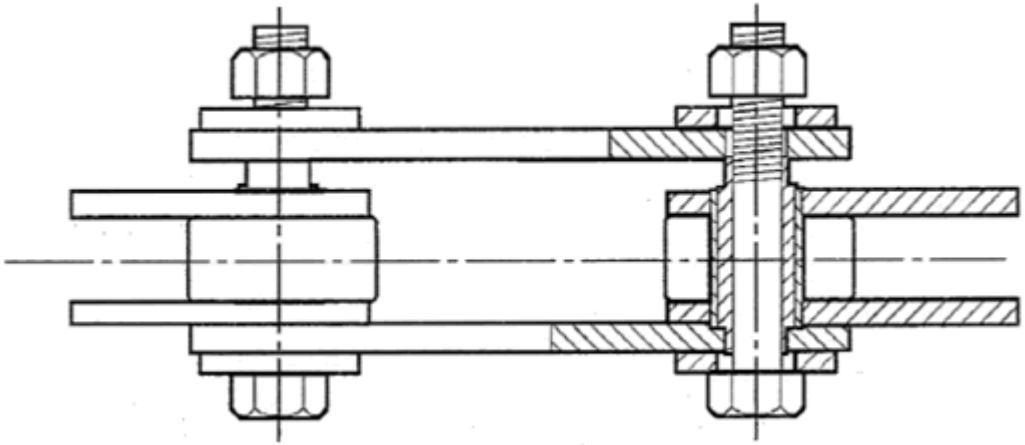
## Installation and Assembly

When assembling new chain, or repairing existing chain, the following precautions should be taken;

a) All power to the equipment should be isolated before any work begins on the chain.
b) Ensure that any replacement links are on site and of the correct type, before breaking the existing chain.
c) Tension on the chain should be completely removed, so that the joints can articulate.
d) Sprockets should be locked in place to prevent rotation whilst working on the chain. This is especially important on inclined conveyors or elevators.
e) The chain should be held in position on both sides of the link to be broken, or connecting link to be removed.
f) Safe working practices should be employed at all the times. The following points are important and should be adhered to whilst working on chains;

1) Connecting pins must not be modified to ease insertion into link plates, nor should holes within link plates be opened up. Interference fits between these components are an essential part of the chains construction.
2) Heat should not be applied to any of the chain components, as this will seriously degrade the material properties.

