

Sheet Metal Typical Tolerance Reference Guide

For Design Guidance Only — Not a Substitute for Fabricator Confirmation

ISO 2768

JIS B 0408 / B 0410

ASM EF-001 (Guideline)

ATI Sheet Standards (Raw Stock)

Tripair Gauge Chart (Industry Ref)

ShincoFab

How to Use This Guide

Raw Material vs. Fabricated Part

Sections 4–5 cover *incoming raw stock* tolerances (thickness, flatness, width). These govern what leaves the mill — not what comes off your press brake. Sections 1–3 cover *fabricated-part* tolerances after cutting, punching, and forming. Never use raw-stock tolerances to accept or reject a finished part.

Formal Standard vs. Guideline

Content labeled **ISO / JIS** comes from published international standards. Content labeled **GUIDELINE** (ASM EF-001) reflects widely-used shop experience — useful defaults, but not universally binding. Content labeled **INDUSTRY REF** (Tripair, ATI) is supplier or association data — cross-check with your mill certificate or ASTM/EN spec.

Inspection Conditions

All fabricated-part measurements should be taken:

- In a *restrained* condition (not free-standing) for formed parts
- At 20 °C (68 °F) ambient
- On a flat datum surface
- With calibrated gauges (dial indicator or CMM)

Free-state measurements of bent parts will show higher deviation than restrained.

Default recommendation: Write "General Tolerances: ISO 2768-m" in your drawing title block for standard commercial sheet metal. Override individual critical features with tighter callouts only where function requires it. Always confirm achievable tolerances with your fabricator before finalizing drawings.

1 ISO 2768 General Tolerances ISO / JIS STANDARD

ISO 2768-1/2 (equivalent to JIS B 0405 / JIS B 0419) sets general tolerances for drawings that do not call out individual limits on every dimension. Place "General Tolerances: ISO 2768-m" in the title block to invoke these defaults for the whole part. Classes: **f** = Precision · **m** = Medium (recommended for commercial sheet metal) · **c** = Coarse · **v** = Very Coarse.

Table 1 — Linear Tolerances (mm) Nominal dimension range

ISO 2768-1 JIS B 0405-1991, Section 4 (Linear dimensions excluding chamfered portions)

Class	Description	0.5–3	3–6	6–30	30–120	120–400	400–1000	1000–2000	2000–4000
f	Precision	±0.05	±0.05	±0.1	±0.15	±0.2	±0.3	±0.5	—
m ★	Medium	±0.1	±0.1	±0.2	±0.3	±0.5	±0.8	±1.2	±2
c	Coarse	±0.2	±0.3	±0.5	±0.8	±1.2	±2	±3	±4
v	Very Coarse	—	±0.5	±1	±1.5	±2.5	±4	±6	±8

★ ISO 2768-m is the recommended default for general commercial sheet metal work. Dimensions under 0.5 mm must be individually tolerated. These values apply to linear dimensions excluding chamfered portions (see Table 6 for chamfer/rounding).

Table 2 — Angular Tolerances Length of shorter side of the angle

ISO 2768-1 JIS B 0405-1991, Section 5 (Angle tolerance)

Class	Description	≤ 10 mm	10–50 mm	50–120 mm	120–400 mm	> 400 mm
f	Precision	±1°	±30'	±20'	±10'	±5'
m ★	Medium	±1°	±30'	±20'	±10'	±5'
c	Coarse	±1°30'	±1°	±30'	±15'	±10'
v	Very Coarse	±3°	±2°	±1°	±30'	±20'

Per ISO 2768-1 Table 3 (Tolerances for angular dimensions), the **f** and **m** tolerance classes carry identical angular values across all length ranges — this is intentional in the standard and not a transcription error. The *f/m* distinction only differentiates linear tolerances (Table 1). For sheet metal press brake bends, actual angular capability is further affected by springback and typically requires over-bending; confirm achievable angular tolerance with your fabricator before specifying tighter than ±1°.

