Dynamic Stampings, Inc.®

METAL STAMPING GUIDELINES

Presented by

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These guidelines are intended to assist you understand, design and buy short run metal stampings more efficiently and economically. It does not cover all possibilities but rather contains basic rules of thumb. Dynamic Stampings is always available to assist with design assistance.

Material Selection

Over-specifying a material grade and blank thickness are major factors that drive up the cost of metal stamping. There are many choices of materials that will respond well to metal stamping and forming processes. However, the price and availability can vary in a wide range, so it has significant impact on the cost and delivery of production. The following are some key factors that should be taken into consideration when selecting the material and specifying physical characteristics of the material.

Most common material grades are offered in standard gage thicknesses and tolerances. These sizes are usually readily available as stock items and are generally the best choice when cost and delivery are a major factor.

Blank Design: Minimum area should never be less than material thickness or .060" and is suggested to be a minimum of one and one half times material thickness.

Radiuses and Corners: Can be sharp if material thickness is 1/16" or less. If material is over 1/16", corner radius should be no less than 1/2 material thickness.

Piercing Round Holes: Hole diameters should not be less than the material thickness and/or .060" in diameter. If less than material thickness or .060", the hole must be drilled rather than punched.

Material Webs

If the material web, which is the distance between the hole and edge of material, is a minimum of the stock thickness, the hole can be punched in the blank and pierce die. However, if the material web is less than material thickness, the hole must be punched in a secondary operation which increases cost. A web that is less than the material thickness and punched in a secondary operation will result in distortion on the blank periphery. This distortion is hardly visible until the web is reduced to less than 1/2 material thickness. The amount of distortion will increase progressively as the web decreases, becomes to thin and breaks through.

Piercing Holes—Adjacent To Bends

The recommended minimum inside distance from the edge of a hole to a bend is 1-1/2 times the material thickness plus the bend radius. If this distance is less, distortion is likely to occur. If distortion is not acceptable, the hole must be punched after forming, in a separate operation. This will increase your stamping costs.

Flatness Tolerances: Commonly used flatness tolerances for metal stamping are: Flatness will not be guaranteed better than .004" per inch for the first two inches; .003" for every inch thereafter.

Tolerances: Dimensional tolerances will be maintained unless otherwise specified. If no tolerances are indicated, standard tolerances are +/- .005" on lineal dimensions +/-.0015" on hole diameters. Angles will be held to +/-1°.

Edge Condition – Burr: Industry standard for a commercial burr is no burr can exceed 10% of material thickness. However, Dynamic Stampings will guarantee that its commercial burr will be held to less than 5% of material thickness. Removal of a burr can be achieved cost effectively through vibratory deburring or sanding.

Bends: It is necessary to take special care in designing bends in your stamping to avoid material tearing. To avoid this, design the blank profile to allow bend relief where possible. This eliminates fatigue under stress. The result is higher quality part.

Dimensioning

Whenever dimensioning to a form, the dimensions should be given to the inside of the material. This eliminates the variation in material thickness affecting the dimension.

Extrusions

An extrusion is to increase the material thickness to achieve more bearing surface or more threads for tapping. Maximum height is usually 1 material thickness. A cost effective alternative to an extruded and tapped hole is the use of inserted hardware (PEM fasteners).

Glossary of Terms

Barrel Tumbling: Process in which parts to be deburred are put together with abrasive material into a barrel and rotated for prolonged periods for the purpose of burr removal and edge rounding.

Bend Radius: Should always be dimensioned as an inside radius.

Bend Relief: Clearance notch at an end flange to allow bending without distorting or tearing adjacent material.

Bending: Generally applied to forming. Creation of a formed feature by angular displacement of a sheet-metal work piece.

Blank: The flat piece of sheet metal stock cut to shape by stamping or cutting and before forming or other secondary operations performed.

Blanking: Stamping of the outside shape of a part.

Bow Distortion: Out of flatness condition in sheet material commonly known as "Oil Canning" in which, with the edges of the sheet restrained, the center of the sheet can be popped back and forth but cannot be flattened without specialized equipment.

Breakout: Fractured portion of the cross section of a cut edge of stock. A condition naturally occurring during shearing, blanking, punching, and other cutting operations.

Burn Mark: Heat discoloration created in the contact area of a welding electrode.

Burr: Raised, sharp edge inherent in cutting operations such as shearing, blanking, punching and drilling.

Burr Direction: Side of the stock on which burrs appear.

Burr-Free: Edge without sharp protrusions.

Burr Height: Height to which burr is raised beyond the surface of the material.

Burr Rollover: Condition of burr displacement resulting from mechanical deburring operation.

Clamp Marks: Slight indentations at the edge of one side of stock caused by pressure from turret press holding devices.

Coining: Compressive metal flowing action.

Compound Die: Tool used to pierce, form and blank a part at the same time, with one stroke of the press.

Concentricity: Dimensional relationship of 2 or more items sharing a common center line.

