Drive Chains

Design Considerations

Drive chains are used for power transmission and speed reduction. Horsepower, which is 33,000 foot-pounds of work per minute, is the unit of measurement of power.

Horsepower (mechanical)

$$HP = \frac{T(RPM)}{63{,}000}$$

$$HP = \frac{P(FPM)}{33{,}000}$$

Where:

T = Torque (in.-lb.)
P = Net chain pull (lbs.)
RPM = Shaft speed (rev./min.)
FPM = Chain speed (ft./min.)

Chain Speed (In FPM)

$$FPM = \frac{RPM\ (no.\ of\ teeth)\ (pitch\ in\ inches)}{12}$$

Horsepower (electric motor)

$$HP\ (3\ Phase) = \frac{Volts \times Amperes \times 1.732 \times Efficiency \times Power\ Factor}{746}$$

$$HP\ (1\ Phase) = \frac{Volts \times Amperes \times Efficiency \times Power\ Factor}{746}$$

Alignment

Accurate alignment of shafts and sprocket tooth faces provides uniform distribution of the load across the entire chain width. Uniform distribution of the load contributes substantially to optimum drive life. Be sure that the shaft, bearings, and foundations are suitable to maintain the initial alignment. Periodic maintenance should include an inspection of alignment to ensure optimum chain life.

Arrangement

Drive chains are ideally installed with the shaft in the horizontal position, as shown in Figures 1 and 2.

Figure 1

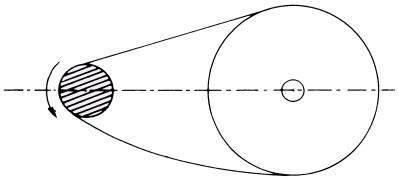
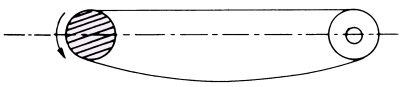
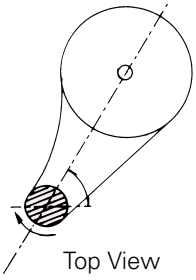


Figure 2



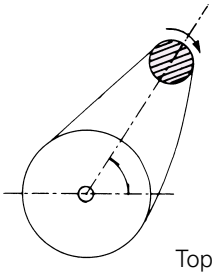
When chains are installed at angles approaching the shaft vertical position, they elongate quickly and may slip off the sprockets. In such cases, make sure the sprockets are adjusted properly. (See Figures 3 and 4.)

Figure 3



Top View

Figure 4



Top View

Position of Sprockets

The two shafts should be parallel and the sprockets should be firmly installed. Use a straight edge to check that the two sprockets are installed along the same horizontal level. This is illustrated in Figures 5 and 6.

Figure 5

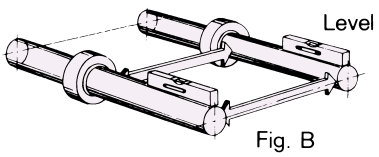


Fig. B

Figure 6

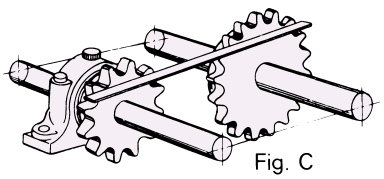


Fig. C

Lubrication

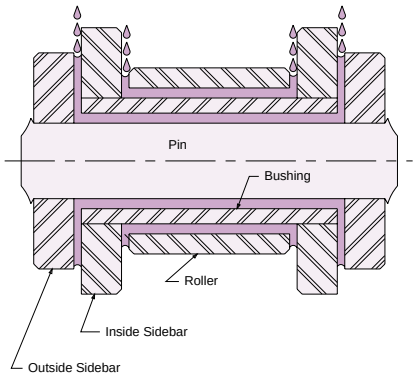
Lubrication Increases the Service Life

One of the most important factors in getting the best possible performance out of your drive chain is proper lubrication. No matter how well a transmission system is designed, if it is not properly lubricated, its service life will be shortened.

