ENGINEERING AND MATERIAL STANDARD

FOR

INSTRUMENT PROTECTION

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1. SCOPE

This Standard coveres the basic engineering and materials requirements for instrument protection aspects, which includes; sealing, purging, heating, instruments shading and enclosures.

For high temperature and severe vibration environments, reference to be made to the related instrument standards.

It is intended to be used in oil, gas, and petrochemical industries.

2. REFERENCES

Throughout this Standard the following standards and codes are referred to. The editions of these standards and codes that are in effect at the time of publication of this Standard shall, to the extent specified herein, form a part of this Standard. The applicability of changes in standards and codes that occur after the date of this Standard shall be mutually agreed upon by the Company and the Vendor/Consultant.

ASTM (AMERICAN SOCIETY FOR TESTING AND MATERIALS)

A 53	"Pipe Steel, Black and Hot Dipped, Zinc-Coated Welded and Seamless"
A 112	"Zinc Coated (Galvanized) Steel Tie Wires"
A 269	"Seamless and Welded Austenitic Stainless Steel Tubing for General Service"
B 21	"Naval Brass Rod, Bar, and Shapes"
B 75	"Seamless Copper Tube"
B 241	"Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube"

ANSI (AMERICAN NATIONAL STANDARDS INSTITUTE)

B 31.1	"Code for Pressure Piping"

IEC (INTERNATIONAL ELECTROTECHNICAL COMMISSION)

529	"Enclosure Protection Classification".

API (AMERICAN PETROLEUM INSTITUTE)

RP-550, Section: 8	"Seals, Purges and Winterizing"
5 L	"Line Pipe"

IPS (IRANIAN PETROLEUM STANDARDS)

G-EL-190	"Electrical Heat Tracing"
M-EL-270	"Wires and Cables"

3. UNITS

This standard is based on International System of Units, (SI) except where otherwise specified.

4. GENERAL

Instrument installation methods shall ensure proper, dependable operation of the instruments under all operational and climatic conditions.

1) Conditions requiring special provisions comprise:

a) Liquids which solidify (or have high viscosity) at 20°C These fluids shall not enter the instrument, because shop repair would be impossible.

b) Liquids which solidify at the lowest ambient temperature (including water at sub-zero temperatures). These liquids shall not enter the instruments and pressure piping, to prevent malfunctioning and/or damage.

c) Special attention shall be given to gas measurements where hydrate formation may occur at low temperatures.

d) Fluids containing solids (including coke particles).

2) For solidifying liquids, or where hydrate formation is expected, the seal may be either a diaphragm seal or a liquid seal in the instrument and piping.

For liquids containing solids, a diaphragm seal may also be applied, provided the process connection is large enough to prevent plugging.

For all other cases a suitable purge medium shall be applied through the instrument and its piping.

3) Where the above provisions are not sufficient, e.g. in cold climates, heating of pressure piping and instrument shall be applied, then care shall be taken that the instrument is not overheated.

4) It should be realized that purging and heating systems are expensive, both in installation and operation, and are only effective when the supply is reliable. For this reason, purging and heating shall be avoided wherever possible.

5. SEALING

5.1 Liquid Seals

a) Where liquid seals are applied, the sealing liquid shall:

- Differ in density from the fluid to be measured;
- not mix or react with the process fluid or otherwise interfere with the process;
- not evaporate under operating and ambient temperatures;
- not freeze at the lowest possible operating and ambient temperature.

b) Sealing liquids having a density higher than that of the process fluid should be used.

c) Filling/flushing connector(s) shall be provided at the lowest point for filling the impulse line(s) and instrument with sealing liquid.

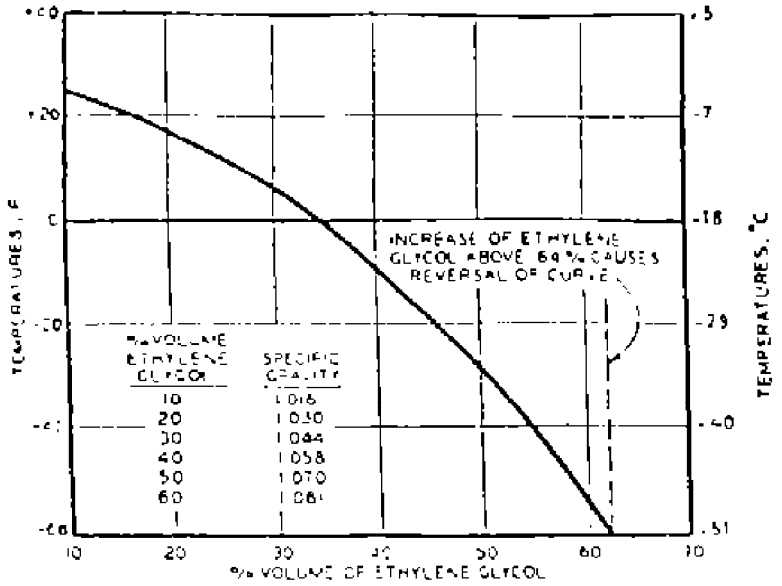
d) Seal pots shall be installed to provide a buffer volume.

e) A seal pot shall be provided in the pressure piping. The latter shall be provided with a filling valve at the lowest point and a vent plug or vent valve on the highest point.

Type of sealing liquid shall be indicated on the pressure piping drawing.

f) When the liquid sealing method is adopted consideration shall be given in the selection of the sealing liquid to local availability and cost.

g) Water or ethylene glycol and water mixture have the requisites for most sealing operations in the petroleum industry and are used almost to the exclusion of any others. Ethylene glycol should be the inhibited type to prevent it from becoming corrosive. Characteristics of ethylene glycol and water mixtures are given in Fig. 1 other sealing liquids and their properties are given in Table 1.



ETHYLENE GLYCOL AND WATER SOLUTION

Fig. 1

Note:

Cruve does not represent true freezing point of ethylene glycol and water solution. It gives recommended mixtures which assure the proper operation of a sealed instrument.

TABLE 1 - GENERAL PROPERTIES OF SEALING AND MANOMETER-LIQUIDS

Liquids	Specific Gravity 60 F/60 F	Specific Gravity 68 F/60 F	Action with Water Vapor	Vapor Pressure (Millimeters of Mercury at 68 F)	Viscosity in Centipoises 15 60 F	Viscosity in Centipoises 20 68 F	Freezing Point °C	Freezing Point (Degrees Fahrenheit)	Boiling Point °C	Boiling Point (Degrees Fahrenheit)	Flash Point °C	Flash Point (Degrees Fahrenheit)	Thermal Expansion Per Degree Fahrenheit Times 10^6	Thermal Expansion Per Degree Centigrade Times 10^6
Water	1.0000	0.9992	...	17.5	1.1249	1.0050	0	32	100	212	Nonflammable		115	207
Mercury	13.57	13.56	Negligible	0.0012	1.62	1.6	-39	—38	360	679	Nonflammable		101	182
Kerosine, 41 deg API at 60 F	0.8200	.	Negligible	.	2.2	2.0	-28	—20	149	300+	49	120	480	864
Ellison gage oil	0.8340	.	Negligible	.	.	.	4410	.	149	300+	60	140	466	839
Halowax oil	.	1.19 to 1.23		0.3*			-411	2410 — 42			95	203	367	660
Ethyl alcohol, C_2H_6O	0.7939	0.7907	Absorbs	43.9	1.3	1.2	-117	—179	78	173	13	55	600	1,080
36 percent by volume ethyl alcohol in ethylene glycol		1.000	Absorbs				-57	—60	78	173	21	70	427	769
Ethylene glycol, $C_2H_6O_2$	1.117	1.114	Absorbs	0.12	25.66	20.9	-13	9	195	388	118	245	354	638
50 percent by weight ethylene glycol in water	1.068	1.065	Absorbs	13.3	4.364	3.76	-36	—32	107	225	Nonflammable			
Butyl Cellosolve (ethylene glycol monobutyl ether), $C_6H_{14}O_2$	...	0.9019	Absorbs	0.85	.	3.3	-73	—100	171	340	68	155		
Carbitol solvent (diethylene glycol monoethyl ether), $C_6H_{14}O_3$	.	1.0273	Absorbs	0.13			-60	—76	195	383	96	205		
Glycerin (glycerol), $C_3H_8O_3$	1.2650	1.2623	Absorbs	9.4		1,410.0	18	64	290	554	160	320	281	505
50 percent by weight glycerin in water	1.1295	1.1274	Absorbs		7.5	5.99	-23	—9.4	106	223				
Dibutyl phthalate, $C_{16}H_{22}O_4$	.	1.0484	Negligible	0.01		20.3	-35	—31	315	642	171	340	439	790
Benzene (benzol), C_6H_6	0.884	0.8794	Negligible	74.7	0.7	0.66	5.5	42	80	176	-11	12	687	1,237
o-Dibromobenzene, $C_6H_4Br_2$		1.959	Negligible				1.7	35.2	221	430	65.5	150+	432	778
1,1-Dibromoethane, $C_2H_4Br_2$	.	2.093	Negligible	34.7	1.85	1.7	4.4	40	110	230	24	75+	532	958
Acetylene tetrabromide (tetrabromoethane), $C_2H_2Br_4$	...	2.969	Absorbs slightly				-20	—4			Nonflammable		370	660
Fluorolube FS (trifluorovinyl chloride polymers)	1.868	...		0.018†			-60	—71						
Fluorochemical N-43, $(C_4F_9)_3N$	1.872	..		.			-50	—58						
Fluorochemical O-75, $C_8F_{16}O$	1.760	.		..			-100	—148	...					
Kel-F oil (trifluorochloroethylene polymers)	1.910	..	...	...			<-37.2	<—35						

* At 122 F.

