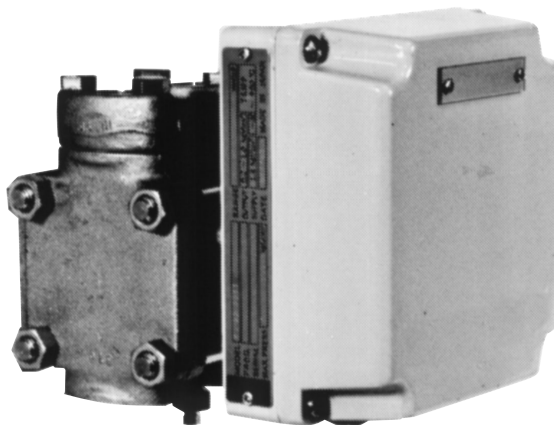


YAMATAKE

PREX3000 Pneumatic Differential Pressure Transmitter

Model: KDP

User's Manual



Yamatake Corporation

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Chapter 1 : Scope

This manual covers the operation instructions for the PREX3000 Differential Transmitter. Be sure to read this manual before using the instrument.

This manual has been written for instruments with the standard specifications. Note that some items may differ for those instruments with modified specifications.

Chapter 2 : General Precautions

2-1 : Inspection upon delivery

Upon receiving the instrument, immediately check it for any damage which it might have sustained while being shipped. If any signs of damage to the instrument are found or if there are any missing accessories, immediately notify the transport company and your Yamatake agent.

2-2 : Checking the specifications

The main specifications are given on the nameplate fixed on the casing of the instrument. Check that the specifications conform with those in the model number table. (When making any enquires regarding the instrument, please state the model number and serial number.)

2-3 : Transporting the instrument

To prevent damage to the instrument when it is being moved to the place of installation, it is best if it is packed as it was shipped from the factory.

2-4 : Storing the instrument

- (1) Store the instrument in a place where the instrument is not exposed to rain or other adverse weather or to mechanical vibration or shocks. Although the “specification” storing temperature range of the instrument is -40°C to $+85^{\circ}\text{C}$ (that of the instrument with indicator is 0°C to $+55^{\circ}\text{C}$), it is most recommendable to store the instrument at normal temperature and normal humidity (approximately 25°C and 65% RH).
- (2) It is most recommendable to store the instrument in the packing in the state in which the instrument is delivered to you.
- (3) When storing the instrument which has been used, be sure to drain out liquid from both high and low pressure sides of the meter body and thoroughly clear the instrument.
- (4) When the measured fluid is toxic, handle the instrument carefully even after the pressures are released from the instrument.

2-5 : Place of installation

To maintain the instrument's performance and reliability for a long period, pay attention to the following points when selecting a place of installation for the instrument.

2-5-1: Ambient temperature

- (a) Select a place where temperature change is minimal.
- (b) When it is unavoidable to install the instrument in a place where it is subjected to radiation from a source of heat (such as the process plant itself), provide a heat insulator and select a well ventilated location so that the ambient temperature of the instrument is made as low as possible.
- (c) If there is a possibility of the measured fluid freezing, provide a heat insulator or take appropriate measures to prevent freezing.

2-5-2: Atmosphere

Avoid, as much as possible, installing the instrument in a corrosive atmosphere.

2-5-3: Vibration and shock

Select a place where the instrument is not subjected to mechanical vibration or shock.

2-6 : Pressure application

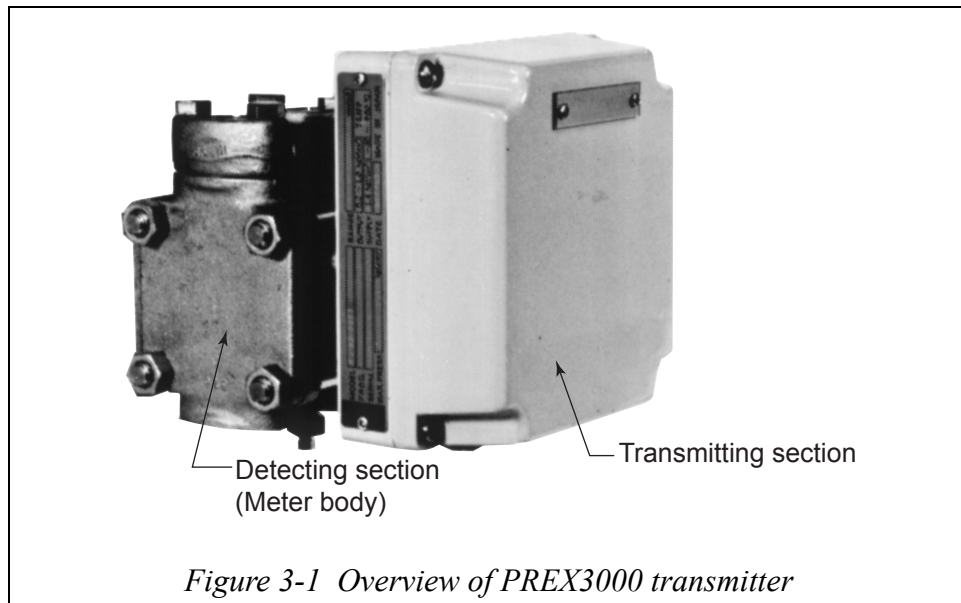
Regarding application of pressures to the instrument, pay attention to the following items:

- (1) The instrument is delivered with the clamping-bolts of the adaptor flanges untightened. Be sure to tighten them before using the instrument.
- (2) Never apply pressures higher than the rated pressures. (See "3-2 : Specifications" on page 3-2.)
- (3) Be sure to completely release the pressures from the instrument before tightening or loosening its clamping-bolts.

Chapter 3 : General

3-1 : General

The PREX3000 is a pneumatic transmitter which converts a process differential-pressure or a pressure into pneumatic signals (20 to 100 kPa {0.2 to 1.0 kgf/cm²}). The transmitter consists of a transmitting section and a detecting section (meter body).



3-2 : Specifications

3-2-1:Standard specifications

Measuring range (continuously adjustable)

Table 3-1: Measuring range

Range	Regular type		Flange type	Remote seal type	Measuring range
	---	High static pressure type			
High ΔP	KDP11	KDP81	KDP61	KDP71	0-25 to 0-500 kPa {0-2500 to 0-50000 mmH ₂ O}
Medium ΔP	KDP22	KDP82	KDP62	KDP72	0-2.5 to 0-53.9 kPa {0-250 to 0-5500 mmH ₂ O}
Low ΔP	KDP33	---	---	---	0-0.5 to 0-6 kPa {0-50 to 0-600 mmH ₂ O}
Very low ΔP	KDP44	---	---	---	0-0.1 to 0-1.2 kPa {0-10 to 0-120 mmH ₂ O}

Process connection

KDP11/22/33/44, KDP61/62 (Flange); Rc1/2 (PT1/2 internal thread)

KDP81/82; Rc1/4 (PT1/4 internal thread)

KDP71/72 Flange

Extended diaphragm type: JIS10K, 20K-100A (RF) equivalent

ANSI150, 300-4B (RF) equivalent

Flash diaphragm type: JIS 10K, 30K-80A (RF) equivalent

ANSI150, 300-3B (RF) equivalent

Air supply connection

Rc1/4 (PT1/4) or 1/4NPT internal thread

Air supply pressure

140±14 kPa {1.4±0.14 kgf/cm²}

Output

20-100 kPa {0.2-1.0 kgf/cm²}

External load

ID 4 mm × Length 3 m + 20 cc or over

Air supply capacity

20 ℓ/minute(N) or over, with 6.7 kPa {50 mmHg} change

Air consumption

5 ℓ/minute(N) or less (when balanced at output 100%)

Accuracy

KDP11; ±0.5% F.S. (For span 50 to 500 kPa {5000 to 50000 mmH₂O})

±0.75% F.S. (For span 25 to less than 50 kPa {2500 to less than 5000 mmH₂O})

KDP22; ±0.5% F.S. (For span 5 to 53.9 kPa {500 to 5500 mmH₂O})

±0.75% F.S. (For span 2.5 to less than 5 kPa {250 to less than 500 mmH₂O})

KDP33; ±0.5% F.S. (For span 1.0 to 6 kPa {100 to 600 mmH₂O})

±1.0% F.S. (For span 0.5 to less than 1 kPa {50 to less than 100 mmH₂O})

KDP44; ±0.5% F.S. (For span 0.2 to 1.2 kPa {20 to 120 mmH₂O})

±1.0% F.S. (For span 0.1 to less than 0.2 kPa {10 to less than 20 mmH₂O})

KDP61/71/81; ±0.5% F.S. (For span 50 to 500 kPa {5000 to 50000 mmH₂O})

±1.0% F.S. (For span 25 to less than 50 kPa {2500 to less than 5000 mmH₂O})

KDP62/72/82; ±0.5% F.S. (For span 5 to 53.9 kPa {500 to 5500 mmH₂O})

±1.0% F.S. (For span 2.5 to less than 5 kPa {250 to less than 500 mmH₂O})

Dead band

0.1% F.S.

Damping (KDP44)

Time constant: Minimum 2 sec. or less, Maximum 25 sec. or over, continuously variable.

Operating pressure range**Table 3-2: Operating pressure range**

Model	Cover mate		
	Carbon steel, SUS	Monel	PVC
KDP11/22	-50 kPa to 10 MPa {-0.5 to 100 kgf/cm ² }	-50 kPa to 10 MPa {-0.5 to 100 kgf/cm ² }	-10 kPa to 1.5 MPa {-0.1 to 15 kgf/cm ² }
KDP33	-50 kPa to 3.5 MPa {-0.5 to 35 kgf/cm ² }	-50 kPa to 3.5 MPa {-0.5 to 35 kgf/cm ² }	-10 kPa to 1 MPa {-0.1 to 10 kgf/cm ² }
KDP44	-1.5 kPa to 0.05 kPa {-150 to 5 mmH ₂ O}	---	---
	-50 kPa to maximum flange rated pressure JIS10K: up to 1.4 MPa {14 kgf/cm ² }		-10 kPa to 1.5 MPa {-0.1 to 15 kgf/cm ² }
KDP71/72	JIS30K: up to 5.1 MPa {51 kgf/cm ² } ANSI150: up to 1.4 MPa {14 kgf/cm ² } ANSI300: up to 3.7 MPa {37 kgf/cm ² }		---
KDP81/82	-50 kPa to 42 MPa {-0.5 to 420 kgf/cm ² }	---	---

~Note Refer to the annexed table regarding max. working pressure on flange and remote seal type.

Operating temperature

Meter body (process fluid): -40 to +120°C

Transmitter (ambient): -30 to +80°C

PVC cover: 0 to 55°C

Operating humidity

10 - 90% RH

Construction

Dustproof and waterproof, meets

IEC IP54, NEMA TYPE 3R,

JIS F 8001 Class 3 splashproof, and

JIS C 920 rainproof specifications

Materials

Meter body cover -Carbon steel (SF45A), SUS316... (KDP11/22/33/44/61/62/81/82)

Monel, PVC... (KDP11/22/33/61/62)

Flange - Carbon steel (IF45A), SUS304... (KDP61/62/71/72)

Measuring element: SUS316 (diaphragm: SUS316L), SUS316L, Monel, Tantalum

Wet part gasket: Teflon

Centerbody: SUS304 (KDP44 is Al)

Transmitter case: Aluminum alloy

Capillary tube length

2, 3, 5 m (remote seal type) SUS316

Mounting

KDP11/12.....On vertical or horizontal 2-inch pipe

KDP33/44Horizontal 2-inch pipe

KDP61/62Directly flange mounted to process flange

KDP71/72Directly flange mounted to process flange

(Transmitter body is mounted on vertical or horizontal 2-inch pipe)

Net weight

KDP11/22.....Approx. 8kg

KDP33Approx. 14.6 kg

KDP44Approx. 17.5kg

KDP61/62Approx. 13 kg (80A - JIS 10K Flange)

KDP71/72Approx 17.5 kg (80A - JIS 10K Flange)

KDP81/82Approx. 15.0 kg

Finish

Acryl baking finish

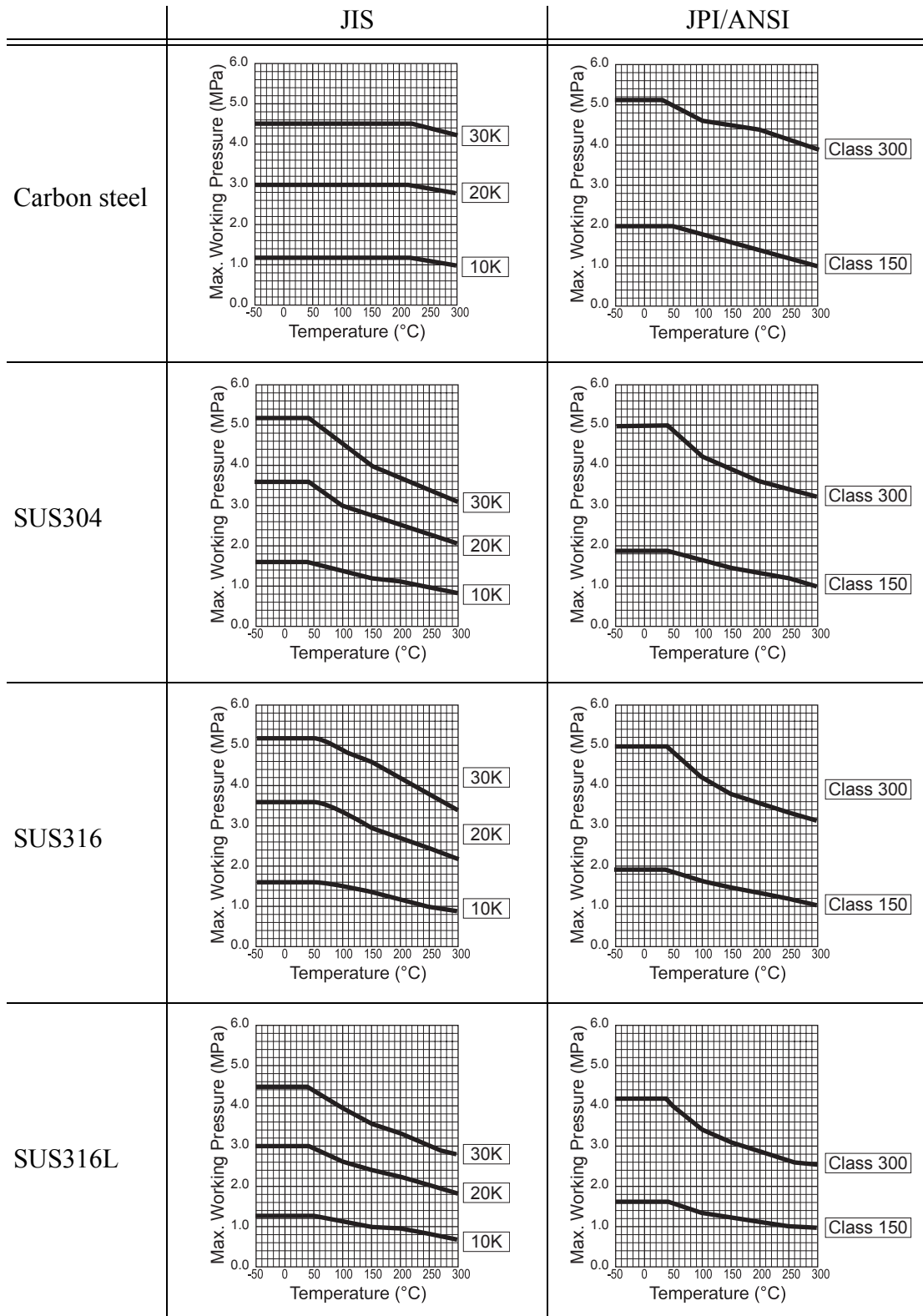
Color: Light beige (munsell 4Y 7.2/1.3)

3-2-2:Max. working pressure

~Note 1. Max. working pressure depends on flange rating, flange materials and operating temperature. Please refer to the following data. Operating range of temperature depends on specification of transmitters.

