

TECHNICAL SPECIFICATION

SPECIAL PURPOSE STEAM TURBINES (AMENDMENTS/SUPPLEMENTS TO ISO 10437)

DEP 31.29.60.31-Gen.

August 2005

DESIGN AND ENGINEERING PRACTICE



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PART I INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for the design, materials, fabrication, inspection, testing and preparation for shipment of steam turbines for special-purpose applications.

This DEP is based on ISO 10437. Part II and Part III of this DEP amend, supplement and delete various clauses of ISO 10437.

Part II of this DEP applies to special purpose steam turbines.

All clauses of ISO 10437 not modified by this DEP shall remain valid as written.

This is a revision of the DEP of the same number dated December 1998; a summary of the main changes is given in (1.5).

In this DEP, where practical, US Customary units have been added in brackets, for information.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI and SIEP, the distribution of this DEP is confined to companies forming part of the Royal Dutch/Shell Group or managed by a Group company and, where necessary, to Contractors and Manufacturers nominated by them.

This DEP is intended for use in oil refineries, chemical plants, gas plants, exploration and production facilities and, where applicable, supply/marketing installations.

When DEPs are applied, a Management of Change (MOC) process should 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 may 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 as regards 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 with the object of obtaining agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

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

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

The **Principal** is the party, which initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. 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 (Part III).

1.5 SUMMARY OF MAIN CHANGES SINCE PREVIOUS EDITION

This DEP is a revision of, the DEP of the same number dated December 1998, which was based on API Std 612. This edition of the DEP is now based on ISO 10437. Due to the restructuring of the clauses it is impractical to list the changes since the previous edition herein.

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be sent to the DEP Administrator at standards@shell.com. Shell staff may also post comments on this DEP on the Surface Global Network (SGN) under the Standards/DEP 31.29.60.31-Gen. folder. The DEP Administrator and DEP Author monitor these folders on a regular basis.

PART II AMENDMENTS / SUPPLEMENTS TO ISO 10437

2. NORMATIVE REFERENCES

Add to this clause:

Standards referred to in this DEP are listed in Part IV.

3. TERMS AND DEFINITIONS

3.51 Add new clause:

minimum pressurization temperature

lowest possible ambient temperature of the casing (or container, piping, etc.) at which the casing (or container, piping, etc.) may be pressurized to 25 % or more of its design pressure during warm up.

3.52 Add new clause:

local gauge board

gauge board located directly at the steam turbine

See (12.5.4).

3.53 Add new clause:

local panel

panel located near the steam turbine train, containing the instruments for routine checking of the steam turbine during normal operation, in addition to the alarm panel

See (12.5.4).

6. BASIC DESIGN

6.1. GENERAL

6.1.1 Add to this clause:

Steam turbine rated power and speed shall not exceed the limits of the Vendor's proven design and shall be well within the range of the Vendor's successful experience.

Steam turbine shall be designed for a minimum operating period of 12 years between required overhaul inspections.

6.1.3 Add to this clause:

The driven equipment vendor for mechanical drives has unit responsibility. The turbine vendor shall assist the vendor of the driven equipment in fulfilling his obligation as the party responsible for the entire train, including the driver and all power transmitting components. For power generation, the steam turbine manufacturer has unit responsibility.

6.1.6 g) Add to this clause:

The Vendor shall present NEMA swing certification for the turbine pressure retaining components. If the turbine is capable of operating levels greater than the NEMA swings, the vendor shall specify those limits for which the turbine can accept.

6.1.6 i) Add new clause:

The maximum continuous speed of the turbine shall be not less than the maximum continuous speed of the driven equipment.

6.1.9 Add to this clause:

When requested by the purchaser, the vendor shall review and comment on the purchaser's piping and foundation drawings.

The vendor shall provide a list of field installation activities that should be witnessed by the vendor's representative. Factory representatives shall be present to assist the Contractor during initial installation (including the piping checks specified below) and initial start-up. An outline of initial start-up procedures shall be prepared by the vendor and shall be agreed upon by all parties involved prior to operation commencing.

6.1.11 Add to this clause:

The following shall also apply:

- a) All left-handed threads shall be clearly marked.
- b) Any maintenance item with a mass more than 20 kg (44 lb) shall be provided with lifting lugs or similar dedicated fixed lifting point(s). Screw-in eyebolts are only acceptable for bearing housing covers and for internal components where other lifting arrangements are impractical. Holes for eyebolts shall be permanently marked with the correct bolt size to be used. If this marking is impractical, bolt size information should be clearly indicated in the instruction manual.

6.1.15 Add to this clause:

The following shall also apply:

- a) The Contractor shall comply with DEP 31.10.00.31-Gen. and thereby communicate to the vendor the specified equipment noise limitations by using data sheet DEP 31.10.00.94-Gen., which forms part of the requisition.
- b) The vendor shall assure this noise limits are specified to all sub-suppliers.

- c) The vendor shall submit expected sound power levels and sound pressure levels of the equipment, together with any other relevant information as requested in the data sheet, DEP 31.10.00.94-Gen with the tender.
- d) The vendor shall indicate what special silencing measures, if any, are proposed in order to meet the specified levels. If noise enclosures are supplied, the full access to the equipment for maintenance purposes shall be ensured by means of an appropriate design.

6.1.16 Add to this clause:

Motors, electrical components and electrical installations shall be in accordance with DEP 33.64.10.10-Gen.

6.1.20 Add new clause:

The vendor shall state in the proposal that the offered design details and materials have been used on new turbines for a minimum of 5 years or have acquired at least 16,000 h of successful operation. Any component not meeting these requirements shall be listed as an exception. Although continuous advancements and improvements by the manufacturer in his product line are recognized, these changes are subject to the Principal's approval. At the discretion of the Principal, alternative designs may be requested if the manufacturer fails to provide evidence of proven reliability.

The vendor shall also confirm that at least two units of similar rating and mechanical design have been produced at the vendor's proposed manufacturing plant.

6.1.21 Add new clause:

In the event of any design or manufacturing error, faulty material or damage relating to any turbine part, the component in question shall be replaced unless otherwise agreed by the Principal.

Any proposal to recover the component rather than replace it, and the method of repair, shall be submitted to the Principal to obtain approval. Additional tests or calculations may be required to prove (a) the effectiveness of the repair, and (b) that there will be no detrimental effect on the serviceability of the component.

At the discretion of the Principal a temporary repair or recovery may be accepted subject to a later replacement of the complete component or assembly by the vendor.

