International Association of Oil & Gas Producers

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Specification for Air Dryer Packages

Revision history

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Acknowledgements

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

Foreword

This specification was prepared under a Joint Industry Project 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). Ten key oil and gas companies from the IOGP membership participated in developing this specification under JIP33 Phase 2 with the objective to leverage and improve industry level standardization for projects 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, based on the ten participating members’ company specifications, resulting in a common and jointly approved specification, and building on recognized industry and international standards.

This specification has been developed in consultation with a broad user and supplier base to promote the opportunity to realize benefits from standardization and achieve significant cost reductions for upstream project costs. The JIP33 work groups performed their activities in accordance with IOGP’s Competition Law Guidelines (November 2014).

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 vision from the CPC industry is to standardize specifications for global procurement for equipment and packages, facilitating improved standardization of major projects across the globe. While individual oil and gas companies have been improving standardization within their own businesses, this has limited value potential and the industry lags behind other industries and has eroded value by creating bespoke components in projects.

This specification aims to significantly reduce this waste, decrease project costs and improve schedule through pre-competitive collaboration on standardization.

Following agreement of the relevant JIP33 work group and approval by the JIP33 Steering Committee, the IOGP Management Committee has agreed to the publication of this specification by IOGP. Where adopted by the individual operating companies, this specification and associated documentation aims to supersede existing company documentation for the purpose of industry-harmonized standardization.

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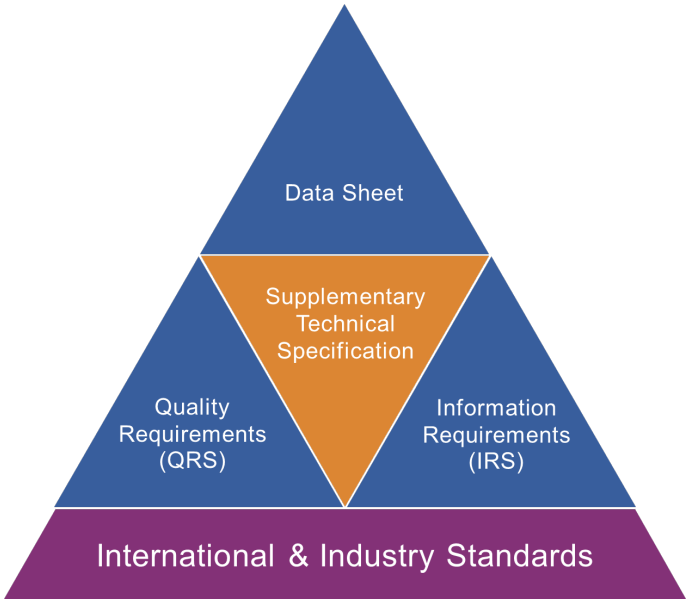
Introduction

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

This JIP33 standardized procurement 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
Supplementary Technical Specification

It is required to use all of these documents in conjunction with each other when applying this specification, as follows:

S-613: Specification for Air Dryer Packages

This specification is to define a minimum common set of specification requirements for the procurement of air dryer packages. The terminology used within this specification is in accordance with ISO/IEC Directives, Part 2.

S-613D: Data sheets for Air Dryer Packages

This document provides project specific requirements where this specification requires the user to define an application specific requirement. It also includes information required by the purchaser for technical evaluation. Additional purchaser supplied documents are also listed on the data sheets, to define scope and technical requirements for enquiry and purchase of the equipment.

S-613L: Information requirements for Air Dryer Packages

This document defines the information requirements, including format, timing and purpose, for information to be provided by the vendor. It also defines the specific conditions which must be met for conditional information requirements to become mandatory. The information requirements listed in the IRS have references to the source of the requirement.

S-613Q: Quality requirements for Air Dryer Packages

This document includes a conformity assessment system (CAS) which specifies standardized user interventions against quality management activities at four different levels. The applicable CAS level is specified by the purchaser on the data sheets.

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

Unless defined otherwise in the purchase order, 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 (data sheets, IRS, QRS);

d) this specification;

e) the parent standard.

1 Scope

The scope for this specification covers the minimum requirements for air dryer packages for instrument, plant and process air applications. The scope only includes air dryer packages for air supplied as oil-free.

While this document covers minimum requirements for design, materials, fabrication, assembly, inspection, testing and documentation for regenerative desiccant type dryers; refrigerant and membrane type dryers are addressed at a generic functional level.

This specification does not cover heat of compression rotary drum dryers.

2 Normative references

ASME BPVC Sec. VIII Div. 1	Rules for Construction of Pressure Vessels
ASME B 31.3	Process Piping
EN 13445	Unfired Pressure Vessel
IEC 60034	Rotating Electrical Machines
IEC 60079	Explosive Atmospheres
ISO 3744	Acoustics- Determination of sound power levels and sound energy levels of noise sources using sound pressure – Engineering methods for an essentially free field over a reflecting plane
ISO 7183	Compressed air dryer – Specifications and testing
ISO 8573-1	Compressed air – Contaminants and purity class
ISO 9614	Acoustics- Determination of sound power levels of noise sources using sound intensity
ISO 12944 (all parts)	Paints and varnishes – Corrosion protection of steel structures by protective paint systems
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)

3 Terms and definitions

3.1 after-filter

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

3.2 desiccant

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

EXAMPLES Silica gel, activated alumina or molecular sieve

NOTE The term excludes deliquescent substances

3.3 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. The adsorbent is regenerated by passing dry air to removie the adsorbed water

3.4 dry air receiver

single or multiple vessels installed downstream of the dryers

3.5 heated regenerative dryer

regeneration is achieved by passing heated air through the desiccant. The heating effort may be provided via electrical heaters, steam, or a process heat exchanger

3.6 heatless regenerative dryer

regeneration is achieved by passing a non-heated volume of air through the desiccant to be regenerated

3.7 heat-of-compression dryer

desiccant dryer that uses hot compressed air from final stage compressor discharge to regenerate the desiccant. The hot air is then cooled and dried with zero to marginal purge loss

3.8 membrane dryer

A compressed air dryer that consists of a semi-permeable membrane wall through which water vapour, can permeate. Water vapour that has diffused through the membrane layer is then conducted away and ejected out to atmosphere.

3.9 moisture separator

equipment installed downstream of the aftercooler or regeneration cooler to remove free water from air.

