TECHNICAL SPECIFICATION

GENERAL-PURPOSE STEAM TURBINES
(AMENDMENTS/SUPPLEMENTS TO API STANDARD 611)

DEP 31.29.60.30-Gen.

September 1983
(DEP Circular 29/99 has been incorporated)

DESIGN AND ENGINEERING PRACTICE

USED BY

COMPANIES OF THE ROYAL DUTCH/SHELL GROUP

PREFACE

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They are based on the experience acquired during their involvement with the design, construction, operation and maintenance of processing units and facilities, and they are supplemented with the experience of Group Operating companies. Where appropriate they are based on, or reference is made to, national and international standards and codes of practice.

The objective is to set the recommended standard for good design and engineering practice applied by Group companies operating an oil refinery, gas handling installation, chemical plant, oil and gas production facility, or any other such facility, and thereby to achieve maximum technical and economic benefit from standardization.

The information set forth in these publications is provided to users for their consideration and decision to implement. This is of particular importance where DEPs may not cover every requirement or diversity of condition at each locality. The system of DEPs is expected to be sufficiently flexible to allow individual operating companies to adapt the information set forth in DEPs to their own environment and requirements.

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1) Operating companies having a Service Agreement with SIOP, SIEP, SIC or other Service Company. The use of DEPs by these Operating companies is subject in all respects to the terms and conditions of the relevant Service Agreement.

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All administrative queries should be directed to the DEP Administrator in SIOP.

NOTE: In addition to DEP publications there are Standard Specifications and Draft DEPs for Development (DDDs). DDDs generally introduce new procedures or techniques that will probably need updating as further experience develops during their use. The above requirements for distribution and use of DEPs are also applicable to Standard Specifications and DDDs. Standard Specifications and DDDs will gradually be replaced by DEPs.

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PART I. INTRODUCTION

This specification, which is an upgrading and revision of Standard Specification ST-2-2/3 dated April 1960, contains the minimum technical requirements for general-purpose steam turbines for use in oil refineries, chemical plants, gas plants and, where applicable, in exploration, production and new ventures.

This specification gives SIPM/SICM amendments and supplements to API Standard 611, Second Edition, January 1952, `General-Purpose Steam Turbines for Refinery Services'.

It shall be used in conjunction with data/requisition sheet DEP 31.29.61.95-Gen. for general-purpose steam turbines.

As a rule the requirements of this specification shall be adhered to.

However, national and/or local regulations may exist in which some of the requirements are more stringent.

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, economic and legal aspects.

In all cases the contractor shall inform the principal of any deviation from the requirements of this specification 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 specification as closely as possible.

Unless otherwise authorized by SIPM, the distribution of this specification is confined to companies belonging to or managed by the Royal Dutch/Shell Group, and to contractors and manufacturers/suppliers nominated by them.

All publications referred to are listed in Part IV.

PART II. GENERAL INFORMATION

This specification is written in four parts of which Part III, the principal part, gives SIPM/SICM amendments and supplements to API Std 611, Second Edition, January 1982.

Problems stemming from the publication of revisions or amendments to the above standard by the American Petroleum Institute in 1983 or subsequent years shall be referred to the principal.

General-purpose steam turbines shall conform to API Std 611, as amended or supplemented by this specification.

For ease of reference, the clause (or paragraph) numbering of API Std 611 has been used throughout Part III of this specification.

Clauses (paragraphs) in API Std 611 not mentioned remain unaltered. Where cross references are made, the number of the section/sub- section/clause of this specification referred to is shown in brackets.

A bullet (•) in the margin against certain clauses (paragraphs) in API Std 611 indicates that a decision by the principal is required. These decisions shall be indicated directly on data/requisition sheet DEP 31.29.61.95-Gen., when provisions are made for them; otherwise they shall be indicated on the data/requisition sheet(s) under the heading `Additional Requirements' or stated in the purchase order.

DEFINITIONS

For the purpose of this specification, the following definitions shall hold:

Shall and Should - the word `shall' is to be understood as mandatory and the word `should' as strongly recommended to comply with the requirements of this specification.

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, authorized to act for the Principal.