6.2 NAMEPLATES AND ROTATION ARROWS

6.2.4 Add to this clause:

- m) Year of manufacture

6.2.6 Replace this clause with:

Nameplates shall be in the English language. Data units shall be same as shown on approved datasheets

7. CASINGS

7.1 PRESSURE CASING

7.1.3 Add to this clause:

The temperature corresponding to the maximum allowable working pressure of 0.7 bar (ga) (10 psig) shall be at least 150 °C (300 °F).

7.1.5 Add to this clause:

If possible, vertical joints in the turbine casing shall be discontinuous at the horizontal split to avoid a four-cornered joint.

7.1.6 Add to this clause:

The design details of the high-pressure joints shall be submitted for reviewed by the Principle for turbines with inlet pressures 40 bar (ga) (580 psig) or higher.

The vendor shall demonstrate by engineering calculation and by experience that the high-pressure joint design will not leak at the highest design steam pressures and temperatures. The calculations shall include, as a minimum, joint contact pressure and bolt tensions.

All high-pressure steam joints shall be hydraulic tensioned. The vendor shall provide the necessary tool for tensioning these joints. Designs requiring re-torquing joint bolting while hot are not acceptable as a means of achieving a tight joint.

7.1.10 Add to this clause:

Eyebolt to lift the upper casing shall not be used or provided.

7.1.13 Add to this clause:

There shall be no tapped openings in the pressure casing unless approved by the Principal.

7.1.15 f) Add to this clause:

The main casing joint and the main turbine nozzles shall be designed so the studs and nuts can be tensioned by an approved hydraulic tensioning method. There shall be sufficient access around the bolting to facilitate the use of the hydraulic tooling.

7.1.19 Add new clause:

The residual Gaussian magnetic flux density in fabricated steel casings and steel castings that have been weld repaired shall be not greater than 10 Gs.

7.1.20 Add new clause:

If casing expansion keys and slide surfaces are used, the vendor shall provide a suitable material combination which prevents sticking during transient and normal operating conditions.

7.2 CASING CONNECTIONS

7.2.3 Replace this clause with:

Casing openings for piping connections shall be at least DN 20 (NPS 3/4) and shall be flanged or machined and studded. There shall be no threaded openings in the casing unless approved by the Principal.

Piping connections to the casing DN 25 (NPS 1) and large shall be full penetration butt weld connections, not socket weld connections. Openings of less than DN 25 (NPS 1) may be reinforced boss connections of the "weldolet" type, using only full penetration butt welds

7.2.7 a) Replace this clause with:

Cast iron flanges shall not be used.

7.2.10 Add to this new clause:

The exhaust casing on condensing turbines shall be designed with adequate inspection openings for blade inspection and general access to the exhaust hood.

7.3 INTERNAL STATIONARY COMPONENTS

7.3.2 Replace last sentence with:

Nozzles or stationary blading shall be welded to the diaphragms. The design of the stationary blading at the horizontal joint shall be vendor's standard design.. Designs featuring partial blading at the diaphragm split line are unacceptable.

Add to this clause:

The diaphragm shall have a continuous flow path across the split line and not have any discontinuities that can cause any excitation at the downstream rotor blading.

7.3.5 Add new clause:

Diaphragm anti-rotation devices shall be mounted at the split joint.

7.3.6 Add new clause:

Casing diaphragm seats in the wet region of the flowpath shall be made from erosion-resistant materials or shall have replaceable inserts.

8 ROTATING ELEMENTS

8.1 GENERAL

8.1.1 Add to this clause

An overshoot speed is a momentary excursion, not lasting more than a few seconds.

8.1.2 Replace this clause with:

Rotors shall be of integrally forged construction.

8.1.5 Add new clause:

Rotors shall be designed with an integral "flinger" between the bearing housings and gland seals to help prevent moisture from entering the bearing housings.

8.2 SHAFTS

8.2.4 Add to this clause:

The shaft end shall have an integral coupling hub. Shaft shall be provided with an integral radial tooth gear wheel for speed measurement. The teeth shall be wide enough for full rotor float without thrust bearing.

8.3 BLADING

8.3.3 Add new clause:

Blade stress levels developed by the driven equipment shall be low enough to ensure trouble-free operation.

The average steam bending stress shall not exceed 3.5 N/mm^2 (507 psi) for control stages, 7.0 N/mm^2 (1,015 psi) for stages in the wet-dry region of the turbine, and 10.5 N/mm^2 (1,523 psi) for all other stages, unless approved by the Principal

8.3.4 Add new clause:

Tenons shall be round or oval, and shall have generous fillets at the junction with the turbine blades. Fillets shall be free of tool marks and shall be shot-peened

8.3.5 Add new clause:

Tenon holes in shrouds shall be:

- 1) drilled or milled; and
- 2) finished with generous radii or chamfer on both sides of the holes; and
- 3) free of significant tool and grinding marks.

Shrouds shall be rolled to the proper radius prior to fitting, and shall be fitted to the blades and peened so that there are no gaps between the shrouds and the blades. The Vendor shall state the method used for rivet setting the tenons.

8.3.6 Add new clause:

Titanium shrouding shall be used where the temperature permits it, unless otherwise approved by the Principal.

8.3.7 Add new clause:

At the pre-selection meeting and in the proposal, the turbine supplier shall submit a comprehensive listing of preliminary blade selection for each row of blading including

calculations of steam bending stress for each row. Additionally, the supplier shall submit a general history of experience for each of the blades indicating where used, years of service, and loading.

8.3.8 Add new clause:

Prior to manufacturing, the supplier shall provide the following design data for each row of blades for the Principal's review and acceptance:

- a) Steam bending stresses.
- b) Campbell diagrams.
- c) Goodman diagrams together with supporting computations showing total operating stress (steady state plus cyclic) of all blading for which resonant interference occurs within the normal operating speed range. The Vendor shall also list the maximum allowable blade stresses.
- d) Calculation stresses on the closing block assemblies.
- e) Information on blades and shrouds, in order to allow for an independent audit of the blade stresses.

9. ROTOR DYNAMICS

9.1.4 Add to this clause:

The turbine vendor shall supply all necessary information to the driven equipment manufacturer for calculation of torsional critical speeds.

9.2 LATERAL ANALYSIS

9.2.4 Add to this clause:

h) Dynamic analysis shall consider rotor-lifting forces due to steam admission.

9.2.5 Modify this clause:

Delete the words "if specified".

