

REDLINE
Version 2.0 to Version 1.0

Specification for Air Dryer Packages

Redline Version

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).

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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.

ABOUT THE REDLINE VERSION

This Redline version aims at comparing Version 2.0 to Version 1.0 but may not capture all changes.

The Redline version is not a specification document. It is a mark-up copy provided for information only. The user must refer to the official published version.

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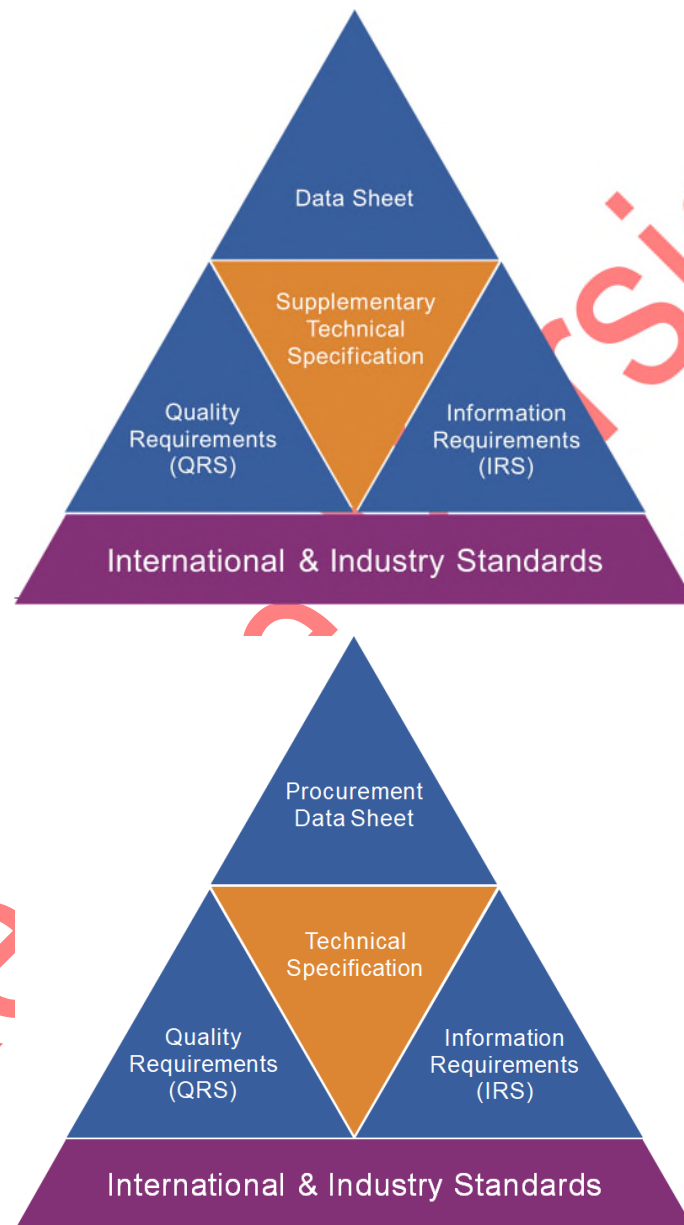
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Introduction

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~~ 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 ~~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~~ be applied in conjunction with the supporting procurement of air dryer packages. The terminology used within this ~~specification is in accordance with ISO/IEC Directives, Part 2~~ 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 sSheets for Air Dryer Packages

~~This document provides project specific requirements where this specification requires the user to define an~~ The procurement data sheet defines application specific requirement. It also includes ~~information required by the purchaser for~~ 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 ~~are may also listed on~~ be incorporated or referenced in the procurement data sheets, to define scope and technical requirements for enquiry and purchase of the equipment.

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

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

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

~~This document includes a conformity assessment system (CAS) which specifies standardized user interventions against~~ The QRS defines quality management system requirements and the proposed extent of purchaser conformity assessment activities ~~at four different levels~~ 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 ~~on~~ in the data ~~sheets~~ sheet or in the purchase order.

~~The~~ 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 ~~supplementary~~ specification and QRS are fixed documents.

~~Unless defined otherwise in the purchase order, the~~ 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 sheets, IRS, QRS);
- d) this specification;
- ~~e) the parent standard.~~

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1 Scope

~~The scope for this~~ 1.1

This specification ~~covers the minimum requirements~~ is intended for air dryer packages ~~for~~ in instrument, plant and process air applications. ~~The scope only includes air dryer packages for air supplied as~~ using an oil-free air supply.

~~While this document~~ 1.2

This specification covers ~~minimum requirements for~~ the 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~~ 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 ~~Div. 1~~, Division 1, *Rules for Construction of Pressure Vessels*

~~ASME B 31.3~~ ~~Process Piping~~

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~~ pressure vessel*

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

IEC 60079 (all parts), *Explosive ~~A~~ 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~~

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 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) — 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 and 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

EXAMPLES Silica gel, activated alumina or molecular sieve.

NOTE

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.

~~The adsorbent is regenerated by passing dry air to remove the adsorbed water~~

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3.1.4—dry air receiver

~~single or multiple vessels installed downstream of the dryers~~

3.5—heated regenerative dryer

~~regeneration is achieved~~ 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.

3.6—1.5**heatless regenerative dryer**

~~regeneration is achieved~~ unit which removes absorbed water by passing a non-heated volume of air through the desiccant ~~to be regenerated~~

3.7—1.6**heat-of-compression dryer**

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

3.8—1.7**membrane dryer**

A compressed air dryer that ~~consists of~~ uses 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—1.8**moisture separator**

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

NOTE—Note 1 to entry: Separators are typically of the centrifugal ~~or~~, coalescing ~~or~~ demister types.

3.10—1.9**pre-filter**

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

3.11—1.10**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 that~~ dew begins to form

3.12—1.11**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

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 2—

Note to entry 3: 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—1.12**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~~

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

~~3.15~~ — 1.13

regeneration cooler

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

~~3.16~~ — 1.14

wet air receiver

vessel that is installed downstream of the compressor ~~after-cooler~~ 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~~ — 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.~~

4.12 Reference conditions

~~Table 1~~ — Reference conditions shall be in accordance with Table 1.

