INVOLUTE GEAR DATA

(From: MODEL ENGINEERS'WORKSHOP magazine, 1996)

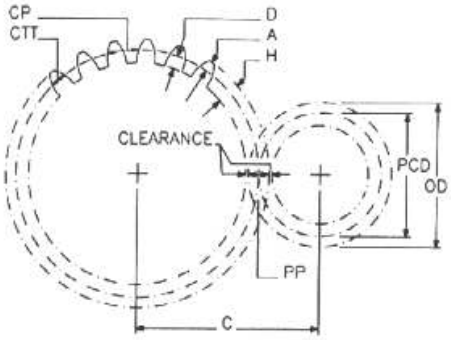
GEARS. involute form

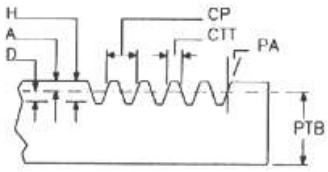
TOOTH SIZE
There are three methods of defining gear tooth size

Diametral pitch.	DP.	The number of teeth per one inch of pitch circle diameter.
Module.	MOD.	The length, in mm, of the pitch circle diameter per tooth.
Circular pitch.	CP.	The distance between adjacent teeth measured along the are at the pitch circle diameter

OTHER DEFINITIONS.

Addendum.	A.	The height of the tooth above the pitch circle diameter.
Centre distance.	C.	The distance between the axes of two gears in mesh.
Circular tooth thickness.		
	CTT.	The width of a tooth measured along the are at the pitch circle diameter.
Dedendum.	D.	The depth of the tooth below the pitch circle diameter.
Outside diameter.	OD.	The outside diameter of the gear.
Pitch circle dia.	PCD.	The diameter of the pitch circle.
Pitch point.	PP.	The point at which the pitch circle diameters of two gears in mesh coincide. Effectively the diameters at which plain discs would create the same ratio if relying on friction alone.
Pitch to back.	PTB.	The distance on a rack between the pitch circle diameter line and the rear face of the rack.
Pressure angle.	PA.	The angle between the tooth profile at the pitch circle diameter and a radial line passing through the same point. See sketch.
Whole depth.	H.	The total depth of the space between adjacent teeth.





FORMULA MODULE System (metric)

Addendum $A = MOD$

Centre distance

$$C = \frac{PCD(g) + PCD(p)}{2}$$

Circular pitch

$$CP = m \times MOD$$

Dedendum

$$D = H - A$$

Module

$$MOD = \frac{PCD}{N}$$

Number of teeth

$$N = \frac{PCD}{MOD}$$

Outside diameter

$$OD = (N + 2) \times MOD$$

Pitch circle diameter

$$PCD = N \times MOD$$

Whole depth (finer than 20DP)

$$H = 2.4 \times MOD$$

Whole depth (20DP and coarser)

$$H = 2.25 \times MOD$$

FORMULA DP System (imperial)

Addendum

$$A = \frac{1}{DP}$$

Centre distance

$$C = \frac{PCD(g) + PCD(p)}{2}$$

Circular pitch

$$CP = \frac{PI}{DP}$$

Circular tooth thickness

$$CTT = \frac{CP}{2}$$

Dedendum

$$D = H - A$$

Diametral pitch

$$DP = \frac{N}{PCD}$$

Number of teeth

$$N = DP \times PCD$$

Outside diameter

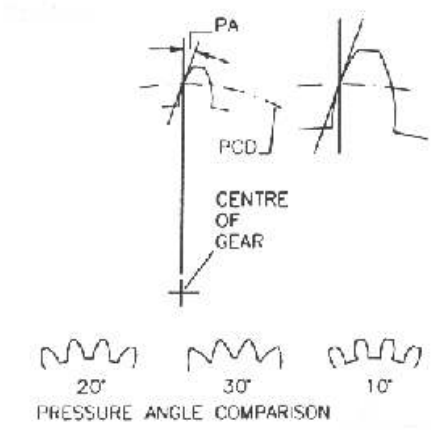
$$OD = \frac{N + 2}{DP}$$

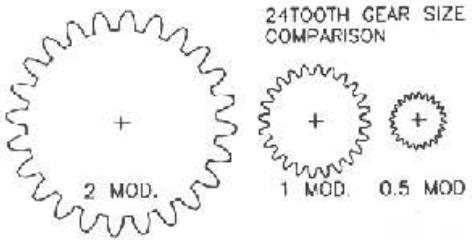
Pitch circle diameter

$$PCD = \frac{N}{DP}$$

Whole depth (20DP and coarser}

$$H = \frac{2.25}{DP}$$





NOTES

1. The pressure angle for commercially available gears is invariably 20 degrees. Sketch 1 shows, on the left, a 20 degree pressure angle gear, centre 30 degrees, and right 10 degrees.

2. When two gears are meshed correctly their pitch circle diameters coincide at the pitch point (PP). A clearance then results between the top of the tooth on one gear, and the bottom of the gap between two adjacent teeth on the other. The amount of clearance is the difference between the Addendum and the Dedendum. That is Clearance = D -- A.

3. When two gears mesh together the larger is called the gear and the smaller the pinion. That meshed with a rack is also called the pinion.

4. The shape of the space between adjacent teeth varies considerably with the number of teeth on the gear. Gears having a few teeth have very rounded teeth whilst gears with a large number of teeth, have almost straight sided teeth. The space between the adjacent teeth, being that cut by the milling cutter, vary considerably. Therefore, in theory, a different cutter is required for each number of teeth. In practice, except for extremely critical applications, a compromise is adopted and 8 different cutters are required to cut from 12 teeth up to a rack. Table 1 indicates the range of each cutter. Note, metric cutters(MOD) are numbered in reverse.

5. Gears with small numbers of teeth 11 down to 6 require special consideration. A detailed book on the subject should be read before cutting gears of that size.

6. Commercially available gears with 16 or less teeth may have a modified tooth form known as an addendum modification, or corrected gears. These mesh correctly with standard gears but at a modified centre distance. Consult supplier for details.

7. The tooth shape of the rack is straight sided and with an angle equal to the pressure angle.

10. Table 2 compares the DP and MOD ranges. This table does not imply interchangeability or mixed usage, though for a few sizes and in a non arduous situation it may be acceptable if gears are to hand.

11. A pair of gears, adequately lubricated, meshing smoothly, and at the correct centre distance, should have a transmission efficiency in the order of 97%

Table 1
Cutter number and ranges

DP number	MOD number	For cutting gears
1	8	135T to rack
2	7	557 to 134T
3	6	357 to 54T
4	5	26T to 34T
5	4	21T to 25T
6	3	17T to 20T
7	2	14T to 16T
8	1	12T to 13T

Table 2
DP and MOD system comparisons

DP standard	MOD standard	DP equivalent	MOD equivalent
	0. 4	63.5	
	0.5	50.8	
48			0.53
	0.6	42.33	
40			0.63
	0.7	36.29	
32			0.79
	0.8	31.75	
	1.0	25.4	
24			1.06
	1.25	20.32	
20			1.27
	1.5	16.93	
16			1.59
	2.0	12.7	
12			2.12
	3.0	8.47	
	4.0	6.35	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