† At 100 F.

5.2 Diaphragm Seals

a) Flexible diaphragm or bellows are used to hold the sealing liquid in the instrument and to mechanically separate the sealing medium from the measured fluid.

b) Diaphragm seals may be applied for instruments which can be mounted directly on the process connection, e.g. pressure gages with integral diaphragm seal.

c) Diaphragm seals with capillary systems shall only be specified when no suitable sealing liquid can be selected.

d) Diaphragm seals shall normally be integral with the instrument. The application of diaphragm seals with capillary extentions shall be kept to an absolute minimum.

e) Special attention shall be paid to diaphragm seals on low differential pressure and pressure applications.

f) Applications of diaphragm seals with capillary extensions require the written approval of the user.

g) When a diaphragm seal is required, the largest practical size should be applied.

h) Diaphragm seal material shall be 316 SS, unless otherwise is specified, special coating materials may be considered where these will improve the corrosion resistance of the diaphragm. The type of coating material requires the written approval of the user.

i) The capillary tubing shall be of suitable and flexible material and be shielded by flexible stainless steel tubing with a neoprene or PVC cover, according manufacturer's standard.

j) The length of the capillary tubing shall suit the application, but the length should be at least 1.0 meter. For differential pressure applications the capillary tubings shall be of the same length.

k) The maximum allowable operating temperature for liquid-filled diaphragms shall be observed.

5.3 Seal Chambers

Generally a few types and sizes of seal chambers, or condensate pots, meet most sealing problem requirements. Details for two of the most populars types of seals used are shown in attached drawings, on page: 41. Seal chambers are either to be supplied by the manufacturers or made in the field.

6. PURGING

6.1 General

Some instrument applications are made possible by the use of purge fluids which may be liquid or gas. These Fluids are introduced into the instrument lines and flow out through the instrument and to sweep the lines clean of the measured material which tends to enter the instrument lines.

6.2 External Purging

a) External purging may be considered only if other methods to eliminate problems caused by condensation, vaporization, or plugging are not practicable. Its use however, should be avoided whenever possible since it could cause false differentials; the installation costs are also higher and more frequent maintenance is required.

b) The purge fluid shall be free from solids, be non-corrosive and in single phase at the operating temperatures and pressures. It shall not interfere with the process nor react with the fluid to be measured. Purge systems shall have a guaranteed source, at a pressure which is constant and higher than the maximum process pressure, and a low but constant flow rate shall be maintained in each line.

c) Purging of instrument lines requires a suitable purge liquid or gas at a pressure sufficiently high to ensure continuous and even flow of the purge into the instrument lines. For example, purge oil should be clean free of a tendency to flash, non contaminating to products and available at a pressure greater than that of the measurement. Purge gases must be clean, dry, and compatible with process conditions.

d) The approximate velocity at the process connection shall be 0.06 m/s for liquid purge and 0.6 m/s for gas or steam purge.

e) The purge injection point shall be close to the instrument and since the process fluid may enter part of the impulse line on purge supply failure, the materials shall be selected accordingly.

f) A restriction orifice nipple shall be installed to keep the purge flow constant. A constant pressure regulator shall be installed under varying supply or process pressures, and under increasing resistance to flow in the case of partial plugging of lines or connections.

g) Essentially a purge assembly consists of a filter which can be flushed, check valve(s) and a vent valve with anti-tamper facilities. The check valve(s) shall be of high quality, to be spring-loaded and have a soft seat to ensure a perfect shut-off.

h) Where the rate of purge flow is not greater than the displacemen of fluid brought about by the operation of the instrument surge chambers, or pots, shall be installed.

6.3 Self-Purging

a) Where self-purging is applied, process connections should be located on top (or at the side) of the equipment, the impulse line(s) shall drop vertically downwards from the instrument and then continue, sloping downwards at a ratio between 1:10 and 1:20 to the mechanical isolating valve(s) at the process connection. To prevent errors of measurement due to liquid static head if the self-purging is not operating properly, the vertical drop from the instrument shall be as short as possible.

b) The first part of the impulse line(s) from the process connection shall be insulated to reduce heat influx to the process fluid, while the following part shall have an exposed length to enable evaporation of the process fluid by heat influx from the surrounding atmosphere.

For typical details of self purging impulse lines see typical drawing 1A & 1B on pages: 35 & 36.

c) In all cases, it is necessary that all process fluids evaporate at the operating pressure and at the lowest ambient temperature. Where the liquid contains heavy components which will not evaporate at minimum ambient temperature, heating of the impulse line(s) shall be applied to assist evaporation.

d) Heating of impulse lines shall be provided where self-purging is not expected to operate satisfactorily under all process conditions, e.g. during start-up and shut-down.

7. HEATING, WINTERIZING AND INSULATION

7.1 General

a) Where heating of impulse lines is necessary, use should be made of process heat by installing the first part of the impulse line up to the seal pot, inside the insulation of the process piping or equipment. Where this is not possible or when sealing liquid is not applied, the impulse lines and the wetted parts of the instrument shall be heated from an external source.

Overheating of the instrument shall be avoided. See typical drawings 2 through 5 on pages: 37 through 40.

b) An appropriate layer of insulation shall be provided between the instrument line and heat tracing to prevent liquid in these lines from vaporising.

c) Heat tracing shall not be applied to condensation chambers where this would cause vaporisation.

d) Winterization or heating shall not obstruct the operation of items such as valves, cocks, etc.

e) A pre-assembled instrument housing around the instrument body, manifold, and heating facilities shall be provided.

f) Saturated steam is the heating medium most commonly used, but when not available, hot water or hot oil systems or electric tracing shall be considered.

7.2 Heating and Winterizing

a) Low-pressure steam at 4 barg is usually suitable for heating purposes. When high temperatures are required, or when instruments are located far away from the low-pressure steam system, medium-pressure steam up to 20 barg shall be considered.

b) The steam supply systems should be used as follows:

- low pressure steam, for winterizing and for heating process fluids with a maximum pour point of 50°C.
- medium pressure steam, for heating process fluids with a pour point above 50°C.

c) The steam supply and condensate return piping, which forms part of mechanical engineering, shall run close to the take-off and return points. See figs. 3 & 4 on pages: 33 & 34.

d) Where practical,instruments shall be installed in heated buildings to simplify protection requirements and facilitate maintenance.

e) The arrangement shall be such that the instrument can be removed without disconnecting the tracer tubing and/or tracer block.

f) All steam tracing material shall be copper tube throughout with brass fittings. Stainless steel tubing shall be used in areas where copper may be unsuitable e.g. corrosion environments.

g) Non-metallic spacers fitted between impulse lines and heat tracing tubing shall be used to prevent overheating.

h) When heating is required, e.g. for fluids with high pour points, heater tubing and the impulse line shall be clamped together.

i) In all cases the clamping material should normally be stainless steel.

j) The total number of joints in the tracer tubing shall be kept to a minimum.

Notes:

1) The heating of all "in line" equipment, e.g. control valves, turbine meters, positive displacement meters, etc., which is installed in process piping shall be incorporated in the pipe tracing which forms part of mechanical engineering.

2) Stainless steel means 316 AISI type.

3) Hollow bolts shall not be applied to heat the d/p cell body.

4) Other material may be used after approval of the user.

k) Each instrument shall have its own steam supply and condensate return with isolating valves, labelled with the tag number of the instrument. See Figs. 3 & 4, on pages: 33 & 34.

l) The steam flow in the tracer tubing shall be downwards and pockets in the tubing shall be avoided because build-up of condensate will prevent a continuous steam flow.

m) Each tracer line shall terminate in a condensate return line via a strainer and steam trap, at the lowest point, which forms part of mechanical engineering. See Figs. 3 & 4, on pages: 33 & 34.

n) The heating steam system(s) for pressure piping shall be separated from other steam systems, and have a separate isolating valve at the plot limit, enabling continuation of steam heating during plant shutdowns.

o) The condensate shall flow via closed piping into the condensate collecting system (when existing). Back pressure of the condensate system shall be taken into account when selecting the steam trap. For isolated instruments away from the condensate collecting system, a free condensate outlet into the oil-free plant drainage system shall be considered.

p) All steam supply lines, and the traced pressure piping and instrument parts, shall be heavily insulated. All couplings (break joints) shall preferably be outside the insulation.

q) Condensate return lines may also require insulation (and even steam tracing) to prevent freezing.

r) Steam tracing shall be designed such that the lines and instrument are in direct contact with the heating lines, where maximum heating effects are essential, the tracing shall be cemented to the connecting lines and instrument. However care must be taken not to overheat, or unevenly heat the lines and instruments.

s) For instruments requiring heating and or weather protecting facilities, a code shall be indicated next to the instrument number circle, as following:

H- Heating
ST- Steam Traced and Insulated
ET- Electric Traced and Insulated
WS- Winter Seal
B- Body Enclosure
P- Protective Shade

t) Steam tracer lines are to be securely bracketed to instrument or impulse lines. Care shall be taken to assure that tracer lines and insulation do not cover vent holes, external adjusting screws, valve handles, etc.

u) Where instruments have glass fronts, such as rotameters and level gages, care shall be taken to assure that tracer lines do not extend over the glass covers.

v) Where spacers are indicated between the tracer line and the instrument, care shall be taken to assure that the spacer is securely placed in position and the instrument or impulse line is not exposed to overheating.

w) Control valves are not traced with the associated process piping, except that valves are steam traced on gas or vapor services with high pressure drops, where hydrates may be formed, or where freezing or congealing may occur.