Table 1 — Reference conditions

Condition	SI units	US customary units
Air temperature	0 15 °C	60 °F
Absolute air pressure	1.013 bar bara	14.7 psi psia
Relative humidity	0 % (dry)	0 % (dry)
Flow	Normal Standard cubic metres per hour (N Sm ³ /h)	Standard cubic feet per minute (s 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 ~~Desiccant dryer~~ General

4.3.1.1

Each dryer package shall ~~consist of the following, as a minimum:~~ have a local control panel and package instrumentation.

a) ~~twin~~ 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;

b) 4.3.2.2

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

c) 4.3.2.3

The desiccant dryer package shall have 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) 4.3.2.4

The desiccant dryer package shall have a 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~~ **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,~~ **Wet air receivers** ~~shall be sized with a minimum hold-up time of 2 minutes of the maximum volumetric 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 **assembled** on a common structural steel skid ~~or~~ , baseplate **or modular frame**.

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 Desiccant dryers shall have a purge outlet silencer, that complies with the maximum sound pressure level specified in the data sheet. except for the heat of compression type dryers.~~

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.~~

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

~~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.~~

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

~~If specified in the data sheet,~~ Desiccant vessels shall ~~be ASME code stamped~~ have a relief valve.

5.2.4

~~If specified in the data sheet,~~ Desiccant 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 desiccant fill and desiccant drain ports.

5.2.8

~~If~~ When desiccant vessels ~~are provided with~~ have an internal heater, the heating elements shall not be in direct contact with the desiccant ~~and shall allow removal of the~~.

5.2.6

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

Air flow through the desiccant during 5.2.7

Desiccant regeneration cycle air flow shall be in the opposite direction to the ~~air flow during normal drying cycle operations~~ air flow.

5.2.9

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

5.2.10

~~Air velocity into and through the~~ The desiccant bed shall not cause damage, channelling or carry over of the desiccant ~~be supported by a stainless steel screen or sieve tubes.~~

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

5.2.14¹⁰

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

5.2.15

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

5.2.16¹¹

~~The vendor~~ Desiccant vessels shall provide in the data sheet:

- ~~have~~ a) ——— the total time for one complete drying vent and regeneration cycle; a drain.
- ~~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.~~

5.2.12 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-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~~ 5.3.2

Each pre-filter for each dryer package may be provided, if approved by the purchaser.

5.3.2

~~Upstream shall have 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

~~FilterPre-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 pre-filters and configured with a high differential pressure alarm.

5.3.5

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

5.3.6

~~The~~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 shall be equal to or less than 1,0 micron absolute or less.

5.4 After-filter

5.4.1

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

~~If the dryer package is provided with full sparing configuration, a single~~5.4.2

Each after-filter for each dryer package may be provided, if approved by the purchaser.

5.4.2

~~Upstream shall have 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~~After-filters shall have a solid particle removal rating shall be equal to or less than 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~~ after filters.

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.~~

Motor enclosures shall be TEFC.

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~~ Electric heaters shall have a temperature controller ~~and~~.

5.5.2.2

Electric heaters shall have an independent high ~~skin~~ temperature cut-out shall be provided ~~trip~~.

5.2.2.2

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

5.5.2.3

~~Control~~ Electric heater control and over temperature protection ~~for electric heater~~ shall be integrated with the ~~Dryer~~ 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

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

5.6.1.2

~~Unless specified otherwise, The dryer package shall have 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 The local control valves, panel shall be provided with a suitable have the specified 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 Mechanical switches shall require purchaser's approval not be provided.~~

5.6.2 Control system

5.6.2.1

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

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 ~~provide display, status and an~~ alarm indication ~~as a minimum~~ for:

- ~~a) which desiccant vessel is in drying mode;~~
- ~~b) which desiccant vessel is in regeneration mode;~~

e) ~~valve switching valve operational and failure status;~~

d) 5.6.2.5

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

e) 5.6.2.6

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

f) 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 ~~alarm;~~.

g) 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 ~~alarm;~~.

h) 5.6.2.11

The local control panel shall display the regeneration heater ~~high-skin temperature alarm and trip, if applicable.~~

5.6.2.12

The local control panel shall ~~have the requisite communication interface with purchaser's control system via a~~ display an alarm status for high integrity Ethernet communication link regeneration heater skin temperature.

5.6.2.13

The local control panel shall ~~allow~~ for remote operation ~~and~~.

5.6.2.14

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

5.6.2.15

The local control panel shall ~~have provision for remote monitoring~~ display an alarm status of: package signals.

a) ~~dew point;~~

b) ~~switching valve operational and failure status.~~

5.6.2.16

~~If procured with~~ When an air compressor package, and as is part of the same train configuration, the dryer control system shall ~~allow synchronisation~~ synchronize with the air compressor control system for start-up, ~~load, unload~~ loading, unloading 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~~ Actuated on/off valves DN 50 (NPS 2) and smaller shall be ~~2~~non-lubricated two-way ball or double-offset butterfly valves with double-acting actuators and ~~position indicators~~open and close limit switches.

5.6.3.2

~~Control valves and actuated~~ Actuated on/off valves DN 80 (NPS 3) and larger shall be non-lubricated, ~~2~~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 ~~polytetrafluoroethylene (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 ~~will~~shall be accomplished by the solenoid valve configuration, ~~to ensure fail safe operation in case of power failure.~~

5.6.3.6

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.~~stay in their last position (fail last).

5.6.3.7

~~Vendor proprietary~~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 not be 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~~ Compression tube fittings shall be of the ~~flareless~~ double-ferrule type.

5.6.5.2

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

5.6.5.6 Dew point instruments

5.6.5.1

Dew point ~~transmitters~~ 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 ~~provided with~~ 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 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) ~~may~~ shall be threaded ~~per~~ in accordance with ASME B1.20.1 or flanged.

5.7.4

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

5.7.5

Piping, ~~including vents~~ vent and ~~drains~~ drain connections shall not be smaller than DN 20 (NPS $\frac{3}{4}$), ~~except instrument~~ $\frac{3}{4}$) or larger.

5.7.6

Instrument connections, ~~which may~~ shall be DN 15 (NPS $\frac{1}{2}$), $\frac{1}{2}$) or larger.

5.7.67

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

5.7.78

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

5.7.8

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

5.7.9

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

5.7.10

~~Slip-on~~ flanges shall be double-welded.

5.7.1011

~~All ASTM A105 / A105M~~ When the minimum design temperature is less than -9,4 °C (15 °F), 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~~ ASTM A350/A350M Grade LF2 Class 1 material shall be used.

5.7.11~~12~~

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

5.7.12~~13~~

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

5.7.13~~14~~

~~Drain lines~~ Tie-in connections 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~~ have anchor type supports at ~~all the~~ baseplate tie-in connections to minimise the nozzle load ~~edge~~.

5.7.16~~—~~ Valves~~15~~

5.7.16.1

Ball valves constructed ~~so~~ such 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 valve 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~~ for stem retention.