* For Group operating companies having a service agreement with SIPM or SICM, the term Principal shall be taken as referring to SIPM - MFEE/21.

The **Contractor** is the party which carries out all or part of the design, engineering, procurement, construction and commissioning for the project, The Principal may sometimes undertake all or part of the duties of the Contractor.

The **Purchaser** is the party which buys the general-purpose steam turbine for its own use or as agent for the owner. The Purchaser may be either Principal or Contractor.

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

The term **`Vendor'** is considered to be synonymous with the term Manufacturer/Supplier as defined above.

PART III. AMENDMENTS/SUPPLEMENTS TO API STANDARD 611

SECTION 1 GENERAL

1.1 SCOPE

1.1.1 Delete `... for refinery service.' at end of first sentence.

1.1.2.1 Delete second sentence and replace by:

They are generally applied where steam conditions will not exceed 42 bar absolute pressure and 400°C temperature, or where speed will not exceed 6000 revolutions per minute.

1.1.2.2 Delete last sentence and replace by:

Requirements for special-purpose turbines are defined in API Std 612 as amended/supplemented by DEP 31.29.60.31 -Gen.

1.3 CONFLICTING REQUIREMENTS

Delete this clause and replace by:

In the case of conflict between documents relating to the inquiry or order, the following priority of documents shall apply:

- first priority : purchase order and variations thereto
- second priority: data/requisition sheets and drawings
- third priority : this specification.

1.5 REFERENCED PUBLICATIONS

Delete from this clause:

API Std 615: `Sound Control of Mechanical Equipment for Refinery Services'.

NFPA Bulletin No. 70 National Electrical Code, Chapter 5, Articles 500, `Hazardous (Classified) Locations', and 501, `Class I Locations'.

Add to this clause:

All publications referred to in this specification are listed in Part IV.

SECTION 2 BASIC DESIGN

2.1 GENERAL

2.1.1 Add to this clause (incorrectly numbered 2.1.1.2 in API Std 611):

Turbine ratings shall not exceed the limits of the vendors design, but shall be well within the range of the manufacturer's actual experience. Only equipment which has proven its reliability in service is acceptable.

2.1.5 Add to this clause:

Single-stage turbine wheels may be of the overhung design if combined with an integral gear where a gear transmission is required.

2.1.9 Delete first sentence and replace by:

The combined performance of the turbine and its driven equipment after installation, shall be the responsibility of the vendor, which has been nominated as being responsible for the complete unit.

2.1.10 Delete this clause and replace by:

Cooling water systems shall be designed for the conditions specified in the data/requisition sheet; under no circumstances shall they be designed for a working pressure of less than 5 bar ga.

Provision shall be made for complete venting and draining of the system.

2.1.11 Delete this clause and replace by:

Noise control

Turbines shall be designed to minimize the generation of noise and shall not exceed the noise limits given in the supplementary clauses below.

2.1.11.1 ***General***

All definitions, notations, measuring equipment, measuring procedures, test reporting, calculation methods and calculation procedures shall be in accordance with OCMA publication NWG-1.

2.1.11.2 ***Noise limits***

Unless otherwise specified, the following limits shall be met at any measuring location not less than 1 m from the equipment surface:

Sound Pressure Limit in dB re 20 µPa

Turbine	87 dB(A)
Turbine + driven equipment	90 dB(A)

If the equipment produces impulsive and/or narrow band noise, the above limits shall be taken 5 dB(A) lower, thus 82 dB(A) for the turbine and 85 dB(A) for the turbine + driven equipment.

Noise levels shall have an upper tolerance of + 0 dB.

The above requirements apply in absence of reverberation and background noise from other sources, and for all operating conditions between minimum flow and rated flow.

In the event that more stringent limits apply, then these will be indicated on data/requisition sheet DEP 31.10.00.94-Gen. which forms part of the requisition.
In such cases, the equipment shall not exceed the sound power or sound pressure limit stated in the requisition.

2.1.11.3 *Noise abatement*

Where excessive noise from equipment cannot be eliminated by low noise design, corrective measures should preferably take the form of acoustic insulation for pipes, gearboxes, etc. Where noise hoods are proposed, prior approval of the principal shall be obtained regarding construction, materials and safety requirements.

