


CENTRIFUGAL PUMPS

DATE	STATUS	SPNSR	APVD
16JUN20	Reaffirmed	MRV	PFD

1. GENERAL

1.1 Scope

- a. This Standard Specification covers the design of American Petroleum Institute (API) Standard 610, Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries, single stage overhung, between bearing, multi-stage, and high speed integral gear pumps, and hydraulic power recovery turbines.
- b. Exceptions or variations shown in the UOP Project Specifications take precedence over requirements shown herein.

1.2 References

Unless noted below, use the edition and addenda of each referenced document current on the date of this Standard Specification. When a referenced document incorporates another document, use the edition of that document required by the referenced document.

- a. American Petroleum Institute (API) Standard 610, "Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries"
- b. API Standard 613, "Special Purpose Gear Units for Petroleum, Chemical and Gas Industry Services"
- c. API Standard 677, "General Purpose Gear Units for Petroleum, Chemical and Gas Industry Services"
- d. American Society for Testing and Materials (ASTM), A 193, A 194, A 216, A 494, B 865
- e. American Society of Mechanical Engineers (ASME) B16.5, "Pipe Flanges and Flanged Fittings, NPS ½ through NPS 24 Metric/Inch Standard"
- f. ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, Pressure Vessels
- g. ASME B46.1, "Surface Texture (Surface Roughness, Waviness, and Lay)"
- h. Standards of the Tubular Exchanger Manufacturers Association (TEMA)
- i. National, state, and local governmental regulations and laws

2. DESIGN



This standard is intended to be used as an addendum to API Standard 610. Numbering in this section coincides with actual paragraph numbers from API Standard 610. 11th Edition.



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6.1 General**Paragraph 6.1.1, Addition/Clarification**

Centrifugal pumps shall comply with the requirements of API 610, except where modified by the UOP Project Specification(s).

Vendor's offering shall be a size and design which has a successful record of proven field service at operating conditions similar to those specified (proto-types are not acceptable). An installation list shall be submitted upon request.

Paragraph 6.1.3, Addition

Single and two-stage pumps operating at temperatures less than 300°F (150°C) and multi-stage pumps operating at temperatures less than 200°F (93°C) shall be suitable for instantaneous startup from ambient to full operating temperature.

For higher operating temperatures the vendor shall provide as part of the operating manual a suitable startup procedure and any required monitoring equipment (i.e., skin thermocouples) to assure that the pump, including seal(s), does not incur damage due to rapid heat up.

Paragraph 6.1.8, Addition

UOP requires an NPSH margin of 2 feet (0.6 meters) or 15% of the NPSH required, whichever is greater. This margin is included in the system calculations. It is not included in the NPSH available reported in the data sheets. The pump NPSH required must be less than or equal to the NPSH available reported in the data sheets.

Inducers are not permitted, except for API 610 pump type OH6.

Paragraph 6.1.9, Addition

The suction specific speed shall not exceed 11,000 (USGPM, ft.), 13000 (M3/hr, meters).

The suction specific speed of pumps over 100 HP (75 kW) per stage in water, or aqueous solution over 50% water, services shall not exceed 9500 (USGPM, ft.), 11000 (M3/hr, meters).

Suction specific speeds of up to 24000 (USGPM, ft) are acceptable for high speed integrally gear driven type pumps (Pump type OH6)

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Paragraph 6.1.11, Addition

Pumps shall have stable head/capacity curves which continuously rise to minimum continuous flow.

Paragraph 6.1.28, Clarification

Pumps shall be designed to operate in a totally unprotected, outdoor environment.

Paragraph 6.1.35, New

Pumps shall be designed for continuous operation at a minimum of 50°F (28°C) higher than specified maximum operating temperature.

6.3 Paragraph 6.1.36, New**Paragraph 6.3.1, Addition**

Contractor to verify that downstream equipment, piping, and instrumentation design pressures are adequate for the actual shutoff pressure of purchased pumps.

The design pressure of downstream equipment was established by UOP based on *estimated* pump shutoff pressure. Pump shutoff pressure was estimated as follows:

- a. Fixed speed motor driven pumps

$$\text{Est. Shutoff Pressure} = P_{\text{max. suction}} + 1.25*(\Delta P_{\text{rated}}).$$

- b. Steam turbine driven pumps

$$\text{Est. Pump Shutoff Pressure} = P_{\text{max. suction}} + 1.38*(\Delta P_{\text{rated}})$$

NOTE: The rated pump differential is based on pumped fluid maximum specific gravity.

6.4 Nozzles and Pressure casing Connections**Paragraph 6.4.2.3, Addition**

Flange classes are specified in accordance with ASME B16.5. Flange classes listed in the UOP Project Specifications are based upon design pressure and temperature conditions only, and do not account for other loads. The final design of all flanges shall account for gasket seating and external loads. Differential thermal expansion of dissimilar joints and transient thermal conditions such as start-up/shutdown and operational upset shall be accommodated.

