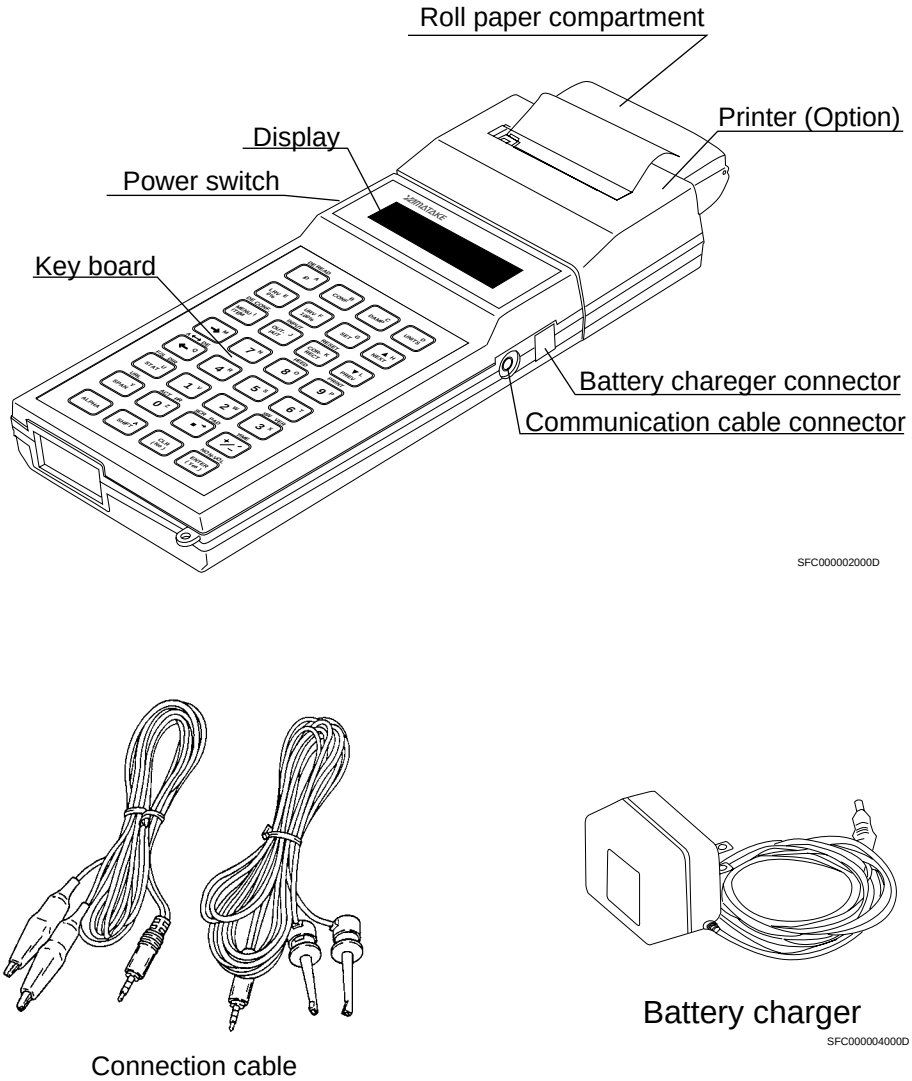


Figure 6-1 Details of SFC

The following table describes the components of the SFC.

Table 6-1:

Name	Description
Paper roll compartment	- Stores heat-sensitive paper roll for print out.
Printer section (option)	- This is an optional item. - A 24 characters/line thermal printer. - Prints out internal data of the transmitter or communication data. - The printer section is one with the main unit and cannot be separated.
Display window (screen)	- Displays messages or data from the transmitter in 16 characters x 2 lines. - The data display screen is available in either English or Japanese.
Power switch	- Turning ON the power switch of the SFC automatically starts self-diagnostics.
Keyboard	- There are 32 touch keys. - Each key provides a separate and other functions are accessed after pressing the SHIFT key. - The keyboard is available in either English or Japanese version.
Communication cable connector	- Connect the plug side of the communication cable.
Communication cable	- Be sure to use the supplied dedicated cables.
Battery charger connector	- Connect the plug side of the battery charger.
Battery charger	- Charge the battery of the SFC using the supplied battery charger. **~Note** *When the battery voltage drops, the following sign appears in the display window.* :

6-2 : Functions of SFC

6-2-1 :Key types

The SFC keyboard has 32 touch keys.

Each key is assigned to up to three types of input functions.

-The alphabet

To enter a letter of the alphabet press the [ALPHA] key to display the “□“cursor in the display window first. Then, press the key of the desired letter.

- Function, numeral or symbol at the center of the [ID] key

To access this function, numeral or symbol, make sure the”_“cursor is displayed in the display window.

Pressing the [ALPHA] key toggles the “□“cursor and “_” cursor.

- Function displayed on the key

To access this function, press the [SHIFT] key to display SHIFT in the display window first.

SHIFT-

Then, press the key you want to enter. If you have pressed the [SHIFT] key by mistake, press the [CLR] key.

6-2-2 :Key color-coding

The 32 touch keys can be roughly divided into 5 categories according to their function, and are color-coded as follows.

- Green: Mainly used to communicate with the transmitter or display or change the setting.
- Orange: Mainly used to communicate with transmitter or select the screen or decide the menu.
- Yellow: Mainly used to enter numerals.
- Dark brown:Mainly used for diagnostics or check.
- White: Used to control the keyboard or for auxiliary operation.

6-2-3 :General rules for keyboard operations

The following points should be noted when operating the SFC keyboard:

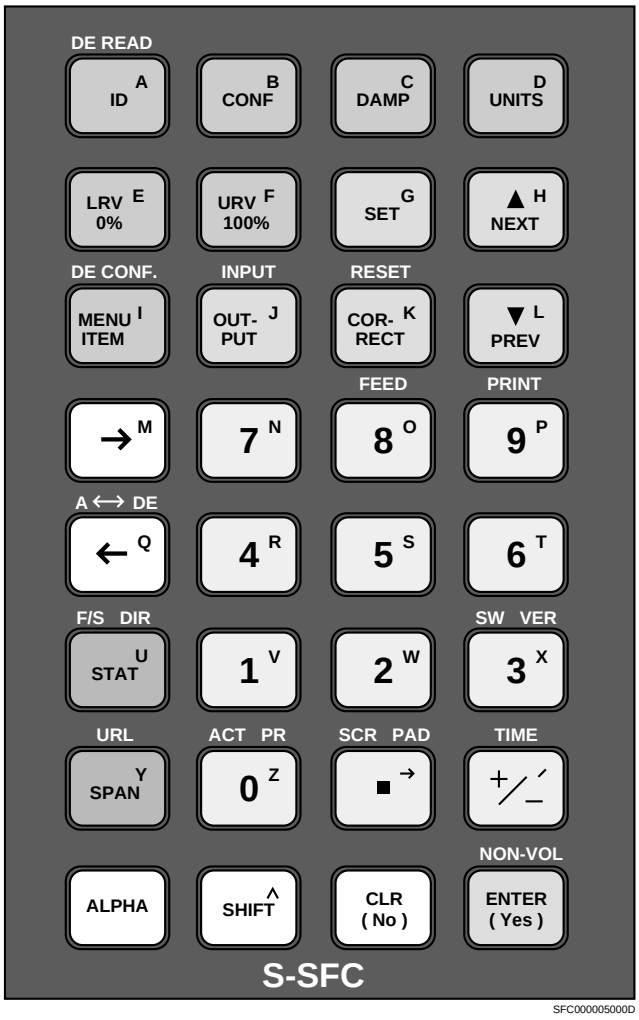
- Press keys firmly and slowly. If the screen does not respond, this means the key input has not been accepted. Press the key slowly once again.

- The status in the display window shows whether the key is active or inactive. Pressing an inactive key does not affect the entry on the screen and the function just before the key is pressed remains active. Retry pressing an active key.

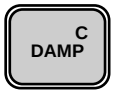
- The SFC operates on an interactive basis. When an interrogative message appears on the screen, press the [ENTER] key to answer “Yes” and press [CLR] to answer “No”.

6-2-4 :Key names and functions

This section describes the functions assigned to the green keys, which are mainly used to communicate with the transmitter or to change or display the settings.

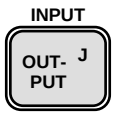
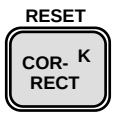


6-2-4-1 Key names and function (for Green keys)

Button	Description	
	When pressed alone at cursor	When pressed after SHIFT key
DE READ 	ID: Starts communication with the transmitter. The display window shows TAG No. of the transmitter. It is possible to write or rewrite the TAG No. on this screen.	Used when the conversion output is DE. Has the same function as ID.
	CONF: Press this key to use a dedicated function. The dedicated functions have a hierarchical structure. Refer to Dedicated Function.	No effect
	DAMP: Press this key to display or change the damping time constant of the transmitter.	No effect
	UNITS: Press this key to display or set the engineering units of the flow rate measured using the transmitter.	No effect
	LRV 0%: Displays the Lower Range Value (LRV) of the current set value. Change the LRV on this screen.	No effect
	URV 100%: The Upper Range Value (URV) of the current set value is displayed. Change the URV on this screen.	No effect
DE CONF. 	MENU ITEM: Used to display or select a different item located at the same hierarchy and with the same function.	DE CONF: Used to display or select variables output in digital communication.

6-2-4-2 Key names and function (for Orange keys)

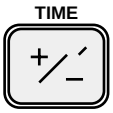
This section describes the functions assigned to the orange keys, which are mainly used to communicate with the transmitter or to select a screen or to select from the menu.

Button	Description	
	When pressed alone at cursor	When pressed after SHIFT key
	No effect	No effect
	NEXT: Scrolls up the screen in the CONFIG function.	No effect
	PREV: Scrolls down the screen in the CONFIG function.	No effect
	OUTPUT: Displays a value in percentage, which is transmitted by the transmitter to the control loop.	INPUT: Displays the differential pressure being input to the transmitter.
	CORRECT: Press this key to adjust the zero point of the transmitter. This operation is available while INPUT (input) is being read.	No effect
	ENTER: Press this key to answer “Yes” to a question on the screen. The screen will move one step up or down or data set by the SFC is written into the database of the transmitter.	NON-VOL: The data set by the SFC is forcibly written into non-volatile memory of the transmitter.

6-2-4-3 Key names and functions (for Yellow keys)

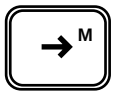
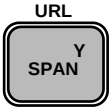
This section describes the functions assigned to the yellow keys which are used to enter numerals.

Button	Description	
	When pressed alone at cursor	When pressed after SHIFT key
PRINT 9 P	9: Enters numeral 9.	PRINT: Prints out internal data of the transmitter. This printing operation is called “configuration printout”.
FEED 8 O	8: Enters numeral 8.	FEED: Advances printing paper by 1 line. The display window shows “PRINTER FEED”. As long as this prompt is displayed, each pressing of this key advances paper by 1 line. To cancel this operation, press the CLR key.
7 N to 4 R	7 to 4: Enters numeral 7 to 4.	No effect
SW VER 3 X	3: Enters numeral 3.	Displays the software versions of the transmitter and SFC. If the SFC is not communicating with the transmitter, only the version of the SFC is shown.
2 W	2: Enters numeral 2.	Displays “KEYBAORD TEST row* column*” and then displays the row and column of the key pressed immediately after. Used to check the keyboard for any problems.
1 V	1: Enters numeral 1.	No effect

Button	Description	
	When pressed alone at cursor	When pressed after SHIFT key
	0: Enters numeral 0.	ACT PR: Prints out a response from the transmitter every time the key is operated. This operation is called “action printout”.
	♦: Enters a decimal point.	SCR PAD: Writes a memo into the database of the transmitter.
	Inverts the sign in the case of numerical input.	TIME: Displays the current year, month, day and time.

6-2-4-4 Key names and functions (for Brown and White keys)

This section describes the functions assigned to the dark brown and white keys which are used to diagnose or check the transmitter or to control the keyboard, etc.