When control valves used as direct connected regulators require winterizing, the pressure control line and valve diaphragm chamber containing the process fluid shall be heat traced and insulated. When the diaphragm chamber is sealed, the pressure control line shall be heat traced and insulated from the point of seal to the process line connection.

x) The maximum length of tracer line serviced by one trap shall be limited to the values given in table below:

STEAM PRESSURE		TOTAL DISTANCE		TOTAL VERTICAL DISTANCE	
BARG	PSIG	METER	FEET	FEET	METER
0 - 3.4	0 - 50	30	100	10	3.0
3.4 - 8.2	51 - 120	45	150	15	4.5
8.2 - 11.2	121 - 165	60	200	20	6.0
11.2 - 17	166 - 250	75	250	25	7.5
17 - ABOVE	251 - ABOVE	90	300	30	9.0

y) The maximum run of tracer lines shall be measured from the point at which the tracer line is first attached to the traced line (or equipment) to the point at which it leaves the traced line (or equipment). Where the tracer is wrapped around several valves or instruments, etc.., the above maximum runs shall be reduced by 25%.

z) Inspection and Testing

1) The following visual inspections shall be made prior to insulating:

- Tubing and pipe bends shall be visually inspected for kinked or flattened sections. All such sections shall be cut-out and replaced.

- Tracer attachment shall be checked to ensure freedom of movement towards expansion loops.

- Tracer attachment shall be inspected at expansion loops, at equipment breakpoints, and at other changes of direction where movement of the tracer could damage the insulation.

2) The tracer system shall be pressure tested, prior to insulating. Hydrostatic test pressure shall be at least 7 barg (100 psig) or 1.5 times design pressure, whichever is greater.

7.3 Steam Tracing

7.3.1 Design considerations for the system

a) Tracer sizing shall be based on the following:

- Using the insulation thickness specified.
- The normal operating (fluid) temperature.
- The average winter temperature.
- The average wind speed of the coldest month.

b) Tracer systems shall be designed on the basis of tracer attachment by tie wires or bands. Alternate methods of attachment including the use of preinsulated steam supply and condensate lines are acceptable when economical justification is accepted by the user's Engineer.

c) Spacers shall be provided between tracers and the piping or equipment when any of the following fluids are being handled.

- Acid or caustic fluids.
- Heat sensitive fluids.
- Fluids having electrolytic properties where hot spots will accelerate the corrosion rate.

Additionally, spacers shall be provided between tracers and piping or equipment which is lined with glass, rubber, plastic or other heat degradable materials.

d) A separate steam distribution header shall be provided for tracing instruments and attendant piping, connected in such a manner that the instrument tracing will not be shut off when steam is shut off to other users. An exception is allowed for local pressure indicators which may be protected by the pipeline or equipment tracers.

e) The steam supply for tracers required continuously for equipment protection against ambient temperatures shall be independent of the steam supply required intermittently for winterization.

f) Bypass piping around steam traps is required where the process being protected cannot tolerate any loss of heat due to interrupted steam flow. All bypass installations shall be reviewed with the user's Engineer.

g) Lead lines for differential pressure instruments shall have common heating and insulation.

7.3.2 Design considerations for the instruments

a) Control valves

Where control valves are installed in process piping which require steam tracing, heating of the valve body is usually incorporated in this pipe tracing. Unions shall be provided in the tracer piping for removal of the valve.

b) Positive displacement meters

Electric heating (with thermostat) is the standard method. However, when steam tracing is applied, the same considerations as for control valves shall be applied.

c) Displacer-type level instruments

These usually require heavy steam tracing. A cage of ½ in. piping shall be fabricated and clamped around the displacer chamber.

d) Level gages

Copper tubing 3/8 in. OD shall be applied on both sides of the body of the level gage.

e) All other instruments

Copper tubing 3/8 in. OD shall be tied to, or wrapped around, the instrument pressure piping (and, when required, also the instrument).

The line-up shall be such that the instrument can be removed without need for disconnecting the steam tracing.

7.3.3 Steam tracing materials

a) Copper or copper alloys shall not be used under the following conditions for tracer system components:

1) The temperature specified for mechanical design is greater the 260°C (500°F) .
2) There is a possibility of ammonia contamination in the steam.
3) Within process unit areas where the components will be in contact with elemental sulfur dust or molten sulfur (leakage).

b) Tracers for aluminum equipment shall be aluminum or stainless steel.

c) Tie wire or bands for securing tracers shall be as follows:

1) Material selection for tie wire or bands shall be as given below:

TRACER MATERIAL	TIE WIRE OR BAND MATERIAL
CARBON STEEL	GALVANIZED CARBON STEEL
COPPER	COPPER COATED STEEL OR COPPER
ALUMINUM, STAINLESS STEEL	STAINLESS STEEL

2) The minimum diameter of tie wire shall be 1.6 mm. Copper wire shall be soft drawn. Galvanized steel and stainless steel wire shall be annealed.

3) The minimum size of bands shall be 10 mm × 0.4 mm.

d) Spacers (used between tracers and the piping or equipment) shall be an insulating material suitable for the steam temperature. Sections of rigid, load bearing, insulation such as calcium silicate or cellular glass are acceptable.

e) Wall thickness of tubing tracers shall be as given below:

MATERIAL	TUBING SIZE (NPS OR OD AS INDICATED) in.	mm.	WALL THICKNESS in.	mm.
TUBING: CARBON STEEL	½ OD	12	0.065	1.65
	¾ OD	20	0.095	2.41
	1 OD	25	0.109	2.77
COPPER, STAINLESS STEEL, ALUMINUM	¼ THRU ¾ OD	6 THRU 20	0.032	0.81
	1 OD	25	0.049	1.24

f) Expansion Loops

Expansion loops shall be provided for all straight runs of tracer longer than 7.5 m as follows:

1) Spacing shall not exceed 30 m.

2) The sum of the effective legs of the loops shall be at least (0.6 m for 7.5 m) runs, and (1 m for 30 m) runs.

3) Loops shall be oriented to be self draining.

g) Fittings

Compression type, brass fittings shall be used with copper tubes, and suitable fittings shall be used for other type of tubing.

7.4 Electrical Tracing

a) The advantage of electrical heating is that heat input can be tailored to the application and can be controlled thermo-statically at a reasonable cost.

b) When selecting heating elements, care should be exercised to assure that they are not potential sources of ignition.

c) Electrical tracing should normally be applied for winterizing only. Its use requires the written approval of the user.

Note:

Electrical tracing shall not be applied for processes where the maximum working temperature exceeds the guaranteed temperature limitation of the selected heating tape.

d) The heating equipment shall satisfy the requirements for electrical safety in accordance with the area classification.

e) When electrical heating is adopted the heating shall be thermostatically controlled.

f) The arrangement of the electric tracing shall be such, that transmitters can be removed without disconnecting the electrical heating block. The electrical heating block and/or electric heater which is attached to the manifold, forms part of instrument engineering.

g) All other components of electric tracing form part of electrical engineering. Refer to IPS-G-EL-190 "Electrical Heat Tracing" & IPS-M-EL-270 "Cables and Wires".

h) All materials shall be of the same quality which have proven successful in their respective uses in similar service and under similar conditions. The workmanship must be of high quality in every detail.

i) Consideration shall be given but not limited to environmental conditions, pipe material, pipe size and length fittings, type and thickness of insulation, lowest ambient design temperature, fluid flow conditions, type of control required such as thermistors, thermostats, etc. and area classification.

7.5 Insulation

a) Those parts of impulse lines which are filled with high-pour point fluids shall be surrounded by the insulation of the process piping or equipment to keep them hot.

b) The traced impulse lines and instrument parts, and all steam supply lines, shall be insulated. All unions in the tracer tubing and the impulse lines shall be accessible without removing the complete insulation, special markers on the outside of the insulation shall indicate their location.

c) The steam return lines may also require insulation and even winterizing to prevent freezing of the condensate.

d) For impulse lines, seal pots, steam supply lines, etc., the insulation normally consist of mineral wool fixed or wrapped around and covered with a weather-proof material. The chloride content in the mineral wool insulation should not exceed 10 mg/kg.

e) Other materials require the written approval of the user.

8. ENCLOSURES AND PROTECTIVE SHADES

8.1 Enclosures (Housing)

a) Under very adverse climatic conditions it may be necessary to install the entire instrument in a heated housing. This will considerably increase the installation cost, also because the pressure piping is usually much longer, and it shall therefore only be considered when absolutely necessary. When applied, the housings shall allow free access to pressure piping and instrument for their removal and/or repairs. Thermo-statically controlled electric heating is preferred to prevent overheating of the instrument.

b) The body enclosures shall be constructed such that parts which require removal for disconnecting the instrument are fixed to the mounting plate.

Note:

1) The electronic parts of instruments should not be installed within an enclosure in order to avoid that the area classification around that part is adversely effected.

c) Features which should be considered in determining the type and design of housings are:

1) WORKING SPACE AND ACCESS

The free space around the instrument, inside its housing, should be adequate for routine maintenance procedure and for the removal of the instrument. Properly sized and positioned access doors are necessary. Observation windows may be a desirable optional feature.

