

RENOLD

SECTION 3

CONVEYOR CHAIN INSTALLATION & MAINTENANCE

Chain Installation and Maintenance

Introduction

Renold Chain has, for many years, been a leader and innovator involved in the design and manufacture of standard conveyor chain and the development of engineered products for such applications as escalators, travelators, sterilizers, cement conveyors, leisure rides and numerous other specialised systems for the mechanical handling industry. We have a detailed understanding of the maintenance needs on such applications and can now offer the manufacturers and operators of conveyor systems the benefits of this knowledge.

Chain is one of the most widely used moving mediums in mechanical handling systems, being robust and very adaptable, but it is also one of the most neglected components within such equipment when general or routine maintenance is carried out. In many cases this product is attended to when problems occur, normally when the chain is already damaged and the only real option is to fit a replacement to the system.

This section has been designed with the manufacturer and operator in mind. It covers the functional aspects of using Renold conveyor chain and emphasizes the correct use of preventative maintenance procedures, which will ensure better machine performance, less down time, lower overall maintenance costs and extended chain life.

Installation of New Chain

When installing a complete set of new chains the method of installation depends on the state of the conveyor, i.e. if the old chain is still in place, or the chain has been removed to allow refurbishing of the sprockets, tracks etc.

Old Chain Still In Place

On some installations where sprocket and track wear are minimal e.g. escalators, it is possible to replace the chain as the old chain is removed.

Any fixtures, slats, steps, buckets etc., which join two or more chains should be removed, except for enough to keep the chains at the correct spacing. The chains should then be broken at the tension end by removing an outer link or connecting link as necessary. Handling lengths of the new chains can then be attached to the old chains using old connecting links if possible. Care should be taken to ensure that the chains are in the correct orientation. New fixtures should be connected to the new chain or old fixtures should be reconnected to maintain chain cross centres.

The drive can then be used to inch the new chains on and the old chains off.

When the new chains have been fed onto the conveyor the next new handling lengths can be attached, this time using new connecting links. At the same time, the old chain can be disconnected from the lower strands. Repeat until all the chain has been replaced.

No Chain in Place

Where the conveyor has no chain in situ, (i.e. after refurbishing tracks etc., or a new conveyor), the method of installing chain should be decided according to conveyor layout, access available and equipment available. The following notes are intended as a guide only.

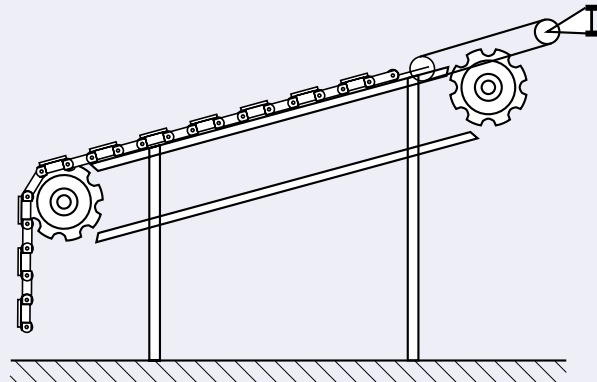
Horizontal & Inclined Conveyors

Where possible, chain should be fed on at the take-up end of the conveyor and pulled up to the drive end. When enough chain has been installed to fill up to the drive, the chain can then be inched over the drive sprocket and into the return tracks. Care should be taken to make sure that the chain is always restrained and cannot run back.

NOTE: On horizontal conveyors, chain can be fed into the return tracks either over the drive or take-up wheels.

On inclined conveyors the chain will need to be hauled up using a block and tackle, 'Tirfor' or winch (Fig. 1). Care should be taken to make sure that the chain is always restrained and cannot run back. On twin strand conveyors with slats/buckets etc., where access is available at the end of the conveyor, the chain handling lengths can be fully assembled with slats/buckets etc. before being installed on the conveyor and then be drawn in as complete units.

Fig. 1

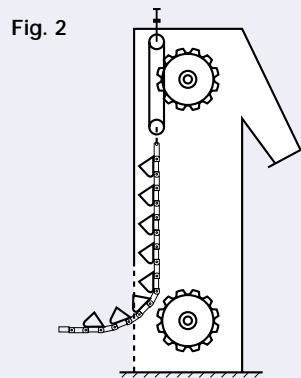


Bucket Elevators

On light duty elevators it may be possible, if access and space are available, to install the chain from the top of the elevator and join the chain at the drive sprocket.