9.2.12 Add new clause:

In addition to the other requirements, the lateral analysis report shall include the following:

- a) Dimensional data of the bearing design in sufficient detail to enable calculations of stiffness and damping coefficients.
- b) Shaft geometry with sufficient detail to model the shaft including the location of bearing centerlines and mounted components.
- c) The weight, polar and transverse moments of inertia and centre of gravity of the blade rows, balance piston, shaft end seals and coupling(s) with sufficient detail to conduct an independent analysis of the rotor.
- d) The input model used for the vendor's analysis.
- e) The support stiffness used in the analysis and its basis.

9.2.13 Add new clause:

Stability analysis shall be performed in accordance with API 617, Section 1, paragraphs 2.6.5 and 2.6.6.

9.5 TORSIONAL ANALYSIS

9.5.1 Replace this clause with:

The vendor having unit responsibility shall ensure that a torsional vibration analysis of the complete coupled train is performed and shall be responsible for directing any modifications necessary to meet the requirements of 9.5.2 through 9.5.6.

9.5.5 Add to this clause:

The Vendor shall submit procedures for carrying out stress analyses and the corresponding acceptance criteria to the purchaser for approval by the Principal.

9.6 VIBRATION AND BALANCING

9.6.3 Add to this clause:

Unless otherwise approved by the Principal, completely assembled rotating elements shall be subject to high-speed (at rated speed) balancing.

9.6.7 Modify this clause

After high-speed balancing, the assembled rotor shall be low speed balanced checked. Balance records shall be provided with the rotor.

9.6.8 Add to this clause

The unfiltered vibration level in any plane, including runout, shall be not greater than 25 μm (0.001 in).

10. BEARINGS, BEARING HOUSINGS, AND SEALS

Complete radial and thrust bearing assemblies shall be designed and manufactured by a single source.

10.1 RADIAL BEARINGS

10.1.1 Add to this clause

Radial bearings shall be tilting pad load between pad design, unless otherwise approved by the Principal. The bearings shall be sized based upon steel backed pads. The back of the shoes shall also be hardened steel.

Damper type bearings shall not be used.

Spherical seat bearings may be used with the approval of the Principal.

The bearings shall be suitable for operating at barring and turning gear speeds without damaging the babbit lining.

10.1.3 Add new clause:

Bearing metal temperatures shall not exceed 105 °C (221 °F) under any load conditions and at the maximum specified ambient or cooling water temperature

10.1.4 Add this new clause:

Radial bearings shall be fitted with bearing-metal temperature sensors installed in accordance with DEP 32.31.09.31-Gen.

The type of bearing-metal temperature sensors shall be identified on the datasheet.

When embedded thermocouples are specified, they shall be Type E thermocouples. If RTDs are specified, they shall be platinum (100 Ω, three-wire).

Load-bearing pad and one adjacent pad shall have bearing-metal temperature sensors.

10.2 THRUST BEARINGS AND COLLARS

10.2.1 Add to this clause:

Thrust bearing shall have capability for reverse rotation. The corresponding load-carrying capability shall be stated in the proposal

10.2.5 Add to this clause:

Bearings shall have a unit load limit of 1.7 N/mm² (247 psi) unless otherwise approved by the Principal

The vendor's primary offering shall be direct lubricated low oil consumption bearings. As an alternative, the vendor may offer their standard flooded bearing. In the proposal, the vendor shall state the power demand difference between the two thrust bearings if applicable.

10.2.6 Add to this clause:

Thrust bearing shall have a design that permits axial bearing clearance adjustment by shims. Machining of the thrust pads for this purpose is not acceptable.

10.2.9 Add new clause:

Thrust bearings shall be fitted with bearing-metal temperature sensors installed in accordance with DEP 32.31.09.31-Gen.

The type of bearing-metal temperature sensors shall be identified on the datasheet.

When imbedded thermocouples are specified, they shall be Type E thermocouples. If RTDs are specified, they shall be platinum (100 Ω , three-wire).

Bearing-metal temperature sensors shall be provided in every other pad on both the active and inactive side of the bearing.

10.3 BEARING HOUSING

10.3.7 Add new clause:

Bearing housings shall have DN 20 (NPS 3/4) connections for nitrogen purge to the labyrinth seals. This purge feature shall not be used as a means of correcting oil leaks on the test stand.

10.3.8 Add new clause:

The bearing temperature sensors shall terminate with connections inside the bearing housings. Extension wires from the connections shall be routed to vendor-supplied junction boxes. Extension wires shall be run in flexible electrical conduit.

10.3.9 Add new clause:

Oil and instrument connections shall be in the lower half of the bearing housing to eliminate the need for removal during bearing inspection and maintenance.

10.3.10 Add new clause:

All wire entries into the bearing housings shall be provided with proper sealing against leakage.

10.3.11 Add new clause:

For baseplate-mounted equipment, the vendor shall supply and mount the tooling balls on both sides of the lower half of each bearing housing, close to the split line. The corresponding tooling balls shall be supplied and mounted on the baseplate. During the mechanical test run of the turbine, the turbine vendor shall demonstrate that the balls are mounted in the proper position and that their use is not obstructed by any piping or structure.

10.5 SHAFT SEALS

10.5.1 Add to this clause:

Stepped labyrinth rings mounted on the rotor shall not be used. If stepped labyrinths are applied they shall be integrally machined.

10.5.2 Add to this clause:

Interstage diaphragm seals shall be bronze materials. Cast-iron diaphragm seals are prohibited.

11. MATERIALS

11.1 GENERAL

11.1.1 Add to this clause:

The Vendor shall advise all parts that are designed on other criteria than ultimate stress, with criteria listed

11.1.10 Add to this clause:

In turbines operating on saturated steam, all components in the steam path (e.g. nozzles, blading, diaphragms) shall be made of erosion-resistant material.

11.1.11 Replace this clause with:

All pressure-containing parts shall be made of steel.

Grey cast iron shall not be used for turbine casing.

11.1.15 Add to this clause:

Charpy testing shall be required if the casing can be pressurized at temperatures below -30°C (-22°F).

11.1.16 Add new clause:

Rotating blading shall be forged. Alternative designs are subject to the approval of the Principal.

11.2 CASTINGS

11.2.1 Add to this clause:

All pressure retaining castings shall comply with the internationally recognized materials specification for the part. Castings which are found to contain defects shall be repaired to comply with the material specification or shall be replaced.

11.2.3 Add to this clause:

Approval by the Principal shall be obtained before any major weld repair is carried out.

Major weld repairs are defined in (16.2.2).

