TSM
Thermal Solutions Manufacturing, Inc.

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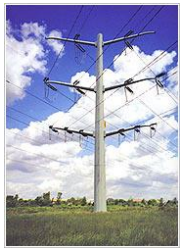
Engineered Manufacturing

My Background

Phoenix USA Inc. – Design Engineer

Thomas & Betts – Drafter/Designer



TACO Metals – Design Engineer

My Future

Thermal Solutions Mfg.

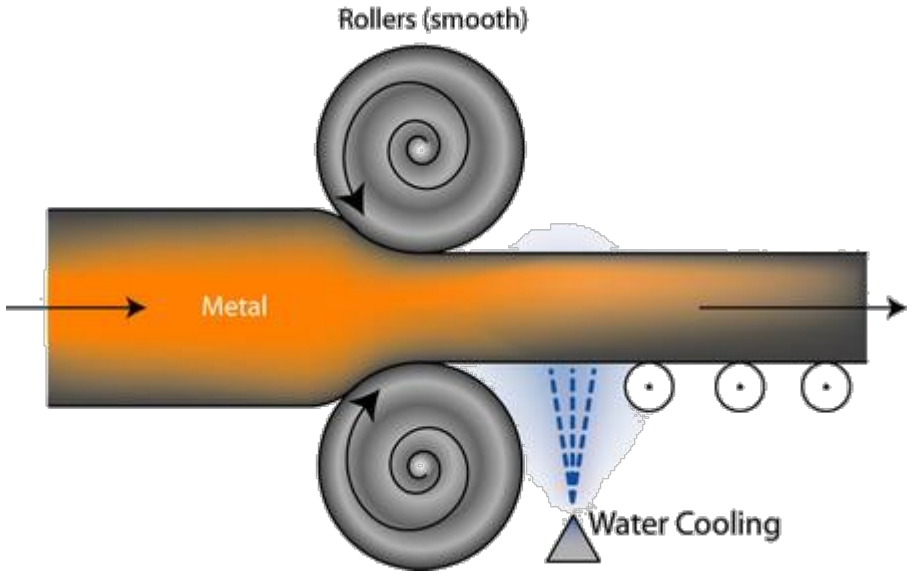
Happy Birthday to me!

Common Industry Material Types

- **Steel**
  - Cold Rolled
  - Hot Rolled
- **Stainless Steel**
  - 304
  - 316

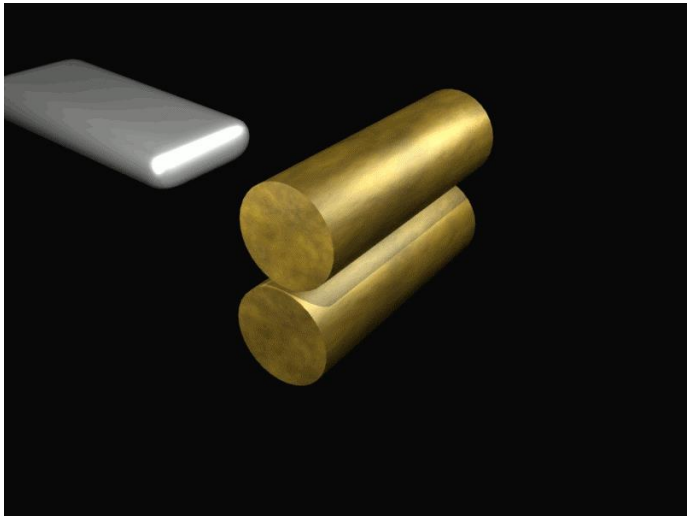
Hot Rolled Steel

- Hot rolling is a mill process which involves rolling the steel at a high temperature
- Hot rolled steel is typically cheaper than cold rolled steel due to the fact that it is often manufactured without any delays in the process, and therefore the reheating of the steel is not required
- When the steel cools off it will shrink slightly thus giving less control on the size and shape of the finished product when compared to cold rolled.



Cold Rolled Steel

- Cold rolled steel is essentially hot rolled steel that has had further processing.
- The material is cooled (at room temperature) followed by annealing and/or tempers rolling.
- Cold rolling increases the strength and hardness and decreases ductility of steel. In addition to improvement of mechanical properties, cold rolling results in more control over the shape and dimensions of the finished product.



