MATERIAL AND EQUIPMENT STANDARD

FOR

INSTRUMENTS AIR SYSTEM

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1. SCOPE

This Standard covers the basic specification of instrument air supply components materials including: air compressors, buffer vessel, air drier, piping and fittings. 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.

ANSI (AMERICAN NATIONAL STANDARDS INSTITUTE)

B 16.5	"Steel Pipe Flanges and Flanged Fittings"
B 31.3	"Petroleum Refinery Piping"

ASME (AMERICAN SOCIETY OF MECHANICAL ENGINEERS)

Section VIII, Div. 1.	"Boiler and Pressure Vessel Code"

BSI (BRITISH STANDARDS INSTITUTION)

BS 1515-Part1	"Fusion Welded Pressure Vessels"
BS 1655	"Flanged Automatic Control Valves for the Petroleum Industry"

IPS (IRANIAN PETROLEUM STANDARDS)

IPS-E-GN-100	"Units"
IPS-M-EL-132	"Induction Motors"
IPS-E-IN-200	"Instrument Air System"
IPS-E-IN-100	"General"
IPS-M-PM-210	"Recipro. Comp. for Utility & Instr. Air Services"
IPS-E-PR-880	"Gas (Vapor)-Liquid Separators"

3. UNITS

International system of units (SI) in accordance with IPS-E-GN-100 shall be used. Except for the temperature, which shall be in degrees Celsius instead of kelvin, and for pipes and fittings threads, which shall be in inches of NPT.

4. AIR COMPRESSORS

The compressors shall be dry-type cylinder and shall supply oil free air, and be complete with non-return valves, intercoolers, aftercoolers, condensate draining facilities, etc.

The compressors and their drives shall satisfy the requirements for running equipment as specified in the standard IPS-M-PM-210 "Reciprocating Compressors for Utility and Instrument Air Services"

Electric motors shall be in accordance with electrical standard of this Practice IPS-M-EL-132, and be suitable for installation in a non-hazardous area, unless otherwise specified.

Compressor controls and piping shall be as stated in engineering part of this Standard. IPS-E-IN-200.

5. BUFFER VESSEL (AIR RECEIVER)

The sizing of the buffer vessel shall be based on the design quantity of instrument air, plus the tool air consumption until the safeguarding device closes, as stated in engineering part of this Standard (IPS-E-IN-200).

Note:

The sizing of the air receiver shall be based on the design quantity of instrument air consumption for the period required to bring the emergency compressor into service. The minimum of 15 min. should be selected if not time period specified for this purpose. The capacity should also be sufficient for condensate collection and removal.

For requirements of condensate separators, see ISO Material and Equipment Standard for Separators and IPS standards E-PR-880 and 895.

The buffer vessel shall have automatic and manual draining facilities. The wall thickness shall have a 3 mm corrosion allowance and the lower part of the vessel shall be provided internally with a protective coating.

For the design and construction of the vessels, BS 1515 Part 1 or the ASME Boiler and Pressure Vessel code, Section VIII, Div. 1 or any other approved standard of equivalent authority is usually acceptable.

6. AIR DRIER

The specification of the drier shall contain all data necessary to ensure the supply of suitable instrument air in quantity and quality.

Wherever possible, construction in accordance with the manufacturer's standard should be accepted.

For the design and construction of the vessels, BS 1515 Part 1 or the ASME Boiler and Pressure Vessel code, Section VIII, Div. 1 or any other approved standard of equivalent authority is usually acceptable.

For the design, fabrication, erection and testing of piping ANSI B 16.5 and ANSI B 31.3 are usually acceptable.

A detailed specifications of a twin-vessel desiccant drier is given in Appendix A.

7. AIR SUPPLY PIPING

Piping forming part of instrument engineering shall normally be made of galvanized materials. However for those plants where the use of galvanized materials are not allowed, the piping forming part of instrument engineering shall be made of carbon steel.