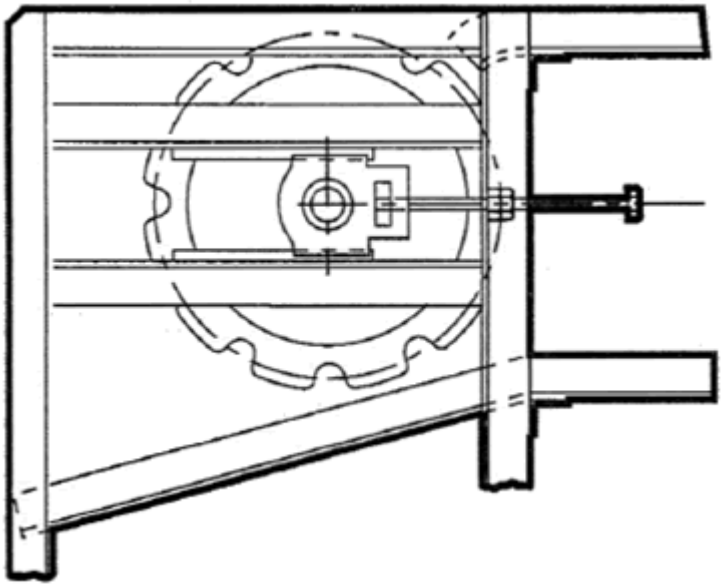
## Solid Pin Connectors

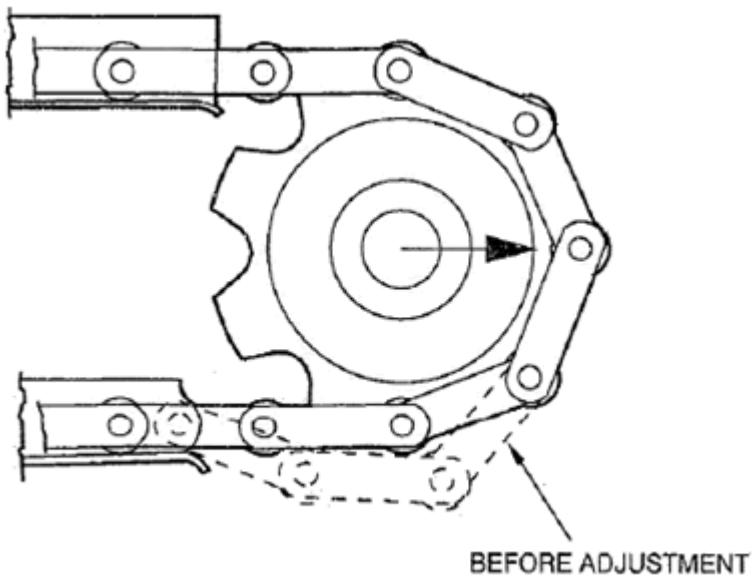


a) Ensure the chain is secured on both sides of the assembly point
b) Unless the chain is unable to be lubricated due to its working environment, ensure that the connecting pins are coated in grease or oil before inserting the pins through the two ends of the chain
c) Place the loose plate over the ends of the connecting/bearing pins and ensure the fixed plate side is supported, to prevent the pins from being pushed back out.
d) Carefully force the loose plate over the connecting/bearing pins, equally and alternately, using a hollow punch, hammer, hydraulic press or jack.
e) When the plate is correctly seated over the connecting pins, apply the self-locking retaining nuts.
f) Finally, check the assembled joint is free to articulate. If the joint is tight, a light blow to the pin heads on the fixed plate side should free the joint

*Figure – Screw type connecting link*

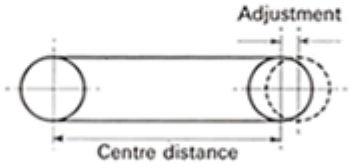
## Adjustment




BEFORE ADJUSTMENT

$$\text{Adjustment (in)} = \frac{\text{Centre distance (in)} \times \text{factor}}{\text{Chain pitch (in)}}$$

| *Chain series* | *Factor* |
|---|---|
| 3,000 lbf | 0·016 |
| 6,000/7,500 lbf | 0·020 |
| 12,000/15,000 lbf | 0·030 |
| 24,000/30,000 lbf | 0·040 |
| 36,000/45,000 lbf | 0·040 |
| 60,000 lbf | 0·050 |
| 85,000 lbf | 0·050 |




EXAMPLE: Conveyor 30 ft centres using 8·0 in pitch. 30,000 lbf chain

$$\text{Adjustment} = \frac{30 \times 12 \times 0{\cdot}040}{8}$$
$$= 1{\cdot}8 \text{ in}$$

For optimum performance and correct running, all chain systems should be provided with means to compensate for elongation due to wear. As a chain conveyor or elevator is a positive form of drive, no pre-tensioning of the chain is necessary. The only adjustment required is the take-up of the clearances between the pins and bushes in each link; this should be done before the conveyor is run.

The amount of adjustment should allow for the joining up of the chain and elongation due to wear. Wherever possible, the adjusting wheel or track should be set at a convenient position following the drive point. This ensures that the effort required to adjust the chain is minimal. Take-up positions should, whenever possible, be introduced at positions where the conveyor

makes a 180º bend. At these positions, the chain take-up will be equal to twice the adjustment. If a 90º position is unavoidable, then track movement, particularly on overhead conveyors, will arise. Where multiple drives are used, it is preferable to provide an adjustment for each drive point.

After the chain has been installed and any additional fixtures have been put in place, the tension on the chain should be adjustment, prior to starting the machine. This adjustment should remove any slack from the chain, but should not go as far as pre-tensioning the chain. One of the simplest methods of adjustment is a screw type take up unit, as shown in figure 2. However, care must be taken on these units, as accidently pre-tensioning the chain can reduce the chains life.

As a general guide to adjusting chain;

a) Check that the tail shaft is inline i.e. adjust the bearing slides if necessary.
b) Adjust the take up screws until the chain does not hang from the underside of the sprocket, as shown in figure 3.
c) Lock the adjustment screws into position.
d) Carefully run the unit for a minimum of one complete cycle, allowing the chain and any attachments to settle, before re-checking the chain adjustment.
e) Repeat steps b) to d) if necessary.

Where an automatic take up unit is installed i.e. hydraulic, spring, pneumatic etc. care should be taken to prevent unnecessary pre-tensioning of the chain (see Calculating Tension Loads)

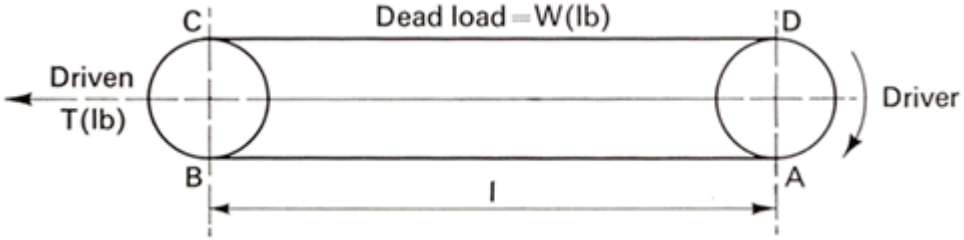
After the chain has been correctly adjusted and lubricated (if applicable), the unit should be allowed to run for 8-24 hours, without load, to ensure that all components can bed in. After this period, the take up should be re-checked and adjusted if necessary. The amount of adjustment varies according to the length and pitch of the chain, which can be estimated as per the left hand table.