5.7.17

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

5.7.16.4~~18~~

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

5.7.16.619

Quarter turn block valves ~~used for critical isolation (such as isolation valve upstream and downstream of filter vessels and equalizing valve) shall include~~ in isolation services shall have a locking 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~~ pad lock.

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~~

5.7.20

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

~~Alternatively, a plate and shell type cooler or air-cooled exchanger may be proposed, subject~~

5.7.21

~~Drain lines up to purchaser's approval.~~

5.8.2 —

~~Coolers~~ the tie-in point 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~~ rated for the drain traps, if used, shall be H-rated, with full stainless steel body and a soft seal same design pressure as the equipment being drained.

5.8.4 The Regeneration cooler and moisture separator at

5.8.1

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

5.8.2

When moisture is not free draining into the moisture separator, the regeneration cooler ~~outlet~~ 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 driers 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~~ support structure

5.9.1

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

5.9.2

Baseplate welding shall be ~~provided with continuous weld for all load-bearing structures.~~

5.9.23

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

5.9.4

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

5.9.35

~~Design code for~~ The 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~~ and support structure shall be designed for operating, ~~accidental and~~ transportation loads, such as, wind, seismic and blast, ~~as defined by the purchaser.~~ loads.

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 vessels~~ and auxiliary equipment ~~as identified by the purchaser.~~

5.110.2

Nameplates shall be 316L stainless steel.

5.10.3

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

5.10.4

Nameplate ~~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~~information shall be ~~clearly~~ stamped or engraved ~~on the~~, and legible.

5.10.5

Nameplates shall include the manufacturer's name.

5.10.6

The dryer skid nameplate:

- a) ~~vendor's name~~
- b) ~~_____~~ shall include the serial number.
- e) ~~_____~~ **5.10.7**

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

- d) ~~rated delivered capacity~~
- e) ~~_____~~ **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.

- f) ~~design pressure dew point~~
- g) ~~_____~~ **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 ~~no.~~ number or tag ~~no.~~ number.

- h) ~~_____~~ **5.10.12**

The dryer skid nameplate shall include the purchase order ~~no.~~ number.

Units 5.10.13

Nameplates shall ~~be~~ include units consistent with those used on the data sheets.

5.11.410.14

~~Nameplates for individual equipment items shall include the Purchaser's item no. or has an assigned tag no-number, the tag number and name of the 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

~~Material selection requirements~~ The material of construction shall be in accordance with Table 2.

6.1.2

~~When the recommendations and guidelines of ISO 21457, unless explicitly~~ material of construction is not specified in Table 2 ~~or in the data sheet.~~, the material selection philosophy shall be in accordance with ISO 21457.

6.1.23

Hot-dip galvanizing shall be performed after fabrication.

6.1.4

After galvanizing, flange faces shall be inspected and lightly refinished ~~as necessary to ensure seal integrity~~ in conformance with the requirements of ASME B16.5.

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) <i>(Note 1)^a</i>	Material of construction (harsh environment) <i>(Note 1)^b</i>
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) <i>water cooled</i> ^c		
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 P <i>p</i> iping	Carbon steel (hot-dip galvanis ed <i>ed</i>) or carbon steel (coated) + 1.5 mm corrosion allowance	316 stainless steel
Water P <i>p</i> iping <i>(Note 2)</i> ^c	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 <i>coated</i>)	316 stainless steel
Silencer internals	316 stainless steel	316 stainless steel
Base Frames <i>Baseplates and support structure</i>	Carbon steel (hot-dip galvanis ed <i>ed</i>) or carbon steel (coated)	Carbon steel (hot-dip galvanis ed <i>ed</i>) or carbon steel (coated)
Instrument H <i>h</i> ousing	Stainless steel or aluminium	316 stainless steel or aluminium
Junction B <i>b</i> ox	Carbon steel (coated) or 316 stainless steel or	316 stainless steel or aluminium

	aluminium	
Local Control Panel control panel	Carbon steel (coated)	316 stainless steel
<p>^a Base case requirements apply applies to atmospheric corrosion categories C1 to C3 (low to medium corrosivity) as defined by ISO 12944-2.</p> <p>^b Harsh environments applies to corrosion categories C4 to CX (high to extreme corrosivity) as per definition.</p> <p>^c Cooling water is to be fresh water or glycol-water mixture.</p>		
<p>NOTE 1</p> <p>NOTE 2 Cooling water is assumed to be fresh water or glycol-water mixture.</p> <p>NOTE 3 Refer to 6.3.7 and 6.3.8</p>		

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~~6.3.10~~ Coating procedure specification

6.2 Welding

~~6.3.10.2.1~~

~~When specified in the data sheet, surface preparation and coating~~ Welding shall be performed in accordance with a qualified ~~coating~~ welding procedure specification, prepared 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 compliance ~~accordance~~ with ISO 12944-85.

6.3.2

Offshore and marine coastal coating systems shall be in accordance with ISO 12944-9 or ~~alternative equivalent standard, and following the recommendations of the paint manufacturer.~~ IOGP S-715.

~~6.3.10.2.3~~

~~The~~ Onshore and non-marine coating procedure specification systems shall ~~describe complete~~ 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 related works to be performed, including surface preparation,~~ 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 application, qualification and inspection.

7 Inspection and testing

7.1 Pressure testing

~~Vendor shall carry out inspection, Pressure 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.~~

7.31.1

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

7.4

~~All on~~ On-skid piping shall be subjected to ~~undergo~~ a hydrostatic test or pneumatic test as a 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.

7.51.2

Pressure vessels 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.~~

7.61.3

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 ~~the~~ dryer controls ~~, shall be performed by~~ verify the vendor and include as a minimum:

a) ~~valve~~ switching cycle for adsorption and desorption;

b) ~~7.2.2~~

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

c) ~~7.2.3~~

Functional tests for dryer controls shall verify heater temperature control;

d) ~~7.2.4~~

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

e) ~~correct~~ 7.2.5

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

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7.77.2.6 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 ~~functionally~~ tested to verify ~~correct functioning~~ the functionality of:

- a) ~~visual display;~~
- b) ~~control switches;~~
- c) ~~the control logic;~~

d) ~~7.2.6.4~~

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

e) ~~7.2.6.5~~

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

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

7.87.3 Performance testing

7.3.1

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

7.3.2

The performance test of the dryer shall demonstrate:

- a) ~~pressure dew point at rated flow rate through the dryer;~~
- b) ~~pressure drop across dryer package;~~
- c) ~~purge flow rate;~~
- d) ~~the drying and regeneration cycle time;~~
- e) ~~pressurisation and de-pressurisation;~~
- f) ~~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;

~~g) power consumption;~~

~~h)~~ 7.3.5

The A-weighted 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 measured at 1,0 m (3,3 ft) from the skid boundary.~~

~~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~~The dryer package shall apply initial preservation ~~after~~be preserved following completion of all inspection, testing activities at package vendor's premises. The preservation shall make the and final inspection.

