International Association of Oil & Gas Producers

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Specification for Air Dryer Packages

JIP33
JOINT INDUSTRY PROGRAMME

Revision history

VERSION	DATE	PURPOSE
2.0	June 2022	Second Edition
1.0	December 2018	First Edition

Acknowledgements

This IOGP Specification was prepared by a Joint Industry Programme 33 Standardization of Equipment Specifications for Procurement organized by IOGP with support by the World Economic Forum (WEF).

Foreword

This specification was prepared under Joint Industry Programme 33 (JIP33) "Standardization of Equipment Specifications for Procurement" organized by the International Oil & Gas Producers Association (IOGP) with the support from the World Economic Forum (WEF). Companies from the IOGP membership participated in developing this specification to leverage and improve industry level standardization globally in the oil and gas sector. The work has developed a minimized set of supplementary requirements for procurement, with life cycle cost in mind, resulting in a common and jointly agreed specification, building on recognized industry and international standards.

Recent trends in oil and gas projects have demonstrated substantial budget and schedule overruns. The Oil and Gas Community within the World Economic Forum (WEF) has implemented a Capital Project Complexity (CPC) initiative which seeks to drive a structural reduction in upstream project costs with a focus on industry-wide, non-competitive collaboration and standardization. The CPC vision is to standardize specifications for global procurement for equipment and packages. JIP33 provides the oil and gas sector with the opportunity to move from internally to externally focused standardization initiatives and provide step change benefits in the sector's capital projects performance.

This specification has been developed in consultation with a broad user and supplier base to realize benefits from standardization and achieve significant project and schedule cost reductions.

The JIP33 work groups performed their activities in accordance with IOGP's Competition Law Guidelines (November 2020).

This second edition cancels and replaces the first edition published in December 2018. Due to technical writing requirements leading to extensive changes, this second edition should be treated as a new document.

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Introduction

The purpose of this specification is to define a minimum common set of requirements for the procurement of air dryer packages for application in the petroleum and natural gas industries.

This specification follows a common document structure comprising the four documents as shown below, which together with the purchase order define the overall technical specification for procurement.

JIP33 Specification for Procurement Documents
Technical Specification

This specification is to be applied in conjunction with the supporting procurement data sheet, information requirements specification (IRS) and quality requirements specification (QRS) as follows.

IOGP S-613: Specification for Air Dryer Packages

This specification defines the technical requirements for the supply of the equipment.

IOGP S-613D: Procurement Data Sheet for Air Dryer Packages

The procurement data sheet defines application specific requirements, attributes and options specified by the purchaser for the supply of equipment to the technical specification. The procurement data sheet may also include fields for supplier provided information attributes subject to purchaser's technical evaluation. Additional purchaser supplied documents may also be incorporated or referenced in the procurement data sheet to define scope and technical requirements for enquiry and purchase of the equipment.

IOGP S-613L: Information Requirement Specification for Air Dryer Packages

The IRS defines the information requirements, including contents, format, timing and purpose to be provided by the supplier. It may also define specific conditions which invoke information requirements.

IOGP S-613Q: Quality Requirement Specification for Air Dryer Packages

The QRS defines quality management system requirements and the proposed extent of purchaser conformity assessment activities for the scope of supply. Purchaser conformity assessment activities are defined through the selection of one of four generic conformity assessment system (CAS) levels on the basis of evaluation of the associated service and supply chain risks. The applicable CAS level is specified by the purchaser in the data sheet or in the purchase order.

The terminology used within this specification and the supporting procurement data sheet, IRS and QRS is in accordance with ISO/IEC Directives, Part 2.

The procurement data sheet and IRS are published as editable documents for the purchaser to specify application specific requirements. The specification and QRS are fixed documents.

The order of precedence (highest authority listed first) of the documents shall be:

a) regulatory requirements;

b) contract documentation (e.g. purchase order);

c) purchaser defined requirements (procurement data sheet, IRS, QRS);

d) this specification.

1 Scope

1.1

This specification is intended for air dryer packages in instrument, plant and process air applications using an oil-free air supply.

1.2

This specification covers the design, materials, fabrication, assembly, inspection, testing and documentation for regenerative desiccant type dryers. Refrigerant and membrane type dryers are addressed at a functional level.

1.3

Heat of compression rotary drum dryers are not covered by this specification.

2 Normative references

The following publications are referred to in this document, the procurement data sheet (IOGP S-613D) or the IRS (IOGP S-613L) in such a way that some or all of their content constitutes requirements of this specification. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ASME B1.20.1, *Pipe Threads, General Purpose, Inch*

ASME B16.5, *Pipe Flanges and Flanged Fittings NPS ½ Through NPS 24 Metric/Inch Standard*

ASME B31.3, *Process Piping*

ASME *BPVC*, Section VIII, Division 1, *Rules for Construction of Pressure Vessels*

ASME *BPVC*, Section VIII, Division 2, *Rules for Construction of Pressure Vessels – Alternative Rules*

ASTM A350/A350M, *Standard Specification for Carbon and Low-Alloy Steel Forgings, Requiring Notch Toughness Testing for Piping Components*

EN 1993-1-8, *Eurocode 3: Design of steel structures – Part 1-8: Design of joints*

EN 13445, *Unfired pressure vessel*

IEC 60034-1, *Rotating electrical machines – Part 1: Rating and performance*

IEC 60079 (all parts), *Explosive atmospheres*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEEE Std 841, *Standard for Petroleum and Chemical Industry—Severe Duty Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors—Up to and Including 370 kW (500 hp)*

IOGP S-619, *Specification for Unfired, Fusion welded Pressure Vessels*

IOGP S-703, *Supplementary Specification to IEC 60034-1 Low Voltage Three Phase Cage Induction Motors*

IOGP S-715, *Supplementary Specification to NORSOK M-501 Coating and Painting for Offshore, Marine, Coastal and Subsea Environments*

IOGP S-733D, *Data Sheet for Low Voltage Motors (IEEE Std 841)*

ISO 7-1, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation*

ISO 7183, *Compressed-air dryers — Specifications and testing*

ISO 12944-2, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 2: Classification of environments*