When a chain has been adjusted to this extent, it will be due for replacement. Where this calculated figure exceeds twice the pitch of the chain, then a minimum adjustment of plus 1.5 pitches, minus 0.5 pitches on the nominal centre distance should be provided. This amount of adjustment will allow the removal of two pitches of chain as wear occurs; with the minus adjustment providing sufficient slack for the initial connecting up of the chain.

On dredging feed elevators, where the boot wheel is the adjustable member, provision should he made not only for wheel adjustment but also for the lining of the boot so that the buckets remain at a constant distance from the lining.

*Figure – Screw type take up unit*
*Figure – Chain prior (dotted line) and post adjustment*
*Figure – Adjustment Calculation*

## Calculating Tension Loads




An assessment of the tension load is necessary for automatic take-up systems. In a simple two strand slat conveyor, the tension load TA applied by the automatic take-up is that required to balance the effects of the unloaded and loaded strands at the take-up position.

The theoretical tension load TT (lbf) required is given by the following expression:-

TT=Chain pull at B + chain pull at C

To this should be added the frictional sliding or rolling resistance of the take-tip unit. To cater for this it is usual to increase the theoretical tension load by 10%.

Therefore TA= 1.10 (chain pull at B + chain pull at C).

*Figure – Tension Load*

## Maintenance Planning

To obtain the maximum working life from a set of chains and sprockets, the maintenance of the equipment should be scheduled on a regular basis. This will help to reduce the amount of down time and assist with planning in any inconvenience caused by the necessary replacement of chains or components.

If the equipment is not part of a regular maintenance schedule, then replacement parts and sprockets should be held on site. Failure to plan for an unexpected breakdown can lead to costly downtime, especially on non-standard chains, where replacement parts and sprockets can be a few weeks away.

## Maintenance Schedule

A ‘typical’ maintenance schedule is shown below and should be adapted to suit the specific application, based on the chains working environment and working cycle.

Every Week

- Check lubrication (if applicable)

After the First Month

- Check the chain take up and adjust if necessary
- Check for any unusual wear, identify any cause and rectify immediately

Every 3 Months

- Check the chain take up and adjust if necessary
- Check for any unusual wear, identify any cause and rectify immediately

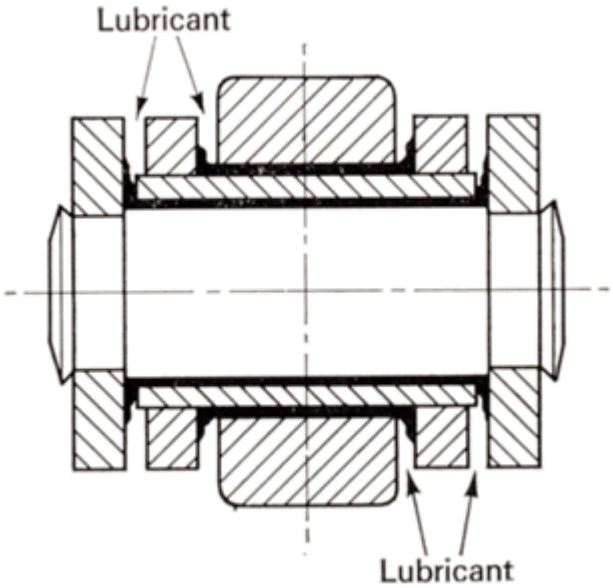
After 3 Months

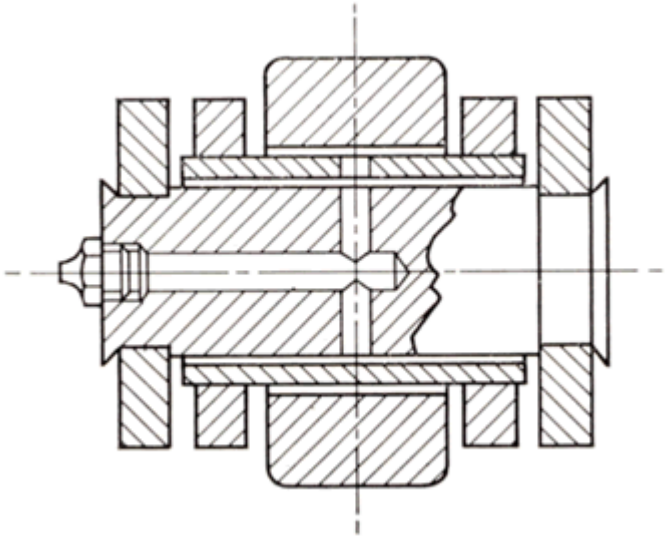
- Check the chain take up and adjust if necessary
- Perform maintenance on the lubrication system (if applicable)

Annually

- Check the chain take up and adjust if necessary
- Check for any unusual wear, identify any cause and rectify immediately
- Check for any wear on the chains side plates
- Check the chain for elongation / pitch extension
- Check for any accumulation of dirt or foreign materials
- Check shaft and sprocket alignments
- Check the sprockets for any wear
- Check the lubrication system (if applicable)

## Lubrication - General





Effective lubrication of the chain bearing surfaces is essential to obtain optimum performance in addition to minimising power absorption, rate of wear, liability of corrosion and noise.