Details of all major weld repairs, and of the heat treatment where applicable, shall be recorded and reported to the Principal. Details of the repair, including a drawing identifying the location, shall be included in the manufacturers data report.

All repairs shall meet the inspection requirements and acceptance standards for the original material.

Casting upgrades at the foundry is not considered to be a major repair.

11.3 WELDING

11.3.4 a) Add to this clause:

Connection welds shall be 100 % radiography inspected where possible. Magnetic particle inspection, liquid penetrant or ultrasonic inspection of welds shall be used where radiography is not possible.

12. CONTROLS AND INSTRUMENTATION

12.1 GENERAL

Add to this clause:

Instrumentation and connections for instruments shall be in accordance with DEP 32.31.09.31-Gen and DEP 32.31.00.32-Gen. as specified on the datasheets.

Controls and instrumentation shall be designed and manufactured for use in the area classification specified by the purchaser and shall comply with local regulations.

All conduit, armoured cable and supports shall be designed and installed so that it can easily be removed without damage and shall be located so that it does not hamper removal of noise hoods, lagging, bearings, seals, or other equipment internals

12.2 TURBINE GOVERNING SYSTEM

12.2.1 Add to this clause:

Governor actuating system shall be a combination of electronic and hydraulic. The turbine vendor shall provide the following speed control components:

- Speed pickups wired to a junction box;
- Hydraulic actuators connected to the turbine governor controlled valve(s);
- Electro-hydraulic relays wired to a junction box;
- Hydraulic positioners, as required.

The electronic governor shall be specified on the datasheets. For steam turbine in unspared essential service, the governor design shall be fault tolerant and have adequate redundancy to permit on-line maintenance for a period of six years.

12.2.3 Add to this clause:

The turbine vendor shall comment on the proposed governor unit and its suitability for providing accurate speed control. The turbine vendor and Shell Principal shall mutually agree on the governor unit to be used.

12.2.6 Add to this clause:

In addition to the two probes to the governor, one spare mounted speed probe shall be provided. This spare probe shall be wired to the junction box along with the other speed probes. If the governor can accept three probes, this spare probe shall be connected to the electronic governor as an additional input.

12.2.15 Add new clause:

For small steam turbines and within the vendor's steam chest experience, a single governor valve may be offered. If significant performance improvement can be obtained with multiport governor valves, it may be offered as an alternative.

12.2.16 Add new clause:

Governor valves and valve stems shall be designed to avoid valve flutter or flow-induced valve vibration over the entire control region. Forces acting on the valves or valve bar due to the steam velocity in the steam chest shall not in anyway prevent or hamper free valve travel. Since the above cannot normally be tested at the test stand, the vendor shall provide references of similar designs at comparable operating conditions in the quotation stage.

12.2.17 Add new clause:

Valve seats shall be mounted in steam chests so that the seats will not dislodge due to thermal transient gradients. Apart from seal welds, no other welding shall be used to fit seats into the steam chest

12.2.18 Add new clause:

Each valve shall be numbered on the valve and on an exposed area of the corresponding bonnet. Valve opening shall reflect the same numbering.

12.3 OVERSPEED SHUTDOWN SYSTEM

12.3.1 General

Add to this clause:

The design requirements in 12.3.1 are applicable to turbines with electronic overspeed trip systems. Turbines with mechanical overspeed trip bolts do not have to comply with all of these paragraphs.

12.3.1.1 Add to this clause:

The turbine vendor is responsible for the design and manufacturing of the overspeed trip system and shall demonstrate the safety and the integrity of the total system by:

- Providing system calculations that demonstrate the overspeed system's speed of response will prevent the rotor from exceeding 127 % of the rated speed on an instantaneous, complete loss of coupled inertia and load while operating at the rated conditions.
- Providing references where the proposed design has been used in the past plus mean time between failure data on each component within the trip system. The vendor shall provide calculated predicted system availability and overt failure frequency (tolerance to nuisance trips). The system design shall have a minimum overt failure frequency of 50 years. If the vendor's standard design cannot achieve this fault tolerance level, an alternative design shall be proposed. Any alternate design shall be approved by the Principal.
- Demonstrating the system design meets the required speed of response during mechanical testing of the turbine.

12.3.1.3 Replace this clause with:

A turbine with an exhaust pressure less than atmospheric pressure shall have an exhaust vacuum breaker actuated by the shutdown system during overspeed trip. The purchaser and vendor shall agree on the design of this system.

The valve shall be provided by the condenser supplier and shall normally be located on the surface condenser.

12.3.3 Electro hydraulic solenoid valves

12.3.3.2 Add to this clause:

Trip solenoid valves shall be low-powered valves and shall be explosion proof. The principal shall approve any deviation.

12.3.3.3 Replace this clause with:

Trip solenoid valves shall be de-energized to shutdown and shall be installed close to the trip valve(s) or trip and throttle valve(s), and have no other device between them and the trip valve(s) or trip and throttle valve(s) except test isolation valves. Unless otherwise specified on the data requisition sheets, two trip solenoid valves, operating in parallel, shall be supplied. Test isolation valves shall be locked in the open position for normal operation.

As a minimum, manual to close spring loaded to open valves can be considered for solenoid testing. When specified on the data requisition sheet and approved by the Principal, maintenance isolation valves shall be provided to allow replacement of individual trip solenoid valves with the turbine in operation.

Note: Dual solenoid valves are required on turbines with fully electronic overspeed trip systems.

12.3.4 Trip valves/combined trip and throttle valves

12.3.4.1 Add to this clause:

As specified on the datasheets, a separate independent trip valve(s) or combined trip and throttle valve(s) shall be provided. Valve(s) selection shall be approved by the Principal.

12.3.4.4 Add to this clause:

k) The packing on trip and throttle valve stems shall be bushing type.

12.3.4.7 Add to this clause:

The turbine vendor shall calculate the response time for the trip system upon loss of load with the machine running at maximum continuous operating speed, and shall confirm that the system will respond fast enough to prevent the rotor speed from exceeding its design capabilities.

12.4 OTHER ALARMS AND SHUTDOWNS

12.4.3 Add to this clause:

Alarms and shutdown shall be as described in this clause with the following modifications:

Alarms:

Add:

- Turning gear not engaged (if applicable).

Shutdowns:

Delete:

- very high bearing temperature

Add:

High radial vibration shutdown may be deleted as specified on the datasheets.

Standard thrust position shutdown is 2002; however, 2003 thrust position shutdown is required if specified on the datasheets.