ISO 12944-5, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 5: Protective paint systems*

ISO 12944-6, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 6: Laboratory performance test methods*

ISO 12944-9, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 9: Protective paint systems and laboratory performance test methods for offshore and related structures*

ISO 19901-5:2021, *Petroleum and natural gas industries — Specific requirements for offshore structures — Part 5: Weight management*

ISO 21457, *Petroleum, Petrochemical and natural gas industries — Material selection and corrosion control for oil and gas production systems*

NEMA MG 1, *Motors and Generators*

NEMA 250, *Enclosures for Electrical Equipment (1000 Volts Maximum)*

NFPA 70, *National Electrical Code*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

3.1.1
after-filter
particulate filter located downstream of air dryers to remove dust formed by the breakdown of air dryer desiccant

3.1.2
desiccant
solid substance (adsorbent) with the ability to retain water without change of state

EXAMPLE Silica gel, activated alumina or molecular sieve.

Note 1 to entry: The term excludes deliquescent substances.

3.1.3
desiccant dryer
compressed-air dryer that extracts water vapour from the wet compressed air by the principle of adsorption (attraction and adhesion of molecules in a gaseous or liquid phase) to the surface of an adsorbent or desiccant

3.1.4
heated regenerative dryer
unit which removes absorbed water by passing heated air through the desiccant

Note 1 to entry: The heating effort may be provided via electrical heaters, steam, or a process heat exchanger.

3.1.5
heatless regenerative dryer
unit which removes absorbed water by passing non-heated air through the desiccant

3.1.6
heat-of-compression dryer
desiccant dryer that uses hot compressed air from the final stage compressor discharge to regenerate the desiccant

3.1.7
membrane dryer
compressed air dryer that uses a semi-permeable membrane wall through which water vapour can permeate

3.1.8
moisture separator
equipment installed downstream of the aftercooler or regeneration cooler to remove free water from air
Note 1 to entry: Separators are typically of the centrifugal, coalescing or demister types.

3.1.9
pre-filter
filter installed upstream of the air dryer to remove dust and other particles, oil vapour and free water to prevent damage to the desiccant beds in adsorption type air dryers

3.1.10
pressure dew point
temperature at a given pressure and water-vapour content that dew begins to form

3.1.11
purge air flow
volume-flow of compressed air entering the dryer minus the compressed air leaving the dryer during regeneration cycle

Note to entry 1: For desiccant dryer, this is the slip-stream from dry air passed through a saturated desiccant bed to capture the moisture, before discharging into atmosphere.

Note to entry 2: Typically, purge air is expanded to atmospheric pressure.

Note to entry 3: For membrane dryers, purge air flow is the sum of “sweep-gas” plus permeate.

3.1.12
refrigeration dryer
compressed-air dryer that extracts water vapour by the application of cooling and subsequent condensation

Note 1 to entry: Condensation of water vapour occurs on internal cooling surfaces and is then separated and drained.

3.1.13
regeneration cooler
heat exchanger that cools hot air from the heat regenerated desiccant bed

3.1.14
wet air receiver
vessel that is installed downstream of the compressor aftercooler and upstream of the dryer

3.2 Abbreviated terms

DN diamètre nominal (French for nominal diameter)

NPS nominal pipe size

PTFE polytetrafluoroethylene

TEFC totally enclosed fan cooled

4 General requirements

4.1 Reference conditions

Reference conditions shall be in accordance with Table 1.

Table 1 — Reference conditions

Condition	SI units	US customary units
Air temperature	15 °C	60 °F
Absolute air pressure	1.013 bara	14.7 psia
Relative humidity	0 % (dry)	0 % (dry)
Flow	Standard cubic metres per hour (Sm^3/h)	Standard cubic feet per minute (Scfm)

4.2 Design life

4.2.1

The design life of structures, vessels and piping shall be a minimum of 20 years.

4.2.2

Air dryer packages shall be designed for at least three years of uninterrupted operation.

4.3 Package scope

4.3.1 General

4.3.1.1

Each dryer package shall have a local control panel and package instrumentation.

4.3.1.2

Each dryer package shall have a structural steel base frame with lifting lugs.

4.3.2 Desiccant dryers

4.3.2.1

The desiccant dryer package shall have two desiccant vessels.

4.3.2.2

The desiccant dryer package shall have pre-filters and after-filters.

4.3.2.3

The desiccant dryer package shall have interconnecting piping and switch-over valves.

4.3.2.4

The desiccant dryer package shall have a dew point sensor with transmitter.

4.3.3 Wet air receiver

Wet air receivers shall be sized with a minimum hold-up time of 2 min of the maximum volumetric air flow rate through the receiver.

5 Technical requirements for desiccant dryers

5.1 General

5.1.1

The package shall be self-contained, with all components assembled on a common structural steel skid, baseplate or modular frame.

5.1.2

Desiccant dryers shall have a purge outlet silencer, except for the heat of compression type dryers.

5.2 Desiccant vessel

5.2.1

When the pressure vessel design code is ASME *BPVC*, Section VIII, Division 1, the screening and evaluation method for fatigue analysis shall be in accordance with ASME *BPVC*, Section VIII, Division 2.

5.2.2

Fatigue analysis shall include attachments welded to the pressure envelope and the following locations:

a) head-to-shell;

b) support-to-vessel;

c) nozzle-to-vessel wall, considering external piping loads.

5.2.3

Desiccant vessels shall have a relief valve.

5.2.4

Desiccant vessels shall have desiccant fill and desiccant drain ports.

5.2.5

When desiccant vessels have an internal heater, the heating elements shall not be in direct contact with the desiccant.

5.2.6

When desiccant vessels have an internal heater, the heating element shall be removable without removing desiccant from the desiccant vessel.

5.2.7

Desiccant regeneration cycle air flow shall be in the opposite direction to the drying cycle air flow.

5.2.8

The desiccant bed shall be supported by a stainless steel screen or sieve tubes.

