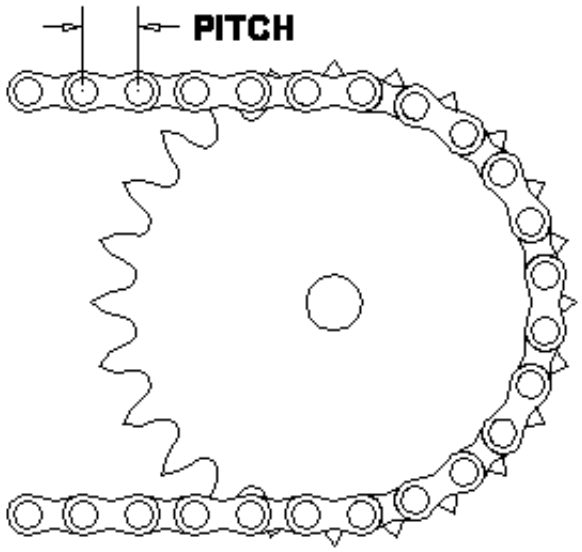
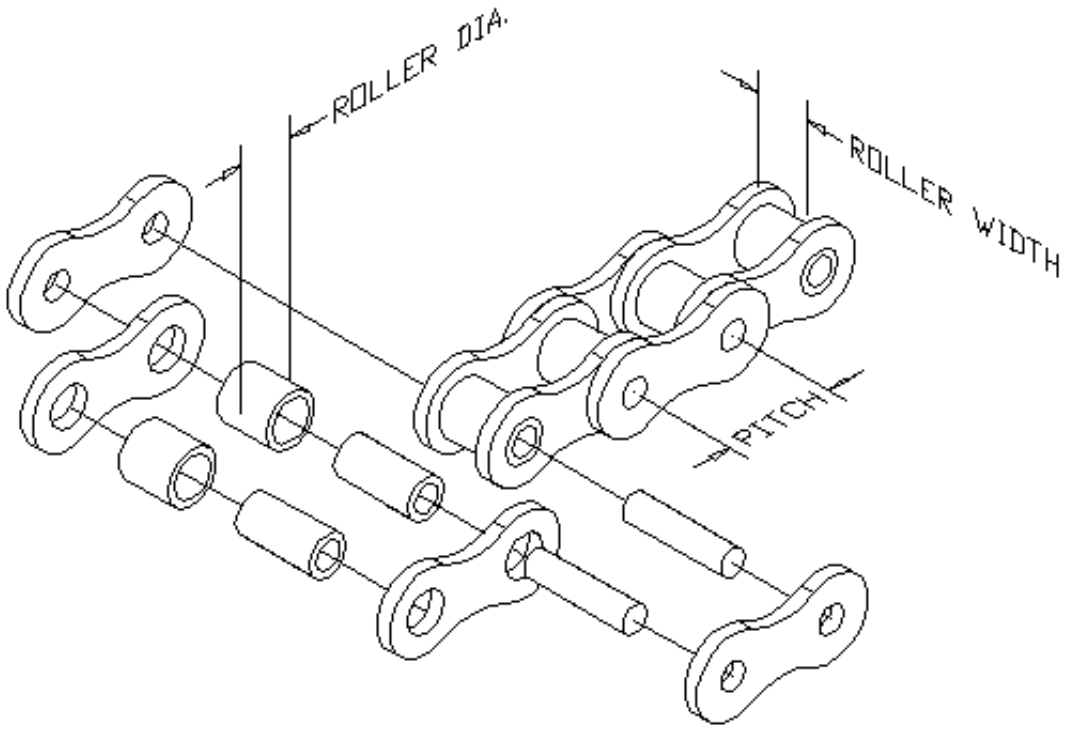
Notes on Sprockets and Chains

A sprocket is a toothed wheel upon which a chain rides. Contrary to popular opinion, a sprocket is not a gear.