Note: For condensing turbines, the purchaser shall include very high condensate level in the shutdown system

12.4.4 Add to this clause:

The turbine trip system shall be designed to detect when the trip valve or trip and throttle valve has been manually tripped locally and shall activate the Principal's shutdown system.

12.4.5 Add to this clause:

The turbine vendor shall advise the purchaser of any alarms and/or shutdowns considered essential to safeguard the turbine.

12.4.9 a) Replace this clause with:

If applied, electrical switches for alarms or trips shall open to trip (i.e. fail-safe).

12.5 INSTRUMENT AND CONTROL PANELS

12.5.4 Add new clause:

12.5.4 Unless otherwise specified on the datasheets, local panels for the equipment train or lubrication set are not required. All measurement and control instrumentation shall be routed to the plant's distributed control system (DCS). Local gauge boards may be provided and may be located on the baseplate if approved by the Principal. If approved by the Principal, the local gauge board may be integrated in the local panel.

12.6 INDICATING INSTRUMENTATION

12.6.2 Temperature gauges

12.6.2.1 Modify this clause as follows:

Delete the words "or gas filled". Add sentence "The stem diameter shall be 6 mm (0.24 in)".

12.6.3 Thermowells

Add to this clause:

Thermowells shall be in accordance with Standard Drawing S 38.103.

Add new clause:

12.6.6 Vibration, position, and bearing temperature detectors

If specified on the data requisition sheets, non-contacting vibration and axial position transducers shall be supplied, installed and calibrated in accordance with DEP 32.31.09.31-Gen.

Generally, the following detectors are required.

- a) X-Y probes at each bearing location.
- b) Dual axial position probes.
- c) One key phasor
- d) Radial bearing temperature sensors
- e) Thrust bearing temperature sensors

Vibration and bearing temperature components and installation shall comply with DEP 32.31.09.31-Gen.

The turbine vendor shall supply transducers, extension cables, proximeters, junction boxes and connecting conduit. Connecting conduit segment closest to the transducers shall be flexible. The Purchaser shall provide the monitors.

13 ELECTRICAL SYSTEMS

Add to this clause:

Electrical components and electrical installations shall be in accordance with DEP 33.64.10.10-Gen.

Instrument wiring and power cabling, with the exception of power supply to electric motors, shall be connected to terminal strips installed in junction boxes. Instrument signals and wiring or cabling with different voltages shall be connected to separate terminal boxes.

Junction boxes shall be located on the ends or sides of the turbine mounted to the lower case half. Location of the junction boxes shall not interfere with bearing inspection, coupling removal and/or removal of the upper case half. The location of the junction boxes shall be shown on the layout drawing.

14. PIPING AND APPURTENANCES

14.1 GENERAL

14.1.1 Modify this clause:

Replace API 614 with DEP 31.29.60.32-GEN.

14.1.2 Replace this clause with:

Threaded connections shall not be used, except for instrument connections and cooling water connections. Threaded connections shall not be seal-welded.

14.1.3 Add to this clause:

Pipe flange gaskets shall be in accordance with the specified piping class.

14.1.4 Add new clause:

Auxiliary piping shall be confined to the lower portion of the casing and shall be routed as close as possible to the turbine to minimize interference with normal maintenance access. Flanged connections shall be located as close as possible to the turbine casing.

Steam chest and casing drains shall terminate with blind flanges.

Where possible, the vendor shall manifold auxiliary piping to provide a single connection for each required service, except where such manifolds would interfere with normal operating and maintenance access areas.

Flanged connections shall be provided at the following locations for instrumentation by others:

- a) Steam chest
- b) Steam pressure at first stage
- c) Steam pressures at intermediate stages as specified on the data sheet

14.2 OIL PIPING

Add to this clause:

Lubricating oil supply flanges shall lie in a vertical plane to facilitate installation and checking of screens during lubricating oil system commissioning. Other flanges shall be directed downward. Where possible, the vendor shall manifold auxiliary piping to provide a single connection for each required service, except where such manifolds would interfere with normal operating and maintenance access areas.

Lubricating oil piping connections shall be butt-welded connections. Socketwelded connections are unacceptable.

15. ACCESSORIES

15.1 COUPLINGS AND GUARDS

15.1.2 Add to this clause:

Unless otherwise approved by the Principal, non-lubricated spacer type membrane or disc couplings shall be used.

15.1.3 Add to this clause:

Integral flanged coupling hubs shall be provided unless otherwise approved by the Principal. If an integral flange cannot be supplied, a keyless hydraulically fitted coupling shall be provided. Keyed coupling shall not be used.

15.2 GEAR UNITS

Add to this clause:

Gear units shall comply with DEP 31.29.00.32-Gen.

15.3 MOUNTING PLATES

15.3.1 General

15.3.1.2 Replace this clause with:

Unless otherwise specified, mounting plates shall be supplied with vertical levelling screws for field levelling. A levelling screw shall be provided near each anchor bolt. If the equipment and mounting plates are too heavy to be lifted using levelling screws, alternate methods shall be provided by the equipment vendor. The design of the alternative method shall be included in the proposal.

15.3.1.3 Replace this clause with:

Mounting plates shall be furnished with horizontal (axial and lateral) jackscrews. The lugs holding these jackscrews shall be attached to the mounting plates so that they do not interfere with the installation of the equipment, jackscrews or shims. Means shall be provided for moving the equipment vertically for removal or insertion of shims. Precautions shall be taken to prevent vertical jackscrews (if provided) in the equipment feet from damaging the shimming surfaces. Alternative methods may be proposed for lifting the equipment for the removal or insertion of shims or for moving the equipment horizontally, such as provision for the use of hydraulic jacks. Such arrangements should be proposed for equipment that is too heavy to be lifted or moved horizontally using jackscrews. Alignment jackscrews shall be plated for corrosion resistance.

15.3.1.7 Replace this clause with:

Unless otherwise specified, the equipment vendor shall prepare the mounting plates by commercially abrasive blasting all grout contacting surfaces in accordance with ISO 8501-1 Grade Sa2 (SSPC SP 6) and shall precoat these surfaces with an epoxy primer in preparation for epoxy grout.

15.3.1.8 Replace this clause with:

All machinery mounting surfaces on the mounting plate shall be machined flat and parallel to the axial plane(s) of the machinery mounting feet after fabrication and shall extend at least 25 mm (1 in) beyond the outer three sides of the equipment feet. These mounting surfaces shall meet the following requirements:

- 1) Each mounting surface shall be machined to a finish of 6.3 μm (250 μin) arithmetic average roughness (Ra) or smoother.