Noise control measures shall cause no hindrance to operations nor any obstruction to routine maintenance activities.

2.1.11.4 *Information to be submitted with the tender*

The manufacturer shall state on data/requisition sheet DEP 31.10.00.94-Gen., as requested, either the sound pressure level not less than 1 m from the equipment surface in octave bands and in dB(A), or the maximum sound power level of the equipment, in octave bands and in dB(A).

The manufacturer shall also indicate what special silencing measures, if any, have been applied in order to obtain these levels.

2.1.12 Delete this clause and replace by:

All electrical components and installations shall be suitable for the area classification and grouping specified in the data/requisition sheet.

2.2 PRESSURE CASINGS

2.2.4 Delete first sentence and replace by:

Axially split horizontal turbines shall be designed to permit inspection and removal of the rotor and wearing parts without removal of the casing from its foundation.

2.2.6 Delete first sentence and replace by:

Casing and supports shall be designed to have sufficient strength and rigidity to limit change of alignment due to pressure, torque or allowable piping forces and moments to 50 µm (0.002 in.) at centre line, i.e. 100 µm (0.004 in.) total indicator reading (TIR).

2.3 CASING APPURTENANCES

2.3.2 Delete this clause and replace by:

A sentinel warning valve is not required.

2.4 CASING CONNECTIONS

2.4.1 Delete this clause and replace by:

Inlet and outlet connections shall be flanged, oriented as specified in the data/requisition sheet, and shall be suitable for maximum inlet and maximum exhaust steam conditions as specified and defined in paragraph 1.4.1 of API Std 611.

2.4.5.3 Delete this clause

2.4.8 Delete first sentence and replace by:

Mounting flanges for vertical turbines shall be of steel, and adequately bolted and ribbed for rigidity.

2.5 EXTERNAL FORCES AND MOMENTS

Add to this clause:

Many factors, such as heavy piping loads, misalignment at operating conditions, and improper supporting structure, may adversely affect site performance. In order to minimize these factors, the manufacturer shall review and comment upon the purchasers piping and foundation drawings for pump and fan turbine drivers.

2.6 ROTATING ELEMENTS

2.6.2 **Shafts**

2.6.2.2 Delete `When specified,' from the beginning of this clause.

2.6.2.3 Add to this clause:

Chrome plating is not acceptable.

2.7 SEALS

2.7.3 Delete this clause and replace by:

A separate vacuum device for mounting and connecting to the glands to reduce external steam leakage shall be furnished by the manufacturer if he considers this necessary to avoid contamination of the bearing oil.

2.7.4 Delete `When specified,' from the beginning of the fourth sentence.

2.8 DYNAMICS

2.8.1 **Critical speed**

2.8.1.5 Delete `When specified,' from beginning of second sentence and replace by `When non-contacting vibration probes are provided,'.

2.8.1.10 Delete `When specified,' from the beginning of this clause.

2.8.1.11 Delete `When specified,' from the beginning of this clause.

2.8.2 **Vibration and balance**

2.8.2.3 Delete the whole of this clause

2.8.2.4 Delete this clause and replace by:

For the assembled machine, with the driver half of the coupling mounted on the shaft or coupled to the driven equipment, operating at maximum continuous speed or at any other speed within the specified operating range, the overall unfiltered peak-to-peak amplitude of vibration, including run-out*, in any plane measured on the shaft adjacent and relative to each radial bearing shall not exceed the following value or 50 μm, whichever is the less:

$$\text{Unfiltered double amplitude including run-out} = 10\sqrt{\frac{75000}{n}}\,\mu m \quad \text{(micrometers)}$$

in which: n = maximum continuous speed in revolutions per minute

At trip speed, the vibration shall not exceed the above value plus 25%.

* See sub-note 9 in API Std 611.

2.8.2.5 Delete this clause and replace by:

When proximity probes are not provided or when vibration cannot be measured on the shaft, the unfiltered root mean square vibration velocity, measured on the bearing housing in any plane by means of an instrument complying with ISO 2954 - 1975(E) while operating at speeds described in (2.8.2.4) of this specification, shall not exceed 3 mm/s.

