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# DESIGN PROJECT

DESIGN OF CHAIN DRIVE

## Design of chain used in Hero Jet Gold 28T Bicycle

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# Summary

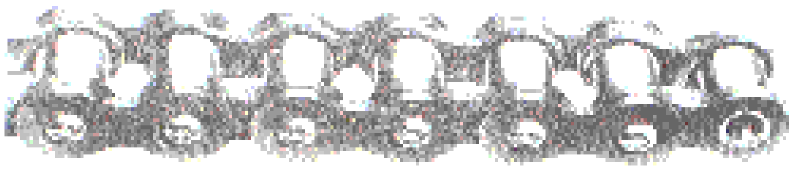
*In this project, I am discussing about roller chain used in Hero Jet Gold 28T. Roller chains or Bush roller chain is the type of chain drive most commonly used to transmission of mechanical power on many kinds of Domestic, Industrial and Agricultural machineries, Including conveyors, Motor cycles, Bicycles, Print press. I am discussing the design of roller chain used in hero jet gold bicycle, construction and its manufacturing processes.*


# Introduction

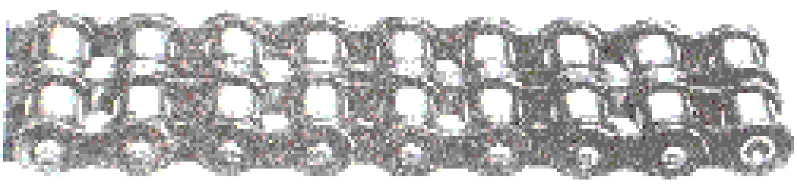
*Chain drive consist of an endless chain wrapped around two sprockets. A chain is defined as series of links connected by pin joints.*

*The sprocket is a toothed wheel with a special profile for the teeth.*

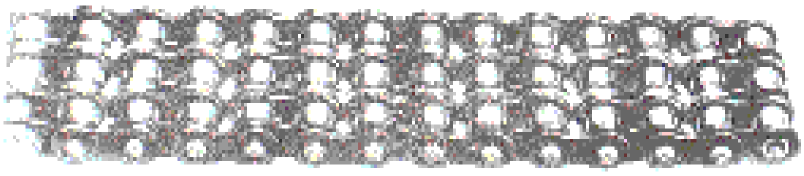
*In this project I am discussing about the chain used in bicycles. Bicycle chain is a roller chain that transfer power from the pedal to the drive wheel of bicycle thus pushing it forward. Most bicycle chain made of plain carbon or alloy steel, but some are nickel-plated to prevent rust.in this we are discussing about manufacturing process like cutting, punching press, curling etc. there are different types of roller chain like simple ,duplex and triplex chains*



Simplex



Duplex



Triplex

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# Methodology

*I am collected the roller chain used in the hero jet gold 28T bicycle from the bicycle workshop. And I used the Vernier calliper from college laboratory to measure the pitch of chain (p)(mm), diameter of roller($d_1$)(mm), and width between inner plate($b_1$)(mm).*

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PARTS OF A THREAD PITCH MICROMETER
ANVIL ARE INTERCHANGEABLE
AS PER THE PITCH OF THE SCREW