APPENDICES

APPENDIX A
AIR DRIER SPECIFICATIONS

A.1 GENERAL

This specification covers the minimum requirements for an instrument air drier.

The drier shall be supplied complete, including prefilters and afterfilters. All mechanical and electrical equipment, valves, interconnecting piping, etc., and all instrumentation and control equipment required for semi-automatic operation or fully automatic.

The unit shall be assembled and tested at the factory and be ready for immediate use at its destination after placing on the foundation and making the connections.

A.2 APPLICATION DATA

A.2.1 TAG NUMBERS

Drying vessels
Afterfilters / prefilters
Air blower

A.2.2 PROCESS DATA

Capacity	:	m^3/s at 15°C and 1.013 bar abs (one atmosphere)
Inlet pressure, normal	:	barg
maximum	:	barg
Inlet temperature, max.	:	°C
Inlet relative humidity	:	100% (free of oil)
Outlet dew point, max.	:	°C at 7.0 barg

A.2.3 AMBIENT CONDITIONS

Air temperature, max.	:	°C
normal	:	°C
min.	:	°C
Humidity, normal	:	%
Altitude	:	
Earthquakes	:	

A.2.4 AVAILABLE UTILITIES

Electricity

For motors and heaters	:	V-AC:	Hz: 3 phase
For other equipment	:	V-AC:	Hz: 1 phase
For automatic control system	:	V-DC	

APPENDIX A (continued)

Note:

1) Heaters shall be used for heat type only.
2) Steam heater can be used also.

A.3 OPERATION AND CONTROLS (FOR HEATED AND HEATLESS TYPES)

The unit shall be designed for continuous operation in timed cycles of alternate drying and regeneration. Each drying vessel shall be capable of drying for at least 10 hours without increase in dew point or other detrimental effects.

The regeneration (including cooling) of each bed shall not take more than 6 hours.

Recommended cycle time between regeneration:

- Normal : 8 hours (regeneration 6 hours, stand-by 2 hours).
- Maximum : 10 hours (regeneration 6 hours, stand-by 4 hours).
- For heatless type the time cycle shall be normally 10 minutes.

The regeneration shall take place at an elevated temperature and under atmospheric pressure. The unit shall have an electric heater or steam heater for heating the regeneration air.

At the end of the regeneration period the bed shall be cooled to (approximately) ambient temperature.

At the start and the end of regeneration, the pressure in the desiccant vessel must be changed gradually to avoid damage to the desiccant through sudden pressure drop or rise. For this purpose an automatically timed, slow-operating exhaust valve must be provided.

Repressurizing shall be completed within 5-10 minutes. Repressurizing and depressurizing for heatless type normally shall be few seconds.

In addition to the fully automatic regeneration of heater type drier the regeneration cycle may be semi-automatic as follows:

- Manual change-over of the vessels.
- Manual operation of the switch starting the regeneration cycle.
- Automatic operation through all further stages of the regeneration cycle.
- For heatless type the regeneration cycle shall be fully automatic.

The bed temperature shall be controlled (if heated type is used) in such a way that it will not rise above the safe desiccant temperature if the moisture content of the bed is low. If required, additional safety thermostats shall be installed to protect the bed and coils against overheating as a result of any possible failure or maloperation.

Note:

A temperature switch in the regeneration air outlet is not required if the heated air temperature is controlled to be always below the maximum safe desiccant temperature by a control thermostat in the regeneration heater outlet and a local temperature indicator is provided in this outlet.

Contacts shall be provided for making an alarm when:

- The regeneration air fails.
- The regeneration cycle does not proceed properly.
- Regeneration cycle time have elapsed from the start of the regeneration cycle (for heated type).
- Moisture of outlet air is more than recommended limit. Each alarm contact shall be single-pole double-throw and have a rating of at least 24 V DC, 0.5 A inductive. These alarm contacts shall be potential-free, and be adequately separated from other parts of the control system.