- 2) To prevent a soft foot, when the machine is installed on the mounting plate, all mounting surfaces in the same horizontal plane shall be within 25 μm (0.001 in).
- 3) Each mounting surface shall be machined within a flatness of 40 $\mu\text{m}/\text{m}$ (0.0005 in per ft) of mounting surface.
- 4) Different mounting planes shall be parallel to each other within 50 μm (0.002 in).
- 5) Hold-down bolt holes shall be drilled perpendicular to the mounting surfaces, machined or spot faced to a diameter suitable for a fully eccentric washer next to the hole to allow for equipment alignment. The hole shall be at least 12 mm (0.5 in) larger in diameter than the hold down bolt.

15.3.1.9 Replace this clause with:

Unless otherwise specified, the purchaser shall provide anchor bolts. Anchor bolts shall not be used to fasten machinery to the mounting plates

15.3.1.14 Add to this clause:

Alignment shims shall be in accordance with API RP 686 and shall straddle hold down bolts and vertical jackscrews and shall be at least 5 mm (0.2 in) larger on all sides than the equipment feet.

15.3.1.15 Add new clause:

Grouted mounting plates shall be adequately sized to limit the static loading to 0.7 N/mm² (102 psi) on the grout.

15.3.1.16 Add new clause:

The diametrical clearance between anchor bolts and the anchor bolt holes in the mounting plates shall be at least 6 mm (0.24 in).

NOTE: This is required to assist in aligning and setting the baseplate or soleplates over the foundation anchor bolts.

15.3.1.17 Add new clause:

When the machine is properly aligned on the mounting plate in the shop, each hold-down bolt shall have a minimum clearance of 1.5 mm (0.06 in) between the bolt and the bolt hole.

NOTE: This clearance allows the machinery to be moved laterally during final field alignment.

15.3.1.18 Add new clause:

Adequate working clearance shall be provided at the bolt locations to allow the use of standard socket or box wrenches and to allow the equipment to be moved using the horizontal and vertical jackscrews.

15.3.1.19 Add new clause:

Unless otherwise specified, mounting plates shall not be drilled for components to be mounted by others.

15.3.2 Baseplates

15.3.2.1 Add to this clause:

The baseplate shall be constructed with longitudinal steel beams and full support cross members. Cross members shall be located underneath the support plane of the turbine and all turbine-driven equipment.

All baseplate structural welds shall be continuous (i.e. not intermittent stitch welding).

15.3.2.5 Add to this clause:

If the baseplate is intended to be grouted onto a concrete foundation, adequate access shall be provided into each compartment so that all load carrying structural members can be properly grouted. Decking or grating shall be removable for access to internal structural members. Provision shall be made to allow draining of the spaces between structural members.

15.3.2.10 Add new clause:

If specified, non-skid decking or grating covering all walking and working areas shall be provided on the top of the baseplate.

If, after grouting, the purchaser plans to completely fill the baseplate with cement as a finished surface, decking or grating is not required.

15.3.2.11 Add new clause:

If horizontal solid-decked surfaces are provided, they shall be sloped to avoid collection of water.

15.3.2.12 Add new clause:

The bottom of the baseplate shall have machined mounting pads. These pads shall be machined in a single plane after the baseplate is fabricated.

Note: These machined mounting pads allow field levelling when the baseplate is mounted on sub-soleplates or structural steel members.

15.3.3 Soleplates and subplates

Add to this clause:

Soleplates shall be large enough to extend beyond the feet of the equipment in all directions and shall be designed such that machine feet do not cover the anchor bolts. If specified, anchor bolt holes shall be counterbored so that the hold-down nuts do not extend beyond the upper surface of the soleplate.

15.4 RELIEF VALVES

15.4.1 Add to this clause:

Sentinel valves shall not be used.

15.5 LUBRICATION AND CONTROL OIL SYSTEM

15.5.2 Add to this clause:

Unless otherwise specified, a lubricating oil and control oil system common with the driven unit shall be provided. This system shall be supplied by the vendor with unit responsibility.

15.5.4 Modify this clause:

Replace API 614 with DEP 31.29.60.32-Gen.

15.5.6 Add to this clause:

Bearings for external parts that are subject to rotary or sliding motions shall be designed as non-lubrication design.

15.7 INSULATION AND JACKETING

15.7.1 Add to this clause:

Steam turbines shall be insulated with removable blanket type insulation. Insulation and jackets shall be designed to cause no obstruction to operational activities and to be readily removable for maintenance.

The insulation shall not contain asbestos.

15.10 SPARE ROTATING ASSEMBLY

15.10 Add new clause:

A spare rotating assembly shall be provided with each turbine. It shall include:

- complete spare rotor assembly;
- one set of bearings;
- one set of shaft end seals and interstage labyrinths.

16. INSPECTION, TESTING AND PREPARATION FOR SHIPMENT

16.1 GENERAL

16.1.1 Add to this clause:

The Vendor's standard inspection and quality plans shall be reviewed during the coordination meeting.

16.1.7 Replace this clause with:

The purchaser's representative, the vendor's representative, or both shall indicate compliance with this DEP by initiating, dating, and submitting a completed checklist to the purchaser before shipment. For a typical inspector's checklist, see Annex I.

16.1.8 Add new clause:

The scope of the Principal's shop inspection shall be confirmed prior to manufacture. It may include, but need not be limited to, the following:

- a check (against outline drawings which have been approved by the purchaser) of all main dimensions, base plate dimensions, location of foundation bolt holes, size/position/rating of flanges and coupling guard arrangement;
- an inspection of flange face finish;
- a verification that the Vendor has performed the specified inspections and tests with satisfactory results;
- a verification of the required material certificates and (to the extent specified) their traceability to the respective components;
- a visual check for good workmanship and finish of internals;
- verification of taper fits with matched plug and ring set;
- a check of casing wall thickness;
- measurement of the running clearances.

16.1.9 Add new clause:

Correction of manufacturing errors resulting in design changes shall be recorded. Any modifications that may change the turbine's dynamic behaviour shall be submitted for review within one week of occurrence and shall be subject to the approval of the Principal.

16.1.10 Add new clause:

Plating shall not be used to correct manufacturing errors.

16.2 INSPECTION

16.2.2 Materials inspection

16.2.2.1 Replace the text before Table 4 with:

General

Materials inspection shall be as specified in 16.2.2.2.