Chain Construction

Chains have a surprising number of parts. The *roller* turns freely on the *bushing*, which is attached on each end to the *inner plate*. A *pin* passes through the bushing, and is attached at each end to the *outer plate*. Bicycle chains omit the bushing, instead using the circular ridge formed around the pin hole of the inner plate.



Chain Dimensions

Chain types are identified by number; ie. a number 40 chain. The rightmost digit is 0 for chain of the standard dimensions; 1 for lightweight chain; and 5 for rollerless bushing chain. The digits to the left indicate the *pitch of the chain in eighths of an inch*. For example, a number 40 chain would have a pitch of four-eighths of an inch, or 1/2", and would be of the standard dimensions in width, roller diameter, etc.

The roller diameter is "nearest binary fraction" (32nd of an inch) to 5/8ths of the pitch; pin diameter is half of roller diameter. The width of the chain, for "standard" (0 series) chain, is the nearest binary fraction to 5/8ths of the pitch; for narrow chains (1 series) width is 41% of the pitch. Sprocket thickness is approximately 85-90% of the roller width.

Plate thickness is 1/8th of the pitch, except "extra-heavy" chain, which is designated by the suffix H, and is 1/32" thicker.

ANSI Standard Chain Dimensions

Chain No.	Pitch	Roller Diameter	Roller Width	Sprocket thickness	Working Load
25	1/4"	0.130"	1/8"	0.110"	140 lbs
35	3/8"	0.200"	3/16"	0.168"	480 lbs
40	1/2"	5/16"	5/16"	0.284"	810 lbs
41	1/2"	0.306"	1/4"	0.227"	500 lbs
50	5/8"	0.400"	3/8"	0.343"	1400 lbs
60	3/4"	15/32"	1/2"	0.459"	1950 lbs
80	1"	5/8"	5/8"	0.575"	3300 lbs

Bicycle and Motorcycle Chain Dimensions

Chain No.	Pitch	Roller Diameter	Roller Width	Sprocket thickness
Bicycle, with Derailleur	1/2"	5/16"	1/8"	0.110"
Bicycle, without Derailleur	1/2"	5/16"	3/32"	0.084"
420	1/2"	5/16"	1/4"	0.227"
425	1/2"	5/16"	5/16"	0.284"
428	1/2"	0.335"	5/16"	0.284"
520	5/8"	0.400"	1/4"	0.227"
525	5/8"	0.400"	5/16"	0.284"
530	5/8"	0.400"	3/8"	0.343"
630	3/4"	15/32"	3/8"	0.343"

Selecting a Chain

Two factors determine the selection of a chain; the working load and the rpm of the smaller sprocket. The working load sets a lower limit on pitch, and the speed sets an upper limit.

$$\text{Maximum Pitch} = (900 \div \text{rpm})^{2/3}$$

The smaller the pitch, the less noise, wear, and mechanical losses will be experienced.

Sprockets

There are four types of sprocket;

- Type A: Plain Plate sprockets
- Type B: Hub on one side
- Type C: Hub on both sides
- Type D: Detachable hub

Sprockets should be as large as possible given the application. The larger a sprocket is, the less the working load for a given amount of transmitted power, allowing the use of a smaller-pitch chain. However, chain speeds should be kept under 1200 feet per minute.

The dimensions of a sprocket can be calculated as follows, where P is the pitch of the chain, and N is the number of teeth on the sprocket;

Pitch Diameter = P ÷ sin (180° ÷ N)

Outside Diameter = P × (0.6 + cot (180° ÷ N))

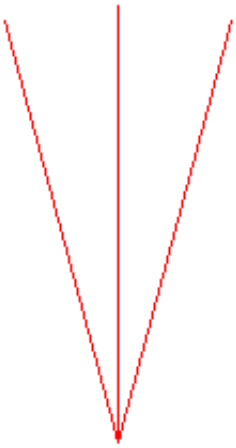
Sprocket thickness = 0.93 × Roller Width - 0.006"

