Notes for API 609 – 2021 Edition: Butterfly Valves

1. General Compliance Check

- **API 609 Scope:** The vendor must supply **butterfly valves** for industrial applications, available in:
    - Double-flanged type
    - Lug-type
    - Wafer-type
    - Butt-welding ends
- **Valve Category & Size & Pressure Class:**
    - Category A – Cold Working Pressure (CWP) rated (Concentric Disc Design).

      —NPS 2 to NPS 60 for valves having ASME class 125 or class 150 flange bolting patterns
    - Category B – ASME pressure-temperature rated (Eccentric or Offset Disc Design or a concentric disc configuration).

      — for lug and wafer, class 150 and 300: NPS 2 to NPS 60.

      — for lug and wafer, class 600: NPS 3 to NPS 60.

      — for double-flanged short and long pattern, class 150, 300, and 600: NPS 3 to NPS 60.

      — for butt-welding ends, class 150, 300 and 600: NPS 3 to 60.

2. Pressure-Temperature Ratings

- **Shell Rating:**
    - Check compliance with ASME B16.34 (for Steel, Nickel-Alloy) or ASME B16.42 (for Ductile Iron).
- **Seat Rating:**
    - PTFE and RPTFE seats should meet API 609 minimum seat pressure-temperature ratings (Table 1).

Table 1—Minimum Seat Pressure-temperature Ratings for Category B Valves

Temperature °C (°F)	Class 150				Class 300				Class 600	
	PTFE or modified PTFE		RPTFE or modified RPTFE		PTFE or modified PTFE		RPTFE or modified RPTFE		RPTFE or modified RPTFE	
	bar	psig	bar	psig	bar	psig	bar	psig	bar	psig
–29 to 38 (–20 to 100)	19.7	285	19.7	285	51.0	740	51.0	740	102.0	1480
66 (150)	18.8	273	18.8	273	48.8	708	48.8	708	89.6	1300
93 (200)	17.9	260	17.9	260	37.9	550	46.5	675	62.1	900
121 (250)	16.9	245	16.9	245	29.3	425	36.5	530	48.3	700
149 (300)	15.9	230	15.9	230	20.7	300	26.9	390	37.9	550
177 (350)	9.7	140	14.8	215	12.1	175	17.2	250	27.6	400
204 (400)	3.4	50	6.9	100	3.4	50	6.9	100	17.2	250

    - If alternate materials are used, check if pressure-temperature charts are provided by the vendor.

- **Differential Pressure Rating:**
    - Ensure the valve's differential pressure rating does not exceed seat pressure rating.

3. Material Compliance

Verify that the vendor's material specifications match API 609 requirements and the project's material requirements.

3.1 Body Material:

- Steel: ASTM A216 WCB, ASTM A351 CF8M (SS 316), ASTM A995 (Duplex SS)
- Ductile Iron: ASTM A395
- Bronze: ASTM B62
- Nickel-Alloy: ASME B16.34-compliant
- *Verify NACE Compliance (for sour service applications): ANSI/NACE MR0175 / MR0103*

3.2 Disc & Shaft Material:

- Common Disc Materials: SS 316, Duplex SS, Inconel, Aluminum Bronze
- Shaft Material: SS 410, SS 316, Monel, or Alloy 20 (for corrosive services)
- Verify corrosion resistance based on service conditions.

3.3 Seat & Packing Materials:

- **Seat Materials:**
    - Elastomers (EPDM, Viton, Nitrile, PTFE)
    - Metal seats for high-temperature services
- **Packing Materials:**
    - Graphite (for high-temperature service)
    - PTFE (for low-friction applications)

3.4 Gland Bolting:

- Must meet minimum strength per ASME B16.5.
- Verify material compatibility with operating temperatures.

4. Dimensional & Flange Compatibility Check

- **Face-to-Face Dimensions:**
    - Ensure standardization per ASME B16.10, ISO 5752, or EN 558.

Table 2—Face-to-face Dimensions for Category A Valves (Lug- and Wafer-type)

Valve Size (NPS)	Face-to-face Dimensions		Maximum Variance ±	
	mm	in.	mm	in.
2	43	1.69	1.5	0.06
2 1/2	46	1.81	1.5	0.06
3	46	1.81	1.5	0.06
4	52	2.06	1.5	0.06
5	56	2.19	1.5	0.06
6	56	2.19	1.5	0.06
8	60	2.38	3.3	0.13
10	68	2.69	3.3	0.13
12	78	3.06	3.3	0.13
14	78	3.06	3.3	0.13
16	102	4.00	3.3	0.13
18	114	4.50	3.3	0.13
20	127	5.00	3.3	0.13
24	154	6.06	3.3	0.13
30	165	6.5	6.4	0.25
36	200	7.88	6.4	0.25
42	251	9.88	6.4	0.25
48	276	10.88	6.4	0.25
50 to 60	— [a]		6.4	0.25

[a] Dimensions shall be manufacturer's standard or as agreed between purchaser and manufacturer.