~Note 2. In the case of the remote sealed type (KKP75, KFKB□□-75), max working pressure depends on the smaller value of either 1.05 MPa or following data.

Table 3-3: Max working pressure



3-2-3:Optional specifications

Suppression and elevation

Table 3-4: Suppression and elevation

Model	Span kPa {mmH ₂ O}	Suppression (max.) kPa {mmH ₂ O}	Elevation (max.) kPa {mmH ₂ O}
KDP11	25 to 500 {2,500 to 50,000}	50 {50,000}	475 {47,500}
KDP22	2.5 to 53.9 {250 to 5,500}	53.9 {5,500}	51.4 {5,250}
KDP33	0.5 to 6 {50 to 600}	6 {600}	5.5 {550}
KDP44	0.1 to 1.2 {10 to 120}	1.2 {120}	1.1 {110}
KDP61	25 to 500 {2,500 to 50,000}	500 {50,000}	475 {47,500}
KDP62	2.5 to 53.9 {250 to 5,500}	53.9 {5,500}	51.4 {5,250}
KDP71	25 to 500 {2,500 to 50,000}	500 {50,000}	475 {47,500}
KDP72	2.5 to 53.9 {2,50 to 5,500}	53.9 {5,500}	51.4 {5,250}
KDP81	25 to 500 {2,500 to 50,000}	500 {50,000}	475 {47,500}
KDP82	2.5 to 53.9 {250 to 5,500}	53.9 {5,500}	51.4 {5,250}

~Note $elevation + span \leq maximum\ span$

Air-set (filter and pressure regulator) (All models)

Primary pressure: 200-990 kPa {2-9.9kgf/cm²}

Secondary pressure: 140 kPa {1.4 kgf/cm²}

Filter mesh diameter: 5 microns

Connections: Rc1/4 (PT1/4) or 1/4NPT internal thread

Integral orifice (KDP11/22/33)

Flow measuring ranges

Liquid: 1.3-2,000 ℓN/hr water equivalent (15°C, 1atm.)

Gas: 0.04-50 Nm³/hr air equivalent (0°C, 1atm.)

High-accuracy type (KDP11/22)

KDP11: ±0.25% F.S. (For span 50 to 500 kPa {5,000 to 50,000 mmH₂O})

±0.5% F.S. (For span 25 to 50 kPa {2,500 to 5,000 mmH₂O})

KDP22: ±0.25% F.S. (For span 5 to 53.9 kPa {500 to 5,500 mmH₂O})

±0.5% F.S. (For span 2.5 to 5 kPa {250 to 500 mmH₂O})

3-3 : Model number table

3-3-1:KDP11/22

Basic model no.	Cover material		Measuring element material		Airpiping connection	Pressure unit/ Output	Options	Description
	HP	LP	HP	LP				
KDP11								0-25 to 0-500 kPa {0-2,500 to 0-50,000 mmH ₂ O}
KDP22								0-2.5 to 0-53.9 kPa {0-250 to 0-5,500 mmH ₂ O}
	-1							Carbon steel (SF45A)
	-2							SUS316
	-3							Monel
	-5							PVC
		1						Carbon steel (SF45A)
		2						SUS316
		3						Monel
		5						PVC
			2					SUS316 (diaphragm: SUS316L)
			3					Monel
			4					Tantalum
			8					SUS316L
				2				SUS316 (diaphragm: SUS316)
				3				Monel
				4				Tantalum
				8				SUS316L
					A			Rc1/4 (PT1/4) internal thread
					B			1/4NPT internal thread
						1		kgf/cm ² (or mmH ₂ O) / 0.2 to 1.0 kgf/cm ²
						2		PSI / 3 to 15 PSI
						3		bar / 0.2 to 1.0 bar
						4		Pa / 20 to 100 kPa
						8		Pa / 19.6 to 98.1 kPa {equivalent to 0.2 to 1.0 kgf/cm ² }
						-X		No option
						-5		Elevation
						-6		Suppression
						-7		Air-set
						-H		High-accuracy type

KDP33

Basic model no.	Cover material		Measuring element material		Air piping connection	Pressure unit/ Output	Options	Description
	HP	LP	HP	LP				
KDP33								0-0.5 to 0-6 kPa {0-50 to 0-600 mmH ₂ O}
	-1							Carbon steel (SF45A)
	-2							SUS316
	-3							Monel
	-5							PVC
		1						Carbon steel (SF45A)
		2						SUS316
		3						Monel
		5						PVC
			2					SUS316 (diaphragm: SUS316L)
			3					Monel
			4					Tantalum
			8					SUS316L
				2				SUS316 (diaphragm: SUS316L)
				3				Monel
				4				Tantalum
				8				SUS316L
					A			PT1/4 internal thread
					B			1/4NPT internal thread
						1		kgf/cm ² (or mmH ₂ O) / 0.2 to 1.0 kgf/cm ²)
						2		PSI / 3 to 15 PSI
						3		bar / 0.2 to 1.0 bar
						4		Pa / 20 to 100 kPa
						8		Pa / 19.6 to 98.1 kPa {equivalent to 0.2 to 1.0 kgf/cm ² }
						-X	No option	
						-5	Elevation	
						-6	Suppression	
						-7	Air-set	

KDP44

Basic model no.	Cover material		Measuring element material		Airpiping connection	Pressure unit/ Output	Options	Description
	HP	LP	HP	LP				
KDP44								0-0.1 to 0-1.2 kPa {0-10 to 0-120 mmH ₂ O}
	-1							Carbon steel (SF45A)
	-2							SUS316
		1						Carbon steel (SF45A)
		2						SUS316
			2					SUS316 (diaphragm: SUS316L)
				2				SUS316 (diaphragm: SUS316L)
					A			PT1/4 internal thread
					B			1/4NPT internal thread
						1		kgf/cm ² (or mmH ₂ O) / 0.2 to 1.0 kgf/cm ²
						2		PSI / 3 to 15 PSI
						3		bar / 0.2 to 1.0 bar
						4		Pa / 20 to 100 kPa
						8		Pa / 19.6 to 98.1 kPa {equivalent to 0.2 to 1.0 kgf/cm ² }
						-X	No option	
						-5	Elevation	
						-6	Suppression	
						-7	Air-set	

KDP61/62

Basic model no.	Flange & cover material		Measuring element material		Flange rating	Length of extended part of flange	Air piping connection	Pressure unit/ Output	Options	Description
	Measuring side	Reference side	Measuring side	Reference side						
KDP61										0-25 to 0-500 kPa {0-2,500 to 0-50,000 mmH ₂ O}
KDP62										0-2.5 to 0-53.9 kPa {0-250 to 0-5,500 mmH ₂ O}
	-1									Carbon steel (SF45A)
	-7									SUS304
		1								Carbon steel (SF45A)
		2								SUS316
		3								Monel
		5								PVC
			2							SUS316 (diaphragm: SUS316L)
			3							Monel (excluding extended diaphragm type)
			4							Tantalum (excluding extended diaphragm type)
			8							SUS316L
				2						SUS316 (diaphragm: SUS316L)
				3						Monel
				4						Tantalum
				8						SUS316L
					1					Flush diaphragm type 80 mm - JIS 10K (RF) equiv. flange
					2					Flush diaphragm type 80 mm - JIS 30K (RF) equiv. flange
					3					Flush diaphragm type 3 in. - ANSI150 (RF) equiv. flange
					4					Flush diaphragm type 3 in. - ANSI300 (RF) equiv. flange
					5					Extended diaphragm type 100 mm -JIS 10K (RF) equiv. flange
					6					Extended diaphragm type 100 mm -JIS 30K (RF) equiv. flange
					7					Extended diaphragm type 4 in. - ANSI150 (RF) equiv. flange
					8					Extended diaphragm type 4 in. - ANSI300 (RF) equiv. flange
						00				Flush diaphragm type
						10				Extended diaphragm type: 100mm
						15				Extended diaphragm type: 150mm
							A			PT1/4 internal thread
							B			1/4NPT internal thread
								1		kgf/cm ² (or mmH ₂ O) / 0.2 to 1.0 kgf/cm ²
								2		PSI / 3 to 15 PSI
								3		bar / 0.2 to 1.0 bar
								4		Pa / 20 to 100 kPa
								8		Pa / 19.6 to 98.1 kPa {equivalent to 0.2 to 1.0 kgf/cm ² }
									-X	No option
									-5	Elevation
									-6	Suppression
									-7	Air-set

KDP71/72

Basic model no.	Flange material		Measuring element material		Flange rating	Capillary tube length	Length of extended part of flange	Air piping connection	Pressure unit/ Output	Options	Description
	HP	LP	HP	LP							
KDP71											0-25 to 0-500 kPa {0-2,500 to 0-50,000 mmH ₂ O}
KDP72											0-2.5 to 0-53.9 kPa {0-250 to 0-5,500 mmH ₂ O}
	-1										Carbon steel (SF45A)
	-7										SUS304
		1									Carbon steel (SF45A)
		7									SUS304
			2								SUS316 (diaphragm: SUS316L)
			3								Monel (excluding extended diaphragm type)
			4								Tantalum (excluding extended diaphragm type)
			8								SUS316L
			2								SUS316 (diaphragm: SUS316L)
			3								Monel (excluding extended diaphragm type)
			4								Tantalum (excluding extended diaphragm type)
			8								SUS316
				1							Flush diaphragm type 80 mm -JIS 10K (RF) equiv. flange
				2							Flush diaphragm type 80 mm -JIS 30K (RF) equiv. flange
				3							Flush diaphragm type 3 in. - ANSI150 (RF) equiv. flange
				4							Flush diaphragm type 3 in. - ANSI300 (RF) equiv. flange
				5							Extended diaphragm type 100 mm -JIS 10K (RF) equiv. flange
				6							Extended diaphragm type 100 mm -JIS 30K (RF) equiv. flange
				7							Extended diaphragm type 4 in. - ANSI150 (RF) equiv. flange
				8							Extended diaphragm type 4 in. - ANSI300 (RF) equiv. flange
						02					2 m
						03					3 m
						05					5 m
							00				Flush diaphragm type
							10				Extended diaphragm type: 100mm
							15				Extended diaphragm type: 150mm
								A			PT1/4 internal thread
								B			1/4NPT internal thread
									1		kgf/cm ² (or mmH ₂ O) / 0.2 to 1.0 kgf/cm ²
									2		PSI / 3 to 15 PSI
									3		bar / 0.2 to 1.0 bar
									4		Pa / 20 to 100 kPa
									8		Pa / 19.6 to 98.1 kPa {equivalent to 0.2 to 1.0 kgf/cm ² }
										-X	No option
										-5	Elevation
										-6	Suppression
										-7	Air-set

KDP81/82

Basic model no.	Cover material		Measuring element material		Air piping connection	Pressure unit/ Output	Options	Description
	HP	LP	HP	LP				
KDP81								0-25 to 0-500 kPa {0-2,500 to 0-50,000 mmH ₂ O}
KDP82								0-2.5 to 0-53.9 kPa {0-250 to 0-5,500 mmH ₂ O}
	-1							Carbon steel (SF45A)
	-2							SUS316
		1						Carbon steel (SF45A)
		2						SUS316
			2					SUS316 (diaphragm: SUS316L)
			3					Monel
			4					Tantalum
			8					SUS316L
				2				SUS316 (diaphragm: SUS316L)
				3				Monel
				4				Tantalum
				8				SUS316L
					A			PT1/4 internal thread
					B			1/4NPT internal thread
						1		kgf/cm ² (or mmH ₂ O) / 0.2 to 1.0 kgf/cm ²
						2		PSI / 3 to 15 PSI
						3		bar / 0.2 to 1.0 bar
						4		Pa / 20 to 100 kPa
						8		Pa / 19.6 to 98.1 kPa {equivalent to 0.2 to 1.0 kgf/cm ² }
							-X	No option
							-5	Elevation
							-6	Suppression
							-7	Air-set

3-4 : Structure

The housing and the base plate of the transmitter itself make up the pneumatic circuit boards. As the componential blocks of the transmitter are installed in their respective positions on the base plate, air connections for them are automatically accomplished. No connections of pipes or tubes are needed.

3-4-1:Nozzle and flapper

The nozzle is mounted on the base plate side and the flapper is mounted at the end of the beam.

3-4-2:Pilot relay

The pilot relay boosts the back pressure of the nozzle. The pilot relay is mounted on the manifold which is part of the structure of the casing in a unit-structure.

3-4-3:Feedback mechanism

The feedback mechanism is comprised of a feedback bellows which receives the output pressure of the pilot relay, a floating pivot for balancing three forces, and a span arm fixing element. The beam on which the flapper is mounted on is also included in the feedback mechanism.

