# ENGINEERING CONSTANTS

## RULES AND FORMULA FOR GEAR SIZES

### DIAMETRAL PITCH* SPUR GEARS

| To Find | Having | Rule |
|---|---|---|
| Diametral Pitch | Circular Pitch | Divide 3.1416 by the Circular Pitch. |
| Diametral Pitch | Pitch Diameter and Number of Teeth | Divide Number of Teeth by Pitch Diameter. |
| Diametral Pitch | Outside Diameter and Number of Teeth | Divide Number of Teeth plus 2 by Outside Diameter. |
| Pitch Diameter | Number of Teeth and Diametral Pitch | Divide Number of Teeth by Diametral Pitch. |
| Pitch Diameter | Number of Teeth and Outside Diameter | Divide the product of Outside Diameter and Number of Teeth by Number of Teeth plus 2. |
| Pitch Diameter | Outside Diameter and Diametral Pitch | Subtract from the Outside Diameter the quotient of 2 divided by the Diametral Pitch. |
| Pitch Diameter | Addendum and Number of Teeth | Multiply Addendum by the Number of Teeth. |
| Outside Diameter | Number of Teeth and Diametral Pitch | Divide Number of Teeth plus 2 by the Diametral Pitch. |
| Outside Diameter | Pitch Diameter and Diametral Pitch | Add to the Pitch Diameter the quotient of 2 divided by the Diametral Pitch. |
| Outside Diameter | Pitch Diameter and Number of Teeth | Divide the Number of Teeth plus 2 by the quotient of Number of Teeth divided by Pitch Diameter. |
| Outside Diameter | Number of Teeth and Addendum | Multiply the Number of Teeth plus 2 by Addendum. |
| Number of Teeth | Pitch Diameter and Diametral Pitch | Multiply Pitch Diameter by the Diametral Pitch. |
| Number of Teeth | Outside Diameter and Diametral Pitch | Multiply Outside Diameter by the Diametral Pitch and subtract 2. |
| Thickness of Tooth | Diametral Pitch | Divide 1.5708 by the Diametral Pitch. |
| Addendum | Diametral Pitch | Divide 1 by the Diametral Pitch. |
| Root | Diametral Pitch | Divide 1.157 by the Diametral Pitch. |
| Working Depth | Diametral Pitch | Divide 2 by the Diametral Pitch. |
| Whole Depth | Diametral Pitch | Divide 2.157 by the Diametral Pitch. |
| Clearance | Diametral Pitch | Divide .157 by the Diametral Pitch. |
| Clearance | Thickness of Tooth | Divide thickness of Tooth at Pitch Line by 10. |

*Diametral Pitch is the Number of Teeth to each inch of Pitch Diameter.

### CIRCULAR PITCH† SPUR GEARS

| To Find | Having | Rule |
|---|---|---|
| Circular Pitch | Diametral Pitch | Divide 3.1416 by the Diametral Pitch. |
| Circular Pitch | Pitch Diameter and Number of Teeth | Divide Pitch Diameter by the product of .3183 and Number of Teeth. |
| Circular Pitch | Outside Diameter and Number of Teeth | Divide Outside Diameter by the product of .3183 and the Number of Teeth plus 2. |
| Pitch Diameter | Number of Teeth and Circular Pitch | The continued product of the Number of Teeth, the Circular Pitch and .3183. |
| Pitch Diameter | Number of Teeth and Outside Diameter | Divide the product of Number of Teeth and Outside Diameter by Number of Teeth plus 2. |
| Pitch Diameter | Outside Diameter and Circular Pitch | Subtract from the Outside Diameter the product of the Circular Pitch and .6366. |
| Pitch Diameter | Addendum and Number of Teeth | Multiply the Number of Teeth by the Addendum. |
| Outside Diameter | Number of Teeth and the Circular Pitch | The continued product of the Number of Teeth plus 2, the Circular Pitch and .3183. |
| Outside Diameter | Pitch Diameter and the Circular Pitch | Add to the Pitch Diameter the product of the Circular Pitch and .6366. |
| Outside Diameter | Number of Teeth and Addendum | Multiply the Addendum by the Number of Teeth plus 2. |
| Number of Teeth | Pitch Diameter and and Circular Pitch | Divide the product of Pitch Diameter and 3.1416 by the Circular Pitch. |
| Thickness of Tooth | Circular Pitch | One-half the Circular Pitch. |
| Addendum | Circular Pitch | Multiply the Circular Pitch by .3183. |
| Root | Circular Pitch | Multiply the Circular Pitch by .3683. |
| Working Depth | Circular Pitch | Multiply the Circular Pitch by .6366. |
| Whole Depth | Circular Pitch | Multiply the Circular Pitch by .6866. |
| Clearance | Circular Pitch | Multiply the Circular Pitch by .05. |
| Clearance | Tooth Thickness | 1/10 the Thickness of Tooth at Pitch Line. |

†Circular Pitch is the distance from the center of one tooth to the center of the next tooth, measured along the pitch circle.