Button	Description	
	When pressed alone at cursor	When pressed after SHIFT key
	→: Moves the cursor to the right.	No effect
	←: Moves the cursor to the left.	A ↔ DE (analog ↔ digital): Switches between analog and digital communications.
	STAT: Displays self-diagnostics result of the transmitter.	FIS DIR: Displays failsafe divection.
	SPAN: Displays the span of the measuring range.	URL: Displays the upper limit of the measuring range.
	ALPHA: Press this key before entering a letter of the alphabet. When the "□"cursor appears on the display section, it is ready to enter. Press this key once again to enter a function or numeral displayed in the center of each key. When the display section shows a cursor, it is ready to enter this function or numeral.	No effect
	SHIFT: Press this key to enter a function displayed above each key. When the display section shows "SHIFT-", it is ready for input.	No effect
	CLR: Clears the display in the display window and the SFC waits for input. Or press this key to answer "No" to a question on the screen. The screen moves one level up or down.	When exiting the CONFIG function, pressing this key jumps from a lower level to EXIT CONFIG at a stroke.

6-3 : Before communicating using SFC

6-3-1 :What can be done using the SFC

It is possible to communicate with the transmitter, read data or change settings using the SFC. This section explains the functions of the SFC organized by purpose.

⚠ CAUTION

Be sure to use the SFC with software version 7.0 or newer. Using the earlier versions may cause incorrect operation.

6-3-1-1 Check during operation

The following functions are used while the transmitter is in operation.

- Starting communication: ID/DE READ key
- Displaying flow rate measured value: INPUT key
- Displaying transmitting output: OUTPUT key
- Displaying self-diagnostics result: STAT key

6-3-1-2 Data printing

The SFC with a printer has the following printing functions.

- Printing internal data: PRINT key
- Continuous printing of response results: ACT PRINT key

6-3-1-3 Setting and changing

The following functions are used to set or change the internal data of the transmitter.

- Tag number
- Output format
- Display format (flow rate/linear/display flow rate)
- Display format (engineering unit/% display)
- High and low limits of engineering quantity
- Low limit of set range
- High limit of set range
- Span of set range (Display only)
- Engineering unit of measured pressure
- Damping time constant
- Low flow cutoff value
- Burnout direction (Display only)
- Production number (Display only)
- Software version (Display only)
- Self-diagnostics result (Display only)

6-3-2 :Functions of SFC

Introduction

The functions available with the SFC include functions directly assigned to the respective keys and CONFIG functions that are entered by pressing the CONF key.

6-3-2-1 Key assigned functions

The following are the functions directly assigned to the SFC keys.

ID/DE READ	: Starts communication.
INPUT	: Reads the real measured value of flow rate and sets the specific gravity.
OUTPUT	: Reads the output of the transmitter in percentage or outputs a constant current from the transmitter.
STAT	: Displays self-diagnostics result of the transmitter.
PRINT	: Prints out internal data of the transmitter.
ACT PR	: Continuously prints out response result.
A ⇔ DE	: Switches between digital and analog outputs.
DE CONF	: Selects an output format of digital signal.
LRV, URV, SPAN	: Displays or sets the output range.
UNIT	: Sets engineering units or sets specific gravity.
DAMP	: Sets a damping time constant.
SW VER	: Displays the software version.

6-3-2-2 CONFIG functions

An SFC has the following major dedicated functions:

- Display and change the output format
- Display and change the display format
- Save data
- Display and change the low-flow cutoff value
- Display sensor temperature
- Display PROM No.

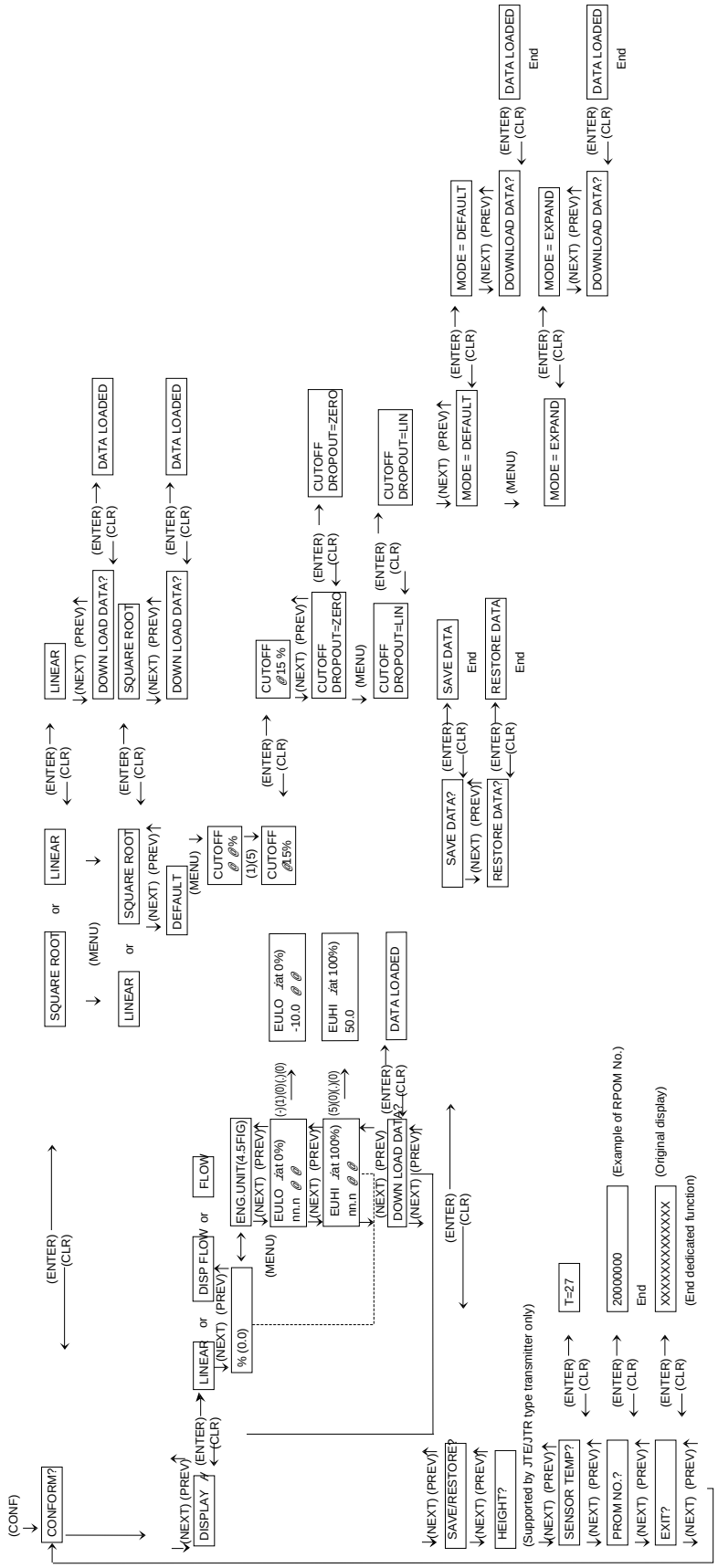
6-3-3 :Hierarchic structure of CONFIG functions

6-3-3-1 Hierarchic structure chart

The CONFIG functions form a hierarchic structure. Before using the CONFIG functions, check the positions of the respective sub-functions with the supplied hierarchic structure chart.

The SFC screen displays only two lines, and so if it is not clear which hierarchy is shown, see the hierarchy chart on page 6-13.

Hierarchic structure of chart



6-3-4 :Rules of key operations and interaction with screens

6-3-4-1 General rules for key operations

The following points should be noted when operating the SFC keyboard.

- Press keys firmly and slowly. If the screen does not respond, this means the key input has not been accepted. Press the key slowly once again.

- There are active keys and inactive keys depending on the screen in the display window. When an inactive key is pressed, pressing the [CLR] key will restore to a state in which key input can be accepted. After this, press an active key.

6-3-4-2 Interaction rules

The SFC can be operated on an interactive basis. Interact with the SFC according to the following rules:

- To answer “Yes” to a question on the screen, press the [ENTER] key. Answering “Yes” to a question on the screen of the CONFIG functions normally moves to a hierarchy one level lower. However, answering “Yes” to the prompt of “EXIT...” exits the function and returns to a hierarchy one level higher.

- To answer “No” to a question on the screen, press the [CLR] key. Answering “No” to a question on the screen of the CONFIG functions normally moves to a hierarchy one level higher. However, answering “No” to the prompt of “EXIT...”returns to the start screen of the function.

- To select a different function in the same hierarchy, press [NEXT]/[PREV] keys.

- To scroll the screen in order to select a different item in the same hierarchy and with the same function, press the [MENU ITEM] key. While the CONFIG function is active, pressing the [SET] + [CLR] keys at any hierarchy will show a screen “EXIT CONFIG?”. Pressing the [ENTER] key here makes it possible to exit the CONFIG function at a stroke.

6-3-4-3 Display of # mark

While the SFC is communicating with the transmitter, a # mark may appear in the last column at the bottom of the screen. The # mark is an alarm which appears under the following circumstances.

- A minor fault has occurred.

- The transmitter is operating in constant current generation mode or special mode.

When the # mark appears, check the status of the transmitter with the [STAT] key and take appropriate action with reference to “Error Messages and Action” on page 2-45.

6-3-5 :Charging SFC

⚠ CAUTION

When a ":" mark appears in the 8th column at the top of the SFC screen as shown below, stop using the SFC immediately and charge the SFC. Continuing to use the SFC will over discharge the battery of the SFC and make it impossible to charge it further.

SFC may only be changed or recharged non-hazardous area with the associated battery charger.

Approximate charging time required is shown, below:

- Non-explosion-protected SFC: 6 hours
- Intrinsically safe SFC: 10 hours

Procedure

How to charge an SFC: Use the battery charger (included).

Step	Description
1	Turn off the power switch of the SFC
2	Disconnect the communication cable from the transmitter.
3	Disconnect the communication cable plug from the SFC.
4	Connect the plug of the battery charger cable to the SFC.
5	Connect the plug of the battery charger body to a commercial power receptacle. Charging will begin.
6	When the required charging time elapses, disconnect the battery charger, end charging.

6-4 : Check during operation

6-4-1 :Starting communication: ID/DE READ key

⚠ CAUTION

Before starting communication between the SFC in a system with analog output and the transmitter, be sure to change the control loop to “manual control”. This is to prevent fluctuation in analog output of the transmitter, which is caused by starting the SFC and communicating with the transmitter, from directly affecting the control loop.

Use the following procedure to start the SFC. The key operations of the SFC and display of the display window slightly vary depending on whether the system has digital output or analog output.

Step	Procedure	SFC screen
1	Connect the communication cable of SFC to the transmitter.	
2	Make sure the wiring between the transmitter signal line and SFC is correct.	
3	Turn the SFC on. Result: - The SFC executes self-diagnostics and the screen to the right appears. Turn on the power switch of the SFC. After checking that the process is in manual control mode, press the NON-VOL ENTER (Yes) key.	SELF CHECK... LOOP IN MANUAL? PRESS ID
4	Press the DE READ ID A key.	WORKING... DSTJ TAG NO. LIN DP FIT-1234
5	Read the tag number (displayed in the data display window). Check whether the SFC is connected to the correct transmitter. • If not, connect the communication cable to the correct transmitter.Repeat from step 2.	DSTJ TAG NO. LIN DP FIT-1234

6-4-2 :Displaying self-diagnostics result: STAT key

It is possible to display the self-diagnostics results of the transmitter sequentially from the SFC. This key is useful when used in combination with Action Printout.

Step	Procedure	SFC screen
1	Make sure that the SFC is set to “READY“. If it is not, press the CLR (No) key to set it to “READY“	DSTJ FIT-1234 READY...
2	Press the F/S DIR U STAT key. Result: - When no error has occurred, the message shown here to the right appears. - If a minor fault has occurred, “#“appears at the end of the bottom line of the SFC display window.	DSTJ FIT-1234 WORKING... DSTJ FIT-1234 STATUS CHECK=OK DSTJ FIT-1234 OUTPUT MODE #
3	After checking the self-diagnostics results, press the CLR (No) key to return to step 1.	

6-5 : Data printing

6-5-1 :Overview of printing function

Introduction

To carry out correct flow rate measurement, it is important to check the internal setting or response from the transmitter before starting to operate the transmitter or while the transmitter is in operation. At this time, it is convenient if you use the SFC with a printer to communicate with the transmitter and print out data. The SFC with a printer has two types of printing functions as defined below.

Definition

Configuration printout (data printout)

The SFC printer can print out internal data of the transmitter such as the transmitter tag number (TAG No.), damping time constant, low flow cutoff. This printing function is called “configuration printout” or “data printout”.

Action printout (continuous printout):

The SFC is provided with a function that continuously prints out results of responses to key operations of the SFC from the transmitter. This printing function is called “action printout” or “continuous printout”.