2.9 BEARINGS AND BEARING HOUSINGS

2.9.1 Add to this clause:

Anti-friction bearings are not acceptable on turbines rated above 75 kW.

2.9.2 Delete second sentence and replace by:

Multi-stage turbines shall have hydrodynamic thrust bearings.

2.9.3 Delete this clause and replace by:

Vertical turbines may have oil-lubricated ball- or roller-type radial and thrust bearings.

Driven equipment shall be provided with its own thrust bearing.

2.9.8 Delete third sentence and replace by:

The thrust collar, if replaceable, shall be positively locked to the shaft to prevent fretting.

2.9.9.1 Convert this clause to SI units:

For gear-type couplings, the external force F, in meganewtons shall be calculated from the following formula, in which kW and r/min are rated power and speed, and D is the shaft diameter at the coupling in millimetres:

$$F = \frac{0.25 \times 9.545 \times kW}{r/min \times D}$$

2.9.15 Add to this clause:

Design requirements of the bearing housing and of the oil mist lubrication system shall be in accordance with DEP 31.29.00.30-Gen.

2.9.17 Delete this clause and replace by:

When the data/requisition sheet specifies that vibration probes shall be provided, two radial vibration probes shall be mounted in each bearing housing and two axial position probes shall be mounted at the thrust end of each machine.

Probes and probe location shall be as specified in API Std 670.

2.10 LUBRICATION

2.10.2 Delete this clause and replace by:

Where oil is supplied from a common system to two or more machines (such as compressor and turbine), the oil shall be suitable for all equipment served by the common system.

2.10.3 Delete this clause and replace by:

Where a wide variable-speed range is anticipated (such as encountered with continuous slow roll operation) this will be specified, and lubrication of turbine and accessories shall be given special consideration.

2.10.4 Delete this clause and replace by:

Turbines with pressure oil systems (other than self-contained governors) shall have the following items included in the oil system (see Appendix B of API Std 611 for typical oil system schematic):

1. A main oil pump driven by the shaft or by the low-speed shaft of a unit with an integral gear, unless another source of oil is provided.
2. Oil rings for start-up lubrication.
3. An automatically controlled stand-by pump, separately driven, for equipment requiring rapid starting or operation at idling speeds.
4. Flanged sight flow indicators in each bearing oil drain line.
5. A shell-and-tube-type oil cooler with fixed tube sheets. Internal oil coolers are not acceptable.
6. A cartridge filter with a steel pressure casing and with maximum clean pressure drop of 0.3 bar to filter particles exceeding 25 µm size.
7. Thermometers (with separate sockets) before and after the oil cooler, and on each bearing to indicate bearing temperature.
8. A valved connection for a pressure gauge for each pressure level, and valved

connections to measure pressure before and after the filter device, all in accordance with DEP 32.31.09.31-Gen.

9. Low-oil pressure shutdown device as approved by the principal.

10 Valved connections for low-pressure alarm switch and shutdown switch in accordance with DEP 32.31.09.31-Gen.

11 Oil reservoir with characteristics as described in paragraph 2.10.4, item 11, in API Std 611.

2.10.5 Delete this clause and replace by:

Main and stand-by oil pumps shall have steel cases. All other oil-containing pressure components shall be steel.

2.10.6 Delete `When specified,' from the beginning of this clause and replace by `When required because of ambient site conditions,'.

2.11 TURBINE DRIVERS FOR LUBE OR SEAL OIL PUMPS

Delete the whole of this paragraph

2.12 MATERIALS

2.12.1 General

2.12.1.1 Delete this clause and replace by:

Materials of construction shall be as specified in the data/requisition sheet, The manufacturer may suggest other materials if, based on his experience, these would render equal or better service.

See paragraph 3.5.1 in API Std 611 for auxiliary piping material requirements.

2.12.1.3 Delete this clause and replace by:

The manufacturer shall specify ASTM optional tests and inspection procedures necessary to ensure that materials are satisfactory for the service and are in compliance with this specification. Such tests and inspections shall be listed in the proposal.