2) LINE ENTRY

Entry is preferably through the sides or the bottom of the box. Entries should be located to minimize piping and fittings.

3) INSULATION

The inside of a housing may be lined with foil-faced fiberglass or suitable insulating material securely attached to the walls. Insulating paint may also be used inside or outside the box with satisfactory results.

4) MOUNTING

Housings may be self-supporting, wall-anchored, or attached to the instrument support.

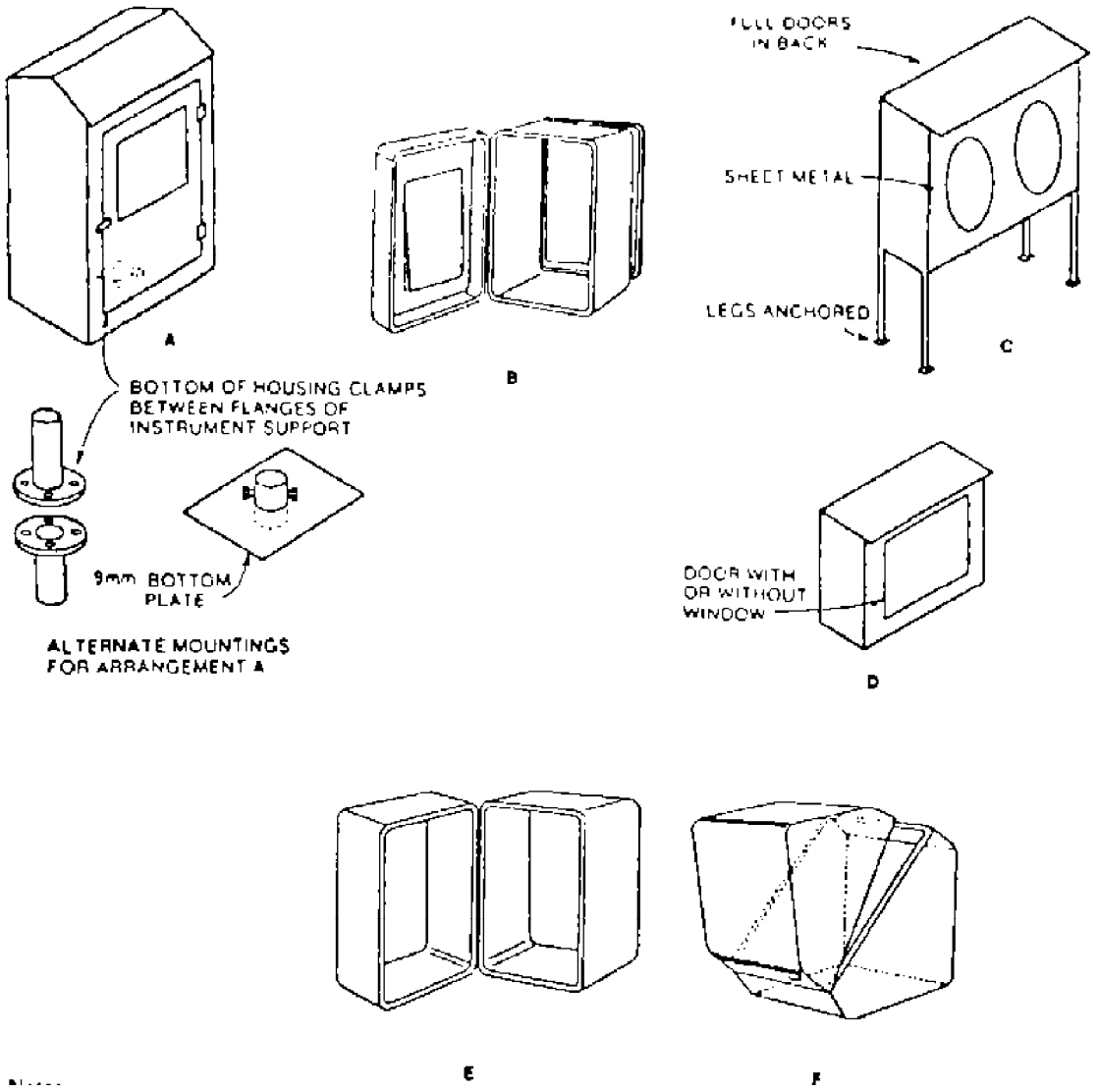
5) VISIBILITY OF INSTRUMENT

Instruments may be flush-mounted on housing walls or behind windows in the door or side of the housing.

6) WEATHERPROOFING

Housings should be rainproof and dustproof with line entries sealed. Metal housings should be galvanized or painted, or both. The hardware and assembly bolts and screws should be corrosionproof.

Typical instrument housings and mountings are given in Fig. 2.



Notes:

1) Housing insulation is foil-faced fiberglass, celotex, or insulating paint.

2) Arrangement "A" shows a typical instrument housing and mountings. Line entry point is optional; door in both front and back; window in front door.

3) Arrangement "B" is the same as Arrangement A except that a molded polyurethane enclosure is used.

4) Arrangement "C" shows a self-supporting housing.

5) Arrangement "D" shows wall-or line-supported housing. Back of box is heavy sheet metal. The housing is bolted to the wall or line bracket and supports the instrument.

6) Arrangement "E" is the same as Arrangement D except that a molded polyurethane enclosure is installed.

7) Arrangement "F" is a line-mounted or post-mounted polyurethane enclosure for small instruments.

INSTRUMENT HOUSINGS AND MOUNTINGS

Fig. 2

8.2 Protective Shades

a) Subject to environmental conditions,shades should be applied to protect the instruments.

b) Electronic instruments installed in tropical climates shall always be provided with a protective shade.

c) The shade shall be fixed to the mounting plate in such a way, that quick installation and removal is guaranteed.

d) Metal protective shades shall be galvanized or painted or both. The assembly bolts and screws shall be corrosion proof.

9. TRAPS, DRAINERS AND STRAINERS

a) Impulse type steam traps shall be used for general service such as headers, branches, and tracing as detailed in relevant piping specifications.

b) Inverted bucket traps shall not be used without written permission from the user in cases where these types apply.

c) Vacuum of lift traps shall be used for draining condensate from low pressure systems where the available pressure differential is too low for other types of traps.

d) Automatic drain valves, either float or diaphragm type for draining condensate or liquid from air or gas lines and receivers shall be used.

e) Ball float traps (continuous drainers) shall be used for modulating service such as draining condensate from temperature controlled reboilers, for trapping liquid in gas or air streams, and for venting air or gas from liquid streams.

f) Strainers shall be installed in the piping upstream of all continuous drainers. Metallic gaskets shall be used for steam pressure above, 20 barg. Integral strainers are preferred.

g) The body material for ball float traps and automatic drain valve shall be as follows:

1) 17 bar(g) and lower, cast steel.
2) Over 17 bar(g) forged steel or stainless steel as applicable.

h) End connections shall conform to piping specifications, except for steam tracing traps which shall be screwed type.

i) Trim material for traps and strainers shall be stainless steel.

j) The body material for steam tracing traps shall be stainless steel.

k) Minimum body size shall be ½ in. for traps in steam tracing or unit heater services. Minimum size shall be ¾ in. for all other traps.

10. CLIMATIC ZONE CLASSIFICATIONS

10.1 Zone Classification

Generally it is usefull to use the following climatic zone classifications for selecting the protection and winterizing procedure according to the following Tables:

CLIMATIC ZONE CLASSIFICATION	TEMPERATURE CONDITION
A	DAILY MEAN TEMP. NOT BELOW (-1°C).(1)
B	DAILY MEAN TEMP. BELOW (-1°C), BUT FOR NOT EXCEEDING 24 HRS DURATION.
C	DAILY MEAN TEMP. BELOW (-1°C) FOR PERIODS EXCEEDING 24 HRS DURATION BUT LOWEST AVERAGE AMBIENT TEMP. NOT BELOW (-18°C)(2)
D	LOWEST AVERAGE AMBIENT TEMP. BELOW (-18°C)(2)

Notes:

1) Where diurnal changes of about 16°C (30°F), are common, and where a daily mean temperature is not far above (-1°C), classification as zone A should be reviewed to assure satisfactory unit safety and operability.

2) Where the ambient temperature is the atmospheric temperature, the lowest average ambient temperature shall be taken as the lowest average temperature for the four coldest days (non consecutive) which occurred in any year.

