CONSTRUCTION STANDARD

FOR

INSTRUMENTS AIR SYSTEM

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1. SCOPE

This Standard covers the basic recommendations for installation and construction practice of inst. Air supply system, which includes, air compressors, buffer vessel, air drier, piping and fittings.

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

2. REFERENCES

In this Standard the following standards and codes are referred to and to the extent specified herein, form a part of this Standard.

API (AMERICAN PETROLEUM INSTITUTE)

RP-550	"Installation of Refinery Instruments and Control System"
Part-I Sec.9	"Process Instrumentation and Control Instrument Air Supply"

ISA (INSTRUMENT SOCIETY OF AMERICA)

RP-7.1	"Pneumatic Control Circuit Pressure Test"
S-7.3	"Quality Standard For Instrument Air"

IPS (IRANIAN PETROLEUM STANDARD)

IPS-E-GN-100	"Units"

3. UNITS

All dimensions and ratings shall be metric to SI units (See: IPS-E-GN-100) except for temperatures which shall be in Deg. Celsius, and for pipes and fittings threads which shall be in inches of NPT.

4. SERVICE CONDITIONS

4.1 The air supply plant shall be located in a non-hazardous area.

4.2 All piping interconnecting the compressors, buffer vessel, and air drier shall be so arranged that each major piece of equipment can be taken out of operation without interrupting the air supply.

4.3 In cold climates this piping as well as the bottom part of the buffer vessel, shall be heat traced and insulated.

4.4 All equipment shall satisfy the limitations for noise generation as specified in related standard IPS-G-SF-900 "Noise Control and Vibration".

4.5 Galvanized piping and branches shall not be welded or brazed.

4.6 Appropriate jointing compound shall be used on all screwed fittings.

4.7 Loose dirt and rust shall be removed before the piping is installed.

4.8 All piping and valves shall be clearly identified, e.g. by painting in the color specified by the user, and/or by labeling, the latter especially is used for main valves.

4.9 After installation, the piping shall be pressure tested and flashed by blowing with air or nitrogen.

5. AIR SUPPLY PIPING

5.1 General

5.1.1 The piping system for instrument air supply shall be designed in close cooperation between instrument engineering, utility engineering and mechanical engineering taking into account the:

- Segregation
- Plant lay-out
- Pipe sizes

5.1.2 The complete lay-out of the piping system, including the takeoff points, pipe sizes, etc. shall be shown on a drawing or on a set of drawings. These drawings shall also clearly indicate the demarcation points between mechanical engineering and instrument engineering.

5.1.3 In general, all piping in pipe tracks and pipe bridges, and all piping in sizes 2 in. and larger in plant sections (including branch-off points and valves) and the piping up to the air filter/reducer station in the control center form part of mechanical engineering.

All piping smaller than 2 in. in the plant and the air filter/reducer station(s) with downstream piping in the control center form part of instrument engineering.

5.2 Lay-Out

5.2.1 The lay-out of the supply piping depends on:

- The lay-out of the plant and plant sections.
- The location of the air supply plant.
- The location of pipe bridges, cable trunking, etc.
- The location of the instruments.

5.2.2 Piping for instrument air supply shall be completely separated from that for tool air supply.

5.2.3 The lay-out drawings shall include all instrument air supply piping in pipe tracks, pipe bridges and plant sections up to and including the branch-off points for individual instruments or groups of instruments, piping for the latter need not, however, be shown in detail on these drawings.

5.2.4 The piping shall be arranged such that a continuous supply of instrument air is ensured even under abnormal situations, such as shutdown of plant sections, or when major changes to piping have to be made. For a typical arrangement, see Appendix A.

5.2.5 Piping in the plant sections shall run close to the trunking for instrument signal cables to facilitate supporting of pneumatic signal line, see Appendix B.

5.2.6 Piping in pipe tracks and pipe bridges shall have a minimum size of 1 ½".

5.2.7 For exceptionally long piping, a calculation shall be made to ensure that the decrease in pressure between the outlet of the air drier and the most remote consumer does not exceed 1 bar.

5.3 Piping Details

5.3.1 All main piping shall be provided with drain valves at low point and at dead ends. See Note 3 of Appendix B.

5.3.2 Branch-off points for future extensions, etc. shall be provided with an isolating valve and blind flange. See Note 4 of Appendix B.

5.3.3 Branch-off points from piping in pipe tracks and pipe bridges shall be 1 in. minimum, be located on the top of the horizontal piping and be provided with an isolating valve. See Note 1 of Appendix B.

5.3.4 Branch-off points from piping in process sections to individual instrument shall be ½ in. minimum and be provided with bronze globe valve. See Note 6 of Appendix B.

5.3.5 Groups of up to 5 instruments located close together may be supplied by a common ½ in. take-off, a ¼ in. brass or bronze globe valve (bronze is preferred) shall then be provided close to each individual consumer.

5.3.6 Such a ¼ in. valve shall also be provided in individual supply piping if the isolating valve at the take-off point is not easily accessible.

5.3.7 At least 15% spare ½" valved connections shall be provided evenly distributed through the plant. (See Appendix B Note 5).

5.3.8 The fitting and tubing shall be installed by skilled personnel, strictly in accordance with the manufacturer's instructions.

5.3.9 The instrument air lines shall be pressure tested after installation, refer to para. 8 of this Standard.

5.3.10 The maximum number of consumers that may be connected to the same (½ in. NPT) take-off point shall be calculated, taking into account the minimum allowable inlet pressure of each air filter reducer and the total length of supply tubing, assuming maximum air consumption of all connected instruments.

5.3.11 The air supply piping to the control center may run underground where basement is provided and shall be protected against corrosion.

The location shall be such that when required in the future the piping can be excavated for repairs, etc.

5.3.12 All instrument air lines shall be adequately supported throughout the plant. The following shall be used as a guide for supporting horizontal runs, as minimum:

½ inch Pipe support every	2400 mm
¾ inch Pipe support every	3000 mm
1 inch Pipe support every	3600 mm
1 ½ & 2 inch Pipe support every	4500 mm

5.3.13 Individual instrument air supply and pneumatic field transmission lines to and from instruments and junction boxes shall be PVC coated ¼" copper tubes unless otherwise specified (e.g.) stainless steel for corrosive atmosphere.

6. AIR SUPPLY FOR PLANT-MOUNTED INSTRUMENTS

6.1 All plant-mounted instruments including final control elements requiring air shall be provided with an individual block valve and air supply set, consisting of a filter, pressure regulator with drain valve and a pressure gage.

6.2 If the instrument has an internal supply pressure gage, the pressure gage on the reducer may be omitted.

6.3 The variety in type of air supply sets shall be kept as small as possible.

6.4 Instruments in local panels shall have individual air supply sets, unless for larger panels where a common filter/reducer station is sufficient.

6.5 All components such as air filter regulators, lock-up devices, solenoid valves shall be bolted to stainless steel mounting plate which is fixed to a support with carbon steel bolts. The mounting plates shall have facilities for installing nameplates. The nameplates shall be fixed to the plates with screws.

6.6 Mounting plates shall not be supported from vibrating process pipes or on piping other than carbon steel. For such applications they shall be installed on separate supports and the reduced air supply lines and pneumatic signal line tubing shall then be sufficiently flexible to take the vibration.

6.7 Copper tubing is considered to be self supporting up to lengths of 0.5 m; for longer lengths, the tubing shall be supported by means of race way, channel, angle, pipe (race way is preferred).

6.8 Air supply piping to the valve mounted instruments shall not be hung from the air filter regulator. It may be supported from the control valve.

7. TESTING

7.1 All pneumatic instruments shall be isolated before testing.

7.2 Instrument air headers shall be pneumatically tested to 1.2 times max. operating pressure and all screwed joints soap tested. Hydrostatic testing of instrument air header is not permitted. Bubbler method is recommended (See Appendix C).