Lubrication

Wear between the pin and bushing causes drive chain to elongate. These parts should, therefore, be well lubricated, as shown in Figure 7. The gap between the inside sidebar and the outside sidebar on the slack side of the chain should be filled with oil. This oil forms a film which minimizes wear on the pin and bushing, thus increasing the chain's service life. It also reduces noise and acts as a coolant when the chain runs at high speeds.

Figure 7



Suggested Lubricants

Only high quality oil should be used to lubricate the drive chain. Neither heavy oil nor grease is suitable. The viscosity of the oil used will depend on the chain size, chain speed, and ambient temperature. The lubricants suggested for specific temperature ranges are shown in Table 1.

Table 1 — Lubrication Table

Temperature (˚F)	Suggested Lubricant
20˚ - 40˚	SAE 20
40˚ - 100˚	SAE 30
100˚ - 120˚	SAE 40
120˚ - 140˚	SAE 50

Lubrication Systems

The following lubricating systems are suggested:

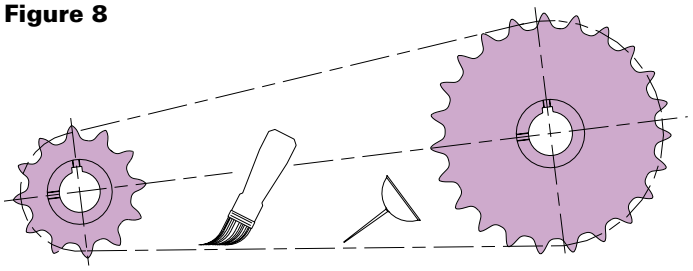
Drip Lubrication

Use a simple casing and supply oil by drip feed. Each strand of chain should receive 15 to 120 drops of oil per minute depending on the chain speed.

Manual Lubrication

On the slack side of the chain apply oil with an oil filler or brush in the gap between the pin link sidebar and roller link sidebar. (See Figure 8.) Reapply every eight hours or as often as necessary to prevent the bearing area of the chain from becoming dry.

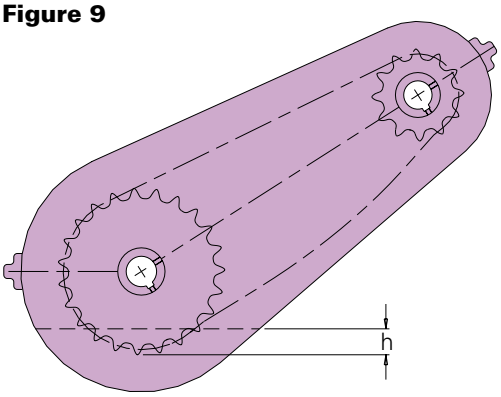
Figure 8



Oil Bath Lubrication

Install the chain in a leak-free casing (Figure 9). The oil depth (h) should extend only to the middle point of the pin end. The oil will be adversely affected by the generated heat if the oil depth is too great.

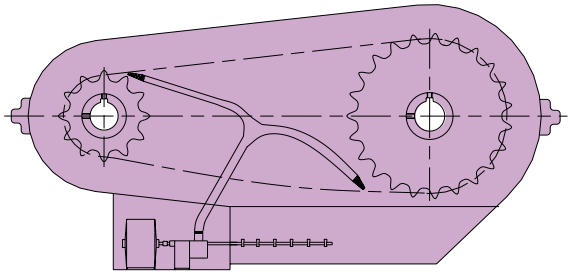
Figure 9



Lubrication Using a Pump (Oil Stream)

Use a leak-free casing. Circulate the oil with a pump. The number of supply holes should be one more than the number of strands of chain. Supply a constant amount of oil to each hole (Figure 10). The oil should also be cooled in this process.

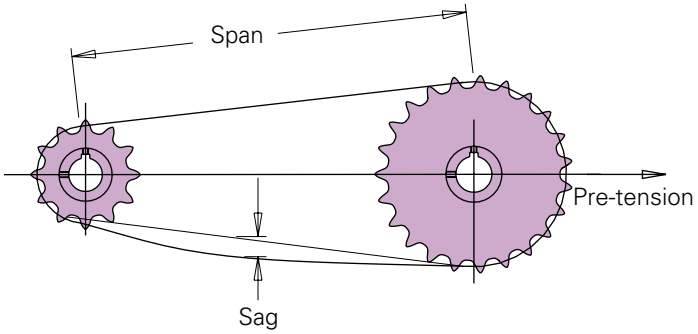
Figure 10



Catenary Sag

Pre-tension on the slack strand should be adequate to hold chain inward on the sprocket tooth profile. The 3% catenary sag distance on the slack strand achieves correct pre-tension levels, illustrated in Figure 11.