304 Stainless Steel

- Type 304, with its chromium-nickel content and low carbon, is the most versatile and widely used of the austenitic stainless steels. Cheaper than 316 SS.
- Applications for this group of alloys are varied and all provide ease of fabrication and cleaning, prevention of product contamination
- Applications including auto molding and trim, wheel covers, kitchen equipment, hose clamps, springs, truck bodies, exhaust manifolds, storage tanks, pressure vessels and piping.

316 Stainless Steel

- Type 316 is an austenitic chromium-nickel stainless and heat-resisting steel with superior corrosion resistance.
- It has a greater resistance to chemical attack than the 304 family.
- It is durable, easy-to-fabricate, clean, weld and finish.
- This is an advantage for objects that require resistance to extreme environmental conditions such as salt water, de-icing salts, brine solutions, or other chemical forms of chemical exposure.

Material Protection

- **Pickled - is a metal surface treatment used to remove impurities, such as stains, inorganic contaminants, rust or scale from ferrous metals, copper, precious metals and aluminum alloys.**
- **Galvanizing - is the process of applying a protective zinc coating to steel or iron, to prevent rusting. Galvanized steel is widely used in applications where corrosion resistance is needed without the cost of stainless steel.**

Material Gauges

- **Not all gauges are created equal.**

11GA

Brass Sheet = .09074”

Steel Sheet = .1196”

Stainless = .125”

Galvanized = .1233”

	Brass and Aluminum Sheets		Cold and Hot Rolled Steel Sheets		Aluminum, Brass, Copper, Steel Tubes, Copper Sheets, Hoop Steel		Stainless Steel Sheets		Galvanized Steel Sheets		
	AMERICAN OR BROWNE & SHAPE		MANUFACTURERS STANDARD		BIRMINGHAM WIRE GAUGE		UNITED STATES STANDARD		GALVANIZED SHEET GAUGE		
GA	Inches	MM	Inches	MM	Inches	MM	Inches	MM	Inches	MM	GA
3	.2294	5.827	.2391	6.073	.259	6.579					3
4	.2043	5.189	.2242	5.694	.238	6.045					4
5	.1819	4.620	.2092	5.313	.220	5.588					5
6	.1620	4.115	.1943	4.935	.203	5.156					6
7	.1443	3.665	.1793	4.554	.180	4.572					7
8	.1285	3.264	.1644	4.175	.165	4.191	.17187	4.365	.1681	4.269	8
9	.1144	2.906	.1495	3.797	.148	3.759	.15625	3.968	.1532	3.891	9
10	.1019	2.588	.1345	3.416	.134	3.404	.14062	3.571	.1382	3.510	10
11	.09074	2.305	.1196	3.038	.120	3.048	.125	3.175	.1233	3.1318	11
12	.08081	2.053	.1046	2.656	.109	2.769	.10937	2.778	.1084	2.753	12
13	.07196	1.828	.0897	2.278	.095	2.413	.09375	2.381	.0934	2.372	13
14	.06408	1.628	.0747	1.897	.083	2.108	.07812	1.984	.0785	1.9939	14
15	.05707	1.450	.0673	1.709	.072	1.829	.07031	1.785	.0710	1.803	15
16	.05082	1.291	.0598	1.518	.065	1.651	.0625	1.587	.0635	1.6129	16
17	.04526	1.150	.0538	1.366	.058	1.473	.05625	1.4287	.0575	1.460	17
18	.04030	1.024	.0478	1.214	.049	1.245	.050	1.270	.0516	1.310	18
19	.03589	.912	.0418	1.061	.042	1.067	.04375	1.111	.0456	1.158	19
20	.03196	.812	.0359	.911	.035	.889	.0375	.9525	.0396	1.005	20
21	.02846	.23	.0329	.835	.032	.813	.03437	.873	.0366	.929	21
22	.02535	.644	.0299	.759	.028	.711	.03125	.7937	.0336	.853	22
23	.02257	.573	.0269	.683	.025	.635	.02812	.714	.0306	.777	23
24	.02010	.511	.0239	.607	.022	.559	.025	.635	.0276	.701	24
25	.01790	.455	.0209	.531	.020	.508	.02187	.555	.0247	.627	25
26	.01594	.405	.0179	.454	.018	.457	.01875	.476	.0217	.551	26
27	.01420	.361	.0164	.416	.016	.406	.01718	.436	.0202	.513	27
28	.01264	.321	.0149	.378	.014	.356	.01562	.396	.0187	.474	28
29	.01126	.286	.0135	.343	.013	.330	.01406	.357	.0172	.436	29
30	.01003	.255	.0120	.305	.012	.305	.0125	.3175	.0157	.398	30

