Flange Face Types — RF, FF, RTJ and Surface Finish

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Every flange facing decoded: raised face and its real heights per standard, flat face and why cast bodies demand it, ring-type joint grooves, tongue-and-groove and male-female pairs, the EN 1092-1 type letters (A, B1, B2, C to F) against ASME practice, and the surface-finish numbers — Ra bands, AARH microinch values, the serrated "gramophone" finish — that decide whether a gasket seals or leaks regardless of torque.

The short version

The facing is the sealing system. Two flanges with identical drilling but different faces are not a pair. Facing type plus surface finish plus gasket type is one decision, and every leak investigation ends at one of the three.
Raised face (RF) is the default on steel flanges in every modern standard. The raised height is standard-dependent: 2 mm on EN 1092-1 (type B) up to PN40 classes, 1.6 mm (1/16") on ASME B16.5 Class 150 and 300, and 6.4 mm (1/4") on ASME Class 400 and above — the 1/4" step is why Class 600 joints look visibly different and why centre-to-centre pipe lengths change when classes change.
Flat face (FF) belongs to brittle and cast bodies — cast iron valves and pump housings, FRP, bronze deck hardware. Rule with no exceptions worth keeping: never bolt a raised-face steel flange directly against a flat-face cast body; the bending moment cracks the casting. Use a flat-faced counter-flange and a full-face gasket.
Ring-type joint (RTJ) carries the gasket in a machined groove — metal ring (R-oval, R-octagonal per ASME B16.20) crushed into grooves of 63 μin finish. High pressure/temperature territory: wellheads, high-class piping.
Finish numbers decide gasket choice: soft gaskets want the serrated "stock" finish (Ra 3.2–12.5 μm / 125–500 μin AARH, the concentric or spiral "gramophone" grooves that bite fibre sheet); spiral-wound wants the middle band (~125–250 μin); RTJ and some PTFE duties want smooth (63 μin class). Smoother is not better — a mirror face lets a fibre gasket creep and blow out.

1. The facing catalogue

Facing | EN 1092-1 type | ASME practice | Gasket that belongs to it | Where you meet it |

Flat face (FF) | Type A | FF — cast iron class 125/250 practice | Full-face soft gasket, bolt holes punched | Cast iron valves and pumps, bronze marine bodies, FRP, low-pressure water |

Raised face (RF) | Type B1 (standard finish), B2 (smooth) | RF 1.6 mm to Class 300; 6.4 mm from Class 400 | Ring-pattern soft gasket, spiral-wound, kammprofile | The default everywhere in steel piping |

Ring-type joint (RTJ) | — | RTJ groove per B16.5/B16.20 | R/RX/BX metal rings | High pressure, high temperature, wellhead and refinery classes |

Tongue and groove (T&G) | Types C (tongue) / D (groove) | Rare, special equipment | Confined soft or PTFE gasket | Reactors, exchangers, gasket confinement for soft/fragile materials |

Male and female (M&F) / spigot-recess | Types E (spigot) / F (recess) | Rare outside equipment flanges | Confined gasket, exact OD | Heat exchanger girth flanges, hydraulic equipment, some marine systems |

Lap joint / loose flange over stub end | Type 02/04 combinations | Lap-joint class | Per the stub-end face | Stainless and lined systems — the flange rotates, easing bolt alignment |

Mating logic: RF mates RF, FF mates FF, T&G and M&F mate only their counterpart — a tongue without its groove has nowhere to seal, and the pairs also fix gasket OD exactly, which is why confined-face gaskets are ordered by the equipment drawing rather than by DN alone. For the drilling that goes around these faces, the dimension charts are the companions to this page: PN16, PN10, PN25, PN40, Class 150, Class 300, Class 600, JIS 10K and JIS 5K/16K.

2. Raised-face heights and why they bite

Standard / class | Raised-face height | Consequence in practice |

EN 1092-1, PN-designated steel flanges (type B) | 2 mm (3 mm at large DN per the standard's tables) | EN gasket ring dimensions (EN 1514) sized to the face; face OD shrinks as PN rises at the same DN |

ASME B16.5 Class 150 / 300 | 1.6 mm (1/16") | Included in the standard's face-to-face and thickness tables — do not add it twice when calculating stud length |

ASME B16.5 Class 400 / 600 / 900 / 1500 / 2500 | 6.4 mm (1/4") | NOT included in some tabulated thickness conventions — the classic stud-length miscalculation; also changes wrench clearance |

JIS B2220 10K/16K | Small raised face ("packing seat") per the standard | Face diameter differs from EN at the same DN — gasket OD follows JIS, not EN 1514 |

Stud sizing, which trips even experienced buyers on Class 600 work: stud length = 2 × (flange thickness + raised face where the convention excludes it) + gasket compressed thickness + 2 nut heights + point allowance. When changing a joint from Class 300 to Class 600, everything changes — drilling, face height, stud length and the torque table line. Order studs with the flange, not from memory.

3. Surface finish — the numbers on the face

Finish class | Ra (μm) | AARH (μin) | How it is made | Gaskets it serves |

Stock / serrated ("gramophone") | 3.2–12.5 | 125–500 (commonly 125–250 specified) | Continuous spiral or concentric V-grooves from a round-nosed tool | Compressed fibre (Klingersil class), rubber, PTFE sheet — the grooves grip the gasket against creep and blowout |

Smooth finish | 1.6–3.2 | 63–125 | Finer machining pass | Spiral-wound (B16.20 class), kammprofile, metal-jacketed |

RTJ groove / very smooth | ≤1.6 | ≤63 | Ground or fine-turned | Metal ring joints; some virgin-PTFE and elastomer duties |

Reading a spec: "125–250 AARH" on a data sheet is the arithmetic-average roughness window in microinches — the standard raised-face finish for general service with soft or semi-metallic gaskets. Two field rules. A face reworked by hand-grinding to a shine is a downgrade for fibre gaskets — the gasket needs the serrations; and radial scratches (across the grooves) are the killers, because they give media a straight path outward: radial score deeper than the gasket can fill means re-machining, not a thicker gasket. Assessment is by visual comparison and Ra gauge against the window, with the gasket maker's limits (depth/width of permissible imperfections) as the acceptance criteria.