5.2.9

When silica gel is the desiccant, a layer of at least 150 mm (6 in) of activated alumina shall be at the inlet end of the desiccant bed.

5.2.10

The desiccant expected life shall be calculated based on the cycling frequency and maximum moisture loading for the specified inlet conditions.

5.2.11

Desiccant vessels shall have a vent and a drain.

5.2.12 Steam heaters

5.2.12.1

Steam heated coils shall include isolation valves.

5.2.12.2

Steam heated coils shall include a strainer.

5.2.12.3

Steam heated coils shall include a steam trap.

5.3 Pre-filter and regeneration filter

5.3.1

Dual pre-filters shall be provided, each sized for 100 % of the dryer inlet capacity.

5.3.2

Each pre-filter shall have upstream and downstream block valves.

5.3.3

Pre-filter elements shall be coalescing cartridge type.

5.3.4

A differential pressure transmitter shall be provided across the pre-filters.

5.3.5

An automatic drain trap with manual bypass and isolation valves shall be provided for each pre-filter.

5.3.6

Pre-filters shall have a solid particle removal rating equal to or less than 1,0 micron absolute.

5.3.7

Regeneration blower inlet filters shall have a solid particle removal rating equal to or less than 1,0 micron absolute.

5.4 After-filter

5.4.1

The desiccant dryer outlet shall have dual after-filters, each sized for 100 % dryer capacity.

5.4.2

Each after-filter shall have upstream and downstream block valves.

5.4.3

After-filters shall be particulate filters.

5.4.4

After-filters shall have a solid particle removal rating equal to or less than 1,0 micron absolute.

5.4.5

A differential pressure transmitter shall be provided across the after-filters.

5.5 Electrical

5.5.1 Motors

5.5.1.1

Motor enclosures shall be TEFC.

5.5.1.2

Motors shall be supplied with a minimum of Class F insulation.

5.5.2 Heaters

5.5.2.1

Electric heaters shall have a temperature controller.

5.5.2.2

Electric heaters shall have an independent high temperature trip.

5.5.2.3

Electric heater control and over temperature protection shall be integrated with the dryer local control panel.

5.5.2.4

Electric heat tracing shall be terminated at a dedicated heat tracing junction box.

5.6 Instrumentation and control

5.6.1 General

5.6.1.1

The dryer package shall have a skid-mounted local control panel.

5.6.1.2

The local control panel shall have the specified communication protocol.

5.6.1.3

Mechanical switches shall not be provided.

5.6.2 Control system

5.6.2.1

The local control panel shall display which desiccant vessel is in drying mode.

5.6.2.2

The local control panel shall display which desiccant vessel is in regeneration mode.

5.6.2.3

The local control panel shall display the status of the switching valve position.

5.6.2.4

The local control panel shall display an alarm indication for valve switching failure.

5.6.2.5

The local control panel shall display the outlet dew point temperature.

5.6.2.6

The local control panel shall display an alarm status for high dew point temperature.

5.6.2.7

The local control panel shall display the pre-filter differential pressure.

5.6.2.8

The local control panel shall display an alarm status for pre-filter high differential pressure.

5.6.2.9

The local control panel shall display the after-filter differential pressure.

5.6.2.10

The local control panel shall display an alarm status for after-filter high differential pressure.

5.6.2.11

The local control panel shall display the regeneration heater skin temperature.

5.6.2.12

The local control panel shall display an alarm status for high regeneration heater skin temperature.

5.6.2.13

The local control panel shall allow for remote operation.

5.6.2.14

The local control panel shall display the data for remote monitoring.

5.6.2.15

The local control panel shall display an alarm status of package signals.

5.6.2.16

When an air compressor is part of the same train configuration, the dryer control system shall synchronize with the air compressor control system for start-up, loading, unloading and shutdown.

5.6.3 Control and actuated valves

5.6.3.1

Actuated on/off valves DN 50 (NPS 2) and smaller shall be non-lubricated two-way ball or double-offset butterfly valves with double-acting actuators and open and close limit switches.

5.6.3.2

Actuated on/off valves DN 80 (NPS 3) and larger shall be non-lubricated, two-way double offset butterfly valves with double-acting actuators and open and close limit switches.

5.6.3.3

Butterfly valve internals shall be stainless steel with reinforced PTFE seats.

5.6.3.4

For temperatures above 200 °C (392 °F), butterfly valve internals shall be stainless steel with graphite seats.

5.6.3.5

Valve failure position shall be accomplished by the solenoid valve configuration.

5.6.3.6

Dryer switching sequence valves shall be failure lock type to stay in their last position (fail last).

5.6.3.7

Proprietary dryer switching valves shall not be used.

5.6.4 Relief valves

Relief valves shall not discharge to a location within the operation and maintenance access area.

5.6.5 Instrument tubing

5.6.5.1

Compression tube fittings shall be flareless, double-ferrule type.

5.6.5.2

Compression fittings shall be from a single manufacturer.

5.6.6 Dew point instruments

Dew point transmitters shall be provided with a measuring chamber.

5.7 Piping and piping valves

5.7.1

Piping shall be designed, fabricated and tested in accordance with ASME B31.3.

5.7.2

Flanges shall conform to ASME B16.5.

5.7.3

Piping connections smaller than DN 50 (NPS 2) shall be threaded in accordance with ASME B1.20.1 or flanged.

5.7.4

Piping connections DN 50 (NPS 2) or larger shall be flanged.

5.7.5

Piping, vent and drain connections shall be DN 20 (NPS ¾) or larger.

5.7.6

Instrument connections shall be DN 15 (NPS ½) or larger.

5.7.7

Piping sizes DN 65 (NPS 2½), DN 90 (NPS 3½) and DN 125 (NPS 5) shall not be used.

5.7.8

Proprietary connection types shall not be used for purchaser connections.

5.7.9

Connections DN 50 (NPS 2) and smaller shall have bracing.

5.7.10

Slip-on flanges shall be double-welded.

5.7.11

When the minimum design temperature is less than -9,4 °C (15 °F), carbon steel flanges shall be ASTM A350/A350M Grade LF2 Class 1.