2.12.3 Castings

2.12.3.3 Delete this clause and replace by:

The repair of leaks and defects in pressure-containing castings by peening or burning-in, or by impregnation with plastics or cement compounds is prohibited.

Repair by welding or by plugging shall be undertaken only when permitted by the material specification, and then only in accordance with the procedures below.

Repair by welding

Weldable grades of steel castings may be repaired by welding subject to the following criteria:

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

   * Refer to definition included after item 6.

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

3. For steel castings, the repair welding procedure and the repair welder's qualifications shall both be in accordance with ASTM A 488. For aluminium or aluminium alloy castings see `Recommended practice for the welding of aluminium and aluminium alloy castings', available from SIPM. Repair procedures are subject to approval by the principal.

4. The total quantity of weld metal deposited shall be less than 10% of the mass of the casting.

5. After weld repair, castings shall be suitably heat-treated if this is specified in the relevant material specification. A major* weld repair shall always be followed by a suitable heat treatment.

6. Details of all major weld repairs, and of the heat treatment where applicable, shall be recorded and reported to the principal.

* The definition of a major weld repair is to be taken as either a removal of more than 50% of the wall thickness, or a length of more than 150 mm in one or more directions, or a total surface area of all repairs exceeding 20% of the total casting surface area.

Repair by plugging

Cast gray iron or modular iron may be repaired by plugging within the limits specified in ASTM A 278, ASTM A 536 or ASTM A 395, respectively. The drilled holes for plugs shall be carefully examined by dye penetrant to ensure removal of all defective material. All necessary repairs not covered by ASTM shall be subject to approval by the principal.

Details of all repairs shall be recorded and reported to the principal, who shall be informed of the need for plugging before any repair is carried out.

2.12.4 Welding

2.12.4.1 Add to this clause:

Tungsten inert gas (TIG) welding shall be applied for all welds in the fabrication of stainless steel piping.

2.12.5 Low temperature

Delete this clause

2.13 NAMEPLATES AND ROTATION ARROWS

2.13.2 Delete second sentence and replace by:

The text on nameplates shall be in the English language and the data shall be in SI units, unless otherwise specified.

The information on nameplates shall include the year of manufacture.

SECTION 3 ACCESSORIES

3.1 GEAR UNITS

3.1.1 Delete this clause and replace by:

Integral (built-in) gear units may be considered for applications where their inclusion will improve the efficiency of the turbine drive.

3.1.2 Delete this clause

3.1.3 Delete this clause

3.1.4 Delete this clause and replace by:

Gears shall be at least equal to AGMA 420.04 for shaft speeds less than 3600 revolutions per minute. For shaft speeds of 3600 revolutions per minute or higher, gears shall comply with AGMA 421.06 and API Std 613.

3.1.6 Delete this clause

3.1.8 Delete this clause

3.2 COUPLINGS AND GUARDS

3.2.1 Delete this clause and replace by:

Flexible couplings and guards between drivers and driven equipment shall be supplied by the manufacturer of the driven equipment, who shall supply the driver coupling hub and idling adaptor (as required under (4.2.3.1), item 4, of this specification) to the turbine manufacturer for mounting on the turbine shaft before the mechanical test run.

3.2.7 Delete last sentence and replace by:

Where tapered shafts are provided, the taper shall conform to NEMA SM 23.

3.3 MOUNTING PLATES

3.3.1 Delete this clause and replace by:

The equipment shall be furnished with a baseplate.

3.3.2 Delete this clause and replace by:

In 3.3.2.1 through 3.3.2.9 of API Std 611, the term `mounting plate' refers to baseplate.

3.3.2.2 Delete `When specified,' from this clause.

3.3.2.7 Delete this clause and replace by:

The manufacturer shall supply all necessary foundation bolts when this is specified on the data/requisition sheet.

3.3.2.8 Delete this clause and replace by:

The fasteners for attaching components to baseplates shall be supplied by the manufacturer.

3.3.3 **Baseplates**

3.3.3.1 Delete first sentence from this clause

3.3.3.2 Add to this clause:

When lifting the baseplate complete with all equipment mounted, beam defection shall not exceed l/1200, where `l' is the total length of the beam in millimetres.

