

CYCLOIDAL WHEEL AND PINION CUTTERS FOR CLOCKS AND WATCHES

Calculation of the Module of existing wheel or pinion

$$\text{Module } M = \frac{\text{Tip Diameter in Millimetres (D)}}{\text{Number of teeth (N) + addendum}}$$

$$\text{Also } M = \frac{\text{Twice the centre distance in Millimetres}}{\text{Sum of teeth in wheel and pinion}}$$

$$\text{Centre Distance} = \frac{M}{2} \times (\text{Sum of teeth in wheel and pinion})$$

$$\text{For conversion, Module } M = \frac{25.4}{\text{Diametral Pitch}}$$

$$\text{For conversion, Diametral Pitch} = \frac{25.4}{M}$$

Calculation of blank diameter

Blank Diameter = Module x (N + Addendum allowance from Table below).

Example: for a pinion of 6 leaves and a Module of 0.7
Blank Diameter = 0.7 x (6 + 1.71) = 5.397mm

This enables the module of a wheel or pinion to be found when the centre distance is not known. For

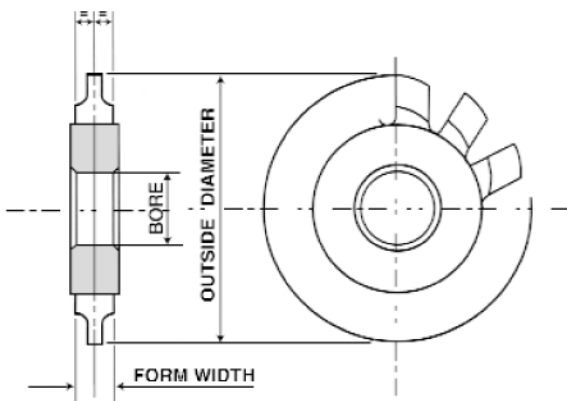
$$\text{Module } M = \frac{\text{Tip Diameter}}{N + \text{Addendum allowance}}$$

For odd number pinions of say 7 leaves use a hole gauge to measure the tip diameter.

Table of Addendum allowances

Number of leaves	Ogive	Ratio Tooth/Space	Add to number of teeth or leaves
6	Full	1/2	1.71
7	Full	1/2	1.71
8	Full	1/2	1.71
10	1/3	2/3	1.61
12	1/3	2/3	1.61
16	1/3	2/3	1.61
Wheel	-	1/1	2.76

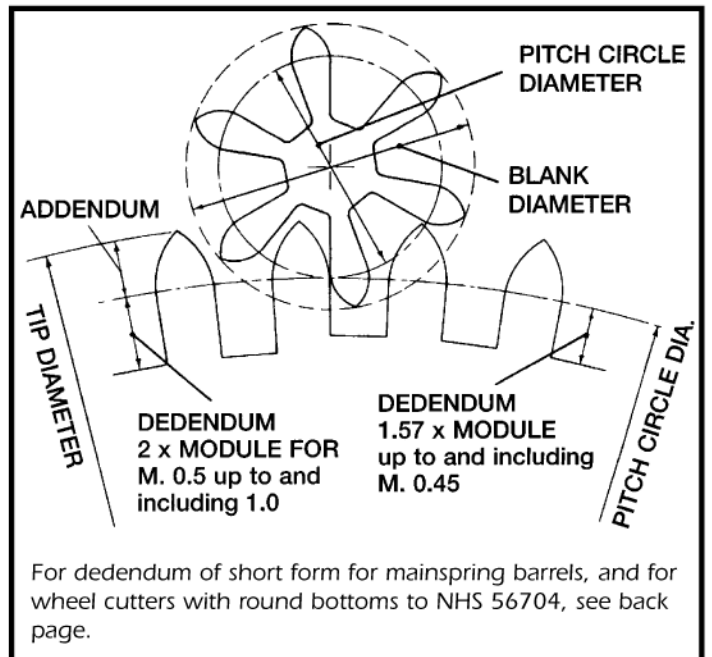
For Cutting Pinions for old work with thicker leaves, use cutter 0.05 module smaller than calculated. The addendum allowance is unchanged.



The profiles are made in accordance with BS 978 Part 2, NHS 56702/3 and have square bottoms, also NHS 56704 with round bottoms. These cutters can be sharpened without loss of form. For suitable grinding wheels see right.

The cutters are relieved using profile ground solid carbide tools; the finish on the form of the cutter teeth is therefore of a high quality.

All cutters are made from 8% Cobalt M42 (HSS-E) high speed steel hardened and treble tempered under vacuum, there is therefore no change in the surface chemistry of the tool. This steel is of first quality, and is known for its ability to keep a good cutting edge to give long duration between sharpenings. Hardness circa 68 ROCKWELL C.