7.3 The dangers associated with pneumatic testing and the consequences of failure of any part of the system under test due to the stored energy in a compressed gas, should be recognized, and suitable precautions taken.

7.4 Any pneumatic test shall include a preliminary check at not more than 1.5 barg. The pressure shall be increased gradually in steps providing sufficient time to allow conditions to stabilize and to check for leaks.

7.5 When conducting pressure tests at low metal temperatures, the possibility of brittle fracture shall be considered. For carbon steel piping it is recommended that pneumatic testing should not be carried out when the metal temperature is 7 degrees Celsius or less.

7.6 A clean, dry air supply shall be used for testing instrument tubing and calibrating instruments. The following precautions are required:

a) Before any instrument air header or supply line is put into service, it shall be blown down with air at a velocity sufficient to blow out all dirt or other lose foreign matter.

b) If the plant instrument air system is not in service, then the following additional precautions must be observed:

- A knockout pot with low-point drain shall be provided to remove water from the air supply. A desiccant cartridge type drier shall be mounted immediately downstream of the knockout pot.

- A filter set of the packed fiber element type shall be mounted downstream of the dessicant drier. The filter shall be designed for the removal of oil from air.

7.7 Permissible Leak Tolerance

Tubing leaks which cause the black pointer (see Appendix D) to decrease at the rate of 1 psi per 100 feet of ¼" tubing per 5 seconds are not acceptable. Instrument air lines terminated in control valve topworks must be corrected by converting the topworks capacity to equivalent feet of tubing by means of the following Table: refer to ISA-RP 7.1 pneumatic control circuit pressure test.

CONVENTIONAL CONTROL VALVE TOPWORKS	APPROXIMATE EQUIVALENT METER OF 6 mm (FEET OF ¼") COPPER TUBING
VALVES WITH POSITIONERS	0 (0)
11" O.D. TOPWORKS	32 (104)
15" O.D. TOPWORKS	116 (385)
17" O.D. TOPWORKS	221 (770)
20" O.D. TOPWORKS	315 (1050)

7.8 Location of Leaks

Locate suspected leaking parts with any suitable commercial bubble fluid or soap solution.

7.9 Alternative

Higher test pressures may be required to locate tubing leaks for pilots having higher maximum operating pressures.

7.9.1 A portable test unit consisting of a supply air valve, a bleed valve, an instrument air regulator and a pressure gage connected with ¼" pipe and equipped with suitable flexible end connections may be used.

7.9.2 Tubing leaks which cause the pressure gage to decrease more than 1 psi during the test period are not acceptable. The test period is 2 minutes for each 30 m of 6 mm tubing (100 feet of ¼" tubing). Use the Table in 8.7 for control valve topworks volume conversion to equivalent (feet of ¼ inch) meter of 6 mm copper tubing.

8. INSTALLATION DRAWINGS

8.1 A set of drawings shall be available for all air consumers, showing in detail:

- The correct position of the air consumer with respect to the connection(s).
- The method of supporting.
- The arrangement of the air lines with any special provisions.
- A list of the materials required.

8.2 Typical "hook-up" drawings fulfilling the above requirements are given attached with this Standard.

8.3 One drawing for more than one installation is allowed when the hook-ups are truly identical in the details given above.

8.4 The air lines are shown on the drawings in thick lines and all other pipelines and equipment in thin lines. The isolating valves and counter flanges which form part of mechanical engineering are shown in dotted line.

8.5 If "hook-up" drawings other than those given in the Standard form have to be prepared, they shall be of A-4 size, using blank forms.

8.6 The drawings shall be assembled in one set, complete with a cover sheet, an index sheets and a list of materials, etc. A typical example of such a set is shown in Appendices G, H, and I.

8.7 "Engineering notes" have been included on some of the drawings, for assistance in the proper use thereof.

8.8 For instruments requiring protection facilities, the code letter "P" shall be indicated in the list of Appendix H.

8.9 The quantity of material required for the installation shown, shall be indicated in the quantity column on each drawing.

8.10 The total quantities required for all instruments included shall be entered on standard forms which provide the basis for the requisitioning of materials. A reasonable allowance of spare materials should be added.

Note:

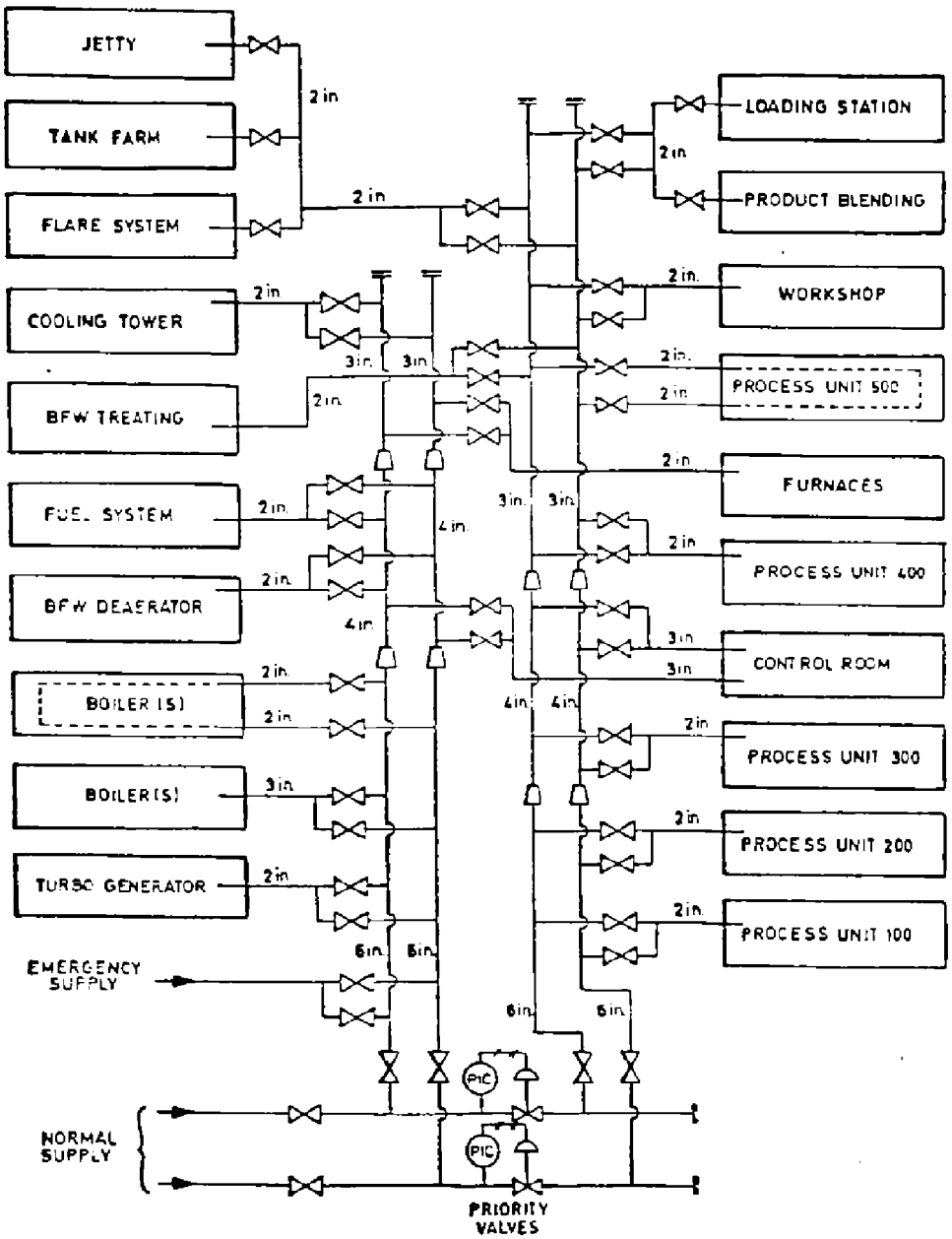
The contractor may wish to apply a computerized system for the handling of installation materials which should provide the following information:

- **Itemized material requirements per sheet.**
- **Total requirements per items.**
- **Material requisitioning.**

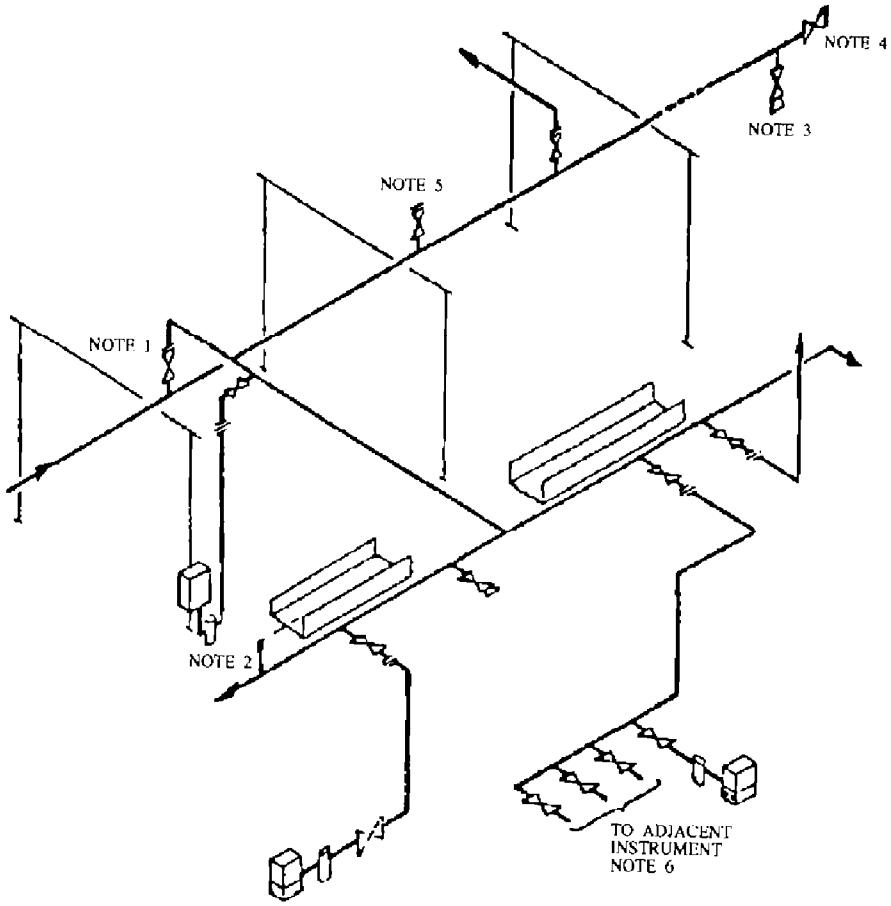
If the contractor intends to use such a computerized system, he shall obtain agreement from the user for the format and contents of the computer output sheets.

APPENDICES

APPENDIX A
TYPICAL ARRANGEMENT OF AIR SUPPLY PIPING



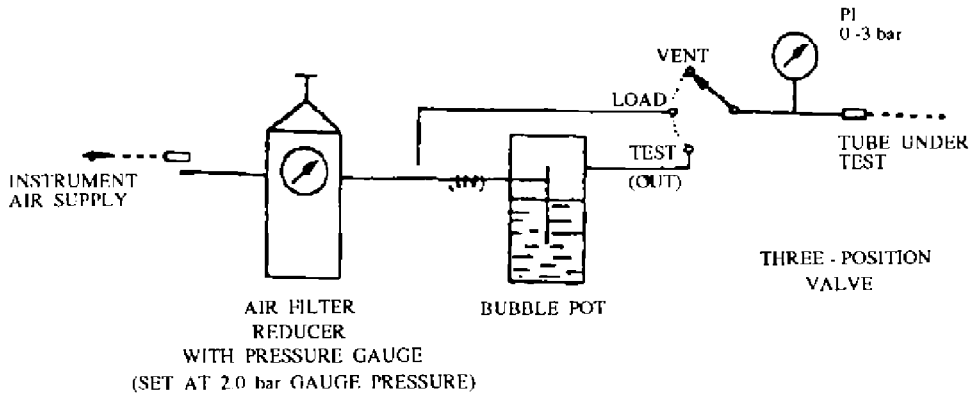
APPENDIX B
TYPICAL DETAILS FOR AIR SUPPLY PIPING



Notes:

1) Branch-off points from horizontal piping in pipe bridges located on the top of the piping.
2) Supply piping close to trunking for instrument cables.
3) Drain valves at low points and dead ends of piping.
4) Valve at the end of main piping for future extension.
5) Spare connection.
6) Piping in process sections

APPENDIX C
LEAK TESTING OF PNEUMATIC TUBING BUBBLER METHOD



Test Procedure

1) Connect the test rig shown to the control room end of the tubing, with valve in the VENT position.

2) Open far end of tubing, blow out by turning valve to LOAD position and check for correct line.

3) Close far end of tubing, when system is at 2 bar gage pressure, turn valve to TEST position.

4) Observe rate of bubble flow Up to 3 bubbles per minute is usually acceptable if the rate is higher, fittings should be checked, if necessary, with soap water.

5) Turn valve via LOAD to VENT position and disconnect tubing from test rig.

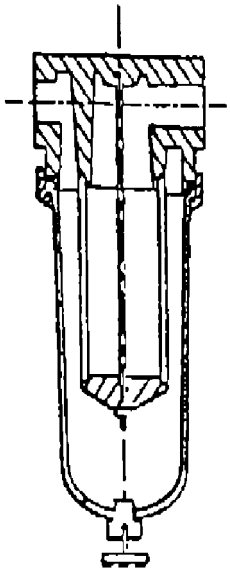
Material Required (all threaded ¼ in. NPT female)

a) One drift-free air reducer with integral filter.
b) One three-position valve.
c) One air filter with high-impact transparent (polycarbonate) bowl. Modified as shown in the next page.

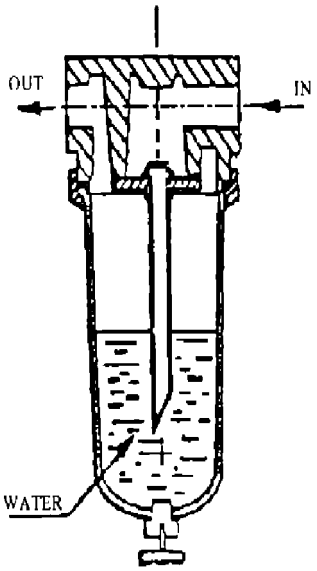
(to be continued)

APPENDIX C (continued)

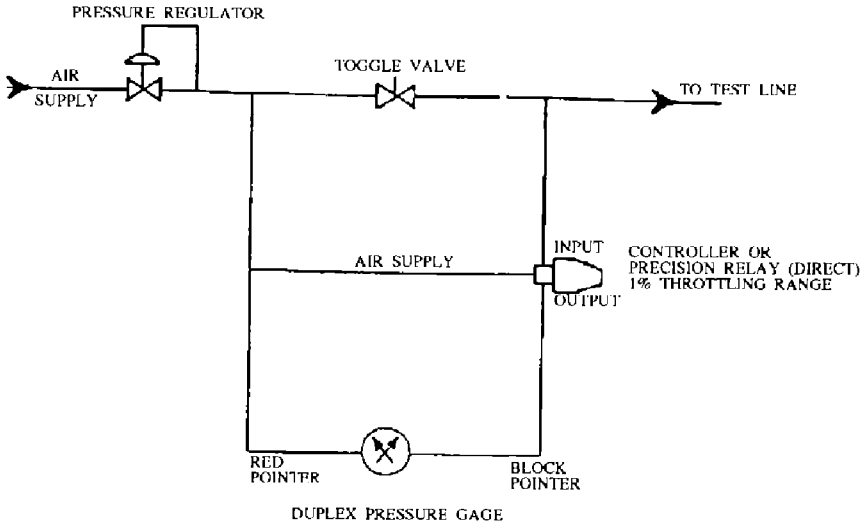
TYPICAL AIR FILTER
in original condition



BUBBLE POT
made from air filter



APPENDIX D
TEST ASSEMBLY



APPENDIX E
INSTALLATION NOTES

Before and during the actual installation of the instruments and their air lines the following points shall be observed:

E.1 LOCATION

The location drawings show in general the required position of the instrument(s) relative to the connection points. The exact location shall be determined at site. The responsible instrument engineer shall mark this location on the process equipment, plant structures, etc.