3.3.3.5 Delete this clause and replace by:

Decking covering all walk and work areas shall be provided on the top of the baseplate.

3.4 CONTROLS AND INSTRUMENTATION

3.4.1 **General**

3.4.1.1 Delete this clause and replace by:

Amended per Circular 29/99

Instrumentation and connections for instruments shall be in accordance with DEP 32.31.09.31-Gen. and DEP 32.31.00.32-Gen.

3.4.1.3 Delete this clause, see (2.9.17) of this specification.

3.4.1.4 Delete `When specified,', from this clause.

3.4.2 **Control systems**

3.4.2.1 Delete `... unless otherwise specified.' from first sentence.

3.4.3 **Gage board**

Delete this clause

3.4.4 **Instrumentation**

Delete the whole of this paragraph, see (3.4.1.1) of this specification.

3.4.5 **Alarms and shutdowns**

Delete the whole of this paragraph, see (3.4.1.1) of this specification.

3.5 PIPING AND APPURTENANCES

3.5.1 **General**

3.5.1.3 Delete as specified on the data sheet from first sentence.

3.5.1.8 Delete this clause and replace by:

Spiral-wound metal, asbestos-filled, or metal-jacketed flange gaskets shall be used.

3.5.2 **Oil piping**

3.5.2.3 Delete this clause and replace by:

All supply piping including fittings and tubing downstream of the filters shall be of stainless steel.

3.6 INSULATION AND JACKETING

3.6.1 Delete `When specified,' from first sentence,

Add to this clause:

Insulation shall not contain asbestos.

SECTION 4 INSPECTION AND TESTING

4.1 INSPECTION

4.1.1 **General**

4.1.1.2 Delete this clause and replace by:

The requirements for the certification of materials test data are set out in the following supplementary clauses and shall be adhered to.

4.1.1.2.1 The different types of certificate which shall be used by the manufacturer for verifying that the requirements of the specification and contract are met are distinguished below.

Type A

Certificates by which the manufacturer confirms that the product supplied corresponds to what was specified, on the basis of test results taken from the in production testing of products of the same material and same manufacturing method as the delivery concerned.

Type B

Certificates by which the manufacturer's inspector confirms that the product supplied corresponds to what was specified, on the basis of tests carried out on the delivery itself or on standards-specified test specimens related to the delivery.

The necessary testing shall have been carried out by a testing centre which is independent of production in the manufacturing works and which has the necessary facilities at its disposal, When the independence of the testing centre cannot be established, a Type C certificate shall be submitted.

Type C

Certificates as described under Type B with the additional requirement that the tests shall be witnessed by an independent inspector who shall be approved by the principal. Certificates shall be valid only when stamped and signed by this independent inspector.

4.1.1.2.2 All certificates shall contain the following information:

- name of manufacturer
- purchase order number and date
- manufacturer's order number
- identification number of certificate and its date of issue
- material specification(s)
- dimensions in SI units, unless otherwise specified or applicable
- material charge number, batch number or heat-lot number
- chemical composition recorded from results of chemical analyses
- mechanical properties recorded from test results
- NDT methods and results, where applicable
- heat treatment procedures, furnace charge number and heat treatment records, where applicable
- such supplementary or additional information as may be required.

Additionally, all Type C certificates shall state:

- name of independent inspector who has witnessed the test(s)
- this independent inspector's identification symbol.

  Unless otherwise specified, the material concerned shall be stamped with an identical symbol using low-stress dies.

4.1.1.2.3 As a minimum, material certificates in accordance with Type A are required for carbon steel pressure-containing parts with a design temperature below 400°C, and for rotors, blades and nozzle rings.

Material certificates in accordance with Type B or Type C are required only if specified.

4.1.1.5 Delete this clause and replace by:

When radiographic, magnetic particle, dye-penetrant or ultrasonic inspection is specified or required:

- radiographic inspection procedure shall be in accordance with ASTM E 94
- magnetic particle inspection method shall be in accordance with ASTM E 709
- dye-penetrant inspection method shall be in accordance with ASTM E 165
- ultrasonic inspection shall be in accordance with ASTM A 609.