Corner: Three surfaces meeting at one point.

Corner Radius: Outside radius.

Counterboring: Machining or coining operation to generate a cylindrical flat-bottomed hole.

Countersinking: Machining or coining operation to generate a conical angle on a hole.

Deburr: To remove the sharp, knife-like edge from parts.

Dedicated Tooling: Commonly referred to as "hard tooling" is tooling made to produce a specific part.

Die: Tool with a void or cavity which is precisely fitted to a "Punch" used to shear or form sheet metal parts.

Die Clearance: Amount of space between the punch and die opening.

Die Marks: Scratches, scrub marks, indentations, galling or burnishing of sheet metal work pieces by tooling.

Draw: The stretching or compressing of a sheet metal part into a die by a punch to create a 3-dimensional part.

Drawing: Engineering document depicting a part or assembly.

Ductility: Ability of a material to be bent or otherwise formed without fracture.

Edge Bulge: Condition resulting from any forming, piercing, hardware insertion, or spot welding operation too close to an edge.

Edge-to-Feature: A dimension between the edge of the part and a feature.

Feature-to-Feature: Dimension between two features on a part.

Flange: Formed projection or rim of a part generally used for stiffness or assembly.

Formed Tab: Small flange bent at an angle from the body of a metal workpiece.

Forming: Operation converting a flat sheet metal workpiece into a three dimensional part.

Gauge: 1) Instrument for measuring, testing, or registering. 2) Numeric scale for metal thickness.

Gouge: Surface imperfection, deeper than a scratch, often with raised edges.

Grain Direction: 1) Crystalline orientation of material in the direction of mill rolling. 2) Orientation of a surface finish generated by abrasive method.

Grinding: Process of removing material by abrasion.

Hard Tooling: Tooling made for a specific part. Also called "dedicated tooling".

Hem (Dutch Bend): Edge of material doubled over onto itself for the purpose of safe handling or to increase edge stiffness.

Hole Rollover: Rounding of the top edge of a pierced feature caused by the ductility of the metal, which flows in the direction of the applied force.

Hole-to-Form: Distance from the edge of a hole to the inside edge of a formed feature.

Hole-to-Hole: Dimension between the centers of holes.

Metal Thinning: Thickness reduction during any forming operation.

Nesting: 1) Grouping of identical or different parts in multiples within a workpiece to conserve material. 2) In packaging, stacking of parts whose shape permits one to fit inside another.

Nibble Marks: Slight irregularities on the edge of the stock surface after progressive punching and/or turret punch press operation.

Notching: Operation in which the punch removes material from the edge or corner of a strip or blank.

Penetration: 1) Depth of a cutting operation before breakout occurs. 2) In welding, the depth of material through which fusion occurs.

Perpendicularity: Dimensional relationship of a part or datum located at right angles (90°) to a given feature.

Piercing: Punching of openings such as holes and slots in material.

Progressive Tool: Die using multiple stations or operations to produce a variety of options. Can incorporate piercing, forming, extruding and

drawing, and is usually applied to high quantity production runs.

Pull Down: Area of material next to the penetrating edge of a piercing punch, or die edge of the blanking station, where the material yields, i.e. flows in the direction of the applied force, creating a rounded edge. Also known as "roll-over".

Punch Press: Machine supplying compression force for cutting or reshaping materials.

Scrap: Leftover, unused material relegated to recycling.

Shear-to-Feature: Shearing of an edge of stock to an exact dimension from an already existing feature.

Shearing: Cutting force applied perpendicular to material causing the material to yield and break.

Shut Height: Clearance in a press between ram and bed with ram down and adjustment up.

Slug: Scrap from a piercing operation.

Squareness: Measure of perpendicularity of adjacent edges or surfaces.

Spring Back: Partial rebounding of formed material caused by its elasticity.

Staking: Method of fastening using displaced material for retention.

Stiffening Rib: Embossed feature in a sheet metal workpiece which is added to make the part more rigid.

Stripper: Mechanical hold-down device applied to the workpiece during the punching process.

Stripper Marks: Imprints on one side of the stock around pierced holes, caused by punch strippers.

Stripping: Process of disengaging tooling from the workpiece.

Strips: Sheet material, sheared into narrow long pieces.

Tapping: Operation to create internal threads by either cutting or forming.

Tolerance: Permissible variation from a specification for any characteristic of the product.

Transfer Die: Variation of a progressive die where the part is transferred from station to station by a mechanical system. Mainly used where the part has to be free from the strip to allow operations to be performed in a free state.

Turret Press: Automatic punch press indexing the material and selecting the intended tool out of the rotary tool holding device (turret) totally by computer control for piercing, blanking and forming work pieces as programmed.

V Die: Tool used in conjunction with a V punch.

V Punch: Vee shaped tool used for angle forming.

Vibratory Finishing: Burr removal process in which an appropriate number of parts, depending on part size and abrasive material, is accelerated and decelerated by mechanical means inside of a drum-like enclosure.