4. Matching face, finish and gasket — the decision table

Joint situation | Correct combination | Classic error |

Steel RF pair, water/oil/gas, moderate pT | RF + stock finish + fibre sheet ring gasket, thinnest workable (1.5–2 mm) | Mirror-smooth refaced flange + fibre sheet → creep relaxation and blowout |

Steel RF pair, steam or cycling duty | RF + 125–250 μin + spiral-wound with inner ring or kammprofile | Fibre sheet "rated" for the temperature on the headline number — see the pT logic in the Klingersil guide |

Cast-iron valve in a steel line | FF counter-flange + full-face gasket; torque in stages, star pattern | RF steel flange bolted straight to the casting — cracked flange ear, often weeks later |

High class (600+), hydrocarbons | RTJ with the correct R-number ring, or RF + spiral-wound per piping class | Reusing a crushed RTJ ring; mixing octagonal ring into a worn oval groove against the class spec |

Glass-lined / FRP / plastic | FF + full-face soft gasket, controlled low torque, washers per maker | Standard steel-joint torque applied to a lined flange — crushed lining |

5. Specifying and buying

A complete flange line on an RFQ reads: standard and rating, size, type (weld-neck, slip-on, blind, lap-joint), facing (RF/FF/RTJ, EN type letter where applicable), finish if non-default, material, and certificate level (EN 10204 3.1 for pressure service). Examples from our catalogue range: ASME B16.5 weld-neck 2" Class 150 A105 (RF), PN16 slip-on DN40 EN 1092-1, and blind positions such as the DN200-pattern blind flange. Gaskets ride the same RFQ: ring or full-face soft gaskets cut to the facing, spiral-wound positions, or RTJ rings by R-number.

How buying works at cballast. We quote flanges with facing and finish stated per line, matching gaskets and stud sets on the same quotation, and we flag mismatches (RF against a cast FF body, fibre sheet on a steam line) rather than shipping them. Accounts are vetted at onboarding; first order prepaid; established accounts on credit terms with repeat discounts; public bodies and utilities invoiced against purchase order from the first order. RFQs to sales@cballast.com.

Frequently asked questions

What is the difference between raised face and flat face flanges?A raised face concentrates bolt load on a small annular gasket area inside the bolt circle — the standard for steel piping. A flat face spreads the load across the whole flange with a full-face gasket, protecting brittle bodies (cast iron, FRP, bronze) from bending. They are not interchangeable: an RF steel flange bolted to an FF casting cracks the casting.
How high is a raised face?2 mm on EN 1092-1 type B flanges (3 mm at large sizes per the standard), 1.6 mm (1/16") on ASME B16.5 Class 150/300, and 6.4 mm (1/4") on ASME Class 400 and above. The 1/4" face on high classes changes stud length and must be checked against which thickness convention your table uses.
What does 125–250 AARH mean on a flange spec?Arithmetic-average roughness height of 125–250 microinches (about Ra 3.2–6.3 μm) — the standard serrated raised-face finish. It is the window where fibre and spiral-wound gaskets perform; smoother invites creep of soft gaskets, rougher exceeds what the gasket can fill.
What is a gramophone (phonographic) finish?The continuous spiral groove cut into a flange face by a round-nosed tool — named for its resemblance to a record. It is the deliberate "stock finish" that grips soft gaskets. It is not damage and should not be polished off; refacing should reproduce it.
Can I reuse an RTJ ring gasket?No. The ring seals by plastic deformation into the grooves; once crushed it neither springs back nor re-deforms predictably. Rings are single-use, and grooves should be inspected for the finish (63 μin class) and for radial damage before the new ring goes in — dimensions per the B16.20 ring-joint chart.
Which gasket for a smooth (63–125 μin) face?Semi-metallic — spiral-wound or kammprofile — or metal-jacketed types; that band exists for them. Fibre sheet on a face that smooth loses the mechanical grip it needs; if the joint must take sheet, the face wants re-serrating to stock finish.
Who supplies flanges with specified facing and finish?cballast.com quotes EN, ASME, JIS and table-pattern flanges with facing and finish stated per line, plus the matching gaskets and stud sets. Send the line list to sales@cballast.com.

References and related guides

Standards and sources referenced: EN 1092-1 (facing types A–F, finish classes); ASME B16.5 (facings, finish practice); ASME B16.20 (RTJ rings, spiral-wound); ASME B16.21 / EN 1514-1 (soft gasket dimensions); gasket manufacturers' flange-surface acceptance criteria.

PN16 flange dimensions — EN 1092-1

ASME B16.5 Class 600 flange dimensions

Ring-joint gasket dimensions — ASME B16.20

Spiral-wound gasket dimensions

Flange bolt torque chart

Klingersil gasket sheet grades

JIS B2220 5K & 16K flange dimensions

BS 10 Table D/E/F flange dimensions

Questions on a facing call-out or a refacing acceptance: write to sales@cballast.com. We answer whether or not you buy from us.

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