Table 3 — Straightness & Flatness Tolerances (mm)

ISO 2768-2 JIS B 0419-1991

Class	≤10	10–30	30–100	100–300	300–1000	1000–3000
H	0.02	0.05	0.1	0.2	0.3	0.4
K	0.05	0.1	0.2	0.4	0.6	0.8
L	0.1	0.2	0.4	0.8	1.2	1.6

Table 4 — Perpendicularity Tolerances (mm)

ISO 2768-2 JIS B 0419-1991

Class	≤100	100–300	300–1000	1000–3000
H	0.2	0.3	0.4	0.5
K	0.4	0.6	0.8	1
L	0.6	1	1.5	2

Table 5 — Symmetry Tolerances (mm)

ISO 2768-2 JIS B 0419-1991

Class	≤100	100–300	300–1000	1000–3000
H	0.5	0.5	0.5	0.5
K	0.6	0.6	0.8	1
L	0.6	1	1.5	2

Table 6 — Chamfer / Edge Rounding Tolerances (mm)

ISO 2768-1 JIS B 0405-1991, Section 4 (Chamfered portions & edge rounding dimensions)

Class	0.5–3	3–6	> 6
f & m	±0.2	±0.5	±1
c & v	±0.4	±1	±2

Applies only to dimensions explicitly indicated on the drawing as chamfered or rounded (e.g., "C1.0" or "R2"). Does not govern all edges — burr height, general deburring allowance, and unspecified edge breaks are outside ISO 2768 scope and must be called out separately.

2 Fabrication Feature Tolerances SHOP GUIDELINE

These are recommended shop guidelines, not a formal published standard. Values are based on ASM EF-001 (Approved Sheet Metal industry guideline) and reflect typical achievable accuracy on standard CNC laser/punch and press-brake equipment. Actual capability varies with material alloy, thickness, tooling condition, and part geometry. Always confirm with your fabricator. Parts within 305 mm (12 in) overall envelope; measurements taken with part in restrained condition.

Table 7 — Recommended Feature-Based Tolerances (Typical Shop Guidelines)

GUIDELINE Based on ASM EF-001 — Recommended Default Sheet Metal Tolerances, Rev A

Dim	Description	Tolerance (mm)	Tolerance (in)	Application Notes
A	Sheared Edge to Hole	±0.13	±0.005	Hole center from a laser/shear cut edge; same flat surface
B	2 Holes on One Surface	±0.13	±0.005	Hole-to-hole center distance; both on same flat, unformed face
C	Formed Edge to Hole	±0.25	±0.010	Hole center measured from a bent (formed) edge
D *	Holes Across 2 Bends	±0.76	±0.030	* Not recommended — tolerance stacking (springback, K-factor) across bends is hard to control
E *	Holes Across 4 Bends	±0.76	±0.030	* Not recommended — use elongated slots or reference flat-surface datums instead
F	Sheared Edge to Bend	±0.25	±0.010	Flange length; cut edge to bend tangent line
G	Across 2 Bends	±0.38	±0.015	Box / channel width; spans two parallel bends
H *	Formed Part Overall	±0.76	±0.030	* Not recommended — overall envelope accumulates all bend errors; datum is ambiguous

* Dimensions D, E, and H that span multiple bends accumulate springback error and lose a clear datum reference. Tighter tolerances on these require secondary operations (restrike, fixture, CMM verification) and significantly increase cost. Use slot strategies or single-surface datums wherever possible.

Key Measurement Reference Rules (for Table 7 Dimensions)

Dim A — Sheared Edge to Hole: Measure from the nearest face of the straight cut edge (laser or shear) to the hole center, on the same flat unformed surface. Datum = the cut edge. Measure in free state before forming.

Dim C — Formed Edge to Hole: Measure from the inner tangent point of the bend radius to the hole center. Restrain the part flat (clamp or fixture) during measurement — free-state springback will introduce error up to 0.5–1 mm on stiff materials.

Dim G — Across 2 Bends (box/channel width): Measure inside-to-inside (for channel width) or outside-to-outside consistently. Specify which on the drawing. Place part in a fixture or on a flat plate; do not measure free-standing for formed channels wider than 50 mm.

Dim B — Hole to Hole (same surface): Measure center-to-center between holes on the same flat face. Part may be placed flat on surface plate. Free state is acceptable as no bends are involved.

Dim F — Sheared Edge to Bend: Equivalent to flange length. Measure on the flat pattern (before forming) from cut edge to the bend start line. If measured after forming, restrain the flange and measure to the outside of the bend radius; subtract bend allowance as needed.