The lubricant used for chains must be of a grade capable of reaching the bearing surfaces between the bearing pin and hush, and between the bush and roller, and with adequate body to maintain an oil film over the whole of these surfaces. It must also maintain its lubricating properties under operating conditions and be free from corrosive elements.

In all cases the lubricant should be applied immediately after the chain leaves the driving wheel and with the chain running. This is the point of least tension and the most likely position where the lubricant will reach the rubbing surfaces. Chains can be lubricated automatically with drip feed or oil mist spray lubricators or manually with a brush and lubricant. For normal conditions a good quality mineral based lubricant with a medium viscosity is recommended.

Mineral based lubricants carbonise at about 140ºC, thus causing a build up of carbon between pin/bush and bush/roller. For temperatures up to 300ºC a colloidal graphite lubricant suspended in a volatile carrier should he used. Evaporation of the carrier (usually white spirit) leaves a film of graphite on the wearing surfaces, but this will not be retained for a long period and must be re-applied at regular intervals.

Chains operating in abrasive conditions can also be lubricated with a dry lubricant but for extremely abrasive applications grease gun lubricated chain be used:-

Prevention of contamination of lubricant is usually considered in the context of handling food for human consumption. On such applications, vegetable oils or medicinal paraffin may be acceptable, and will provide satisfactory lubrication when applied by the normal methods. If non lubricated chains are essential, a reduction in chain life must be accepted, and taken into account when selecting the chain. For dairies or similar industries the possibility of bottles being marked by a lubricant is not acceptable, and soluble oil or liquid soap and water are widely used. When designing conveyor systems on which product contamination will occur, every effort should be made to avoid proximity of the chain to the product, as this will obviously assist the provision of satisfactory lubrication without running into contamination difficulties. *Figure – Standard Chain Lubrication Figure – Through Pin Lubrication*

## Lubrication in Dirty Water Environments

Chains operating in dirty water environments, such as a sewage treatment works, are often completely immersed, making it impossible to lubricate regularly. Under these conditions, chains are either designed to be replaced frequently, or special materials are used in their construction, to allow continuous operation in wet conditions. Where chains are accessible, grease gun lubrication should be used with water repellent grease, to periodically flush out old grease and contaminants.

## Lubrication – Pre Treatments

Pre-treatments can be applied to chains at the time of manufacture in order to give pre-lubrication or reduce the friction between components. Phosphating is the application of a manganese phosphate coating to the pin and bush surfaces. This provides a small degree of pre lubrication, however, its main advantage is to increase the effectiveness of subsequent lubrication, by offering a prepared surface to the grease. Molybdenum Disulphide and PTFE coatings can be applied to reduce the friction between components and acts as a preliminary lubricant.

It should be noted that pre-treatments provide a coating, which can be eroded under abrasive conditions

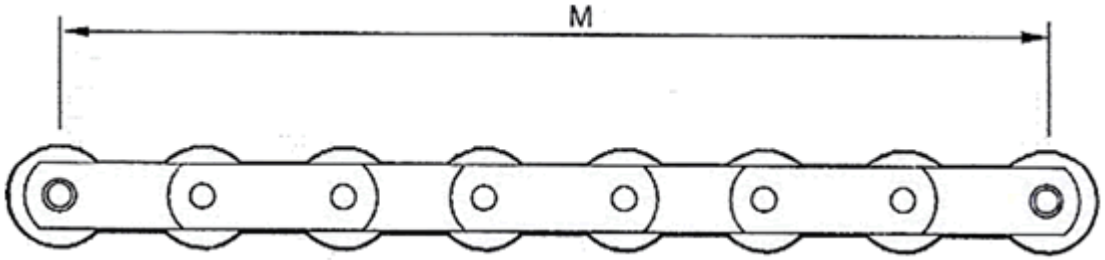
## Unlubricated Chain

In some environments, it is not possible to provide pre-coating or lubrication, due to either product contamination, or the possibility of creating unstable compounds. Under these circumstances, chain life can be improved by periodic cleaning/washing to remove contaminants which have built up over the chain. Compressed air can often be used in this task, if the material is loose and/or of a relatively low mass.