Webs: Material between two openings or edges.

Material Gauges—Steel

	Thickness		Weight Per Area	
Gauge	in	mm	lb/ft²	kg/m²
4	0.2242	5.695	9.146	44.656
5	0.2092	5.314	8.534	51.668
6	0.1943	4.935	7.927	38.701
7	0.1793	4.554	7.315	35.713
8	0.1644	4.176	6.707	32.745
9	0.1495	3.797	6.099	29.777
10	0.1345	3.416	5.487	26.790
11	0.1196	3.038	4.879	23.822
12	0.1046	2.657	4.267	20.834
13	0.0897	2.278	3.659	17.866
14	0.0747	1.897	3.047	14.879
15	0.0673	1.709	2.746	13.405
16	0.0598	1.519	2.440	11.911
17	0.0538	1.367	2.195	10.716
18	0.0478	1.214	1.950	9.521
19	0.0418	1.062	1.705	8.326
20	0.0359	0.912	1.465	7.151
21	0.0329	0.836	1.342	6.553
22	0.0299	0.759	1.220	5.955
23	0.0269	0.683	1.097	5.358
24	0.0239	0.607	0.975	4.760
25	0.0209	0.531	0.853	4.163
26	0.0179	0.455	0.730	3.565
27	0.0164	0.417	0.669	3.267
28	0.0149	0.378	0.608	2.968
29	0.0135	0.343	0.551	2.689
30	0.0120	0.305	0.490	2.390
31	0.0105	0.267	0.428	2.091
32	0.0097	0.246	0.396	1.932
33	0.0090	0.229	0.367	1.793
34	0.0082	0.208	0.335	1.633
35	0.0075	0.191	0.306	1.494

Material Gauges—Stainless Steel

	Thickness		Weight Per Area	
Gauge	in	mm	lb/ft²	kg/m²
4	0.2344	5.954	9.755	47.627
5	0.2187	5.555	9.101	44.437
6	0.2031	5.159	8.452	41.267
7	0.1875	4.763	7.803	38.098
8	0.1719	4.366	7.154	34.928
9	0.1562	3.967	6.500	31.728
10	0.1406	3.571	5.851	28.568
11	0.1250	3.175	5.202	25.398
12	0.1094	2.779	4.553	22.229
13	0.0937	2.380	3.899	19.039
14	0.0781	1.984	3.250	15.869
15	0.0703	1.786	2.926	14.284
16	0.0625	1.588	2.601	12.699
17	0.0562	1.427	2.339	11.419
18	0.0500	1.270	2.081	10.159
19	0.0437	1.110	1.819	8.879
20	0.0375	0.953	1.561	7.260
21	0.0344	0.874	1.432	6.990
22	0.0312	0.792	1.298	6.339
23	0.0281	0.714	1.169	5.710
24	0.0250	0.635	1.040	5.080
25	0.0219	0.556	0.911	4.450
26	0.0187	0.475	0.778	3.800
27	0.0172	0.437	0.716	3.495
28	0.0156	0.396	0.649	3.170
29	0.0141	0.358	0.587	2.865
30	0.0125	0.318	0.520	2.540
31	0.0109	0.277	0.454	2.215
32	0.0102	0.259	0.424	2.073
33	0.0094	0.239	0.391	1.910
34	0.0086	0.218	0.358	1.747

Material Gauges—Aluminum

	Thickness		Weight Per Area	
Gauge	in	mm	lb/ft²	kg/m²
4	0.2043	5.189	2.883	14.076
5	0.1819	4.620	2.567	12.533
6	0.1620	4.115	2.286	11.162
7	0.1443	3.665	2.036	9.942
8	0.1285	3.264	1.813	8.854
9	0.1144	2.906	1.614	7.882
10	0.1019	2.588	1.438	7.021
11	0.0907	2.304	1.280	6.249
12	0.0808	2.052	1.140	5.567
13	0.0720	1.829	1.016	4.961
14	0.0641	1.628	0.905	4.417
15	0.0571	1.450	0.806	3.934
16	0.0508	1.290	0.717	3.500
17	0.0453	1.151	0.639	3.121
18	0.0403	1.024	0.569	2.777
19	0.0359	0.912	0.507	2.474
20	0.0320	0.813	0.452	2.205
21	0.0285	0.724	0.402	1.964
22	0.0253	0.643	0.357	1.743
23	0.0226	0.574	0.319	1.557
24	0.0201	0.511	0.284	1.385
25	0.0179	0.455	0.253	1.233
26	0.0159	0.404	0.224	1.096
27	0.0142	0.361	0.200	0.978
28	0.0126	0.320	0.178	0.868
29	0.0113	0.287	0.159	0.779
30	0.0100	0.254	0.141	0.689
31	0.0089	0.226	0.126	0.613
32	0.0080	0.203	0.113	0.551
33	0.0071	0.180	0.100	0.489
34	0.0063	0.160	0.089	0.434
35	0.0056	0.142	0.079	0.386