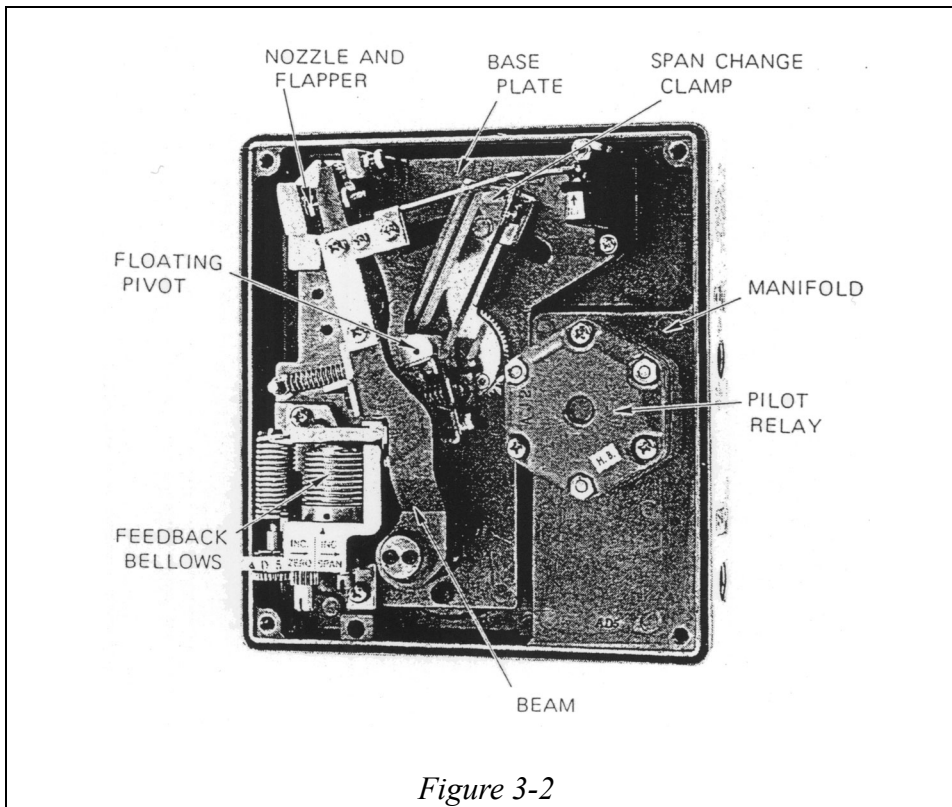
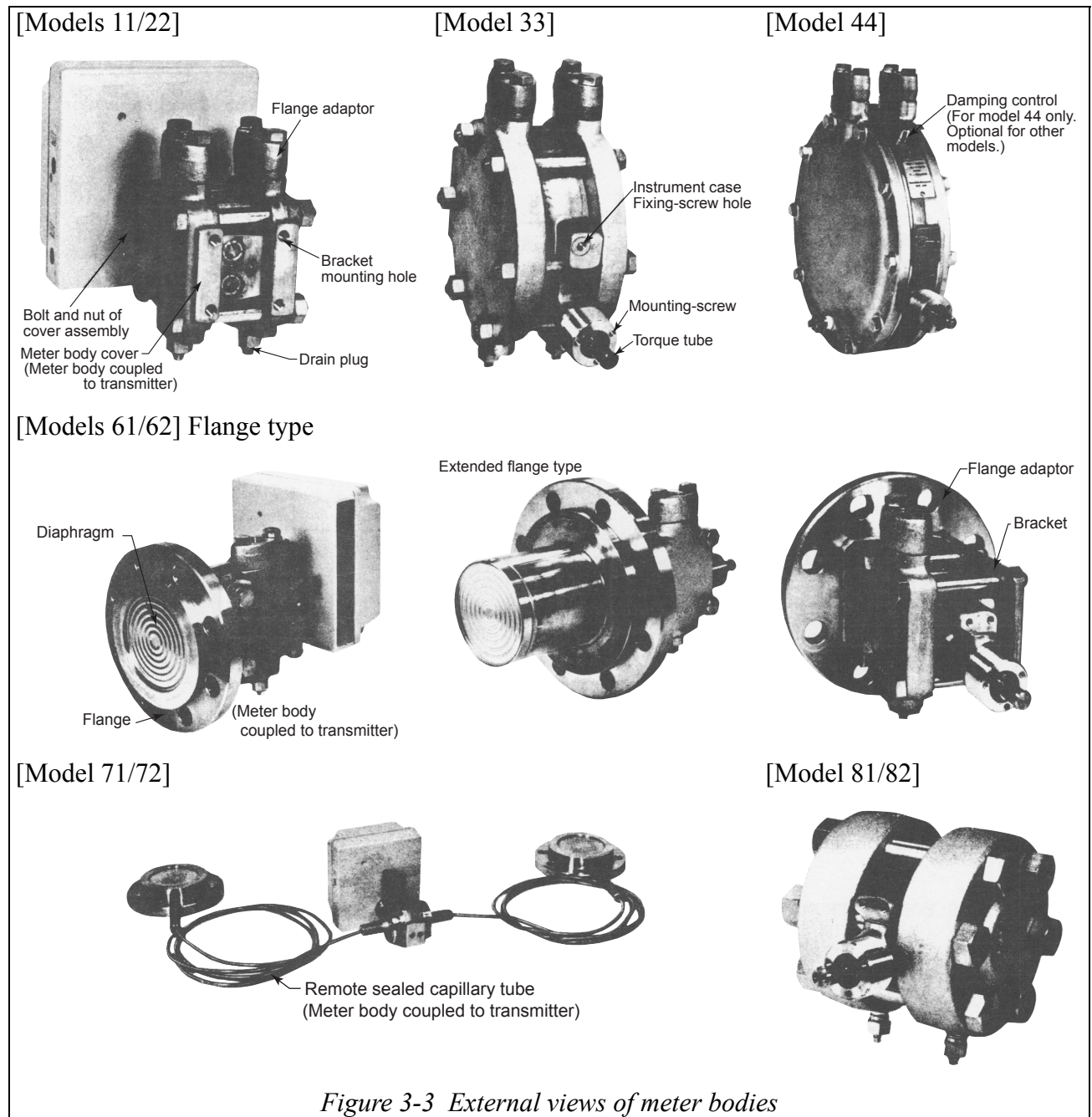


Figure 3-2

3-4-4: Meter bodies

External views

Although external views of meter bodies differ by models as shown in Figure 3-1, the bracket mounting section and instrument connection section are identical for models 11/22, 71/72, and for models 33/44, 81/82.



The meter body consists of a center body, flange cover, nuts and bolts (Figure 4-3). As shown in Figure 3-4 to Figure 3-7, the process differential-pressure is introduced from the high-pressure side (on the right when facing the transmitter) and low-pressure side (on the left when facing the transmitter) and exercises force onto the pressure receiving bellows through the diaphragm and sealing liquid (silicon oil). Consequently, movements proportional to the magnitude of pressures are conveyed to the torque

tube. The torque proportional to the pressure is conveyed by the torque tube to the input beam of the transmitting section.

Overload protection mechanism

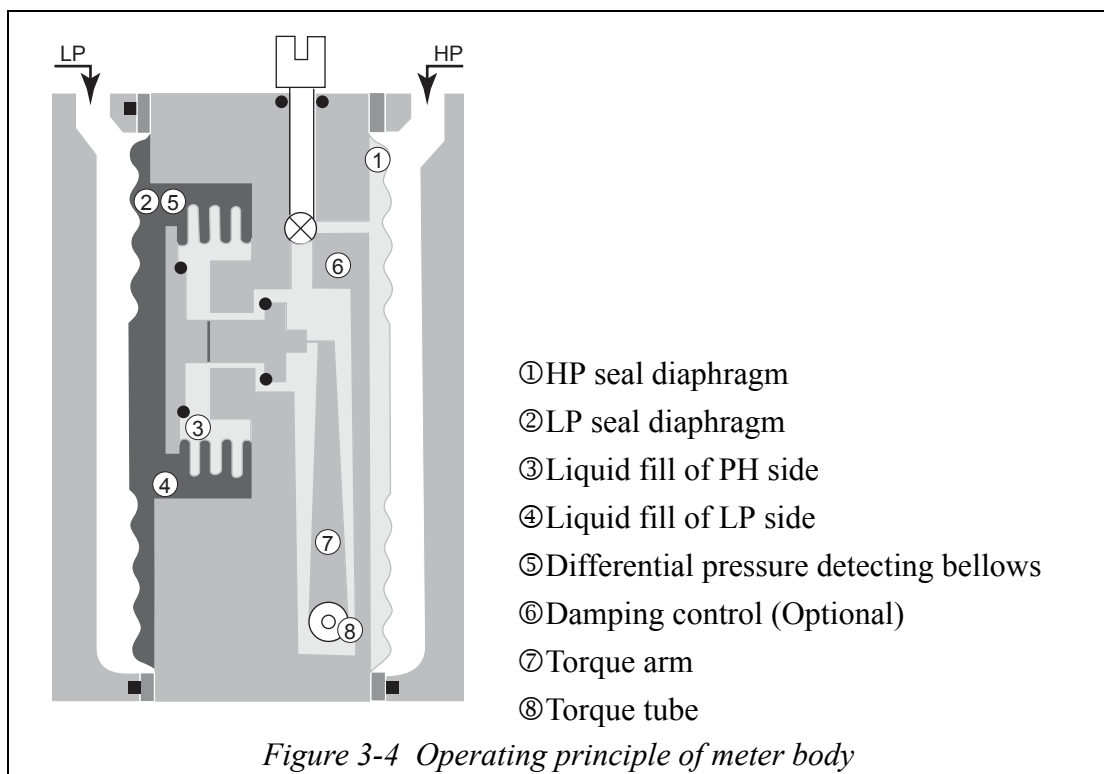
Where pressure higher than the measured pressure is applied from the high-pressure or low-pressure side, the measuring bellows moves and the movement of the sealing liquid becomes zero between the inside of the bellows and the high-pressure chamber due to the O-ring seal. After being sealed off by the O-ring, the over-pressure is received by the whole part of the center body due to the incompressible nature of the sealing liquid. Consequently, the measuring bellows etc. are not subjected to unreasonable force.

Structures and operating principles

The structure and operating principles of the meter bodies are covered in this section.

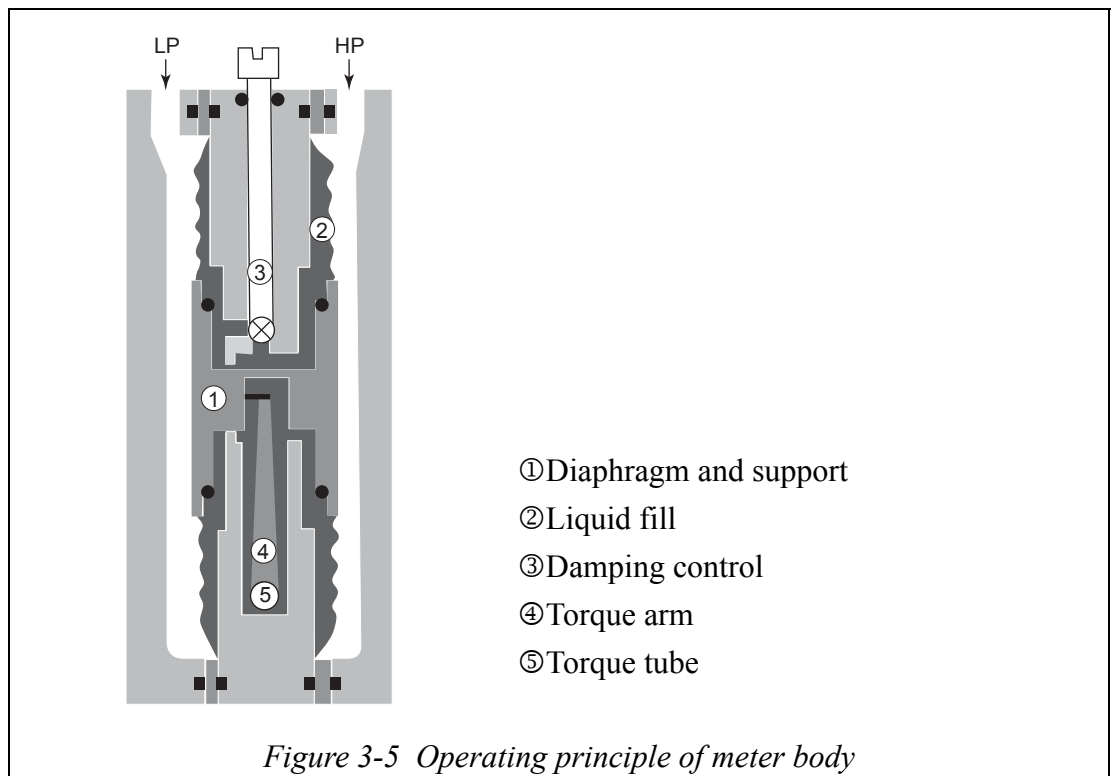
Models 11/12, 33 and 81/82

- The high and low process pressures (HP and LP) are fed via diaphragms ① and ② to the center section (oil filled section) of the meter body. The HP acts on the differential pressure detecting bellows from the right hand side ③ and the LP from the left hand side ④. When a state of equilibrium is reached (zero differential pressure state), identical forces are exercised on both sides of the differential pressure detecting bellows ⑤.
- As the pressure of the HP side rises thereby increasing the differential pressure, the differential pressure detecting bellows moves leftward. The movement of the bellows is fed as a torque via the torque arm to the beam of the transmitter.