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Mitutoyo


SELECTION OF FITS

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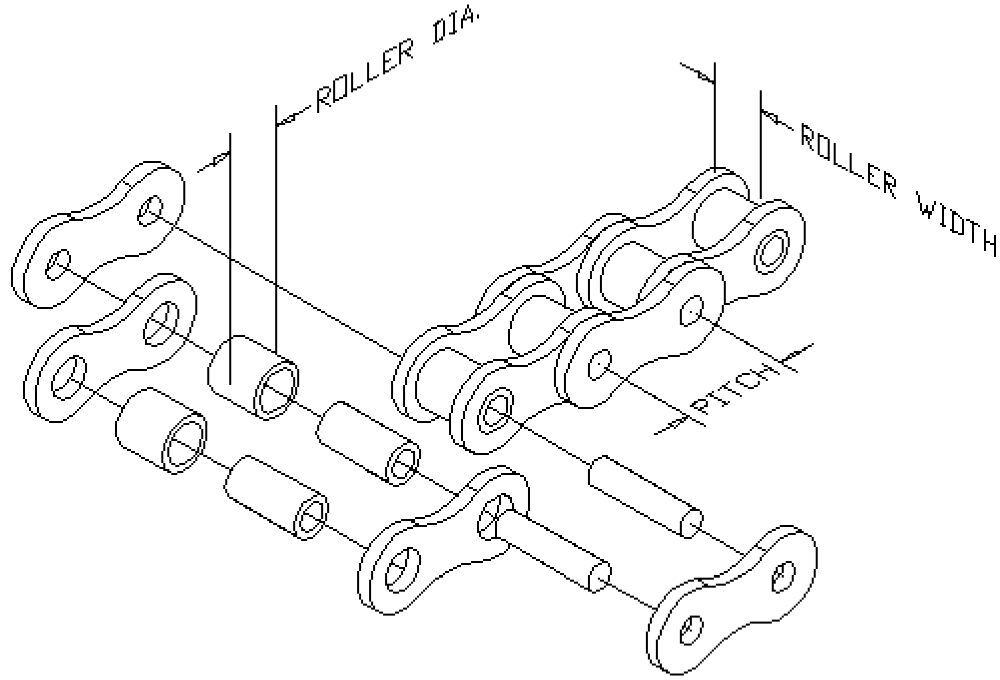
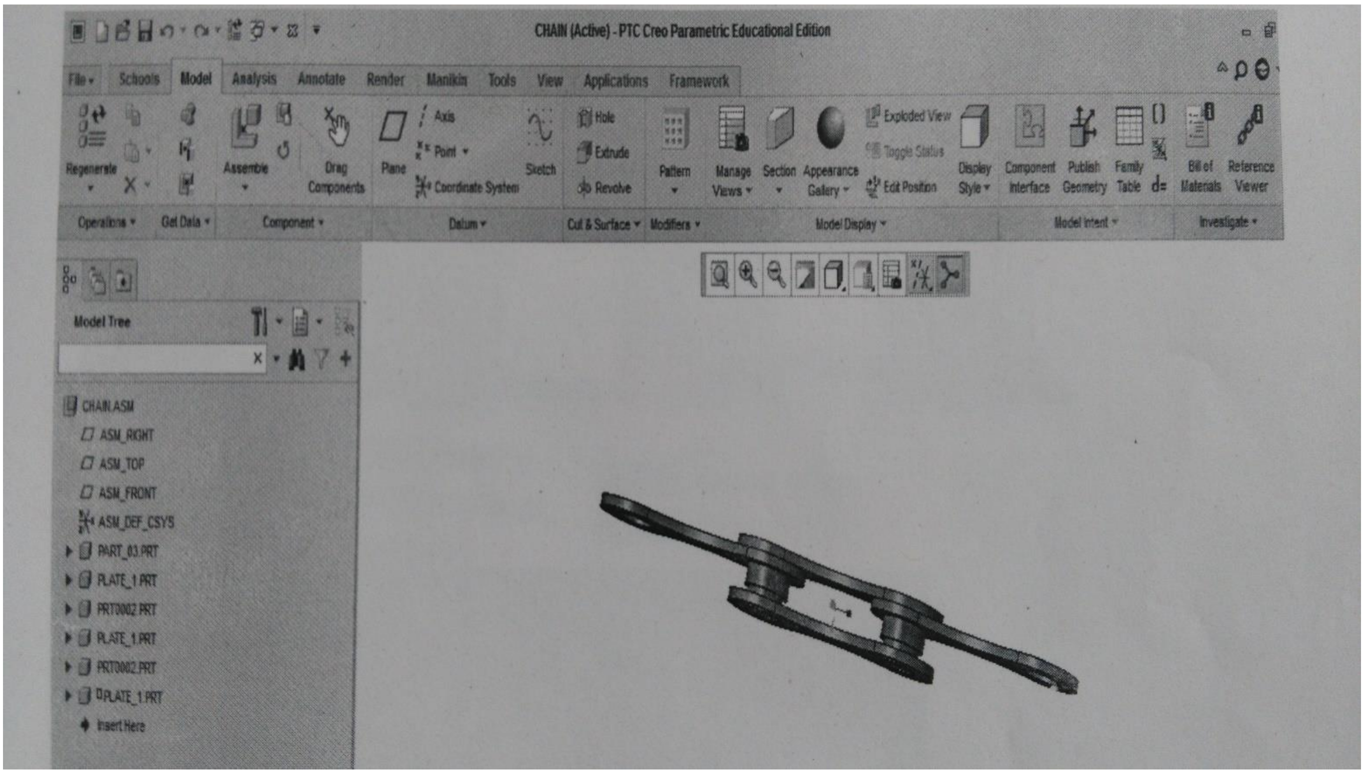