On heavy duty elevators (usually twin strand) it may be necessary to fully or partially assemble the chains and buckets in handling lengths and lift them up through the bottom of the casing (Fig. 2). When enough chain has been assembled to reach the drive sprockets it can either be fed over the sprockets and driven down as more chain is installed and then joined at the bottom, or it can be secured at the top and the opposite side hauled up and joined at the top and the bottom.

NOTE: Great care should be taken to secure chain properly in elevators to prevent it falling down inside the casing.



Assembly & Installation

When assembling new chain or repairing existing chain, the following precautions are necessary.

- All power to the conveyor should be isolated before any work is started on the chain.
- Care should be taken to identify the chain and to ensure that correct replacement links are at hand before breaking the chain.
- The chain tension should be slackened off completely so that joints are loose.
- The sprockets should be prevented from rotating whilst working on the chain, especially on inclined conveyors or elevators.
- The chain should be suitably restrained on both sides of the link to be broken, or connecting link to be removed.
- The correct working practices should be employed at all times.

The following points are also important and should be adhered to:-

- The necks of connecting pins should not be ground or filed to ease insertion into the chain plates, nor should the plate holes be relieved. The press fit is an essential part of the chain construction and should not be destroyed.
- Do not apply heat to the connecting plates to ease insertion of the connecting pins. This could seriously damage the material properties.

Reconnecting Chain

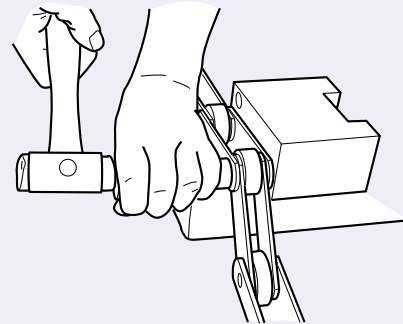
The method of chain connection depends upon the type of connecting link used. The main ones are either solid pin (i.e. No. 107, 58, 69, 86), or hollow pin (No. 107).

Whichever type is used, the following steps are recommended:-

Solid Pin Connectors

- Secure the chain on both sides of the assembly point.
- Unless the chain has to run unlubricated, coat the connecting pins with grease or oil and insert the pins into the two ends of the chain.
- Place the loose plate over the ends of the connecting pins and support the fixed plate side of the chain against the assembly force.
- Progressively force the loose plate onto the connecting pin necks equally and alternately, using a hollow punch and hammer or a hydraulic press or jack. (See Fig. 3).
- When the plate is fully seated, apply the connector e.g. nut, split pin or circlip, or rivet the pin end. (See following notes on riveting).
- Check that the assembled joint flexes freely. If it is tight, a light blow on the opposite end of the connecting pins should free the joint.

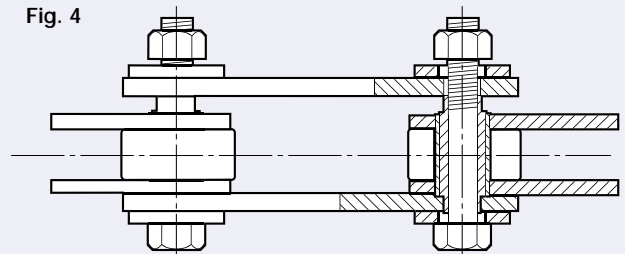
Fig. 3



Hollow Pin Connectors

- Secure the chain on both sides of the assembly point.
- Unless the chain has to run unlubricated, coat the hollow pins with grease or oil and insert the pins into the two ends of the chain.
- Place the loose plate over the ends of the hollow pins and support the chain on the fixed plate side against the assembly force.
- Progressively force the loose plate onto the hollow pin necks equally and alternately, using a hollow punch and hammer, a hydraulic press or jack, or a bolt and spacer type tool. (Fig. 4).
- When the plate is fully seated, rivet the pin ends (see following notes on riveting).
- Check that the assembled joint flexes freely. If it is tight, a light blow with a hammer on the opposite end of the hollow pins should free the joint.