Dims D, E, H (not recommended): If these must be measured, always fixture the part fully before measurement. Record datum face, fixture method, and gauge type on the inspection report. Free-state measurements of multi-bend spans are not reproducible and should not be used for acceptance decisions.

3 Press Working & Shearing Tolerances JIS STANDARD

Grade equivalents: Grade A = Precision (ISO f class) · Grade B = Medium (ISO m class) · Grade C = Coarse (ISO c class). Select Grade B for standard commercial work. These values apply to *fabricated dimensions* after forming, not to raw material stock. Source: JIS B 0408-1991 (press working from sheet metal) and JIS B 0410-1991 (shear from metal plates). Values have been verified against the original JIS text; transcription errors are possible — confirm critical values against the official standard before use.

Table 8 — Punching Tolerances (mm)

JIS B 0408-1991 Table 1

Dimension (mm)	Grade A	Grade B ★	Grade C
≤ 6	±0.05	±0.1	±0.3
6–30	±0.1	±0.2	±0.5
30–120	±0.15	±0.3	±0.8
120–400	±0.2	±0.5	±1.2
400–1000	±0.3	±0.8	±2
1000–2000	±0.5	±1.2	±3

Table 9 — Bending & Drawing Tolerances (mm)

JIS B 0408-1991 Table 2

Dimension (mm)	Grade A	Grade B ★	Grade C
≤ 6	±0.1	±0.3	±0.5
6–30	±0.2	±0.5	±1
30–120	±0.3	±0.8	±1.5
120–400	±0.5	±1.2	±2.5
400–1000	±0.8	±2	±4
1000–2000	±1.2	±3	±6

Table 10 — Shearing: Cut Width Tolerances (mm)

JIS B 0410-1991 Table 1 — General dimensional tolerances of cut widths

Standard Dimension (mm)	t ≤ 1.6 mm		1.6 < t ≤ 3 mm		3 < t ≤ 6 mm		6 < t ≤ 12 mm	
	Grade A	Grade B	Grade A	Grade B	Grade A	Grade B	Grade A	Grade B
≤ 30	±0.1	±0.3	—	—	—	—	—	—
30–120	±0.2	±0.5	±0.3	±0.5	±0.8	±1.2	—	—
120–400	±0.3	±0.8	±0.4	±0.8	±1	±1.5	—	—
400–1000	±0.5	±1	±0.5	±1.2	±1.5	±2	—	—
1000–2000	±0.8	±1.5	±0.8	±2	±2	±3	—	±2.5
2000–4000	±1.2	±2	±1.2	±2.5	±3	±4	—	±4

“—” means this combination of dimension range and material thickness is not defined in JIS B 0410-1991. Per the standard, unlisted combinations shall be **agreed upon by agreement between manufacturer and purchaser** — this is not a data gap; it is a scope boundary. Do not assume the tightest or loosest adjacent value applies. For these cases, write an individual tolerance on the drawing and confirm with your shearing house before order placement.

Table 11 — Shearing: Straightness Tolerances (mm)

JIS B 0410-1991 Table 2

Nominal Cut Length (mm)	t ≤ 1.6		1.6 < t ≤ 3	
	Grade A	Grade B	Grade A	Grade B
≤ 30	0.1	0.2	—	—
30–120	0.2	0.3	0.2	0.3
120–400	0.3	0.5	0.3	0.5
400–1000	0.5	0.8	0.5	1
1000–2000	0.8	1.2	0.8	1.5
2000–4000	1.2	2	1.2	2.5

Table 12 — Shearing: Perpendicularity Tolerances (mm)

JIS B 0410-1991 Table 3

Nominal Short Side (mm)	t ≤ 3		3 < t ≤ 6	
	Grade A	Grade B	Grade A	Grade B
≤ 30	—	—	—	—
30–120	0.3	0.5	0.5	0.8
120–400	0.8	1.2	1	1.5
400–1000	1.5	3	2	3
1000–2000	3	6	3	6
2000–4000	6	10	6	10

4 Material Gauge Thickness Tolerances INDUSTRY REF — RAW STOCK ONLY

This is raw incoming stock thickness data, not fabricated-part tolerance. The Tripar gauge chart is a widely-cited industry reference compiled from ASTM and mill standards, but it is a supplier/association reference, not a single mandatory national standard. Actual mill tolerances vary by ASTM grade (e.g., A1008 for CRS, A653 for GS, A480 for SS) and by mill order quantity. Always verify against your mill test certificate or specific ASTM/EN specification for contractual purposes.