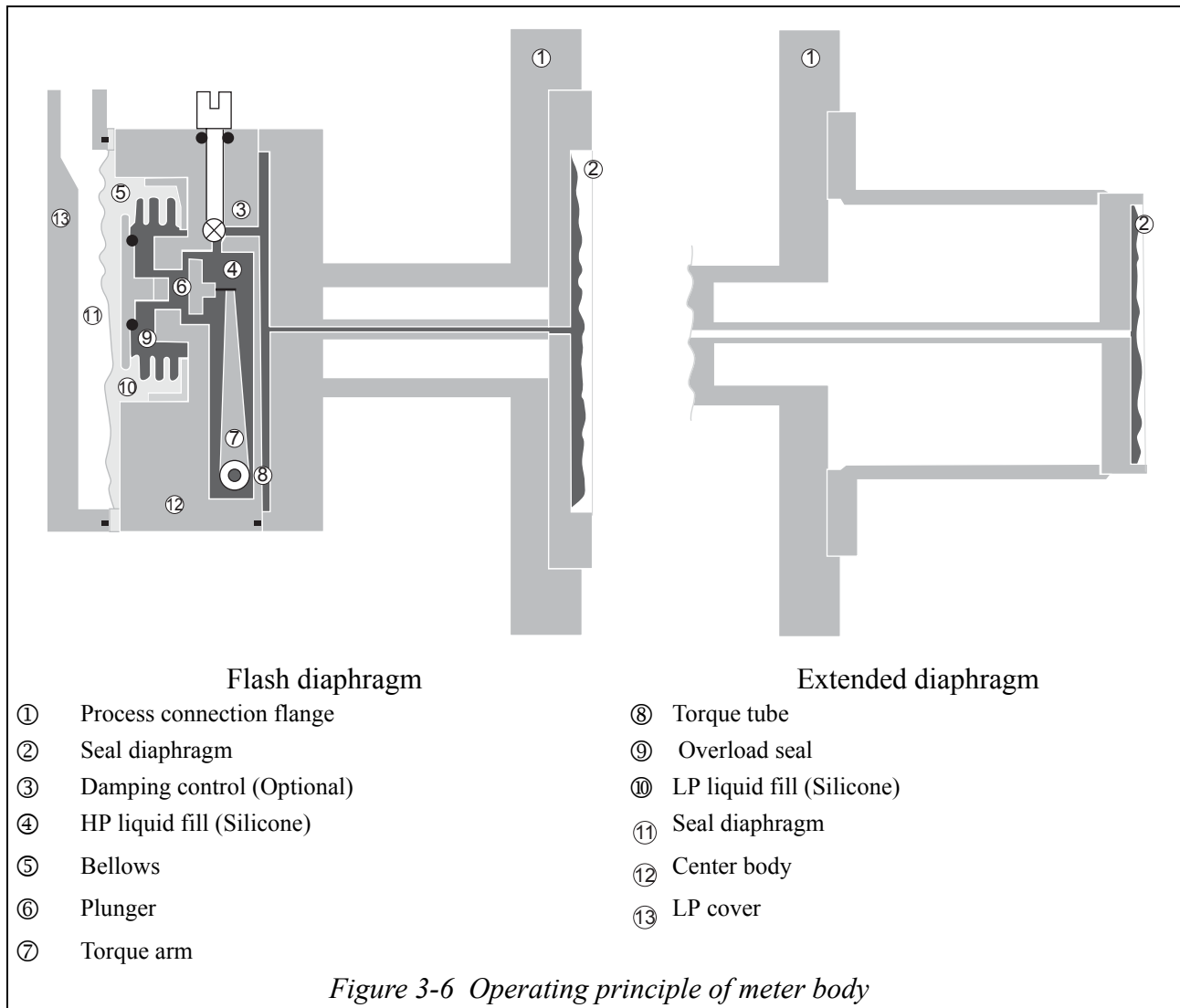
Model 44

- The high and low process pressures (HP and LP) are fed via the diaphragm and supports ① to the center section (silicone filled section) ② of the meter body. The HP acts on the pressure detecting diaphragm from the right hand side and the LP from the left hand side. When a state of equilibrium is reached (zero differential pressure state), identical forces are exercised on both sides of the differential pressure detecting diaphragm.
- As the pressure of the HP side rises, the support moves leftward. The liquid fill flows through the damping control ③. The movement of the diaphragm is fed as a torque via the torque arm ④ to the beam of the transmitter.



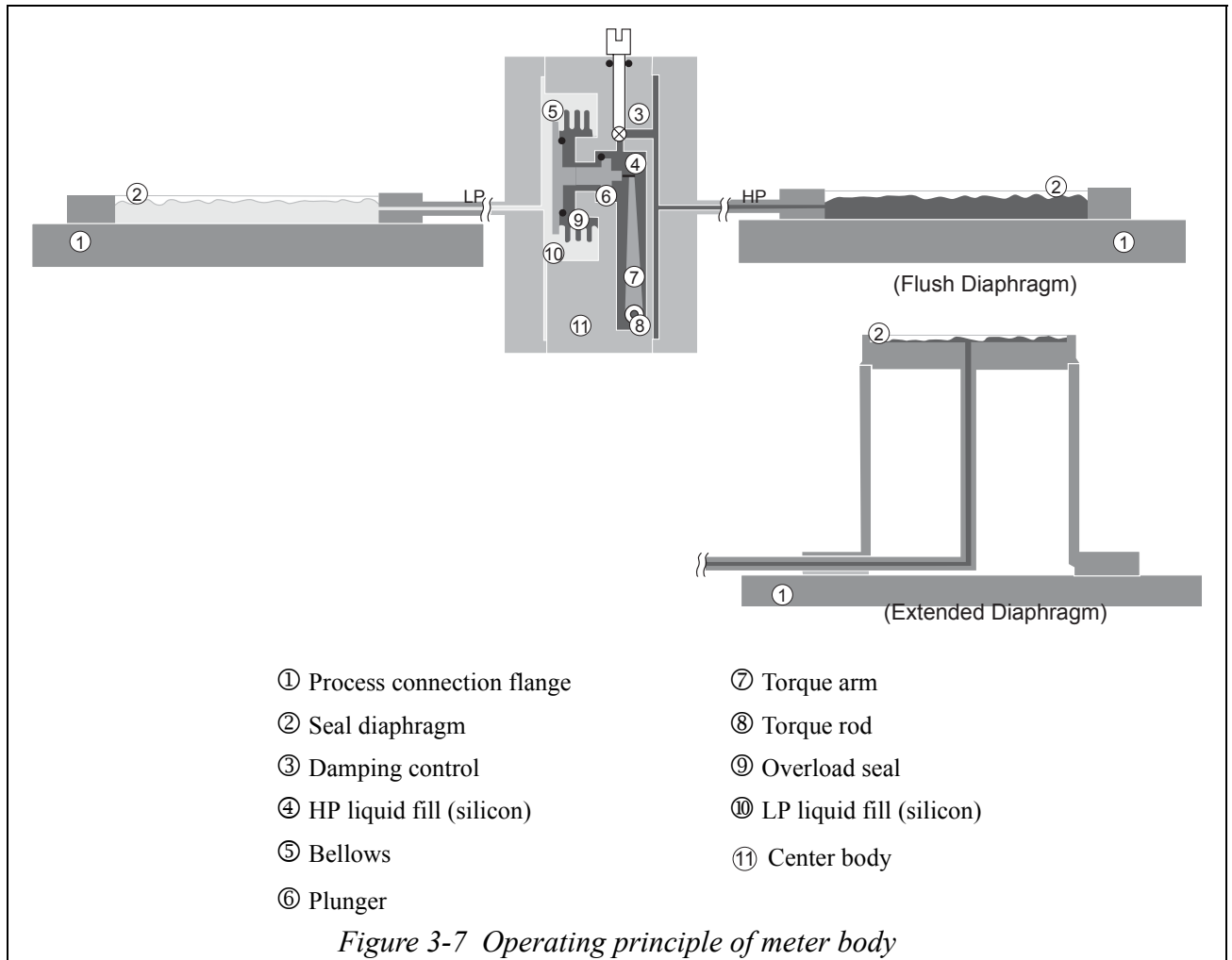
Models 61/62

- The high and low process pressure (HP and LP) are fed via diaphragms ② and ⑪ to the center section (silicone filled section) of the meter body. Pressure which is proportional to the liquid head in the process vessel is fed via the seal diaphragm ② and liquid fill to the bellows ⑤ at the center section of the meter body.
- The bellows ⑤ moves proportional to the liquid head pressure. The movement of the bellows is fed as a torque via the plunger ⑥ and torque arm ⑦ to the beam of the transmitter.



Models 71/72

- The high and low process pressures (HP and LP) are fed via diaphragms ② to the center section (silicon filled section) ⑪ of the meter body. The HP is fed via the seal diaphragm ② and liquid fill ④ to the bellows ⑤ at the center section of the meter body. The LP is fed via the seal diaphragm ② and liquid fill ⑩ to the bellows ⑤.
- The bellows ⑤ moves in proportion to the differential pressure between HP and LP. The movement of the bellows is fed as a torque via the torque rod ⑧ to the beam of the transmitter



Chapter 4 : Operating Principle

The input for the transmitter is applied as a torque through the torque tube. The torque causes the gap between the nozzle and flapper to change. This movement causes the back pressure of the nozzle to change. The back pressure is boosted in both pressure and capacity by the pilot relay in order to be used as an output air pressure.

The output air pressure of the pilot relay is converted into a mechanical force by the feedback bellows. The mechanical force is fed as vector F_1 to the beam through the strap as shown in Figure 4-1, thereby making up a negative feedback loop to balance the output air pressure at a valve proportional to the input.

For elevation (or suppression), a force is applied to the beam by the elevation (or suppression) spring.

Span change can be accomplished by changing the direction of vector F_3 . As the direction of vector F_3 is changed, the effective force exercised by vector F_1 changes and consequently the feedback gain changes, thereby realizing span change.

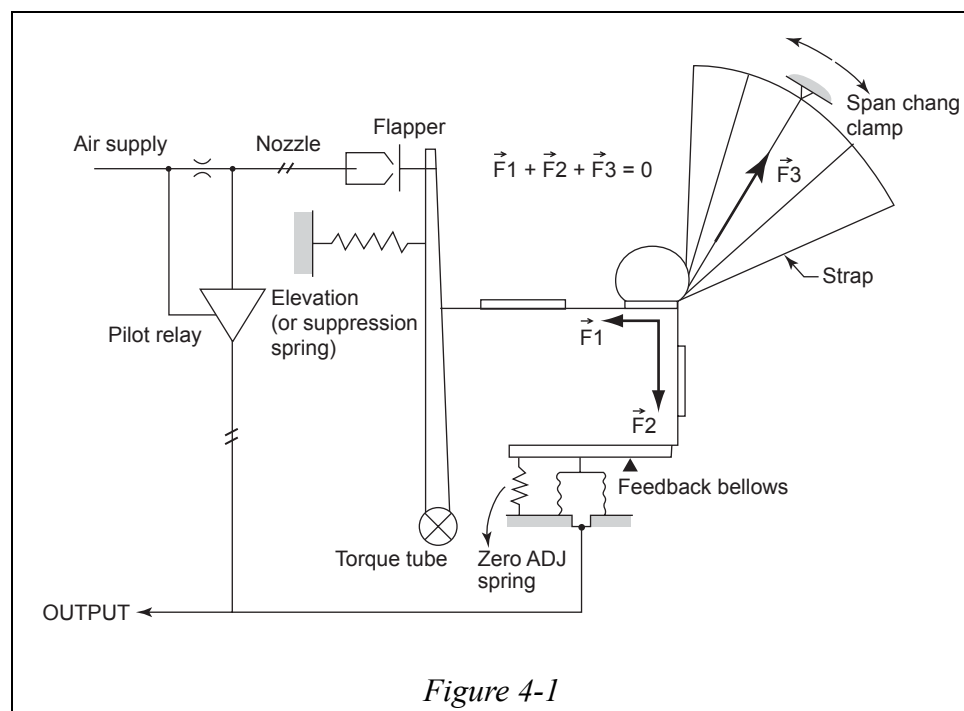


Figure 4-1

Chapter 5 : Installation

5-1 : Place of installation

When selecting a place for installation for the instrument, take into consideration these matters related to instrument inspection, maintenance, longevity, and operation safety.

- (1) Select a place where temperature change is minimal (within the limits of -30°C to $+80^{\circ}\text{C}$). Avoid a place where the instrument may be exposed to high temperature by radiation from a source of heat.

If water is being measured, be careful of freezing which may cause damage to the meter body. Take appropriate measures to guard against freezing.

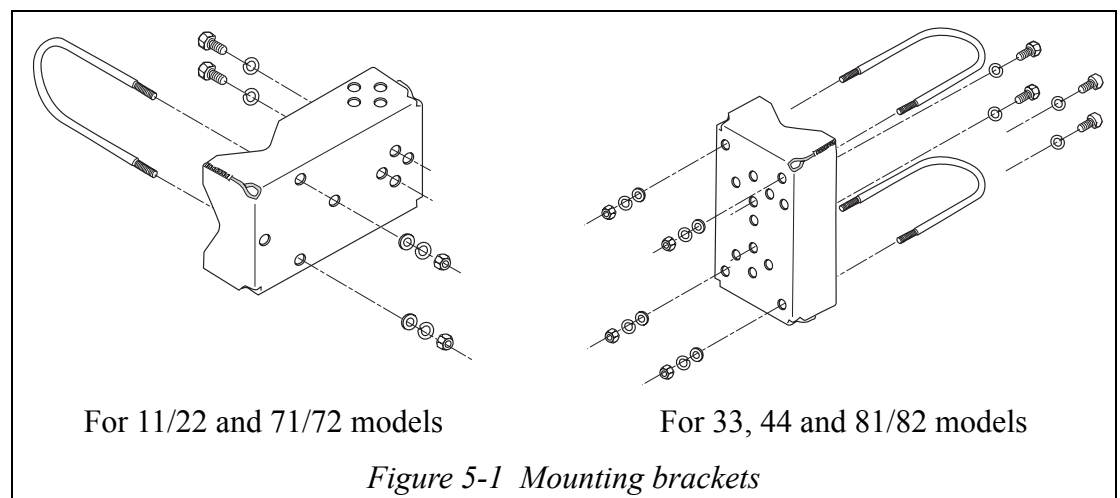
- (2) Select a place where is reasonably free from humidity and vibration.
- (3) Be sure there is enough space to insert a screwdriver for adjustment and span change.

5-2 : Positioning

Install the meter body in such attitude that its diaphragm or bellows planes are made vertical.

5-3 : Bracket and bolts

There are two types of mounting brackets. The bracket and bolts for installation are supplied with each meter body.



5-4 : Installation of regular-type meter body

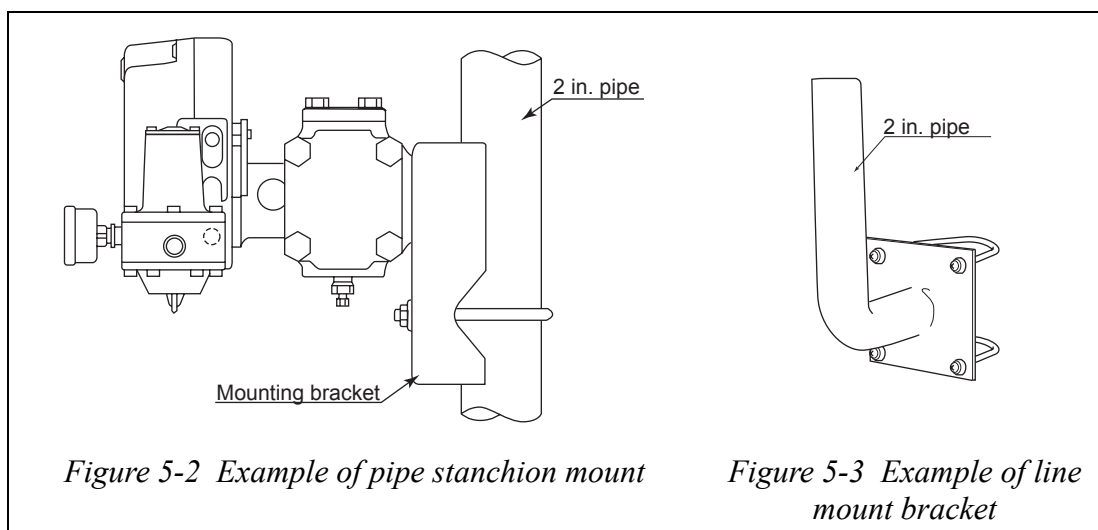
The meter body, together with the transmitter coupled to it, can be installed using either one of the following methods:

- Pipe stanchion mount
- Process pipe mount

In either case, fix the meter body to a 2 in. vertical or horizontal pipe using the mounting bracket and U-shape bolt. Fix the pipe securely to a foundation so that the pipe does not sway. (See Figure 5-2.)