Fig. 4

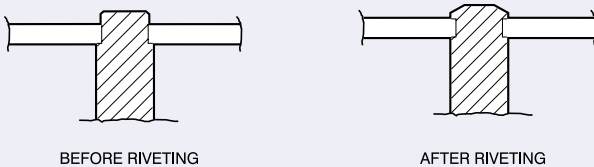


Chain Installation and Maintenance

Riveting Solid Pins

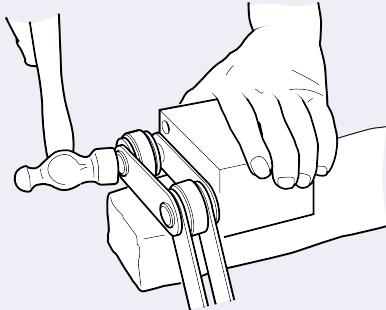
To rivet a solid bearing pin, the chain should be supported on the opposite end of the bearing pin against the riveting force. On very small bearing pins, a couple of sharp taps with a hammer on the end of the pin will be enough to spread the rivet end. However, on larger bearing pins (i.e. 7500lb (33kN) breaking load and above) this will not be satisfactory. The outside edge of the pin needs to be peened over to form a satisfactory rivet. A hammer blow directly on the end of these larger pins will not be enough to accomplish this. This can be done with:-

Fig. 5



- a) A hammer, working around the pin head. (Care should be taken to hit the bearing pin edge and avoid damaging the link plate) (Fig. 6).

Fig. 6

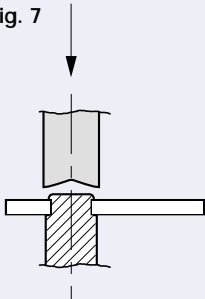


- b) Work around the pin head with a pneumatic hammer. (Again avoid damaging the link plate).
- c) A riveting punch and hammer, progressively turning the punch after each blow of the hammer to peen completely around the bearing pin head (Fig. 7). Use the factory riveted pins as a guide to rivet spread.

Riveting Hollow Pins

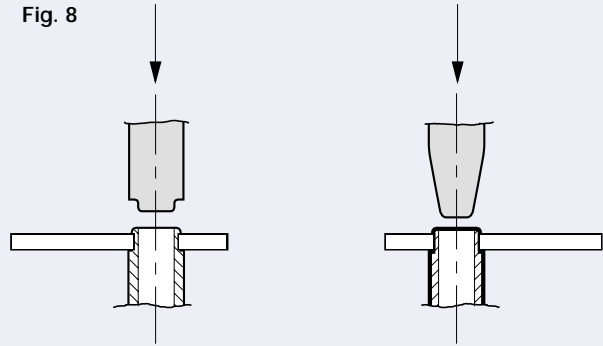
As for solid pins, the chain should be supported on the opposite end of the pin against the riveting force. The end of the bearing pin then needs to be slightly expanded to prevent the plate working off the pin. This can be done using a conical ended drift or a radiused punch and a hammer. Use the factory assembled pins as a guide to rivet spread. (Fig. 8).

Fig. 7



NOTE: When riveting chain, observe normal safety precautions. Wear safety glasses and protective clothing and make sure tools are in good condition and properly used.

Fig. 8



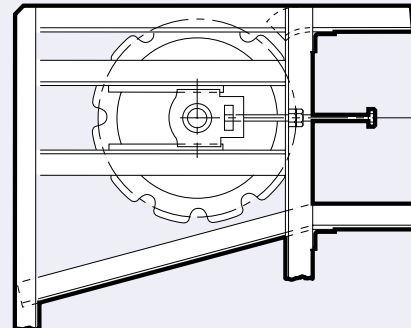
Adjustment

Once the chain has been installed and all the fixtures are in place, adjustment of the chain will be necessary before the chain is run. Care must be taken that the chain is not over adjusted, as this will add pre-tension into the chain which will in turn reduce chain life.

The main requirement of chain adjustment is to remove slack from the chain (i.e. to take up the clearances between the pins and bushes in each link). Pre-tensioning of the chain is not required.

On the majority of conveyors, a screw type take-up unit is used (see Fig. 9) due to its simplicity and lower cost. On this type of unit it is easy to keep on turning the adjustment screws and pre tension the chain, so great care is needed.