Radius Selection

MILD STEEL Recommended Bend Allowance

BEND RADIUS	THICKNESS OF MILD STEEL							
	0.022	0.032	0.040	0.051	0.064	0.091	0.128	0.187
	Bend Allowance in inches per Degree							
1/32	0.00072	0.00079	0.00086	0.00094	0.00104	0.00125	0.00154	0.00200
1/16	0.00126	0.00135	0.00140	0.00149	0.00159	0.00180	0.00209	0.00255
3/32	0.00180	0.00188	0.00195	0.00203	0.00213	0.00234	0.00263	0.00309
1/8	0.00235	0.00243	0.00249	0.00258	0.00268	0.00289	0.00317	0.00364
5/32	0.00290	0.00297	0.00304	0.00312	0.00322	0.00343	0.00372	0.00418
3/16	0.00344	0.00352	0.00358	0.00367	0.00377	0.00398	0.00426	0.00473
7/32	0.00398	0.00406	0.00412	0.00421	0.00431	0.00452	0.00481	0.00527
1/4	0.00454	0.00461	0.00467	0.00476	0.00486	0.00507	0.00535	0.00582
9/32	0.00507	0.00515	0.00521	0.00530	0.00540	0.00561	0.00590	0.00636
5/16	0.00562	0.00570	0.00576	0.00584	0.00595	0.00616	0.00644	0.00691
11/32	0.00616	0.00624	0.00630	0.00639	0.00649	0.00670	0.00699	0.00745
3/8	0.00671	0.00679	0.00685	0.00693	0.00704	0.00725	0.00753	0.00800
13/32	0.00725	0.00733	0.00739	0.00748	0.00758	0.00779	0.00808	0.00854
7/16	0.00780	0.00787	0.00794	0.00802	0.00812	0.00834	0.00862	0.00908
15/32	0.00834	0.00842	0.00848	0.00857	0.00867	0.00888	0.00917	0.00963
1/2	0.00889	0.00896	0.00903	0.00911	0.00921	0.00943	0.00971	0.01017
17/32	0.00943	0.00951	0.00957	0.00966	0.00976	0.00997	0.01025	0.01072
9/16	0.00998	0.01005	0.01012	0.01020	0.01030	0.01051	0.01080	0.01126
19/32	0.01051	0.01058	0.01065	0.01073	0.01083	0.01105	0.01133	0.01179
5/8	0.01107	0.01114	0.01121	0.01129	0.01139	0.01160	0.01189	0.01235
21/32	0.01161	0.01170	0.01175	0.01183	0.01193	0.01214	0.01245	0.01289
11/16	0.01216	0.01223	0.01230	0.01238	0.01248	0.01268	0.01298	0.01344
23/32	0.01269	0.01276	0.01283	0.01291	0.01301	0.01322	0.01351	0.01397
3/4	0.01324	0.01332	0.01338	0.01347	0.01357	0.01378	0.01407	0.01453