5.7.12

Instrument air, cooling water and condensate drainage piping and tubing shall have a single-point tie-in connection located at the skid edge with isolation valve.

5.7.13

The purchaser's tie-in connections shall be brought to the edge of the skid.

5.7.14

Tie-in connections shall have anchor type supports at the baseplate edge.

5.7.15

Ball valves constructed such that the ball is held in place with a threaded portion of the valve body shall not be used, unless the valve halves are positively secured together by seal welding by the valve manufacturer.

5.7.16

Valve stems and valve shafts shall be designed for stem retention.

5.7.17

The weakest link of the valve stem design shall be outside of the pressure boundary.

5.7.18

Ball, plug and butterfly valves shall have an anti-static device.

5.7.19

Quarter turn block valves in isolation services shall have a locking mechanism capable of accepting a car seal or pad lock.

5.7.20

The anti-blow-out stem retention configuration shall be located internally to the valve.

5.7.21

Drain lines up to the tie-in point shall be rated for the same design pressure as the equipment being drained.

5.8 Regeneration cooler and moisture separator

5.8.1

Desiccant dryers shall have a regeneration cooler for heat of compression type dryers.

5.8.2

When moisture is not free draining into the moisture separator, the regeneration cooler shall have an automatic drain trap.

5.8.3

Automatic drain traps shall have an isolation and manual bypass valve at the lowest point between the regeneration cooler and the moisture separator.

5.8.4

Shell and tube exchangers for heat-of-compression dryers shall be water-in-tube and air-in-shell configuration.

5.8.5

When drain traps use a solenoid, the solenoid shall be H-rated, with a stainless steel body and soft seal.

5.8.6

The moisture separator shall be provided with dual automatic drain traps with isolation valves.

5.8.7

The moisture separator shall be provided with a high-level alarm.

5.9 Baseplate and support structure

5.9.1

The baseplate shall be a single-fabricated structural steel unit.

5.9.2

Baseplate welding shall be continuous.

5.9.3

The support structure shall be provided with lifting attachments for at least a four-point lift.

5.9.4

The assembled skid structure shall be designed for a single-point lift.

5.9.5

The baseplate and support structure shall be designed for operating, transportation, wind, seismic and blast loads.

5.10 Nameplate

5.10.1

A nameplate shall be securely attached at a visible location on the dryer skid, desiccant vessels and auxiliary equipment.

5.10.2

Nameplates shall be 316L stainless steel.

5.10.3

Nameplates shall be affixed with 316L stainless steel rivets or screws.

5.10.4

Nameplate information shall be stamped or engraved, and legible.

5.10.5

Nameplates shall include the manufacturer's name.

5.10.6

The dryer skid nameplate shall include the serial number.

5.10.7

The dryer skid nameplate shall include the size, model and type.

5.10.8

The dryer skid nameplate shall include the rated air flow rate.

5.10.9

The dryer skid nameplate shall include the rated discharge pressure.

5.10.10

The dryer skid nameplate shall include the dew point temperature at the rated pressure.

5.10.11

The dryer skid nameplate shall include the purchaser's item number or tag number.

5.10.12

The dryer skid nameplate shall include the purchase order number.

5.10.13

Nameplates shall include units consistent with those used on the data sheet.

5.10.14

When an equipment item has an assigned tag number, the tag number and equipment name shall be on the name plate or a separate tag plate.

5.10.15

The content on nameplates for the package components shall follow industry practices depending on the component type.

6 Material

6.1 General

6.1.1

The material of construction shall be in accordance with Table 2.

6.1.2

When the material of construction is not specified in Table 2, the material selection philosophy shall be in accordance with ISO 21457.

6.1.3

Hot-dip galvanizing shall be performed after fabrication.

6.1.4

After galvanizing, flange faces shall be inspected and lightly refinished in conformance with the requirements of ASME B16.5.

Table 2 — Material selection

Item	Material of construction (base case) [a]	Material of construction (harsh environment) [b]
Desiccant vessel	Carbon steel (coated)	Carbon steel (coated) or 316 stainless steel
Vessel internals	316 stainless steel	316 stainless steel
Pre-filter housing	Carbon steel (coated)	316 stainless steel
After-filter housing	Carbon steel (coated)	316 stainless steel
Electric heater housing	Carbon steel (coated)	Carbon steel (coated) or 316 stainless steel
Regeneration cooler (water cooled) [c]		
Shell	Carbon steel (coated)	Carbon steel (coated) or stainless steel
Tube	316 stainless steel or 90/10 Cu-Ni or admiralty brass	316 stainless steel or 90/10 Cu-Ni or admiralty brass
Tube sheet and baffle	Compatible with the tube material	Compatible with the tube material
Piping, tubing and miscellaneous items		
Air piping	Carbon steel (hot-dip galvanized) or carbon steel (coated)	316 stainless steel
Water piping [c]	Carbon steel (coated)	Carbon steel (coated)
Switching valve body	Carbon steel (coated)	316 stainless steel
Tubing and fittings	316 stainless steel	316 stainless steel
Silencer housing	Carbon steel (coated)	316 stainless steel
Silencer internals	316 stainless steel	316 stainless steel
Baseplates and support structure	Carbon steel (hot-dip galvanized) or carbon steel (coated)	Carbon steel (hot-dip galvanized) or carbon steel (coated)
Instrument housing	Stainless steel or aluminium	316 stainless steel or aluminium
Junction box	Carbon steel (coated) or 316 stainless steel or aluminium	316 stainless steel or aluminium
Local control panel	Carbon steel (coated)	316 stainless steel

[a] Base case applies to atmospheric corrosion categories C1 to C3 (low to medium corrosivity) defined by ISO 12944-2.

[b] Harsh environments applies to corrosion categories C4 to CX (high to extreme corrosivity) defined by ISO 12944-2.

[c] Cooling water is to be fresh water or glycol-water mixture.

6.2 Welding

6.2.1

Welding shall be performed in accordance with a qualified welding procedure and an internationally recognized standard.