NOTE Separators are typically of the centrifugal or coalescing types

3.10 pre-filter

filter installed upstream the air dryer to remove dust and other particles, oil vapours and free water, which would damage the desiccant beds in the adsorption type air dryers

3.11 pressure dew point

temperature to which air must be cooled, at a given pressure and water-vapour content, for it to reach saturation; the temperature at which dew begins to form

3.12 purge air flow

volume-flow of compressed air entering the dryer minus the compressed air leaving the dryer during regeneration cycle. For desiccant dryer, this is slip-stream from dry air flow passed through saturated desiccant bed to capture the moisture, before discharging into atmosphere.

NOTE 1 Typically, purge air is expanded to atmospheric pressure

NOTE 2 For membrane dryers, purge air flow is the sum of “sweep-gas” plus permeate.

3.13 reference conditions

the ambient pressure and temperature conditions at which dryer performance is specified

3.14 refrigeration dryer

compressed-air dryer that extracts water vapour by the application of cooling and subsequent condensation. Condensation of water vapour occurs on internal cooling surfaces and is then separated and drained

3.15 regeneration cooler

heat exchanger that cools hot air from the heated regenerating desiccant bed

3.16 wet air receiver

vessel that is installed downstream of the compressor after cooler and upstream of the dryer

4 General requirements

4.1 Design Life

Unless, otherwise specified, the air dryer package including all auxiliaries covered in this standard shall be designed and constructed for a minimum service life of 20 years and at least 3 years of uninterrupted operation.

4.2 Reference conditions

Table 1 – Reference conditions

	SI units	US customary units
Air temperature	0 °C	60 °F
Absolute air pressure	1.013 bar a	14.7 psi a
Relative humidity	0 % dry	0 % dry
Flow	Normal cubic metres per hour (Nm^3/h)	Standard cubic feet per minute (scfm)

4.3 Package scope

4.3.1 Desiccant dryer

Each dryer package shall consist of the following, as a minimum:

a) twin desiccant vessels;

b) pre-filters and after-filters;

c) interconnecting piping and valves including switch-over valves, relief valve, drain and vent;

d) necessary control and instrumentation with field instruments, local control panel and skid edge junction box;

e) dew point sensor with indicator and transmitter;

f) structural steel base frame with lifting lugs;

g) first fill of desiccant;

h) noise attenuation equipment including purge air outlet silencer;

i) regeneration heater with on-off temperature control, if applicable;

j) regeneration blower (1x 100 %) with driver motor and inlet filter, if applicable;

k) regeneration cooler with automatic drain trap, if applicable;

l) insulation and heat tracing with heat tracing junction box;

4.3.2 Refrigerant dryer

The scope shall follow the scope definition of the vendor's standard product along with any off package item such as activated carbon filters and pre-filter required for the service.

4.3.3 Membrane dryer

The scope shall follow the scope definition of the vendor's standard product along with any off package item such as activated carbon filters and pre-filter required for the service.

4.4 Sizing and selection

4.4.1

Selection of dryer type shall be based on the dryer's ability to deliver the required minimum-pressure dew point for the defined system flow, pressure and range of ambient temperature and relative humidity as defined in the data sheet. It should also take into consideration the life cycle cost, efficiency, reliability and maintainability of the dryer.

Note Annex A provides general selection guidelines and recommendations for air dryers in different applications and air purity requirements.

4.4.2

The need for a wet air receiver shall be evaluated and confirmed based on provision and size of the moisture separator downstream of compressor aftercooler and pressure pulsation on the compressor discharge header.

4.4.3

If specified in the datasheet, vendor shall supply the wet air receiver.

4.4.4

The wet air receiver, if provided, shall be sized with a minimum hold up of 2 minutes of the maximum air flow rate through the receiver.

4.4.5

A standalone refrigeration dryer shall not be used for instrument air applications.

4.4.6

A refrigeration dryer in series with a desiccant dryer may be used for instrument air applications, if approved by the purchaser.

5 Technical requirements for desiccant dryers

5.1 General

5.1.1

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

5.1.2

The package shall be suitable for outdoor installation, unless otherwise specified in the data sheet.

5.1.3

The package shall be non-Ex zone certified, unless otherwise specified in the data sheet.

5.1.4

The arrangement of equipment, piping and valves shall provide adequate operational clearance and maintenance access, including safe manual handling.

5.1.5

All pressure-containing welds and the attachment of nozzles and fittings shall be full penetration welds. Backing strips, if used shall be removed.

5.1.6

Packages shall be fitted with a purge outlet silencer, that complies with the maximum sound pressure level specified in the data sheet.

5.1.7

The A-weighted sound pressure level at rated dryer flow rate under free field operating conditions, during purge and blow down cycle, measured at 1,0 m (3.3 ft) from skid boundary, shall be limited within the specified noise limit, defined in the data sheet.

5.1.8

Air dryer packages for instrument air service shall deliver air at a maximum pressure dew point, which is at least 10 °C (18 °F) below the minimum temperature to which any part of the instrument air system is exposed, unless otherwise specified in the data sheet.

5.2 Desiccant vessel

5.2.1

Vendor shall be responsible for the correct sizing of vessels based on the maximum inlet air volume flow rate at operating pressure and maximum moisture loading stated in the data sheet.

5.2.2

Vessels shall be fabricated pressure equipment, designed, constructed and tested to ASME Section VIII Div.1 or EN 13445, unless otherwise specified in the data sheet.

5.2.3

If specified in the data sheet, vessels shall be ASME code stamped.

5.2.4

If specified in the data sheet, vessels shall be compliant with the essential safety requirements of the Pressure Equipment Directive (PED) 2014/68/EU.

5.2.5

The vendor shall provide evidence that the vessels can withstand the cyclic fluctuation of pressure and temperature for the specified service.

5.2.6

Carbon steel vessels shall include a minimum corrosion allowance of 3 mm (0,125 in) unless otherwise specified in the data sheet.

5.2.7

Vessels shall have dedicated fill and drain ports.

5.2.8

If desiccant vessels are provided with an internal heater, heating elements shall not be in direct contact with the desiccant and shall allow removal of the heating element without removing any desiccant material.

Air flow through the desiccant during regeneration shall be in opposite direction to the air-flow during normal drying cycle operations.

5.2.9

Desiccant beds shall be supported by stainless steel screens or sieve tubes.

5.2.10

Air velocity into and through the desiccant bed shall not cause damage, channelling or carry over of the desiccant.

5.2.11

The vendor shall state the design moisture loading and air flow velocities through the vessels in the data sheet.