Printer

The optional SFC printer is a 24 characters/line thermal printer. When the power switch to the SFC is turned ON, the printer automatically starts to move and stops after moving back-and-forth once. At this time, the recording paper will advance a little (approximately 5 mm).

Advancing recording paper

To advance recording paper, press 

+ 

.

The screen will display “PRINTER FEED” and the recording paper is advanced by one line. While this prompt is displayed, the recording paper is advanced by one line every time the 

key is pressed.

To cancel the feed function, press the 

key.

Feeding recording paper

When the printer is running short of recording paper, feed the paper roll compartment with a paper roll. For a detailed procedure, see the SFC User's Manual (CM2-SFC100-2001).

6-5-2 :Printing internal data: PRINT key

Configuration printout (data printout) is used to print out internal data of the transmitter such as a damping time constant, or low flow cutoff.

Use the following procedure to carry out configuration printout.

Step	Procedure	SFC screen
1	Start communication between the SFC and transmitter. For a detailed procedure, see "6-4-1 : Starting communication: ID/DE READ key".	
2	Make sure that the SFC is set to “READY“. If it is not, press the CLR (No) key set it to “READY“	DSTJ FIT-1234 READY...
3	Press the SHIFT key.	SHIFT-
4	Press the PRINT 9 P (PRINT) key. Result: - Configuration printout starts.	WORKING... PRINTING...
5	When printing is completed, press the CLR (No) key to return step 2.	DSTJ FIT-1234 READY...

6-5-2-1 Printing example

An example of printed data is shown, below. The meanings of individual lines are explained.

Printing example	Meaning
Tag No. FIT 1234	Tag No.
'01-01-01 10:00	Date. time
TYPE : DIFF, PRESSURE	Type
ANA/DE : ANALOG XMTR	Output mode
FORM : LINEAR (or SQUARE ROOT)	Output format
PROM# : 2104695800	PROM No.
SW VER : B.1	Software version
DAMP : 0.00 s	Damping time constant
SPAN : 70.00 kPa	Span
LRV : 10.00 kPa	Measured value corresponding to 0% output
URV : 99.64 kPa	Measured value corresponding to 100% output
URL : 99.64 kPa	Maximum value of set range
F/SAFE : DOWNSCALE	Burnout direction
HEIGHT : 0.0000 m\	Tank flange height
DISPLAY	
CONF : DISP FLOW	Display format
TYPE : EBG. UNIT	Display type
EULO : -10.000	Low limit of engineering quantity
EUHI : 50.00	High limit of engineering quantity
INPUT : 45.00 kPa	Input differential pressure to transmitter
OUTPUT : 50.0 %	Transmitter output (%)
SV : T = 25°C (77°F)	
STATUS CHECK= OK	Self-diagnosis result of transmitter

6-6 : Continuously printing response result: ACT PRINT key

Action printout (continuous printout) is used to continuously print out results of responses from the transmitter to key operations from the SFC and keep the data.

Use the following procedure to carry out action printout.

Step	Procedure	SFC screen
1	Start communication between the SFC and transmitter. For the detailed procedure, see “Starting communication” on page 2-10.	
2	Make sure that the SFC is set to “READY“ If it is not, press the CLR (No) key to set it to “READY.“	DSTJ FIT-1234 READY...
3	Press the SHIFT key.	SHIFT-
4	Press the ACT PR 0 (ACT PR) key.	DSTJ FIT-1234 ACTION PRINT?
5	Press the NON-VOL ENTER (Yes) key. Result: Action printout starts by printing: * ACTION PRINT * START TAG No. FIC-1234 '95-12-18 15:30 Hereafter, the operation content and results of response from the transmitter are printed out every time the key is operated.	
6	Press the SHIFT key to stop the action printout operation.	SHIFT-

Step	Procedure	SFC screen
7	Press the ACT PR / 0 Z key (ACT PR) key.	DSTJ FIT-1234 ACTION PRINT?
8	Press the CLR (No) key. Result: The action printout operation ends by printing: * ACTION PRINT * END Then, the screen returns to that of step 2.	

Printing example

An example of an action printout corresponding to actual key operation will be explained.

Key operation

SHIFT ^ + ACT PR / 0 Z + NON-VOL / ENTER (Yes) keys

C / DAMP keys

URL / Y / SPAN

LRV E / 0%

SHIFT ^ + 0 + CLR (No) keys

Printing example of corresponding action printout

```
*   ACTIONPRINT       *
    TAG. No. FIT-1234
'01. 07. 10 16:11

DAMP
0.0            s

SPAN
300.0        mm

LRV
0.000         mm


*   ACTION PRINT
```

6-7 : Display and Change Transmitter Setting

6-7-1 :Overview

Applicable setting

The following settings (values and states) can be displayed or changed by operating SFC keys. This operation can be executed even during measurements.

The following settings (values and states) can be displayed or changed by operating SFC keys. This operation can be executed even during measurements.

✔: Enabled -: Disabled

Item	Change	Display
Tag No.	✔	✔
Output format	✔	✔
Display format	✔	✔
High and low limits of engineering quantity	✔	✔
Low limit of set range	✔	✔
High limit of set range	✔	✔
Span of set range	✔	✔
Engineering unit	✔	✔
Damping-Time constant	✔	✔
Low flow cutoff value	✔	✔
Burnout direction	-	✔
PROM No.	-	✔
Software version	-	✔
Sensor temperature	-	✔

Save settings

After changing settings (values and states), save settings using this procedure.

Remarks:

Settings (values and states) that are input to the transmitter are automatically saved after about 30 seconds. They are not erased by switching OFF the transmitter.

Step	Description	SFC screen
1	Press the SHIFT key and the NON-VOL ENTER (Yes) key, in that order. • The data has been saved in the transmitter.	SHIFT- DSTJ FIT-1234 WORKING... ↓ DSTJ FIT-1234 DATA NONVOLATILE

6-7-2 :Display or Change Tag No.

Display or change the tag No. using this procedure.

Here, the procedure to change FIT-1234 to ABC- 5678 as in this example.

Step	Description	SFC screen
1	Turn ON the power switch of the SFC. Press the NON-VOL ENTER (Yes) key.	LOOP IN MANUAL? ↓ PRESS ID
2	Press the DE READ ID A key. Branch: If no change required to the tag No., press the CLR (No) key.	DSTJ TAG NO. LIN DP FIT-1234 DSTJ FIT-1234 READY...
3	Press the ALPHA, DE READ ID A, B CONF, and C DAMP keys, in that order. Remarks: After an input error, return the cursor by pressing the ALPHA, and A DE ← Q keys, in that order. Press the ALPHA key again and input the correct keys	DSTJ TAG NO. LIN DP ABC-1234
4	Press the ALPHA and TIME +/− keys, in that order.	DSTJ TAG NO. LIN DP ABC-1234
5	Press the 5 S, 6 T, 7 N, and FEED 8 O keys, in that order.	DSTJ TAG NO. LIN DP ABC-5678

Step	Description	SFC screen
6	Press the NON-VOL ENTER (Yes) key.	DSTJ TAG NO. WORKING... ↓ DSTJ TAG NO. LIN DP ABC-5678
7	Press the SHIFT and NON-VOL ENTER (Yes) keys, in that order. The data is saved in the transmitter.	SHIFT- DSTJ ABC-5678 WORKING... ↓ DSTJ ABC-5678 DATA NONVOLATILE ↓ DSTJ ABC-5678 READY...

6-7-3 :Display or Change Output Format

This function works for flow rate measurement.

Flow rate is proportional to the square root of the differential pressure arising at a contracting mechanism. Flow rate is also proportional to the transmitters output differential pressure. In the Linear format, differential pressure is converted to electrical signals and output, without further processing. In the Square Root format, the square root of the differential pressure is calculated in the transmitter, and the result output.

Display or change the currently-selected format by key operation.

When Square Root is selected, set low-flow cutoff value, flow rate mode, and dropout format. Refer to 6.5.7.

Display or change the output format (linear/square root) of the transmitter using this procedure:

Step	Description	SFC screen
1	Press the B CONF key.	DSTJ CONFIG CONFORM?
2	Press the NON-VOL ENTER (Yes) key. Display the currently-selected output format (linear or square root).	CONFORM LINEAR (Linear) Or CONFORM SQUARE ROOT (Square root)
3	Branch: if no change required to the format, press the DE CONF. MENU ITEM key and proceed to step 4. if no change required to the format, press the CLR (No) key twice.	

Step	Description	SFC screen
4	Press the NON-VOL ENTER (Yes) key.	CONFORM ENTERED IN SFC ↓ CONFORM LINEAR
5	Press the ▲ H NEXT key.	CONFORM DOWNLOAD DATA?
6	Press the NON-VOL ENTER (Yes) key. Changes the output format to Linear or Square Root.	CONFORM WORKING... ↓ CONFORM DATA LOADED!
7	Press the CLR (No) key.	DSTJ FIT-1234 READY...
8	Press the ^ SHIFT and NON-VOL ENTER (Yes) keys in that order. Saves the data in the transmitter.	SHIFT- DSTJ FIT-1234 WORKING... ↓ DSTJ FIT-1234 DATA NONVOLATILE

6-7-4 :Display or Change Indicator Display Format (Flow Rate /Linear/ Display Flow Rate)

This function enables displaying or changing the display format, of the indicator.

- When the output format is Square Root, the display format is fixed to Flow Rate (FLOW).
- When the output format is LINEAR, select either LINEAR or DISP FLOW for the display format.

~Note *Display Flow Rate: In some cases, for processing by higher level equipment, the required output format of a transmitter is Linear. Select Flow Rate can be selected for the indicator display format when the transmitter output format is Linear.*

~Note *For detailed information on the indicator, refer to 5.8.*

Display or change the display format (linear/display flow rate) of the transmitter indicator using this procedure:

Step	Description	SFC screen
1	Press the B CONF key.	DSTJ CONFIG CONFORM?
2	Press the ▲H NEXT key.	DSTJ CONFIG DISPLAY?
3	Press the NON-VOL ENTER (Yes) key. Displays the currently-selected display format (flow rate, linear or display flow rate).	DISPLAY CONF FLOW (Output format: Square) DISPLAY CONF LINEAR or (Display format: Linear) DISPLAY CONF ENTERED IN SFC (Display format: Display Flow Rate)

Step	Description	SFC screen
4	Branch: If no change required to the format, press the CLR (No) key twice. To change to the format, press the DE CONF. MENU ITEM key, and proceed to the next step. *1) When the output format is Square Root, the display format cannot be changed from Flow Rate (FLOW).	
5	Press the NON-VOL ENTER (Yes) key.	DISPLAY CONF ENTERED IN SFC ↓ DISPLAY CONF DISP FLOW
6	Press the ▲ H NEXT key several times, or press the CLR (No) key.	DISPLAY DOWNLOAD DAT.?
7	Press the NON-VOL ENTER (Yes) key. Changes the display format to Linear or Display Flow Rate.	DISPLAY WORKING... DISPLAY DATA LOADED! DSTJ CONFIG DISPLAY?
8	Press the CLR (No) key.	DSTJ FIT-1234 READY...

Step	Description	SFC screen
9	Press the SHIFT and NON-VOL ENTER (Yes) keys, in that order. Saves the data in the transmitter.	SHIFT- ↓ DSTJ FIT-1234 WORKING... DSTJ FIT-1234 DATA NONVOLATILE DSTJ FIT-1234 READY...

6-7-5 :Display or Change Indicator Display Format (Engineering Unit / %)

This function enables displaying or changing the display format (engineering unit or%) of the indicator.

Display or change the display format (engineering unit /%) of the indicator using this procedure:

Step	Description	SFC screen
1	Press the B CONF, ▲ H NEXT, NON-VOL ENTER (Yes), and ▲ H NEXT keys, in that order. Displays the currently-selected display format (engineering unit or %).	DISPLAY TYPE % (0.0) or DISPLAY TYPE ENG. UNIT (4.5FIG)
2	Branch: If no change required to the format, press the CLR (No) key twice. To change the format, press the DE CONF. MENU I ITEM key, and proceed to the next step.	
3	Press the NON-VOL ENTER (Yes) key.	DISPLAY TYPE ENTERED IN SFC ↓ DISPLAY TYPE % (0.0)
4	Press the ▲ H NEXT key several times, or press the CLR (No) key.	DISPLAY DOWNLOAD DAT.?