ROLLER DIA.
ROLLER WIDTH
PITCH

Pitch (p) = 12 + (34*0.02) =12.68mm

Roller Dia ($d_1$) = 7 + (42*0.02) =7.84mm

Width ($b_1$) = 3 + (19*0.02) =3.38mm

# <u>CAD/Creo Drawing:</u>

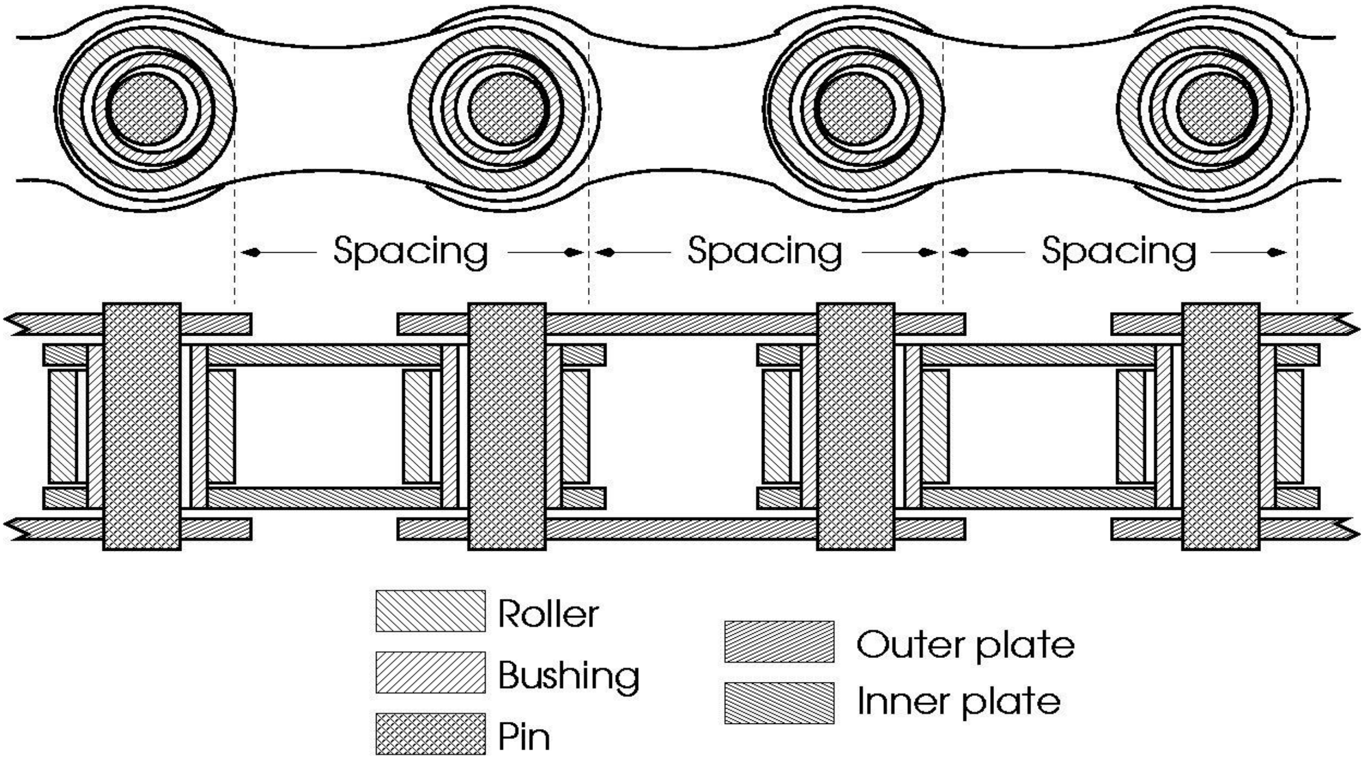


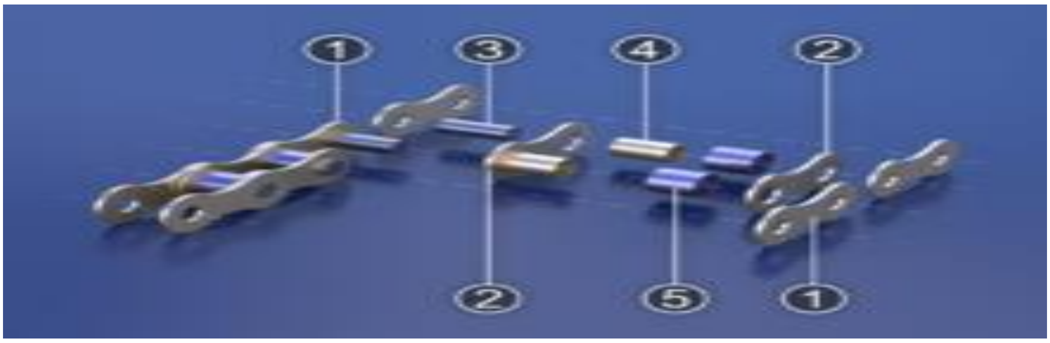
# Design Procedure

## ➢ Construction of Roller Chain

*The construction of roller chain is the image below.*

*It consist of alternate link made of inner plate and outer link plates.*




1. *Outer plate*
2. *Inner plate*
3. *Pin*
4. *Bushing*
5. *Roller*

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**Equations:**

$\alpha = \left(\frac{360}{z}\right)$

$sin\ (\frac{\propto}{2}) = (\frac{p/2}{D/2})$

$D = (\frac{p}{\sin\left(\frac{180}{z}\right)})$

$V = \frac{\pi Dn}{(60*10^3)}$

$\pi D \approx zp$

$$\therefore v = \frac{\pi Dn}{60*10^3}$$

$L = L_n \times p$

$$L_n = 2\left(\frac{a}{p}\right) + \left(\frac{z_1+z_2}{2}\right) + \left(\frac{z_2+z_1}{2}\right)^2 * \left(\frac{p}{2}\right)$$

$$a = \frac{p}{4}\{\left[L_n - \left(\frac{z_1+z_2}{2}\right)\right] + \sqrt{\left[L_n - \left(\frac{z_1+z_2}{2}\right)\right]^2 - 8\left[\frac{z_2-z_1}{2\pi}\right]^2}$$

$$kW = \frac{p_1 v}{1000}$$