5.2.12

Desiccant shall be silica gel, activated alumina or molecular sieve, unless otherwise approved by the purchaser.

5.2.13

If silica gel is used as the desiccant, a 150 mm (6 in) minimum layer of activated alumina or molecular sieve is required at the inlet end of the desiccant bed.

5.2.14

Desiccant shall be high-performance water resistant type to reduce reactivation capacity and extended desiccant life.

5.2.15

The vendor shall provide expected life of the supplied desiccant and cycling frequency, based on maximum moisture loading for the specified inlet conditions.

5.2.16

The vendor shall provide in the data sheet:

a) the total time for one complete drying and regeneration cycle;

b) duration of each individual stage, as applicable (e.g. drying, regeneration heating, regeneration cooling, moisture stripping etc.);

c) duration for pressurisation and de-pressurisation prior to cycle changeover;

d) interval for valve cycle switching for main switching valves and purge-flow valve

The vendor may also propose a dryer design with dew point dependent switching to facilitate reduced valve switching and purge flow loss.

5.3 Pre-filter

5.3.1

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

If the dryer package is provided with full sparing configuration, a single pre-filter for each dryer package may be provided, if approved by the purchaser.

5.3.2

Upstream and downstream block valves shall be provided for each filter for on-line changeover and on-line replacement of the off-line unit.

5.3.3

Filter elements shall be coalescing cartridge type capable of removing water droplets of oil aerosol, water, dust and other foreign matter.

5.3.4

A differential pressure transmitter shall be provided across the filters and configured with a high differential pressure alarm.

5.3.5

Automatic drain trap with manual bypass shall be provided for each pre-filter.

5.3.6

The particle removal rating shall be 1,0 micron absolute or less.

5.4 After-filter

5.4.1

The dryer outlet shall be provided with dual after-filters, each sized for 100 % dryer capacity.

If the dryer package is provided with full sparing configuration, a single after-filter for each dryer package may be provided, if approved by the purchaser.

5.4.2

Upstream and downstream block valves shall be provided for each filter for on-line changeover and on-line replacement of the off-line unit.

5.4.3

After-filters shall be particulate filters capable of removing suspended particles and desiccant dust that may be carried over from dryer.

5.4.4

The particle removal rating shall be 1,0 micron absolute or less.

5.4.5

A differential pressure transmitter shall be provided across the filters and configured with a high differential pressure alarm.

5.5 Electrical

5.5.1 Motors

5.5.1.1

Motors shall conform to either IEC 60034, NEMA MG-1 or IEEE 841, unless otherwise specified in data sheet.

5.5.1.2

Enclosure for Motors shall be totally enclosed fan cooled.

5.5.1.3

For general outdoor environments, motors shall have as a minimum, weather protection class IP55.

5.5.1.4

For environments with areas exposed to powerful water jets and deluge or offshore open deck , IP56 weather protection class shall be used.

5.5.1.5

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

5.5.2 Heaters

5.5.2.1

Redundant temperature controller and high skin temperature cut-out shall be provided.

5.2.2.2

Temperature transmitters shall be provided; if specified in the data sheet.

5.5.2.3

Control and over temperature protection for electric heater shall be integrated with the Dryer control panel.

5.6 Instrumentation and control

5.6.1 General

5.6.1.1

Instruments, controls and protective devices necessary for safe and reliable operation shall be provided.

5.6.1.2

Unless specified otherwise, a skid-mounted local control panel of vendor standard design for the control, monitoring and protection functions for the unit shall be provided.

5.6.1.3

All field analogue instruments, such as transmitters and control valves, shall be provided with a suitable communication protocol, as defined in the data sheet, to facilitate communication, remote monitoring and diagnostics from purchaser's control system.

5.6.1.4

Unless otherwise specified, control and instrumentation shall be suitable for outdoor installation. Ingress protection shall conform to class IP65 as per IEC 60079 or NEMA 4X as per NEMA 250.

5.6.1.5

All pressure transmitters on the skid shall be provided with single block and bleed manifolds.

5.6.1.6

Use of mechanical switches shall require purchaser's approval.

5.6.2 Control system

5.6.2.1

If specified in the data sheet, a programmable logic (PLC) type controller shall be provided.

5.6.2.2

The local control panel shall provide display, status and alarm indication as a minimum for:

a) which desiccant vessel is in drying mode;

b) which desiccant vessel is in regeneration mode;

c) switching valve operational and failure status;

d) outlet dew point;

e) high dew point alarm;

f) pre-filter high differential pressure alarm;

g) after filter high differential pressure alarm;

h) regeneration heater high skin temperature alarm and trip, if applicable.

5.6.2.3

The local control panel shall have the requisite communication interface with purchaser's control system via a high integrity Ethernet communication link for remote operation and control, data monitoring, retrieval.

5.6.2.4

The local control panel shall have provision for remote monitoring of:

a) dew point;

b) switching valve operational and failure status.

5.6.2.5

If procured with an air compressor package, and as part of the same train configuration, the dryer control system shall allow synchronisation with the air compressor control system for start-up, load, unload and shutdown.

5.6.2.6

When specified by the purchaser, package control may be integrated into the purchaser's control system.

5.6.2.7

If package control is integrated in the purchaser's control system, the vendor shall:

a) provide termination of all signals at a skid edge junction box or remote input and output cabinet;

b) provide necessary documentation related to system control and functionalities for implementing the control logic into the purchaser's control system;

c) be responsible for verifying that the intended control logic is correctly implemented in purchaser's control system.

5.6.3 Control and actuated valves

5.6.3.1

Control valves and actuated valves DN 50 (NPS 2) and smaller shall be 2-way ball or double-offset butterfly valves with double-acting actuators and position indicators.

5.6.3.2

Control valves and actuated valves DN 80 (NPS 3) and larger shall be non-lubricated, 2-way double offset butterfly valves with double-acting actuators.

5.6.3.3

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

5.6.3.4

Valve failure position will be accomplished by the solenoid valve configuration, to ensure fail safe operation in case of power failure.

Dryer inlet switching sequence valves shall be failure lock type to ensure the uninterrupted air flow to the plant in case of a power failure.

5.6.3.5

Vendor proprietary dryer switching valves shall require purchaser's approval.

5.6.3.6

Expected maintenance and replacement schedules for actuated valve and switch-over valves being used for changeover between drying and regeneration cycle shall be provided.