Table 13 — Sheet Metal Gauge Thickness & Tolerance Chart (Inches, Raw Stock)

INDUSTRY REF Tripar Inc. Sheet Metal Tolerance Chart — triparinc.com | HRS = Hot Rolled Steel · CRS = Cold Rolled Steel · GS = Galvanized Steel · SS = Stainless Steel · ALUM = Aluminum

Gauge	HRS (in)	HRS Tol	CRS (in)	CRS Tol	GS (in)	GS Tol	SS (in)	SS Tol	ALUM (in)	ALUM Tol
3	0.2391	±.009	0.2391	—	—	—	0.2500	—	0.2294	±.011
4	0.2242	±.009	0.2242	—	—	—	0.2344	—	0.2043	±.011
5	0.2092	±.009	0.2092	—	—	—	0.2187	—	0.1819	±.009
6	0.1943	±.009	0.1943	—	—	—	0.2031	—	0.1620	±.009
7	0.1793	±.008	0.1793	±.008	—	—	0.1875	±.007	0.1443	±.007
8	0.1644	±.008	0.1644	±.008	—	—	0.1650	±.007	0.1285	±.007
9	0.1495	±.008	0.1495	±.008	0.1532	±.009	0.1562	±.007	0.1144	±.006
10	0.1345	±.008	0.1345	±.006	0.1382	±.009	0.1406	±.006	0.1019	±.006
11	0.1196	±.008	0.1196	±.006	0.1233	±.009	0.1250	±.005	0.0907	±.0045
12	0.1046	±.008	0.1046	±.006	0.1084	±.009	0.1094	±.005	0.0808	±.0045
13	0.0897	±.007	0.0897	±.005	0.0934	±.008	0.0937	±.004	0.0720	±.004
14	0.0747	±.007	0.0747	±.005	0.0785	±.008	0.0781	±.004	0.0641	±.004
15	0.0673	±.006	0.0673	±.005	0.0710	±.006	0.0703	±.004	0.0571	±.0035
16	0.0598	±.006	0.0598	±.005	0.0635	±.006	0.0625	±.003	0.0508	±.0035
17	0.0538	±.006	0.0538	±.004	0.0575	±.005	0.0562	±.003	0.0453	±.0035
18	0.0478	±.005	0.0478	±.004	0.0516	±.005	0.0500	±.003	0.0403	±.003
19	0.0418	±.004	0.0418	±.004	0.0456	±.005	0.0437	±.003	0.0359	±.003
20	0.0359	±.003	0.0359	±.003	0.0396	±.004	0.0375	±.002	0.0320	±.0025
21	0.0329	±.003	0.0329	±.003	0.0366	±.004	0.0344	±.002	0.0285	±.0025
22	0.0299	±.003	0.0299	±.003	0.0336	±.004	0.0312	±.002	0.0253	±.002
23	0.0269	±.003	0.0269	±.003	0.0306	±.004	0.0281	±.002	0.0226	±.002
24	0.0239	±.003	0.0239	±.003	0.0276	±.004	0.0250	±.0015	0.0201	±.002
25	0.0209	±.003	0.0209	±.003	0.0247	±.004	0.0219	±.0015	0.0179	±.002
26	0.0179	±.002	0.0179	±.002	0.0217	±.003	0.0187	±.0015	0.0159	±.0015
27	0.0164	±.002	0.0164	±.002	0.0202	±.003	0.0172	±.0015	0.0142	±.0015
28	0.0149	±.002	0.0149	±.002	0.0187	±.003	0.0156	±.0015	0.0126	±.0015
29	0.0135	±.002	0.0135	—	0.0172	±.003	0.0141	—	0.0113	±.0015
30	0.0120	±.002	0.0120	—	0.0157	±.003	0.0125	—	0.0100	±.0015

"—" = tolerance not published for that gauge/material combination in this reference. For gauges 31–36 or unlisted combinations, contact your steel service center and reference applicable ASTM specifications (e.g., ASTM A1008 for CRS, A653 for GS, A480 for SS, B209 for aluminum sheet).