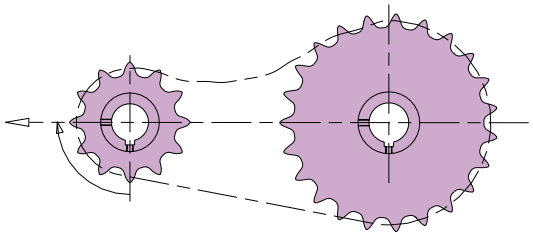
Figure 11



Sag = 3% of chain span

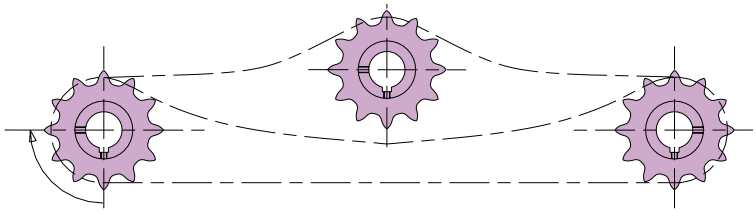
Attention should be paid to the following arrangements. If the slack side is on top, it is necessary to eliminate excessive chain slack. When the center distance is short, chain slack should be adjusted by increasing the center distance illustrated in Figure 12.

Figure 12



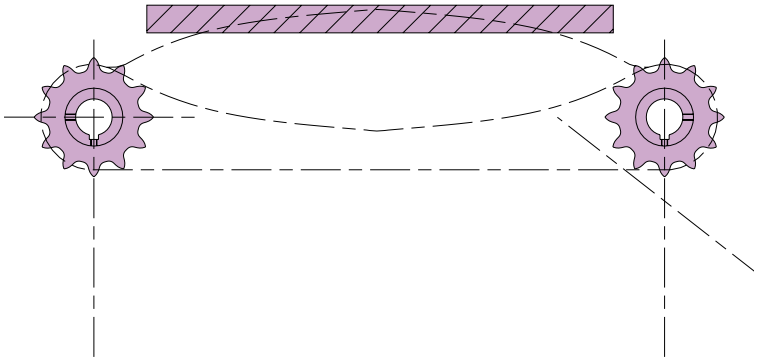
When the center distance is long, chain slack should be adjusted by installing an idler, illustrated in Figure 13.

Figure 13



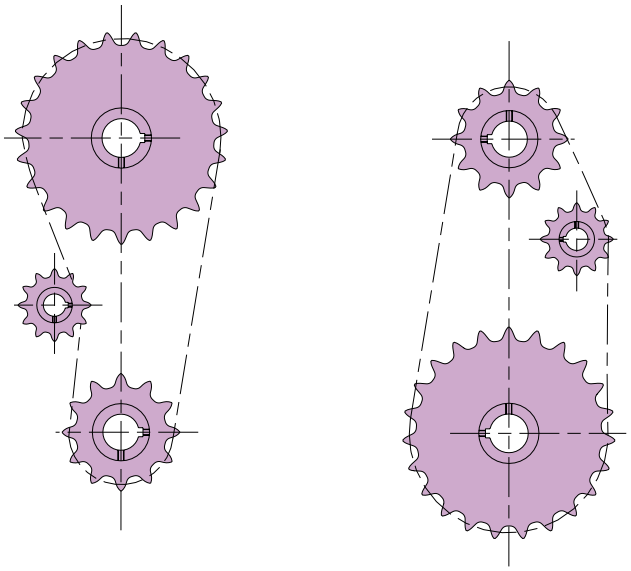
If vibration occurs due to high chain speed, install a guide. This is shown in Figure 14.

Figure 14



If the centerline is vertical, install an idler which functions automatically to eliminate extra chain slack. If the driving shaft is on the lower side, an idler must be installed, as shown in Figure 15.