5.6.3.7

Solenoid valves used for controlling dryer regeneration and duty cycles shall be capable of operating with air containing desiccant fines without sticking or clogging.

5.6.4 Relief valves

5.6.4.1

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

5.6.4.2

Calculations shall be provided for all relief valve sizes and settings, including accumulation in accordance with API Std 520.

5.6.4.3

If radial relief valves are used, they shall have a guard in place to prevent discharge impacting personnel.

5.6.5 Instrument tubing

5.6.5.1

Instrument tubing fittings shall be of the double-ferrule type.

5.6.5.2

Tubing fittings and fitting components shall be from a single manufacturer and not interchanged with fittings from other manufacturers.

5.6.5 Dew point Instruments

5.6.5.1

Dew point shall be continuously monitored at each dryer package outlet by a fixed online dew point transmitter.

5.6.5.2

Dew point transmitter shall have a measuring chamber with a 'high' dew point alarm configured in the local control panel.

5.6.5.3

Dew point alarm shall be repeated in purchaser's control system through compatible interface communication link.

5.6.5.4

Dew point analyser shall be supplied, if specified on the data sheet.

5.7 Piping

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) may be threaded per ASME B1.20.1 or flanged.

5.7.4

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

5.7.5

Piping, including vents and drains, shall not be smaller than DN 20 (NPS ¾), except instrument connections, which may be DN 15 (NPS ½).

5.7.6

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

5.7.7

Proprietary connection types shall not be used unless specifically approved by purchaser.

5.7.8

Bracing shall be provided for vent, drain and small-bore connections.

5.7.9

All slip-on flanges shall be double welded.

5.7.10

All ASTM A105 / A105M carbon steel flanges shall be limited to design minimum temperatures of 9.4 °C (-15 °F) and warmer. For colder climates, ASTM A 350/A 350M Grade LF2 Class 1 material shall be used.

5.7.11

All utility lines shall be provided with single-point tie-in connection with the isolation valve located at the skid edge.

5.7.12

All customer tie-in connections shall be brought to the edge of the skid.

5.7.13

Drain lines shall be terminated to edge of baseplate with isolation valve at purchaser's tie-in point.

5.7.14

Vendor shall advise the purchaser of the allowable load and movement at the tie-in point.

5.7.15

Vendor shall provide anchor type support at all baseplate tie-in connections to minimise the nozzle load.

5.7.16 Valves

5.7.16.1

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

5.7.16.2

Valve stems and shafts for all valves including check valves with external stem shall be blowout proof if:

a) the stem or shaft becomes separated from the closure device;

b) the stem nut becomes detached from the yoke;

c) the packing gland is removed.

5.7.16.3

Valve stems shall be designed such that the weakest link is outside of the pressure boundary.

5.7.16.4

Ball and butterfly valves shall have anti-static device

5.7.16.6

Quarter turn block valves used for critical isolation (such as isolation valve upstream and downstream of filter vessels and equalizing valve) shall include a mechanism capable of accepting a pad lock or car seal for the purpose of locking or car-sealing the valve in its intended position.

5.7.16.7

Valves that are open to atmosphere in the final installed position shall have their outboard connection either plugged or blinded.

5.8 Regeneration cooler

5.8.1

For heat of compression desiccant driers, shell and tube exchanger with water in tube and air in shell configuration shall be used.

Alternatively, a plate and shell type cooler or air-cooled exchanger may be proposed, subject to purchaser's approval.

5.8.2

Coolers shall be designed and constructed to ASME Section VIII Div.1 or EN 13445, or as specified in the data sheet.

5.8.3

Solenoids for the drain traps, if used, shall be H-rated, with full stainless steel body and a soft seal.

5.8.4

The moisture separator at cooler outlet shall be provided with dual drain trap with an alarm.

5.9 Baseplate and Support Structure

5.9.1

Baseplate shall be a single-fabricated structural steel unit and shall be provided with continuous weld for all load-bearing structures.

5.9.2

The structure shall be provided with lifting lugs for at least a four-point lift, designed for single-point lift for the completely assembled skid.

5.9.3

Design code for baseplate lifting lugs shall be specified in the data sheet.

5.9.4

For off-shore installation of skid, additional certifications for lifting lugs and lifting beams shall be specified by the purchaser.

5.9.5

Baseplate and supports shall be designed for operating, accidental and transportation loads, such as wind, seismic and blast, as defined by the purchaser.

5.10 Nameplate

5.10.1

A nameplate shall be securely attached at a readily visible location on the dryer skid, on each desiccant vessel or any other auxiliary equipment as identified by the purchaser.

5.11.2

Nameplate shall be of corrosion- resistant alloy. Attachment pins, when used, shall be of the same material.

5.11.3

As a minimum, the following data shall be clearly stamped or engraved on the dryer skid nameplate:

a) vendor's name

b) serial number

c) size, model and type

d) rated delivered capacity

e) rated discharge pressure

f) design pressure dew point

g) purchaser's item no. or tag no.

h) purchase order no.

Units shall be consistent with those used on the data sheets.

5.11.4

Nameplates for individual equipment items shall include the Purchaser's item no. or tag no. and name of the equipment.

6 Material

6.1 General

6.1.1

Material selection requirements shall be in accordance with the recommendations and guidelines of ISO 21457, unless explicitly specified in Table 2 or in the data sheet.

6.1.2

Hot dip galvanizing shall be performed after fabrication. After galvanizing, flange faces shall be inspected and lightly refinished as necessary to ensure seal integrity.

6.2 Welding

6.2.1

Welding of all pressure-containing parts, piping and baseplate and support structures shall be carried out as per approved and qualified welding procedure in accordance with internationally recognized standards, such as ASME BPVC Section IX or AWS D1.1 or ISO 15614-1.

6.2.2

Repair welds shall be subject to the same heat treatment and non-destructive examination as the original welding.

6.3 Coating

6.3.1

Surface preparation, coating and coating activities shall be compliant, as a minimum, with the requirements of ISO 12944 (all parts) or alternative equivalent standard approved by the purchaser.

Coating system for carbon steel surface shall be selected in accordance with the paint systems defined in Annex-C of ISO 12944-5, based on the atmospheric corrosivity as defined in data sheet.

6.3.2

For offshore applications the requirements of ISO 12944-9 shall be applicable.

6.3.3

Bearings, seals, flange mating faces, instrument dials, cases, cables and cable trays, shafts, polished or machined surfaces, control valve stems, nameplates and item tags shall not be coated. These items are to be suitably protected from blasting and coating being applied to adjacent equipment.