4.1.16 Insert new clause:

Marking

Marking is required for component parts certified under material certificates Type B and Type C, see (4.1.1.2.3) of this specification.

Parts with a wall thickness in excess of 5 mm, except those items manufactured from austenitic stainless steel or from nickel alloys, shall be legibly marked by hard-die stamping on to a painted background, and at a point clearly visible later. Pipes should be marked at a point approximately 250 mm from one end.

Only low-stress stamps shall be used for hard-die stamping, and the stamps shall be round-nosed with a minimum radius of 0.25 mm.

For items manufactured from austenitic stainless steel or from nickel alloys, and for items with a wall thickness of 5 mm or less, the marking shall be applied by stencil using a water insoluble ink which contains no injurious substances such as metallic pigments, sulphur, sulphides or chlorides which could attack or harmfully affect the material.

The stamping/marking shall include:

- manufacturer's symbol; the stamp shall be identical to symbol on certificate*
- material and product identification
- charge or batch number
- heat treatment chart or furnace charge reference number, where applicable
- heat treatment symbol or code, where applicable
- NDT symbol or code, where applicable
- size and schedule
- hydrostatic test pressure in bar, where applicable.

* where applicable the third-party agency identification stamp or mark shall be identical to the stamp/mark on the certificate.

NOTE: Where the size of the fitting does not permit complete marking, the identification marks may be omitted in the reverse order presented above, or another form of identification may be used with the prior agreement of the principal.

4.1.2 **Castings**

4.1.2.1 Delete this clause and replace by:

Casting surfaces shall be examined visually after final machining by the manufacturer and shall be free of adhering sand, scale, cracks and hot tears. Other surface discontinuities shall meet the visual acceptance standards specified in MSS SP-55.

Following visual inspection, and if specified, magnetic particle inspection shall be carried out on all surfaces including machined gasket sealing surfaces. Acceptability of defects shall be based on a comparison with the reference photographs given in ASTM E 125. For each

type of defect, the degree of severity shall not exceed the limits in the following table:

Type	Degree
I	1
II	2
III	2
IV	1
V	1
VI	1

Dye-penetrant inspection shall be used only when magnetic particle inspection is not feasible. Acceptability of defects shall be based on a comparison with the reference photographs given in ASTM E 125. For each type of defect, the degree of severity shall not exceed the limits given in the table above.

4.1.2.2 Delete this clause and replace by:

Full non-destructive inspection shall be carried out, when specified, on all critical areas, such as abrupt changes in section, weld ends, at the junction of risers, gates or feeders to the casting, and areas of high stress,

Prior to inspection, the purchaser and the manufacturer shall agree the critical areas and the type of non-destructive testing which shall be applied. Radiographic inspection shall be applied wherever possible.

The interpretation of radiographs shall be in accordance with ASTM E 186, ASTM E 280 or ASTM E 446, whichever is applicable. For each type of defect, the degree of severity shall not exceed the limits in the following table:

Thickness mm	Gas and blow holes	Sand spots and inclusions	Internal shrinkage	Cracks and hot tears
			Types 1, 2, 3 and 4	
Below 25	2	2	2	Not allowed
25 - 50	3	3	2	
51 - 114	3	3	2	
Over 114	3	3	2	

Ultrasonic inspection shall be carried out where radiography is not possible. The following levels of acceptance shall apply:

Thickness mm	Acceptance level
Below 25	2
50 - 100	3
Over 100	4

4.2 TESTING

4.2.2 **Hydrostatic testing**

4.2.2.3 Delete `... 15 minutes, unless otherwise specified.' at end of second sentence and substitute `... 30 minutes.'.

4.2.3 **Mechanical running test**

4.2.3.1 Delete `... 1-hour...' from the text and substitute `... 4-hour...'

Add new item to this clause:

4. The test shall be carried out with the half coupling and idling adaptor in place (resulting in a moment equivalent to that of the contract half coupling plus one half of the coupling spacer).

4.3 PREPARATION FOR SHIPMENT

4.3.1 Add to this clause:

Preparation for shipment shall be in accordance with the requirements of the inquiry and of the purchase order(s) and the variations thereto.

