

MECHATRIC | ENGINEERING TRAINING

Engineering Specification of API Couplings

API 671 (1998) • API 610 / ISO 13709 (2010)

Scope, selection, sizing, dynamic behavior, procurement and verification

A specification-driven approach

Define the coupling duty and service envelope; identify mandatory and purchaser-specified requirements; produce a reviewable RFQ and compliance matrix.

SPECIFY → CALCULATE → VALIDATE → DOCUMENT

Documents supplied for this training

API 671: Third Edition, October 1998; API 610: Eleventh Edition, September 2010 (ISO 13709:2009). The two API 671 uploads appear to be the same 1998 edition. Check contract-required editions before procurement.

SPECIFY → CALCULATE → VALIDATE → DOCUMENT

Different roles in the rotating-equipment train

API 610 §7.2 defines pump-train coupling and guard requirements. API 671 specifies special-purpose coupling design, dynamics, balancing, inspection, testing and vendor data. A pump compliant with API 610 does not automatically require full API 671 compliance.

SPECIFY → CALCULATE → VALIDATE → DOCUMENT

Determine applicability contractually

API 610 §7.2.4 makes ISO 14691 / ISO 10441 / API 671 a purchaser-specified option; §7.2.2(f) invokes API 671 / ISO 10441 balancing provisions above 3,800 r/min. Specify the exact edition, deviations and acceptance evidence.

SPECIFY → CALCULATE → VALIDATE → DOCUMENT

Identify the mechanical principle

Gear coupling • Metallic flexible-element coupling (disc / diaphragm designs) • Quill-shaft coupling • Torsional-damping/resilient design where specifically required. Selection begins with system behavior, not brand preference.

SPECIFY → CALCULATE → VALIDATE → DOCUMENT

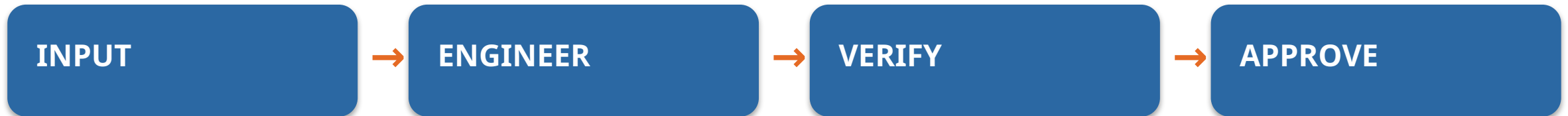
From duty definition to technical approval

1 Duty and shaft data → 2 Rated/peak torque → 3 speed and dynamics → 4 misalignment and axial travel → 5 hub/DBSE → 6 balance and safety → 7 inspection/test → 8 compliance sign-off.

SPECIFY → CALCULATE → VALIDATE → DOCUMENT

Define the machinery train completely

Driver and driven machine type; rated/normal/maximum power; normal, minimum and maximum continuous speed; overspeed/trip; torque events; rotation; installation; environment; operating cycles.



Continuous torque from power and speed

$T \text{ [N}\cdot\text{m]} = 9550 \times P \text{ [kW]} / n \text{ [rpm]}$. Use the applicable operating point; do not treat motor nameplate power as the only process torque basis. Evaluate maximum power at relevant speed.

SPECIFY → CALCULATE → VALIDATE → DOCUMENT

Illustrative 1,500 kW / 3,000 rpm train

Base torque = 4,775 N·m. At a selection factor of 1.5, screening torque = 7,163 N·m. At 1.75, screening torque = 8,356 N·m. These are sizing examples, not catalog ratings or substitutes for transient checks.

SPECIFY → CALCULATE → VALIDATE → DOCUMENT

1998 edition defaults, unless otherwise specified

Gear coupling: 1.75; elastomeric coupling: 1.75; flexible-element coupling: 1.5; quill-shaft coupling: 1.5. Apply to the duty defined in the standard; documented exceptions require agreement.

SPECIFY → CALCULATE → VALIDATE → DOCUMENT

Do not overlook the connection

API 671 §2.1.1.5 uses a 1.75 steady-state torque factor for the shaft juncture unless otherwise specified. Verify keys, interference fit, shaft stress and any hydraulic/keyless connection separately from coupling element rating.