Step	Description	SFC screen
5	Press the NON-VOL ENTER (Yes) keys. Changes the display format to % or engineering unit.	DISPLAY WORKING... DISPLAY DATA LOADED! DSTJ CONFIG DISPLAY?
6	Press the CLR (No) key.	DSTJ FIT-1234 READY...
7	Press the SHIFT ^ and NON-VOL ENTER (Yes) keys, in that order. Saves the data in the transmitter. .	SHIFT- ↓ DSTJ FIT-1234 WORKING... DSTJ FIT-1234 DATA NONVOLATILE DSTJ FIT-1234 READY...

6-7-6 :Display or Change High and Low Limits of Engineering Quantity

This function is effective only when Engineering Unit is selected for the indicator display format.

Display or change the high and low limits of engineering quantity displayed on the indicator using this procedure:

Step	Description	SFC screen
1	Press the [CONF B], [▲ H NEXT], [NON-VOL ENTER (Yes)], and [▲ H NEXT] keys, in that order. Check that engineering unit is selected.	DISPLAY TYPE ENG. UNIT (4.5FIG)
2	Press the [▲ H NEXT] key.	EULO (at 0%) 0.0000
3	Press the [TIME +/−], [1 V], [ACT PR 0 Z], [SCR PAD ■→], [ACT PR 0 Z] and keys, in that order.	EULO (at 0%) -10.0
4	Press the [NON-VOL ENTER (Yes)] key.	EULO (at 0%) ENTERED IN SFC ↓ EULO (at 0%) -10.0
5	Press the [▲ H NEXT] key. THe low limit of engineering quantity (-10.0) has been set.	EUHI (at 100%) 60.0
6	Press the [5 S], [ACT PR 0 Z], [SCR PAD ■→], and [ACT PR 0 Z] keys, in that order.	EUHI (at 100%) 50.0

Step	Description	SFC screen
7	Press the NON-VOL ENTER (Yes) key. Set the high limit of engineering quantity (50.0).	EUHI (at 100%) ENTERED IN SFC ↓ EUHI (at 100%) 50.0
8	Press the ▲H NEXT key. Press the NON-VOL ENTER (Yes) key. Changes the high and low limits of engineering quantity to the set values.	DISPLAY DOWNLOAD DAT.? DISPLAY WORKING... ↓ DISPLAY DATA LOADED! DSTJ CONFIG DISPLAY?
9	Press the CLR (No) key	DSTJ FIT-1234 READY...
10	Press the ^ SHIFT and NON-VOL ENTER (Yes) keys in that order. Saves the data in the transmitter.	SHIFT- DSTJ FIT-1234 WORKING... ↓ DSTJ FIT-1234 DATA NONVOLATILE DSTJ FIT-1234 READY...

6-7-7 :Display or Change Low Flow Cutoff Value

This function is effective only when Square Root is selected for the output format. When the flow rate falls below a fixed value (valid range of low flow cutoff value: 0~20%), the flow rate is processed as zero.

Also, a dropout format (linear/zero) and a flow rate mode (DEFAULT/EXPAND) can be selected.

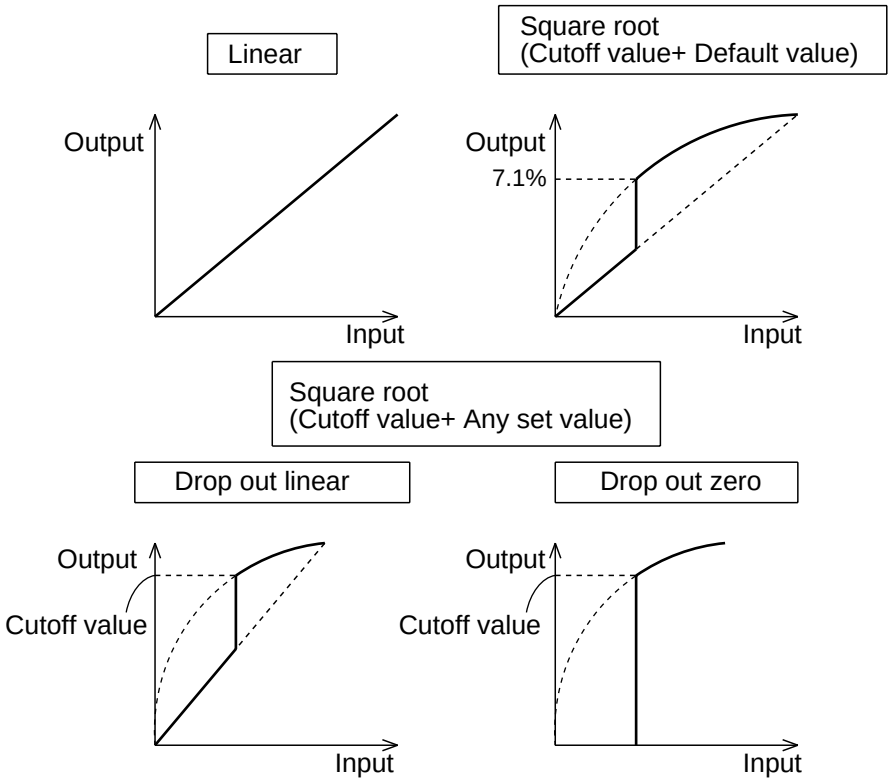


Figure 6-2 Relationship Between Input and Output (%) Determined by Low Flow Cutoff Value Setting

~Note *Flow rate mode*

DEFAULT:Ordinarily, this mode is selected, in most cases.

EXPAND:This mode is selected when the range is expanded. For example, when the range is set near the normal flow rate, or when reverse flow rate output must be obtained using a reversible orifice.

Set a low flow cutoff value, and select a dropout format (linear/zero) and a flow rate mode (DEFAULT/EXPAND) using this procedure:

Low flow cutoff value setting

Step	Description	SFC screen
1	Press the B CONF key.	DSTJ CONFIG CONFORM?
2	Press the NON-VOL ENTER (Yes) key. Ensure that the currently-selected output format is Square Root. If the output format is Linear, change it to Square Root, following the instructions in 6.5.3.	CONFORM SQUARE ROOT (Square Root)
3	Press the ▲H NEXT key. Displays the current cutoff value (Default value (7.1%) or any set value).	CUT OFF DEFAULT or CUT OFF 10.0 %
4	Branch: If no change is required to the value, press the CLR (No) key twice. To change the value, press the DE CONF. MENU I ITEM key, and proceed to the next step. To set the default value, proceed to step 12. To set a non-default value (15%) for the low flow cutoff value, proceed to steps 5 and 6.	CUT OFF %
5	Press the 1 V and 5 S keys (numeric), in that order.	CUT OFF 15 %

Step	Description	SFC screen
6	Press the NON-VOL ENTER (Yes) key. Sets the low flow cutoff value (15%).	CUT OFF ENTERED IN SFC ↓ CUT OFF 15 %

Dropout format (linear or zero) setting procedure

How to select linear:

Step	Description	SFC screen
7	Press the ▲ H NEXT key. Displays the currently-selected dropout format.	CUT OFF DROPOUT = LIN Or CUT OFF DROPOUT = ZERO
8	To change the format, press the DE CONF. MENU I ITEM key to display the setting screen. If no change required to the format, go to step 10.	CUT OFF DROPOUT = LIN
9	Press the NON-VOL ENTER (Yes) key. Sets the dropout format (linear).	CUT OFF ENTERED IN SFC ↓ CUT OFF DROPOUT = LIN

Flow rate mode (DEFAULT or EXPAND) setting procedure

How to select DEFAULT: Press the and keys, in that order.

Step	Description	SFC screen
10	Press the ▲H NEXT key. Display the currently-selected flow rate mode.	CUT OFF MODE = DEFAULT (Forward direction) Or CUT OFF MODE = EXPAND
11	To change the mode, press the DE CONF. MENU I ITEM key, to display the setting screen. If no change required to the format, go to step 13.	CUT OFF MODE = DEFAULT
12	Press the NON-VOL ENTER (Yes) key.	CUT OFF ENTERED IN SFC ↓ CUT OFF MODE = DEFAULT
13	Press the ▲H NEXT key.	CUT OFF DOWNLOAD DATA?
14	Press the NON-VOL ENTER (Yes) key. Set the data.	CONFORM WORKING... ↓ DSTJ CONFIG CONFORM?
15	Press the CLR (No) key.	DSTJ FIT-1234 READY...

Step	Description	SFC screen
16	Press the SHIFT and NON-VOL ENTER (Yes) keys, in that order. Save the data in the transmitter.	SHIFT- DSTJ FIT-1234 WORKING... ↓ DSTJ FIT-1234 DATA NONVOLATILE DSTJ FIT-1234 READY...

6-7-8 :Display or Change Low/High Limits and Span of Set Range

Display or change the differential pressure corresponding to the low/high limits and the span of the set range using this procedure.

Assumes the following current values and new values:

Low-limit value: Change 0.0000 kPa to 20.00 kPa.

High-limit value: Change 50.00 kPa to 60.00 kPa.

Span: Change 50.00 kPa to 40.00 kPa.

Remarks:

Span is automatically determined by the low and high limit values. (Display only)

Always change the low limit value first.

How to display low/high limit values and span

Step	Description	SFC screen
1	Press the LRV E 0% key, to display the low limit value. Press the URV F 100% key, to display the high limit value. Press the URL SPAN Y key, to display the span.	LRV FIT-1234 0.0000 kPa URV FIT-1234 50.00 kPa SPAN FIT-1234 50.00 kPa
2	If no change required to the displayed data, press the CLR (No) key.	
3	Press the LRV E 0% key, to display the low limit value.	LRV FIT-1234 0.0000 kPa
4	Press the 2 W and ACT PR 0 Z keys (numeric), in that order.	LRV FIT-1234 20_ kPa

Step	Description	SFC screen
5	Press the NON-VOL ENTER (Yes) key. Set the low limit value to 20.00kPa.	LRV FIT-1234 WORKING... ↓ LRV FIT-1234 20.00 kPa
6	Press the URV F 100% key, to display the high limit value.	URV FIT-1234 50.00 kPa
7	Press the 6 T and ACT PR 0 Z keys (numeric), in that order.	URV FIT-1234 60_ kPa
8	Press the NON-VOL ENTER (Yes) key. The high limit value was set to 60.00 kPa.	URV FIT-1234 WORKING... ↓ URV FIT-1234 60.00 kPa
9	Press the SHIFT ^ and NON-VOL ENTER (Yes) keys, in that order. Saves the data in the transmitter.	SHIFT- DSTJ FIT-1234 WORKING... ↓ DSTJ FIT-1234 DATA NONVOLATILE

6-7-9 :Display or Change Engineering Unit for Measured Pressure

Valid engineering units

The following engineering units are available. They are displayed in this sequence (or in the reverse sequence) using key operation.

kPa → MPa → hPa → Pa → mbar → bar → inH_2O → inHg → PSI → mmH_2O → mH_2O → kg/cm^2 → g/cm^2 → mmHg

Remarks

- When the engineering unit is changed, the displayed differential pressure on the SFC and the output range are automatically changed to the corresponding values.
- The change is valid only while the SFC is on. Once the SFC power is reset or DE READ ID A key is pressed the engineering unit returns to the default value.

How to display and change the engineering unit:

It is assumed that the currently-selected unit is kPa.

Step	Description	SFC screen
1	Press the D UNITS key.	UNIT FIT-1234 kPa
2	To change the unit, press the ▲H NEXT key or the D UNITS key, successively, until the desired unit is displayed. Press the ▼L PREV key to return to the previous unit.	Display after pressing the D UNITS key or the ▲H NEXT key. UNIT FIT-1234 MPa Display after pressing the ▼L PREV key. UNIT FIT-1234 mmHg

6-7-10 :Display or Change Damping Time Constant

If, due to pulsation of differential pressure under some flow conditions, the transmitter output is unstable and difficult to read, the output can be stabilized by increasing the damping time constant.

Valid damping time constants

The following damping time constants are valid. They are displayed in this sequence (or in the reverse sequence) using key operation. The actual response time is lower than the value by about 0.4 seconds. The unit is second.

0.0 → 0.16 → 0.32 → 0.48 → 1.0 → 2.0 → 4.0 → 8.0 → 16.0 → 32.0

How to display and change the damping time constant:

It is assumed that the currently set value is 1.0 second.

Remarks:

When changing the damping time constant, select the next higher value and check output fluctuations.