To install the meter body in a process pipe line, prepare brackets for mounting the 2 in. pipe to the process pipe. (See Figure 5-3.)

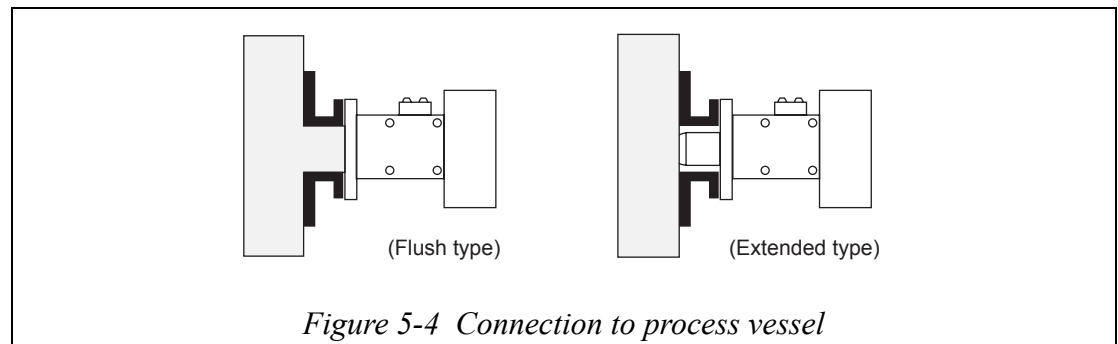
When installing a remote-sealed type of meter body, exercise care not to sharply bend or twist the capillary tube and not to damage the diaphragm.



~Note When installing the transmitter (meter body) on a 2 in. pipe, note that the order of mountings (transmitter, bracket, and 2 in. pipe) differs depending on the mounting direction.

5-5 : Installation of model 61/62 and 71/72

Connect the detector flange to a process flange. Tighten the bolts uniformly. The center of the flange represents the zero point of the liquid level. (See Figure 5-5) If the zero point is raised, the head increases by a corresponding amount.



~Note *No flange gasket accompany the transmitters. Gasket should be prepared by the customer. When using a semi-metallic or rubber gaskets, use a gasket of a shape such that the gasket do not contact the detector diaphragms. (95mm dia.)*

5-6 : Installation of remote-sealed diaphragm type meter body

This type of meter body can be fixed to a pipe stanchion in the same manner as the regular type of meter body. For connection to the process, proceed as follows:

- (1) Connect the tapping flange to the process flange with the bolts and gasket. Evenly tighten the bolts to prevent leakage. Lay the capillary tube so that it is not subjected to much temperature change and fix it so that it does not move.

It is recommended to install the transmitter at a location lower than the flange.

- (2) If a zero point shift has been caused by the head pressure of the seal liquid due to the difference in height between the center of the flange and the center of the pressure receiver, adjust zero by means of the ZERO control (or ELEVATION or SUPPRESSION control). The specific-gravity of the seal liquid is 0.935 at 20°C (For temperature compensation, use a factor of 0.008/10°C).
- (3) For installation of the button diaphragm, refer to its dimension drawing.

When the installed button diaphragm requires to be removed, set the collar (available as an option) to the groove at the rear end of the element (capillary tube side) and retract the screw.

5-7 : Mounting attitude

When the meter body is incorporated with a vent provision, install it in such attitude so that the vent is not obstructed. Entrapped drainage or other foreign matter remaining in the meter body will adversely affect measurement.

It is ideal to install the meter body so that its diaphragm or bellows planes are made vertical.

After installation is finished, perform ZERO adjustment.*

~Note * Refer to the section for calibration.

When a diaphragm pressure receiver type of meter body (models 61/62, 71/72) is used for liquid level measurement, the zero point will be as shown in Figure 5-5. Calculate the output referring to the dimensions and calibrate the instrument accordingly.

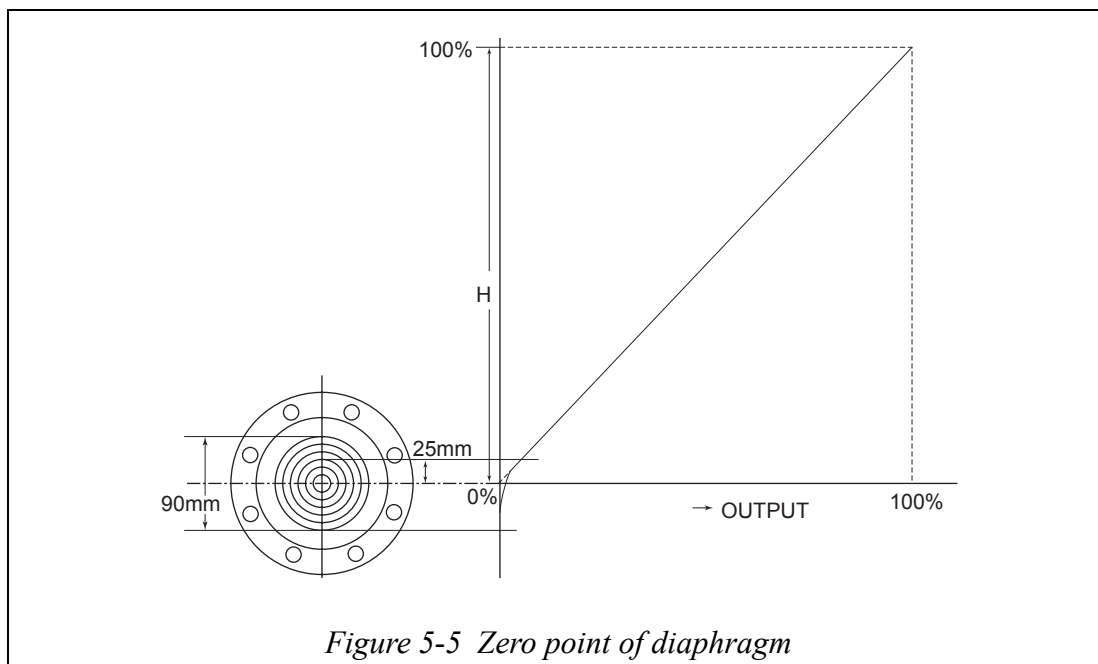


Figure 5-5 Zero point of diaphragm

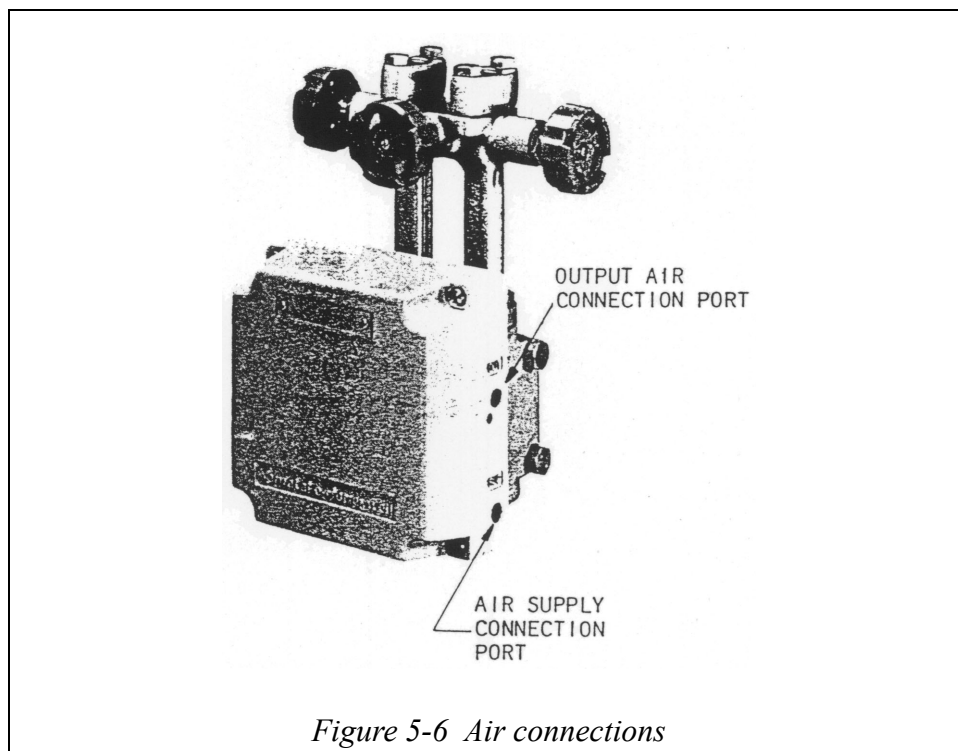
~Note For the portion from the minimum liquid level (0% level) to a height of 25 mm, the output is not linearly proportional to the liquid level.

5-8 : Air supply connection

If no Airset (a combination of regulator and filter) is used, connect the air supply to the air supply connection port (internal thread) which is marked “SUP”. The port marked “OUT” is the output air connection port.

If an Airset is used, connect the output port of the Airset to the air supply connection port of the transmitter.

The transmitter is shipped with its “SUP” and “OUT” ports protected by red vinyl plugs. Remove these plugs when connecting the pipes.



5-9 : Pressure piping

5-9-1: Model 11/22/33/44/81/82

- (1) Piping methods (tapping pressure connection method) may differ depending on the position in which the instrument was installed and the conditions of the process pipe line. In general, the manifold piping method or the manifold valve method is used. (A manifold valve is available as an option.)

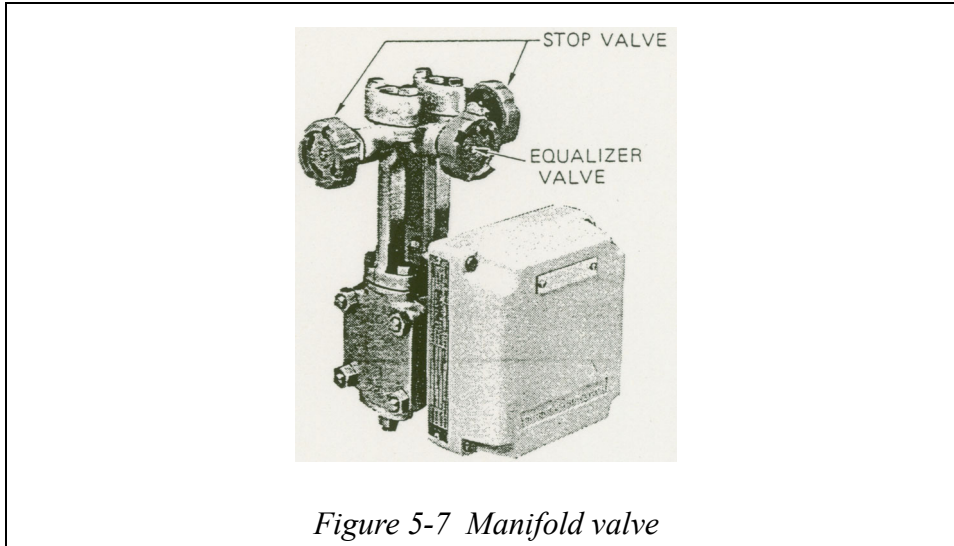


Figure 5-7 Manifold valve

- (2) When in flow measurement and the meter body is installed lower than the pipe line, it is recommended to provide blow pipes.

