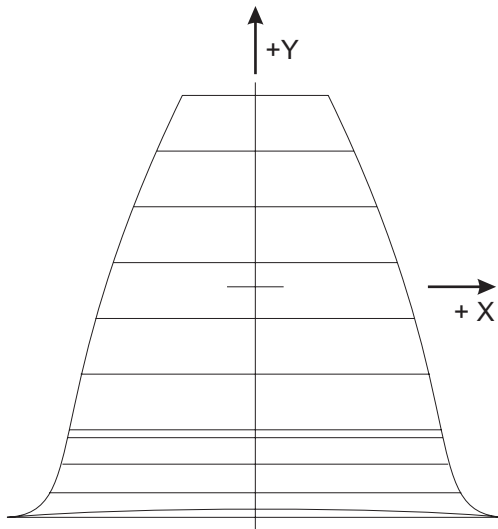


How to Draw Involute Gear Teeth

Using formulas presented in Earle Buckingham's 1950 Edition of Analytical Mechanics of Gears, (see references) we have calculated Cartesian, X-Y coordinates for 14½° and 20° Full Depth gear teeth, and a 30° involute spline.

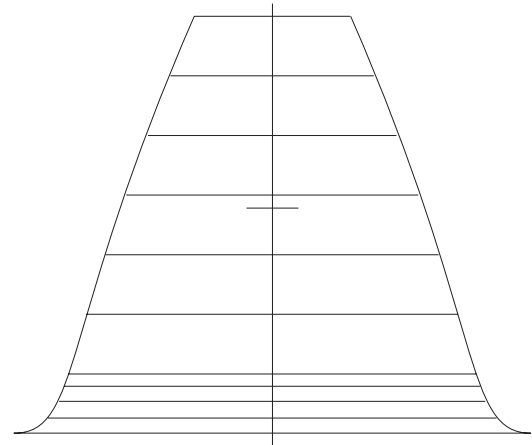
Below are some samples. They are full size diagrams of 1 DP, 25.4 mod hobbed gear teeth, with bottom clearance of 0.157", 3.988 mm. The tables below the diagrams show the (4) points we used to lay out the fillet of the tooth, and the (7) points we used for the involute flanks.

The long horizontal lines are included just to show how the tooth drawing was constructed. They connect the + and - X points for each Y point. The short horizontal line in the middle is the center of the tooth on the pitch line, and zero on the X-Y coordinates. Dimensions in inches.



40 T, 20° Full Depth

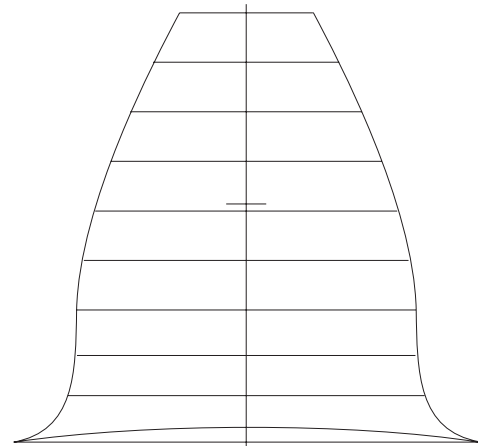
Fillet		Involute	
X	Y	X	Y
1.293	-1.201	0.969	-0.745
1.072	-1.073	0.909	-0.455
1.004	-0.924	0.831	-0.165
0.977	-0.786	0.738	0.126
		0.632	0.417
		0.512	0.707
		0.380	0.997



120 T 20° Full Depth

Fillet		Involute	
1.346	-1.172	1.063	-0.864
1.168	-1.094	0.968	-0.553
1.110	-1.007	0.867	-0.243
1.083	-0.928	0.760	0.068
		0.647	0.378
		0.529	0.689
		0.406	0.999

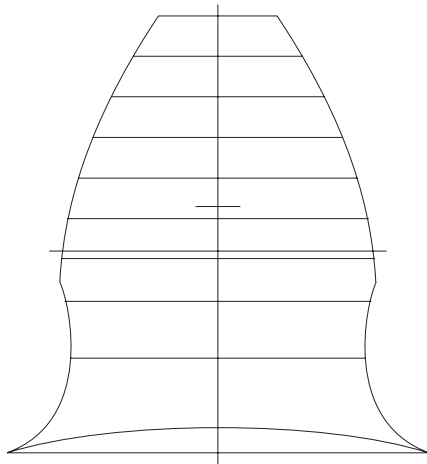
120 T flanks are almost straight.