Step	Description	SFC screen
1	Press the C DAMP key.	DAMP FIT-1234 1.0 s
2	To change the damping time constant, press the ▲H NEXT key or the ▼L PREV key, successively, until the desired value is displayed.	DAMP FIT-1234 WORKING... ↓ Display after pressing the ▲H NEXT key DAMP FIT-1234 2.0 s Display after pressing the ▼L PREV key UNIT FIT-1234 0.48 s

Step	Description	SFC screen
3	Press the SHIFT and NON-VOL ENTER (Yes) keys, in that order. Saves the data in the transmitter.	SHIFT- DSTJ FIT-1234 WORKING... ↓ DSTJ FIT-1234 DATA NONVOLATILE

6-7-11 :Displaying Burnout Direction

Processing after error detection

Three types of burnout function are available to notify an abnormal state:

1. No burnout direction : The transmitter outputs an abnormal value.
2. Upscale : The transmitter increases the output to the high limit (regardless of the input value).
3. Downscale : The transmitter decreases the output to the low limit (regardless of the input value).

The standard specification for this transmitter is No burnout direction. When the transmitter goes into an abnormal state, its details can be displayed by operating the SFC. When it recovers to the normal state, it automatically outputs a normal value.

Select a non-standard burnout direction. Select the corresponding optional specification.

- U: Upscale
- D: Downscale

Transmitters keep outputting a burnout value even after recovery from an abnormal state.

Remarks:

When an abnormality occurs, a message is displayed on the SFC data display window regardless of the burnout type.

How to display the burnout direction:

Step	Description	SFC screen
1	Press the SHIFT key.	SHIFT-
2	Press the F/S DIR STAT key. NON-B/O is displayed for the model of no burnout direction. Displays UPSCALE and DOWNSCALE for the corresponding models.	DSTJ FIT-1234 F/SAFE NON-B/O

6-7-12 :Displaying PROM No.

The PROM No. of this transmitter is marked on its name plate. The PROM No. can be confirmed using the SFC.

How to check the PROM No.:

It is assumed that the PROM No. is 2000000000.

Step	Description	SFC screen
1	Press the B CONF key.	DSTJ CONFIG CONFORM?
2	Press the ▼ L PREV key twice.	DSTJ CONFIG PROM No.?
3	Press the NON-VOL ENTER (Yes) key.	PROM NO. 2000000000
4	After checking the PROM No., press the CLR (No) key twice.	DSTJ FIT-1234 READY...

6-7-13 :Displaying Sensor Temperature

Display the sensor temperature of this transmitter using the SFC.

How to check the sensor temperature:

It is assumed that the sensor temperature is 27°C.

Step	Description	SFC screen
1	Press the B CONF key.	DSTJ CONFIG CONFORM?
2	Press the ▲ H NEXT key four times.	DSTJ CONFIG SENSOR TEMP?
3	Press the NON-VOL ENTER (Yes) key.	SENSOR TEMP WORKING... ↓ SENSOR TEMP T = 27℃ (80℉)
4	After checking the temperature, press the CLR (No) key twice.	DSTJ CONFIG READY...

6-7-14 :Displaying Software Version

Display the software versions of this transmitter and the SFC using the SFC.

How to check the software versions:

It is assumed that the software versions are, as follows:

SFC : 7.1

Transmitter : B.1

Step	Description	SFC screen
1	Press the SHIFT key.	SHIFT-
2	Press the SW VER 3 key.	When the SFC is not connected to the transmitter: S/W VER FIT-1234 SFC = 7.1 WHen the SFC is connected to the transmitter: S/W VER FIT-1234 SFC = 7.1 XMTR = B.1
3	After checking the software versions, press the CLR (No) key.	DSTJ FIT-1234 READY...

6-7-15 :Displaying and changing the sealed liquid temperature correction function

Yamatake's unique sealed-liquid temperature correction function (patent pending) minimizes the influence of ambient temperature changes on transmitter performance.

This function implemented by inputting the height between the flanges of the tank on which the transmitter is mounted. If no inter-flange height is specified in your order, "Height=0 m" is assumed. In this case, the function is not implemented in your transmitter.

Check and set the sealed liquid temperature correction function using this procedure.

The height between flanges is changed from 1 m, to 2 m, in this example.

Step	Description	SFC screen
1	Press the B CONF key.	DSTJ CONFIG CONFORM?
2	Press the ▲ H NEXT key three times. Or, press the ▼ L PREV key four times.	DSTJ CONFIG HEIGHT?
3	Press the NON-VOL ENTER (Yes) key. The currently set inter-flange height is displayed. If the height is 0, the correcting function is not executed.	DSTJ CONFIG WORKING... HEIGHT 5.000 m
4	Press the 2 W key.	HEIGHT 2 m
5	Press the NON-VOL ENTER (Yes) key. The inter-flange height for temperature correction was changed to 2 m.	HIGHT WORKING...
6	After changing the setting, press the CLR (No) key twice.	DSTJ FIT-1234 READY...

6-8 : Constant Current Source Mode

6-8-1 :Set Constant Current Source Mode

Set the transmitter to output constant current within the range of 4 mA (0%) ~ 20 mA (100%). This setting is called constant current source mode.

This function is convenient for loop checking.

How to set the constant current source mode:

It is assumed that the output is fixed at 50% (12 mA).

Step	Description	SFC screen
1	Press the INPUT OUTPUT key. Displays the current output.	OUTPUT FIT-1234 WORKING... ↓ OUTPUT FIT-1234 10.00 %
2	Press the 5 and ACT PR 0 keys (numeric), in that order.	OUTPUT FIT-1234 50_
3	Press the NON-VOL ENTER (Yes) key. This transmitter outputs 12 mA (50%). he # mark indicates that the constant current source mode obtains.	OUTPUT FIT-1234 WORKING... OUTPUT FIT-1234 50.00 % #

Remarks

Release the constant current source mode using this procedure. It is automatically released when no SFC is operated for more than 10 minutes.

6-8-2 :Release Constant Current Source Mode

How to release the constant current source mode:

Step	Description	SFC screen
1	Press the INPUT OUT- PUT J key. Displays the current output.	OUTPUT FIT-1234 WORKING... ↓ OUTPUT FIT-1234 50.00 % #
2	Press the CLR (No) key. Releases the constant current source mode. Check that the # mark disappears. Remarks Release the constant current source mode using this procedure. It is automatically released when no SFC is operated for more than 10 minutes.	OUTPUT FIT-1234 WORKING... ↓ OUTPUT FIT-1234 READY...

6-9 : Writing a Memo

6-9-1 :Recording in Scratch Pad 1

This function enables recording of memos in the SFC's scratch pad. Scratch pads 1 and 2 are available for notes from one technician to another, for specific instruments, for example. Scratch pads are common to most data acquisition systems.

How to record memo in scratch pad 1:

Here, 99-4 ZERO CHECK (Zero point was checked in April 1999) is recorded.

Step	Description	SFC screen
1	Press the SHIFT and SCR PAD keys, in that order.	SHIFT- DSTJ FIT-1234 WORKING... ↓ SCR PADS 1 XXXXXXXXXXXXXXX
2	Press the PRINT 9 P, 6 T, TIME +/-, and FEED 8 O keys, in that order.	SCR PADS 1 99-4 XXXXXXXXXX
3	Press the ALPHA and SCR PAD keys, in that order.	SCR PADS 1 99-4 XXXXXXXXXX
4	Press the ACT PR 0 Z, LRV E 0%, 4 R, FEED 8 O, SCR PAD, DAMP C, ▲ H NEXT, LRV E 0%, DAMP C and RESET COR- K RECT keys, in that order.	SCR PADS 1 99-4 ZERO CHECK

Step	Description	SFC screen
5	Press the NON-VOL ENTER (Yes) key. Recording in scratch pad 1 has been completed.	SCR PADS WORKING... ↓ SCR PADS 1 99-4 ZERO CHECK
6	Press the CLR (No) key to release scratch pad 1.	DSTJ FIT-1234 READY...

6-9-2 :Recording in Scratch Pad 2

How to record memo in scratch pad 2:

Step	Description	SFC screen
1	Press the SHIFT and SCR PAD keys, in that order. Displays the contents of scratch pad 1.	SHIFT- DSTJ FIT-1234 WORKING... ↓ SCR PADS 1 99-4 ZERO CHECK (or XXXXXXX)
2	Press the ▲ H NEXT key.	SCR PADS 2 XXXXXXXXXXXXXXX
3	Record information using the same procedure as scratch pad 1.	
4	Press the CLR (No) key to release scratch pad 2.	DSTJ FIT-1234 READY...

Chapter 7 : Maintenance and Troubleshooting

This section explains the maintenance of the ST 3000 Smart Transmitter and a range of interesting ways to ensure that your transmitter's performance goals may be continuously met during its operating life, including instructions for:

- saving data in this transmitter,
- disassembly and assembly procedures,
- output checking,
- calibration procedures, and troubleshooting procedures.

At the start of operation or during operation, deal with performance problems by following these procedures. If you cannot fix the problem, it is possible that there is a problem with the product itself and you should contact your Yamatake representative immediately.

7-1 : Zero Adjustment

7-1-1 :Overview

Introduction

Zero adjustments can be classified as:

1.Calibrating the zero point based on the current input value

2.Setting the set range (LRV/URV) based on the current input value

Items for adjustment

The two adjustment methods are clearly delineated, below. Explanations of these procedures are found, on subsequent pages.

1) Zero adjustment for use under uniform pressure (with SFC)

2) Balance adjustment using sealing liquid (with SFC)

3) Zero adjustment for use as a level gauge (with SFC)

4) Zero adjustment using an external zero adjustment mechanism (option)

7-1-2 :Zero Adjustment under Uniform Input Pressure (with SFC)

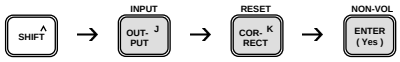
When a transmitter is used, change the applied input pressure to uniform pressure before performing zero adjustment procedures. In some cases, factors such as the mounting posture of the transmitter prevent an indication exactly at 0%. Perform zero adjustment measures using these procedures. However, the zero point may also be correctly adjusted by changing the transmitters orientation.

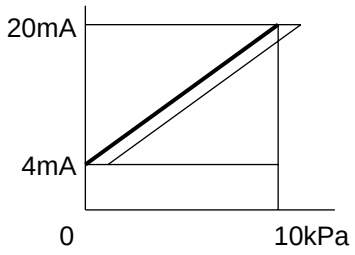
Procedure

Calibrate the zero point based on the current input value

The current input value at zero uniform pressure is the differential pressure that is applied to the sensor due to the influence of mounting posture, etc. Rewrite the factory set zero point calibration data. This operation does not change the LRV or the URV. If the current input value exceeds 3.125% of the transmitters measurement range (URL - LRL), a warning message (*1) for this operation is displayed.

Key-pad operations:





Detailed procedures using an SFC as found in 5.3.1.1 Preparation for Measurement.

*1. Press the 

key after display of warning message Calibration value over OK?

Zero calibration normal# is displayed.

7-1-3 :Zero Adjustment Based on Input Pressure Corresponding to LRV (with SFC)

Even if a transmitter itself has a correct zero point under uniform pressure, it sometimes does not output a zero value due to unbalanced sealing liquid in the connecting pipe. Adjust the balance using these procedures.

Perform this adjustment after ensuring that the sealing liquid level is sufficiently high for ordinary measurement state.

Procedure

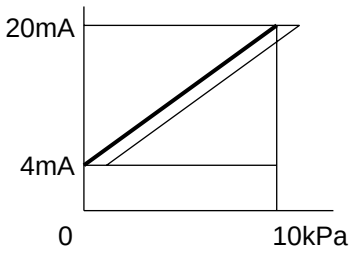
- Set the LRV (low limit of range corresponding to 0% output) based on the current input value
- The current input value, which is the differential pressure applied to the sensor, should be set for the LRV. Without changing the span, this setting automatically changes the LRV and the URV. The factory set zero point calibration data is not rewritten.

(Example) Current input value=0.025 kPa, LRV=0 kPa, URV=10 kPa

The result of the key-pad operation will be, as follows:

LRV=0.025 kPa, URV=10.025 kPa

Key-pad operations:



Detailed procedures using an SFC are found in Section 3.9 Zero Span Adjustment with Input Pressure Equivalent to Range.

7-1-4 :Zero Adjustment Based on Actual Level (with SFC)

When a differential pressure transmitter is used as a level gauge, the zero point can be adjusted by either one of two methods. In both cases, adjust the zero point by changing the LRV and the URV. Refer to 2. Setting the set range (LRV/URV) based on the current input value in 7.1.1 Overview. The factory set zero point calibration data is not rewritten.