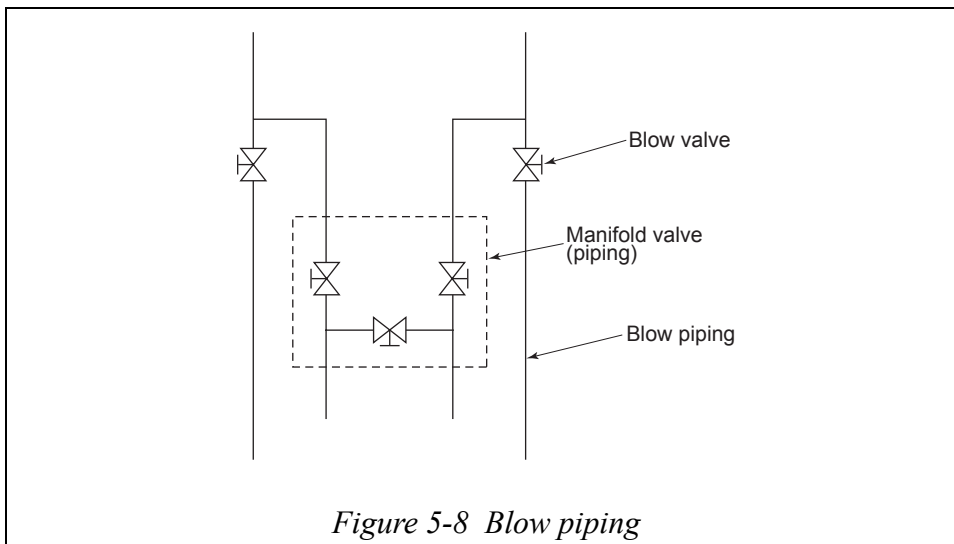


Figure 5-8 Blow piping

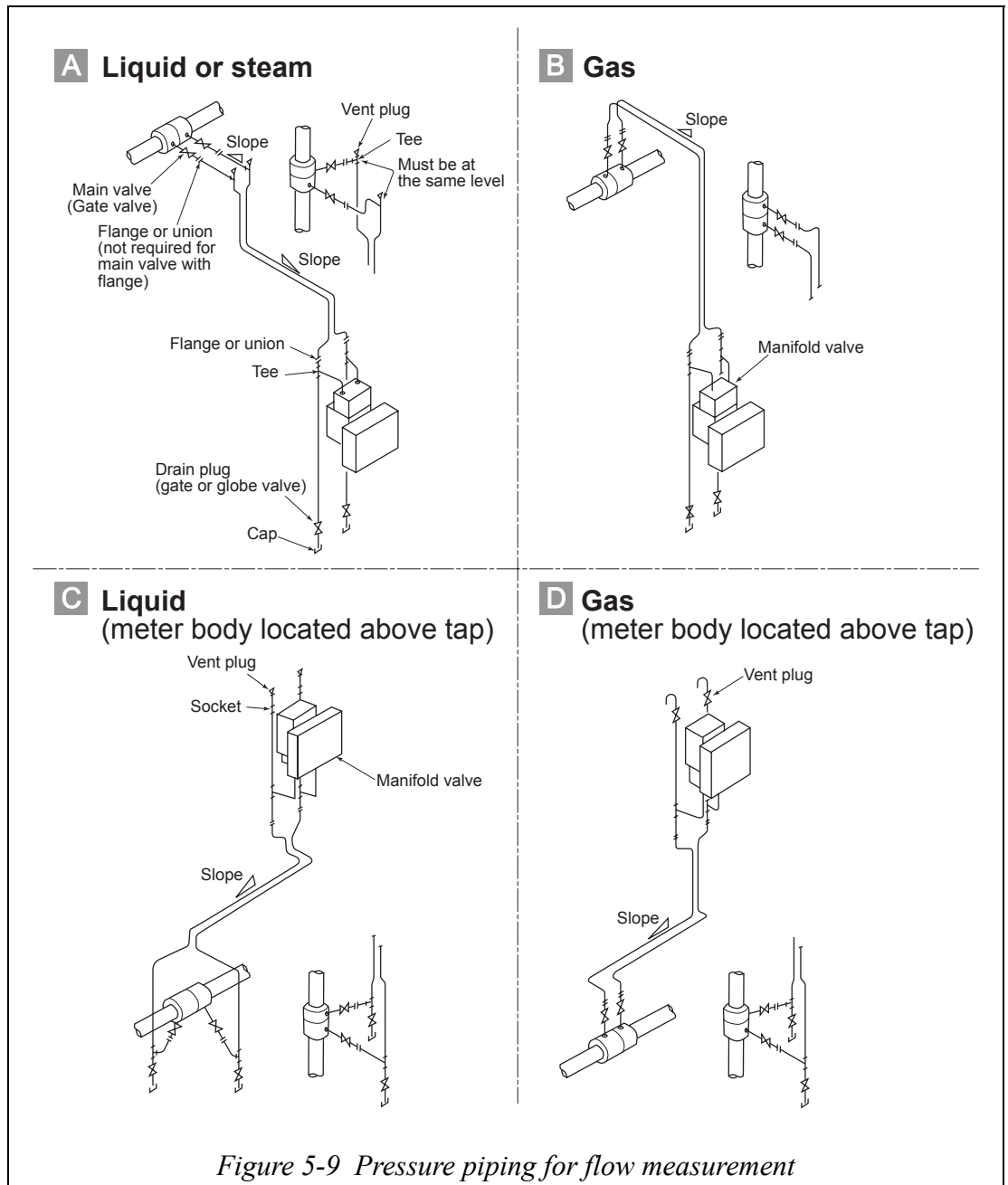
- (3) For the pressure connection piping from the pressure tap position to the transmitter, provide a gradient so that drainage is returned through the tapping position to the process line.
- (4) Regarding the process pressure connection ports of the meter body, the high pressure side (HP) is located to the right and the low pressure side (LP) to the left when viewed from the front of the meter body (transmitter).

If the high pressure side and low pressure side require to be used in the reverse from the viewpoint of piping, use a Reverser unit*.

~Note *The Reverser unit is available as an option. This unit cannot be used for model 81/82.

- (5) For the pipes for pressure tapping from the process pipe, use pressure pipes of an appropriate schedule number and a nominal thickness. A typical example is 1/2 in. schedule 80 steel pipe. For the measurement of water or steam, copper pipes are generally used.

Example of pressure piping are shown in Figure 5-9.

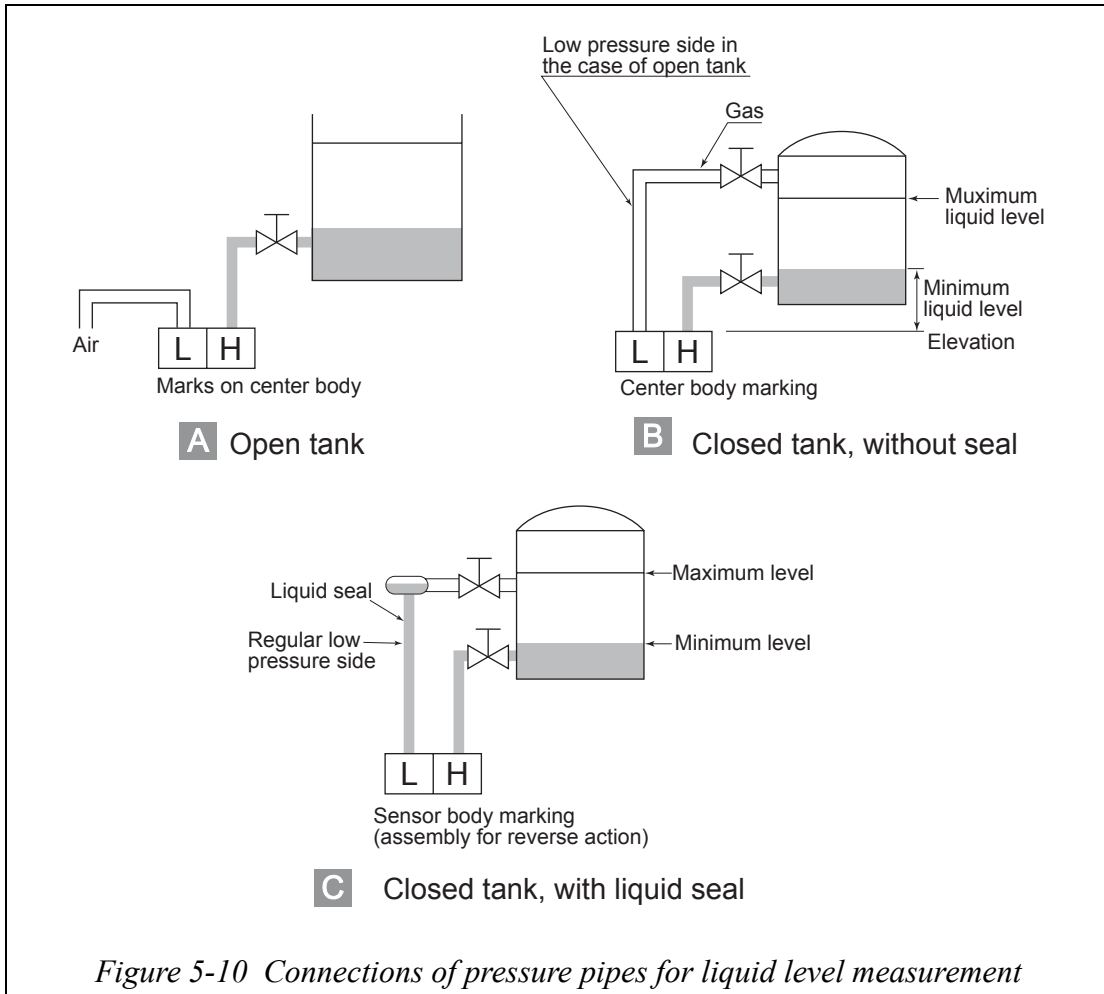


- (6) To change connections to process:

If it is required to change process connections (vent and drain) between upper and lower positions, remove the two flanges of the connection ports plus the plugs of the vent and drain, and change the positions between upper and lower. (Refer to the overall dimension drawings.)

(7) Pressure tapping methods:

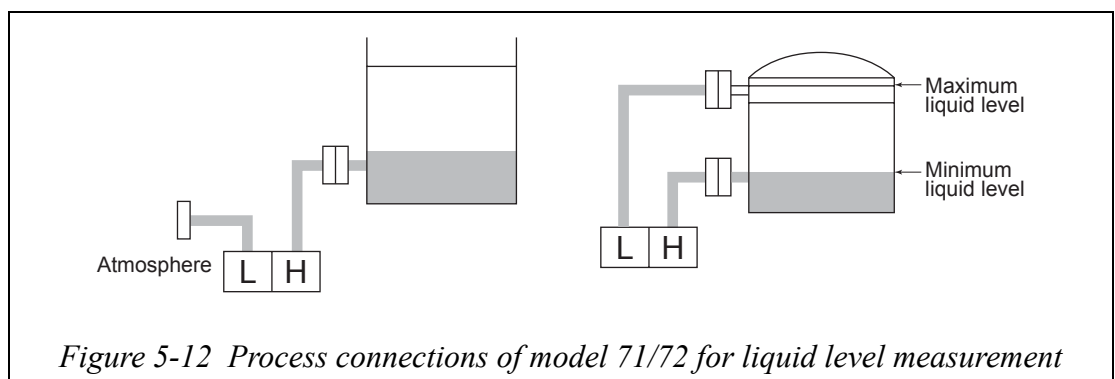
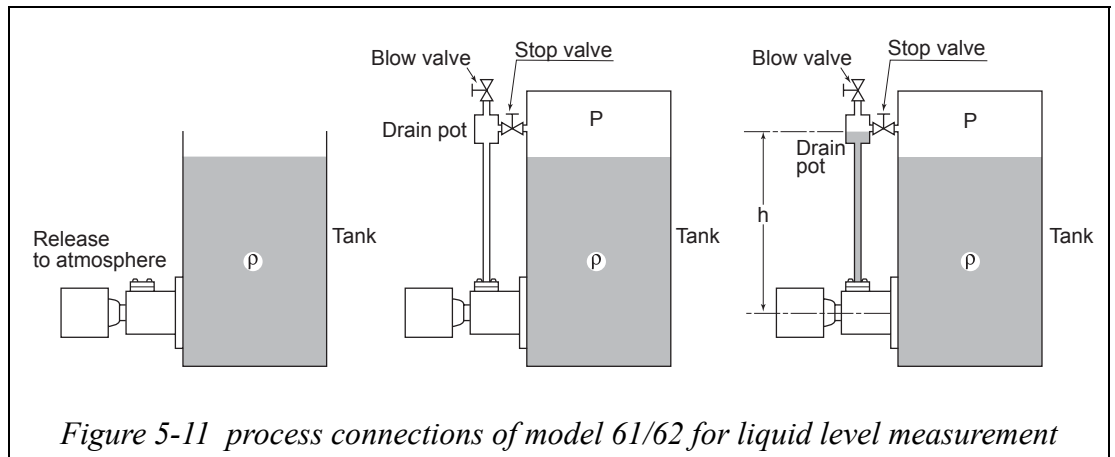
For the tapping methods of process pressures, refer to the illustrations given in this section. “H” is the high pressure side of the meter body and “L” is the low pressure side. They are both marked on the meter body.

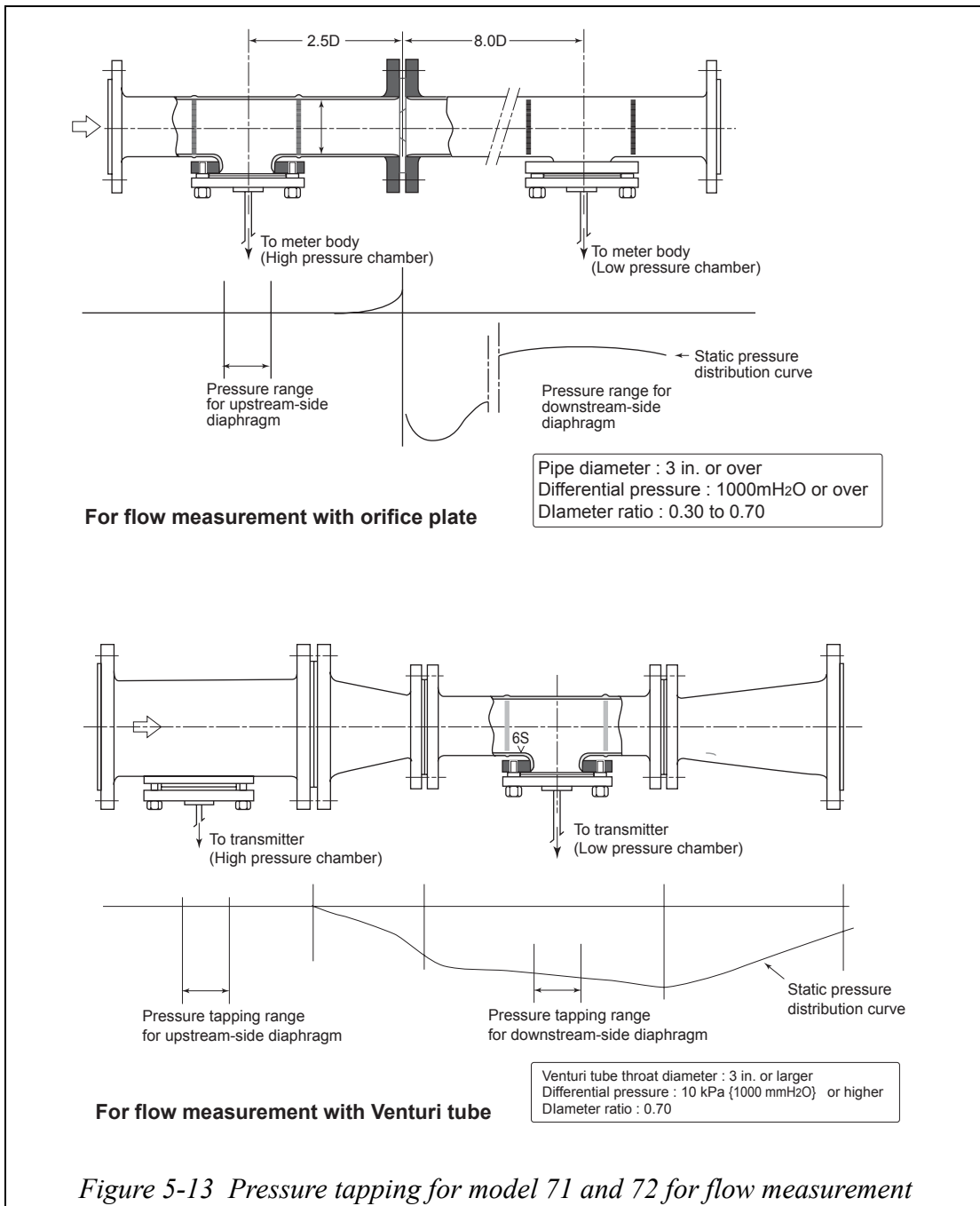


The liquid level corresponding to the difference between the 0% level and the center of the meter body is given from the beginning. In the case of A or B as shown in Figure 5-10, make an compensation (provide an elevation) for the corresponding amount and set the output to 20 to 100 kPa {0.2 to 1.0 kgf/cm²} for liquid level 0 to 100%. In the case of C, a pressure corresponding to the head of the seal liquid is applied to the low pressure side to the state of A or B and consequently the high/low relationship between the H side and L side of the meter body is reversed. Therefore, compensation (suppression) should be made for the seal liquid head to make up for the difference between the 100% level position and the 0% level position.

For “elevation” and “suppression”, refer to “5-10 : Elevation and suppression”.

5-9-2: Connection of flange type meter body to process





- (1) Fix the flanges of the meter body to those of the process side by using gaskets and bolts. Be sure to uniformly and securely tighten the bolts in order to prevent leakage.

Install the capillary tubes in such manner that they are less subjected to large temperature change. Secure them so that they do not move.