*Where,* $\alpha$ *= Pitch angle*

*Z=number of teeth on the sprocket*

*D=pitch circle diameter (mm)*

*v = average velocity of the chain (m/s)*

*n=speed of rotation (rpm)*

*L=length of the chain (mm)*

$L_n = no\ of\ links\ in\ the\ chain$

$z_1 = No\ of\ teeth\ on\ the\ smaller\ sprocket$

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$z_2 = No\ of\ teeth\ on\ the\ larger\ sprocket$

$a = central\ distance\ between\ axes\ of\ driving\ and\ Driven$ *Sprockets (mm)*

$p_1 = Allowable\ tension\ in\ the\ chain(N)$

*kW =Power transmitted by roller chain*

# Calculations:

*In Hero jet gold bicycle we have;*

*p = 12.68mm*

$d_1 = 7.84mm$

$b_1 = 3.38mm$

*z = No of teeth in smaller sprocket = 18*

$$\propto= \left(\frac{360}{z}\right) = \left(\frac{360}{18}\right) = 20°$$

$$D = \frac{p}{\sin\left(\frac{180}{z}\right)} = 12.68/(\sin\left(\frac{180}{18}\right)) = 73.02mm$$

$$v = \left(\frac{\pi zp}{60\times10^3}\right) = \frac{\pi\times18\times12.68\times10^{-3}}{60\times10^3} = 1.195\times10^{-5}m/s$$

$$n = \frac{v\times60\times10^3}{\pi\times D} = \frac{1.195\times10^{-5}\times60\times10^3}{\pi\times73.02\times10^{-3}} = 3.125rpm$$