6.2.2

Repair welds shall undergo the same heat treatment and non-destructive examination as the original weld.

6.2.3

Pressure-containing welds and the attachment of nozzles and fittings to the pressure boundary shall be full penetration welds.

6.2.4

Permanent backing strips shall not be used.

6.3 Coating

6.3.1

Onshore and non-marine coating systems shall be selected in accordance with ISO 12944-5.

6.3.2

Offshore and marine coastal coating systems shall be in accordance with ISO 12944-9 or IOGP S-715.

6.3.3

Onshore and non-marine coating systems shall be qualified to ISO 12944-6.

6.3.4

Bearings, seals, flange mating faces, instrument face, instrument cases, cables, shafts, polished or machined surfaces, control valve stems, nameplates and item tags shall not be coated.

6.3.5

Bearings, seals, flange mating faces, instrument faces, instrument cases, cable trays and cables, shafts, polished or machined surfaces, control valve stems, nameplates and item tags shall be protected from blasting and coating being applied to adjacent equipment.

6.3.6

Cast iron, carbon steel and low alloy steel external surfaces shall be coated.

6.3.7

Stainless steel equipment items and piping shall be coated when operating at a temperature exceeding 60 °C (140 °F) in a marine atmosphere.

6.3.8

Insulated stainless steel equipment and piping shall be coated.

6.3.9

Coating under insulation shall be in accordance with IOGP S-715.

6.3.10

Carbon steel pressure vessels in direct contact with wet compressed air shall have an internal coating.

7 Inspection and testing

7.1 Pressure testing

7.1.1

On-skid piping shall undergo a hydrostatic test or pneumatic test as a pre-assembled spool.

7.1.2

Pressure vessels and heat exchangers shall be hydrostatically tested.

7.1.3

The hold time at hydrotest pressure shall be not less than 1 h.

7.1.4

Seal-welded ball valves shall be hydrotested after welding.

7.2 Functional testing

7.2.1

Functional tests for dryer controls shall verify the valve switching cycle for adsorption and desorption.

7.2.2

Functional tests for dryer controls shall verify heating and cooling cycle times.

7.2.3

Functional tests for dryer controls shall verify heater temperature control.

7.2.4

Functional tests for dryer controls shall verify alarm and trip settings.

7.2.5

Functional tests for dryer controls shall verify the alarm setting of the dew point transmitter.

7.2.6 Local control panel functional test

7.2.6.1

The local control panel shall be tested to verify the functionality of the visual display.

7.2.6.2

The local control panel shall be tested to verify the functionality of the control switches.

7.2.6.3

The local control panel shall be tested to verify the functionality of the control logic.

7.2.6.4

The local control panel shall be tested to verify the functionality of the alarm and trip set points.

7.2.6.5

The local control panel shall be tested to verify the functionality of the communication interface.

7.3 Performance testing

7.3.1

The performance test of the dryer shall be carried out in accordance with ISO 7183.

7.3.2

The performance test of the dryer shall demonstrate the drying and regeneration cycle time.

7.3.3

The performance test of the dryer shall demonstrate pressurization and depressurization.

7.3.4

The performance test of the dryer shall demonstrate the regeneration temperature.

7.3.5

The A-weighted sound pressure level shall be measured at 1,0 m (3,3 ft) from the skid boundary.

8 Preservation and packing

8.1

The dryer package shall be preserved following completion of testing activities and final inspection.

8.2

The equipment shall be preserved for six months of outdoor storage from the time of shipment.

8.3

Exposed machined and unpainted surfaces shall be coated with vapour proof corrosion inhibitor.

8.4

Visible display units and the control panel front face shall be protected against scratches during transportation and handling.

8.5

Open piping and valve connections shall be blinded with material compatible with the metallurgy of the piping system.

9 Spare parts and weight control

9.1 Spare parts

Spare parts shall be the same as were supplied for the original component.

9.2 Weight and centre of gravity data

The weight data of equipment for installation offshore shall be provided in accordance with ISO 19901-5:2021, Clause 8.

Annex A
(informative)
Air dryer selection guidelines

A.1

The air dryer package should be sized and selected to meet the peak system dry air demand for the facility (e.g. instrument air, feed air to nitrogen generator, plant air and process air).

Table A.1 — Air dryer selection

Type	Lowest pressure dew point achievable	Highest compressed air purity class achievable	Selection guidelines and features
Refrigeration	3 °C (37 °F)	Class 4	Low capital cost, most energy efficient, cannot achieve low dew point. Recommended only for plant and process air. Not suitable for instrument air as a standalone dryer.
Membrane	-20 °C (-4 °F)	Class 3	Used in small volume flow rate applications. Recommended mainly for plant and process air.
Desiccant dryers			
Heatless	-70 °C (-94 °F)	Class 0	Lowest capital cost and highest life cycle cost amongst desiccant dryers. High maintenance cost due to fast recycling of dryer. Increased air compressor and driver motor size, increased noise, reduced valve life compared to other desiccant dryers. Consumes high amount of purge air (15 % to 20 %). Short drying cycle (5 min to 10 min). Rapid pressurizing and depressurizing time (about 5 s to 10 s). Recommended for low volume flow application (< 1 000 Nm^3/h) due to high purge flow loss.
Heat regenerated (with internal purge)	-70 °C (-94 °F)	Class 0	Higher capital cost and lower lift cycle cost than heatless dryer. Purge air consumption (up to 10 %). Long drying cycle (4 h to 8 h) and slow pressurization and depressurization time (6 min). Less likely to achieve pressure dew point of -70 °C (-94 °F) as a standalone dryer under high inlet ambient conditions.
Heat regenerated (external blower heated)	-70 °C (-94 °F)	Class 0	Higher capital expenditure than heat regenerated dryer with internal purge but lower life cycle cost. Zero purge loss. Long drying cycle (4 h to 8 h) and slow pressurization and depressurization time (6 min). Less likely to achieve pressure dew point of -70 °C (-94 °F) as a standalone dyer under high inlet ambient conditions.
Heat of compression	-70 °C (-94 °F)	Class 0	Lowest life cycle cost, moderate maintenance cost and lowest operating cost amongst desiccant dryers Improved valve life, lowest noise level zero to marginal purge loss. Long drying cycle (4 h to 8 h) and slow pressurization and depressurization time (6 min).