For dedendum of short form for mainspring barrels, and for wheel cutters with round bottoms to NHS 56704, see back page.

Recommended cutting speeds

For cutting carbon steel pinions with high speed steel cutters:

- Cutter diameter 14mm 430-500 rpm
- Cutter diameter 20mm 300-350 rpm
- Cutter diameter 24mm 250-290 rpm
- Cutter diameter 26mm 230-270 rpm

A copious stream of cutting oil should be used to keep the cutter cool and remove the chips. Mobilmet 745 or similar.

Pinions should never be cut dry.

For cutting brass a speed of up to 3-4000 r.p.m. can be used, but a much lower speed will preserve the tooth cutting edges.

Recommended brass and steel

BRASS for wheels should be hard or half-hard leaded engraving brass such as CZ 118, CZ 119, or CZ 120, with a hardness of 120-130 VNP. Do not use soft brass which will clog the cutter and spoil the work.

STEEL Clock pinions may be cut from silver steel which HAS BEEN FULLY ANNEALED (it is supplied in normalised condition) but steels with a lower carbon content such as EN8 or EN9 are to be preferred.

GRINDING WHEELS

For sharpening High Speed and Carbon Steel Wheel and Pinion Cutters.
Green Silicon Carbide, Vitrified Bond, Cool Cutting.

Grit: GC 220
Hardness: H5
Bond: VG
Dished Form, Ø: 75mm
Bore: 7mm

High grade CBN (Borazon) Wheels also available, mounted on resinal or aluminium, dimensions are nominally the same.

PROFILE DIMENSIONS FOR CLOCK & WATCH WHEEL & PINION CUTTERS



WHEELS

All dimensions as ratios of the module. M. millimetres
British Standard 978 : Part 2. As Swiss Standard NHS 56702 except for *

Module M.	Up to and including 0.45, and 1.1 to 1.5	0.5 and up to and including 1.0	Short form 0.2 to 1.0	Round Bottom* 0.2 to 1.0 NHS 56704
Number of teeth	N	N	N	N
Pitch circle diameter	N x M	N x M	N x M	N x M
Outside or tip diameter (diameter of blank)	(N + 2.76) x M	(N + 2.76) x M	(N + 2.76) x M	(N + 2.50) x M
Root Diameter	(N - 3.14) x M	(N - 4) x M*	(N - 2.14) x M	(N - 3.50) x M
Tooth thickness	1.57 x M	1.57 x M	1.57 x M	1.41 x M
Addendum radius	1.93 x M	1.93 x M	1.93 x M	2.00 x M
Angle of cutter flank	2°	2°	2°	4° - 43
Addendum	1.38 x M	1.38 x M	1.38 x M	1.25 x M
Dedendum	1.57 x M	*2 x M	1.07 x M	1.75 x M
Full tooth depth (depth of feed)	2.95 x M	3.38 x M	2.45 x M	3.0 x M

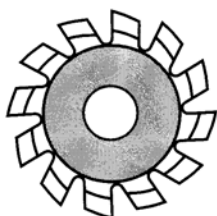
PINIONS

All dimensions as ratios of the module. M. millimetres
British Standard 978 : Part 2. As Swiss Standard NHS 56703 except for *

Number of leaves	6	7	8	10	12	16
Pitch circle diameter	6	7	8	10	12	16
Outside or tip diameter (diameter of blank)	7.71	8.71	9.71	11.61	13.61	17.61
Root diameter *	2.84	3.3	4.2	5.9	7.8	11.8
Leaf thickness	1.05	1.05	1.05	1.25*	1.25	1.25
Addendum radius	1.05	1.05	1.05	0.82	0.82	0.82
Form of addendum	FULL OGIVE PROFILE C 			1/3 OGIVE PROFILE B 		
Angle of cutter flank	20°	17°-9	15°	10°-48	9°	6°-45
Tooth/pitch ratio	1/3	1/3	1/3	2/5	2/5	2/5
Addendum	0.855	0.855	0.855	0.805	0.805	0.805
Dedendum	1.58 [#]	1.85	1.90	2.05	2.10	2.10
Full tooth depth	2.435	2.705	2.755	2.755	2.905	2.905

[#] The old figure of 1.75 is being phased out

To obtain British Standard 978 Part 2, contact:
British Standards Institute, 389 Chiswick High Road, London W4 4AL. Tel: 020 8996 9001 Fax: 020 8996 7001 Website: www.bsi-global.com
Copies of the Swiss Standard NHS 56702, 56703 and 56704 will be sent by us on request free of charge.



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