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# Manufacturing process:

*A bicycle chain is essentially a roller chain. It's designed specially to transfer pedal power to the bicycles rear drive wheel.*

Punch Press

*The manufacturing process starts with punch press. It cuts and presses steel into the shape of a chain's inner link. Ambles of these inner links are sent to a measuring station to confirm the space between the holes is precisely 12.7 millimetres. The tester also gauges the diameter of the holes which must be accurate to with in a fraction of millimetre. The links are then baked in an oven at more than 1500 degree Fahrenheit. The blazing heat followed by a quick cool down hardens the steel. They now shovel these interlinks into a donut shaped machine. They add ceramic and silica powders, and pour in a small amount of water. The machine lid is closed. It shakes vigorously causing the powder and water to form an abrasive paste that polishes the links. They loaded the polished inner links into the metal basket and shut the door. Machinery plunges the basket into a series of chemical baths to give these inner links a nickel Teflon veneer. The nickel Teflon surface will resist corrosion, and its smooth texture will allow the chain to travel easily over gear sprockets. They are now ready to assemble the chain one section at a time. Tubes feed the path one by one into assembly machine. Gripper arms adjust their position to assemble the links to other components such as retainer rings and spacers. The machinery presses pin into the link holes to secure the assembly. Then grippers move the completed section of chain down the line. It takes a whole lot of little pieces to build one short section of bicycle chain. The section are linked*

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*together one long chain, which wings by the inspection station to be examined for flaws. After that, the chain take a dip in hot oil to lubricate the links preventing squeakiness and wear down the road. The chain exits the lubrication station and travel through an absorbent material which soaks up the excess grease. A laser tool then signals and the location where the chain has to be cut and blade chops it at the exact spot. A standard chain is just over 56 inches in length. It consist of 114 inner links and 114 external ones.*