8.2

The equipment ~~suitable~~ shall be preserved for a period of ~~6~~ six months of 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~~Exposed machined and ~~un-painted~~unpainted surfaces shall be coated with vapour proof corrosion inhibitor ~~to protect against onset of corrosion.~~

8.4

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

8.5

Open piping and valve 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~~blinded with the boxed equipment and a set of lifting instructions enclosed~~material compatible with the shipment metallurgy of the piping system.~~

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.~~

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9 Spare parts, ~~operation and maintenance~~ weight control

9.1 Spare parts

~~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~~ be the same as were supplied for the original component.

~~10 Vendor drawing~~ 9.2 Weight and centre of gravity data requirement

~~10.1 General~~

~~10.1.1~~

~~Vendor shall furnish drawings, document and~~ The weight data at proposal, contract and as-built stage, of equipment for installation offshore shall be provided in accordance with the requirements of the information requirement specification ISO 19901-5:2021, Clause 8.

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~~ (e.g. 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.~~

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Table A.1 — Air dryer selection

Table A.1 — Air dryer selection

Type	Lowest Pressure-Dew Point pressure dew point achievable	Highest Compressed Air 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 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 to 10 min). Rapid pressurizing and depressurizing time (about 5- s to 10 s s to 10 s). Recommended for low volume flow application (< 1000-1 000 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 life cycle cost than heatless dryer. Purge air consumption (up to 10 %). Long drying cycle (4- h to 8 h 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 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 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 Z Zero to marginal purge loss. Long drying cycle (4- h to 8 h 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.

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Annex B **(informative)** **Typical schematics**

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

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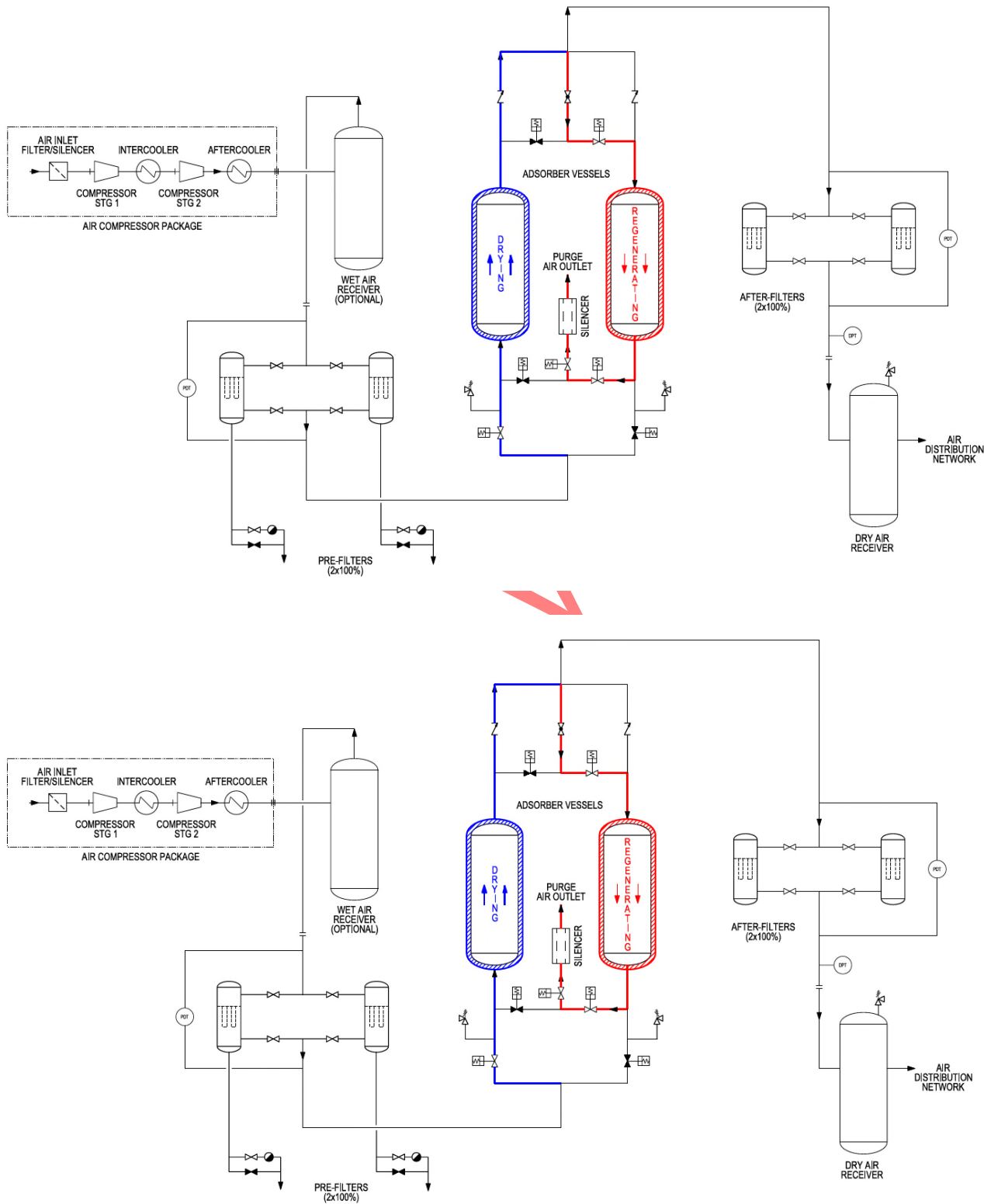