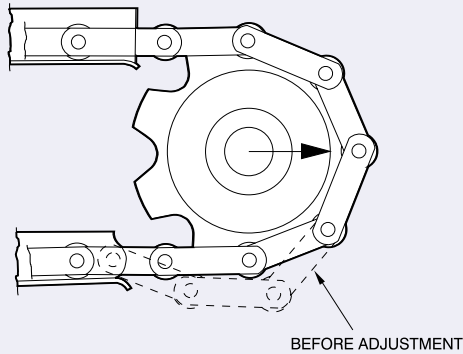
Fig. 9



The following is a general guide to adjustment procedure:-

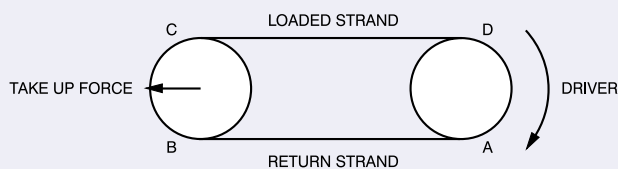
- Check that the tail shaft is in line, i.e. bearings are an equal distance back in the slides.
- Adjust the take up screws a few turns at a time, equally each side, until the chain no longer falls away from the bottom of the tail sprocket or drive sprocket. (See Fig.10).
- Lock the adjusting screws.
- Run the conveyor for at least one complete circuit to allow the chain to settle and recheck the chain adjustment.
- Re-adjust if necessary.

Fig. 10



Where an automatic take-up unit is used, i.e. pneumatic, hydraulic, spring etc., the amount of force exerted on the chain should be limited to prevent unnecessary pre tensioning.

An assessment of the take-up force required on a simple two strand slat conveyor can be found using the following formula.



$$\text{Take-up force} = (\text{Chain pull at B} + \text{chain pull at C}) + 10\%.$$

Using this value as a guide, the actual force can be established by experiment on site.

After the chain has been adjusted and correctly lubricated, the conveyor should be left to run, if possible, for 8 to 24 hours without load to allow the chain components to bed in and bearing surfaces to polish smooth. After this period the take-up should be rechecked and adjusted if necessary.

Throughout the life of the chain the take-up should be checked on a regular maintenance schedule and re-adjusted when necessary. For maximum allowable extension.

Maintenance Planning

To obtain the maximum performance from a set of chains and sprockets with the least amount of down time and inconvenience when replacement is necessary, the maintenance of the equipment needs to be regular and on a planned basis.

If there is no routine maintenance then the common occurrence happens, where chain on an important machine breaks or sprockets become badly worn and there are no replacements in stock and delivery time for replacements is a few weeks, the result is panic, a high cost in down time and inconvenience. By keeping a few spares in stock for important machines and with a little forethought, this can be prevented.

Performance Monitoring

The performance monitoring service offered by Renold is designed to give customers peace of mind in operating any chain system by knowing the current condition of the chain and sprockets.

Performance monitoring enables companies to monitor the wear rates of chain and plan replacements well ahead, thus avoiding expensive breakdown and downtime and ensuring that replacement chains can be ordered in time to avoid delivery problems.

Performance monitoring consists of several stages:-

- On site examination:-** Renold engineers will visit the site and carry out in depth examination of plant, both moving and stationary. This can determine if any serious problems of alignment, tracking, sprocket wear or eccentricity are evident and if methods of operation, maintenance or installation are likely to cause future problems.
- Sample measurement:-** Samples removed on a periodic basis are stripped down to component level and measured for wear, abrasion or deformation.
- Sample Reporting:-** A full report of the measurement and examination is prepared by our laboratory and a copy submitted to the customer together with the Renold Engineer's assessment of the chain condition and suitability for further service. The comparison is also made between current sizes and manufactured sizes.
- Wear Monitoring:-** Analysis of inspection reports over a period can enable customers, in conjunction with Renold Engineers, to predict the effective life of a chain, providing conditions of operation do not change.

If changes are made, discussions with Renold can determine the likely effects beforehand.

Chain Installation and Maintenance

Maintenance Schedule

A typical maintenance schedule is laid out below. This should be adapted to suit each specific application, based on the local conditions and duty cycle.

