

DUAL GEAR

Button Calculator

Calculates form tools required to make Gear Cutters.

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Introduction

This calculator came into being when I needed to calculate the form tool details for some very odd ball gear pairs (the gears are mounted on 2 coaxial shafts and are coupled by a common idler which has a prime number of teeth, I wanted a roving tooth system for wear equalisation, and both ends a different DP) for a project that interested me :-

- 1 Proof of concept, gears and frame only, 3D printed, 2" centres, Idler has 19 teeth.
24 & 19 teeth - 10 3/4 DP, 20 & 19 teeth - 9 3/4 DP
- 2 3D printed prototype, gears, housing etc., 1 1/2" centres, Idler has 19 teeth.
24 & 19 teeth - 14 1/3 DP, 20 & 19 teeth - 13 DP
- 3 Metal prototype, gears, 1 1/2" centres, Idler has 31 teeth.
36 & 31 teeth - 22 1/3 DP, 30 & 31 teeth - 20 1/3 DP

For this I required a calculator which took in Pressure Angle, Number of teeth (2 sets) along with centre distance. The output would be all the data required to produce form tools for both gears. This data can also be used to draw up the gears for 3D printing.

Derek Brown wrote a rather informative article in '**Engineering In Miniature**' back in October 1998 giving me most of the formulae that I required, THANK YOU Derek, the missing one to calculate if we are undercutting came from the Web.

The first cut of the calculator was bare minimum but it slowly grew, like Topsy, to encounter the various was of specifying the pitch ending up with the following input methods :-

DP
Blank Diameter
PCD
Centres (Forces Gear Pair calculation)
Rack (Circular Pitch)

It was later modified to be able to calculate for a single gear rather than a pair, this mode turns off the centres window.

The next step was to take the system for a trip across the Channel to pick up the Gallic way of looking at things, in Milli-Metres and Module. Sending the output to a file for later printing came next and to complete the system a way of setting it up so that when it is started up it is ready for input in the normally required mode.

The unusual start sequence is my normal start up for a program, after all you open the garage before starting the engine and setting out to work.

Calculator Driving.

When the calculator is first started up it reads the 'buttons.cfg' file and uses this data to set itself up, if it cannot find the file it sets up the Default settings and as I don't provide the file the initial settings will be the Default ones. The program is quite happy to run from a CD-ROM but as the file cannot be updated if it exists the Setup Save function quietly ignores the fact.

Reading from top to bottom, left to right we have :-

20.0 degrees (in Press. Angle window)
Gear Pair ON
DPitch
Metric
Other
Centers

along with the windows labelled Press. Angle, both Teeth ones along with Centers coloured Light Blue, with all the other windows yellowish. The Bluish ones are here the program is expecting data to be input while all the Yellowish ones display the results.

I know that it seems an odd mixture but it is a setting that I have used frequently. I initially wrote the Calculator to simplify doing gear pairs on known center distances, I prefer DP to Mod and I find that when drawing the gears in SolidWorks I prefer to use metric as when I think in inch mode I am likely to turn to fractions, my background is electronics / computers NOT engineering. I just saved the settings that I was using at the time and the used the data in 'buttons.cfg' to give me the data used in setting up the Default configuration. It should also encourage the user to set up their own preferences.

If for instance you want to do a change wheel for a Myford select:--

14.5 degrees
Gear Pair OFF
DPitch
Inches
Pitch

Enter the required number of teeth in Teeth and 20 in DPitch and the press the Calculate Button.

If you would like a copy of the results sent to a file for later printing just click in the box labelled 'Output to File', a dialog box will open so that you can specify the file. Many calculation results can be put into the file until either the tick is removed from the box by

clicking or the calculator is closed down. If you would like to change the file that you are outputting to, just clear the tick in the box with a click, then click to set up for the new file.

If the pitch is unknown select Other instead of Pitch and you will be given a choice of measurements :--

Blank

this can be used for instance if in your junk box you have a gear pump body with no gears just measure the bore and set this up with Gear Pair ON and then try putting the same number in the Teeth boxes until a suitable pair emerge i.e. the Centers result equals the center distance of the pump.

PCD

this one is for pedantic s who calculate the required PCD(s).

Centres

what the calculator was written for, this will turn Gear Pair ON if not already in this mode.

Rack

also known as Circular Pitch, useful if you would like to make a gear to run along a rack such as 8 TPI, this would set 25.133 DP.

If you have been using Centers and then select Gear Pair OFF the pitch selector is set to Pitch as Centers is only meaningful when working with a pair of gears.

All the above is also available using Module and Metric settings.

Results can also be translated into the other language by simple manipulation.

To switch Pitch modes set up the required gears using Pitch, calculate, select Others, switch Pitch and then calculate.

To switch Measurement modes, set up the gear(s) and calculate, select Pitch, switch Measurement and then calculate.

If you wish to calculate the in-feeds required when using a single button tool such as when making a fly-cutter just click the Fly-cut box, 'Button Centers in ??' is changed to 'Axial In-feed in ??' and 'Form Tool Depth in ??' is changed to 'Radial In-feed in ??'. To revert to 2 button mode just click the box again.