# ENGINEERING CONSTANTS

## USEFUL INFORMATION

Circumference of a Circle = Diameter × 3.1416.

Diameter of a Circle = Circumference × .3183.

Area of a Circle = Diameter Squared × .7854.

Doubling the Diameter of a Circle Increases its Area Four Times.

Area of Rectangle = Length × Breadth.

Area of Triangle = Base × ½ Perpendicular Height.

Area of Elipse = Product of Both Diameters × .7854.

Area of Parallelogram = Base × Altitude.

Side of an Inscribed Cube = Radius of Sphere × 1.1547.

Side of an Inscribed Square = Diameter × 0.7071 or Circumference × 0.2251 or Circum. ÷ 4.4428.

Side of an Equal Square = Diameter × .8862.

Square:

- A side × 1.4142 = Diameter of its Circumscribing Circle.
- A side × 4.443 = Circumference of its Circumscribing Circle.
- A side × 1.128 = Diameter of an Equal Circle.
- A side × 3.547 = Circumference of an Equal Circle.

Dimensions of Equal Cube = Diameter of Ball × 0.806.

Cubic Inches in a Ball = Diameter Cubed × .5236.

Convex Surface of a Ball = Square the Diameter × 3.1416.

Cubic Contents of a Cone = Area of Base × ⅓ the Altitude.

Surface of Frustum of Cone or Pyramid = Sum of Circumference of Both Ends × ½ Slant Height + Area of both Ends.

Contents of Frustum of Cone or Pyramid = Multiply Area of Two Ends and Get Square Root. Add the Two Areas and × ½ Altitude.

Doubling the Diameter of a Pipe Increases its Capacity Four Times.

A Gallon of Water (U.S.Std.) Weighs 8⅓ Lbs. and Contains 231 Cubic Inches.

A Cubic Foot of Water Contains 7½ Gallons and Contains 1728 Cubic Inches and Weighs 62.4 Lbs. at a Temperature of about 62 Deg. F. The Weight Varies Slightly with the Temperature. To Find the Pressure in Pounds Per Square Inch of a Column of Water = Height of Column in Feet × .434. No Allowance is Made for Friction.

Area of a Sector of a Circle = One-half the Length of the Arc × Radius of the Circle.

Gasoline has a specific gravity of .72, and consequently weighs 5.96 pounds per gallon. This applies to 76° gasoline.

A foot-pound represents the work required to raise a weight of one pound to a height of one foot. There are 33,000 foot-pounds to a horse-power.

A British Thermal Unit represents the amount of heat required to raise the temperature of one pound of water one degree Fahrenheit at or near 39° F. Its symbol is B.T.U. There are 778 foot-pounds in a B.T.U.

There are 42.4 B.T.U. to a horsepower.

The thermal efficiency of a good internal combustion motor is from 30 to 35 per cent.

The mechanical efficiency of a good internal combustion motor should be between 85 and 90 per cent.

On direct drive, with an efficient transmission and differential, about 88 per cent of the power furnished by the motor should be delivered at the rear wheel.

Under the best conditions, about 75 per cent of the indicated horsepower of the engine should be available for useful work.

If the work performed at the rear wheels is reduced to heat units, it will be found that about 23 per cent of the energy represented by the heating value of the fuel is available as useful work.

The piston speed of a motor should not exceed 1,000 feet per minute.

The peripheral velocity of a cast iron flywheel should not exceed 5,000 feet per minute. Should it exceed this speed, there would be danger of the flywheel bursting from centrifugal force.

Atmosphere (14.7 lbs. per square inch) = 1.0335 kilogrammes per square centimetre.

1 Foot-pound = 0.1382 kilogrammetre.

1 lb. per square inch = 0.0703077 kilogramme per square centimetre = 0.7031 gramme per square millimetre = 5.170 centimetres of mercury at 0 degree centigrade.

1 Kilogramme per square millimetre = 1422.32 lbs. per square inch = 0.635 ton per square in.

1 Kilogramme per square centimetre = 14.2232 lbs. per square inch.

1 Gramme per square millimetre = 1.422 lbs. per square inch.

1 Kilogrammetre = 7.233 foot-pounds.

1 Gramme per square centimetre = 0.01422 lb. per square inch.

1 Calorie or French unit of heat = 3.968 British Thermal Units.

French mechanical equivalent of heat (425 kilogrammetres) = 3.074 foot-pounds per unit.

1 Calorie per square metre = 0.369 heat-units per square foot.

1 Calorie per kilogramme = 1.800 heat-units per lb.

English unit of heat, or heat-unit = 0.252 calorie.

English mechanical equivalent to one heat-unit (778 foot-pounds) = 10.67 kilogrammetres.

1 English heat-unit per square foot = 2.713 calories per square metre.

1 English heat-unit per lb. = 5.9 calorie per kilogramme.