MAX MACHINING

DFM Checklist

Design for manufacturing checks before you release the print. Page 1 machined parts, page 2 sheet metal.

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Machined parts MILLING AND TURNING

The drawing itself

- [ ] **Model and print agree.** Same revision on the model, the print and the purchase order.
- [ ] **Units and standard stated.** Inches or millimeters, and ASME Y14.5 with the year.
- [ ] **Tolerance block present.** Default tolerances for .X, .XX, .XXX and angles. Tight tolerances only where a function needs them.
- [ ] **Material fully called out.** Alloy, temper, form and specification (6061-T6 plate per ASTM B209, for example). Say if certs are required.
- [ ] **Finish fully called out.** Standard, type, class, color, thickness, and what to mask. Say whether dimensions apply before or after coating.
- [ ] **Edge break and burrs.** "Break all edges .005 to .015, remove burrs" unless a sharp edge is functional.
- [ ] **Datums on real faces.** Three datums on surfaces that can be fixtured and measured, in a sensible order.
- [ ] **Marking.** Method, location, content and font height. MIL-STD-130 if the contract requires it.

Pockets, walls and corners

- [ ] **Inside corner radii bigger than the tool.** Call out .130 instead of .125 so a 1/4 end mill clears the corner without dwelling. Radius at least 1/3 of the pocket depth where you can.
- [ ] **Depth to tool ratio under 4 to 1.** A pocket 1 inch deep with .125 corners needs a 1/4 end mill at 4 diameters deep. Deeper means chatter and cost.
- [ ] **Floor radii sized to a standard tool.** Or leave them sharp; sharp floors are free, radiused floors need a ball or bull nose.
- [ ] **Walls thick enough to hold still.** .030 in aluminum, .020 in steel for short walls. Tall thin walls deflect and ring.
- [ ] **Outside corners can be sharp.** Inside corners cannot. If a sharp inside corner is needed, add a relief or plan for EDM.
- [ ] **Undercuts and grooves are standard sizes** and reachable with a standard tool.

Holes and threads

- [ ] **Standard drill sizes** for clearance and tap drills. Odd diameters mean reaming or boring.
- [ ] **Depth under 10 diameters.** Deeper holes need peck cycles, gun drills or a second setup.
- [ ] **Blind holes leave room for the drill point** and the tap chamfer. Thread depth plus about 3 pitches of unthreaded hole.
- [ ] **Thread depth 1.5 to 2 diameters.** Strength does not improve past that; tap wear and cost do.
- [ ] **Thread class only when it matters.** 2B / 6H is the default and is right for almost everything.
- [ ] **Inserts for aluminum that gets assembled often.** Helical inserts or key inserts, with the STI drill from our chart.
- [ ] **Holes a full diameter from an edge** and not breaking into other features unless intended.
- [ ] **Position with GD&T at MMC** where the hole is for a fastener. It is cheaper to make and easier to inspect than ± coordinates.

Tolerance and finish

- [ ] **±.005 is the shop norm.** ±.001 is possible and costs more on every operation that touches it. ±.0005 means grinding or extra time; call it out only where needed.
- [ ] **Flatness and parallelism tied to real function.** A sealing face needs it; a mounting foot usually does not.
- [ ] **Surface finish 125 Ra default.** 63 for seals and cosmetic faces. Below 32 is a different process.
- [ ] **Tolerances survive the finish.** Hard anodize grows .001 per side at .002 thick. Plating adds thickness. Say which dimensions apply after coating.
- [ ] **Inspection needs stated.** FAI per AS9102, ballooned report, CofC, material certs, finish certs. Say it on the print or the PO, not after delivery.

RULE OF THUMB

Every tolerance tighter than the tolerance block, every radius smaller than a standard tool, and every finish without a spec costs money or a phone call. Check the boxes, then send the print. We review every drawing before quoting and will flag anything we missed here.

Sheet metal LASER CUTTING, FORMING, HARDWARE

Material and thickness

- [ ] **Thickness as a decimal with the material.** ".060 5052-H32" beats "16 gauge": gauge differs by material.
- [ ] **One thickness per part.** Sheet metal parts are one uniform thickness.
- [ ] **Grain direction noted** for cosmetic brushed parts and for tight bends in hard tempers (bend across the grain).
- [ ] **Material spec and certs** if required: ASTM B209 for aluminum sheet, ASTM A1008 for CRS, ASTM A240 for stainless.

Bends

- [ ] **Inside bend radius at least 1T** for aluminum and steel, 1.5T for stainless over .125, 2.5T for 6061-T6. One radius for the whole part.
- [ ] **Minimum flange about 4T** (half the V die plus radius plus thickness). Short flanges bend crooked or not at all.
- [ ] **Bend relief at every bend that ends inside an edge.** Width at least T, depth at least R + T.
- [ ] **Holes 2.5T + R from a bend**, slots 4T + R. Closer and they stretch into ovals.
- [ ] **Hems: open hem inside diameter at least 1T**, tear drop hems for aluminum. No closed hems in 6061.
- [ ] **Bend angle tolerance ±1°** and bend to bend ±.015 is normal sheet metal. Tighter needs a fixture and a conversation.
- [ ] **Dimension the formed part, not the flat.** Send the formed model. If you send a flat, state the K factor and radius you used.

Holes, hardware and features

- [ ] **Laser holes at least 60 percent of thickness.** Smaller holes get drilled after cutting; say so or let us.
- [ ] **Holes at least 2T from an edge**, 1T absolute minimum.
- [ ] **PEM hardware called out by part number, quantity and side.** Hole size comes from the data sheet; minimum sheet thickness and edge distance too.
- [ ] **Countersinks need thickness.** Keep the countersink depth under 60 percent of T, or use a dimple or a flat head PEM.
- [ ] **Notches at least 1.5T wide** and no deeper than 5 times their width. Tabs at least 2T wide.
- [ ] **Slots and cutouts clear the bend zone** or they distort during forming.
- [ ] **Text and logos** by laser etch or engrave: font height .100 minimum for etch, say which surface.

Finish, welding and tolerance

- [ ] **Powder coat adds 2 to 6 mil.** Mask threads and fits or oversize them. Mark the show surface and the color (RAL) and gloss.
- [ ] **Plating under powder for outdoor parts.** Chem film on aluminum, zinc on steel.
- [ ] **Welds called out** with type, size, length and finish (as welded, ground flush). Leak test if the part holds anything.
- [ ] **Edge finish stated.** As cut, deburred, tumbled, brushed or coated. Deburred is the default if you say nothing.
- [ ] **Flat feature tolerance ±.010**, formed features ±.015, hole to hole across a bend ±.015. Call out tighter only where hardware needs it.
- [ ] **Assembly drawing if hardware installs** or parts weld together, with the hardware list and orientation.

SEND THE FORMED MODEL

A STEP of the formed part plus the print is all we need. We unfold with our own K factors for our press brakes, which is why your flat pattern is a reference, not the controlling document.