A.2

The air dryer package should be provided with a sparing configuration (e.g. 2 x 100 %, 3 x 50 %) to ensure that the system dry air demand and quality can be met during upset conditions or maintenance shutdown of the primary dryer unit.

A.3

Available air dryer technologies for the flow rates covered by this specification should be selected based on product air quality and purity class requirements in accordance with ISO 8573-1, Table 1.

A.4

Table A.1 presents generic guidelines for selection of various technologies and dryer types for different applications.

Annex B
(informative)
Typical schematics

Typical schematics for air dryer packages are shown in Figure B.1 to Figure B.6.

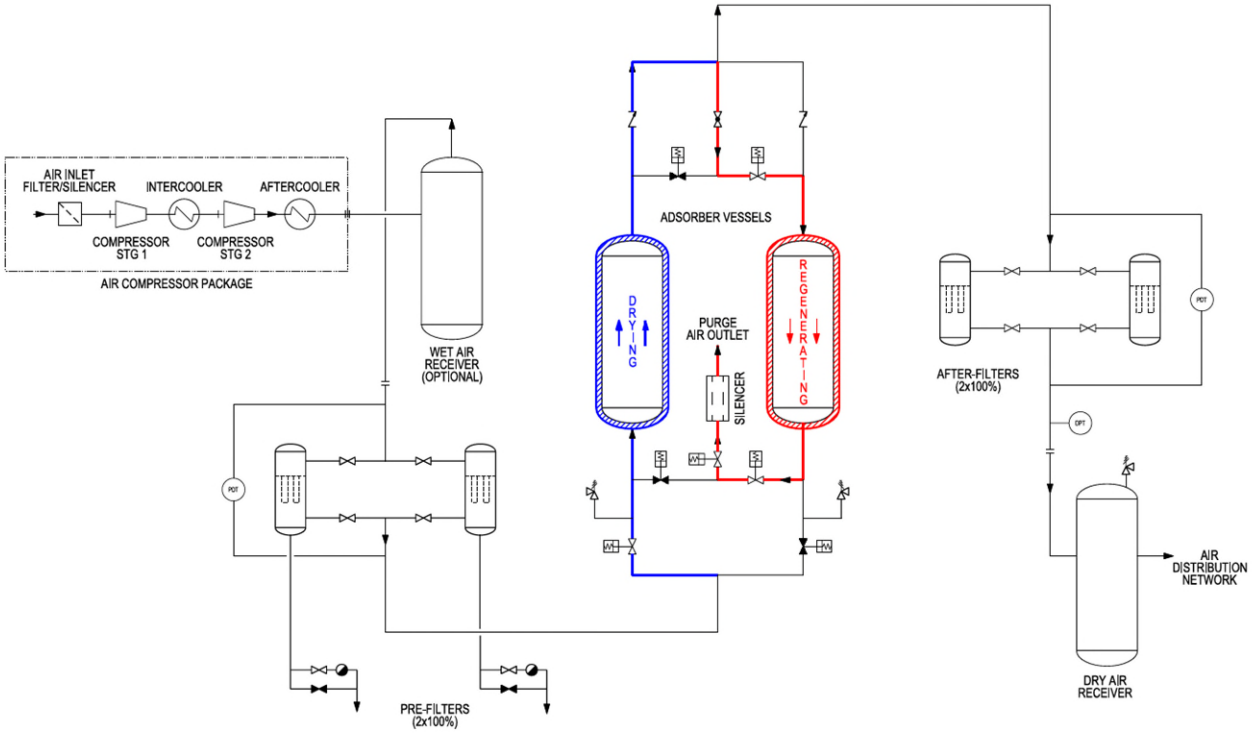


Figure B.1 — Desiccant dryer – Heatless

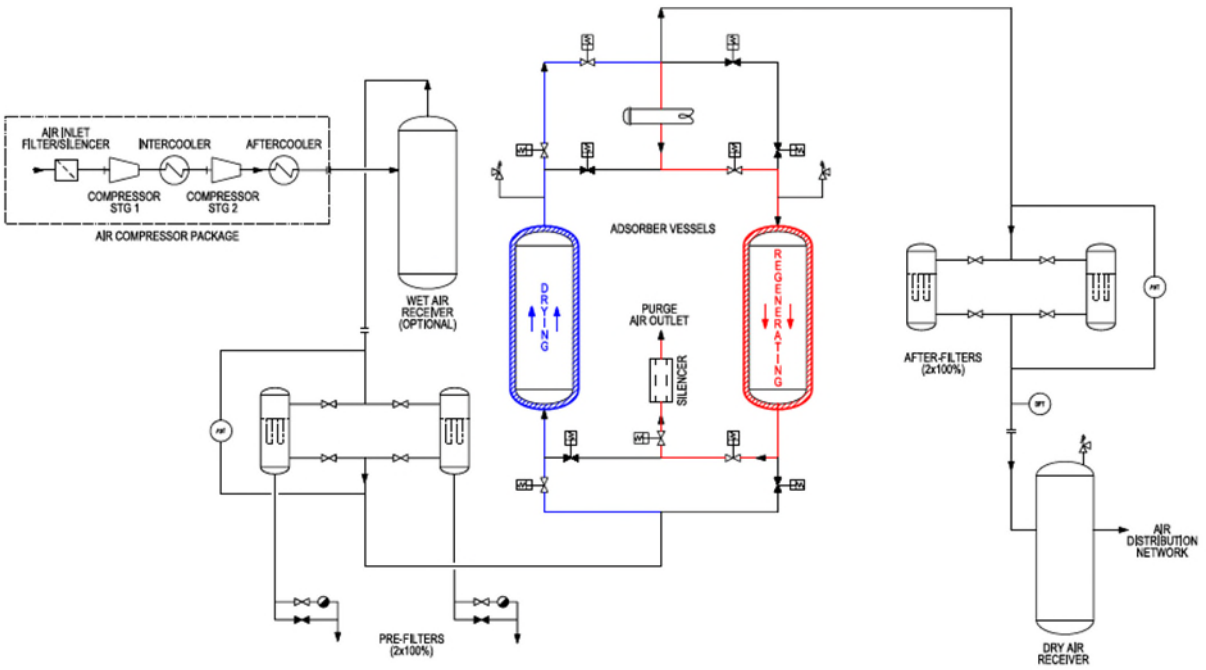


Figure B.2 — Desiccant dryer – Heat regenerated (with internal purge)