## General Inspection

Chains should be inspected at regular intervals throughout its life (see maintenance schedule), to ensure that any faults or defects are identified at an early stage and corrected to prevent further damage.
Inspection of chains and equipment should not be left until a major failure occurs. This can result in extended down times, especially if the replacement parts are not readily available.

## Extension of Chain Pitch




$$Percentage\ extension = \frac{[M - (X \times P)] \times 100}{X \times P}$$

Chain wear can be measured directly by examining the extension of the pitch (due to wear between the pins and bushes), which is usually caused by the articulation of chain under tension around the sprockets.

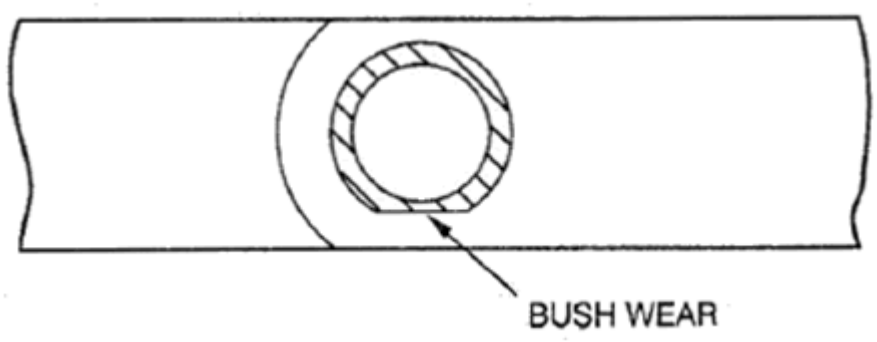
Chain extension can be measured over a length of chain, consisting of as many pitches as possible. The chain should be flat, on a straight section and under tension when the measurement is taken (see figure 5). The measured length ‘M’ can then be used in the following equation to obtain the extension (in %);

Where;
M = Measured Length
X = Number of pitches measured
P = Chain pitch (mm)

The maximum allowable percentage extension is +2.5%. When the chain extension has reached this figure, the chain should be replaced. If regular measurements are taken and recorded, it is possible to predict in advance when the chain will need replacing.

*Figure – Direction for obtaining M*
*Figure – Extension Calculation*

## Bush Wear




If a bush chain is being used, regular checks should be made for wear on outside of the bush, as shown in figure 6. This wear can be due to the bush sliding along guides, or the bush gearing on the sprocket. If the bush is worn through, so as to expose the bearing pin, then the chain should be replaced

If any of the bushes are broken or cracked, then the cause should be identified and immediately rectified. Depending upon the extent of the damage, either individual links, or the entire chain should be replaced.

*Figure – Example showing bush wear*

## Bearing Pin Wear

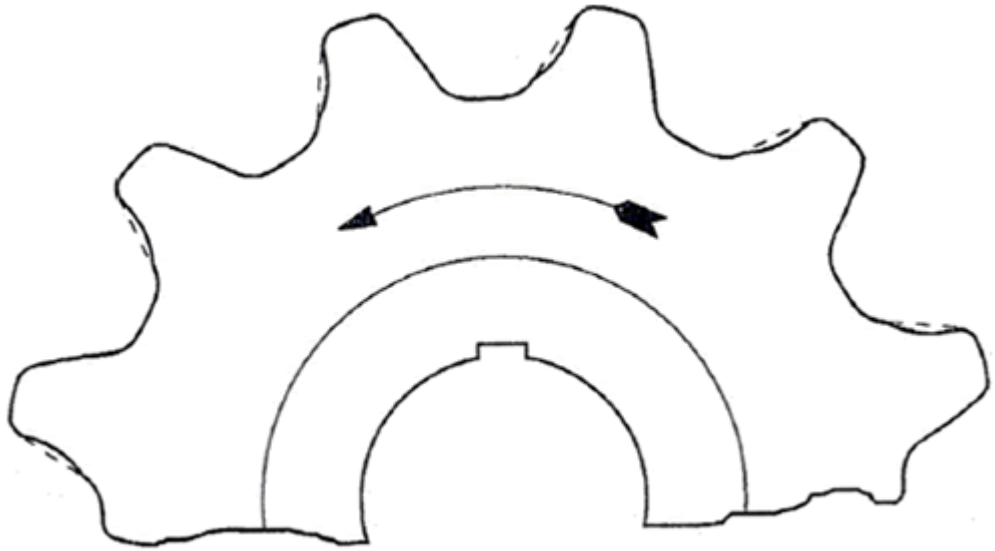
Bearing pin wear, through standard operation, can be detected by measuring the extension of the chain pitch as previously discussed.