The purchaser's inspector at the vendor's factory shall witness (prior to, during and after) major repairs of steel castings (including preparation, repair and inspection). Major repairs are defined as follows:

- a) A defect that is 20 % or more of the thickness at the thinnest section of the casting or an area covering 30 cm² (4.7 in²) or more. This also includes any required weld buildup at flanges or any other area to meet the required minimum thickness.
- b) A repair of any leaks found during hydrostatic testing.

Upgrading at the foundry is not considered to be a major repair.

The Vendor shall notify the purchaser at least five working days prior to scheduled (observed or witnessed) tests and inspections.

16.2.2.2 Add new clause:

Extent of NDE

NDE of materials shall be as follows:

COMPONENT	REQUIRED NDE
Turbine casing - cast	RT (or UT in accordance with 16.2.2.); and MT or PT; and VI
Turbine casing - fabricated	UT or RT; and MT or PT; and VI
Turbine fabrication	
-full penetration welds	RT or UT; and MT or PT
-fillet welds	MT or PT
Diaphragms, guide channels	MT or PT; and VI
Labyrinths	VI
Shaft	UT; and MT or PT; and VI
Bearing housing, bearings	VI and MT; or UT
All surfaces prepared for welding	RT or UT and MT or PT
Weld repairs	Hardness test and RT
All metal-to-metal seating surfaces and gasket seating surfaces	MT or PT and VI
NOTE 1: VI = Visual Inspection MT = Magnetic Particle Examination PT = Liquid Penetrant Examination RT = Radiographic Examination UT = Ultrasonic Examination NOTE 2: "Casing" includes all items of the pressure boundary of the finished turbine casing (e.g. the casing itself and other parts such as nozzles, flanges, end head, closure plates, shear rings, etc). NOTE 3: Timing of inspection - VI/MT/PT shall be performed after final heat treatment in the final machined condition - RT/UT of castings shall be performed after final heat treatment but need not be in the rough machined condition provided that the thickness is within 90 % of the final thickness (that is, no more than 10 % further reduction in thickness allowed). In any case the radiographic sensitivity indicator (e.g. penetrometer) shall be selected based on the actual thickness. - RT of welds and UT of fabricated material and welds shall be performed after final heat treatment. UT of wrought material shall be performed prior to any machining operations (e.g. for keyways, drilled holes etc.) which may interfere with the UT examination. NOTE 4: PT examination shall only be used where MT is not feasible (see 4.2.2.5). NOTE 5: Further requirements are specified in 16.2.2.3 through 16.2.2.8.	

16.2.2.3 Add new clause:

Critical sections of each casting shall be fully radiographed; where such sections cannot be radiographed and/or for wall thickness above 50 mm (2.0 in), UT shall be used. The Vendor shall submit details of the critical sections proposed to receive RT/UT, for the Purchaser's approval.

16.2.2.4 Add new clause:

PT of all blades shall be performed before installation on the rotor. MT of shrouds and closing pins shall be performed after installation.

16.2.2.5 Add new clause:

In addition to the vendor's normal quality control practices, the vendor shall assign a qualified quality control person to make a 100 % visual inspection of blades and shrouds prior to assembly, and to inspect and document proper fitting and assembly of blades and shrouds to the rotor.

16.2.2.6 Add new clause:

For tenons 15 mm (0.6 in) and larger, UT and MT shall be performed after peening.

16.2.2.7 Add new clause:

UT of welds shall be performed for weld thickness over 30 mm (1.2 in). Buttwelds shall be examined by RT. Through-wall casting repairs shall be examined by UT.

16.2.2.8 Add new clause:

Visual Inspection (VI)

VI shall be performed in accordance with ASME V, Article 9. All surfaces shall be inspected. Acceptance criteria for pressure-containing steel castings shall be in accordance with ASTM A 802. Acceptance criteria for other parts shall be in accordance with the material specification and the Vendor's documented procedures.

16.2.3.4 Replace this clause with:

Where the data sheets indicate that hardness testing of materials during fabrication is required, a representative 10 % of the production welds, and associated heat affected zones shall be hardness tested. The vendor shall submit his hardness testing procedures for the Principal's review.

16.2.4 Add new clause:

Certification of materials by turbine component

The Vendor shall furnish material inspection certificates in accordance with ISO 10474, of the type as specified in the table below

COMPONENT	ISO 10474 CERTIFICATE TYPE
Pressure containing parts (casing and major steam connections)	3.1.B (see NOTE)
Rotor and buckets	3.1.B (see NOTE)
Internals - Nozzle ring, bolting, -diaphragms-guides blades, valves, valve seats, valve stems	3.1.B
Main bolting and nuts	3.1.B
All other process and auxiliary piping, flanges and connections	3.1.B
NOTE: Positive alloy material identification (PAMI) shall be applied at the time of assembly for pressure containing parts, rotor shafts and disks and blades, which are made of low-alloy steel, high-alloy martensitic steel, ferritic or austenitic stainless steels or nickel alloys. This shall be used to positively identify that the materials have the specified alloy composition. The method and procedures are subject to approval by the Principal.	

16.2.5 Add new clause:

Marking

All pressure casings shall be marked. Parts with a wall thickness in excess of 5 mm (0.2 in), except those items manufactured from austenitic stainless steel or from nickel alloys, may be marked by hard-die stamping on to a painted background at a place clearly visible later.

If used, only low-stress stamps [dot-type or round-nosed with a minimum radius of 0.25 mm (0.01 in)] shall be used for hard-die stamping.

For items manufactured from austenitic stainless steel or nickel alloys, and for items with a wall thickness of 5 mm (0.2 in) or less, the marking may be applied by stencil using a water-insoluble ink.

The stamping/markings shall include:

- material manufacturer's symbol and, where applicable, the independent inspector's symbol; these symbols shall be identical to the symbols on the material certificate
- material identification
- heat, charge or batch number to relate to the material certificate
- heat treatment symbol or code, where applicable
- non-destructive testing symbol or code, where applicable
- size and schedule, where applicable
- hydrostatic test pressure, where applicable.

NOTE: Where the size of the item does not permit complete marking, the above identification marks may be substituted by a unique code which is fully traceable to the material certificate for the item.

16.3 TESTING

16.3.2 Casing pressure hydro test

16.3.2.1 General

16.3.2.2 Casing integrity test

16.3.2.2.1 Add to this clause:

Auxiliary piping shall be hydrostatically tested to at least the same pressure as the portion of the casing to which it is attached.

16.3.3 Mechanical running tests

16.3.3.1 Add to this clause:

In multi-casing turbine trains, all contract power transmission components (couplings, gears, etc.) and all turbine casings shall be tested in the same configuration during the mechanical test run as that intended for field installation.