SPECIFY → CALCULATE → VALIDATE → DOCUMENT

A separate limit-state verification

Purchaser defines transient magnitude, character and occurrence count. API 671 §2.1.1.8 calls for transmission of at least 115% of specified maximum transient torque for well-known events; unusual cyclic events require agreement.

SPECIFY → CALCULATE → VALIDATE → DOCUMENT

Continuous and occasional loading are different

API 671 §2.1.2 distinguishes continuous fatigue assessment and peak-load yield checks. Document the evaluation method, material data source, combined stresses and vendor-confirmed margins.

SPECIFY → CALCULATE → VALIDATE → DOCUMENT

Not three independent nameplate maxima

Assess angular misalignment, parallel offset and axial displacement at the same time as torque and speed. Thermal growth, foundation movement, shaft deflection and alignment tolerances contribute.

SPECIFY → CALCULATE → VALIDATE → DOCUMENT

1998 edition design screening

Unless otherwise specified, minimum steady-state angular capacity is 0.2° across each flexible element; minimum steady-state axial deflection capacity is largest shaft diameter / 100. These are standard-specific minima, not an unrestricted simultaneous envelope.

SPECIFY → CALCULATE → VALIDATE → DOCUMENT

Understand angularity and offset

Two flex planes accommodate parallel offset through opposed angular deflections. Approximate small-angle geometry: $\theta \approx \text{offset} / \text{flex-plane separation (radians)}$, before adding angular alignment and growth effects. Verify vendor interaction curves.

FLEX PLANE 1

SPACER

FLEX PLANE 2

Axial loads can govern bearing life

Calculate differential thermal expansion and shaft end movement; include assembly tolerance and operating transients. Check axial restoring force and thrust-bearing capacity at temperature and speed.

SPECIFY → CALCULATE → VALIDATE → DOCUMENT

A maintenance-critical dimension

API 671 (1998) §2.1.3 specifies spacer type and 460 mm minimum BSE unless purchaser specifies otherwise. API 610 §7.2.2(d) uses pump-specific removal clearances and a 125 mm minimum / seal-length condition. Do not conflate these.



Default pump coupling construction

Unless otherwise specified: all-metal flexible-element spacer type manufactured to AGMA 9000 Class 9; corrosion-resistant flex elements; steel hubs; positive spacer retention following element rupture.



Safety feature requires positive evidence

A spacer must remain contained following a flex-element failure for API 610 §7.2.2(b). Review engineered anti-fly/retention mechanism; do not assume ordinary element bolts alone are sufficient.



Lubrication and wear are design variables

Evaluate tooth load distribution, lubrication, sealing, misalignment-related tooth loading, maintenance intervals and wear inspection. Compare gear designs only after confirming the API 671 gear-coupling requirements.

SPECIFY → CALCULATE → VALIDATE → DOCUMENT

Disc packs and diaphragms

Flexibility is achieved through elastic metallic deformation. Evaluate element stress/fatigue, fasteners, pack replacement, axial stiffness, corrosion and overload retention; supplier designs differ.

SPECIFY → CALCULATE → VALIDATE → DOCUMENT

Specialized torsional solutions

Quill shafts alter torsional compliance; damping couplings require explicit analysis of thermal and dynamic behavior. Do not assume a torsionally soft design is a direct substitute for a metallic flexible-element coupling.

SPECIFY → CALCULATE → VALIDATE → DOCUMENT

Coupling stiffness affects the full train

Include coupling torsional stiffness and inertia in motor-gearbox-pump/compressor train model; investigate resonance, start-up, speed transients, electrical events and reverse torque where applicable.

SPECIFY → CALCULATE → VALIDATE → DOCUMENT

Hub mass changes rotor response

Evaluate hub mass, polar/transverse inertia, overhung center of gravity, shaft end stiffness and allowable bearing loads. Oversizing for torque may worsen rotor dynamic behavior.

SPECIFY → CALCULATE → VALIDATE → DOCUMENT

API 671 Figures 1–3 summarized conceptually

Method 1: component balance only; Method 2: component balance plus assembly check (standard method); Method 3: component balance plus assembly balance. Specify the method, speed and allowable residual unbalance.