Table 3a—Face-to-face Dimensions for Category B Valves (Lug- and Wafer-type)

Valve Size	Class 150		Class 300		Class 600		Maximum Variance ±	
(NPS)	mm	in.	mm	in.	mm	in.	mm	in.
2	— [a]						3.3	0.13
2 1/2	48	1.88	48	1.88	— [a]		3.3	0.13
3	48	1.88	48	1.88	54	2.12	3.3	0.13
4	54	2.12	54	2.12	64	2.50	3.3	0.13
6	57	2.25	59	2.31	78	3.06	3.3	0.13
8	64	2.50	73	2.88	102	4.00	3.3	0.13
10	71	2.81	83	3.25	117	4.62	3.3	0.13
12	81	3.19	92	3.62	140	5.50	3.3	0.13
14	92	3.62	117	4.62	155	6.12	3.3	0.13
16	102	4.00	133	5.25	178	7.00	3.3	0.13
18	114	4.50	149	5.88	200	7.88	3.3	0.13
20	127	5.00	159	6.25	216	8.50	3.3	0.13
24	154	6.06	181	7.12	232	9.13	3.3	0.13
26 to 60	— [a]						6.4	0.25

[a] Dimensions shall be manufacturer's standard or as agreed between purchaser and manufacturer.

Table 3b—Face-to-face Dimensions for Category B Valves (Double-flanged Long Pattern)

Valve class	Class 150 [a]		Class 300 [a]		Class 600 [a]		Maximum Variance ±	
(NPS)	mm	in.	mm	in.	mm	in.	mm	in.
3	203	8.00	282	11.12	356	14.00	3.3	0.13
4	229	9.00	305	12.00	432	17.00	3.3	0.13
6	267	10.50	403	15.88	559	22.00	3.3	0.13
8	292	11.50	419	16.50	660	26.00	3.3	0.13
10	330	13.00	457	18.00	787	31.00	3.3	0.13
12	356	14.00	502	19.75	838	33.00	3.3	0.13
14	381	15.00	762	30.00	889	35.00	3.3	0.13
16	406	16.00	838	33.00	991	39.00	3.3	0.13
18	432	17.00	914	36.00	1092	43.00	3.3	0.13
20	457	18.00	991	39.00	1194	47.00	3.3	0.13
24	508	20.00	1143	45.00	1397	55.00	4	0.16
26	559	22.00	1245	49.00	1448	57.00	4	0.16
28	610	24.00	1346	53.00	1549	61.00	4	0.16
30	610	24.00	1397	55.00	1651	65.00	4	0.16
32	660	26.00	1524	60.00	1778	70.00	4	0.16
36	711	28.00	1727	68.00	2083	82.00	5	0.19
38 to 60	— [b]						5	0.19

[a] Dimensions listed agree with ASME B16.10 for flanged gate valves.
[b] Dimensions shall be manufacturer's standard or as agreed between purchaser and manufacturer.

Table 3c—Face-to-face Dimensions for Category B Valves (Double-flanged Short Pattern)

Valve class	Class 150 [a] or class 300 [a]		Class 300 [b]		Class 600 [b]		Maximum Variance ±	
(NPS)	mm	in.	mm	in.	mm	in.	mm	in.
3	114	4.50	180	7.09	180	7.09	3.3	0.13
4	127	5.00	190	7.48	190	7.48	3.3	0.13
6	140	5.50	210	8.27	210	8.27	3.3	0.13
8	152	6.00	230	9.06	230	9.06	3.3	0.13
10	165	6.50	250	9.84	250	9.84	3.3	0.13
12	178	7.00	270	10.63	270	10.63	3.3	0.13
14	190	7.50	290	11.42	290	11.42	3.3	0.13
16	216	8.50	310	12.20	310	12.20	3.3	0.13
18	222	8.75	330	12.99	330	12.99	3.3	0.13
20	229	9.00	350	13.78	350	13.78	3.3	0.13
24	267	10.50	390	15.35	390	15.35	4	0.16
26	292	11.50	410	16.14	— [c]		4	0.16
28	292	11.50	430	16.93	— [c]		4	0.16
30	318	12.52	450	17.72	— [c]		4	0.16
32	318	12.52	470	18.50	— [c]		4	0.16
36	330	12.99	510	20.08	— [c]		5	0.19
38	410	16.14	530	20.87	— [c]		5	0.19