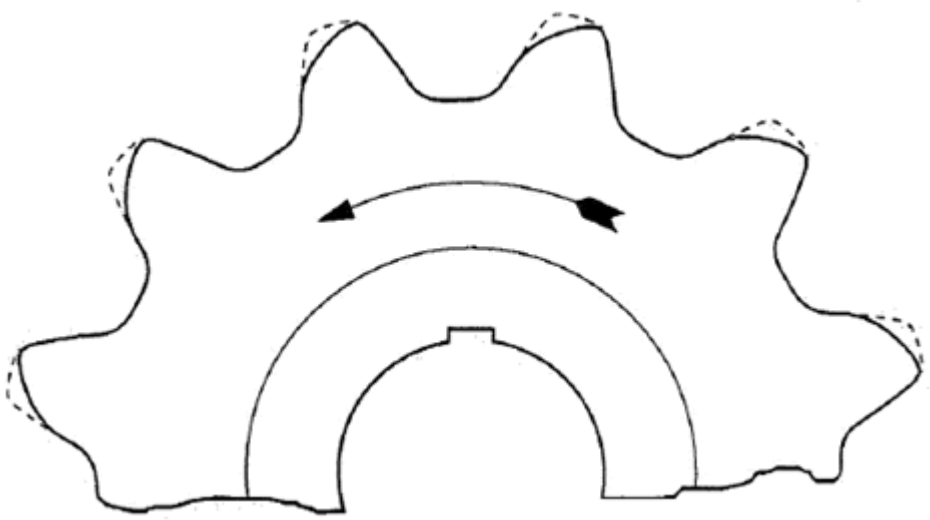
Wear on the bearing pin heads can be caused by;

- Insufficient clearance between the chain and side guide rails
- Uneven track levels across the unit
- Twisted Chain
- Poor alignment or bad guidance

The cause of any abnormal bearing pin wear should be identified and rectified immediately. If the pin heads have worn down to the side plates, then the rivet securing the pins becomes ineffective. Either the damage links or the complete chain should be replaced.

Sprocket Tooth Wear





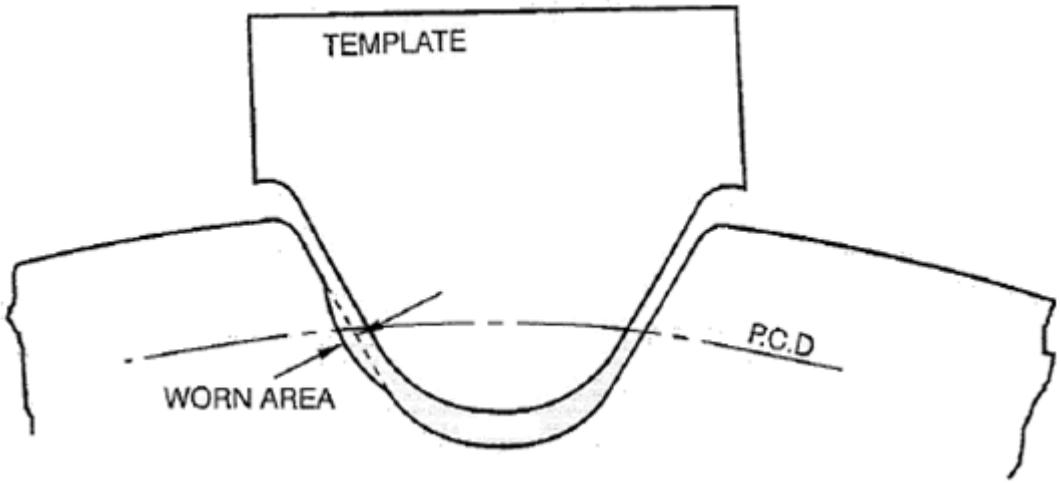
Gradual wear will take place on the teeth of sprockets due to the engagement of the chain, showing up as a worn or polished strip on the face of the tooth, near the root, as highlighted in figure 7. Wear generally occurs at a faster rate on sprockets used with bush chain, due to the sliding engagement of a bush, rather than the rolling engagement of a roller.

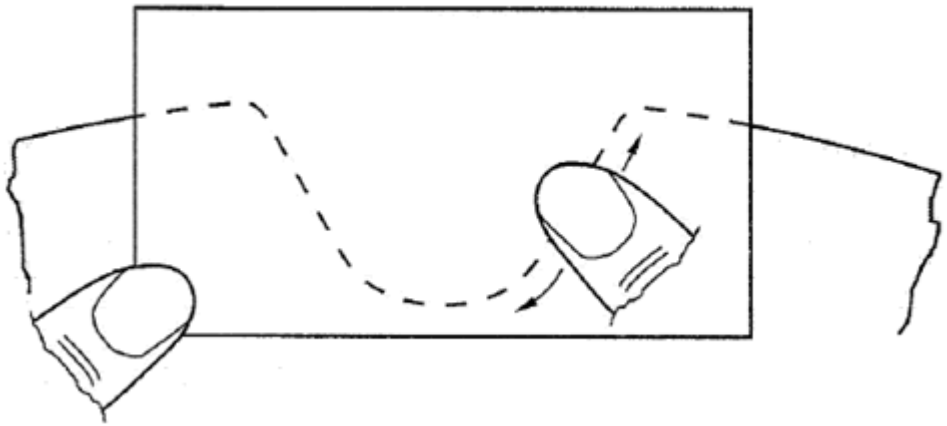
For usual wear, a concave groove will be worn into the face of the teeth. If this continuous, it will start to impede chain engagement and disengagement while weakening the teeth on smaller pitch chains.