Calculating Blank Length

BENDING FORMULA

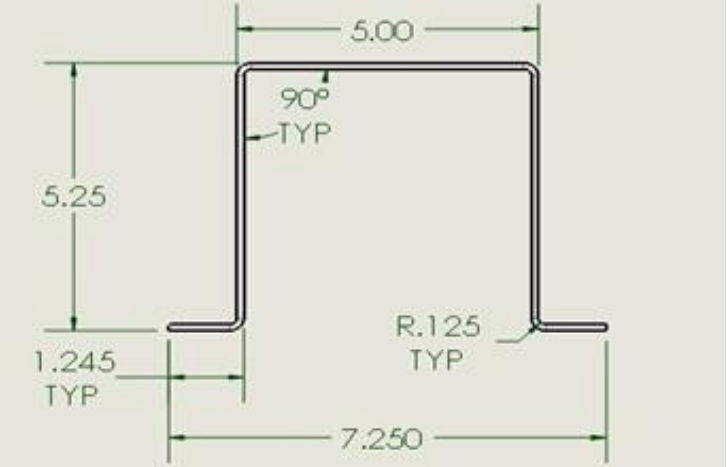
(1.309 X MATERIAL THICKNESS) + (.44 X BEND RADIUS) = BEND DEDUCTION

For example:

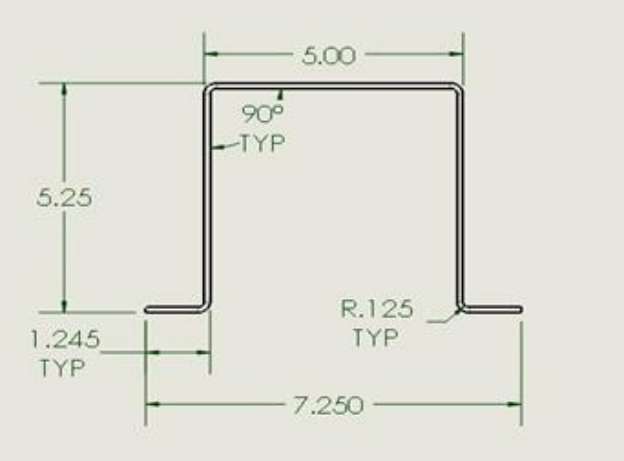
11GA HR Steel = .120” thick

Bend radius = .125”