- (2) Regarding the flange of the low pressure side when in level measurement of an open tank, make sure to secure it in a position where it will be subjected to minimal temperature change and mechanical vibration. Position the LP side flange at a height lower than that of the minimum liquid level.

Regarding the seal diaphragm, protect it so that it will not be damaged and pay attention so that no drain will be entrapped on it and no dust will accumulate on it.

- (3) For flow measurement, tapping for the differential pressure must be done in the “pipe tap” system. Therefore, install the high-pressure-side tap at a position of 2.5D (D denotes the inside diameter of the process pipe) from the upstream side of orifice and position the low-pressure-side tap at a distance of 8D from the downstream side of the orifice.

The tapping connection is of a 3 in. flange connection type. The flanges of the extension seal type of meter body can be directly used for tapping flanges.

5-10 : Elevation and suppression

5-10-1:Definitions of elevation and suppression

The terms “elevation” and “suppression” used in this manual are defined as follows:

Elevation: Synonymous with “suppressed zero range”

An input range whose low end value is greater than zero.

For example, a range of 20 to 100.

Suppression: Synonymous with “elevated zero range”

An input range whose low end value is less than zero.

For example, a range of -20 to 0.

5-10-2:Setting of elevation / suppression

For the adjustment of elevation or suppression, refer to “Chapter 9 : Calibration and Adjustment”.

~Note *The specific-gravity of the liquid fill for models 71/72 is 0.935 at 20°C.
(For temperature compensation, use a factor of 0.008/10°C.)*

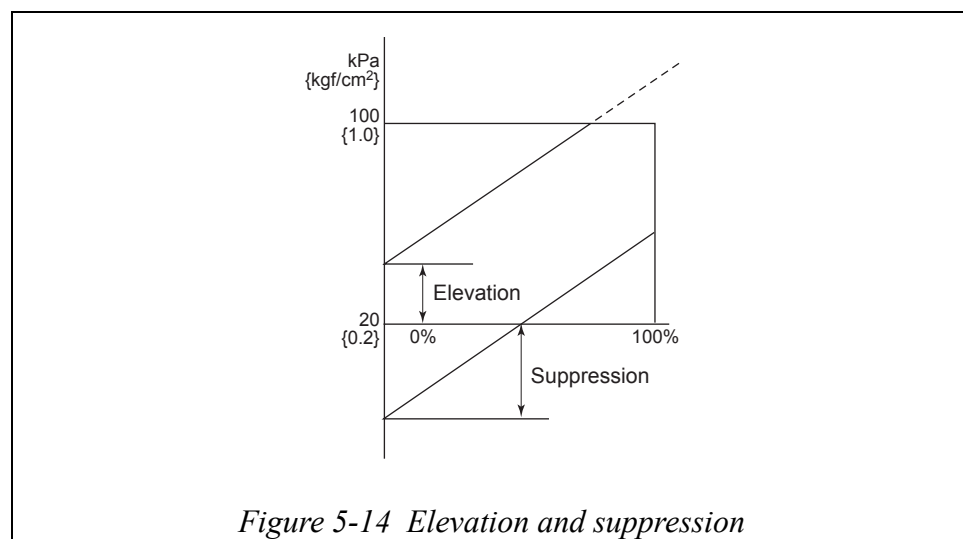


Table 5-1:

Model	Open tank	Closed tank (without seal liquid)	Closed tank (with seal liquid)
11/22/ 33/44/ 81/82	Provide suppression that corresponds to differential level between zero liquid level and center of the pressure receiver multiplied by the specific-gravity of the measured liquid. Figure 5-15- A		Provide suppression by an amount corresponding to the measuring liquid level multiplied by the specific-gravity of the measured liquid (seal liquid).
61/62	No elevation/suppression is needed if the imaginary zero liquid level* conforms with the center position of the diaphragm of the flange connection section. ~Note * Refer to "5-7 : Mounting attitude". If the zero liquid level is higher than the center position of the diaphragm, provide elevation by an amount that corresponds to the height multiplied by the specific-gravity of the measured liquid. Figure 5-15- B		Subtract from suppression the difference between the zero liquid level and the center position of the diaphragm as elevation. Figure 5-15- C
71/72	Provide elevation using a value corresponding to the difference between the center positions of the HP and LP flange diaphragms multiplied by the specific-gravity of the seal liquid. If the zero liquid level is higher than the center position of the HP flange diaphragm, add as elevation an amount corresponding to the height multiplied by the specific-gravity of the measured liquid. Figure 5-15- D	Provide suppression by an value corresponding to difference between the center position of the HP and LP flange diaphragms multiplied by the specific-gravity of seal liquid. If the zero liquid level is higher than the center position of the HP flange diaphragm, subtract from the above suppression an amount corresponding to the height multiplied by the specific-gravity of the measured liquid as elevation. Figure 5-15- E	Not applicable

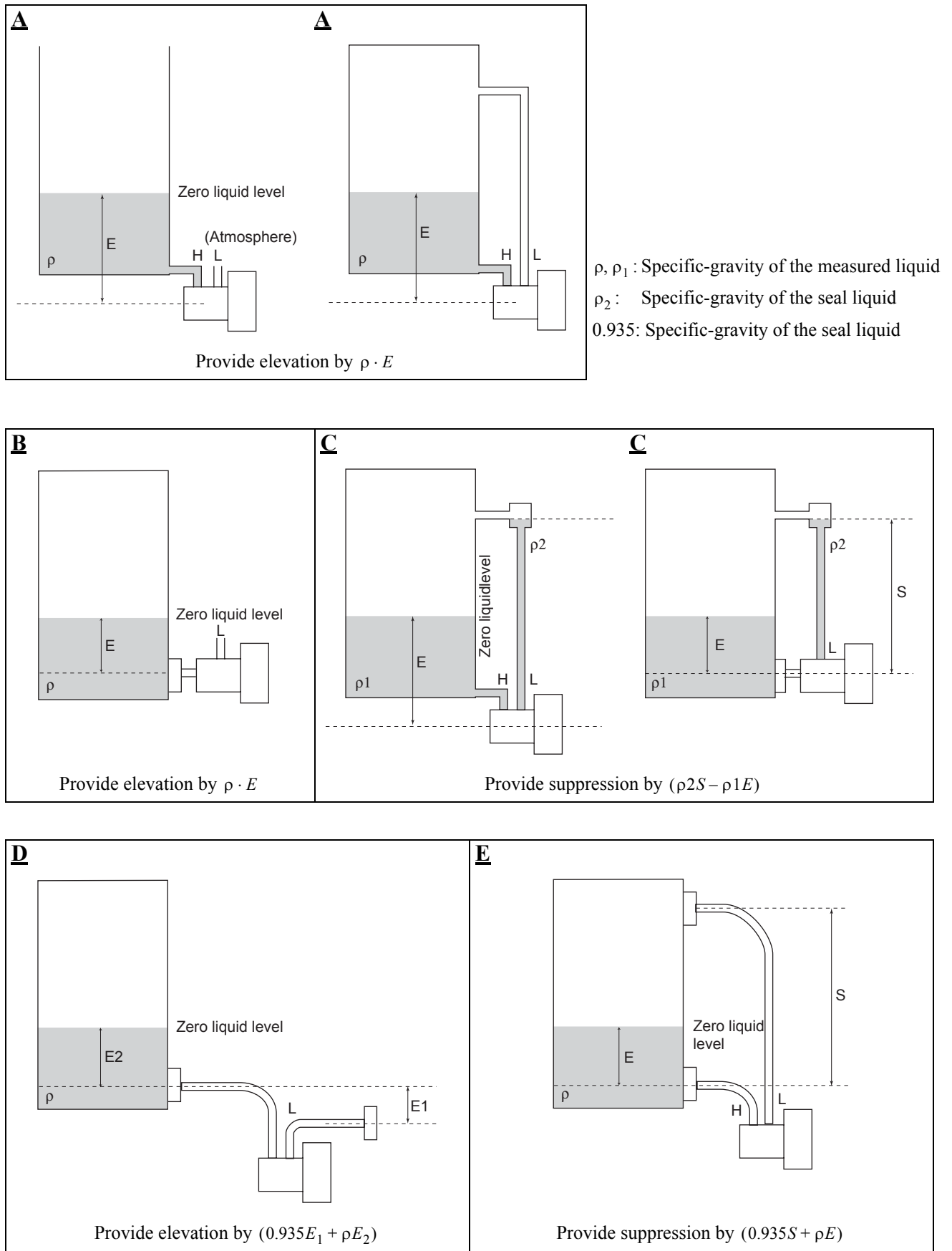


Figure 5-15 Calculation of elevation/suppression values

Chapter 6 : Operation Method

The meter body, together with the transmitter coupled to it, starts operating as the air supply and process input are fed to it. (It is recommended to check that the transmitter is properly functioning before starting the running operation.)

6-1 : Differential pressure (Flow) transmission

The operation method (start up procedure) described here assumes that manifold valves and below piping are prepared as shown in “Chapter 5 : Installation”. For model 71 or 72, operation is ready when its installation has been completed.

- (1) Check that piping has been correctly done.
- (2) Unless self drain or self vent piping has been provided, liquid or gas will be entrapped in the measuring chambers and pressure connection pipes, thereby causing measurement errors. Be sure to purge such liquid or gas. The same is applicable regardless of whether manifold valves are used or manifold piping has been done. For the procedure, refer to “Chapter 7 : Inspection and Maintenance”.

- (3) Zero point check:

When the instrument is ready for measuring, prepare a receiver instrument and check and adjust the zero point as follows: For manifold valves, close the stop valves of both high and low pressure sides and then open the equalizer valve. Next, open the stop valve of the high pressure side alone so that only the process pressure of the high side is applied to both high and low pressure chambers of the meter body. Under this state, check the zero point. After the zero point check has been completed, close the equalizer valve and then open the stop valve of the low pressure side.

- (4) Operating procedure: (Refer to “5-9 : Pressure piping”.)

To start operating the meter body from the state in which all valves are closed, open or close them in due order as described below.

- (a) Open the equalizer valve.
- (b) Open the stop valve of low pressure side tapping-pipe and the stop valve of low pressure side of the manifold.
- (c) Open the stop valve of high pressure side tapping-pipe and the stop valve of high pressure side of the manifold.
- (d) Close the equalizer valve.

6-2 : Liquid level transmission

The operation method (start up procedure) described here assumes that the meter body has been installed as shown in “5-9-1: Model 11/22/33/44/81/82” (6) and “5-9-2: Connection of flange type meter body to process” of “Chapter 5 : Installation”. No operation procedure is needed for the process connections with flanges (diaphragms). Of model 71 or 72, operation is ready when its installation has been completed.

- (1) Check that piping has been correctly done.
- (2) Unless self drain or self vent piping has been provided, liquid or gas will be entrapped in the measuring chambers and pressure connection pipes, thereby causing measurement errors. Be sure to purge any remaining liquid or gas. For this procedure, refer to “Chapter 7 : Inspection and Maintenance”.
- (3) Zero point check:
When the instrument has become ready for measuring, prepare a receiver instrument and check and adjust the zero point.
- (4) Open the stop valves and start operating the instrument. If seal liquid is used, fill the low pressure side tapping-pipe with seal liquid.

Chapter 7 : Inspection and Maintenance

For routine inspection and maintenance, pay attention to the following:

7-1 : Check for leakage from piping

Verify that there is no leakage from the pressure tap points of the piping at the meter body. If any loose connections are found, tighten them securely.

7-2 : Maintaining the meter body and piping

To ensure the instrument performing to specification, keep the meter body and its piping clean. If sediment or any foreign matter is entrapped in the pressure chambers of the meter body, measuring errors may result. To blow and clean the meter body and piping, proceed as described below.

7-2-1: Blow procedure

When no blow pipes are provided

- (1) Close the stop valve on the high pressure side tapping pipe and that of the high pressure side of the manifold valve.
- (2) Ensure that the equalizer valve is closed.
- (3) Close the stop valve on the low pressure side tapping pipe and that of the low pressure side of the manifold valve.
- (4) Slowly open the both side vent plugs to release pressure, then fully close them.
- (5) Open the stop valve on the high pressure side of the manifold valve and that on the high pressure side tapping pipe.
- (6) Open the equalizer and blow the piping via the high pressure side vent plug.
- (7) Close the equalizer valve, the stop valve of the high pressure side of the manifold valve, and that of the high pressure side tapping pipe.
- (8) Open the stop valve on the low pressure side of the manifold valve and that on the low pressure side tapping pipe.
- (9) Open the equalizer valve and blow the piping from the low pressure side vent hole.
- (10) Close all valves.
- (11) Start operating the instrument following the procedure explained in the “Chapter 6 : Operation Method”.

When blow pipes are provided (See Figure 5-8 in “Chapter 5 : Installation”)

- (1) Close the stop valve on the high pressure side of the manifold valve.
- (2) Close the stop valve on the low pressure side of the manifold valve.
- (3) Slowly open the blow valves on both high and low pressure sides to drain out sediment or any other entrapped substances.
- (4) Close the blow valves on both the high and low pressure sides.
- (5) Open the stop valve on the low pressure side of the manifold valve.
- (6) Open the stop valve on the high pressure side of the manifold valve.

Blow of model 61/62 liquid level meter

- (1) For an open tank liquid level meter, drain out liquid by loosening the drain plug at the bottom of the low pressure side cover at appropriate intervals.
- (2) For a closed tank liquid level meter of gas sealed type, first close the stop valve of the low pressure side tapping-pipe and then open its blow valve to purge gas at appropriate intervals.
- (3) For a closed tank liquid level meter of liquid sealed type, check the seal liquid level and replace seal liquid at appropriate intervals.

To replace seal liquid, proceed as follows: Close the stop valve on the low pressure side tapping-pipe, open the blow valve, and loosen the drain plug to drain out the seal liquid. Next, tighten the drain plug and feed seal liquid from the valve for blow until seal liquid overflows from the blow valve, then close the blow valve, and lastly open the stop valve.

7-2-2:Cleaning of meter body

After the blowing of the piping as described in "7-2-1: Blow procedure" on page 7-1 has been completed, clean the meter body as described below. For models 71/72 and 61/62, clean only the diaphragms outside of flanges.

- (1) Remove the covers of the meter body by removing their clamping-bolts.
- (2) Clean the diaphragm and the insides of the covers using a soft brush and detergent. When doing this, be extremely careful not to deform or damage the diaphragm.
- (3) When reassembling the covers, replace the gaskets with new ones as required.

- (4) Fix the clamping-bolts of the covers with the specified tightening torque as given in the following table.