All instruments shall be installed with the instrument center approximately 1.3 m above floor level, grade or platform.

All instruments shall be installed in such a way that they are not subject to vibration and/or extreme environmental conditions, and do not obstruct traffic. Instruments shall not be located under places with potential leakage.

The minimum clearance between any part of the instrument mounting plate and surrounding structures or equipment shall not be less than 0.2 m.

E.2 INSTRUMENT SUPPORTS

When specified in Appendix H, each instrument shall be provided with a support as detailed in attached standard drawings.

Subject to approval by user's instrument engineer, more than one mounting plate may be attached to one instrument support instead of separate supports as shown on the relevant drawing.

Supports at grade or on concrete floors shall have concrete footings.

Pipe supports shall not be mounted on process pipes.

E.3 TUBING AND COMPRESSION FITTINGS

The tubing shall be cut dead square with a tube cutter; the edges shall be deburred. The tube end shall be undamaged, round and without scratches over the length which fits into the compression fitting. Any coating or painting shall be removed.

Tubes shall be bent with a high-quality tube bender which shall have a minimum bending radius as specified by the tubing manufacturer.

Long lengths of tubing shall be supported over the full length and fixed to the support at intervals of approximately 1 m.

Where final control elements may change position relative to the instrument, e.g. due to thermal expansion the air lines shall be so arranged that undue stresses on the compression fittings are prevented.

When tightening compression fitting, the following instructions shall be carefully adhered to:

Insert tubing in the fitting until it rests firmly against the shoulder in the fitting, turn the nut finger-tight, and turn nut with spanner over another 1 turns, holding fitting body with a back up spanner.

(to be continued)

APPENDIX E (continued)

Note:

The user's instrument engineer shall confirm this procedure.

E.4 THREAD SEALANT

NPT threaded connections require PTFE tape to prevent seizing and leakage.

The tape shall be applied as follows:

Place tape on male thread, leaving two threads at the small end free from tape, hold in place and wrap clockwise only once with a slight overlap. Draw tightly around threads so that it conforms to the threaded surface.

E.5 PRESSURE TESTING, etc.

For procedures of pressure testing, applying seal liquid, commissioning, etc., as explained in Appendix C.

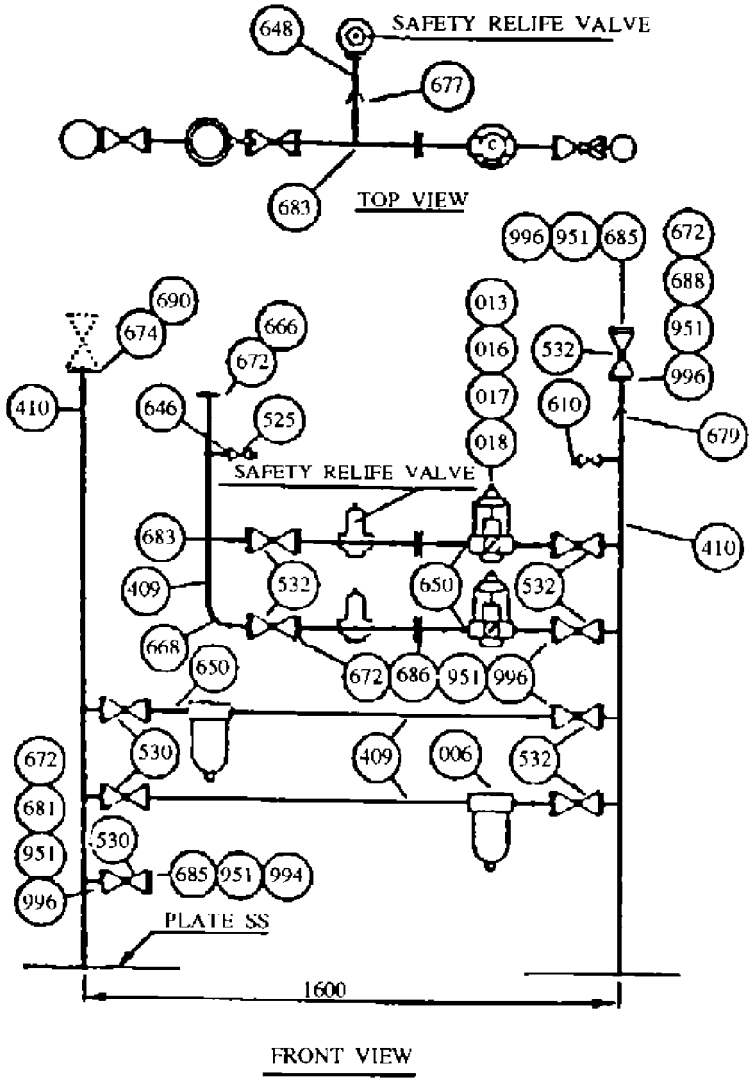
Note:

Instrument air supply and pneumatic signal lines shall only be pressure tested with compressed air.

E.6 CODES FOR PROTECTION FACILITIES

The codes as specified in index of instruments (Appendix H).

APPENDIX F
FILTER/REDUCER STATION



Note:

For materials see next page.

(to be continued)

APPENDIX F (continued)

ITEM	QUANTITY	CODE SIZE OR CONNECTION	DESCRIPTION	MATERIAL	MESC
006	2	2 in. NPT	INSTRUMENT AIR FILTER		
016	2	2 in. NPT	INST. AIR REGULATOR		
017	2	-	PILOT REGULATOR		
018	2	-	REGULATOR GAGE 0-1.6 BAR		
019	2	-	PILOT REGULATOR CONNECTION KIT		
409	2 m	DN 50	LINE PIPE SCH. 40S	SS	
410	4.5 m	DN 80	LINE PIPE SCH. 10S	SS	
145	2	½ in. NPT	GLOBE VALVE SCREWED	SS	
530	3	DN 50	GLOBE VALVE FLANGED	CS	
532	6	DN 50	GLOBE VALVE FLANGED	SS	
610	2	½ in. NPT	PLUG SCREWED	BRONZE	
646	2	½ in. × 75 mm	NIPPLE SCREWED/BEVELLED	SS	
648	2	1 in. × 75 mm	NIPPLE SCREWED/BEVELLED	SS	
650	6	2 in. × 75 mm	NIPPLE SCREWED/BEVELLED	SS	
668	1	DN 50	ELBOW SCHEDULE 40S	SS	
672	23	DN 50	STUB-END SCHEDULE 40S	SS	
674	1	DN 80	STUB-END SCHEDULE 10S	SS	
677	2	DN 50 × 25	REDUCER SCHEDULE 40S	SS	
679	1	DN 80 × 50	REDUCER SCHEDULE 40S	SS	
683	2	DN 50	TEE SCHEDULE 40S	SS	
685	2	DN 50	FLANGE-BLIND	SS	
688	23	DN 50	FLANGE-LAPJOINT	CS	
690	1	DN 80	FLANGE-LAPJOINT	CS	
951	88	$^{5}/_{8}$ " × 80 mm	STUD BOLT WITH 2 NUTS	ALLOY	
998	22	DN 50	GASKET	CAF	

Note:

Material list for Appendix F.

