

DEP SPECIFICATION

INSTRUMENT AIR SUPPLY

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DESIGN AND ENGINEERING PRACTICE

DEM1



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1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for the design and engineering of instrument air supply systems to provide a reliable supply of instrument air of the required quality. In addition, where instrument air systems are combined with nitrogen generation, industrial/tool air and air supply to safety equipment, some minimum requirements are provided.

The scope of this DEP covers the mechanical piping of main header system and does not cover the individual instrument connections. The demarcation is typically where the mechanical piping ends and the instrument tubing begins.

This DEP contains mandatory requirements to mitigate process safety risks in accordance with Design Engineering Manual (DEM) 1 – Application of Technical Standards.

This DEP is a revision of the same number dated February 2017; see (1.5) regarding the changes.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI, the distribution of this DEP is confined to Shell companies and, where necessary, to Contractors and Manufacturers/Suppliers nominated by them. Any authorised access to DEPs does not for that reason constitute an authorization to any documents, data or information to which the DEPs may refer.

This DEP is intended for use in facilities related to oil and gas production, gas handling, oil refining, chemical processing, gasification, distribution and supply/marketing. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process shall be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements could be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable with regards to the safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned, the objective being to obtain agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party that manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party that initiates the project and ultimately pays for it. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The capitalised term **SHALL [PS]** indicates a process safety requirement.

The word **should** indicates a recommendation.

The word **may** indicates a permitted option.

1.3.2 Specific definitions

Term	Definition
ASU	Air Separation Unit
DN	Nominal Diameter
dP	Differential Pressure
HAZOP	Hazard and Operability Study
IA	Instrument Air: dry and oil free air to operate all instruments, see (2.2) for quality requirements
IPF	Instrumented Protective Function
Industrial Air	IA that is supplied to industrial consumers, e.g., processes (see 2.3)
NPT	National Pipe Thread (American Standard)
OD	Outside Diameter
PAS	Process Automation System (also DCS distributed control system)
PDIC	Proportional derivative and integrating controller
PIA	Priority Instrument Air, a segregated IA system that is maintained during load shedding (2.7) to serve consumers with higher reliability requirements
PLC	Programmable Logic Controller
PSA	Pressure Swing Adsorber
PVC	Poly Vinyl Chloride
SIA	Secured Instrument Air: IA that is locally buffered to serve consumers that have a process safety function
Tool Air	Compressed air without the quality requirements of Instrument Air

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section or clause number is shown in brackets (). Other documents referenced by this DEP are listed in (10).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated February 2017. This is an administrative update only to correct references to DEPs that have been involved in either a merge or a split.

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be submitted to the Administrator using one of the following options:

Shell DEPs Online (Users with access to Shell DEPs Online)	Enter the Shell DEPs Online system at https://www.shelldeps.com Select a DEP and then go to the details screen for that DEP. Click on the "Give feedback" link, fill in the online form and submit.
DEP Feedback System (Users with access to Shell Wide Web)	Enter comments directly in the DEP Feedback System which is accessible from the Technical Standards Portal http://www.shell.com/standards . Select "Submit DEP Feedback", fill in the online form and submit.
DEP Standard Form (other users)	Use DEP Standard Form 00.00.05.80-Gen. to record feedback and email the form to the Administrator at standards@shell.com .

Feedback that has been registered in the DEP Feedback System by using one of the above options will be reviewed by the DEP Custodian for potential improvements to the DEP.

1.7 DUAL UNITS

This DEP contains both the International System (SI) units, as well as the corresponding US Customary (USC) units, which are given following the SI units in brackets. When agreed by the Principal, the indicated USC values/units may be used.

1.8 NON NORMATIVE TEXT (COMMENTARY)

Text shown in italic style in this DEP indicates text that is non-normative and is provided as explanation or background information only.

Non-normative text is normally indented slightly to the right of the relevant DEP clause.

2. GENERAL

The instrument air system supplies dry and oil free air to operate all instruments, including the depressurising valves, making the instrument air system the most critical utility in a process plant. This implies that the instrument air system has to meet very high standards of reliability and availability. This reliability usually is defined by the Principal based on the design class.

In the case that the reliability of the instrument air is considered process safety related (e.g., valves for depressurisation), a special configuration called Secured Instrument Air (SIA) will be used.

2.1 ARRANGEMENT

1. The instrument air supply system shall provide the required quantity of:
 - a. instrument air of the quality specified in (2.2);
 - b. industrial air for approved cases, as specified in (2.3);
2. The system shall comprise an air supply plant as specified in (3) to (7), and a main air supply piping system as specified in (8). Specific guidelines for applications are provided in (9).