(1.309 X .120) + (.44 X .125) = .21208 round to three decimal places .212



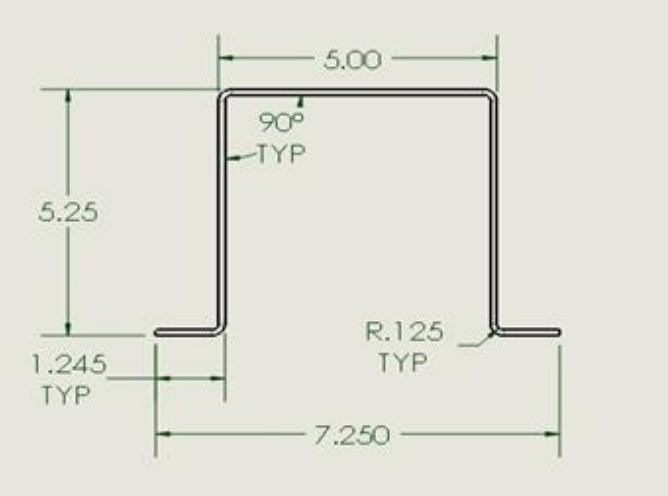
Calculating Blank Length

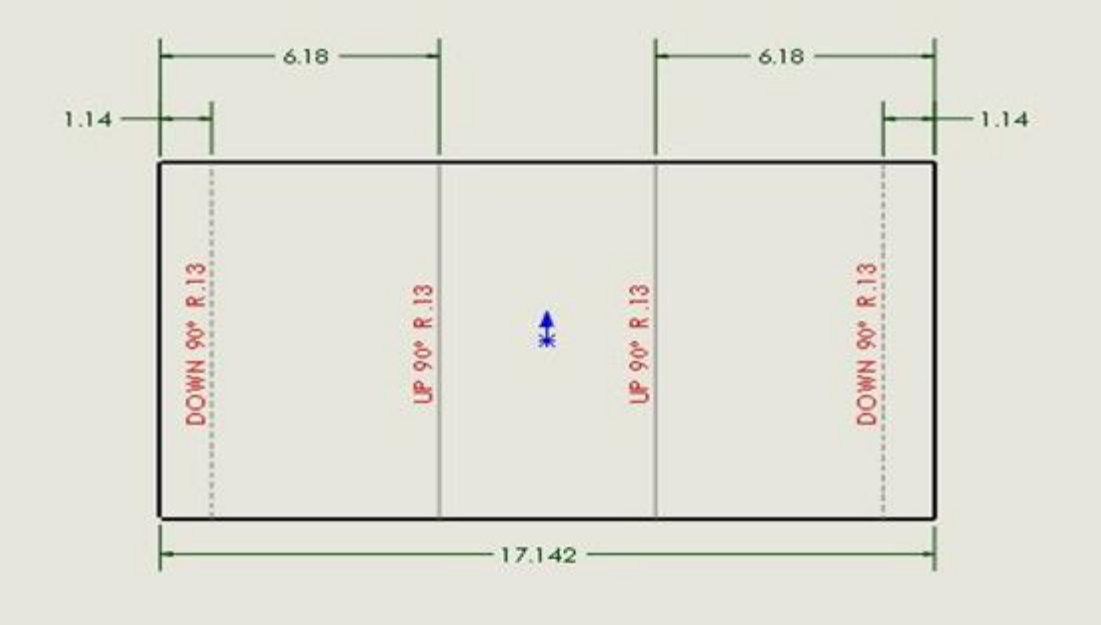


1.245 + 5.25 + 5.00 + 5.25 +1.245 = 17.99

17.99 - .212 Bend Deduction= 17.142” unfolded blank length

Bend Line Placement





To calculate the first bend line: 1.14”

Flange 1.245 – ½ Bend Deduction = 1.139”

To calculate the second bend line: 6.18”

Add flange 1.245” + 5.25” – 1 ½ bend deduction = 6.177”