APPENDIX G
INDEX OF SHEETS

SHEET No.	ISSUE	REVISION DATE					SHEET No.	ISSUE	REVISION DATE			
	O	A	B	C	D			O	A	B	C	D

APPENDIX H
INDEX OF INSTRUMENTS

Tag No.	Mounting			Air lines	Protecting facilities		Tag No.	Mounting			Air lines	Protecting facilities
	Support		Plate					Support		Plate		
	Type	Size	Yes/No	Sheet No.	P			Type	Size	Yes/No	Sheet No.	P

P = Protective shade

APPENDIX I
TYPICAL COMPONENTS

ISSUE	MAT. ITEM	CODE SIZE OR CONNECTION	DESCRIPTION	MATERIAL	MESC
	006	2 in. NPT	INSTRUMENT AIR FILTER		
	011	¼ in. NPT	INSTRUMENT AIR FILTER		
			REGULATOR		
	013	½ in. NPT	INSTRUMENT AIR REGULATOR		
	016	2 in. NPT	INSTRUMENT AIR REGULATOR		
	017	-	PILOT REGULATOR		
	018	-	REGULATOR GAUGE 0-1.6 BAR		
	019	-	PILOT REGULATOR CONNECTION KIT		
	026	½ × ¼ in. NPT	AIR MANIFOLD WITH 5 VALVES	BRASS	
	028	¼ in. NPT	4 WAY AIR BLOCK	BRASS	
	084	¼ in. NPT	PORT PROTECTOR	BRASS	
	409	DN 50	LINE PIPE SCHEDULE 40S	SS	
	410	DN 80	LINE PIPE SCHEDULE 10S	SS	
	7	16 mm OD	TUBING	CS	
	2	6 mm OD	TUBING-BLACK PVC SHEATED	CU	
	120	½ in. NPT	GLOBE VALVE SCREWED	CS	
	525	½ in. NPT	GLOBE VALVE SCREWED	SS	
	530	DN 50	GLOBE VALVE FLANGED	CS	
	532	DN 50	GLOBE VALVE FLANGED	SS	
	604	¼ in. × 40 mm	NIPPLE-SCREWED	BRASS	
	609	¼ in. NPT	PLUG-SCREWED	BRONZE	
	610	½ in. NPT	PLUG-SCREWED	BRONZE	
	611	½ × ¼ in.	BUSHING-SCREWED	BRONZE	
	646	½ in. × 75 mm	NIPPLE-SCREWED/BEVELLED sch. 40S	SS	
	648	1 in. × 75 mm	NIPPLE-SCREWED/BEVELLED		
			SCH. 40S	SS	
	650	2 in. × 75 mm	NIPPLE-SCREWED/BEVELLED	SS	
	668	DN 50	ELBOW SCHEDULE 40S	SS	
	672	DN 50	STUB END SCHEDULE 40S	SS	
	674	DN 80	STUB END SCHEDULE 40S	SS	
	677	DN 50 × 25	REDUCER SCHEDULE 40S	SS	
	679	DN 80 × 50	REDUCER SCHEDULE 40S	SS	
	683	DN 50	TEE SCHEDULE 40S	SS	
	685	DN 50	FLANGE-BLIND	CS	
	688	DN 50	FLANGE-LAPPED JOINT	CS	
	690	DN 80	FLANGE-LAPPED JOINT	CS	
	692	DN 50	FLANGE-BLIND	SS	

(to be continued)

APPENDIX I (continued)

ISSUE	MAT. ITEM	CODE SIZE OR CONNECTION	DESCRIPTION	MATERIAL	MESC
	783	16 mm × ½ in.	MALE CONNECTOR COMPRESSION TYPE	CS	
	789	16 mm OD	UNION TEE COMPRESSION TYPE	CS	
	792	16 mm OD	UNION COMPRESSION TYPE	CS	
	803	6 mm × ¼ in.	MALE CONNECTOR COMPRESSION TYPE	BRASS	
	837	6 mm OD	UNION TEE COMPRESSION TYPE	BRASS	
	892	¼ in. NPT	QUICK CONNECTOR MAKE	BRASS	
	893	4 mm	DUST CAP	PVC	
	951	$^{5}/_{8}$ in. × 80 mm	STUD BOLT WITH 2 NUTS	ALLOY	
	998	DN 50	GASKET	CAF	

Notes:

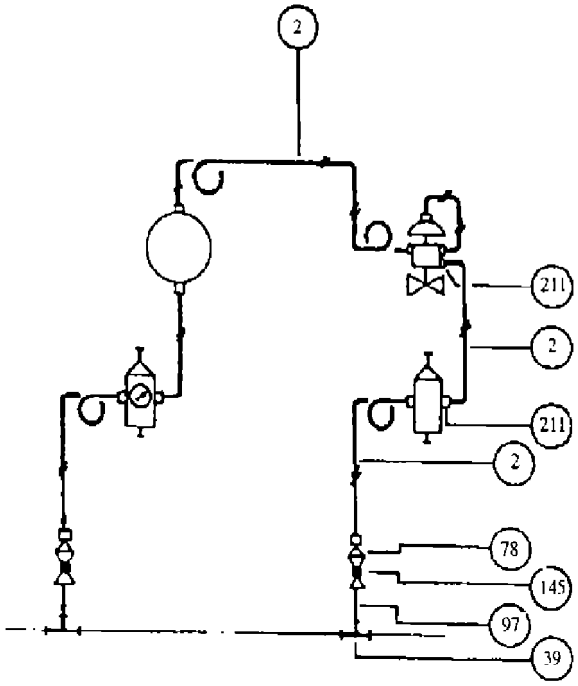
1) This list is typical.

2) For complete material specification, see "Summary of Instrument Installation Materials", which is included in standard drawings volume.

ATTACHMENTS

TYPICAL STANDARD DRAWINGS

P - 1



TAG. No.

NOTES:

1- RADIUS OF FLEXIBILITY LOOPS IN COPPER TUBING TO BE NOT LESS THAN 100 mm.

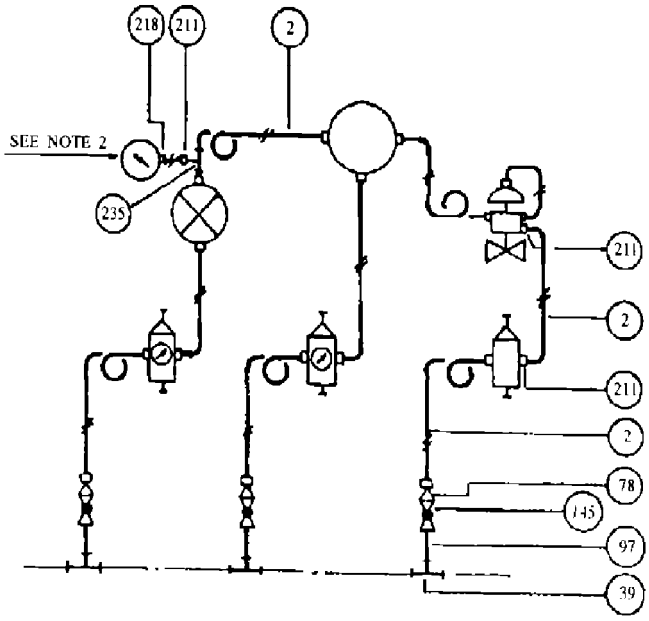
2- STAINLESS STEEL MAY BE USED FOR EXCEPTIONAL CASES SUCH AS CORROSIVE ATMOSPHERES.