2.2 INSTRUMENT AIR QUALITY

2.2.1 General

1. The instrument air shall follow strict specifications on the level of solids (2.2.2) and liquid contamination (2.2.3) and (2.2.5) to avoid malfunctioning of instruments and to prevent corrosion/blockages of the distribution system.
2. Nitrogen or carbon dioxide SHALL [PS] not be used as back-up for IA systems.

2.2.2 Solids

1. The maximum number of particles per m³ (ft³) instrument air shall meet at least Class 2 of Section 5.2 of ISO 8573-1, 2010.
2. See (6.5) for filter requirements to enable the quality standard for solids to be met.

2.2.3 Dew point

1. To prevent condensation in the supply piping and instruments, the pressure dew point of the air at operating pressure shall be at least 10 °C (18 °F) below the lowest ambient air temperature specified for the project or location.
2. Integrated IA systems to supply cryogenic Air Separation Units with compressed air may require pressure dew points specified at -65 °C (-85 °F) depending on the possible combined air drier service.
3. Additional requirements for the IA driers imposed by a cryogenic Air Separation Unit should be specified by the project.

2.2.4 Maximum temperature

1. To control the instrument air supply temperature downstream of the driers, a water cooler should be used in areas with ambient temperatures above 50 °C (122 °F).
2. In order to ensure proper operation of instruments and to prevent the need for personal protection, the maximum temperature shall in all cases be no higher than 60 °C (140 °F), see also (6.6).

2.2.5 Oil contamination

1. The total oil contamination (liquid, aerosol and vapour) of the instrument air shall meet at least Class 1 of Section 5.4 of ISO 8573-1, 2010. This is preferably achieved by selection of oil-free compressors.

2. The Principal may allow non-oil-free compressors to be selected in combination with filtration upstream of the driers to meet Class 1 of Section 5.4 of ISO 8573-1, 2010. In which case, the following filter configuration (in series) shall be selected to meet the above specification:
 - a. coalescing filter to remove the bulk of the oil;
 - b. high efficiency cartridge filtration to meet the specification on liquids;
 - c. activated carbon filtration to remove any oil in the vapour phase.

The requirements given above are in accordance with IEC 60654-4 (see also ISA 7.0.01 and ISO 8573-1, 2010 edition).

3. As the performance of activated carbon filters deteriorates at higher air temperatures, oil removal to Class 1 of Section 5.4 of ISO 8573-1, 2010 may not be achievable at high ambient temperatures without frequent change of the activated carbon cartridge. The approval of the Principal shall be obtained to allow any reduction of specification to Class 2 of Section 5.4 of ISO 8573-1, 2010.
 - a. Refer to ISA 7.0.01 and ISO 8573-1, 2010 edition.
4. For IA systems that are integrated with a cryogenic air separation unit (ASU), the following shall apply:
 - a. if a portion of the compressed air from the IA compressor is used to feed the cryogenic ASU, then refer to Appendix C of DEP 30.05.10.30-Gen. for the requirements of that portion of air;
 - b. if the source of IA is the pre-purified, compressed air used to feed cryogenic air separation unit (ASU) (i.e., immediately downstream of the molecular sieves), then the air quality will be in accordance with Appendix C of DEP 30.05.10.30-Gen.;
 - c. if the source of IA is compressed air that is extracted somewhere upstream of the pre-purifiers on an ASU plant, then this air may require further cooling, drying, and/or solids removal, depending on where the air has been extracted.

2.2.6 Pressure

1. Under normal operation the instrument air pressure at the buffer vessel outlet shall be 7 barg (100 psig) unless approved otherwise by the Principal.
2. The Principal may specify a different pressure; however, for proper operation of the instruments, this shall not be less than 5.5 barg (80 psig).
3. The supply pressure downstream of the compressor and driers should be 1 to 2 bar (15 to 30 psi) higher than the normal operation pressure at the buffer vessel.

This is to allow for pressure drop over piping and control valve(s).

2.3 INSTRUMENT AIR SUPPLY FOR INDUSTRIAL CONSUMERS

1. Instrument air may be supplied to the following industrial consumers. For such cases a separate system shall be installed branching off the instrument air supply system at the battery limit of each processing unit:
 - a. oil mist lubrication systems;
 - b. flare ignition equipment;
 - c. general mechanical clean-out uses, e.g., scouring of filters;
 - d. agitation of heat exchangers;
 - e. drying, purging of equipment, e.g., peep holes in furnaces;
 - f. drying, purging of lines or equipment;