SECTION 6 VENDOR'S DATA

6.1 PROPOSALS

Delete item 1. and replace by:

1. Copies of the relevant data/requisition sheet(s) completed to the furthest extent possible.

6.2 CONTRACT DATA

6.2.1 **Drawings**

6.2.1.1 Delete this clause and replace by:

The number of copies of drawings required and the time within which these have to be submitted, shall be specified in the purchase order.

The information shall include the documents for controls and instrumentation as specified in DEP 32.31.09.31-Gen.

PART IV. REFERENCES

In this specification, reference is made to the following publications.

NOTE: The latest issue of each publication shall be used together with any amendments/supplements/revisions to such publications.

It is particularly important that the effect of revisions to international, national or other standards shall be considered when they are used in conjunction with DEPs, unless the standard referred to has been prescribed by date.

Amended per Circular 29/99

Data/requisition sheet for equipment noise limitation	DEP 31.10.00.94-Gen.
Oil mist lubrication systems	DEP 31.29.00.30-Gen.
Special-purpose steam turbines	DEP 31.29.60.31-Gen.
Data/requisition sheet for general-purpose steam turbines	DEP 31.29.61.95-Gen.
Instruments for measurement and control	DEP 32.31.00.32-Gen.
Instrumentation for equipment packages	DEP 32.31.09.31-Gen.

AMERICAN STANDARDS

General-Purpose Steam Turbines for Refinery Services	API Std 611 Second Edition, January 1982
Special-Purpose Steam Turbines for Refinery Services	API Std 612 Second Edition, June 1979
Special-Purpose Gear Units for Refinery Services	API Std 613 Second Edition, 1977
Noncontacting Vibration and Axial Position Monitoring Systems	API Std 670 First Edition, 1976

Issued by
American Petroleum Institute,
Publications and Distribution Section,
2101 L Street, North West,
Washington, DC 20037, USA

Gray Iron Castings for Pressure Containing Parts for Temperatures up to 650 °F (345 °C)	ASTM A 278
Ferritic Ductile Iron Pressure Retaining Castings for Use at Elevated Temperatures	ASTM A 395
Qualification of Procedures and Personnel for the Welding of Steel Castings	ASTM A 488
Ductile Iron Castings	ASTM A 536
Ultrasonic Examination of Carbon and Low-Alloy Steel Castings	ASTM A 609
Radiographic Testing	ASTM E 94

Magnetic Particle Indications on Ferrous Castings	ASTM E 125
Liquid Penetrant Inspection	ASTM E 165
Heavy-Walled (51 to 114 mm) Steel Castings	ASTM E 186
Heavy-Walled (114 to 305 mm) Steel Castings	ASTM E 280
Steel Castings up to 51 mm in Thickness	ASTM E 446
Magnetic Particle Examination	ASTM E 709

Issued by
American Society for Testing
and Materials,
1916 Race St., Philadelphia,
Pa. 19103, USA

Quality Standard for Steel Castings Visual Method	MSS SP-55

Issued by
Manufacturers Standardization Society,
5203 Leesburg Pike, Suite 502,
Falls Church, Virginia 22041, USA

Steam Turbines for Mechanical Drive Service	NEMA SM 23

Issued by
National Electrical Manufacturers Association,
2101 L Street, NW,
Washington, DC 20037, USA

Practice for Enclosed Speed Reducers or Increasers using Spur, Helical, Herringbone and Spiral Bevel Gears	AGMA 420.04
Practice for High Speed Helical and Herringbone Gear Units	AGMA 421.06

Issued by
American Gear Manufacturers Association,
1901 North Fort Myer Drive, Suite 1000,
Arlington, Virginia 22209, USA

OIL COMPANIES MATERIALS ASSOCIATION

Noise Procedure Specification	OCMA publication NWG-1 Revision 2

Issued by
Heyden & Son Ltd.,
Hillview Gardens, London NW4 2JQ,
England

INTERNATIONAL STANDARD

Requirements for instruments for measuring vibration severity	ISO 2954-1975(E)

Issued by
Central Secretariat of ISO,
1, rue de Varembe,
1211 Geneva 20, Switzerland

Copies can be obtained through the national standards organizations