ITEM	QUAN REQ.	SIZE	DESCRIPTION	MATERIAL
2		¼" O.D.	Copper tube, Dehydrate	Copper PVC Covered
39	2	½"	Tee, Equal Scrd. API 3000 Female Threads	Galvanized Steel
78	2	½" × ¼"	Reducer, Conc. Scrd. API 3000 Male Threads	Galvanized Steel
97	2	½" × 125 mm	Nipple, Barrel Scrd. API SCH. 80	Galvanized Steel
145	2	½"	Valve, Globe, Scrd. API 17.3 bar	Bronze
211	10	¼" API × ¼" O.D.	Connector, Male Scrd. API Compr. Type	Steel

REV.						SHEET-	REV.
PROJ TITLE		B R PROJ ENGR				PROJECT DWG. No.	
STD. TITLE	**INSTRUMENTATION INSTALLATION OF AIR PIPING LOCAL CONTROLLER, VALVE WITH POSITIONER**		DWN	CKD	APR	STANDARD DWG. No. 1	

(to be continued)

P - 2



TAG. No.

NOTES:

1- RADIUS OF FLEXIBILITY LOOPS IN COPPER TUBING TO BE NOT LESS THAN 100 mm.

2- PLUG WHEN LOCAL INDICATOR IS NOT REQUIRED.

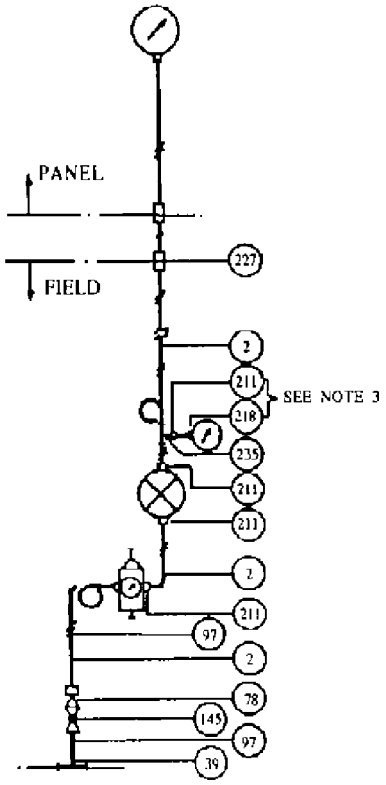
3- STAINLESS STEEL MAY BE USED FOR EXCEPTIONAL CASES, SUCH AS CORROSIVE ATMOSPHERES.

ITEM	QUAN REQ.	SIZE	DESCRIPTION	MATERIAL
2		¼" O.D.	Copper tube, Dehydrate	Copper PVC Covered
39	3	½"	Tee, Equal Scrd. API CL 3000 Female	Galvanized Steel
78	3	½" × ¼"	Reducer, Conc. Scrd. API CL 3000 Male	Galvanized Steel
97	3	½" × 125 mm	Nipple, Barrel Scrd. API SCH. 80	Galvanized Steel
145	3	½"	Valve, Globe, Scrd. API 17.3 bar	Bronze
211	16	¼" API × ¼" O.D.	Connector, Male Scrd. API Compr. Type	Brass
218	1	¼" API × ¼" O.D.	Connector, Female Scrd. API Compr. Type	Brass
235	1	¼" API × ¼" O.D.	Tee, Comp. Type (Female)	Brass

REV.						SHEET-	REV.
PROJ TITLE		B R PROJ ENGR				PROJECT DWG. No.	
STD. TITLE	**INSTRUMENTATION INSTALLATION OF AIR PIPING LOCAL CONTROLLER, VALVE WITH POSITIONER**		DWN	CKD	APR	STANDARD DWG. No. 2	

(to be continued)

P - 3



TAG. No.

NOTES:

1- THE MATERIAL SCHEDULE INCLUDES MATERIAL UP TO THE LOCAL J/BOX (BULKHEAD CONNECTION).

2- RADIUS OF FLEXIBILITY LOOPS IN COPPER TUBING TO BE NOT LESS THAN 100 mm

3- PLUG WHEN LOCAL INDICATOR IS NOT REQUIRED.

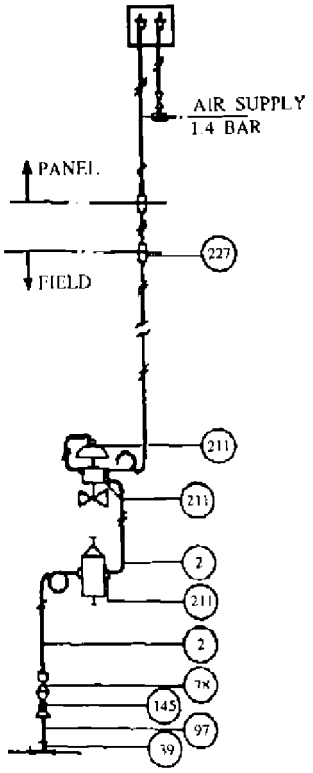
4- STAINLESS STEEL MAY BE USED FOR EXCEPTIONAL CASES, SUCH AS CORROSIVE ATMOSPHERES.

ITEM	QUAN REQ.	SIZE	DESCRIPTION	MATERIAL
2		¼" O.D.	Copper tube, Dehydrate	Copper PVC Covered
39	1	½"	Tee, Equal Scrd. API CL 3000 Female	Galvanized Steel
78	1	½" × ¼"	Reducer, Conc. Scrd. API CL 3000 Male	Galvanized Steel
97	1	½" × 125 mm	Nipple, Barrel Scrd. API SCH. 80	Galvanized Steel
113	1	¼"	Plug, Hexagon, Head, Scrd API, Male, Thread	Brass
145	1	½"	Valve, Globe, Scrd. API 17.3 bar	Bronze
211	5	¼" API × ¼" O.D.	Connector, Male Scrd. API Compr. Type	Brass
218	1	¼" API × ¼" O.D.	Connector, Female Scrd. API Compr. Type	Brass
227	1	¼" O.D.	Polytube × Copper Tube Type 282	Brass
235	1	¼" API × ¼" O.D. × ¼" O.D.	Tee, Comp. Type (Female)	Brass

REV.						SHEET-	REV.
PROJ TITLE		B R PROJ ENGR				PROJECT DWG. No.	
STD. TITLE	**INSTRUMENTATION INSTALLATION OF AIR PIPING LOCAL CONTROLLER, VALVE WITH POSITIONER**		DWN	CKD	APR	STANDARD DWG. No. 3	

(to be continued)

P - 4



TAG. No.

NOTES:

1- RADIUS OF FLEXIBILITY LOOPS IN COPPER TUBING TO BE NOT LESS THAN 100 mm.

2- THE MATERIAL SCHEDULE INCLUDES MATERIAL UP TO THE LOCAL J/BOX BULKHEAD CONNECTION ONLY.

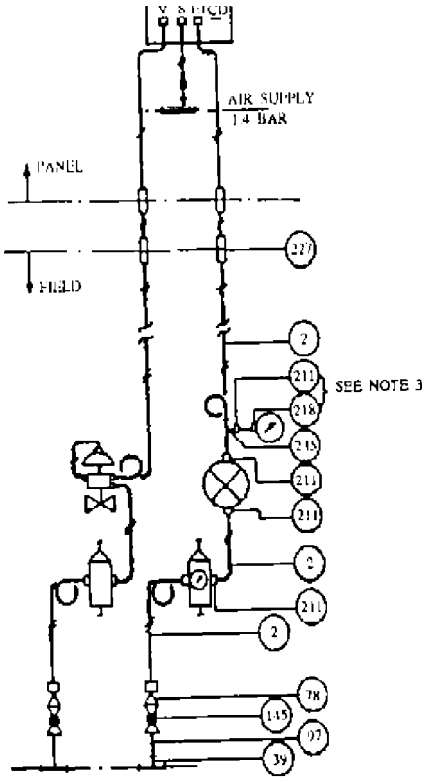
3- STAINLESS STEEL MAY BE USED FOR EXCEPTIONAL CASES, SUCH AS CORROSIVE ATMOSPHERES.