Typical Maintenance Schedule

EVERY WEEK

- Check lubrication and lubricate if necessary.

FIRST MONTH'S RUNNING

- Check chain take-up and adjust if necessary.
- Check for unusual wear and identify cause and rectify.

EVERY 3 MONTHS

- Check chain take-up and adjust if necessary.
- Check unusual wear and identify cause and rectify.

AFTER 3 MONTHS

- Check chain adjustment and rectify if necessary.
- Change oil, oil filter and clear the sump, if lubrication system fitted

ANNUALLY

- Carry out the above checks.
- Check for wear on side plates.
- Check for chain elongation.
- Check cleanliness of components.
 - Remove any accumulation of dirt or foreign materials.
- Check for shaft and sprocket alignment.
- Check for wear on sprockets.
- Check the condition of the lubricant.
- Check the lubrication system.

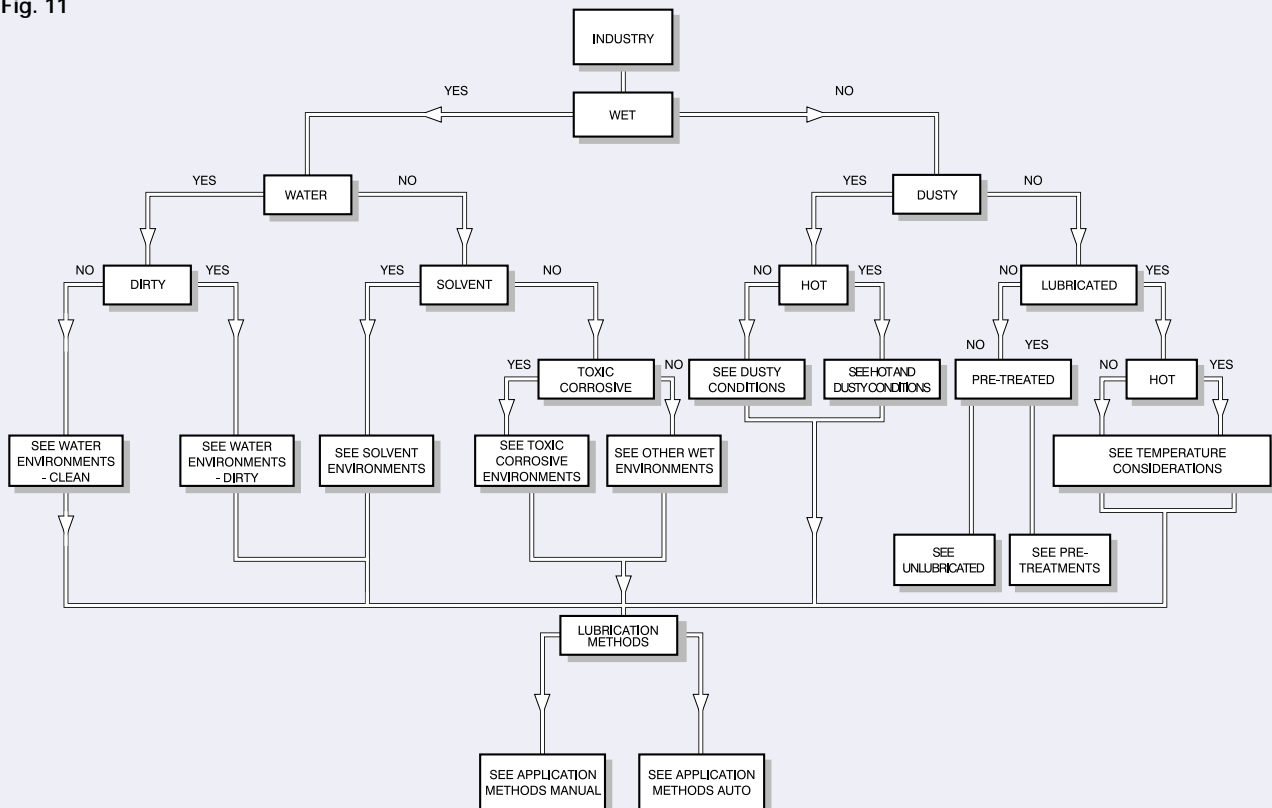
Lubrication

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

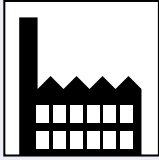
For normal conditions a good quality mineral oil with medium viscosity, for example SAE 20W50, is recommended where operating temperatures are normal.