Table 3c—Face-to-face Dimensions for Category B Valves (Double-flanged Short Pattern) (Continued)

Valve class	Class 150 [a] or class 300 [a]		Class 300 [b]		Class 600 [b]		Maximum Variance ±	
(NPS)	mm	in.	mm	in.	mm	in.	mm	in.
40	410	16.14	550	21.65	— [c]		5	0.19
42	410	16.14	570	22.44	— [c]		6	0.24
48	470	18.50	630	24.80	— [c]		6	0.24
50 to 60	— [c]						6	0.24
NOTE See NOTES TO PURCHASER, B.1.3 d).								

[a] The dimensions listed agree with ISO 5752 Basic Series 13, EN 558 and EN 593.
[b] The dimensions listed agree with ISO 5752 Basic Series 14, EN 558 and EN 593.
[c] Dimensions shall be manufacturer's standard or as agreed between purchaser and manufacturer.

- **Disc Clearance:**
  - Verify disc-to-pipe clearance as per Annex D to avoid interference with pipe ID.
- **Flange Compatibility:**
  - Flange connections should match ASME B16.5 / B16.47 standards.
  - Lug-type valves: Ensure bolt hole threading conforms to ASME B1.1.
  - Wafer-type valves: Must self-center between pipeline flanges.
- **Actuation Mechanism:**
  - Confirm if the valve is manual (lever, gear), pneumatic, or electric.
  - If gear-operated, verify torque rating and handwheel size

5. Special Service Considerations

5.1 Fire-Safe & Fugitive Emissions Compliance

- Fire-safe testing: If required, check if valves are tested per API 607.
- Fugitive emissions compliance: If needed, verify testing per API 641.

5.2 Cryogenic Service (if applicable)

- If cryogenic valves must comply with MSS SP-134 (as per section 5.1.4)

5.3 Antistatic & Electrical Continuity

- If specified, ensure the valve has an antistatic feature for shaft, disc, and body electrical continuity.
- Verify electrical continuity test compliance (<10 ohms resistance per API 609 Section 7.3).

6. Testing & Quality Assurance

6.1 Pressure Testing Requirements

API 598 Compliance – Verify if the vendor performs:
Shell Test (1.5x design pressure)

Seat Leakage Test (with water or air)
High-pressure Closure Test (110% of valve's differential pressure rating)

6.2 Non-Destructive Examination (NDE)

Check if vendor provides:
Radiographic (RT) or Ultrasonic Testing (UT) of welds
Magnetic Particle (MT) or Dye Penetrant (PT) for critical components

6.3 Repair of Defects

Gray Iron, Ductile Iron, or Copper Alloy Valves:
No welding/brazing/plating allowed for defect repairs.

7. Marking & Documentation Review

7.1 Required Nameplate Information

Each valve should have a **permanent marking** with:
Manufacturer's Name
Valve Size (NPS)
ASME Pressure Class
Body Material & Seat Material
Temperature & Pressure Ratings
API 609A (for Category A) or API 609B (for Category B) marking
Fire-safe or fugitive emissions marking (API 607 / API 641) if applicable

7.2 Certificates & Compliance Documents

- Material Test Reports (MTRs) per EN 10204 3.1.
- Inspection & Testing Reports per API 598.
- Fire & Fugitive Emission Test Reports (if applicable).
- Declaration of Conformity for compliance with industry standards.

8. Packaging & Shipping

- Rust Prevention: Machined surfaces must have a rust-preventive coating.
- End Protection: Valves should have plastic, wood, or metal covers to prevent contamination.
- Shipping & Export Packaging: Valves should be secured in wooden crates for overseas transport.
- Spare Parts List: Vendor should provide a recommended spare parts list.

9. Purchase Order Review (Annex B)

Ensure the vendor's offer includes:
Valve Type & Category (A/B)
Size & Pressure Class
Material Specifications (Body, Disc, Shaft, Seat)
End Connection Type (Flanged, Lug, Wafer, Butt-weld)

Testing & Certification Requirements (API 598, API 607, API 641)
Fire-safe or Fugitive Emissions Compliance
Export Packaging Requirements
Spare Parts & Warranty Details

1. Resilient Seat (Soft Seated Butterfly Valves)

Definition:

A resilient seat refers to a non-metallic seat material (such as elastomers or PTFE) that provides flexibility and ensures tight sealing between the disc and the body.