Figure B.1 — Desiccant dryer – Heatless

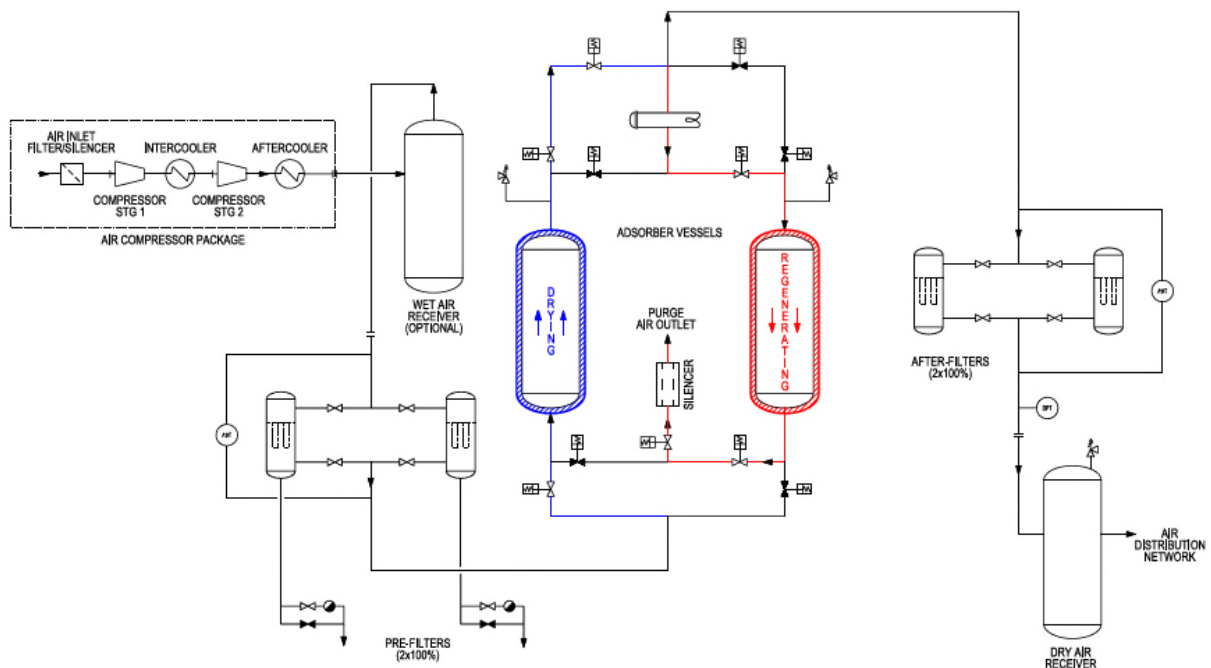
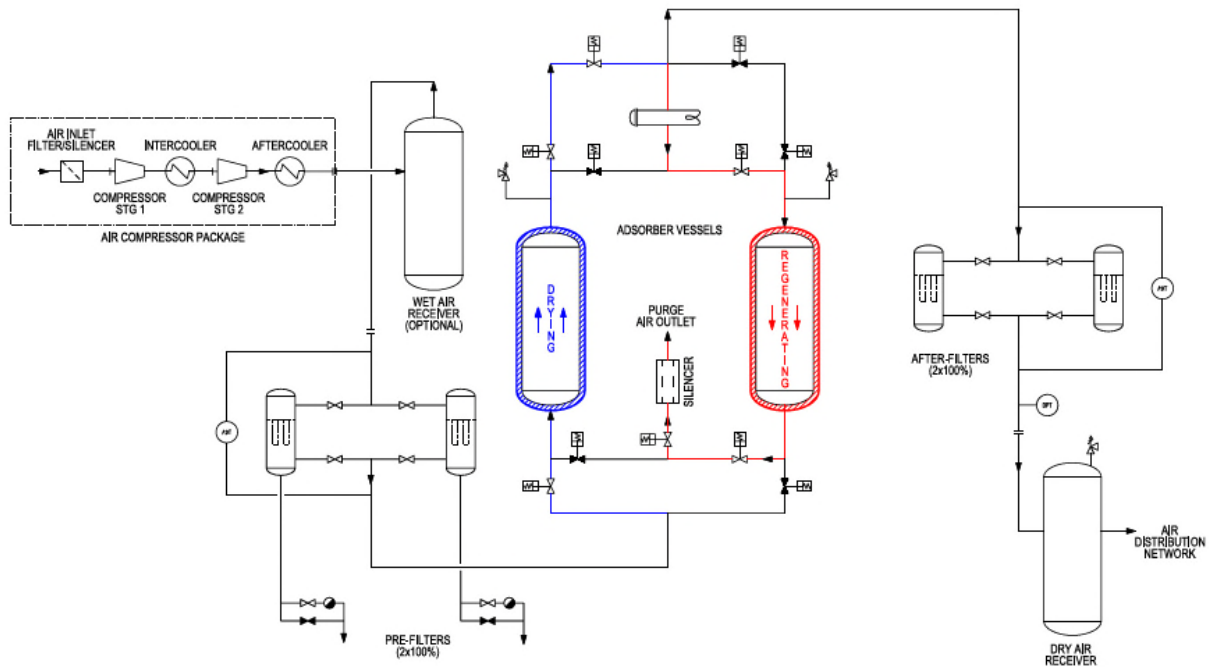


Figure B.2 — Desiccant dryer – Heat regenerated (with internal purge)