The standard treatment given to every Renold chain before leaving the factory, unless otherwise requested, is to immerse the chain in a grease which, when solidified, will act as a protection and preliminary lubricant for the chain. Re-lubrication should be carried out immediately after installation of the chain with a suitable lubricant and at regular intervals thereafter. The following selection procedure for conveyor chain lubrication is designed to give users an idea of the types of lubrication to be used in conditions where normal lubricants would be inadequate. (See Fig 11).

Fig. 11



Industry



Some industries will have special needs from a selected lubricant. These needs will usually be determined by the demands of the product handled and the product susceptibility to contamination and spoiling by direct or indirect contact with lubricant. Some industries with these special needs are listed and users should contact lubricant specialists for recommendations.

Marine Industry
Ceramics
Textiles
Food Industry
Water

Tobacco
Sugar
Hospital Equipment
Nuclear Environment

Temperature Considerations



Low temperature conditions -60°C to 0°C, require application of low temperature, water repellent grease to lubricate and prevent condensation water freezing and locking the chain. Low temperature lubricants are designed to be both lubricants and water repellents. They comprise synthetic oils in an organic or

inorganic carrier. Lubrication is by means of synthetic polymers which, under load, form chains to provide a passive film on friction surfaces. They will not mix with, and actively repel, water. Temperature range -60°C to +120°C.

High temperature 100°C to 450°C.

Up to 160°C a wet film lubricant is generally used. Above 160°C a suitable dry-film, non-carbonising lubricant is generally employed.

Wet-film, high temperature lubricants are usually solid lubricants (greases), which are dispersed in a chlorinated hydrocarbon solvent. This allows penetration of lubricant into critical areas, after which solvent evaporation occurs. (Temperature range -25°C to + 160°C).

Dry-film, high temperature lubricants usually consist of colloidal molybdenum disulphide or graphite in a non-carbonising synthetic carrier. This carrier penetrates into the critical areas of the chain and then evaporates, leaving a dry MoS₂ or graphite film. (Temperature range 0° to + 450°C).

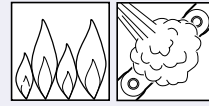
Dusty Conditions



Chain should be pre-lubricated before operation with a suitable dry film lubricant to prevent dust adhering to the lubricant. Periodically the chain should be cleaned and re-lubricated with the same lubricant.

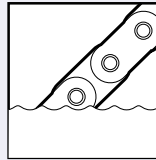
Chains fitted with grease gun lubricated pins and bushes are most effective in these environments.

Hot and Dusty Conditions



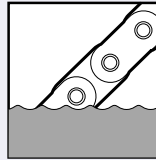
The same considerations should be used as for dusty conditions, but the dry film lubricant should be chosen to be effective at the operating temperature.

Water Environments-Clean



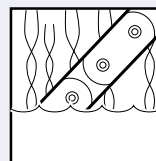
In water plants, chains are usually operating above water level and therefore require lubricants that are effective, but sufficiently adhesive to not fall into potential drinking water. Lubricants are available as special heavy greases and these are most effective when applied to the chain components during chain assembly. Water industry grease comprises a blend of mineral oil, graphite, hydrophobic and anti-corrosive elements. Each in its turn will lubricate, repel water and prevent corrosion. The grease will not dilute in water, is extremely adhesive and actively repels water. The same heavy duty greases are available for chains operating in water where contamination is not a problem. Regular regreasing is necessary in this case. Water authority approval may be required for lubricants used near drinking water.

Water Environments - Dirty



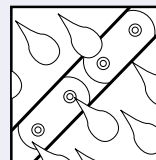
Chains operating in sewage treatment works are frequently completely immersed and, other than a pre-lubrication, it is impossible to lubricate regularly. In these cases, chains are selected to operate sacrificially, or special materials are selected to operate in a continuously wet environment. Where chains are accessible for lubrication, grease gun lubricated chains should be used with water repellent grease to periodically flush out the old grease and contaminants.