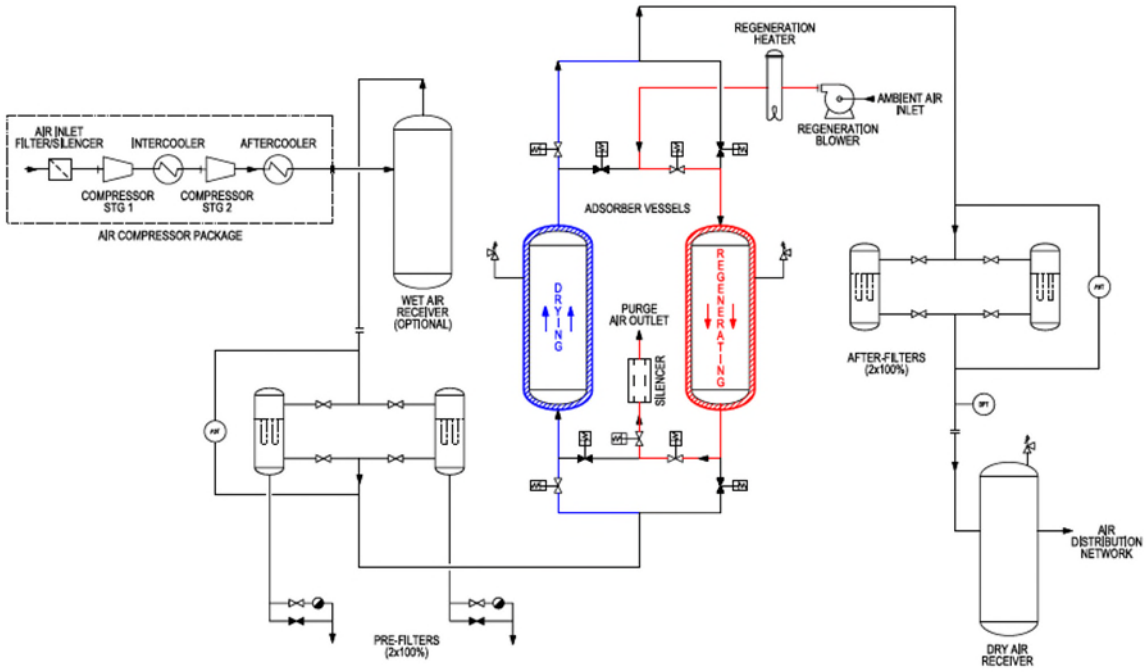
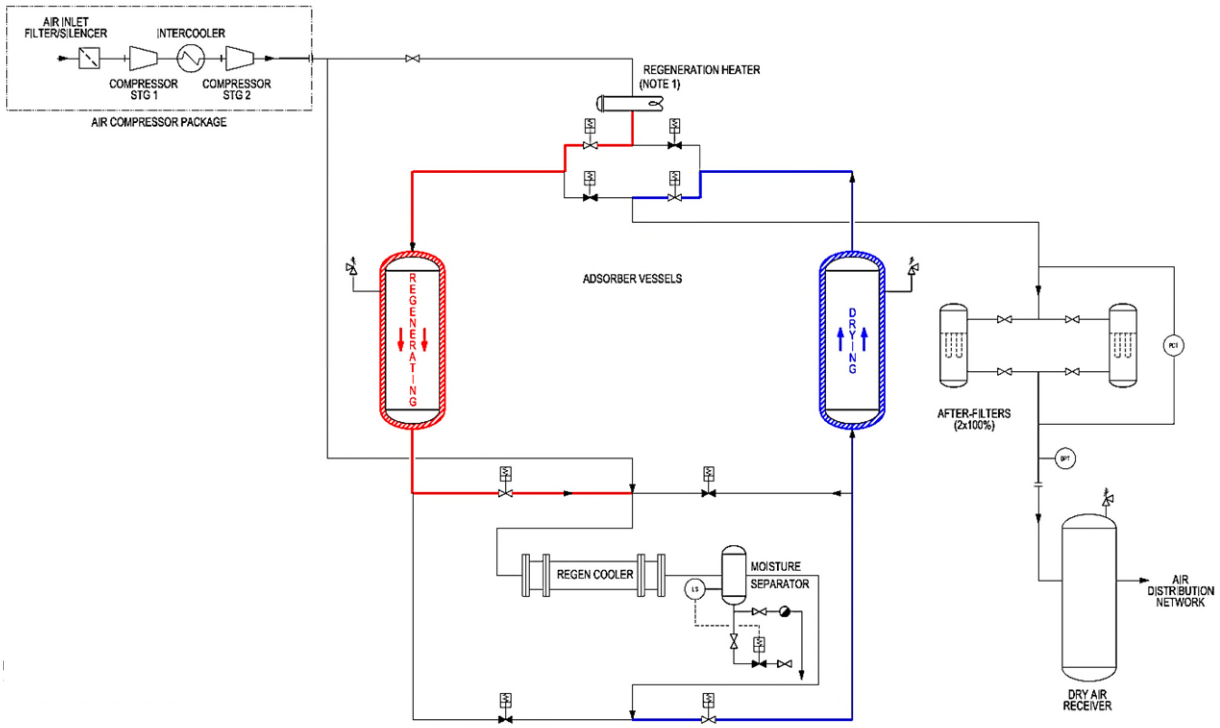
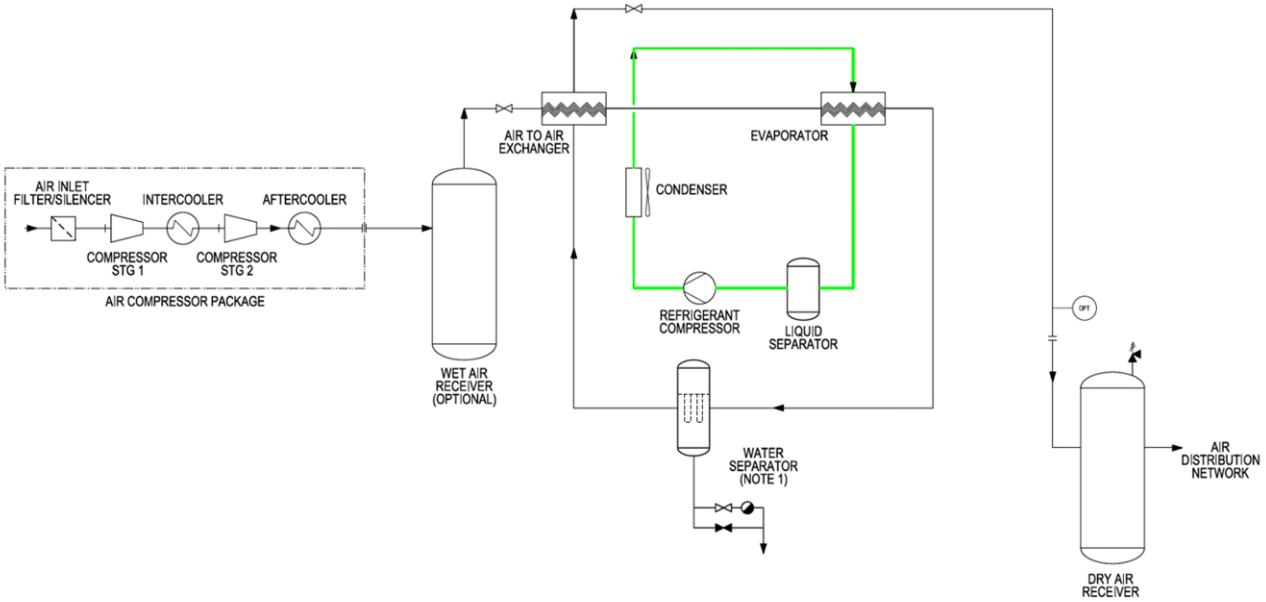