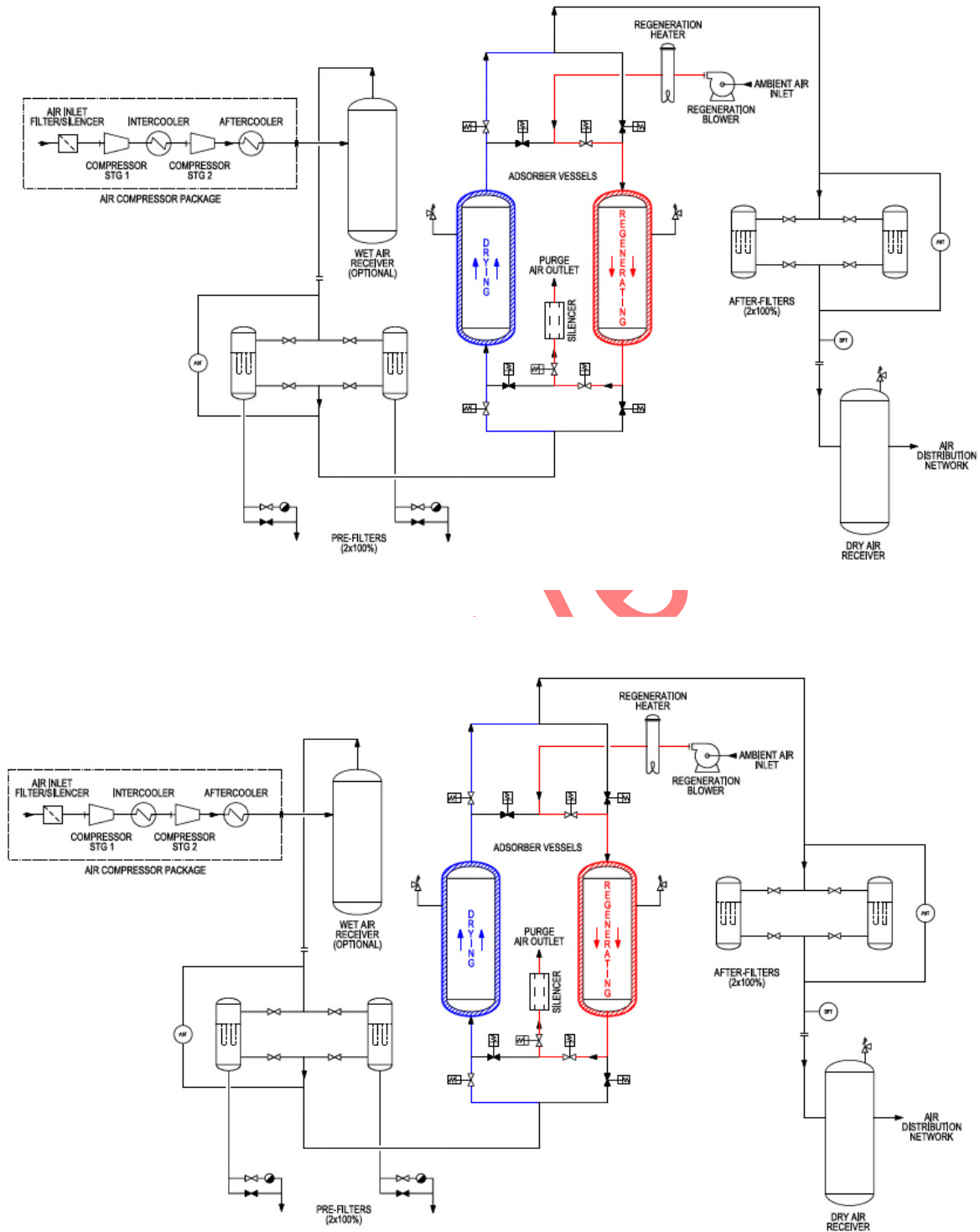
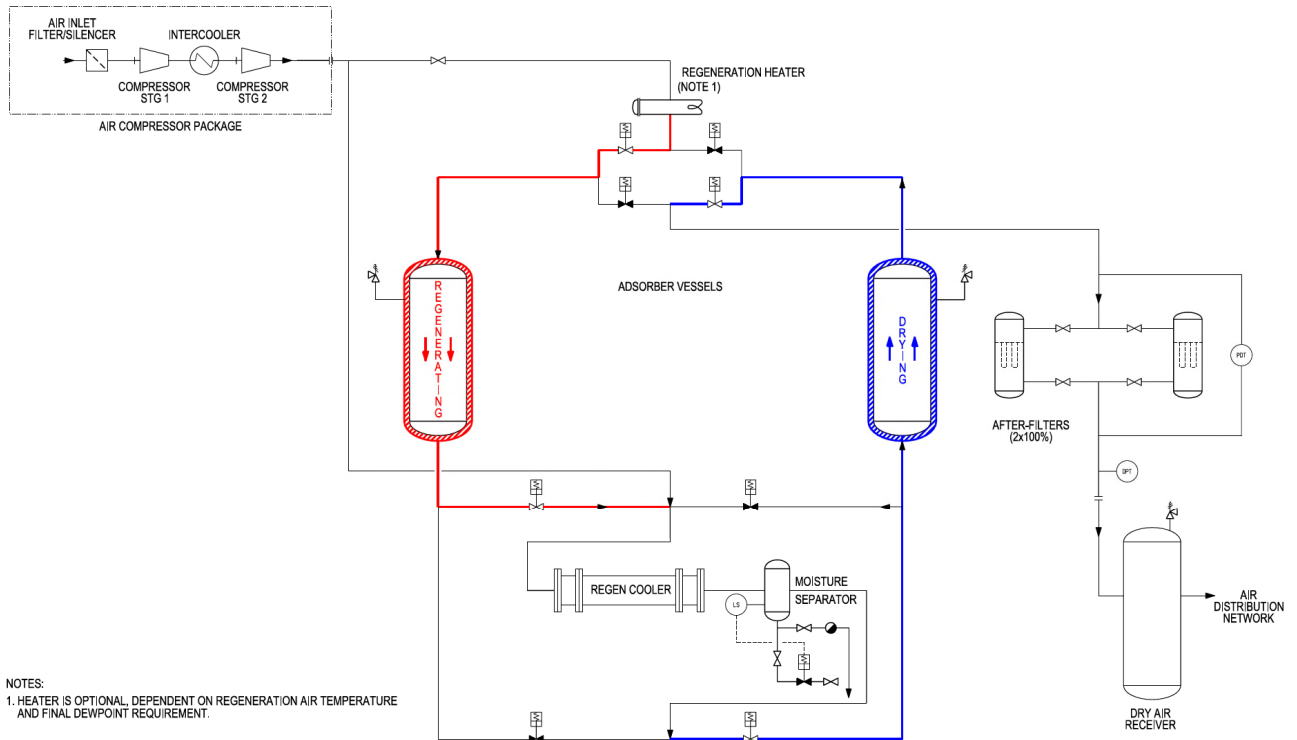
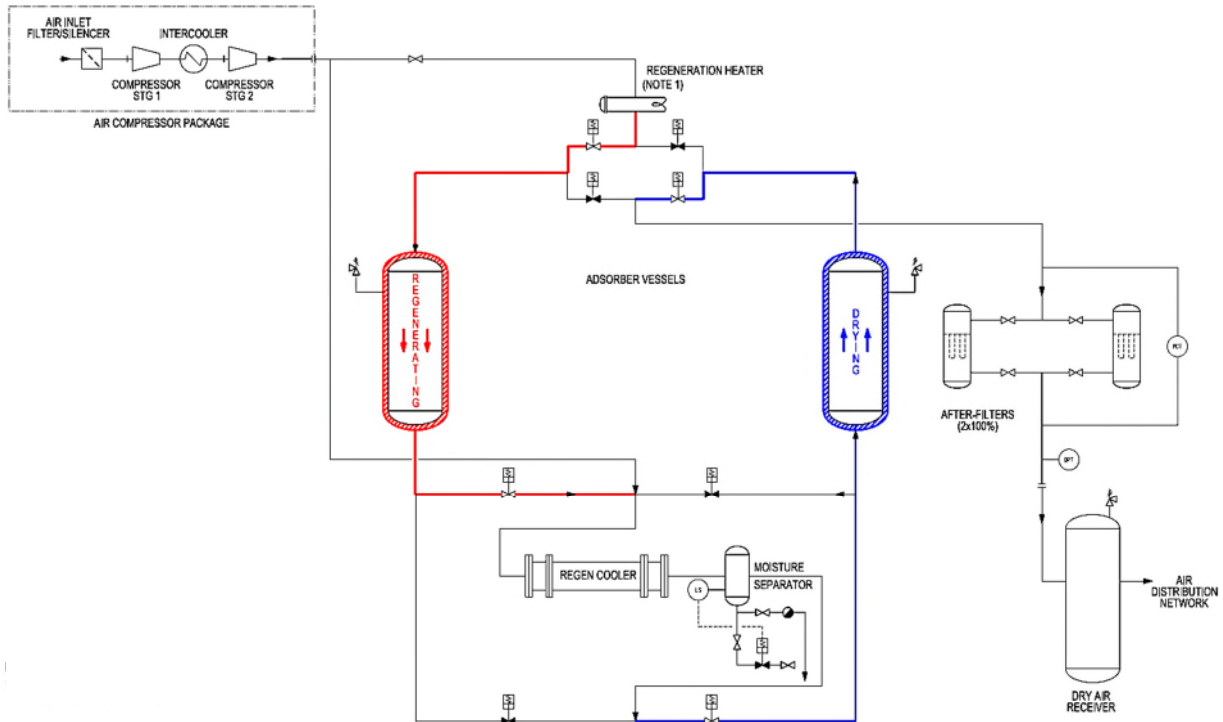