10.2 Application and Methods

Following table should be used for selecting the protection and winterizing procedures:

INSTRUMENTS	ZONE A	ZONE B	ZONE C	ZONE D
1. INSTRUMENT BODIES (OR PORTIONS CONTAINING FLUIDS)	9.2 a	9.2 a	9.2 a	9.2 a
2. INSTRUMENT PIPING	9.2 b	9.2 b	9.2 b	9.2 b
3. LOCALLY MOUNTED INSTRUMENT	9.2 c	9.2 c	9.2 c 9.2 f	9.2 c 9.2 g
4. PROCESS ANALYZERS	9.2 d	9.2 d	9.2 d 9.2 f	9.2 d 9.2 f
5. ELECTRONIC INSTRUMENTS	—	—	9.2 e	9.2 e

a) Preferred practices are insulating, heat tracing and heated instrument housing (if required). The instrument mechanism and indicator portions of the transmitters shall be kept within the manufacturer's recommended temperature rating.

b) Instrument piping shall be winterized by sealing with an anti-freeze solution, where possible. Protective heating of lead lines shall be installed in a manner which will prevent the liquid from overheating and boiling away.

c) Locally mounted pressure gages and instruments, and seals required for corrosion protection, shall be winterized.

d) Enclosed walk-in type analyzer shelters shall be heated if the ambient temperature can drop below 5°C (41°F).

e) Electronic instruments which may be damaged by freezing shall be installed in heated housing or located in building to maintain the temperature within the manufacturer's recommended temperature rating.

f) Enclosed analyzer cabinets shall be heated.

g) Winterizing of locally mounted instruments shall be provided by means of insulated housing with steam coils or electric heating. Heating shall be installed in a manner to avoid hindering removal of the instruments and be within the manufacturer's recommended temperature rating.

		TRAPS AND DRAINERS				SHEET----OF-----		
		No.	BY	DATE	REVISION	SPEC. No.		REV.
						CONTRACT		DATE
						REQ. P.O.		
						BY	CHKD.	APPR.
	Tag Number							
	Service							
	Line No. / Vessel No.							
	Type							
BODY	Material							
	Size: Inlet Outlet							
	End Connections							
	Press. & Temp. Rating							
	Equalizing Conn. Size							
	Conn. Orientation							
TRIM	Trim Material							
OPTIONS	Internal Check Valve							
	Internal Bimetallic Vent							
	Thermostatic Vent Mti.							
	Gage Glass							
STRAINER	Internal Or External							
	Type & Size							
	Body Material							
	Press. & Temp Rating							
	End Connections							
	Blowoff Connections							
	Mesh Size & Material							
PROCESS DATA	Fluid							
	Normal Flow							
	Load Safety Factor							
	Maximum Capacity							
	Oper. Temp. Superheat							
	Press: In Out							
	Allow Press. Diff. max. Normal							
	Oper. sp. gr. Top Bottom							
	Calc. Orifice Size							
	Selected Orifice Size							
	Manufacturer							
	Model Number							

Notes :

IPS for E-IN-210

TRAPS AND DRAINERS

Instructions for IPS Form E-IN-210

1. Identification or item number.

2. Fill in service or location.

3. Write in specific trap type corresponding to general classification such as, inverted bucket, float, drainer, thermodynamic, etc.

7. Specify body material required.

8. Write in inlet & outlet connection size.

9. Specify if traps are to have flanged, screwed socket welded, buttwelded, end connections and specify the respective rating.

10. Write in temperature and pressure rating required.

11. Specify equalizing connection size if required (used with continuous drainers).

12. Show orientation or connections by sketch if necessary.

13. Write in any other features characteristic of the trap body.

14. Write in trim material. If to be manufacturers standard, write in "STD".

15. If specific items of trim, such as valve seats, need to be harder material than 14 above, write in material or description.

16. Indicate if internal check valve is required, state size (applies to Bucket Traps).

17. Specify 1 internal Bi-metallic Vent is required, (applies to Bucket Traps).

18. Indicate if thermostatic vent is required (used with Ball Floats) and specify bellows material.

19. Show if gage glass is required.

20. Write in any other accessory required not included in 16 through 19 above.

23. Specify if strainer is to be of internal or external variety, if to be supplied with trap. If not, write in ”By others.”

24. Indicate the specific type, i.e.,”Y” type, Angle Type, etc. and inlet outlet connection size.

25. Write in body material.

26. Write in strainer temperature and pressure rating.

27. Specify if strainers are to be flanged or screwed and specify the respective rating.

28. Show size of blow off connections. Also indicate if bushing or cap is required.

29. Specify mesh size and material if other than manufacturer’s standard is required.

30. Write in any other strainer requirements.

31. Show fluid being handled.

32. Specify the anticipated normal flow quantity of condensate to be handled.

33. Write in the safety load factor which is added to compensate for the start-up load under reduced pressure conditions.

34. Maximum capacity of trap should always exceed normal quantity to be handled plus the load safety factor.

35. Show the steam temperature plus superheat that may be present.

36. Show the normal pressure at Trap inlet and outlet.

37. Show the allowable pressure differential across the trap or drainer.

38. Show the liquid specific gravity above and below the normal level being held (important for continuous drainers).

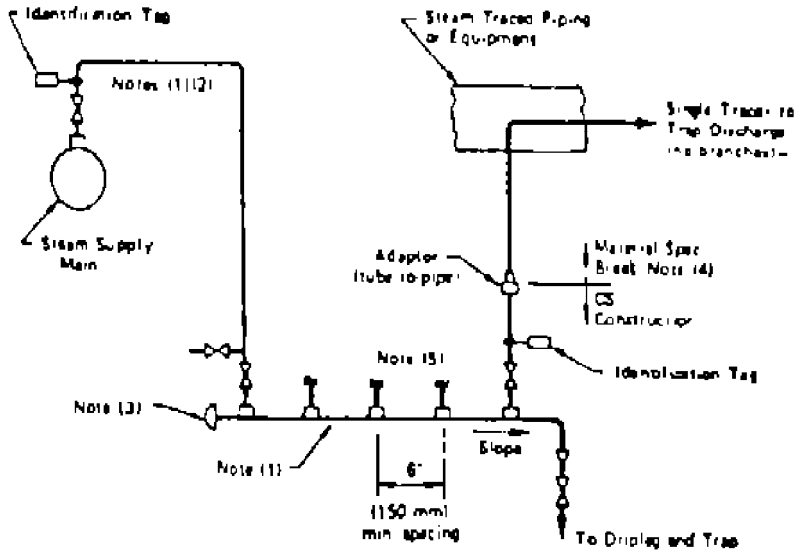
41. Show the calculated orifice size.

42. Specify the orifice selected from manufacturer's charts.

45-46. Write in manufacturer and model number if desired.

DISTRIBUTION HEADERS

The arrangement of piping and tubing components shall be as illustrated below:



Notes:

1) All take off connections located at top of headers.
2) Block valve at main for each distribution header.
3) Preferential location of distribution header based on, layout considerations to be; at accessible locations in elevated pipe-ways; at platforms; near grade.

4) Tube-to-pipe adaptor normally located at start of equipment or piping to be traced. At a change of material (material spec break), the carbon steel piping shall be braced.

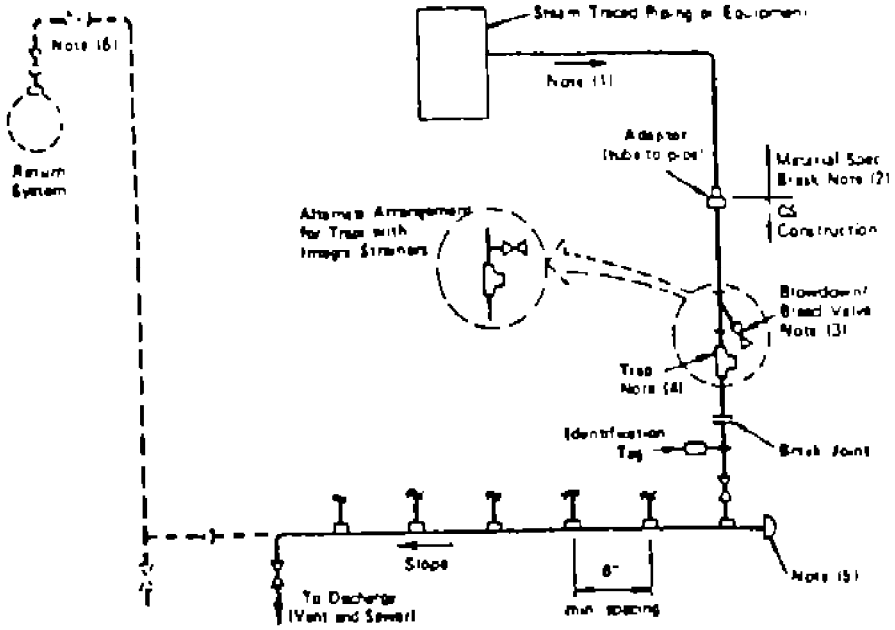
5) Tracer tubing shall be grouped together, whenever practicable, to permit insulation as a unit.

STEAM SUPPLY AND DISTRIBUTION

Fig. 3

CONDENSATE COLLECTION STATIONS

The arrangement of piping and tubing components shall be as illustrated below:



Notes:

1) Tracer configuration to permit gravity flow of condensate to traps. If tracer must rise vertically 3 ft (1 m) or more, it must be trapped before the vertical rise also.

2) Tube-to-pipe adaptor normally located at end of "effective tracer" of equipment or piping being traced. At a change of material (material spec break), the carbon steel piping shall be braced.

3) Y-type strainer required unless trap is furnished with an integral strainer.

4) Orientation of trap and block valves to be vertical whenever practicable. Traps shall always be installed to assure self-draining.