5 Stainless Steel Sheet Standard Tolerances INDUSTRY REF — RAW STOCK ONLY

The following tolerances govern flat-rolled stainless steel sheet as received from the mill — not finished fabricated parts. Applicable range: thickness 0.018"–0.1874", width 24"–48". For thicknesses under 0.018" contact the mill. These are ATI mill tolerances and are representative of North American stainless steel producers; verify against your specific mill's certificate or ASTM A480/A568 for formal acceptance.

Table 14 — SS Sheet Size Tolerances: Roller Leveled

INDUSTRY REF ATI Metals — Sheet Standard Tolerances, Version 1 | Not Resquared

Thickness (in)	Length (in)	Length Tol.	Width Tol. (width ≤ 48 in)
Under 0.131	≤ 120	+1/8, -0	+1/16, -0
Under 0.131	> 120	+1/4, -0	
0.131 and over	All	+1/4, -0	

Table 15 — SS Sheet Size Tolerances: Stretcher Leveled

INDUSTRY REF ATI Metals — Sheet Standard Tolerances, Version 1 | Resquared

Thickness (in)	Length (in)	Length Tol.	Width Tol. (width ≤ 48 in)
Under 0.131	≤ 120	+1/16, -0	+1/16, -0
Under 0.131	> 120	+1/8, -0	
0.131 and over	All	+1/8, -0	

Stretcher leveling produces flatter, squarer sheets and tighter length tolerances. For precision assemblies requiring tight flatness, specify stretcher leveled and resquared on the purchase order. Requirements for more restrictive tolerances should be referred to the mill.

Table 16 — Camber Tolerances (SS Raw Sheet)

INDUSTRY REF ATI Metals

Width (in)	Max Camber per 8 ft straight edge
24–36 (inclusive)	1/8 in (3.2 mm)
Over 36–48 (inclusive)	3/32 in (2.4 mm)

Camber = greatest deviation of a side edge from a straight line over an 8-foot straight edge, measured on the concave side.

Table 17 — Flatness Tolerances (SS Raw Sheet)

INDUSTRY REF ATI Metals

Thickness (in)	Leveling Method	Max Flatness Dev.
0.018–0.1874	Roller Leveled (annealed)	1/2 in from flat
Under 3/16	Stretcher Leveled, L ≤ 96 in	1/8 in from flat
Under 3/16	Stretcher Leveled, L > 96 in	1/4 in from flat

Table 18 — SS Representative Gauge Thickness Tolerances ▲ Width ≤ 48 in only

INDUSTRY REF ATI Metals — Sheet Standard Tolerances, Version 1 | For formal acceptance, reference ASTM A480 Table A2.5 (not this table)

Thickness Range (in) — Under / Including	Gage Number	Tolerance ± (in)	Tolerance ± (mm)
0.1875–0.1451	8 & 9	±0.007	±0.18
0.1451–0.1301	10	±0.006	±0.15
0.1301–0.1141	11	±0.005	±0.13
0.1141–0.0981	12	±0.005	±0.13
0.0981–0.0831	13	±0.004	±0.10
0.0831–0.0721	14	±0.004	±0.10
0.0721–0.0581	15 & 16	±0.003	±0.08
0.0581–0.0401	17–19	±0.003	±0.08
0.0401–0.0291	20–22	±0.002	±0.05
0.0291–0.0160	23–27	±0.0015	±0.04

6 Scope & Limitations — What This Guide Does Not Cover

Material Capability Comparison (same gauge, different alloys) — typical achievable angular tolerance after bending: The values below are illustrative shop experience, not standardized values. Actual results depend on tooling, bend radius, and specific alloy temper.