Figure B.3 — Desiccant dryer – Heat regenerated (external blower heated)

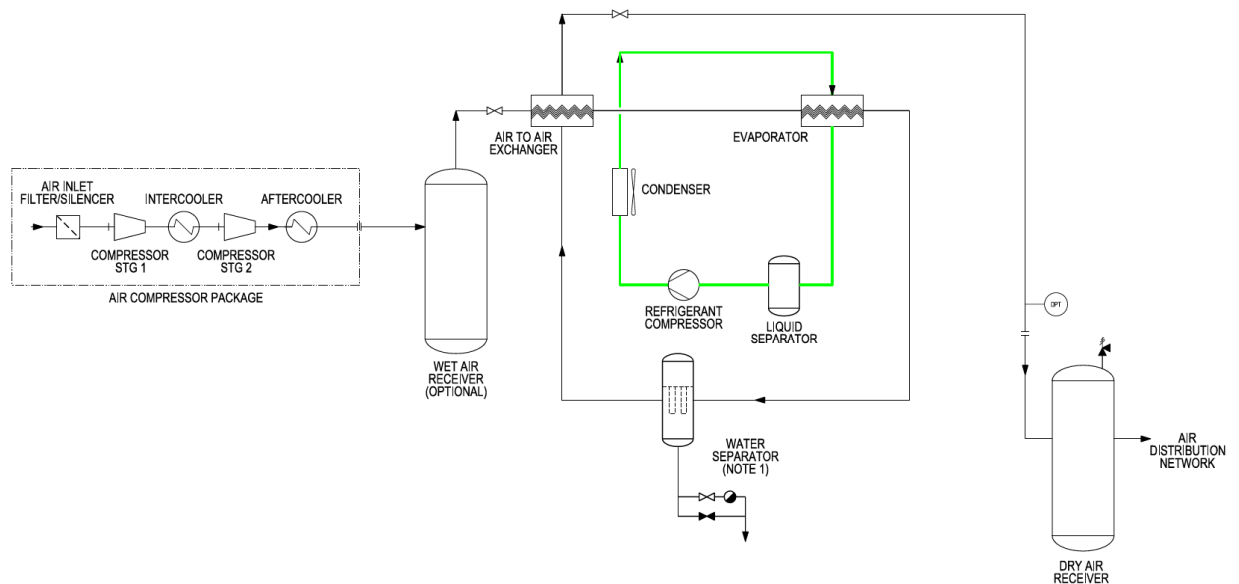


Redline V



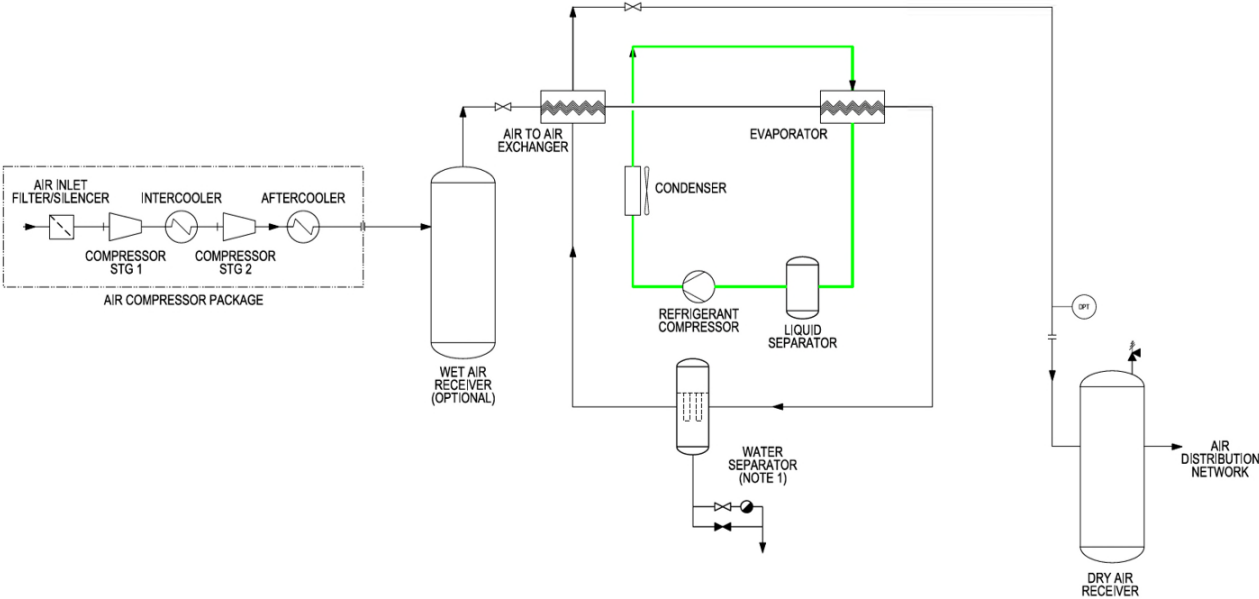
NOTE 1 Heater is optional, dependent on regeneration air temperature and final dewpoint requirement.