Flanges intended for use with spiral wound gaskets shall have a flange surface finish of 125 microinch Ra minimum to 250 microinch Ra maximum. Flanges intended for

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use with other gaskets shall have a flange surface finish within the optimal range for the specified gasket. Finishes shall be judged by visual comparison with surface finish roughness standards conforming to ASME B46.1. Flange finishes shall be protected from damage during fabrication, heat treatment, shipping, storage, and installation.

6.7 Wear Rings and Running Clearances**Paragraph 6.7.4, Addition**

When non-metallic wear ring materials are specified, the pump vendor shall state in his proposal the minimum diametral clearances when the values are less than API Standard 610 Table 5.

6.8 Mechanical Shaft Seals**Paragraph 6.8.4, New**

A dial type thermometer shall be provided when a seal flush cooler is provided.

Vent and drain connections from the mechanical seals shall be piped to a safe area.

Pumps in water service shall be designed so that the water temperature at the seal face does not exceed 180°F (82°C).

A non-sparking fixed throttle bushing shall be provided for Category 1 Arrangement 1 seals.

A non-sparking fixed throttle bushing shall be provided for Category 2 Arrangement 1 and Arrangement 2 seals (when seal chamber dimensions permit).

6.10 Bearings and Bearing Housings**Paragraph 6.10.2.6, Addition**

Pumps with bearing housings lubricated by open or closed loop, pure oil mist shall use Inpro Type OM-32 bearing isolators or equal, as a minimum.

Paragraph 6.10.2.11, Clarification

Pumps with anti-friction bearings shall have a flat surface at least 1" (25 mm) in diameter for the location of magnetic based vibration measuring equipment.



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7.2 Couplings and Guards**Paragraph 7.2.2.a, Addition**

Disc coupling flexible discs shall be a 300 series stainless steel, except for applications in a wet atmosphere in the presence of chlorides, where a material resistant to chloride stress corrosion cracking shall be used.

7.5 Piping and Appurtenances**Paragraph 7.5.2.6, Addition**

Fluid passages within the pump shall be arranged for complete drainage where practical.

The vendor shall provide 3/4" minimum drain piping with a line size gate valve for each drain.

Drain valves shall be located as close to the pump as practical and still be accessible.

Paragraph 7.5.2.8, Addition

Balancing lines for multi-stage pumps shall utilize flanged joints; screwed unions are not acceptable.

Pumps equipped with a tilting shoe thrust bearing shall have a forced feed lubrication system.

7.7 Gears (NEW)

Gears shall comply with API Standard 677 for spared pumping services unless otherwise specified.



Gears shall comply with API Standard 613 for unspared pumping services.

Gears for high speed integrally geared type pumps (OH6) may be produced to manufacturer's standard.

7.8 Oil Coolers (NEW)

Tubes for fresh water service shall be inhibited admiralty.

If ammonia or hot sulfides are present, 70-30 Cu-Ni or titanium only tubes shall be used.

For sea water or brackish water services the tubes shall be aluminum-brass, 90-10 Cu-Ni, 70-30 Cu-Ni, or titanium.

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When a steel channel without non-ferrous cladding or weld overlay is used in sea or brackish water service, the surface of the steel channel shall be faced and coated as follows:

- (1) A weld deposited machined facing of aluminum bronze, Monel, or Cu-Ni shall be applied to the contact edges of the partition plates at the tubesheet sides and the face of the channel flange which is adjacent to the tubesheet. These weld deposits shall extend at least 1 inch (25 mm) back from the tubesheet contact surface.
- (2) Install sacrificial zinc anodes in the channel of exchangers in water service. Anodes shall be of sufficient size for four years of continuous operation.
- (3) All steel surfaces, including nozzles and supports and excluding the zinc anodes, shall be painted with a primer coating.
- (4) ¼" OD tubes are acceptable for lube oil coolers for high speed integrally geared type pumps.

8.3 Testing**Paragraph 8.3.4.3.1, Decision**

NPSH Required Test is required when the NPSHA does not exceed the predicted NPSHR at rated flow by 2 feet (0.60 meters)

9.1 Single-Stage Overhung Pumps**Paragraph 9.1.1.3, Decision / Addition**

The shaft flexibility index shall be calculated in accordance with Annex K.1 and reported in pump vendor's proposal.
The value of the overhung pump shaft flexibility, I_{SF} , for the given pump size factor, K_t shall not exceed 1.2 times the equation K.4 (SI units) or K.5 (US units).

ANNEX H**Table H.4 note a, Exception**

All piping between the casing and the drain valve shall be Schedule 160.