Procedure 1

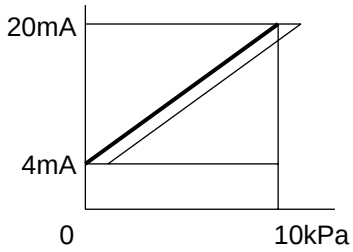
- Set the LRV by setting the current input value for 0%
- Maintain same liquid level for which 0% is the output. Set the zero point based on this input value.

Example: Current input value=0.025 kPa, LRV=0 kPa, URV=10 kPa

The result of the key-pad operation will be, as follows:

LRV=0.025 kPa, URV=10.025 kPa

Key-pad operations:



Detailed procedures using an SFC are found in "5-9 : Zero-span Adjustment with Input Pressure Equivalent to Range".

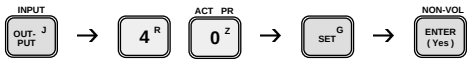
Procedure 2

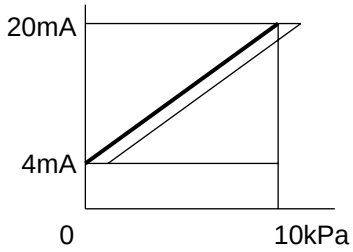
- Set the LRV by setting the current input value for the specified value

Example: When the transmitter output is 35%, it can be adjusted to the current liquid level (e.g. 40%) obtained with a level gauge, using these key-pad operations.

LRV=0 kPa, URV=10 kPa are changed to LRV=0.5 kPa, URV=10.5 kPa

Key-pad operations:

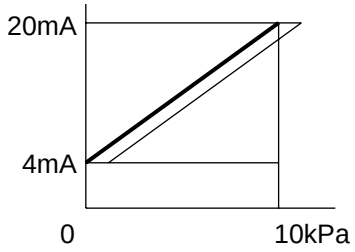




Detailed procedures using an SFC are found in "5-8 : Zero-point Adjustment -- Based on Actual Liquid Level".

7-1-5 :Zero Adjustment Using External Zero Adjustment Mechanism (Option)

Setting the set range (LRV/URV) based on the current input value in "7-1-1 : Overview" applies to zero adjustment using an external zero adjustment mechanism. Therefore, the LRV and the URV are automatically written by this operation. The factory set zero point calibration data is not rewritten.



The adjusting procedure is found in "5-12 : External Zero and Span Adjustment (Option)".

7-2 : Saving and Restoring Data

7-2-1 :Saving Data

Save the set values and states and other data stored in this transmitter to the SFC, and restore data to other transmitters.

This function is useful when replacing a transmitter. It saves input work and prevents key-pad errors.

An SFC has the memory capacity for one transmitter only. Save and restore data one by one.

Note that the data saved using this procedure is erased by turning off the SFC. Always restore data to a target transmitter, before turning off the SFC.

How to save data:

Step	Description	SFC screen
1	Press the DE READ / ID A key.	DSTJ TAG NO. LIN DP FIT-1234
2	Press the CONF B key.	DSTJ CONFIG CONFORM?
3	Press the ▲ H / NEXT key to display the screen shown, on the right.	DSTJ CONFIG SAVE/RESTORE?
4	Press the NON-VOL / ENTER (Yes) key.	SAVE/RESTORE SAVE DATA?

Step	Description	SFC screen
5	Press the NON-VOL ENTER (Yes) key. • Saving has been completed. • Release the save mode by step 6.	SAVE DATA WORKING... ↓ SAVE DATA DATA SAVED ↓ DSTJ CONFIG SAVE/RESTORE?
6	Press the CLR (No) key. • The save mode is released.	DSTJ FIT-1234 READY...

7-2-2 :Restoring Data

How to restore data:

Step	Description	SFC screen
1	Press the DE READ / ID A key.	DSTJ TAG NO. LIN DP FIT-1234
2	Press the B / CONF key.	DSTJ CONFIG CONFORM?
3	Press the ▲ H / NEXT key to display the screen shown on the right.	DSTJ CONFIG SAVE/RESTORE?
4	Press the NON-VOL / ENTER (Yes) key.	SAVE/RESTORE SAVE DATA?
5	Press the ▲ H / NEXT key.	SAVE/RESTORE RESTORE DATA?
6	Press the NON-VOL / ENTER (Yes) key. • Restoring has been completed. • Release the restore mode by step 7.	RESTORE DATA WORKING... ↓ RESTORE DATA DATA RESTORED
7	Press the CLR / (No) key. • The restore mode has been released.	DSTJ FIT-1234 READY...

7-3 : Disassembly and Assembly

7-3-1 :Before You Start

⚠ WARNING

- Never open the case cover while the transmitter is ON or in a hazardous location.
- Handle the explosion-proof transmitter with care. It may lose its explosion-proof performance due to corrosion, deformation, damage to the case cover, or damage to a screw or a joined part.
- The explosion-proof performance of the special explosion-proof pressure transmitter is not guaranteed unless it is LOCKED. Always tighten the case cover completely, and lock the case cover.

Dismounting and mounting the case cover

This transmitter has a locking structure. Before dismounting the case cover, unlock the mechanism using a hexagonal wrench (included).

When remounting, insert the case cover fully and lock it, using a hexagonal wrench.

⚠ CAUTION

After mounting the case cover, make sure that no dust or rain gains ingress into the transmitter case.

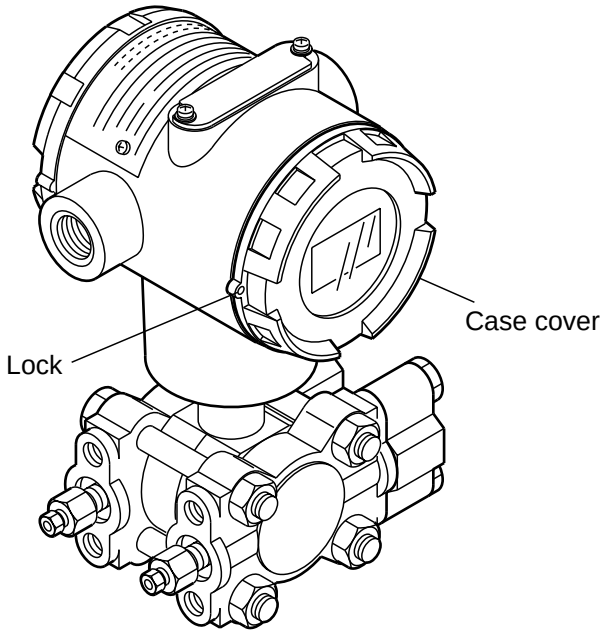


Figure 7-1 Locking Case Cover

7-3-2 :Mount Center Body Cover and Adapter Flange

Dismount covers

Remove the four sets of bolts & nuts, shown in the illustration.

Remarks:

After dismounting, handle the center body cover carefully. Avoid damage to the diaphragm.

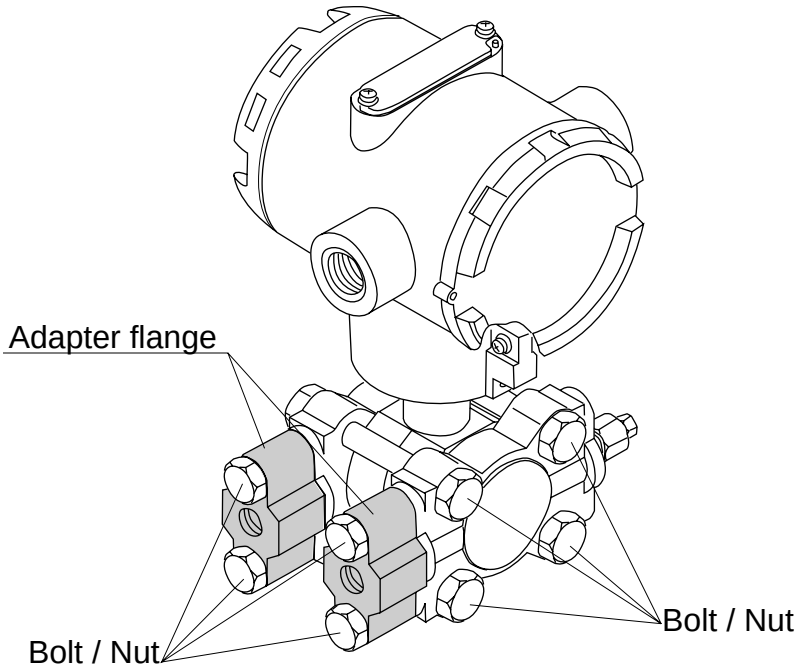


Figure 7-2 Center Body Cover Fixing Bolts

Mount covers and adapter flanges

When mounting the centers body cover and adapter flanges, tighten the bolts to the following torque.

Replace the seal gasket, if it is damaged.

Table 7-1: Cover Bolts / Nuts and Tightening Torque

Model No.	Wetted parts material (other than diaphragm)	Bolt/Nut Material	Bolt/Nut tightening torque N·m		
			Cover material Carbon steel/Stainless steel		Cover material PVC
			When new gasket is used	When existing gasket is reused	When new / existing gasket is used
STD910	SUS316	SUS304	35±2	20±1	-
STD920 STD930	SUS316 Hastelloy C	Carbon steel	22±2	17±1	10±1
		SUS630			-
		SUS304	15±1	10±1	-
STD920 STD930	Tantalum SUS316L	Carbon steel	45±2	30±1.5	15±1
		SUS630			-
		SUS304	35±2	20±1	15±1
STD960	SUS316 Hastelloy C Tantalum SUS316L	Carbon steel SUS630	45±2	30±1.5	-
		SUS304	35±2	20±1	-
STD921 STD931 STD961	SUS316	Carbon steel SUS630	280±30		-
		SUS304	170±20		-
STG940 STG960	SUS316 Hastelloy C	Carbon steel	22±2	17±1	10±1
		SUS630			-
		SUS304	15±1	10±1	10±1
STG940 STG960	Tantalum SUS316L	Carbon steel	45±2	30±1.5	15±1
		SUS630			-
		SUS304	35±2	20±1	15±1
STG981	SUS316 Hastelloy C	Carbon steel SUS630	90±20		-
		SUS304	55±20		-
STA923 STA940	SUS316 Hastelloy C Tantalum SUS316L	Carbon steel SUS630	45±2	30±1.5	-
		SUS304	35±2	20±1	15±1
STC929	SUS316	Carbon steel SUS630	22±2	17±1	-
		SUS304	15±1	10±1	-

Table 7-2: Adapter Flange Bolt / Nut Tightening Torque

Bolt/Nut Material	Bolt/Nut tightening torque N·m	
	Adapter flange materialCarbon steel/Stainless steel	Adapter flange materialPVC
Carbon steel	20±1	7±0.5
SUS630		-
SUS304	10±0.5	7±0.5

7-3-3 :Washing the Center Body

Introduction

The transmitter and the pipes must be kept clean to maintain its accuracy and achieve satisfactory performance. Deposits accumulated in the pressure chamber of the transmitter may result in measurement errors.

Rinsing the center body (STD/STG/STA/STC Type)

Rinse the center body using the following procedure:

(1) Remove the hexagon head bolts of the center body and dismount the cover.

(2) Wash the diaphragm and the inner surface of the cover with a solvent and a soft brush. Take care not to deform or damage the diaphragm.

(3) In reassembling the center body, replace the cover gasket with a new one as necessary.

(4) Tighten the cover bolts at the specified tightening torque. (Refer to "Table 7-1: Cover Bolts / Nuts and Tightening Torque")

Remarks related to cold area

If you stop the operation after measuring liquid that can be frozen (such as water) in a cold area, drain the liquid from the center body (by loosening the drain plug.)

Maintenance of sensor

The sensor does not need any special routine maintenance/inspection. When the flange is dismounted for maintenance, wash the diaphragm using a soft brush and solvent. Work carefully without deforming or damaging the diaphragm.

7-4 : Calibrating Set Range and Output Signals

Some calibration work must be performed by Yamatake or our authorized service provider. Generally, this work requires a high-precision reference input device and highly accurate measuring equipment. Such work is not ordinarily performed by end-users of Yamatake equipment. These instructions are provided for the benefit of users who must perform calibration work themselves.

Calibration includes input calibration (set range) and output calibration (output signals).

7-4-1 :Calibrating Set Range Based on Reference Input

7-4-1-1 Preparation

The low limit (LRV) and the high limit (URV) of the set range are calibrated by inputting reference pressure.

Calibrate the LRV and the URV, in that order.