Setting Up

By Clicking on the Setup button the Setup button will disappear and a set of 6 buttons will appear. The Calculator is fully functional in this state so that the settings can be verified as they are being made.

Default

This buttons sets the Calculator into it initial state.

Reading from top to bottom, left to right we have :-

20.0 degrees
Gear Pair ON
DPitch
Metric
Other
Centers

along with the windows labelled Press. Angle, both Teeth ones along with Centres coloured Light Blue, with all the other windows yellowish. The Bluish ones are where the program is expecting data to be input while all the Yellowish ones display the results.

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Entry & Result

These 4 buttons are to setup the background and foreground colours in the data windows.

Entry

This handles the 3 / 4 data entry windows, depending on the Gear Pair setting. With Press. Angle and Teeth permanently chosen whilst pitch (DP or Module), Blank Diameter, PCD, Centers or Rack are selected as required. The non-selected fields are treated as result fields.

B selects background.

F selects foreground.

Result

This handles the non entry windows in the same manner as above.

Close

When this button is clicked it closes the setup window and re-instates the Setup button. It also save the current state of the Calculator into the file 'Buttons.cfg'.

If after playing around with the current config, and would like to get back to the one you disturbed, you can just exit the Calculator while leaving Setup open.

Example outputs from File

Two Button Mode

Gear Pair

Dimensions are in mm.

Teeth with Centers

Pressure Angle = 20.000
D.P = 22.333
Rack Pitch = 3.572976

Teeth = 36
Blank Diameter = 43.218
PCD = 40.943
Cut Depth = 2.559
Button Diameter = 14.003
Button Centres = 14.759
Cutter Thickness = 4.549
Form Tool Depth = 3.577

Gear Centers = 38.100

Second Gear

Teeth = 31
Blank Diameter = 37.531
PCD = 35.257
Cut Depth = 2.559
Button Diameter = 12.059
Button Centres = 12.930
Cutter Thickness = 4.549
Form Tool Depth = 3.452

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Fly-cutter mode

Gear Pair

Dimensions are in mm.

Teeth with Centers

Pressure Angle = 20.000
D.P = 22.333
Rack Pitch = 3.572976

Teeth = 36
Blank Diameter = 43.218
PCD = 40.943
Cut Depth = 2.559
Button Diameter = 14.003
Axial Infeed = 1.897
Cutter Thickness = 4.549
Radial Infeed = 5.786

Gear Centers = 38.100

Second Gear

Teeth = 31
Blank Diameter = 37.531
PCD = 35.257
Cut Depth = 2.559
Button Diameter = 12.059
Axial Infeed = 1.839
Cutter Thickness = 4.549
Radial Infeed = 5.147

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Mode Changing

Starting in Metric/Mod mode , going to Metric/DP mode, then Inch/DP and finishing in Inch/Mod mode.

Metric/Mod

Inch/DP

Single Gear

Single Gear

Dimensions are in mm.

Dimensions are in inches.

Teeth and Pitch.

Teeth and Pitch.

Pressure Angle = 20.000
Module = 0.800
Rack Pitch = 2.513274

Pressure Angle = 20.000
D.P = 31.750
Rack Pitch = 0.098948

Teeth = 20
Blank Diameter = 17.600
PCD = 16.000
Cut Depth = 1.800
Button Diameter = 5.472
Button Centres = 6.263
Cutter Thickness = 3.200
Form Tool Depth = 2.162

Teeth = 20
Blank Diameter = 0.6929
PCD = 0.6299
Cut Depth = 0.0709
Button Diameter = 0.2154
Button Centres = 0.2466
Cutter Thickness = 0.1260
Form Tool Depth = 0.0851

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Metric/DP

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Inch/Mod

Single Gear

Single Gear

Dimensions are in mm.

Dimensions are in inches.

Teeth with PCD

Teeth with PCD

Pressure Angle = 20.000
D.P = 31.750
Rack Pitch = 2.513274

Pressure Angle = 20.000
Module = 0.800
Rack Pitch = 0.098944

Teeth = 20
Blank Diameter = 17.600
PCD = 16.000
Cut Depth = 1.800
Button Diameter = 5.472
Button Centres = 6.263
Cutter Thickness = 3.200
Form Tool Depth = 2.162

Teeth = 20
Blank Diameter = 0.6929
PCD = 0.6299
Cut Depth = 0.0709
Button Diameter = 0.2154
Button Centres = 0.2466
Cutter Thickness = 0.1260
Form Tool Depth = 0.0851

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Rack Pitch

A gear to run on 8tpi All-Thread rod

Single Gear

Dimensions are in inches.

Teeth with Rack

Pressure Angle	=	20.000
D.P	=	25.133
Rack Pitch	=	0.125000

Teeth	=	20
Blank Diameter	=	0.8754
PCD	=	0.7958
Cut Depth	=	0.0895
Button Diameter	=	0.2722
Button Centres	=	0.3115
Cutter Thickness	=	0.1592
Form Tool Depth	=	0.1075

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