API 609 Requirements:

Category A Valves typically use resilient seats with concentric disc design.

Category B Valves may have offset disc designs with soft-seated options.

Common Resilient Seat Materials:

PTFE (Polytetrafluoroethylene)

EPDM (Ethylene Propylene Diene Monomer)

Nitrile (Buna-N)

Viton (Fluoroelastomer)

Pressure-Temperature Ratings for Resilient Seats:

Minimum seat pressure-temperature ratings for PTFE/RPTFE are specified in Table 1 of API 609.

Temperature ratings are limited to the maximum service limit of the seat material.

Resilient seats must be replaceable in many designs, ensuring easy maintenance.

2. Shell Minimum Thickness

The shell consists of the valve body, cover, bonnet, and other pressure-retaining parts. The minimum wall thickness of the shell ensures mechanical strength and pressure containment.

API 609 Requirements:

The minimum body-wall thickness shall comply with ASME B16.34 for steel, nickel, or special alloy materials.

For ductile iron: Minimum thickness must follow ASME B16.42.

For cast copper alloys: Minimum thickness must follow ASME B16.24.

For non-standard materials, the thickness shall be per manufacturer's design and tested accordingly.

Localized thinning (e.g., at bolt holes) should be considered to maintain structural integrity.

3. Valve Orientation (Installation Position)

Valve orientation refers to the recommended installation position of the butterfly valve in a piping system.

Preferred Orientation:

Shaft in the horizontal position is generally recommended to minimize wear on the seat and shaft seals.

Helps prevent buildup of debris in flow media.

Vertical Shaft Orientation:

Acceptable but can lead to uneven wear in some applications (e.g., if solid particles settle at the bottom).

Flow Direction Considerations:

Bidirectional valves can handle flow in both directions.

Unidirectional valves must be installed with the high-pressure side correctly aligned (per manufacturer's marking).

Dead-End Service:

Lug-type valves used in dead-end service must be tested at 110% of differential pressure.

Check if the valve is rated for dead-end service in both directions or just one.

4. Valve Self-Support (Pipe Support Requirements)

Self-supporting valves do not require external supports and are strong enough to withstand piping loads.

API 609 Guidelines:

Wafer-type and Lug-type valves are NOT self-supporting and must be installed between flanges for proper support.

Double-flanged valves can be self-supporting in some cases, but proper piping alignment is necessary.

If the valve is not self-supporting, external pipe supports or hangers should be used to prevent excessive loading on the valve body.

For large-diameter butterfly valves (NPS 24 and above), additional support may be required to avoid excessive weight on the pipeline.

Proper gasket alignment and bolting torque are required to ensure even sealing and avoid misalignment.

1. Lifting Lug Considerations for Large Butterfly Valves

When Required:

Large-diameter valves (typically NPS 24 and above) may require lifting lugs for safe handling during installation.

Heavy-duty, double-flanged valves may include lifting points for ease of transport and positioning.

Material & Design:

Lifting lugs should be integrally cast, welded, or bolted to the valve body.

Should be designed to withstand the weight of the valve plus additional lifting stresses.

Load Capacity:

Must be rated for safe lifting loads following applicable ASME B30.20 (Below-the-Hook Lifting Devices).

Marking & Safety:

Lifting points should be clearly marked for safe handling.

Manufacturer should provide lifting instructions in the valve handling manual.

2. API 609-Related Guidelines

While API 609 does not require lifting lugs, it does specify:

Valve Body Strength: The body must comply with ASME B16.34 or ASME B16.42, ensuring it can handle external forces, including those during lifting.

Packaging & Shipping Requirements (Section 9):

States that valves must be packaged to prevent damage during transport, implying that proper lifting and handling provisions should be considered.

Face-to-Face Dimension Compliance:

Ensuring proper handling and lifting does not damage the valve flanges or disc mechanism.

3. Vendor Offer Review – Lifting Lug Considerations

✓ Does the valve have lifting lugs for easy handling?

✓ If not, does the vendor provide alternative handling instructions?

✓ Are lifting lugs rated for the valve weight and installation stress?

✓ Do lifting lugs comply with ASME B30.20 for load-bearing safety?