Table 7-1:

Model	Tightening torque (kgf•cm)		Material of clamping-bolts	
	When new gasket is used	when gasket is re-used	Bolt	Cover
11/22, 61/62	450	300	Chrome molybdenum steel	Carbon steel, SUS
33	450	300		
44	400			
81/82	1,400			

7-2-3:Notes for use in freezing weather

When the transmitter used for the measurement of water or of any other liquid which is apt to freeze is paused in freezing weather or in a freezing area, loosen the drain plugs and drain out liquid from the pressure chambers to prevent the liquid from freezing and damaging the instrument.

Chapter 8 : Service and Unit Replacement

The only component which calls for service is the pilot relay. When malfunctioning of the pilot relay is suspected, service it as described below. If the pilot relay is found to be defective, replace it with a new one.

If the meter body requires to be modified due to a specification change, application change or due to failure contact your Yamatake agent. If it is required that modifications be done by yourself, order service tools and the service manual SM2-5220-0000 "PREX3000 KF-B Liquid Level Meters Detector Replacement Procedure".

8-1 : To replace the pilot relay

Remove the pilot relay by removing the three screws shown in Figure 8-1.

If the gasket has deteriorated or has been damaged, replace it also when replacing the pilot relay.

To install the pilot relay, place the gasket in the correct position, set the pilot relay on the manifold by setting the guide pin at the bottom of the pilot relay to the guide hole, and tighten the screws evenly.

8-2 : To service the pilot relay

Remove the pilot relay as described in 1 above, service it as described below, and then install it in its original position.

- (a) Remove the three assembly screws (1) and nuts (19). (See Figure 3-5)
- (b) Parts (3) to (17) will separate in sequence. It is not necessary to separate parts (2) to (6) unless they are to be replaced.
- (c) Clean metal parts with an approved solvent such as petroleum naphtha or Chlorothene. Depress the valve stem (2) against the conical spring (5) to allow the solvent to penetrate through the seat which touches the port section of the valve stem.
- (d) Examine the inner exhaust ring (13) and valve stem (2). If dirty, clean them with a clean cloth. Do not use any solvent to clean them.
- (e) Dry all parts thoroughly with clean compressed air.
- (f) Replace diaphragm (16) and (11) if worn or damaged.
- (g) Reassemble the pilot relay by rejoining all parts in order with assembly screws (1), and nuts (19). Tighten the screws uniformly.

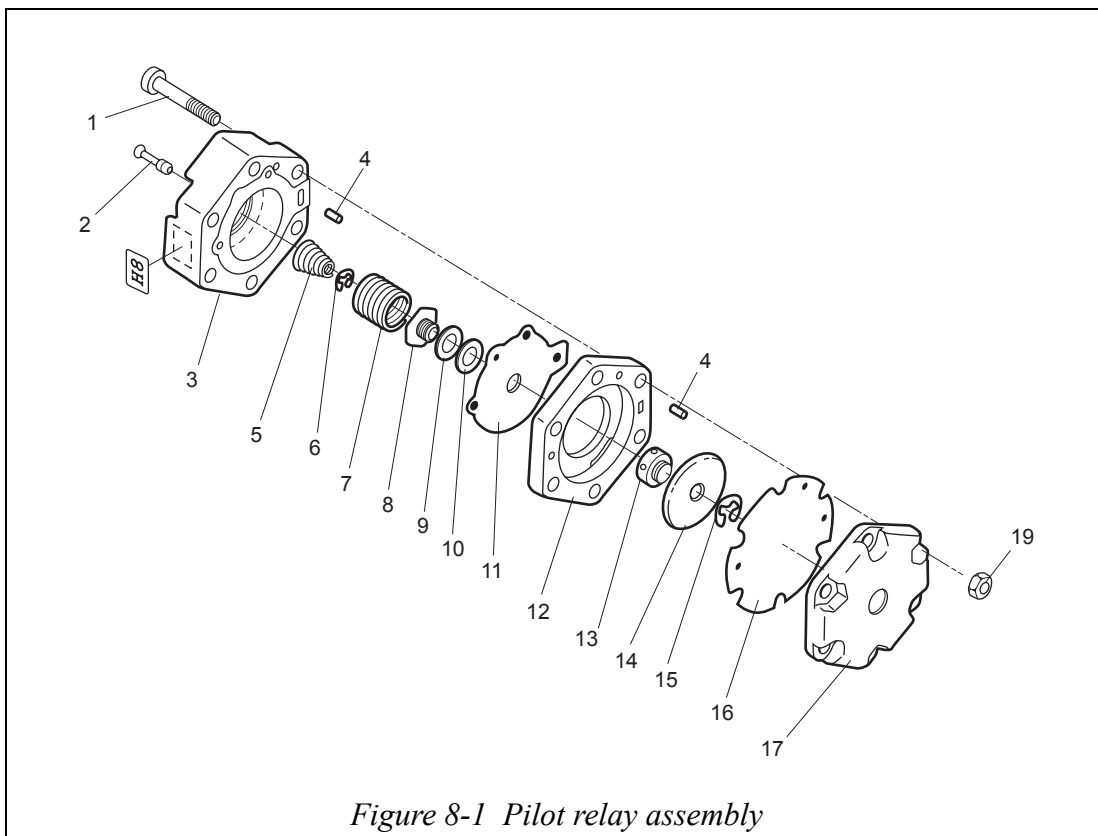


Figure 8-1 Pilot relay assembly

Table 8-1: Parts for pilot relay

No.	Name	Quantity
1	Screw	3
2	Valve stem	1
3	Housing	1
4	Guide pin	6
5	Conical spring	1
6	Washer	1
7	Spring	1
8	Nozzle	1
9	Washer	1
10	Seal	1

No.	Name	Quantity
11	Diaphragm (lower)	1
12	Exhaust ring (outer)	1
13	Exhaust ring (inner)	1
14	Area plate	1
15	Washer	1
16	Diaphragm (upper)	1
17	Cover	1
19	Nut	1

Chapter 9 : Calibration and Adjustment

9-1 : General

The detector (meter body) feeds a torque, which is proportional to the measured process variable, via the torque tube to the transmitting mechanism of the transmitter. Therefore, regardless of the type of the meter body, the transmitter should be adjusted so that it transmits an output signal of 20 to 100 kPa {0.2 to 1.0 kgf/cm²} linearly proportional to the 0% to 100% measuring range.

If the transmitter is incorporated with an elevation / suppression spring assembly, remove the assembly in order to calibrate the measuring range of the transmitter without any zero-point shift.

Connect a precision pressure gauge with a range of approximately 0 to 150 kPa {0 to 1.5 kgf/cm²} to the output port for calibration when checking the transmitter operation or adjustment when replacing meter bodies or changing ranges.

9-2 : Calibration of differential pressure transmitter

- (1) Release the low pressure connection port (marked L) to atmosphere.
- (2) Connect the high pressure connection port (marked H) to a variable pressure source (such as an air supply via a regulator) corresponding to the measuring range and a precision pressure gauge which covers the measuring range. (For a flange type meter body, prepare a piping adaptor.)
- (3) Apply to the high pressure connection port a pressure corresponding to 100% of the measuring range by adjusting the variable pressure source.
- (4) If the output pressure has largely shifted from 100% (100 kPa {1.0 kgf/cm²}), adjust the SPAN CHANGE boss with a screwdriver so that the output pressure becomes approximately 100%. As you turn the boss clockwise, the output pressure rises and the span becomes narrower. As you turn the boss counterclockwise, the output pressure falls and the span becomes wider.
- (5) Release the high pressure connection port to atmosphere.
- (6) If the output pressure has shifted from 0% (20 kPa {0.2 kgf/cm²}), adjust the ZERO ADJ screw so that the output pressure becomes 0%. As you turn the screw clockwise, the output pressure rises, and vice versa.
- (7) Apply to the high pressure connection port a pressure corresponding to 100% of the measuring range.

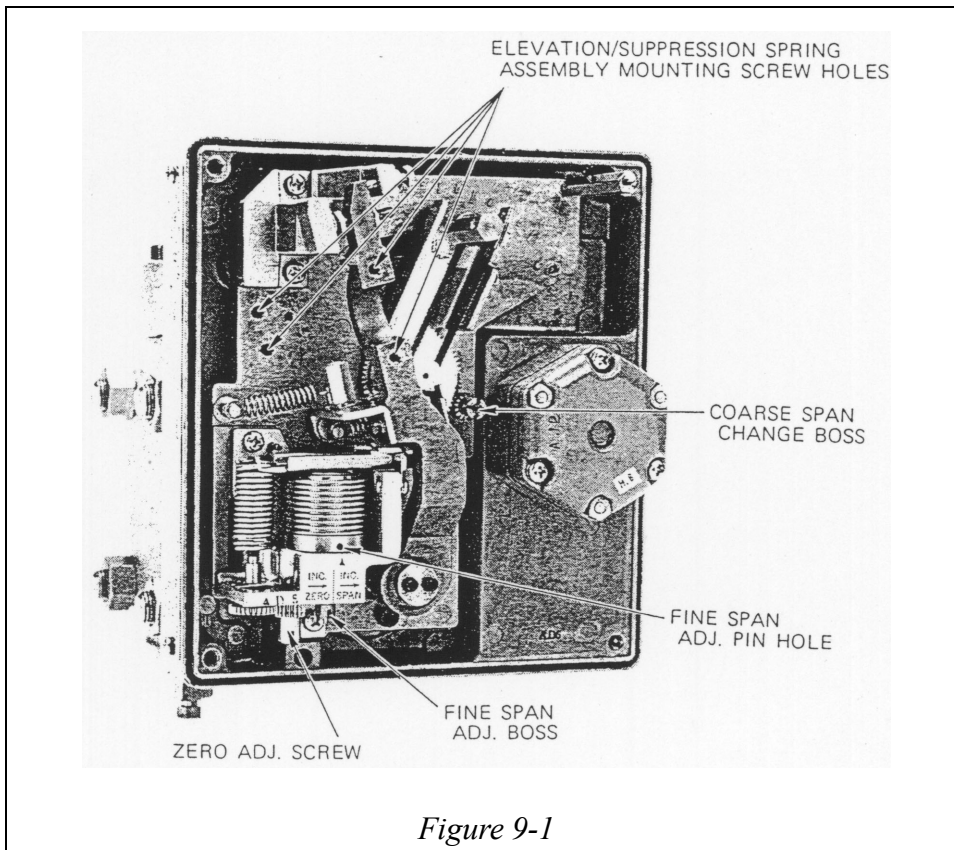


Figure 9-1

- (8) If the output pressure has shifted from 100%, adjust the SPAN ADJ boss at the bottom of the feedback bellows as follows:

If the output is higher than 100%, turn the boss so that the output becomes lower than 100% by an amount of 1/4 of the shift. (For example, if the output is 104%, turn the boss so that the output becomes $100 - 1/4 \times 4 = 99(\%)$).

If the output is lower than 100%, turn the boss so that the output becomes higher than 100% by an amount of 1/4 of the shift. (For example, if the output is 98%, turn the boss so that the output becomes $100 + 1/2 \times 2 = 100.5(\%)$)

The span can be adjusted also by turning the feedback bellows by inserting a pin into the SPAN ADJ PIN HOLE instead of adjusting the SPAN ADJ boss. As you turn the feedback bellows, the span changes as follows:

Clockwise turn of bellows: Output increases. (Span becomes wider.)

Couterclockwise turn of bellows: Output decreases. (Span becomes narrower.)

- (9) Repeat procedures (5) - (8) until the required accuracy is attained.

9-3 : Setting of elevation / suppression

Elevation / suppression can be realized by providing the actual required the zero shift which has initially been eliminated as mentioned in “9-1 : General”.

After setting an elevation / suppression, apply an input corresponding to 100% of the measuring range and, if the 100% point has been shifted, perform SPAN Adjustment. In this case, the zero point and 100% point should be of equal values with the elevation / suppression taken into consideration.

9-3-1:Setting of elevation

When all adjustment (without elevation) has been completed, install the elevation spring assembly on the bass plate and input beam.

Apply an input corresponding to the required zero point shift and turn the spring adjustment bolt with a wrench so that the output pressure becomes 20 kPa {0.2 kgf/cm²}. As you turn the bolt counterclockwise, elevation will increase.

9-3-2:Setting of Suppression

Suppression can be set in the same manner as for elevation. As you turn the spring adjustment bolt clockwise, suppression will increase.

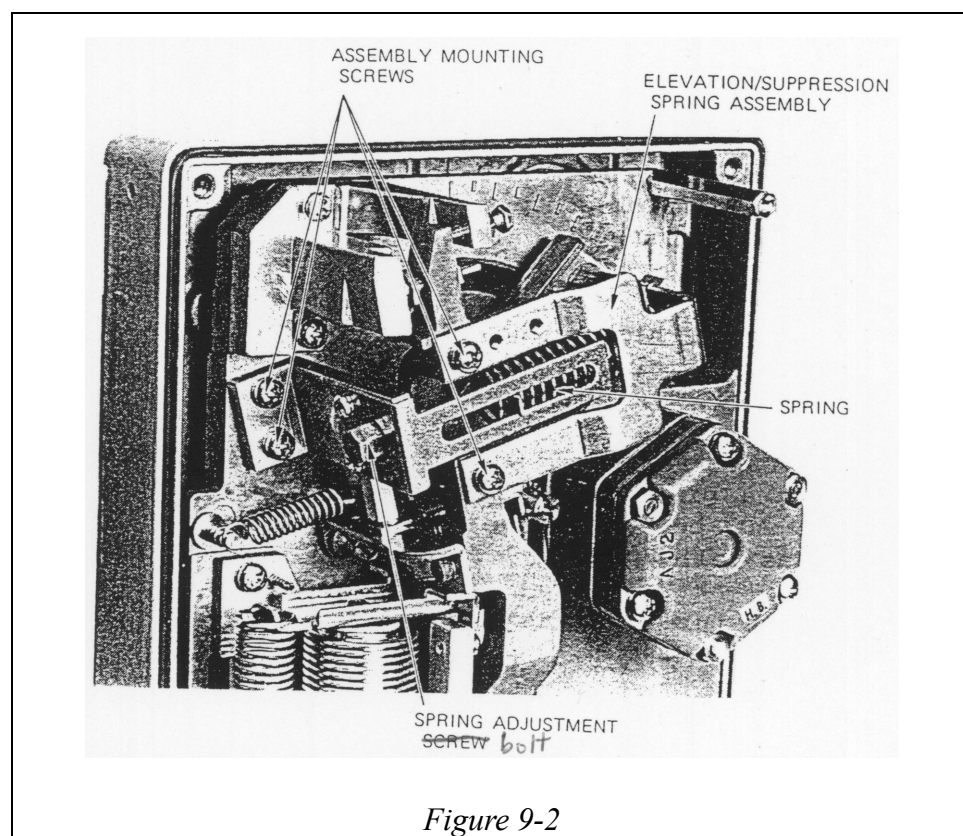


Figure 9-2

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