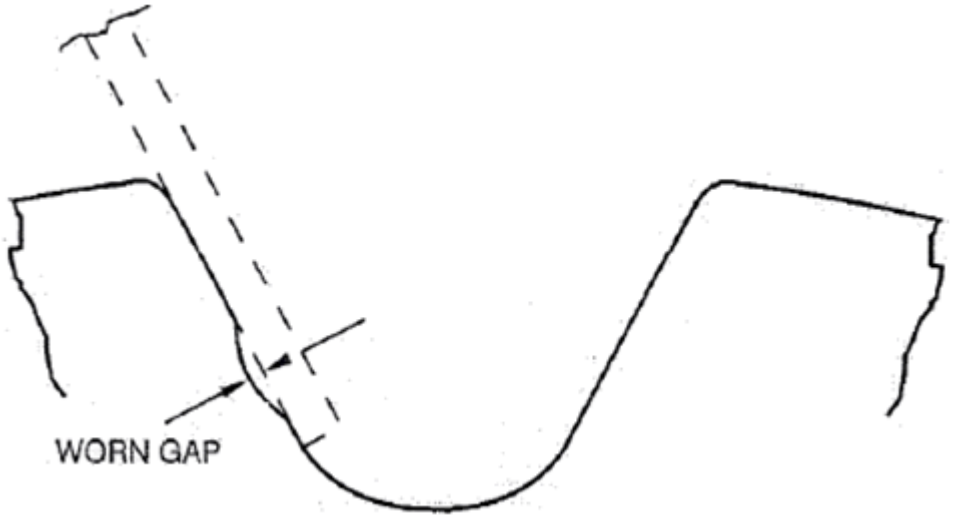
If the chain has not been correctly adjusted and has been running slack, it may tend to jump the teeth on the sprocket, causing the wear pattern in figure 8. This can be rectified by correctly tensioning the chain and replacing the sprocket if necessary.

*Figure – Sprocket tooth profile showing signs of wear*
*Figure – Sprocket tooth profile showing abnormal tooth wear from a slack chain*

## Measurement of Tooth Wear





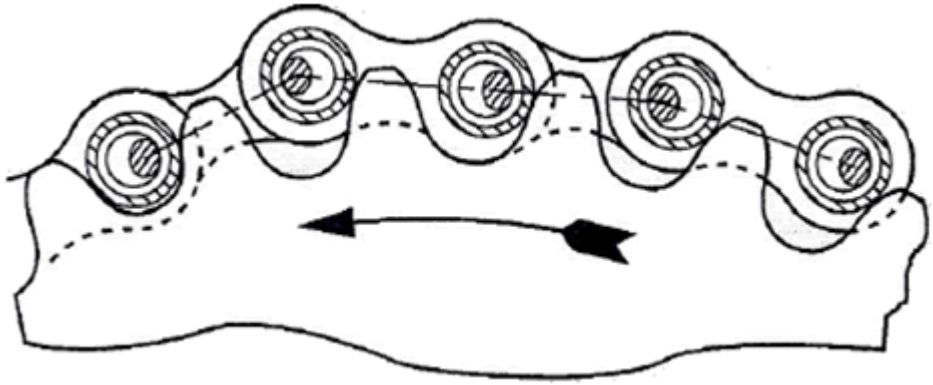

It is usually only possible to make a visual inspection of the tooth profile on sprockets that are in service. However, if access is available during routine down time, then one of the following methods can be used to measure for wear.

a) Clean the tooth of any grease or other contaminants and apply a template taken from a new sprocket (see *figure* )
b) Clean the tooth of any grease or other contaminates, then apply a small amount of grease around the face of the tooth. Hold a stiff piece of paper or card against the sprocket and apply finger pressure all of the way around the tooth profile, to form an impression as shown in the *figure*. This can then be compared to the original tooth profile.
c) On larger diameter sprockets, wear can be measured by holding a straight edge against the tooth and measuring the gap, as illustrated in the *figure*.

For most applications, the amount of wear should not exceed 10% of the bush/roller diameter.