Equipment

Prepare the following equipment before calibration:

- Standard pressure generator : Pressure generated must be close to the measurement range of the transmitter.
  Accuracy requirement : ±0.05% F.S. or ± 0.1% setting
- Power supply: 24 V DC
- Precision resistance: 250 Ω ± 0.005%
- Voltmeter: Digital voltmeter with accuracy (10 V DC range) of ± 0.02% rdg+1 dgt
- SFC

Calibration conditions

All of the following conditions must be met, before performing calibration:

- A laboratory without any air currents. Wind will apply pressure to the pressure receiving unit on the side open to the air, influencing the calibration accuracy.
- Standard temperature of 23°C and humidity of 65%. Normal pressure range (15°C~35°C) and the normal humidity range (45%~75%) are allowable, if no sudden changes occur.
- Accuracy of the measuring equipment must be at least 4 times that of the transmitter.

Set up for calibration

Wire the transmitter in a similar way to that shown below.

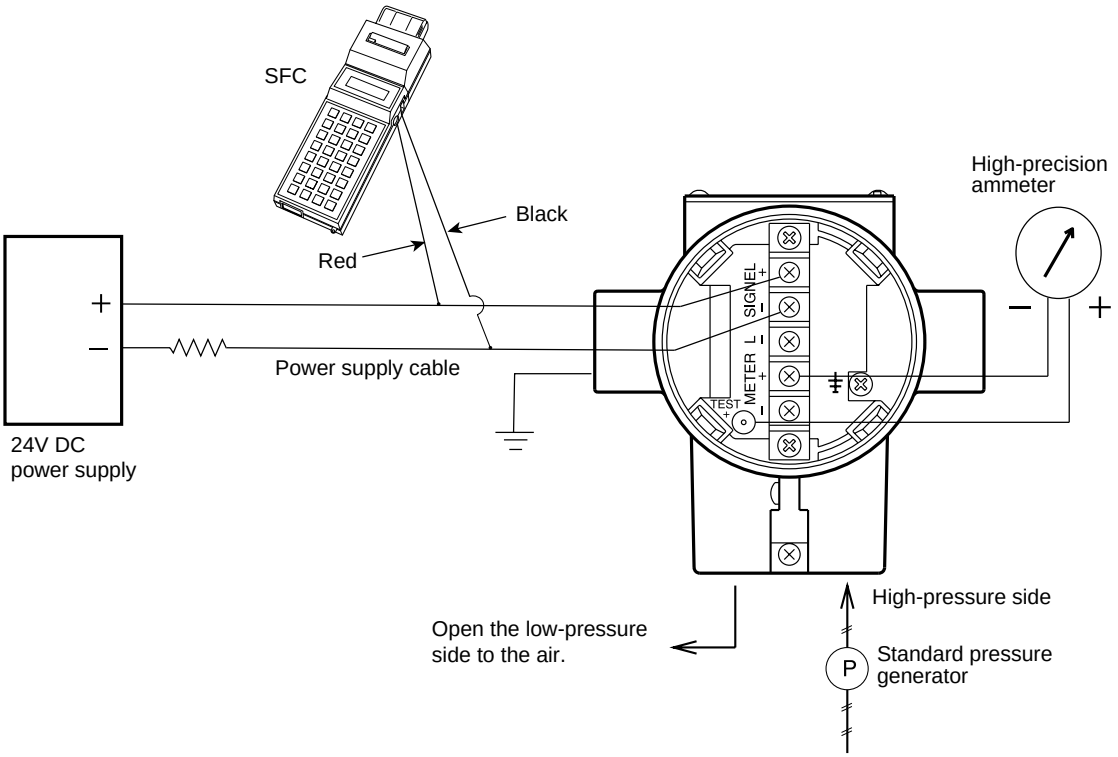


Figure 7-3 Connection for calibration

Set range

Before starting calibration work, use the SFC to check that the set range of the transmitter agrees with the specifications. If they do not correspond, use the SFC to set the correct range. Procedures are found in "6-7-8 : Display or Change Low/High Limits and Span of Set Range".

The set range is calibrated assuming that the low limit 20 kPa and the high limit is 100 kPa.

7-4-1-2 Calibrating Low Limit

How to calibrate the low limit value:

It is assumed that the SFC and the transmitter have just started normal communications.

Example: Low limit value of set range: 20 kPa

Step	Description	SFC screen
1	Apply pressure so that the manometer of the standard pressure generator indicates 20 kPa.	DSTJ TAG NO. LIN DP FIT-1234
2	Press the LRV 0% E key. • The low-limit value currently stored in the transmitter is displayed. It is assumed that the value is 20 kPa.	LRV FIT-1234 20.00 kPa
3	Press the RESET COR-RECT K key.	LRV FIT-1234 CORRECT LRV?
4	Press the NON-VOL ENTER (Yes) key. Press the NON-VOL ENTER (Yes) key. • The low-limit value has been calibrated to the current input pressure to the transmitter. • The low-limit value currently stored in the transmitter can be confirmed.	LRV FIT-1234 ARE YOU SURE? LRV FIT-1234 WORKING... ↓ LRV FIT-1234 LRV CORRECTED LRV FIT-1234 20.00 kPa

Step	Description	SFC screen
5	Press the SHIFT ^ and NON-VOL ENTER (Yes) keys, in that order. • The calibrated low-limit value is saved in the transmitter.	SHIFT- DSTJ FIT-1234 WORKING... ↓ DSTJ FIT-1234 DATA NONVOLATILE

7-4-1-3 Calibrating High Limit

How to calibrate the high limit value:

Example: High limit value of set range: 100 kPa

Step	Description	SFC screen
1	Apply pressure so that the manometer of the standard pressure generator indicates 100 kPa.	
2	Press the URV F 100% key. • The high-limit value currently stored in the transmitter is displayed. It is assumed that the value is 100 kPa.	DSTJ TAG NO. LIN DP FIT-1234 URV FIT-1234 100.00 kPa
3	Press the RESET COR- K RECT key.	URV FIT-1234 CORRECT URV?
4	Press the NON-VOL ENTER (Yes) key. Press the NON-VOL ENTER (Yes) key. • The high-limit value has been calibrated to the current input pressure to the transmitter. • The high-limit value currently stored in the transmitter can be confirmed.	URV FIT-1234 ARE YOU SURE? URV FIT-1234 WORKING... URV FIT-1234 URV CORRECTED URV FIT-1234 100.00 kPa

Step	Description	SFC screen
5	Press the SHIFT ^ and NON-VOL ENTER (Yes) keys, in that order. • The calibrated high-limit value is saved in the transmitter.	SHIFT- DSTJ FIT-1234 WORKING... ↓ DSTJ FIT-1234 DATA NONVOLATILE

7-4-2 :Calibrating Output Signals

7-4-2-1 Before You Start

Output signal calibration (adjustment of the D/A conversion unit) is unnecessary under ordinary operating conditions. Normally, this work is performed by an authorized service provider of Yamatake. For end-users who must perform this work, prepare the following equipment in advance:

Equipment

- High-precision ammeter with accuracy of 0.03% FS or higher
- Resistor with a resistance of 250Ω ±0.005%
- SFC

Set-up

Refer to Figure 7-4. Connect the SFC and an ammeter.

Refer to 3.2.1 Starting Communications. Check to ensure proper wiring. Check that the SFC and the transmitter are in the normal communication status.

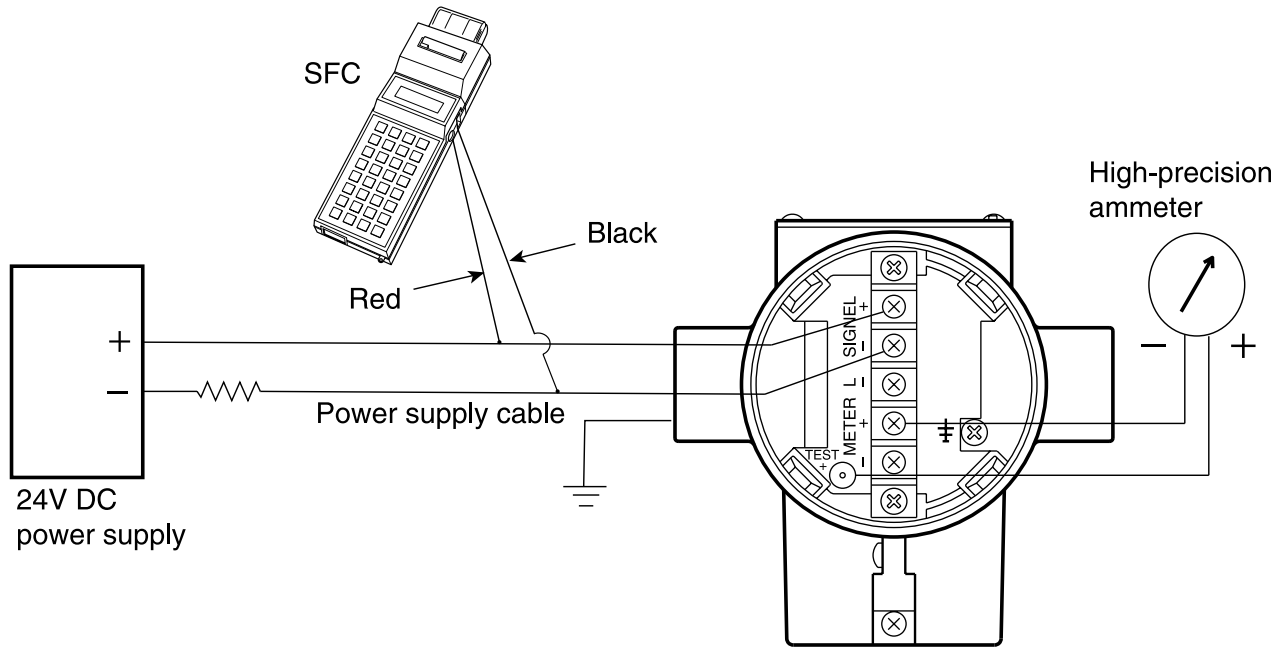


Figure 7-4 Connection for Calibration.

7-4-2-2 Calibrating Output Signal 0%

Set the output to 0% and calibrate the transmitter so that the ammeter indicates 4 mA:

Step	Description	SFC screen
1	Press the INPUT / OUT-PUT J key.	OUTPUT FIT-1234 WORKING... ↓ OUTPUT FIT-1234 0.00 % (The current output is displayed.)
2	Press the ACT PR / 0 Z key.	OUTPUT FIT-1234 0 %
3	Press the NON-VOL / ENTER (Yes) key. • The transmitter has been set to the 4 mA (0%) constant current mode. • # is displayed on the screen during the constant current mode.	OUTPUT FIT-1234 WORKING... ↓ OUTPUT FIT-1234 0.00 % #
4	Ensure that the ammeter indicates 4 mA.	OUTPUT FIT-1234 0.00 % #
5	Press the INPUT / OUT-PUT J key.	OUTPUT FIT-1234 WORKING... ↓ OUTPUT FIT-1234 0.00 % #

Step	Description	SFC screen
6	Press the RESET / CORRECT K key. • If the indicated value is lower than 4 mA, go to step 7. If it is higher than 4 mA, go to step 8.	DSTJ FIT-1234 CORRECT DAC ZERO
7	Press the ▲ H / NEXT key. Check the ammeter indication after each key-press.	OUTPUT FIT-1234 WORKING... OUTPUT FIT-1234 INCREASED 4mA# DSTJ FIT-1234 CORRECT DAC ZERO#
8	Press the ▼ L / PREV key. • Check the ammeter indication after each key-press.	OUTPUT FIT-1234 WORKING... ↓ OUTPUT FIT-1234 DECREASED 4mA DSTJ FIT-1234 CORRECT DAC ZERO
9	Press the CLR / (No) key after completing calibration work.	DSTJ FIT-1234 READY...
10	• Refer to instruction in Item 4. Save the calibrated value and release the constant current source mode.	