20 T, 20° Full Depth

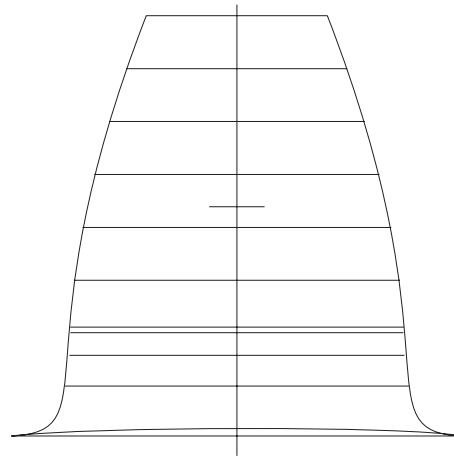
Fillet		Involute	
1.210	-1.240	0.877	-0.549
0.928	-0.998	0.845	-0.294
0.881	-0.789	0.786	-0.037
0.883	-0.552	0.705	0.222
		0.603	0.480
		0.484	0.738
		0.347	0.995

20 T flanks are curved.



12 T, 20° Full Depth
Fillet

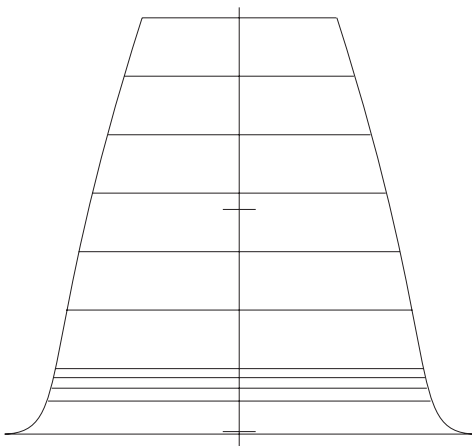
Fillet		Involute	
1.099	-1.283	0.818	-0.271
0.771	-0.790	0.786	-0.063
0.799	-0.494	0.729	0.148
0.879	-0.232	0.652	0.360
		0.556	0.572
		0.442	0.783
		0.310	0.993



40 T, 14-1/2° Full Depth
Fillet

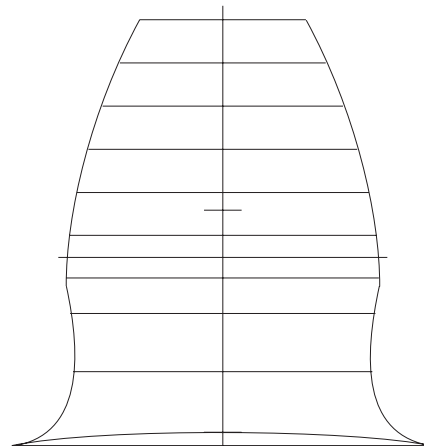
Fillet		Involute	
1.174	-1.194	0.867	-0.656
0.895	-0.934	0.849	-0.383
0.872	-0.774	0.804	-0.108
0.868	-0.627	0.742	0.168
		0.665	0.444
		0.574	0.719
		0.472	0.995

12 T flanks are curved and undercut.



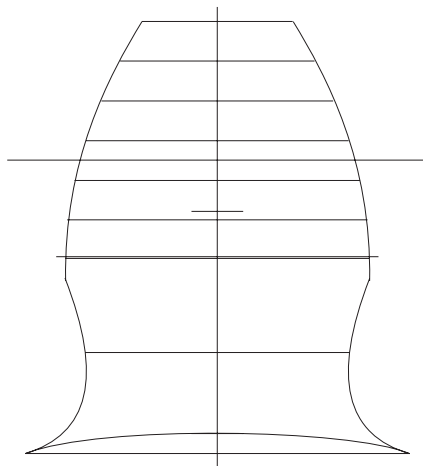
120 T, 14-1/2° Full Depth
Fillet

Fillet		Involute	
1.222	-1.170	0.960	-0.829
0.996	-0.998	0.902	-0.524
0.977	-0.931	0.836	-0.220
0.967	-0.876	0.763	0.085
		0.683	0.389
		0.597	0.694
		0.506	0.998



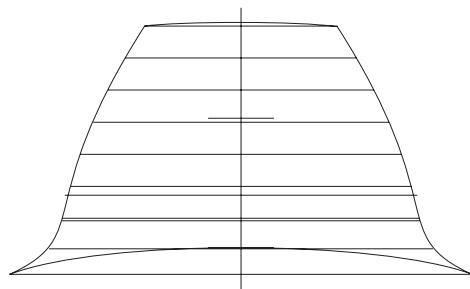
20 T, 14-1/2°, Full Depth
Fillet

Fillet		Involute	
1.099	-1.226	0.813	-0.353
0.779	-0.841	0.800	-0.131
0.795	-0.539	0.760	0.092
0.857	-0.246	0.701	0.317
		0.626	0.542
		0.536	0.767
		0.433	0.991