(to be continued)

APPENDIX A (continued)

All controls shall be of a fail-safe design, i.e., solenoid valves and relays shall be energized when in the regeneration stage, and air supply failure shall cause any pneumatically operated valves to move to a position ensuring continuation of the air supply.

All electrical instruments such as solenoid valves, limit switches, pressure switches shall be wired to a control box conveniently located on the unit. This control box shall be weather proof and be protected against direct solar radiation when installed in a tropical climate.

A common alarm may be connected to main control room if required.

All relays shall be hermetically sealed, and be suitable for a humid, saline tropical climate unless otherwise is specified.

A.4 CONSTRUCTION

A.4.1 GENERAL ARRANGEMENT

The unit shall be of the twin-vessel regenerative desiccant type having four-way switch-over valves and shall be suitable for continuous and uninterrupted service.

Two afterfilters shall be supplied, each capable of handling the full air flow.

Note:

Prefilters are recommended if forming part of manufacturer's standard execution.

An electric heater or steam heater (for heated type only) with blower and electric motor may be provided for supplying regeneration air.

The unit shall be so designed that either of the vessels or filters can be opened for inspection and servicing without affecting the operation of its counterpart.

To permit prompt delivery of spare parts, all components shall be of approved standard type and design.

The complete unit shall be weatherproof, and suitable for outdoor installation in a tropical saline atmosphere, unless otherwise is specified.

The type of desiccant shall be specified by supplier in the tender.

A.4.2 MECHANICAL CONSTRUCTION

Each vessel shall have a drying capacity for the design quantity stipulated in Section 5 of this specification during 10 hours (minimum).

Flow rates through the vessels (superficial speed) shall be sufficiently low so that there will be no movement of the desiccant bed.

Adequate openings shall be provided on each vessel to enable desiccant fill and dump without dismantling the vessels, disconnecting piping, or in any way disturbing the heater or air blower.

Covers for manholes shall have davits; covers for hand holes shall have hand grips. In the drying vessels the internal fittings, mounting rings, screen retainers, screens, etc., shall be of stainless steel and have adequate mechanical strength.

(to be continued)

APPENDIX A (continued)

The afterfilters and prefilters shall have ceramic or pleated fabric cartridges and carbon steel housing with an efficiency of 99.9% for 3 μm particles. The pressure drop shall be specified by the supplier in the tender. The anticipated cartridge life shall be 12 months for normal operation, taking into account the effects of dust carry-over after loading of new desiccant.

The change-over valves in the inlets and outlets of the vessels shall be interlocked four-way valves of the opening-before-closing type.

All valves, including the change-over valves shall be of carbons steel.

When safety/relief valves form part of the supply on the drier, these shall have a carbon steel body; their inlet shall be flanged ANSI class 150 RF (min.). They shall be of the following make and type...

The inlet and outlet connections of the drier shall be flanged ANSI class 150 RF.

Any branch-off from vessels or pipes shall be ¾ inch minimum size. Connections on pipes may be threaded, connections to vessels shall preferably be flanged.

The vessels' heater (for heated type only) and associated piping shall be insulated.

All major parts of the unit shall be provided with a fixed corrosion-resistant metallic nameplate, showing the manufacturer's name, equipment type, model number, serial number and order number. All wording shall be in the English language.

Surface preparation and protective shop painting shall consist of thorough cleaning, derusting and painting with two coats of lead/red oxide primer.

Machined parts shall be protected with "Shell Ensis Fluid" 256, or an equivalent fluid. Internal surfaces shall not be painted.

Each connection shall be protected for shipment with a plug or cap (when threaded) or with a cover plate (when flanged).

A.4.3 CONSTRUCTION CODES

Supplier shall specify in the tender the construction standards and code used for design and construction of the vessels and the piping.

A.4.4 ELECTRICAL REQUIREMENTS

The electrical installation shall be in accordance with electrical rotating machines standard IPS-C-EL-130.