Figure B.3 — Desiccant dryer – Heat regenerated (external blower heated)



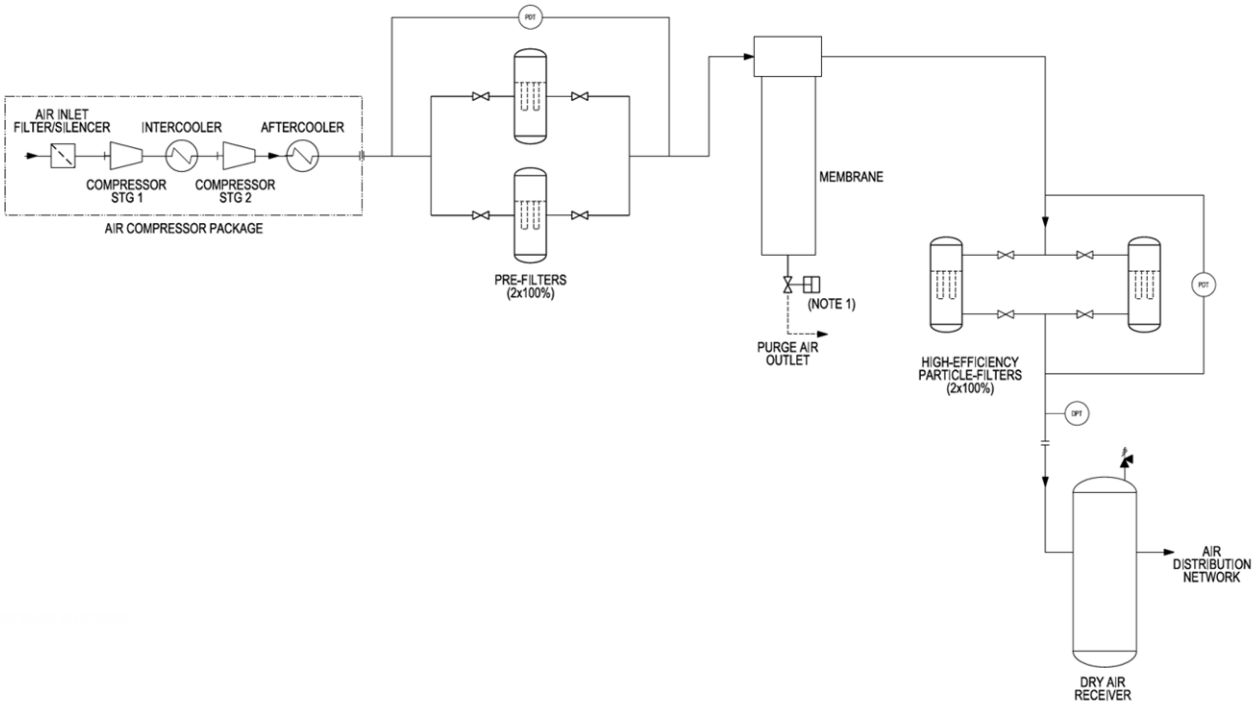
NOTE 1 Heater is optional, dependent on regeneration air temperature and final dewpoint requirement.

Figure B.4 — Desiccant dryer – Heat of compression



NOTE 1 Water separator can be integrated with evaporator.

Figure B.5 — Refrigeration dryer



NOTE 1 Purge stop valve is optional.

Figure B.6 — Membrane dryer

Bibliography

[1] ISO 8573-1, *Compressed air — Part 1: Contaminants and purity class*

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