6.3.4

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

6.3.5

Stainless steel cabinets for control panels are not required to be coated.

6.3.6

Stainless steel equipment items and piping shall be coated when:

a) operating at temperature exceeding 60 °C (140 °F) in offshore environment;

b) insulated regardless of operating temperature.

6.3.7

For insulated equipment, the coating system shall also be compatible with the type of insulation.

6.3.8

Internal coating systems shall be suitable for the operating temperature range of the equipment.

6.3.9

Non-ferrous materials including titanium and cupro-nickels need not be coated.

Table 2 – Material selection

Item	Material of construction (base case) *(Note 1)*	Material of construction (harsh environment) *(Note 1)*
Desiccant vessel	Carbon steel (coated) + 3 mm corrosion allowance + internal coating *(Note 3)*	Carbon steel (coated) + 3 mm corrosion allowance + internal coating *(Note 3)* or 316 stainless steel
Vessel internals	316 stainless steel	316 stainless steel
Pre-filter housing	Carbon steel (coated) + 3 mm corrosion allowance	316 stainless steel
After-filter housing	Carbon steel (coated) + 3 mm corrosion allowance	316 stainless steel
Electric heater housing	Carbon steel (coated) + 3 mm corrosion allowance	Carbon steel (coated) + 3 mm corrosion allowance or 316 stainless steel
Regeneration cooler (Water Cooled) *(Note 2)*		
Shell	Carbon steel (coated) + 3 mm corrosion allowance	Carbon steel (coated) + 3 mm corrosion allowance 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 galvanised) or carbon steel (coated) + 1.5 mm corrosion allowance	316 stainless steel
Water Piping *(Note 2)*	Carbon steel (coated) + 1.5 mm corrosion allowance	Carbon steel (coated) + 1.5 mm corrosion allowance
Switching valve body	Carbon steel (coated)	316 stainless steel
Tubing and fittings	316 stainless steel	316 stainless steel
Silencer housing	Carbon steel (hot dip galvanised)	316 stainless steel
Silencer internals	316 stainless steel	316 stainless steel
Base Fames	Carbon steel (hot dip galvanised) or carbon steel (coated)	Carbon steel (hot dip galvanised) 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

NOTE 1 Base case requirements apply to atmospheric corrosion category C1 to C3 (low to medium corrosivity).
Harsh environments apply to corrosion category C4 to CX (high to extreme corrosivity) as per ISO 12944-2 definition.

NOTE 2 Cooling water is assumed to be fresh water or glycol-water mixture.

NOTE 3 Refer to 6.3.7 and 6.3.8

6.3.10 Coating procedure specification

6.3.10.1

When specified in the data sheet, surface preparation and coating shall be performed in accordance with a qualified coating procedure specification, prepared in compliance with ISO 12944-8 or alternative equivalent standard, and following the recommendations of the paint manufacturer.

6.3.10.2

The coating procedure specification shall describe complete coating related works to be performed, including surface preparation, coating application, qualification and inspection.

7 Inspection and testing

7.1

Vendor shall carry out inspection, testing and certification of equipment and auxiliaries, in accordance with the relevant design standards, statutory and regulatory requirements, this specification and data sheet requirements.

7.2

The extent of purchaser surveillance for requirements for inspection and testing events are as specified in Annex A of IOGP S-613Q.

7.3

The extent of material traceability and certification shall be as detailed in Annex B of IOGP S-613Q.

7.4

All on-skid piping shall be subjected to hydrostatic test or pneumatic test as pre-assembled spool and also subjected to cleanliness test and leak tightness test on the fully assembled piping, prior to functional test of the package.

7.5

Pressure vessel and heat exchangers shall be hydrostatically tested as per the design code and the basis specified on the data sheet with a minimum holding period of 30 minutes.

7.6

Functional tests for the dryer controls, shall be performed by the vendor and include as a minimum:

a) valve switching cycle for adsorption and desorption;

b) heating and cooling cycle times;

c) heater temperature control;

d) alarm and trip settings;

e) correct alarm setting of dew point transmitter.

7.7

The local control panel shall be functionally tested to verify correct functioning of:

a) visual display;

b) control switches;

c) control logic;

d) alarm and trip set points;

e) communication interface.

The control panel hard-wire verification testing and wiring continuity check on the skid shall be performed by the vendor.

7.8

The performance test of the dryer shall be carried out in accordance with section 7 of ISO 7183 to demonstrate:

a) pressure dew point at rated flow rate through the dryer;

b) pressure drop across dryer package;

c) purge flow rate;

d) drying and regeneration cycle time;

e) pressurisation and de-pressurisation;

f) regeneration temperature;

g) power consumption;

h) sound pressure level during purge outlet and blow down.

7.9

Performance test may be carried out as a part of site acceptance test.

7.10

Measurement of sound pressure and sound power level test of the dryer shall be carried out as per ISO 3744 or ISO 9614-2.

7.11

Vendor shall provide factory acceptance test (FAT) and site acceptance test (SAT) procedures, including acceptance criteria, for purchaser's review and approval.

8 Preservation and packing

8.1

Vendor shall apply initial preservation after completion of all inspection, testing activities at package vendor's premises. The preservation shall make the equipment suitable for a period of 6 months outdoor storage from the time of shipment.

8.2

The vendor shall provide completed preservation checklists and preservation report detailing all preservation activities performed.

8.3

All exposed machined and un-painted surfaces shall be coated with vapour proof corrosion inhibitor to protect against onset of corrosion.

8.4

All visible display units and control panel front face shall be adequately protected during transportation and handling.

8.5

Open piping connections shall be blanked-off or capped and shall be sealed to prevent moisture ingress.

8.6

Lifting lugs shall be clearly identified on the equipment package.

8.7

The recommended lifting arrangement shall be identified with the boxed equipment and a set of lifting instructions enclosed with the shipment.

8.8

The package shall be identified with tag number, serial number and shipping label with the relevant information as defined in the purchase order.

8.9

Crated equipment shall be shipped with duplicate packing lists, one inside and one fixed to the outside of the shipping crate.

8.10

All ship loose materials and spare parts shall be identified with a tag number, serial number (where applicable) and indication of the tag number of the equipment of which they are a part.

9 Spare parts, operation and maintenance

9.1

Vendor shall submit separate spare lists for capital, operating and maintenance, and commissioning spares indicating:

a) vendor part number

b) tag or serial number (when applicable);

c) manufacturer and model number;

d) original equipment manufacturer (OEM) part number

e) recommended stocking quantity;

f) unit price;

g) delivery time.