16.3.3.1.h) Add to this clause:

Instrumentation shall be provided by the vendor to display and record real time frequency spectra for each bearing in both planes and in the axial direction for each shaft. The recording shall be continued during the optional part-load running test.

16.3.3.2 b) Add to this clause:

The mechanical integrity of the turbine rotor(s) shall be tested at 105 % of the design trip speed for 3 min after operating for 15 min at trip speed.

After the overspeed test, the spare rotor shall be magnetic particle examined. The acceptance criterion being zero linear indications. Any shroud lifting or indications shall require the main rotor to be also inspected following testing. If the main rotor vibration signature changed after the trip speed test, the rotor shall be examined by MT.

16.3.3.2 e) Add to this clause:

Real-time vibration data shall be recorded and provided to the purchaser.

16.3.3.2 Add to this clauses:

g) During the 4-h test, the lubricating oil viscosity shall be maintained within the range used during the rotor dynamics analysis.

h) Oil leaks from bearing housings or job coupling guards on mechanical run tests are unacceptable and cause of rejection of the turbine.

16.3.3.3 b) Add to this clause:

Vibration readings and bearing temperatures at the end of the four-hour run shall be essentially the same as those recorded at the beginning of the four hour test.

16.3.3.3 e) Replace this clause with:

Recordings shall be made of all real time vibration data for later retrieval and analysis and provided to the customer.

16.3.4.6 Add to this clause:

During the mechanical test, the vendor shall measure and confirm that the overspeed trip system response time meets the design requirements in 12.3.1.1.

16.4 PREPARATION FOR SHIPMENT

16.4.1 Add to this clause:

Vendor shall submit packaging and preservation procedures for review. Vendor's long term storage package (more than one year) shall be included in the proposal as an alternative. Turbines shall be prepared for outdoor storage for a minimum of one year.

16.4.3 j) Add to this clause:

If specified on the datasheets, the spare rotor shall be crated in a metal container, which is suitable for transportation and storage. Before applying the rust preventative, the spare rotor(s) shall be cleaned thoroughly to remove all fingerprints from polished surfaces. Fingerprint remover shall be used as necessary.

The identification attached to the spare rotor shall include the manufacturer's serial number and the statement: SPARE ROTATING ASSEMBLY FOR TURBINE NO. _____.

16.4.3 k) Add to this clause:

Exposed shaft ends shall be protected against physical damage.

16.4.3 Add to this clause:

l) Where vapour-phase inhibitor (VPI) or silica gel crystals in bags are installed in large cavities, either for inhibiting corrosion or absorbing moisture, respectively, they shall be in an accessible area for easy removal. The bags shall be attached with stainless steel wire and their locations indicated with corrosion-resistant tags also fixed with stainless steel wire.

m) Separately shipped parts and spare parts, after treatment for rust prevention, shall be wrapped in VPI paper and packed individually into sturdy boxes. Identification tags shall be attached to each part as well as to the outside of each box. Spare parts shall be crated separately from parts needed for initial installation.

17.2.3 Add to this clause:

The Vendor's proposal shall be in accordance with this DEP and the datasheets. If the vendor is unable to comply with any requirements of this DEP, the proposal shall clearly state the reasons for non-compliance, any exceptions and clarifications. The vendor may propose an alternative which will meet the technical requirement in a satisfactory and reliable manner, for the approval of the Principal.

17.2.3 d) Add to this clause:

Spare parts shall be priced. The pricing for the spare rotor shall include all specified mechanical testing.

17.2.3 i) Add to this clause:

A description of tests, procedures, functions, etc. and other data required by any section of this DEP or the data sheets shall be provided by the vendor in the proposal, whether or not specifically repeated in this section.

17.2.3 Add to this clause:

q) Thrust bearing design basis (i.e. normal, balance drum failure, design rating, etc.).

17.2.4 Curves

Add to this clause:

Inter-stage and end seal clearances used for calculation of leakages shall be shown. The end seal leak flow shall be included in the steam consumption figures, and the compliance with this requirement shall be clearly stated on the diagrams and data sheets.

In the absence of such a declaration, the Principal will assume that the requirement was met for guarantee purposes, but may add a conservatively estimated leak flow to the stated consumption figures for evaluation purposes.

17.3 CONTRACT DATA

17.3.4 Installation, operation, maintenance and technical manuals

17.3.4.1 General

Add to this clause:

If the order covers more than one turbine, separate documentation (including manuals) shall be provided for each turbine.

17.3.4.2 Installation manual

Add to this clause:

The installation manual shall adequately cover the pre-startup checks and the initial startup procedure and checks.

17.3.4.4 Technical data manual

Add to this clause:

If more than one turbine is being supplied, or in cases where the Principal already operates a turbine made by the vendor at the location where the new turbine is intended, spare parts interchangeability charts shall be provided.

PART III REFERENCES

In this DEP, reference is made to the following publications:

- NOTES: 1. Unless specifically designated by date, the latest edition of each publication shall be used, together with any amendments/supplements/revisions thereto.
2. The DEPs and most referenced external standards are available to Shell users on the SWW (Shell Wide Web) at <http://sww05.europe.shell.com/standards>.

SHELL STANDARDS

Noise control (amendments/supplements to ISO 15664)	DEP 31.10.00.31-Gen.
Requisition sheet for Equipment noise limitation	DEP 31.10.00.94-Gen.
Petroleum and natural gas industries - high-speed special-purpose gear units (amendments/supplements to ISO 13691)	DEP 31.29.00.32-Gen.
Instruments for measurement and control	DEP 32.31.00.32-Gen.
Instrumentation for equipment packages	DEP 32.31.09.31-Gen.
Electrical engineering guidelines	DEP 33.64.10.10-Gen.

STANDARD DRAWINGS

Flanged thermowell, DN 40 (NPS 1 ½), ASME Classes up to 1500 incl.	S 38.103
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AMERICAN STANDARDS

Axial and centrifugal compressors and expander-compressors for petroleum, chemical and gas industry services	API 617 (7 th edition, 2002)
Recommended practices for machinery installation and installation design	API RP 686

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Standard practice for steel castings, surface acceptance standards, visual examination	ASTM A 802
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INTERNATIONAL STANDARDS

Preparation of steel substrates before application of paints and related products - Visual assessment of surface cleanliness - Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings	ISO 8501-1
Petroleum, petrochemical and natural gas industries - Steam turbines - Special-purpose applications	ISO 10437:2003

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