## Manufacturers of roller chain are:

- *Campagnolo*
- *Rohloff AG*
- *KMC chain*
- *SRAM*
- *Wippermann*

• Roller Chain Manufacturing Process

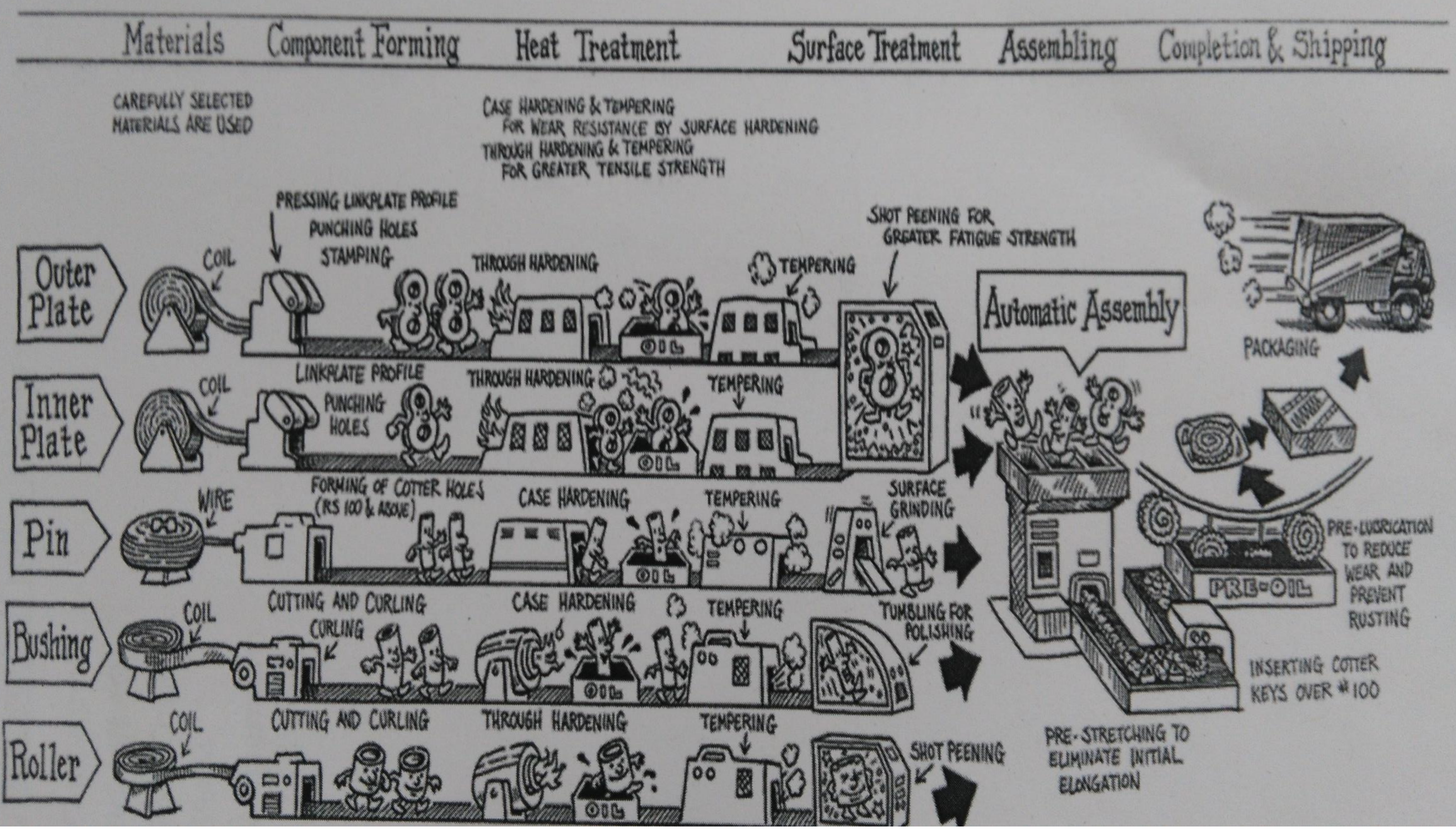

Table 14.1 *Dimensions and breaking loads of roller chains*

| ISO chain number | Pitch p (mm) | Roller diameter $d_1$ (mm) (max.) | Width $b_1$ (mm) (min.) | Transverse pitch $p_t$ (mm) | Breaking load (min) N | | |
|---|---|---|---|---|---|---|---|
| | | | | | Simple | Duplex | Triplex |
| 05B | 8.00 | 5.00 | 3.00 | 5.64 | 4 400 | 7 800 | 11 100 |
| 06B | 9.525 | 6.35 | 5.72 | 10.24 | 8 900 | 16 900 | 24 900 |
| 08A (ANSI-40) | 12.70 | 7.95 | 7.85 | 14.38 | 13 800 | 27 600 | 41 400 |
| 08B | 12.70 | 8.51 | 7.75 | 13.92 | 17 800 | 31 100 | 44 500 |
| 10A (ANSI-50) | 15.875 | 10.16 | 9.4 | 18.11 | 21 800 | 43 600 | 65 400 |
| 10B | 15.875 | 10.16 | 9.65 | 16.59 | 22 200 | 44 500 | 66 700 |
| 12A (ANSI-60) | 19.05 | 11.91 | 12.57 | 22.78 | 31 100 | 62 300 | 93 400 |
| 12B | 19.05 | 12.07 | 11.68 | 19.46 | 28 900 | 57 800 | 86 700 |
| 16A (ANSI-80) | 25.40 | 15.88 | 15.75 | 29.29 | 55 600 | 111 200 | 166 800 |
| 16B | 25.40 | 15.88 | 17.02 | 31.88 | 42 300 | 84 500 | 126 800 |
| 20A(ANSI-100) | 31.75 | 19.05 | 18.90 | 35.76 | 86 700 | 173 500 | 260 200 |
| 20B | 31.75 | 19.05 | 19.56 | 36.45 | 64 500 | 129 000 | 193 500 |
| 24A (ANSI-120) | 38.10 | 22.23 | 25.22 | 45.44 | 124 600 | 249 100 | 373 700 |
| 24B | 38.10 | 25.40 | 25.40 | 48.36 | 97 900 | 195 700 | 293 600 |
| 28A(ANSI-140) | 44.45 | 25.40 | 25.22 | 48.87 | 169 000 | 338 100 | 507 100 |
| 28B | 44.45 | 27.94 | 30.99 | 59.56 | 129 000 | 258 000 | 387 000 |
| 32A(ANSI-160) | 50.80 | 28.58 | 31.55 | 58.55 | 222 400 | 444 800 | 667 200 |
| 32B | 50.80 | 29.21 | 30.99 | 58.55 | 169 000 | 338 100 | 507 100 |
| 40A(ANSI-200) | 63.50 | 39.68 | 37.85 | 71.55 | 347 000 | 693 900 | 1040 900 |
| 40B | 63.50 | 39.37 | 38.10 | 72.29 | 262 400 | 524 900 | 787 300 |
| 48A | 76.20 | 47.63 | 47.35 | 87.83 | 500 400 | 1000 800 | 1501 300 |
| 48B | 76.20 | 48.26 | 45.72 | 91.21 | 400 300 | 800 700 | 1201 000 |
| 64B | 101.60 | 63.50 | 60.96 | 119.89 | 711 700 | 1423 400 | — |