9.2

Spare parts shall comply with all requirements applicable as for the original component.

10 Vendor drawing and data requirement

10.1 General

10.1.1

Vendor shall furnish drawings, document and data at proposal, contract and as-built stage, in accordance with the requirements of the information requirement specification.

10.1.2

The data shall identify purchaser's name, project name, project number, equipment tag number and service name, inquiry or purchase order number as a minimum.

10.2 Proposal

The proposal shall include, as a minimum:

a) proposal data sheet;

b) typical general arrangement drawing with customer tie-in details;

c) typical piping and instrumentation and diagram;

d) a preliminary tabulation of utility requirements;

e) typical inspection and test plan;

f) preliminary supplier master information register (SMIR);

g) list of capital spares.

10.3 Contract Data

10.3.1

For sub-supplied items and components, the manufacturer's data sheet shall be provided.

10.3.2

Vendor shall provide installation, operating and maintenance manual including sufficient written instructions and also necessary drawings, documents, parts list to facilitate purchaser install, operate, and maintain all of the equipment covered by the purchaser order.

10.3.3

The installation, operation and maintenance manual shall be prepared for the equipment covered by the purchase order and typical manuals are not acceptable.

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, such as instrument air, feed air to nitrogen generator, plant air and process air.

A.2

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

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 as presented in ISO 8573-1, Table 1.

A.4

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

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 stand-alone 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 (15-20 %). Short drying cycle (5-10 min). Rapid pressurizing and depressurising time (about 5-10 s). Recommended for low volume flow application (< 1000 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 (4-8 h) and slow pressurisation and depressurisation 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 (4-8 h) and slow pressurisation and depressurisation 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 & lowest operating cost amongst desiccant dryers Improved valve life, lowest noise level Zero to marginal purge loss. Long drying cycle (4-8 h) and slow pressurisation and depressurisation time (6 min).