7-4-2-3 Calibrating Output Signal 100%

Set the output to 100% and calibrate the transmitter so that the ammeter indicates 20 mA:

Step	Description	SFC screen
1	Press the INPUT / OUTPUT key.	OUTPUT FIT-1234 WORKING... ↓ OUTPUT FIT-1234 0.00 %
2	Press the, ACT PR / 0 Z , ACT PR / 0 Z and keys (numeric key), in that order.	OUTPUT FIT-1234 100
3	Press the NON-VOL / ENTER (Yes) key. • The transmitter has been set to the 20mA constant current mode.	OUTPUT FIT-1234 WORKING... ↓ OUTPUT FIT-1234 100.00 % #
4	Ensure that the ammeter indicates 20 mA.	OUTPUT FIT-1234 100.00 % #
5	Press the INPUT / OUTPUT key. The current output is 100%	OUTPUT FIT-1234 WORKING... ↓ OUTPUT FIT-1234 100.00 % #

Step	Description	SFC screen
6	Press the RESET / COR- K / RECT key. • If the indicated value is lower than 20 mA, go to step 7. If it is higher than 20 mA, go to step 8.	DSTJ FIT-1234 CORRECT DAC ZERO
7	Press the ▲ H / NEXT key. • Check the ammeter indication after each key-press.	OUTPUT FIT-1234 WORKING... ↓ OUTPUT FIT-1234 INCREASED 20mA OUTPUT FIT-1234 CORRECT DAC SPAN
8	Press the ▼ L / PREV key. • Check the ammeter indication after each key-press.	OUTPUT FIT-1234 WORKING... ↓ OUTPUT FIT-1234 DECREASED 20mA# OUTPUT FIT-1234 CORRECT DAC SPAN
9	Press the CLR / (No) key after completing calibration work.	DSTJ FIT-1234 READY... #
10	• Refer to instruction in Item 4. Save the calibrated value and release the constant current source mode.	

7-4-2-4 Saving Calibrated Values and Releasing Constant Current Source Mode

Save the calibrated value to non-volatile memory of this transmitter and release the constant current mode:

Step	Description	SFC screen
1	Press the SHIFT key.	SHIFT- # ↓ DSTJ TAG NO. WORKING...
2	Press the NON-VOL ENTER (Yes) keys. • Forceful data saving is completed.	DSTJ FIT-1234 DATA NONVOLATILE ↓ DSTJ FIT-1234 READY...
3	Press the INPUT OUTPUT key. • The current output is 100%	OUTPUT FIT-1234 WORKING... ↓ OUTPUT FIT-1234 100.00 % #
4	Press the CLR (No) key. • # disappears, indicating that the constant current mode has been released.	OUTPUT FIT-1234 WORKING... ↓ DSTJ FIT-1234 READY...

7-5 : Erasing Calibrated Data

7-5-1 :Erasing Calibrated Data

Reset the calibrated data to the initial values (factory set data):

Step	Description	SFC screen
1	Press the SHIFT and RESET CORRECT keys, in that order.	SHIFT- DSTJ FIT-1234 RESET CORRECTS?
2	Press the NON-VOL ENTER (Yes) keys. • The calibrated data is initialized.	DSTJ FIT-1234 CORRECTS RESET ↓ DSTJ FIT-1234 READY...

7-5-2 :Erasing # Mark

Reset the calibrated data to the initial values (factory set data):

Step	Description	SFC screen
1	Set the actual pressure applied to the transmitter to 0kPa.	DSTJ FIT-1234 READY...
2	Press the LRV 0% E key.	LRV FIT-1234 0.0000 kPa #
3	Press the SET G key.	LRV FIT-1234 SET LRV?
4	Press the NON-VOL ENTER (Yes) keys. • The initial value for the low limit is displayed.	LRV FIT-1234 WORKING... ↓ LRV FIT-1234 0.0123 kPa #

How to calibrate the low limit value, based on actual pressure

Step	Description	SFC screen
5	Press the ACT PR 0 Z key.	LRV FIT-1234 0 kPa #
6	Press the NON-VOL ENTER (Yes) key.	LRV FIT-1234 0.0000 kPa #
7	Press the RESET COR-RECT K key. Ensure that no pressure is applied to H.L.	LRV FIT-1234 CORRECT LRV?

Step	Description	SFC screen
8	Press the NON-VOL ENTER (Yes) keys.	LRV FIT-1234 ARE YOU SURE?
9	Press the NON-VOL ENTER (Yes) keys. • The low limit value is calibrated.	LRV FIT-1234 WORKING... ↓ LRV FIT-1234 LRV CORRECTED #
10	Press the SHIFT ^ and NON-VOL ENTER (Yes) keys, in that order • Data is forcefully saved.	SHIFT- # DSTJ FIT-1234 WORKING... ↓ DSTJ FIT-1234 DATA NONVOLATILE#
11	Turn OFF the transmitter. Waiting for at least 2 seconds. Turn on transmitter again.	
12	Press the DE READ ID A keys.	TAG No. WORKING... ↓ DSTJ TAG NO. LIN DP FIT-1234
13	Press the F/S DIR STAT U keys. The # mark disappears.	DSTJ FIT-1234 WORKING... ↓ DSTJ FIT-1234 STATUS CHECK=OK

7-6 : Troubleshooting

7-6-1 :Checking Operation and Actions

The operation of the transmitter can be checked using the SFC. In the event of an abnormality, take appropriate action according to the self-diagnostic message displayed on the SFC.

Abnormalities can be classified as follows:

- Any abnormality in the transmitter, the process, the SFC, or the communication system.
- An abnormality of the transmitter.
- An abnormality of the transmitter or the process.
- An abnormality of the SFC or the communication system.

Check operations

Before checking the operation of the transmitter, connect a SFC to the transmitter. Check for communicating state. Employ these procedures.

Step	Description	SFC screen
1	Press the F/S DIR U STAT key. If a message other than Self-Diagnosis Result OK is displayed, take required action. Refer to instructions in the subsequent pages. • If an error message is displayed, refer to the messages in the subsequent pages.	DSTJ FIT-1234 WORKING... DSTJ FIT-1234 STATUS CHECK=OK (Other message) ↓ DSTJ FIT-1234 READY...

7-6-2 :Error during Communications

Respond to error messages that are displayed during communications.

Message	Required action
DSTJ FIT-1234 CRITICAL STATUS ↓ (3 seconds later) PRESS STATUS!	Press the F/S DIR STAT U key. Take action according to the message. The DE READ ID A, INPUT OUT- PUT J and F/S DIR STAT U keys are effective, even in this state. After taking the necessary action, press the [n] key to check that Self-Diagnosis Result OK is displayed.
:	Low battery. Charge the SFC by following the instructions in 4-1-7.
***** #	Press the F/S DIR STAT U key and take necessary action according to the message. # disappears when the problem is solved. When # disappears, press the F/S DIR STAT U key to make sure that Self-Diagnosis Result OK is displayed.

7-6-3 :Self-Diagnostic Messages

The following messages are displayed by pressing the [n] key at the time of a failure. The meanings of the messages and the necessary action are summarized, here.

Message	Meaning	Required action
NO XMTR RESPONS	Transmitter makes no response.	• Repeat the procedure for starting communications. • Press the  and see what message is displayed. • Check the loop, the SFC connection loop, load resistance, and the supply voltage.

An abnormality of the transmitter is suspect.

Message	Meaning	Required action
DACCOMPFAULT	MDU/DAC fault	Contact the appropriate personnel.
NVM FAULT	Memory fault	Contact the appropriate personnel.
PAC FAULT	PAC fault	Contact the appropriate personnel.
PROM FAULT	PROM function fault	Contact the appropriate personnel.
RAM FAULT	RAM fault	Contact the appropriate personnel.

Message	Meaning	Required action
ROM FAULT	ROM fault	Contact the appropriate personnel.
NO DAC TEMP COM	The temperature correction data on the electronics module was lost	Contact the appropriate personnel.
STATUS UNKNOWN	Unknown error state	Contact the appropriate personnel.

An abnormality of the transmitter or the process is suspect

Message	Meaning	Required action
SENSOR OVER TEMP #	The temperature in the center body is too high.	Install the transmitter in such a way that the temperature does not become too high.
SUSPECT INPUT	• Input data error • Problem in the process • Transmitter fault • Differential pressure transmitter fault	• Check the process. Set the transmitter to the constant current source mode and press the n key. If no message is displayed, report the problem to the contact point indicated on the rear.

Message	Meaning	Required action
M.B.OVERLOAD OR METER BODY FAULT	• The input differential pressure exceeds 2 times the high limit of the valid range. • Differential pressure transmitter fault	• Check the PV value and replace the transmitter with a model of a larger range if necessary. • Contact the appropriate personnel because the pressure receiving part of the transmitter may be damaged.

An abnormality of the SFC or the communication system is suspect.

Message	Meaning	Required action
SFC FAULT	SFC fault	• Repeat the procedure for starting communications. • If the same message is displayed again, contact the appropriate personnel.

Message	Meaning	Required action
FAILED COMM CHK	Communication failure	• Check that the SFC is connected correctly. • Press the n key. If COMM ERROR is displayed, replace the SFC. If any other message is displayed, take the corresponding action, shown in this list.
ILLEAGAL RESPONSE	Communication problem	Check the connection between the SFC and the transmitter, the cabling, and the power supply.
PRINTER FAIL! #	Printer failure	Contact the appropriate personnel.
LOW LOOP RES	Too-small loop resistance	Adjust the resistance value.
HI RES/LOW VOLT	• Too-large loop resistance • Check the loop resistance and adjust it	• Too-small impressed voltage • Increase the voltage.Z

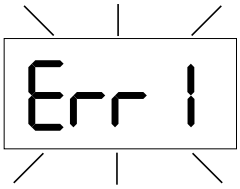
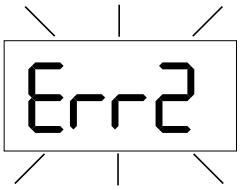
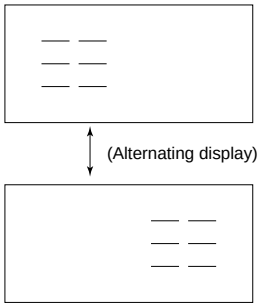
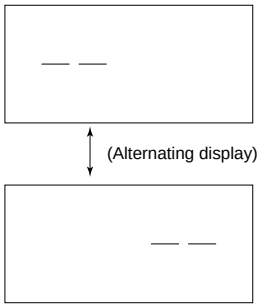
An operation error is suspect.

Message	Meaning	Required action
KEY NOT ALLOWD!	• Wrong key input • Wrong key input pro-cedure	Press the g key to check the display and start the key input again.
CORRECT RESET #	Calibration required	Calibrate the low and high limit values of the set range.
NOT SUPPORT	Key unsupported	Press correct key
EXCESS SPAN CORR #	Excessive span calibration	Check that the input pressure agrees with the calibrated value and calibrate the high limit of the set range.
EXCESSIVE OUTPUT	Requested output value > Output range (-1.25%~105%) in constant current source mode	Press the g key and input data again.
EXCESS ZERO CORR #	Excessive zero calibration	Check that the input pressure agrees with the calibrated value and calibrate the low limit of the set range.
INVALID DATABASE	The transmitter database is not correct when the SFC is turned ON.	• Start the communications again. • Check the database, calibrate the transmitter again, and in put correct data.

Message	Meaning	Required action
CORRECT LRV?	Appropriate input value for the setting?	Check the input value. If it is wrong, correct it.
ENTRY > SEN RANGE	Set range > High limit of set range x 1.5	Press the key to check the numeric value, and repeat the setting procedure.
INVALID REQUEST	Invalid request	Check SFC operation procedure.

7-6-4 :Self-Diagnostic by Indicator (option)

When the indicator or the transmitter has an abnormality (when the indicator is set), the details will be displayed in the digital display unit of the indicator.

Message	Meaning	Required action
 (Blink)	Digital indicator RAM failure	Contact the appropriate personnel.
 (Blink)	DIgital indicator RAM failure	Contact the appropriate personnel.
	Serious failure of transmitter	Contact the appropriate personnel.
	External zero point adjustment failure	Contact the appropriate personnel.
	Transmitter or indicator failure	Contact the appropriate personnel.

7-7 : Insulation Resistance Test and Withstand Voltage Test

⚠ CAUTION

In principle, do not perform an insulation resistance test or a withstand voltage test. In some cases, the built-in varistor with a function for absorbing surge voltage surges may be destroyed during these tests.
If a test must be performed for an unavoidable reason, carefully follow the following procedures.

Test procedure

- Disconnect the external cables from the transmitter.
- Short-circuit the + and - SUPPLY terminals and the + and - METER terminals.
- Perform a test between the short-circuited parts and the ground terminal.
- The required impressed voltage and the judgement criteria are shown below. Don't apply higher voltage to protect the instruments from destruction.

Judgement criteria

Test	Judgement criteria
Insulation resistance test	$2 \times 10^7\ \Omega$ or higher at test voltage of 25V DC (Not higher than 25°C and 60%RH)
Withstand voltage test	50V AC, 1 minute, set current 2mA

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