**Table 14.2** *Power rating of simple roller chain*

| Pinion speed (rpm) | Power (kW) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 06 B | 08A | 08 B | 10A | 10 B | 12A | 12 B | 16A | 16 B |
| 50 | 0.14 | 0.28 | 0.34 | 0.53 | 0.64 | 0.94 | 1.07 | 2.06 | 2.59 |
| 100 | 0.25 | 0.53 | 0.64 | 0.98 | 1.18 | 1.74 | 2.01 | 4.03 | 4.83 |
| 200 | 0.47 | 0.98 | 1.18 | 1.83 | 2.19 | 3.40 | 3.75 | 7.34 | 8.94 |
| 300 | 0.61 | 1.34 | 1.70 | 2.68 | 3.15 | 4.56 | 5.43 | 11.63 | 13.06 |
| 500 | 1.09 | 2.24 | 2.72 | 4.34 | 5.01 | 7.69 | 8.53 | 16.99 | 20.57 |
| 700 | 1.48 | 2.95 | 3.66 | 5.91 | 6.71 | 10.73 | 11.63 | 23.26 | 27.73 |
| 1000 | 2.03 | 3.94 | 5.09 | 8.05 | 8.97 | 14.32 | 15.65 | 28.63 | 34.89 |
| 1400 | 2.73 | 5.28 | 6.81 | 11.18 | 11.67 | 14.32 | 18.15 | 18.49 | 38.47 |
| 1800 | 3.44 | 6.98 | 8.10 | 8.05 | 13.03 | 10.44 | 19.85 | — | — |
| 2000 | 3.80 | 6.26 | 8.67 | 7.16 | 13.49 | 8.50 | 20.57 | — | — |

Table 14.3 *Service factor ($K_s$)*

| *Type of driven load* | *Type of input power* | | |
|---|---|---|---|
| | *IC engine with hydraulic drive* | *Electric motor* | *IC engine with mechanical drive* |
| (i) *Smooth:* agitator, fan, light conveyor | 1.0 | 1.0 | 1.2 |
| (ii) *Moderate shock:* machine tools, crane, heavy conveyor, food mixer, grinder | 1.2 | 1.3 | 1.4 |
| (iii) *Heavy shock:* punch press, hammer mill, reciprocating conveyor, rolling mill drive | 1.4 | 1.4 | 1.7 |

Table 14.5 *Tooth correction factor ($K_2$)*

| *Number of teeth on the driving sprocket* | $K_2$ |
|---|---|
| 15 | 0.85 |
| 16 | 0.92 |
| 17 | 1.00 |
| 18 | 1.05 |
| 19 | 1.11 |
| 20 | 1.18 |
| 21 | 1.26 |
| 22 | 1.29 |
| 23 | 1.35 |
| 24 | 1.41 |
| 25 | 1.46 |
| 30 | 1.73 |

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drive

30

Table 14.4 *Multiple strand factor* ($K_1$)

| *Number of strands* | $K_1$ |
|---|---|
| 1 | 1.0 |
| 2 | 1.7 |
| 3 | 2.5 |
| 4 | 3.3 |
| 5 | 3.9 |
| 6 | 4.6 |