Annex B
(informative)
Typical schematics

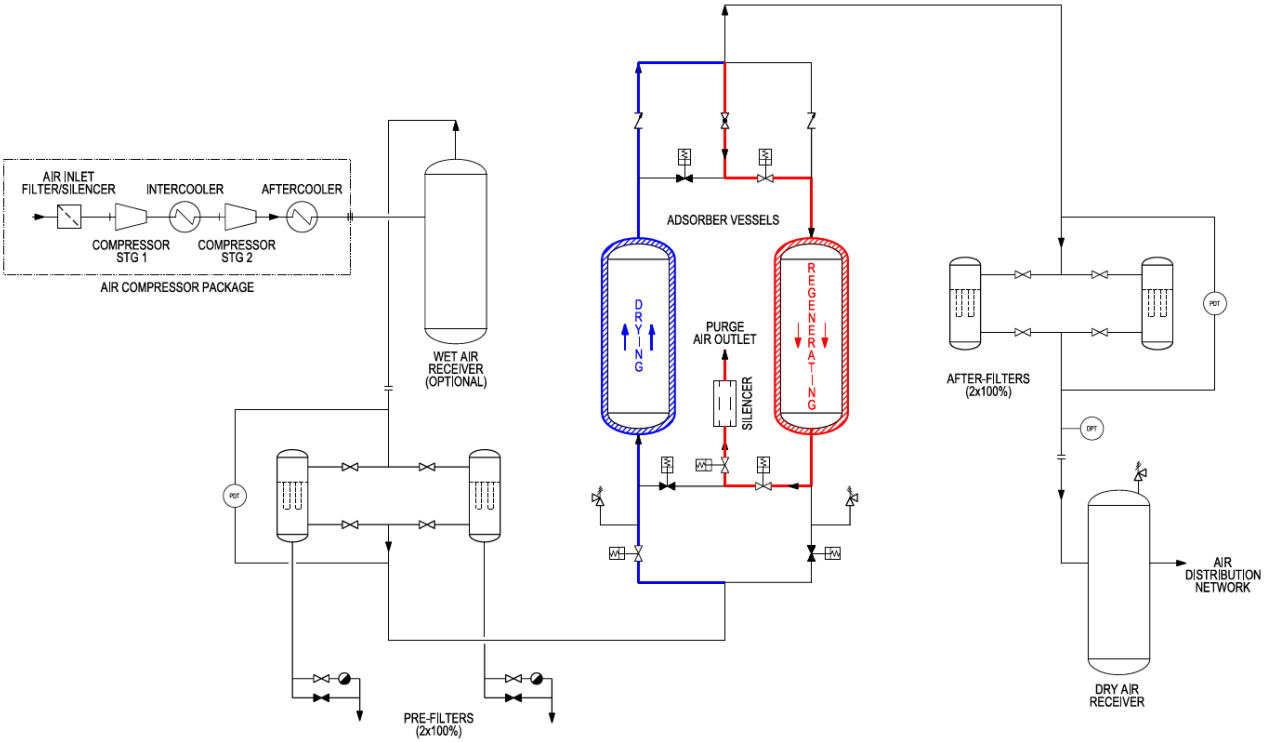


Figure B.1 – Desiccant dryer – heatless

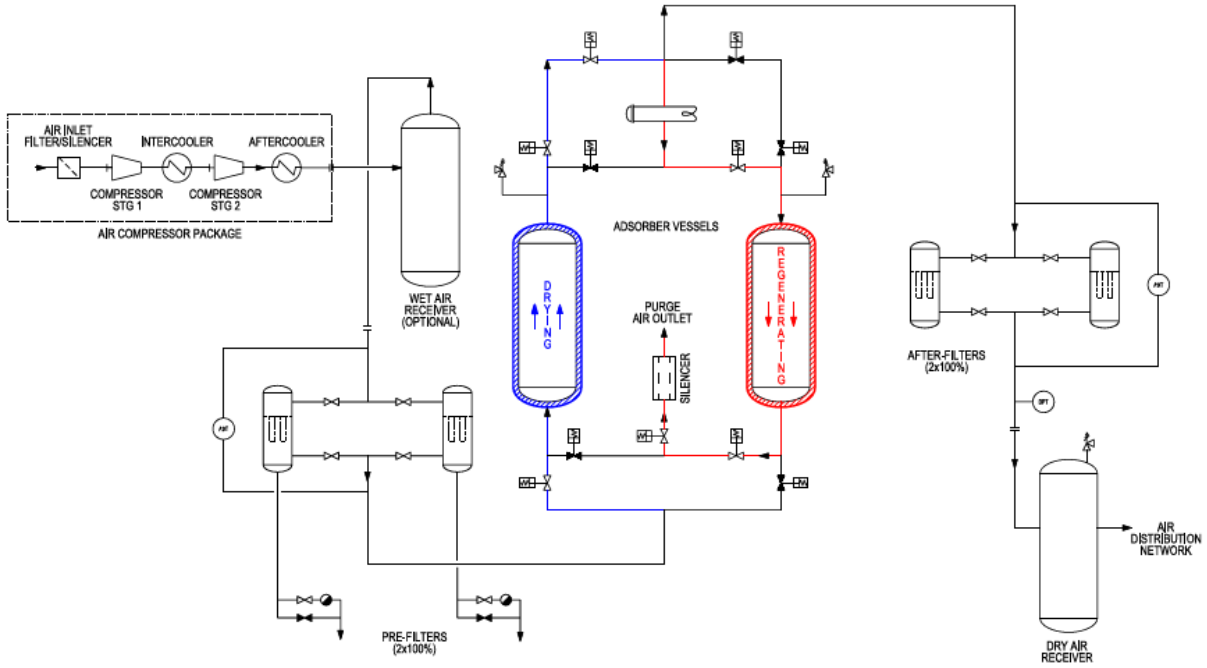


Figure B.2 – Desiccant dryer – heat regenerated (with internal purge)

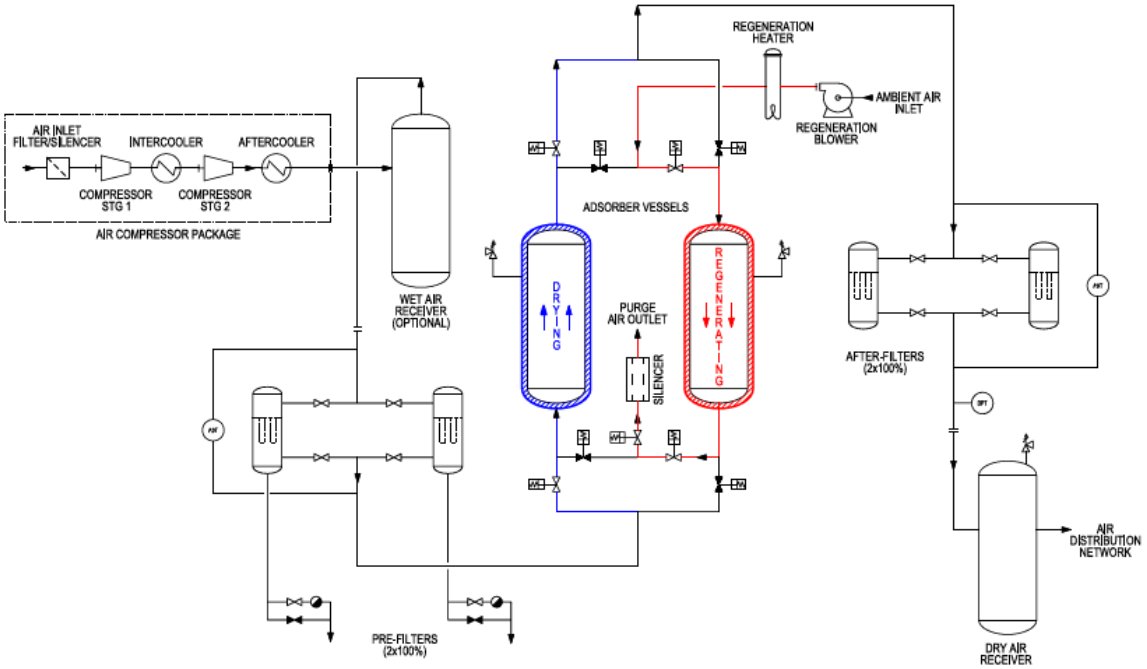


Figure B.3 – Desiccant dryer – heat regenerated (external blower heated)