Bending Sequence

- Layout of bending lines

Bending Sequence

- Machine Set-Up

Bending Sequence

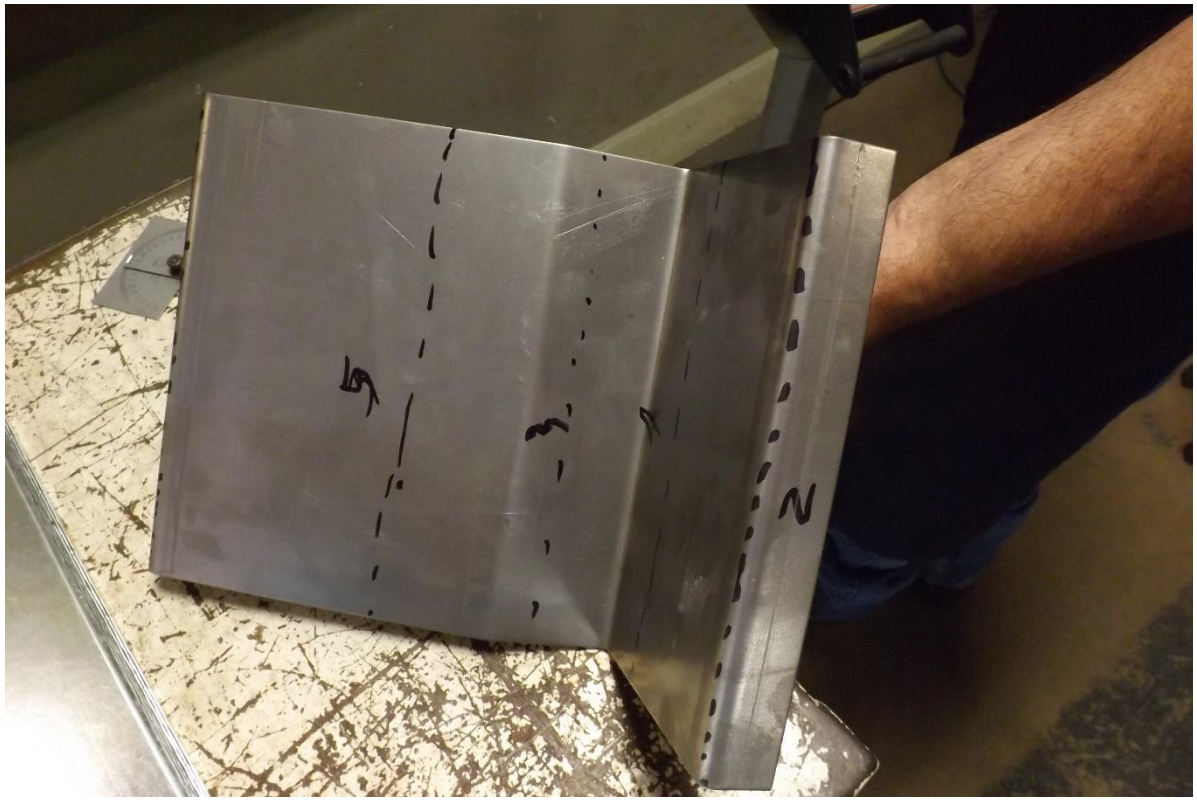
- First Bend

Bending Sequence

- Second Bend

Bending Sequence

- Third Bend

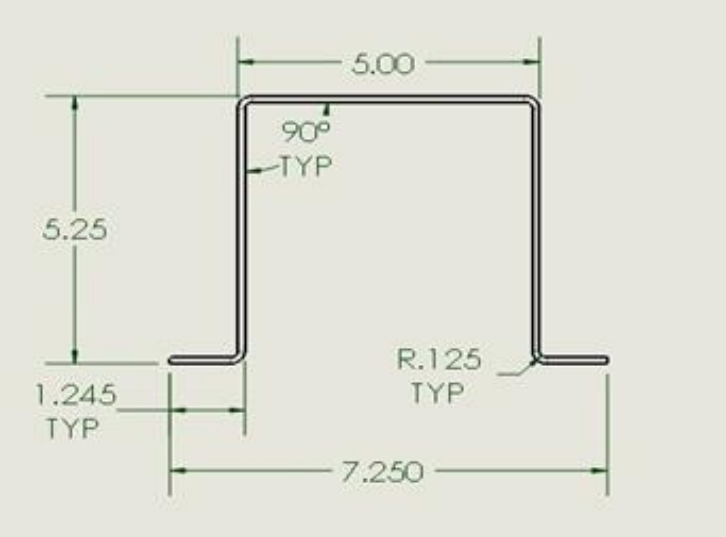


Bending Sequence

- Final Bend

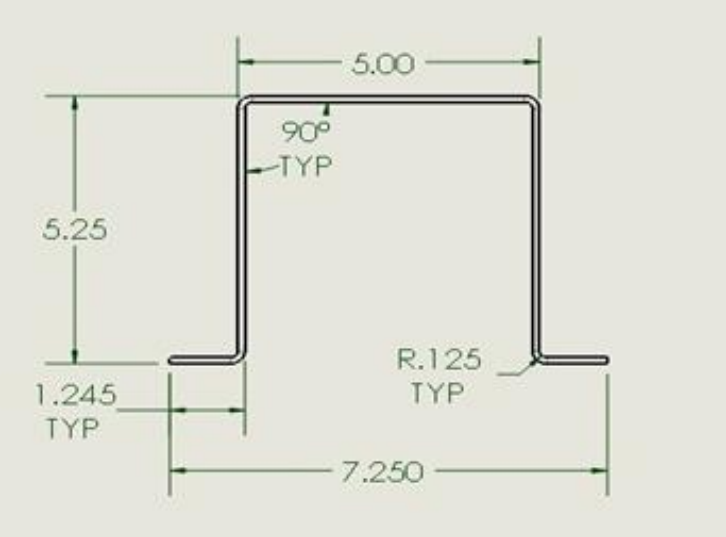
Bending Sequence