1 Component

2 Check assembly

3 Assembly

When high-speed balance becomes explicit

For pump couplings above 3,800 rpm, API 610 §7.2.2(f) calls for API 671 / ISO 10441 component balancing and assembly balance check. Additional G6.3 balance is only if specified (§7.2.3).

SPECIFY → CALCULATE → VALIDATE → DOCUMENT

Define both sides independently

Specify shaft diameters, tolerances, key/keyway, engagement length, end float, bore finish, taper, axial positioning, runout and removal provisions. Confirm the coupling-to-shaft torque capacity.

SPECIFY → CALCULATE → VALIDATE → DOCUMENT

Serviceability drives hub selection

API 610 §7.2.8: for shafts >60 mm where hub removal is needed for seal service, taper fit is required; standard keyed taper 1:16 diametral unless agreed otherwise. §7.2.9 addresses puller holes for interference hubs.

SPECIFY → CALCULATE → VALIDATE → DOCUMENT

A guard is part of the supply scope

API 610 §7.2.13 requires a removable guard enclosing coupling and shafts; guard stiffness must withstand a 900 N static point load without contact with moving parts. Check access, ventilation and material.

SPECIFY → CALCULATE → VALIDATE → DOCUMENT

Specify the exposure, not only the alloy

Record temperature range, corrosion, salt, chemicals, explosive atmosphere, washdown, dust, lubricant compatibility and storage conditions. Require material traceability where the purchase specification demands it.

SPECIFY → CALCULATE → VALIDATE → DOCUMENT

Turn specification into verifiable evidence

Identify critical dimensions, material certificates, heat treatment, NDE if specified, machining runout, fastener traceability, assembly procedures and hold/witness points.

SPECIFY → CALCULATE → VALIDATE → DOCUMENT

Acceptance must be measurable

Agree inspection scope, balance certificates, dimensional records, assembly checks, fit verification and any special test. Do not claim all tests are mandatory without the relevant purchaser selection.

SPECIFY → CALCULATE → VALIDATE → DOCUMENT

Technical bid should be auditable

Vendor drawings; datasheet; rating calculations; mass/inertia and stiffness; permissible misalignment envelope; balance method and results; installation, maintenance and preservation instructions; deviations list.

SPECIFY → CALCULATE → VALIDATE → DOCUMENT

Required inputs / vendor confirmations

Tag, machine train, power/speed envelope, transient torque, selected SF, shaft ends, BSE/DBSE, temperatures, environment, allowable forces, alignment and axial growth. Leave unknown values explicitly open.

SPECIFY → CALCULATE → VALIDATE → DOCUMENT

Geometry, ratings and construction

Coupling type, size, continuous/peak torque, max speed, bore and hub design, flex elements, spacer mass, torsional stiffness, balance class/method, guard, coatings and removal clearances.



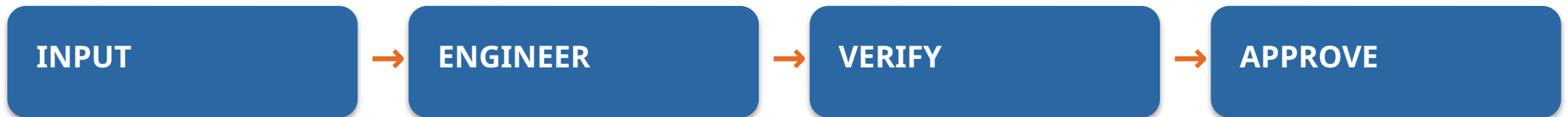
A simple contract control mechanism

For every clause: requirement → offered design → vendor evidence → compliant / deviation / not applicable → purchaser disposition. Record edition, options, agreed exceptions and responsible party.



Illustrative engineering gate check

Pump: 1,500 kW at 3,000 rpm. Check base torque 4,775 N·m; API 610 default metallic spacer construction; seal-removal DBSE; flex-element retention; shaft hubs; misalignment; balance; guard; documented supplier ratings.



Release only after the evidence is complete

Confirm contractual edition and scope; rated/peak torque; combined movements; BSE/DBSE; speed/balance; hub fit; dynamics; guard; material; inspection; documentation; deviations closed. MECHATRIC | Engineering specification training.

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We Welcome Your Questions, Comments & Feedback

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