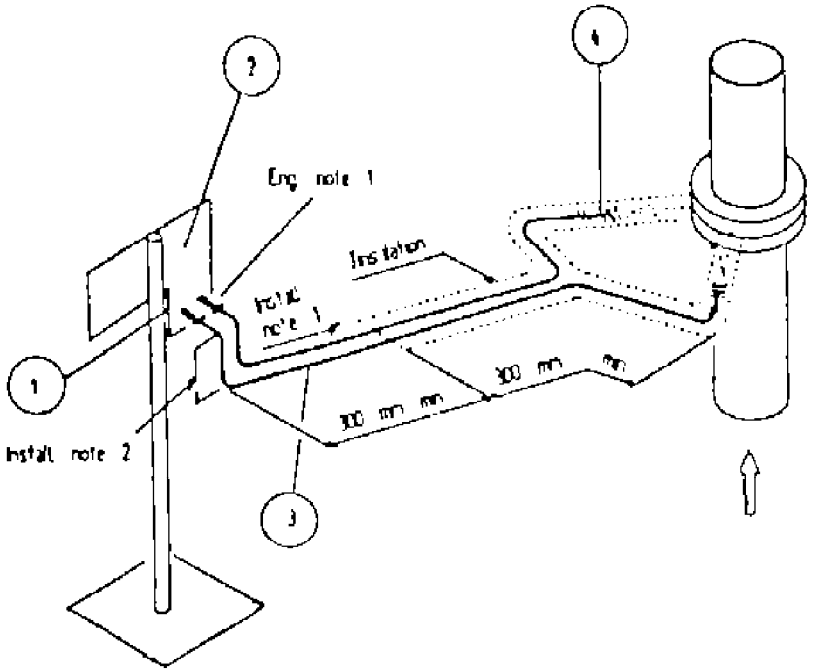
5) Collection header and steam traps located near grade or at platform.

6) Connection to return system located at top of header.

CONDENSATE REMOVAL

Fig. 4

Tag No.



Engineering notes:

1) Male connections shall form a part of the manifold supply.

Installation notes:

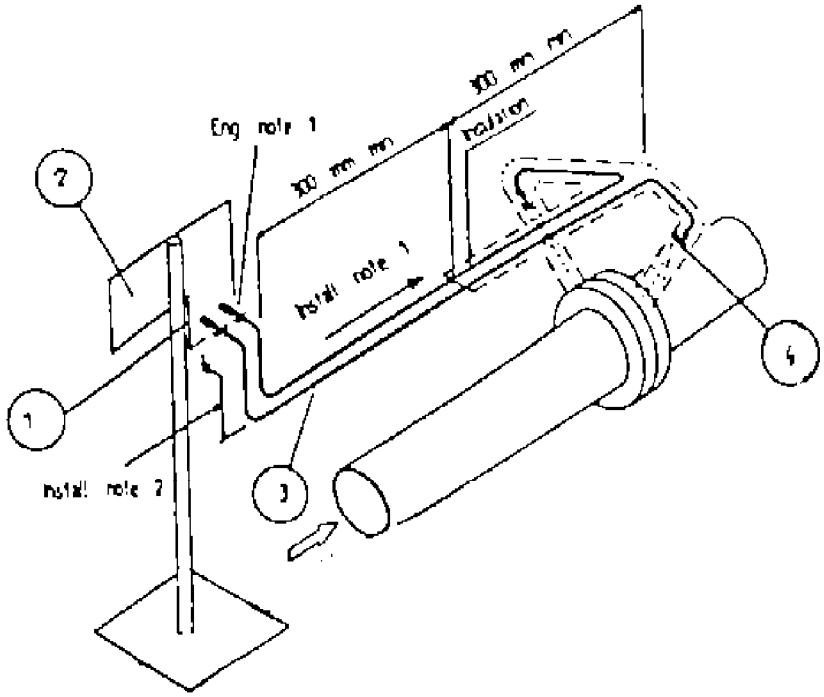
1) Slope 1: 10 to 1:20 and at same elevation.
2) This distance as short as possible.

ITEM	QUANTINTY	SIZE OR CONNECTION	DESCRIPTION	M.E.S.C NO.
1 2 3 4			DOUBLE ISOLATE/EQUALIZE/VENT BLOCK MOUNTING PLATE TUBING LAPPED-JOINT COMPRESSION FITTING	

TYPICAL DRAWING 1A

SELF PURGING IMPULSE LINES-FLOW INSTRUMENTS

Tag No.



Engineering notes:

1) Male connections shall form a part of the manifold supply.

Installation notes:

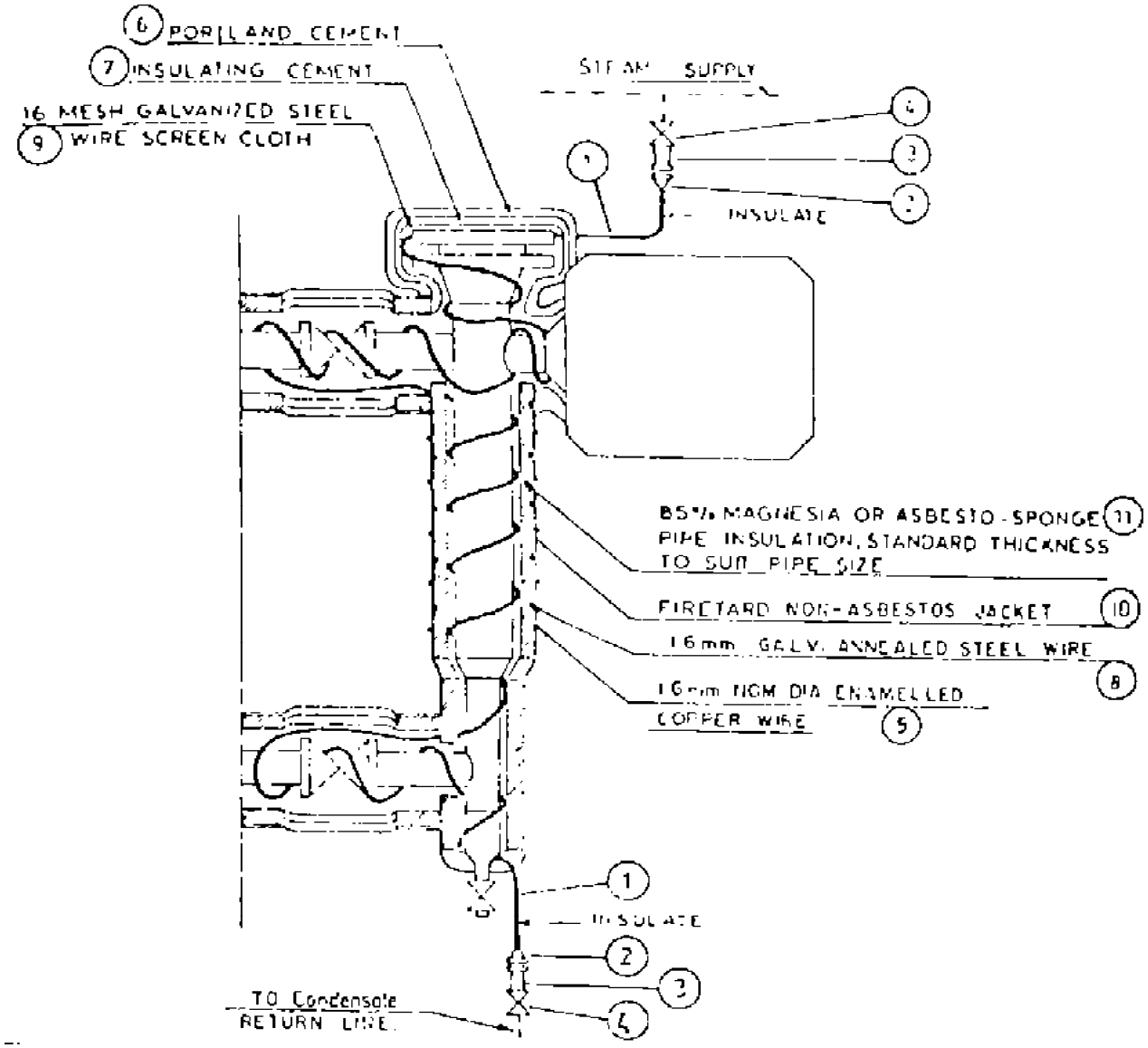
1) Slope 1: 10 to 1:20 and at same elevation.

2) This distance as short as possible.

ITEM	QUANTINTY	SIZE OR CONNECTION	DESCRIPTION	M.E.S.C NO.
1 2 3 4			DOUBLE ISOLATE/EQUALIZE/VENT BLOCK MOUNTING PLATE TUBING LAPPED-JOINT COMPRESSION FITTING	