12 T, 14-1/2° Full Depth			
Fillet		Involute	
0.999	-1.261	0.790	-0.245
0.689	-0.735	0.782	-0.044
0.839	-0.236	0.743	0.161
1.094	0.267	0.683	0.368
		0.603	0.575
		0.506	0.783
		0.392	0.989

Note the undercut at the root of this tooth.



12 T, 30° Spline, 1/2 DP			
Fillet		Involute	
1.205	-0.813	0.929	-0.521
1.000	-0.680	0.889	-0.355
0.932	-0.534	0.836	-0.188
0.918	-0.402	0.770	-0.021
		0.693	0.147
		0.604	0.314
		0.504	0.480

Spline pressure angle is 30°. The tooth is stub. Addendum is half the size of a standard gear tooth addendum.

Notice in the above diagrams that the 20° teeth are more slanted than the 14½° teeth.

Also, the tooth diagrams for 120 tooth gears have straighter flanks than the tooth diagrams for 20 or 40 tooth gears. The smaller the number of teeth in a gear, the more curved the flanks will be.

Also note the way both 12 T diagrams, and the 20 T, 14½° diagram show the tooth necked down at the bottom. The bottom part of the tooth is thinner than it should be. This is called undercut, and will be discussed in Chapter 7.

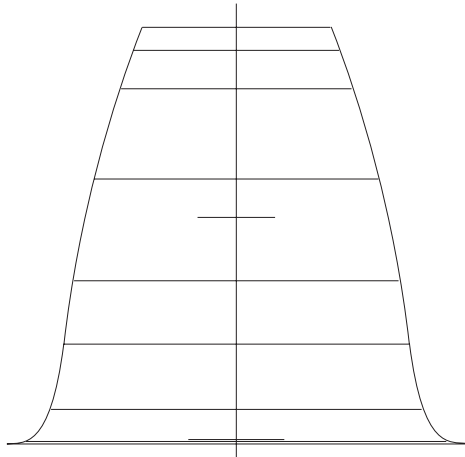
If you want to draw a reasonable approximation of a 20° or 14½° full depth tooth, scale the diagrams overleaf, at the end of this section.

Pick three or four or more fillet and involute Y measurements, and scale the ± X dimension at those Y points. Interpolate X for the number of teeth. Diagrams are sized at 1/3 DP or three times the size of a 1 DP tooth, equivalent to 76.2 module.

Divide the scaled dimensions by the three times the diametral pitch of the tooth size you want to draw. For example, to draw a 5 DP tooth, divide by 15. For module teeth, divide by 76.2, then multiply by desired module.

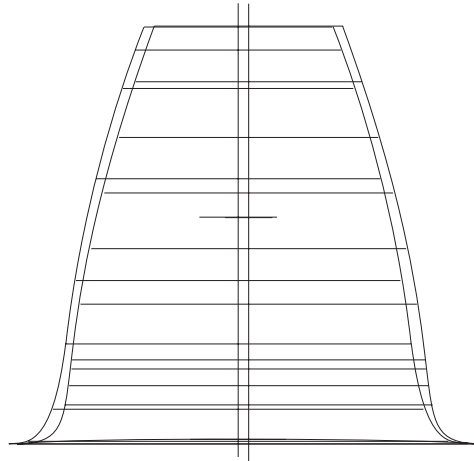
Connect the points with a smoothly curved line and you will have an illustration of the actual tooth shape. You can draw by hand, or use any computer drawing program. It does not have to be a CAD program. The illustrations in this section were done in CorelDraw.

Shown below is a scaled diagram of a tooth from a 70 tooth, 14½° involute spur gear. The X and Y coordinates were scaled from the 14½° chart shown below. The scaled X and Y dimensions were divided by 3, and the plus X and minus X measurements plotted for each Y point.



70T, 14½° Full Depth Scaled

To give us an idea of the accuracy of scaling to draw a gear tooth, the drawing below shows an accurately drawn tooth almost on top of a version scaled from the diagrams at the end of this section. The accurate tooth is the one shifted a little to the right.



70T, 14½° Full Depth

Below shows the same 70T tooth, accurately drawn.