Material	Springback tendency	Typical angular tol. (90° bend)	Typical flange-length tol. (≤100 mm)	Notes
Mild steel (CRS/HRS)	Low–Medium	±0.5°–±1°	±0.25–±0.38 mm	Most predictable; good for tight bends
5052-H32 Aluminum	Medium	±0.5°–±1.5°	±0.25–±0.50 mm	Springback varies by temper; verify K-factor
6061-T6 Aluminum	Medium–High	±1°–±2°	±0.38–±0.76 mm	Higher springback than 5052; harder to hold tight angles
304 Stainless Steel	High	±1°–±2.5°	±0.38–±0.76 mm	Significant springback; over-bend required; confirm with fabricator

Material	Springback tendency	Typical angular tol. (90° bend)	Typical flange-length tol. (≤100 mm)	Notes
Galvanized Steel (GS)	Low–Medium	±0.5°–±1°	±0.25–±0.50 mm	Similar to CRS; coating adds ~0.02–0.04 mm/side

Inspection Conditions

Measurements must specify: free state vs. *restrained condition*; 20 °C (68 °F) ambient; datum reference face; calibrated gauge type (CMM, dial indicator, optical). A bent flange measured in free state may read 0.5–1 mm different from the same flange in a fixture — this is not a process defect; it is springback, and the drawing must state which condition applies.

Process Boundary Conditions

Laser cutting: ±0.1–0.2 mm on feature edges; heat-affected zone (HAZ) ~0.1–0.3 mm wide.
Punching: ±0.05–0.15 mm; pull-down on punch exit side ~5–10% of material thickness.
Press brake bending: ±0.5°–±2° angular; ±0.25–0.76 mm flange length (material-dependent).
Welding: ±0.5–2 mm distortion in long assemblies; weld bead adds ~0.5–2 mm locally.
Press-insert (PEM): ±0.1–0.3 mm hole displacement from insertion force.

Post-Processing Dimensional Changes

Powder coating: +0.05–0.08 mm per surface (plug critical holes before coating).
Anodizing Type II: +0.003–0.005 mm per surface.
Electroless nickel: +0.005–0.015 mm per surface.
Zinc plating: +0.005–0.015 mm per surface.
Design holes and mating features with finish allowance, or specify pre/post-coat dimensions explicitly on the drawing.

Edge & Feature Design Rules

Not covered in tolerance tables: minimum hole-to-bend distance (typically 2× thickness + bend radius); hem/curl inside radius minimum (≥1× thickness to avoid cracking); countersink proximity to bend (min 3× thickness); deburring allowance (~0.05–0.2 mm); minimum laser slot width (≥1× thickness). Violating these rules makes tolerances unachievable regardless of the table values.

Flat Pattern vs. Formed Part Dimensioning

Tolerances on flat-pattern dimensions (before bending) are tighter than formed dimensions (after bending). Specify on your drawing which state is being controlled. A flat-pattern dimension within tolerance can produce an out-of-tolerance formed part due to springback or K-factor variation. Critical: datum features should be on flat (unformed) surfaces wherever possible to avoid accumulated bend error.

Contract & Procurement Use

This guide is for *design reference only*. Do not use as the sole specification in purchase orders or contracts. For binding specifications, reference applicable standards by number, revision, and clause (e.g., ISO 2768-m-K, ASTM A480 Table A2.5, JIS B 0408 Grade B). Always confirm achievable tolerances with your chosen fabricator before finalizing drawings.

Common Dispute Scenarios & How to Avoid Them

Free-state vs. restrained: A bent part measuring out-of-tolerance in free state may be in-tolerance when fixtured. Drawing must specify which condition governs acceptance. Recommended default: restrained for formed parts.

Springback / bend angle: Part is rejected for angle error, but fabricator argues springback was unaccounted for in the drawing. Resolution: agree on the measurement method (protractor, CMM, optical) and restrained vs. free-state before order. Angular tolerance on bent metal cannot be judged the same way as machined features.

Post-coating dimensional change: Part passes pre-coat inspection but fails after powder coating. Resolution: drawing must state whether tolerance applies

pre-coat or post-coat. For critical fits, specify pre-coat size with explicit post-coat allowance, or mask the feature.

Hole position across bends (Dim D/E): Fabricator cannot reliably hit ±0.25 mm across two bends. This is a design problem, not a fabrication defect. Use elongated slots at one side of the joint to absorb stack-up, and datum from a flat surface.

Material thickness variation in formed parts: Wall thickness after bending varies due to thinning on the outer radius. Do not measure formed-part thickness at a bend and compare to the raw gauge chart — these are different measurements. Gauge chart values apply to flat raw stock only.