*Figure – Applying a template to a worn sprocket*
*Figure – Creating a tooth profile impression*
*Figure – Measuring tooth wear with a straight edge*

## Tooth Wear – General Information



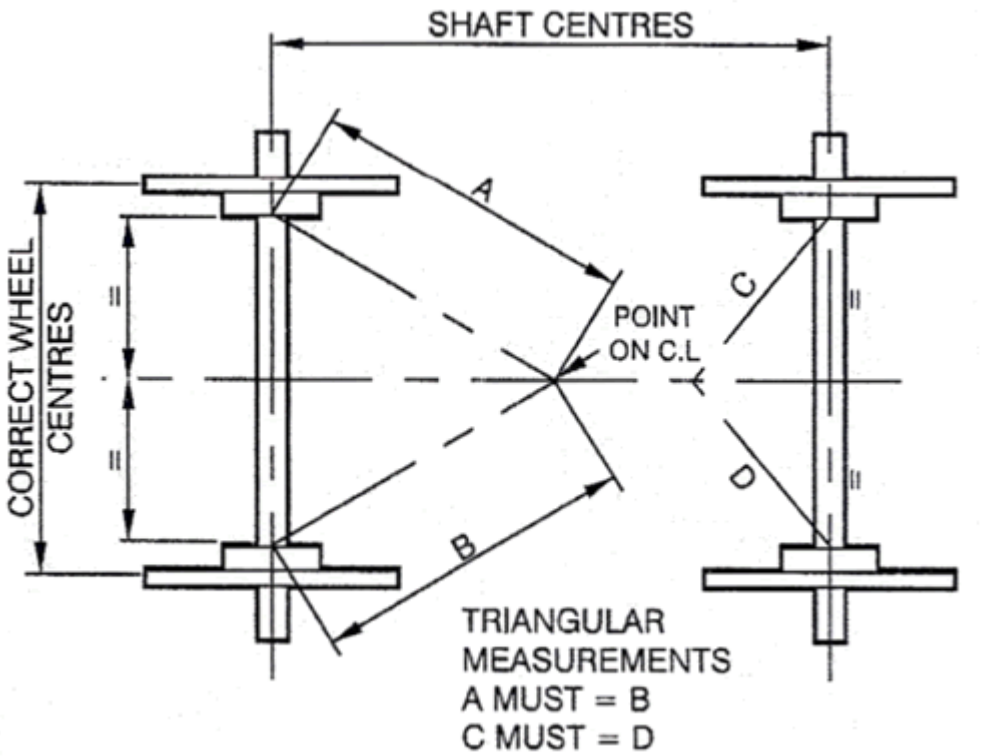
As a result of wear in the chain, the pitch of the chain can increase. This can cause problems with sprocket engagement and causes a greater proportion of the chain force to be transmitted through the most heavily loaded tooth (see *Figure*). In extreme cases, the full force of the chain can be transmitted down a single tooth, resulting in accelerated wear.

It is bad practice to run new sprockets on old chain and vice versa.

It is also good practice to check for any abnormal wear patterns on the sprockets, for example, heavy wear down one side of the sprocket, tapered tooth gap etc. This generally indicates some kind of misalignment, which should be rectified immediately.

*Figure – Poor sprocket engagement caused by chain wear*

## Shafts




The correct alignment of chain tracks, sprockets and shafts is essential for the smooth operation and satisfactory component life on chain driven systems. Checks should be carried out before any new conveyor is used, after chains and/or sprockets have been replaced, or when unusual wear patterns are observed. All shafts should be checked to make sure they are level, with a maximum gradient of 1/300.

Shafts should also be parallel to one another and perpendicular to the conveyors centre line. This can be measured by taking triangulated measurements as shown in the *figure*, and by measuring between the shaft centres on each side of the conveyor.

*Figure – Checking shaft alignments*

## Dismantling & Repairing Chain

When replacing links, sections or entire chains, it is important that the following precautions are taken;

a) All power to the equipment should be isolated before any work begins on the chain.
b) Ensure that any replacement links are on site and of the correct type, before breaking the existing chain.
c) Tension on the chain should be completely removed, so that the joints can articulate.
d) Sprockets should be locked in place to prevent rotation whilst working on the chain. This is especially important on inclined conveyors or elevators.
e) The chain should be held in position on both sides of the link to be broken, or connecting link to be removed.
f) Safe working practices should be employed at all times

It is not advisable to replace component parts in a chain. Complete links or individual sections should be replaced when conducting repairs.

## Removing Connecting Links

When removing connecting links, the chain should be supported on both sides of the disassembly point. With the nuts removed, a sharp blow with a hammer or punch against the end of each pin will release the pin from the loose link plate, allowing the link plate with the pins to be removed.

## Complete Chain Replacement

If an entire chain is to be replaced, it should be split into manageable lengths, by either removing the connecting links one at a time, or by cutting though each section with a torch.