ITEM	QUAN REQ.	SIZE	DESCRIPTION	MATERIAL
2		¼" O.D.	Copper tube, Dehydrate	Copper PVC Covered
39	1	½"	Tee, Equal Scrd. API CL 3000 Female	Galvanized Steel
78	1	½" × ¼"	Reducer, Conc. Scrd. API CL 3000 Male	Galvanized Steel
97	1	½" × 125 mm	Nipple, Barrel Scrd. API SCH. 80	Galvanized Steel
145	1	½"	Valve, Globe, Scrd. API 17.3 bar	Bronze
211	6	¼" API × ¼" O.D.	Connector, Male Scrd. API Compr. Type	Brass
227	1	¼" O.D.	Polytube × Copper Tube Type 282	Brass

REV.						SHEET-	REV.
PROJ TITLE		B R PROJ ENGR				PROJECT DWG. No.	
STD. TITLE	**INSTRUMENTATION INSTALLATION OF AIR PIPING LOCAL CONTROLLER, VALVE WITH POSITIONER**			DWN	CKD	APR	STANDARD DWG. No. 4	

(to be continued)

P - 5



TAG. No.

NOTES:

1- RADIUS OF FLEXIBILITY LOOPS IN COPPER TUBING TO BE NOT LESS THAN 100 mm.

2- THE MATERIAL SCHEDULE INCLUDES MATERIAL UP TO THE LOCAL J/BOX BULKHEAD CONNECTION ONLY.

3- PLUG WHEN LOCAL INDICATOR IS NOT REQUIRED.

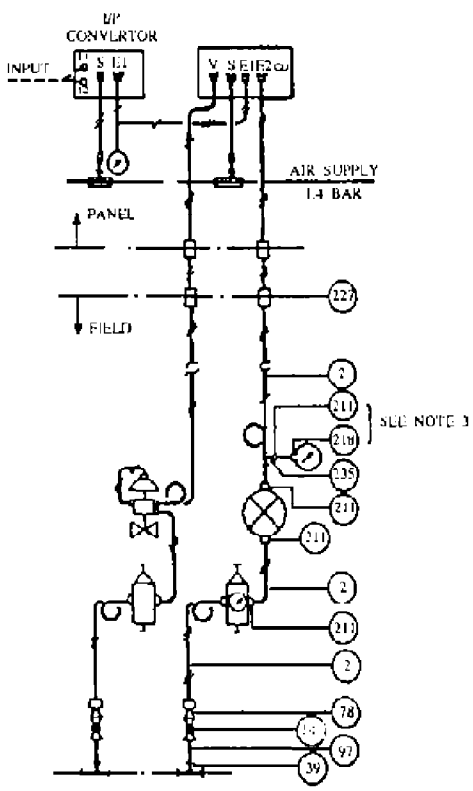
4- STAINLESS STEEL MAY BE USED FOR EXCEPTIONAL CASES, SUCH AS CORROSIVE ATMOSPHERES.

ITEM	QUAN REQ.	SIZE	DESCRIPTION	MATERIAL
2		¼" O.D.	Copper tube, Dehydrate	Copper PVC Covered
39	2	½"	Tee, Equal Scrd. API CL 3000 Female Thread	Galvanized Steel
78	2	½" × ¼"	Reducer, Conc. Scrd. API CL 3000 Male Thr.	Galvanized Steel
97	2	½" × 125 mm	Nipple, Barrel Scrd. API SCH. 80	Galvanized Steel
113	1	¼"	Plug, Hexagon, Head, Scrd API, Male, Thread	Brass
145	2	½"	Valve, Globe, Scrd. API 17.3 bar	Bronze
211	11	¼" API × ¼" O.D.	Connector, Male Scrd. API Compr. Type	Brass
218	1	¼" API × ¼" O.D.	Connector, Female Scrd. API Compr. Type	Brass
227	2	¼" O.D.	Polytube × Copper Tube Type 282	Brass
235	1	¼" API × ¼" O.D. × ¼" O.D.	Tee, Comp. Type (Female)	Brass

REV.						SHEET-	REV.
PROJ TITLE		B R PROJ ENGR				PROJECT DWG. No.	
STD. TITLE	**INSTRUMENTATION INSTALLATION OF AIR PIPING LOCAL CONTROLLER, VALVE WITH POSITIONER**		DWN	CKD	APR	STANDARD DWG. No. 5	

(to be continued)

P - 6



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NOTES:

1- RADIUS OF FLEXIBILITY LOOPS IN COPPER TUBING TO BE NOT LESS THAN 100 mm.

2- THE MATERIAL SCHEDULE INCLUDES MATERIAL UP TO THE LOCAL J/BOX BULKHEAD CONNECTION ONLY.

3- PLUG WHEN LOCAL INDICATOR IS NOT REQUIRED.

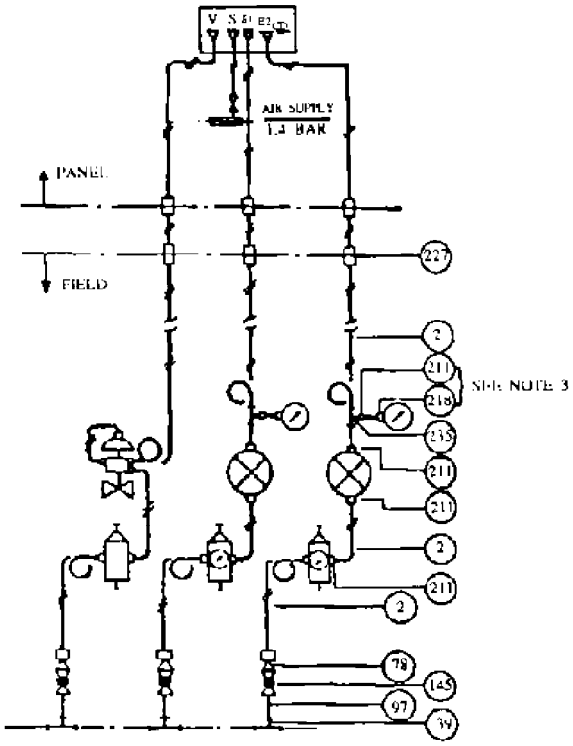
4- STAINLESS STEEL MAY BE USED FOR EXCEPTIONAL CASES, SUCH AS CORROSIVE ATMOSPHERES.

ITEM	QUAN REQ.	SIZE	DESCRIPTION	MATERIAL
2		¼" O.D.	Copper tube, Dehydrate	Copper PVC Covered
39	3	½"	Tee, Equal Scrd. API 3000 Female Thread	Galvanized Steel
78	3	½" × ¼"	Reducer, Conc. Scrd. API 3000 Male Thr.	Galvanized Steel
97	3	½" × 125 mm	Nipple, Barrel Scrd. API SCH. 80	Galvanized Steel
113	2	¼"	Plug, Hexagon, Head, Scrd API, Male, Thread	Brass
145	3	½"	Valve, Globe, Scrd. API 17.3 bar	Bronze
211	16	¼" API × ¼" O.D.	Connector, Male Scrd. API Compr. Type	Brass
218	2	¼" API × ¼" O.D.	Connector, Female Scrd. API Compr. Type	Brass
227	3	¼" O.D.	Polytube × Copper Tube Type 282	Brass
235	2	¼" API × ¼" O.D. × ¼" O.D.	Tee, Comp. Type (Female)	Brass

REV.						SHEET-	REV.
PROJ TITLE		B R PROJ ENGR				PROJECT DWG. No.	
STD. TITLE	**INSTRUMENTATION INSTALLATION OF AIR PIPING LOCAL CONTROLLER, VALVE WITH POSITIONER**		DWN	CKD	APR	STANDARD DWG. No. 6	

(to be continued)

P - 7



TAG. No.