- Layout of bending lines



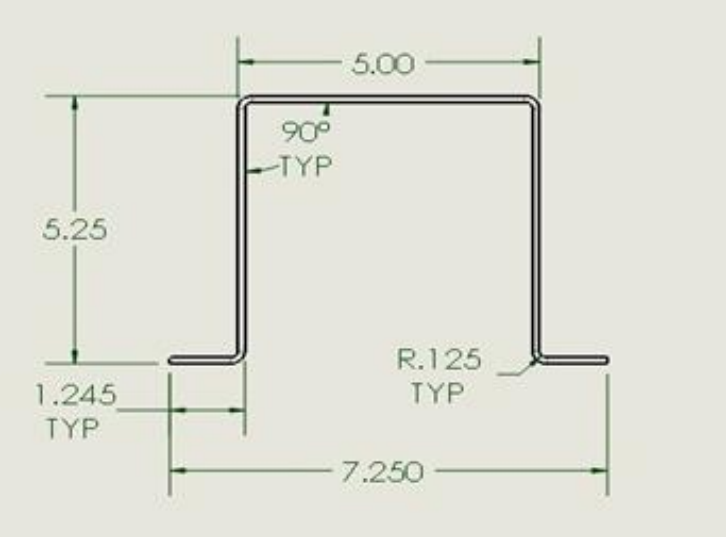
Bending Sequence

- Layout of bending lines



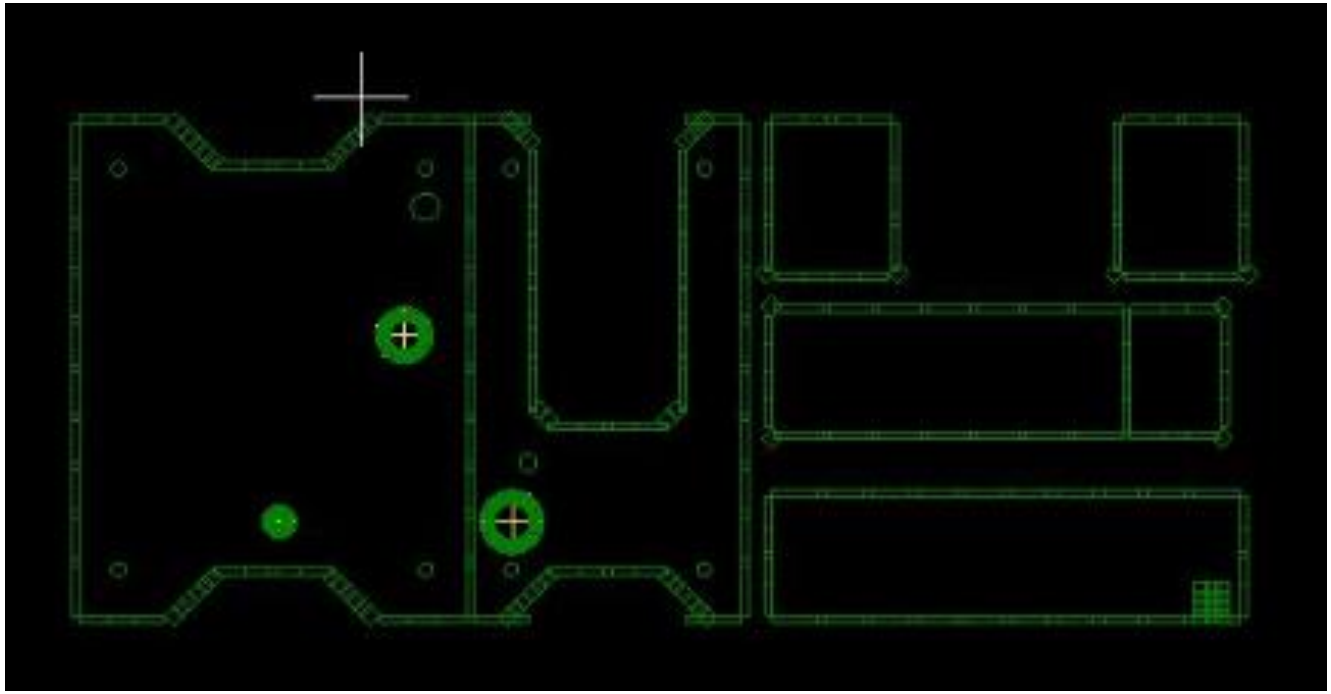
Bending Sequence

- Layout of bending lines



Part Duplication

Free 2D software: Draft Sight
3D Software: SolidWorks
Punch Program: Merry Mech.



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Thank you!