Figure B.4 — Desiccant dryer — Heat of compression



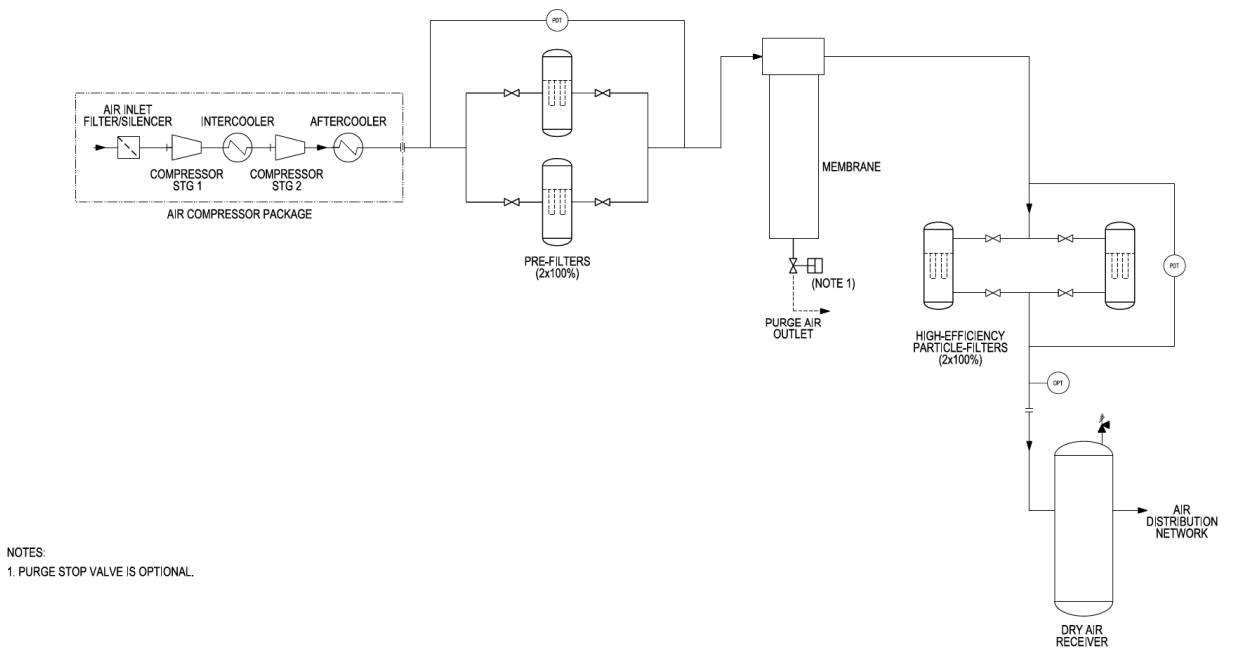
NOTES:

1. WATER SEPARATOR CAN BE INTEGRATED WITH EVAPORATOR.

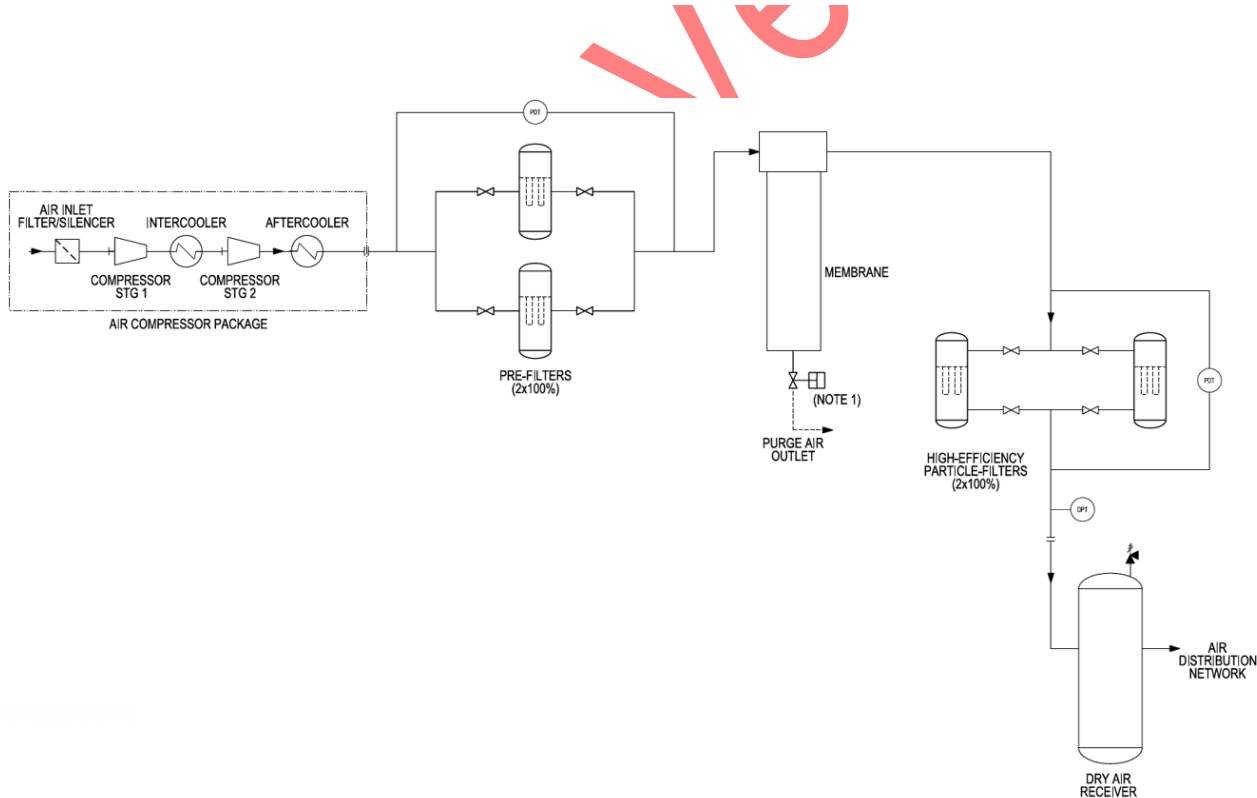


NOTE 1 Water separator can be integrated with evaporator.

Figure B.5 — Refrigeration dryer



NOTES:
1. PURGE STOP VALVE IS OPTIONAL.



NOTE 1 Purge stop valve is optional.

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

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