TYPICAL DRAWING 1B

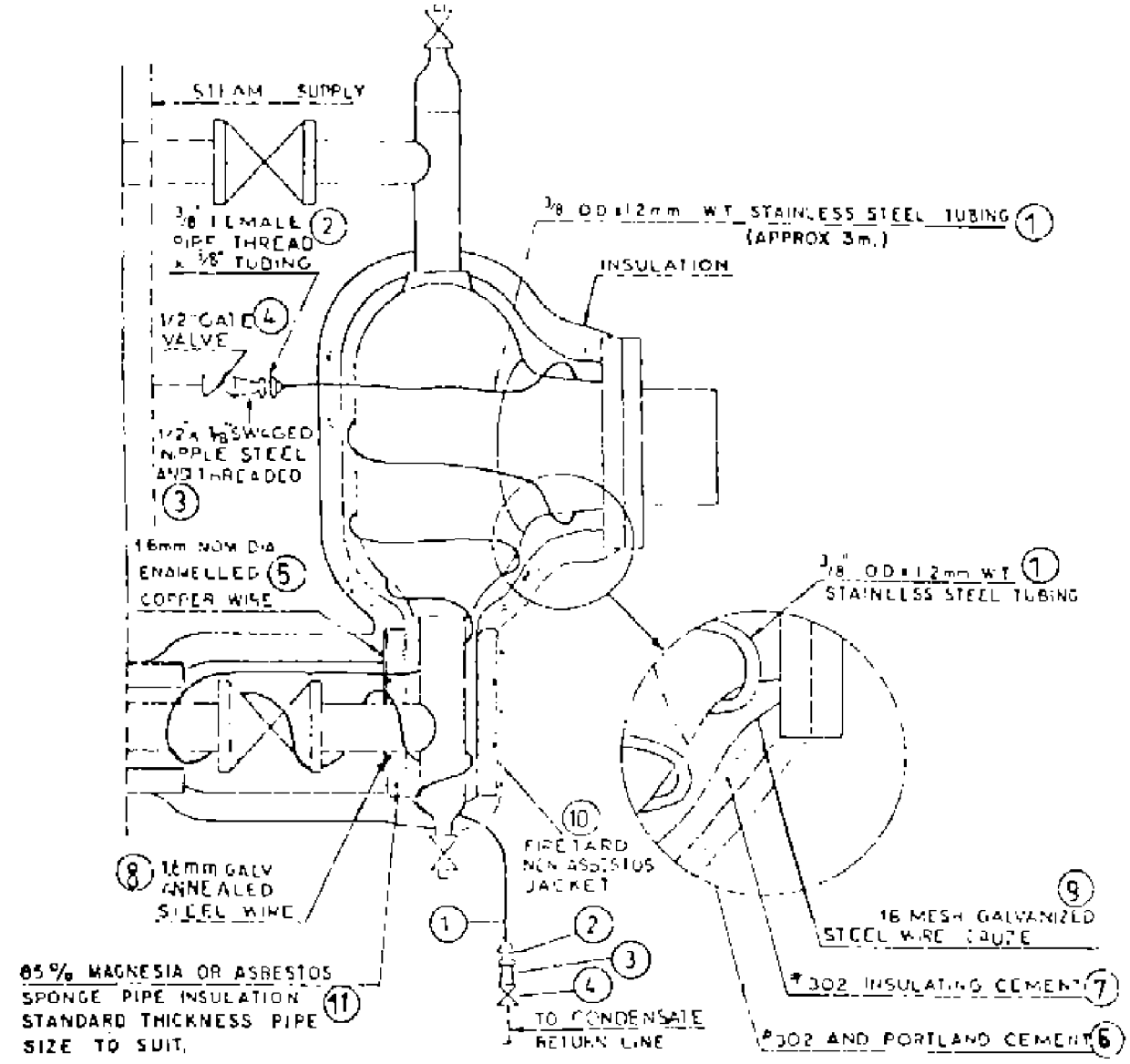
SELF PURGING IMPULSE LINES-FLOW INSTRUMENTS



ITEM	QUAN REQ.	SIZE	DESCRIPTION	MATERIAL	M.E.S.C NO.
1		3/8"	TUBING W.T. 1.2 mm.		
2		3/8"	3/8 FEMALE SCRD. × 3/8" O.D. TUBE CONNECTOR		
3		½" × 3/8"	SWAGED NIPPLE ANSI B2-1 NPT		
4		½"	GATE VALVE, SCRD., API CL 800		
5		1.6 mm.	WINDING WIRE, ENAMELED, ROUND		
6		BG.	PORTLAND CEMENT		
7		DR.	INSULATING CEMENT		
8		1.6 mm	BINDING WIRE ANNEALED STEEL		
9		16	16 MESH WIRE SCREEN CLOTH		
10		1/8" THK.	FIRE TARD JAKET		
11		3 mm	PIPE INSULATION, 85% MAGNESIA OR ASBESTOS SPONGE		

TYPICAL DRAWING 2

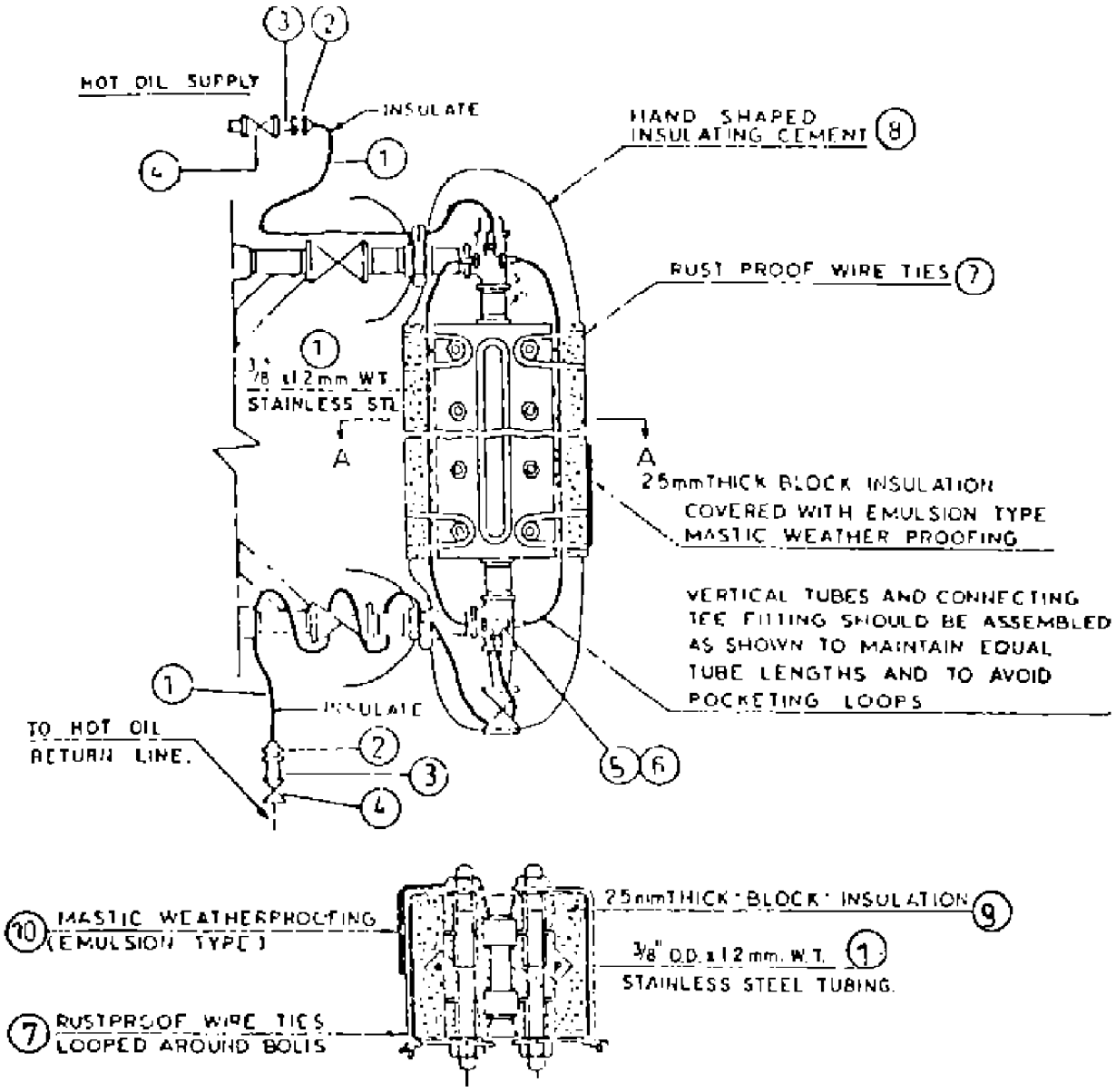
STEAM TRACING DETAIL FOR EXTERNAL DISPLACER TYPE LEVEL INSTRUMENT



ITEM	QUAN REQ.	SIZE	DESCRIPTION	MATERIAL	M.E.S.C NO.
1		3/8" O.D.	TUBING W.T. 1.2 mm.		
2		3/8"	3/8 FEMALE SCRD. × 3/8" O.D. TUBE CONNECTOR		
3		½" × 3/8"	SWAGED NIPPLE ANSI B2-1 NPT		
4		½"	GATE VALVE, SCRD., API CL 800		
5		1.6 mm.	WINDING WIRE, ENAMELED, ROUND		
6		BG.	PORTLAND CEMENT		
7		DR.	INSULATING CEMENT		
8		1.6 mm	BINDING WIRE ANNEALED STEEL		
9		16	16 MESH WIRE SCREEN CLOTH		
10		1/8" THK.	FIRE TARD JAKET		
11		3 mm	PIPE INSULATION, 85% MAGNESIA OR ASBESTOS SPONGE		