All electrical equipment shall be suitable for outdoor location in a non-hazardous area, unless otherwise is specified.

The blower (if it is used) shall be complete with electric motor, coupling, coupling guard and motor starter.

A.5 INSTRUMENTATION

A.5.1 GENERAL

The air drier shall be supplied complete with all necessary instrumentation. To achieve standardization of the instrumentation used on the drier and that used in other parts of the plant, it shall be in accordance with the requirements specified below.

(to be continued)

APPENDIX A (continued)

The supplier will, however, remain responsible and guarantee the proper operation of the drier.

A.5.2 INSTRUMENT SPECIFICATION

The following instruments shall be used, but not limited to the followings:

- Pressure gages
- Pressure and DP switches
- Thermometers
- Temperature switches
- Thermocouples
- Control valves
- Solenoid valves
- Relays and timers
- Sight glass for humidity indication

Supplier shall state in the tender any other type of instruments being supplied.

Indicating scales of instruments shall be graduated as follows:

Temperature	:	range in °C
Pressure	:	Range in barg or m barg

Pneumatic instruments shall have a standard signal range of 0.2-1.0 barg. Each consumer of instrument air shall have an individual air filter/regulator, with drain valve.

Instrument air supply lines to solenoid valves shall have air filters. Trouble-free operation of all pneumatic valves at a minimum instrument air supply pressure of 2.5 barg shall be ensured.

Control valves shall preferably have a cast steel body with stainless steel trim, flanged connections ANSI class 300 RF, face-to-face dimensions in accordance with BS 1655.

Solenoid valves shall have a potted coil in weatherproof housing and shall be suitable for continuous energized service at 120% of their nominal voltage and the maximum ambient temperature specified. Connections shall be threaded (½ in. NPT).

Solenoid valves with mechanical reset shall not be used: where manual reset is required provisions for resetting shall be made in the electric control system.

The control and protection system shall include proper tagging of wiring and components to faciliate maintenance, and rail-mounted terminals with sufficient clearance between signals of different power levels and installed with adequate space for accepting the incoming cables.

Each temperature instrument shall have a thermowell. Any additional requirements will be given by user at the time of ordering.

A.5.3 CONNECTIONS

Connections for instrumentation shall be as follows:

- For pressure instruments

Flanged 1½ in. ANSI 150 RF or threaded ½ in. NPT. female. All pressure connections shall have an isolating valve.

(to be continued)

APPENDIX A (continued)

- For temperature instruments

Flanged 1½ in. ANSI class 150 or 300 RF or threaded 1 in. NPT female:

On vessels : under 90° with the vessel wall.

On pipes : 3 in. and 4 in. under 60° with the downstream pipe
6 in. and larger: under 90° with the pipe.

Note:

Pipes with diameters of 2 in. and smaller shall be locally increased to 3 in. diameter for accommodating the thermowell.

- For other instrument

Instrument air : Threaded 1/2 in. NPT female

For more details in this regard reference shall be made to installation drawings.

A.5.4 MISCELLANEOUS

Instruments and their connections to the process shall always be within 0.5 m horizontally away and not more than 2 m vertically above ground level, floors or platforms, walkways, etc.

All instruments, accessories and control valves shall have fixed nameplates.

All process and instrument connections shall be protected by covers or plugs during shipment.

A.6 INSPECTION AND TEST

Inspection by user or appointed representative will consist of but not necessarily be limited to:

a) visual and dimensional checks;
b) hydraulic and functional tests Where applicable.

For more details see: Factory Inspection and Testing of Instruments and Inst. Systems, IPS-E-IN-100 "General".

A.7 EXTENT OF SUPPLY

The supply of the air drier shall comprise:

- The package unit as described in this specification, complete with desiccant, instrumentation and control system, etc.

- All special tools required for operation and maintenace on the equipment.