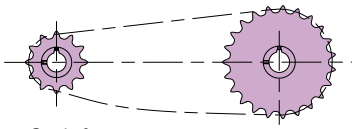
Figure 15



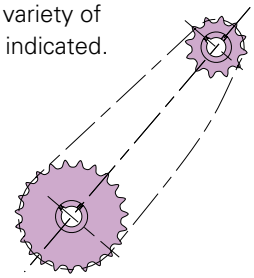
Drive Chain Arrangements

The position of the drive and driven sprockets can greatly affect the life of the chain drive. Figure 16 illustrates a variety of arrangements with favorable and unfavorable features indicated.

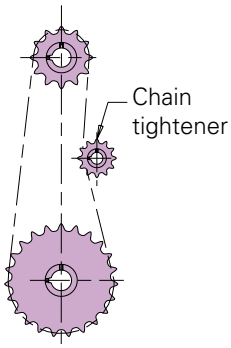
Figure 16



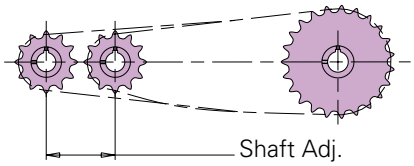
Satisfactory arrangement for drives with short centers.



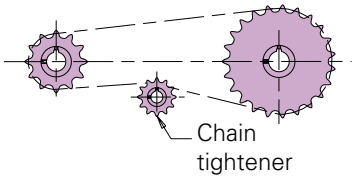
Satisfactory arrangement for drives with short centers.

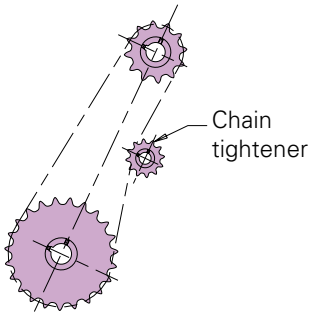


Best arrangement for vertical drives where means for adjusting slack is possible.

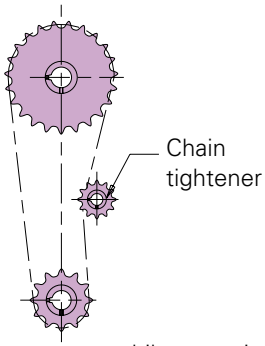


It is best to have one shaft adjustable as shown directly above. Or use a chain tightener as shown in the lower arrangement.

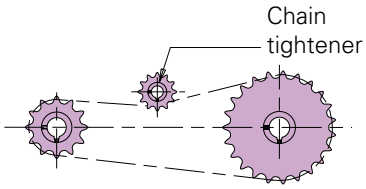




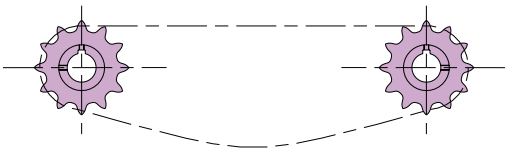
For drives on steep inclines some means must be provided to adjust slack side tension.



This arrangement, while sometimes used, is not as satisfactory as that shown above.



When slack side is on top some means must be provided to adjust slack side tension.

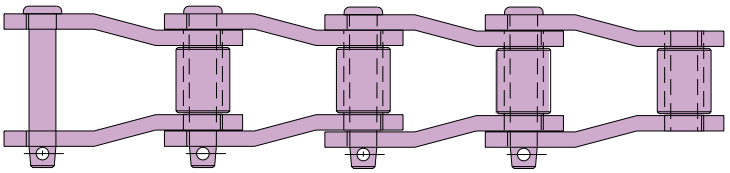


Unsatisfactory arrangement. (No adjustment is provided.)