TYPICAL DRAWING 3

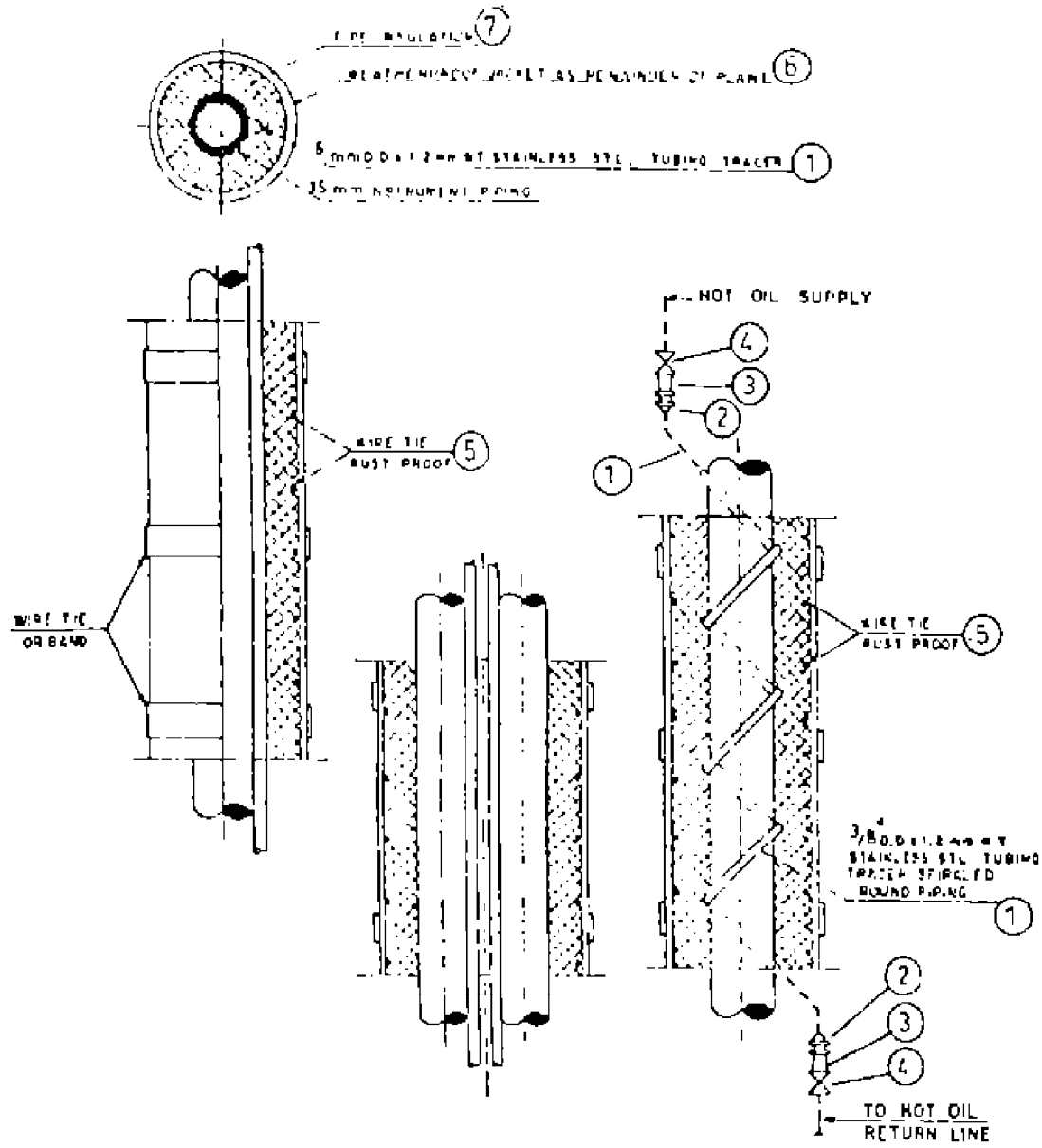
STEAM TRACING DETAILS FOR EXTERNAL BALL FLOAT TYPE LEVEL INSTRUMENT



ITEM	QUAN REQ.	SIZE	DESCRIPTION	MATERIAL	M.E.S.C NO.
1		6 mm O.d (3/8")	TUBING W.T. 1.2 mm.		
2	2	3/8"	3/8 FEMALE SCRD. × 3/8" O.D. TUBE CONNECTOR		
3	2	½" × 3/8"	SWAGED NIPPLE ANSI B2-1 NPT		
4	2	½"	GATE VALVE, SCRD. API CL 800		
5	2	3/8"	TEE, EQUAL, COMPACT SCRD. API 3000		
6	6	3/8"	CONNECTOR, MALE SCRD. ANSI B2.1 NPT		
7			RUST PROOF WIRE TIES		
8		DR.	INSULATING CEMENT		
9		25 mm	BLOCK INSULATION 25 mm THK.		
10			MASTIC WEATHERPROOFING (EMULSION TYPE)		

TYPICAL DRAWING 4

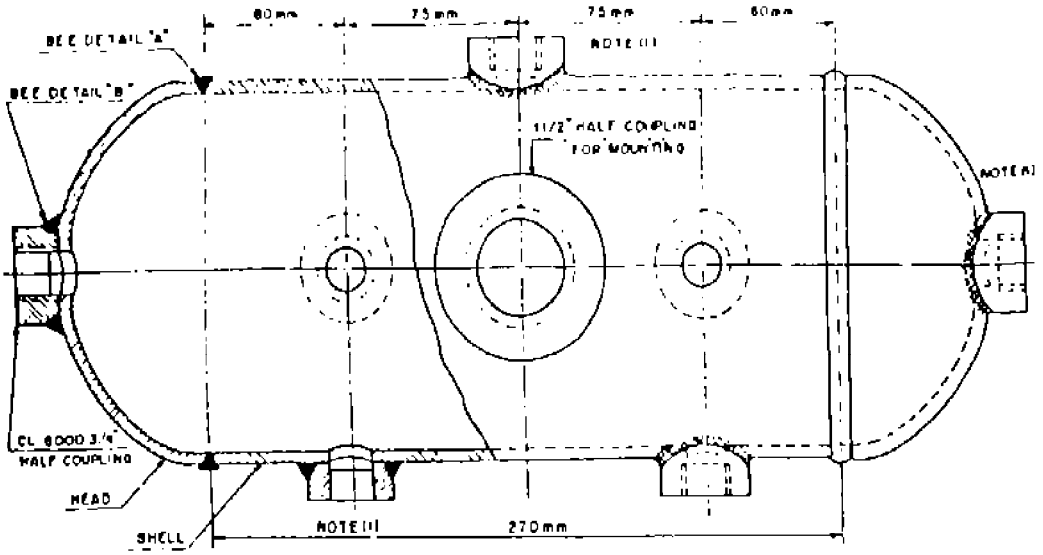
STEAM TRACING DETAILS FOR LEVEL GAGE



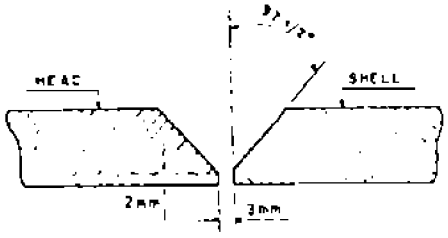
ITEM	QUAN REQ.	SIZE	DESCRIPTION	MATERIAL	M.E.S.C NO.
1		6 mm O.d (3/8")	TUBING W.T. 1.2 mm.		
2	2	3/8"	3/8 FEMALE SCRD. × 3/8" O.D. TUBE CONNECTOR		
3	2	½" × 3/8"	SWAGED NIPPLE ANSI B2-1 NPT		
4	2	½"	GATE VALVE, SCRD., API CL 800		
5			RUST PROOF WIRE TIES		
6			MASTIC WEATHERPROOFING (EMULSION TYPE)		
7			PIPE INSULATION, 85% MAGNESIA' OR ASBESTOS SPONGE		

TYPICAL DRAWING 5

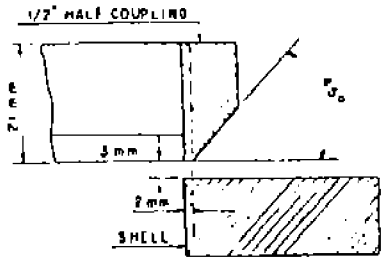
STEAM TRACING DETAIL AND INSULATION OF METER PIPING



150mm (6") DIA. STANDARD SEAL CHAMBER
100mm (4") DIA STANDARD CONDENSATE POT



WELDING DETAIL "A"



WELDING DETAIL "B"

Notes:

1) For 4 in. condensate pots only these connections are required. Extra connections to be plugged (¾ in. plug).

2) 4 in. to be used as condensate pot and 8 in. as seat chamber.

6" DIAL SEAL CHAMBER AND 4" CONDENSATE POT

TYPICAL DRAWING 6

(to be continued)

TYPICAL DRAWING 6 (continued)

CONSTRUCTION AND MATERIAL NOTES:

1) Seal pot to be fabricated in accordance with American Standard Code for pressure piping ANSI B31.1, latest edition local made seal pots should be tested by Equipment Inspection.

2) Shell shall be fabricated of carbon-steel pipe seamless API 5L, grade A or B Sch. 80.

3) Heads shall be fabricated of carbon-steel welding caps Sch. 80.

4) Connections shall be ½ in. half couplings screwed API thread made of bar stock. Steel and suitable for 414 bar cold working pressure.

5) Seal pot to be sand blasted and blown out internally with air after fabrication.

6) All connections shall be plugged with ½ in. solid plugs screwed API thread made of bar stock steel, immediately after sand blasting.

7) Seal pot to be subjected to a hydrostatic test pressure of 108 bar.

8) Seal pot to be stencilled:- MWP 54 bar-test pressure (108 bar).

DESIGN NOTES:

1) Seal pot is designed as per American Standard Code for pressure piping (ANSI 31.1) Shell thickness is designed in accordance with paragraph 324 of the above code.

2) Working pressure 54 bar working temperature 400°C.

3) Corrosion allowance 3 mm.