- One complete spare set of filter elements.

- One complete refill of desiccant.

- One set of recommended spare parts for initial start-up and two years of operation and ten years spares guarantee.

(to be continued)

APPENDIX A (continued)

A.8 INFORMATION IN TENDER

The following information shall be included in the tender:

A.8.1 PRICES

Prices for the equipment as described in the specifications.

A.8.2 INSTRUCTIONS

Ten sets of descriptive instruction manuals with all informations on system installation, operation, maintenance, spare parts list prices and instruments description.

A.8.3 UTILITY REQUIREMENT

The supplier shall advise that the required values given below will not be exceeded.

Cooling water	:	kg/s
Purge air	:	kg/s
Electricity load	:	kW
Steam pressure and flow rate (if reqd.)		

A.8.4 DESICCANT

Type and manufacturer	:	
Quantity for each vessel	:	kg
Pressure drop through bed	:	bar
at.. dm^3/s (at 15°C, 1.013 bar abs) and an inlet pressure of... barg,	:	
Time for complete saturation		
For fresh desiccant	:	h
After 1 year of operation	:	h
Absorption capacity		
Mechanical strength		
Surface area		
Density		

A.8.5 REACTIVATING CYCLES

Drying cycle		
(Assuming complete bed saturation)	:	
Heatless type cycle heating	:	h
Cooling Cycle (for heated type only)	:	h
Electric power consumption (for heated type only)	:	kW
Regeneration air quantity	:	kg/s

APPENDIX A (continued)

A.8.6 PREFILTERS / AFTERFILTERS

Type and size of filter elements	:	
Pressure drop across filters	:	
- In new condition	:	bar
- After 1 year of operation	:	bar

A.8.7 DOCUMENTS

- Specifications of regeneration system including all necessary regeneration equipment, valves, piping etc.

- Instrumentation schemes and electrical diagrams for the control and operation of the unit, including basic logic schemes and function description.

- Data sheets with complete information on each instrument including operating data, make and type, dimensions, length of thermowells, etc.

- Outline drawings showing the main dimensions of the installation.

- Calculations of the noise generated.

All drawings and documents shall be in the English language and all data therein shall be given in SI units.

A.9 INFORMATION IN THE EVENT OF ORDER

In the event of order, supplier shall provide ten sets of all relevant instruction manual for the installation, operation and maintenance, including:

- Details of the equipment used during the regeneration cycle, including valves, timers, etc., for controlling compressed air, electricity and regeneration air.
These details are to be part of a detailed manual for start-up, operation and maintenance.

- Assembly drawing of the unit.

- Piping lay-out drawings including line sizes and flange ratings.

- Equipment outline dimension drawings, stating design pressure.(to be continued)

- Panel lay-out drawing.

- wiring diagrams and listing of makes and types of all electrical components.

- Flow sheet showing control, shutdown and interlocking system, the limits of supply and the location of the instruments.

- Foundation loading diagram.

- Parts lists for all equipment.

- Listing of the spare parts supplied for commissioning and two years' operation.

All drawings to be in the English language.

(to be continued)

APPENDIX A (continued)

A.10 PACKING AND SHIPPING

Equipment must be carefully protected and packed to provide adequate protection during transit to destination and shall be in accordance with any special provision contained in the specification or order.

Special attention must be given to protection against corrosion during transit.

All bright and machined parts must be painted with a rust preventative.

Ancillary items forming an integral part of the equipment should be packed preferably in a separate container if the equipment is normally cased or crated.

Alternatively the ancillary items should be fixed securely to the equipment and adequate precautions taken to ensure that the items do not come loose in transit or be otherwise damaged.

Instruments having delicate movements and assembled into panels for inspection and test must be replaced in makers special shock absorbing packages for transit, all connections being marked for remounting in Iran. Such instruments to be packed in same case as associated panel, but protected by a bulkhead or equivalent packing arrangement.