NOTES:

1- RADIUS OF FLEXIBILITY LOOPS IN COPPER TUBING TO BE NOT LESS THAN 100 mm.

2- THE MATERIAL SCHEDULE INCLUDES MATERIAL UP TO THE LOCAL J/BOX BULKHEAD CONNECTION ONLY.

3- PLUG WHEN LOCAL INDICATOR IS NOT REQUIRED.

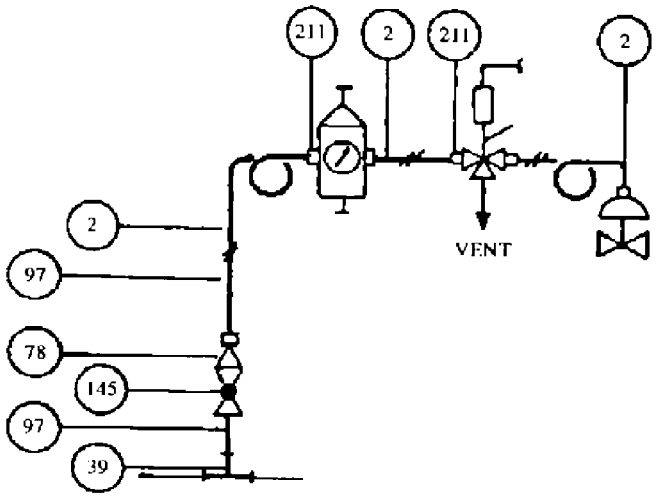
4- STAINLESS STEEL MAY BE USED FOR EXCEPTIONAL CASES, SUCH AS CORROSIVE ATMOSPHERES.

ITEM	QUAN REQ.	SIZE	DESCRIPTION	MATERIAL
2		¼" O.D.	Copper tube, Dehydrate	Copper PVC Covered
39	2	½"	Tee, Equal Scrd. API 3000 Female Thread	Galvanized Steel
78	2	½" × ¼"	Reducer, Conc. Scrd. API 3000 Male Thr.	Galvanized Steel
97	2	½" × 125 mm	Nipple, Barrel Scrd. API SCH. 80	Galvanized Steel
113	1	¼"	Plug, Hexagon, Head, Scrd API, Male, Thread	Brass
145	2	½"	Valve, Globe, Scrd. API 17.3 bar	Bronze
211	11	¼" API × ¼" O.D.	Connector, Male Scrd. API Compr. Type	Brass
218	1	¼" API × ¼" O.D.	Connector, Female Scrd. API Compr. Type	Brass
227	2	¼" O.D.	Polytube × Copper Tube Type 282	Brass
235	1	¼" API × ¼" O.D. × ¼" O.D.	Tee, Comp. Type (Female)	Brass

REV.						SHEET-	REV.
PROJ TITLE		B R PROJ ENGR				PROJECT DWG. No.	
STD. TITLE	**INSTRUMENTATION INSTALLATION OF AIR PIPING LOCAL CONTROLLER, VALVE WITH POSITIONER**		DWN	CKD	APR	STANDARD DWG. No. 7	

(to be continued)

P - 8



TAG. No.

NOTES:

1- RADIUS OF FLEXIBILITY LOOPS IN COPPER TUBING TO BE NOT LESS THAN 100 mm.

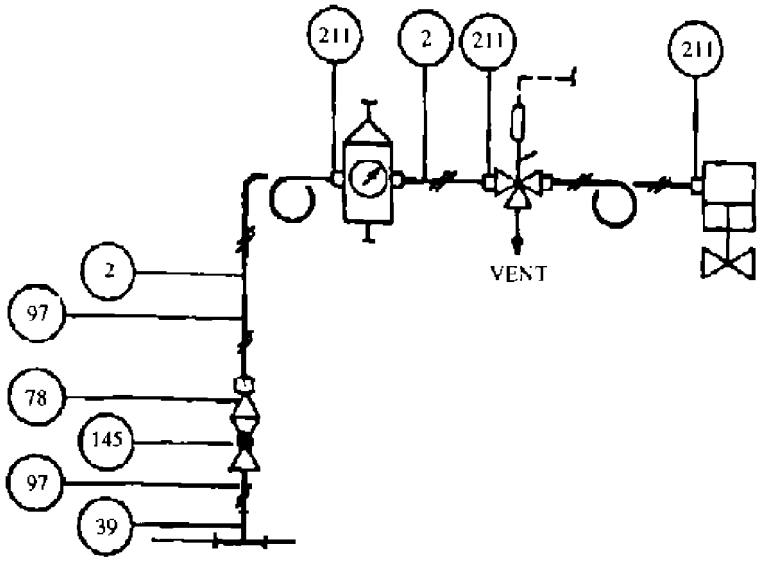
2- STAINLESS STEEL MAY BE USED FOR EXCEPTIONAL CASES, SUCH AS CORROSIVE ATMOSPHERES.

ITEM	QUAN REQ.	SIZE	DESCRIPTION	MATERIAL
2		¼" O.D.	Copper tube, Dehydrate	Copper PVC Covered
39	1	½"	Tee, Equal Scrd. API 3000 Female Threads	Galvanized Steel
78	1	½" × ¼"	Reducer, Conc. Scrd. API 3000 Male Threads	Galvanized Steel
97	1	½" × 125 mm	Nipple, Barrel Scrd. API SCH. 80	Galvanized Steel
145	1	½"	Valve, Globe, Scrd. API 17.3 bar	Bronze
211	5	¼" API × ¼" O.D.	Connector, Male Scrd. API Compr. Type	Brass

REV.						SHEET-	REV.
PROJ TITLE		B R PROJ ENGR				PROJECT DWG. No.	
STD. TITLE	**INSTRUMENTATION INSTALLATION OF AIR PIPING LOCAL CONTROLLER, VALVE WITH POSITIONER**			DWN	CKD APR	STANDARD DWG. No. 8	

(to be continued)

P - 9



TAG. No.

NOTES:

1- RADIUS OF FLEXIBILITY LOOPS IN COPPER TUBING TO BE NOT LESS THAN 100 mm.

2- STAINLESS STEEL MAY BE USED FOR EXCEPTIONAL CASES, SUCH AS CORROSIVE ATMOSPHERES.

ITEM	QUAN REQ.	SIZE	DESCRIPTION	MATERIAL
2		¼" O.D.	Copper tube, Dehydrate	Copper PVC Covered
39	1	½"	Tee, Equal Scrd. API 3000 Female	Galvanized Steel
78	1	½" × ¼"	Reducer, Conc. Scrd. API CL 3000 Male	Galvanized Steel
97	1	½" × 125 mm	Nipple, Barrel Scrd. API SCH. 80	Galvanized Steel
145	1	½"	Valve, Globe, Scrd. API 17.3 bar	Bronze
211	5	¼" API × ¼" O.D.	Connector, Male Scrd. API Compr. Type	Brass

REV.						SHEET-	REV.
PROJ TITLE		B R PROJ ENGR				PROJECT DWG. No.	
STD. TITLE	**INSTRUMENTATION INSTALLATION OF AIR PIPING LOCAL CONTROLLER, VALVE WITH POSITIONER**			DWN	CKD	APR	STANDARD DWG. No. 9	