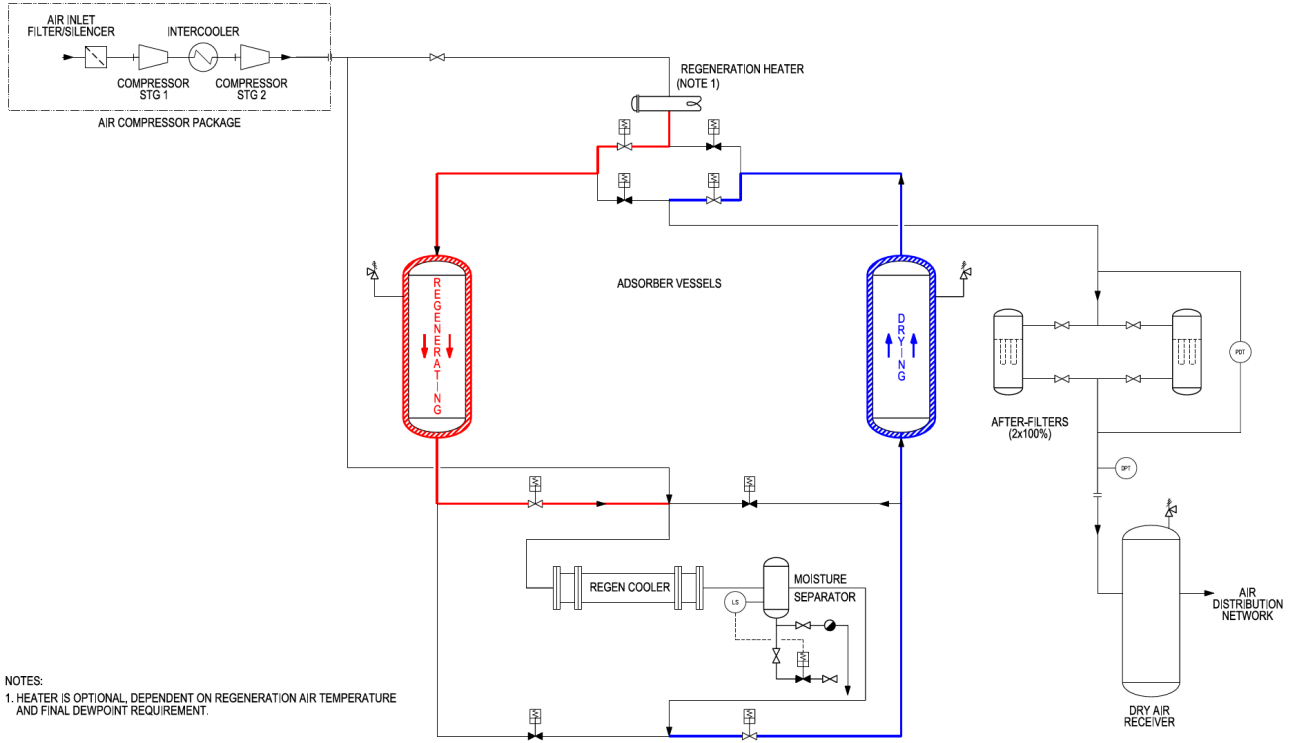
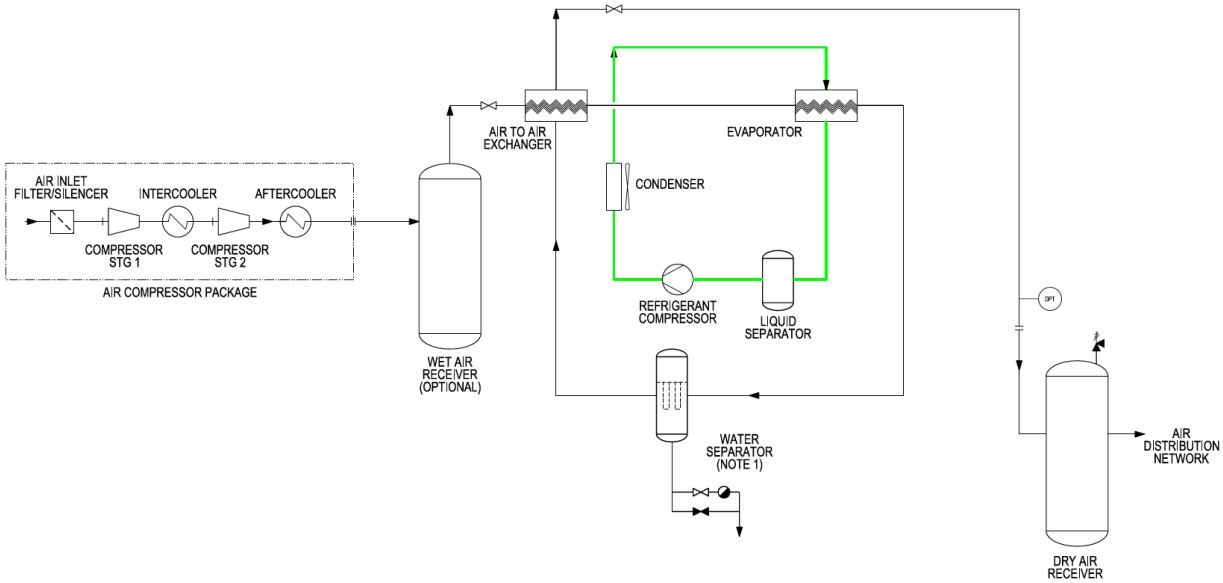


Figure B.4 – Desiccant dryer – heat of compression



NOTES:

1. WATER SEPARATOR CAN BE INTEGRATED WITH EVAPORATOR.

Figure B.5 – Refrigeration dryer

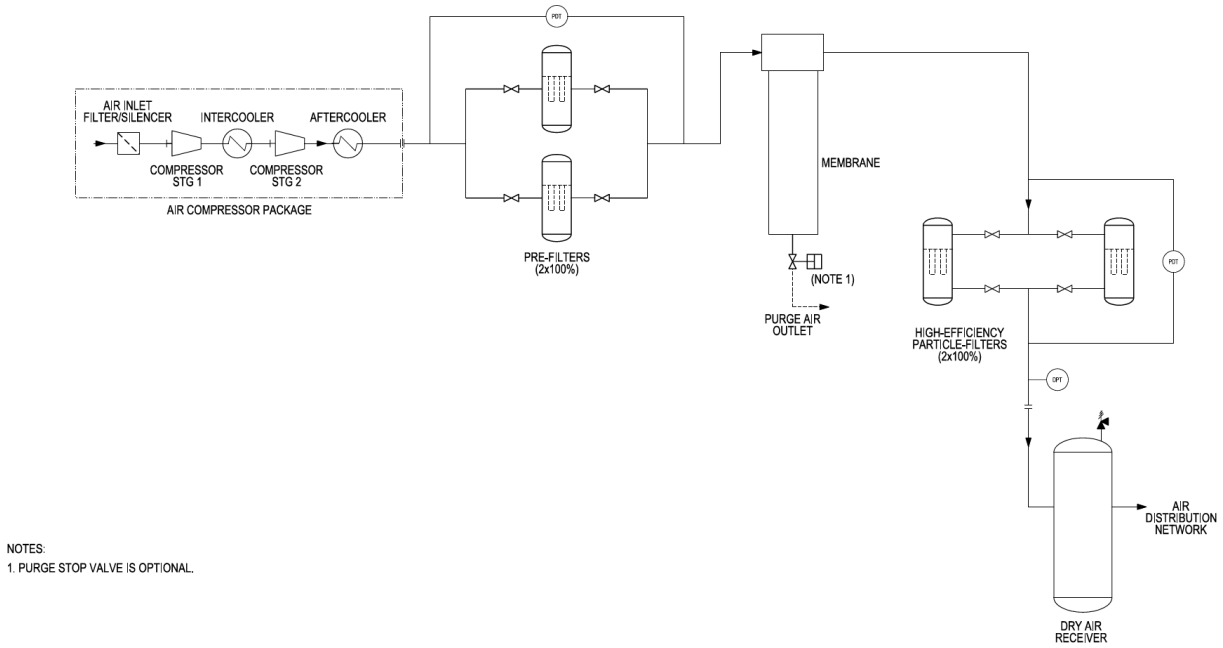


Figure B.6 – Membrane dryer

Bibliography

[1] ASME BPVC Section-IX, Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers: and Welding, Brazing, and Fusing Operators

[2] AWS D1.1, Structural Welding – Steel

[3] EN 10204, Metallic Products – Type of Inspection Documents

[4] ISO 15614-1, Specification and qualification of welding procedures for metallic materials - Welding procedure test - Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys

[5] NFPA 70, National Electrical Code Article 500, 501 ,502, 504

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