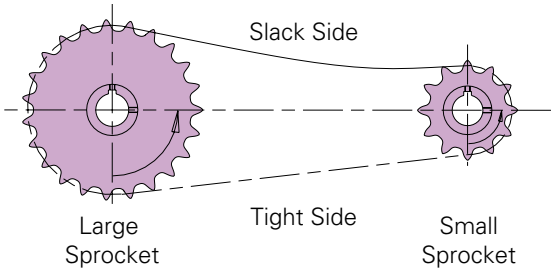
Direction of Travel

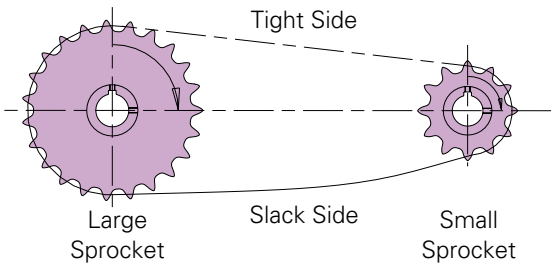
The travel direction affects the wear life of offset drive chains. Figure 17 illustrates the general rule for chain travel direction. It is as follows: The narrow or roller end of links on the tight side should travel toward the small sprocket, regardless if it is a drive or driven sprocket.

Figure 17



(Tight side traveling toward the small sprocket.)





Chain Elongation

You can estimate the remaining chain life by determining chain elongation. This is illustrated in Figure 18. Measure chain elongation in the following manner.

1. Locate a straight section of chain that is under tension.
2. Using a vernier or scale, measure the inside (L1) and outside (L2) of the pins at both ends of the measured links.
3. Calculate the measurement (L) using the formula:

$$L = \frac{(L1 + L2)}{2}$$

4. Calculate chain elongation.

$$\text{Chain elongation} = \frac{\text{Measured length - Standard length x 100\%}}{\text{Standard length}}$$

Where:

Standard length = Chain pitch x Number of links

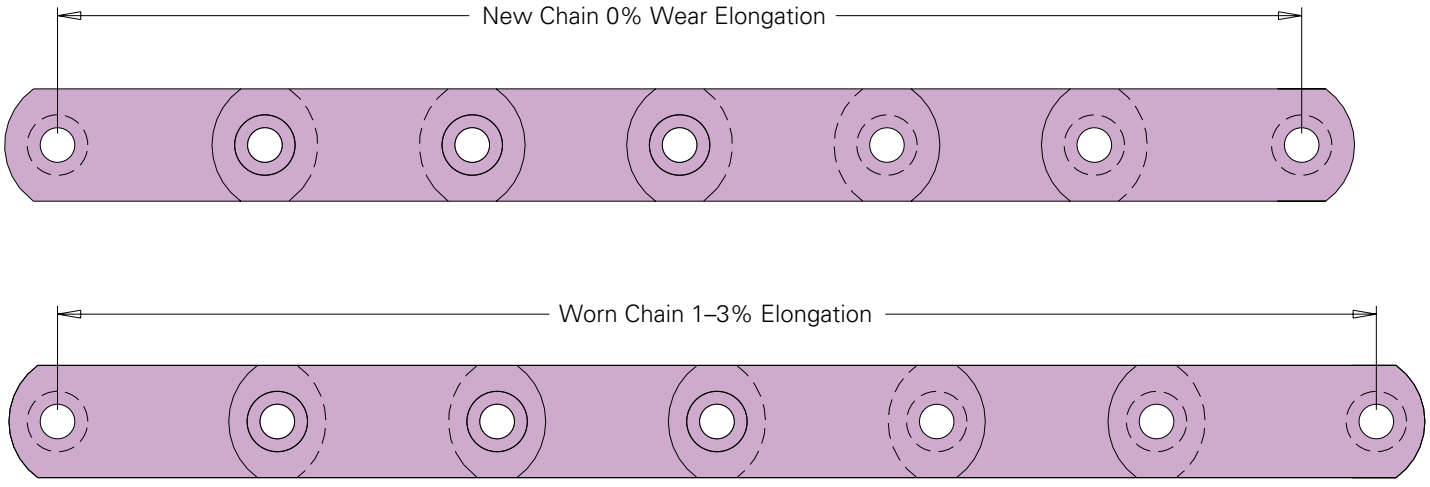
When Chains Should Be Replaced

Replace drive chains corresponding to the number of sprocket teeth as shown in Table 2.

Table 2 — Drive Chain Replacement (Full Wrap)

% Chain Elongation	Number of Teeth in Large Sprocket
1	≥ 140
2	> 72
3	≤ 72

Figure 18



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