

DEP SPECIFICATION

STEAM JET VACUUM EJECTOR SETS

DEP 31.29.56.31-Gen.

September 2012

(Amendment A01 has been incorporated – February 2013)

ECCN EAR99

DESIGN AND ENGINEERING PRACTICE



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1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and provides recommendations for the design, materials, engineering, fabrication, assembly, inspection and performance testing of steam jet vacuum ejector sets.

Only jet vacuum systems using steam as motive fluid are covered in this specification.

Excluded from the scope of this DEP is liquid ring vacuum equipment for which reference is made to DEP 31.29.42.30-Gen.

NOTE: Shell has proprietary requirements beyond those stated in this DEP for steam jet ejector sets and vacuum systems associated with Crude High Vacuum Units (HVUs). Distillation Process specialists from Shell Projects and Technologies' Refining Processes and Process Engineering group (PTD/TM) shall be consulted for specific requirements for these systems.

This DEP is a revision of the DEP of the same number dated September 2010; 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 authorized 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 oil refineries, chemical plants, gas plants, exploration and production facilities and supply/distribution installations. 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

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 word **should** indicates a recommendation.

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets (). Other documents referenced by this DEP are listed in (11).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated September 2010. This has been a major rewrite and it is therefore impractical to summarize the changes here.

Amendment A01

Section	Change
1.6	Updated DEP feedback process.
3.4.1.2	Reference to pressure vessel DEPs have been updated to the new pressure vessel DEP 31.22.00.31-Gen.
11.	Reference to pressure vessel DEPs have been updated to the new pressure vessel DEP 31.22.00.31-Gen.
11.	Added DEP feedback form - DEP 00.00.05.80-Gen.

1.6 COMMENTS ON THIS DEP

Amendment A01

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://swwww.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.

2. GENERAL REQUIREMENTS

Data/requisition sheet DEP 31.29.56.93-Gen. shall be used for the exchange of information between the Principal, Contractor and Manufacturer. Where the sheets show alternatives, those items which are not applicable shall be deleted.

The Manufacturer shall provide all drawings, design details, operation and maintenance manuals, and other information necessary for the design assessment, erection, operation and maintenance of the installation. All information shall be clear and not open to misinterpretation and shall apply specifically to the equipment supplied.

2.1 DATA AND INFORMATION TO BE SUBMITTED WITH THE TENDER

The Manufacturer shall submit with the tender sufficient drawings and detailed information to enable a full evaluation of the steam jet vacuum ejector sets, including as a minimum:

- a) Completed data/requisition sheet DEP 31.29.56.93-Gen.;
- b) Fabrication and engineering documents schedule;
- c) Estimated mass of the completely assembled ejector set;
- d) A list of all recommended spare parts for initial and normal operation, as specified in DEP 70.10.90.11-Gen., with detailed prices and delivery times;
- e) Inspection and test plan;
- f) A list containing all proposed deviations/exceptions from the requisition and this DEP;
- g) General arrangement drawing (lay-out sketch);
- h) Proposals for equipment test run programs, to be carried out both at the Manufacturer's works and at site;
- i) Names of all proposed sub-Manufacturers of main equipment, e.g., pumps, condensers, silencer, instruments, with completed process and mechanical design data sheets being supplied by them as applicable. Materials of construction for all parts, using ISO/ASME material specifications when applicable, shall be listed on the data sheets;
- j) A process flow scheme showing all equipment, lines, valves and instrumentation and indicating limits of supply, the terminal points and sizes thereof;
- k) Noise requirements, see (6.2).
- l) Note that in some cases the Principal or the Contractor may also require some of the elements found in (9.3) as part of the tender (either in final or in "preliminary, estimated" form).

2.2 DATA AND INFORMATION TO BE PROVIDED BY THE PRINCIPAL OR CONTRACTOR

- 2.2.1 For multi-stage steam jet vacuum ejectors, the Principal or the Contractor may provide the Manufacturer with curves of percent condensed vs. temperature and heat release (or enthalpy) vs. temperature at the preliminary selected condensing pressure.
- 2.2.2 The installation equipment shall be listed by the Contractor on a sheet entitled 'Scope of Supply' and the limits of supply on a sheet entitled 'Terminal Points', in accordance with the requirements of each project.
- 2.2.3 If necessary to define the terminal points (e.g., steam supply, etc.), a sketch should be attached to the Terminal Points list.
- 2.2.4 Any specific space limitations shall be specified including the maximum tube length of condensers and/or maximum overall skid dimensions.

3. DESIGN AND ENGINEERING

3.1 ECONOMIC CRITERION

Steam jet vacuum ejectors shall be designed or selected such that an optimum is obtained between capital and operating costs.

The following criterion shall apply:

$[(F \times A) + (B \times G_s) + (C \times G_w)]$ shall be minimised,

in which F = Capital charge percentage

A = Quotation price

B = Steam cost per tonne (lb)

G_s = Steam consumption in tonnes (lbs) per year

C = Cooling water cost per 1000 m³ (gal)

G_w = Cooling water consumption in 1000 m³ (gal) per year

The capital charge percentage shall be specified by the Principal or the Contractor on the data/requisition sheets DEP 31.29.56.93-Gen. together with unit costs of steam (B) and of cooling water (C) which shall be the costs of incremental/decremental quantities (not the average cost of supply).

Where the range of size of ejector options is such that changes may be required in the supporting structure, the appropriate differential capital costs should be accounted for in the calculation.

The most economical interstage pressures and temperatures shall be selected.

3.2 PROCESS DESIGN REQUIREMENTS

3.2.1 Overly conservative estimates of the pressure drop between the process system and the ejector shall be avoided. Also, no safety or over-design factors shall be applied to the design suction pressure. Criteria for acceptable pressure loss and flow velocity in suction lines are given in (Appendix 2) and (Appendix 3) for use in evaluating designs and assuring proper design suction pressure.

3.2.2 A minimum recommended value of specified discharge pressure is 70 mbar (ga) (1 psig). The backpressure due to friction and to process head should be calculated to verify a reasonable specification with due consideration to the presence of flame arrestors, flow meters, seal vessels, long discharge lines and the pressure of the process or fuel system receiving the discharge gas.

3.2.3 When the process suction temperature is less than 0 °C (32 °F), or less than the solidification temperature of a process vapour component, or anytime the suction pressure is less than 7 mbar (abs) (5 mm mercury absolute) the first stage diffuser shall be specified as steam jacketed. Consideration should also be given to heat tracing the suction line.

3.2.4 All load components shall be identified in order for the Manufacturer to size the jets and condensers for acceptable operation. Any desired system safety factor should be applied to the design load, to handle recirculation (control) flows or process surge flows.

3.2.5 (Appendix 4) provides the recommended allowance for air leakage into vacuum process systems. Higher air leakage allowances would normally be applied if the process vessels have rotating shafts, with seals, penetrating the shells. In cases where air could cause excessive corrosion, process fluid degradation, formation of a toxic compound or other unwanted reactions, the allowance for air leakage might be less than shown on (Appendix 4).

In order to avoid significant process upsets due to sudden air in-leakage or generation of non-condensables, the recommended allowances for air in-leakage, including vapours of saturation, should be multiplied by 1.3 for single stage jets and 1.6 for multi-stage jets.