Proceedure for Laying Out a Sprocket

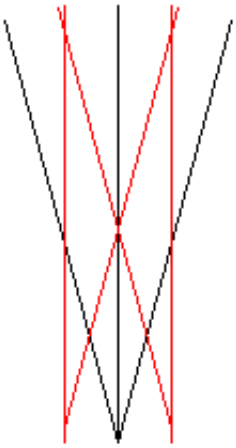
The first thing you need to know to lay out a sprocket is the dimensions of the chain which is to run upon it, specifically the *pitch*, *roller diameter*, and the *roller width* of the chain. The second thing you need to know is the number of teeth in the sprocket, which will depend entirely on your application. From these numbers, the outside diameter and thickness of the required blank can be calculated.

You'll also need to know the angle between teeth - this is simply the 360° divided by the number of teeth.

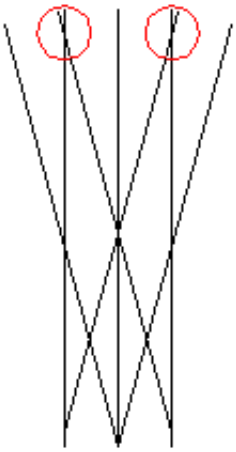
1. Start by drawing a three radial lines from the center of the blank to the edge, separated by an angle equal to the angle between teeth.



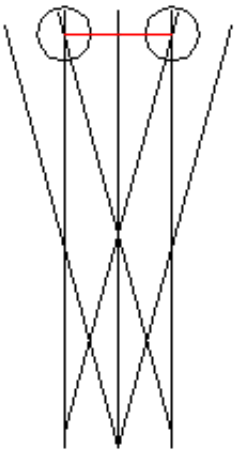
2. Draw lines parallel to these lines, at a distance equal to the pitch of the chain.



3. A roller will be located at each intersection of the parallel lines and the pitch circle. Draw a circle equal to the roller diameter of the chain.

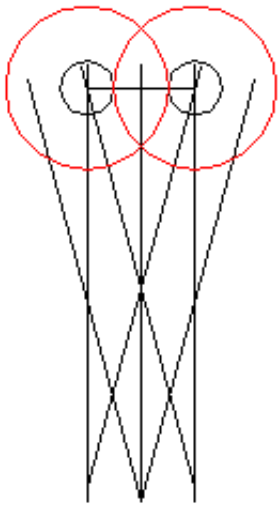


4. Draw lines between the roller centers.

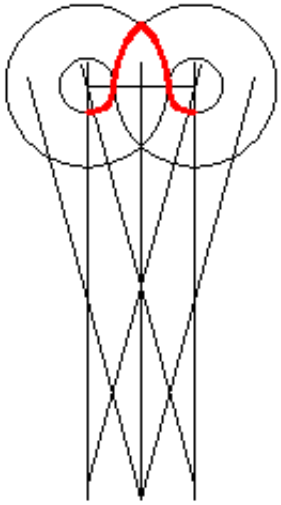


5. Draw circles around the roller centers, that pass through the

intersection of the other roller and the line between centers.



6. The tooth profile is as shown.



The sprocket teeth are usually truncated one chain pitch above the bottom of the seat; this is not shown here. Note that this shape is not the only one that will work - bicycles in particular use various tooth shapes for different circumstances.

Application

Sprockets should be accurately aligned in a common vertical plane, with their axes parallel. Chain should be kept clean and well lubricated with a thin, light-bodied oil that will penetrate the small clearances between pins and bushings.

Center distance should not be less than 1.5 times the diameter of the larger sprocket, nor less than 30 times the chain pitch, and should not exceed 60 times the chain pitch. Center distance should be adjustable - one chain pitch is sufficient - and failing this an idler sprocket should be used to adjust tension. A little slack is desirable, preferably on the bottom side of the drive.

The chain should wrap at least 120° around the drive sprocket, which requires a ratio of no more than 3.5 to 1; for greater ratios, an idler sprocket may be required to increase wrap angle.

References:

- The Complete Chain Guide
- Ryle Sprocket

Back

05/23/2016 22:36:54