Solvent Environments



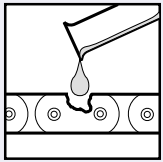
Where chains are operating in a solvent atmosphere, then lubricants must be chosen with great care. Regular re-lubrication is usually not possible due to removal of lubricant by the solvent, causing solvent (and therefore product) contamination. Lubrication suppliers should be consulted and a product obtained that will not be dissolved by the solvent.

Other Wet Environments



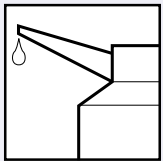
These special environments must be individually considered. Consult specialist lubricant supplier or contact Renold.

9. Toxic or Corrosive Environments



Specialist lubricants must be obtained for these conditions and selection will depend upon the material being handled. Consult specialist lubricant supplier or contact Renold.

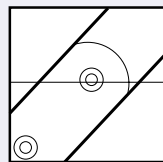
10. Application Methods



Manual. By oil can, brush or aerosol, applied directly on the chain. **Automatic.** By drip feed, preferably one shot lubrication which deposits the correct amount of lubricant at the correct time in the correct place on the chain. It is imperative that lubrication is accurately applied. Too much lubricant is as harmful as too little.

Incorrect application of lubricant will result in irregular motion of the chain, particularly at low speed or light loads due to "stick slip".

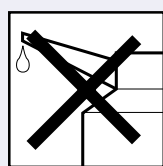
11. Pre Treatments



The following pre treatments can be applied during the manufacture of chain components and the advantages are listed. **Phosphating.** The application of a manganese phosphate coating to pin and bush surfaces. The surface gives a small degree of pre-lubrication, but its main advantage is to provide a key for

subsequent lubrication and makes this much more effective and resilient. **Molybdenum Disulphide.** A coating applied to pins and bushes during manufacture by dipping, followed by oven curing. Lowers friction between components and acts as preliminary lubricant. The film is only a few microns thick and is eroded in abrasive conditions. **PTFE.** Coating applied as above, with very similar characteristics.

12. Unlubricated



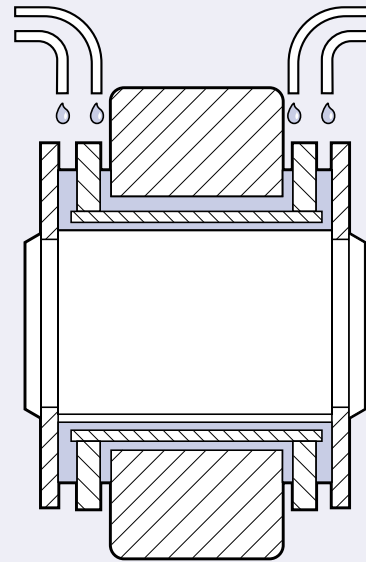
Some environments preclude the use of any type of lubrication or pre-coating, due either to product contamination or the possibility of creating volatile compounds or grinding pastes. In these cases, chain life will be improved by periodic cleaning or washing to remove materials built up over the chain.

Compressed air can sometimes be recommended should material be loose and light in mass.

Lubricant Application Methods

It is important that lubricant is applied to the correct parts of a chain. To merely brush lubricant over the chain plates will prevent external corrosion but will not necessarily benefit the bearing surfaces. Lubricant should be applied between the inner and outer plates above each pitch point, and between the inner plates and roller if a roller is fitted. This should ensure that the lubricant flows into the bearing surfaces (Fig. 12).

Fig. 12



 LUBRICANT

Care should be taken that the correct amount of lubricant is applied. Too much lubricant can lead to roller treads and tracks being contaminated, with subsequent loss of roller traction. At slow speeds and with light loads this can lead to uneven motion i.e. "stick slip". A further problem can be flats appearing on the roller treads which eventually prevent the rollers turning and thus increase the power required to drive the conveyor.

Lubricant is usually applied to the chain by one of the following methods:-

Manually

The three main methods of applying lubricant manually are by oil can, brush or aerosol. The frequency of lubrication will vary depending on environmental conditions. In some cases once per day may be necessary, in others once per week or two weeks.

Lubricant should ideally be applied to the chain as it leaves the drive sprocket, i.e. at point of minimum tension. This will allow the lubricant to penetrate into the bearing surfaces.

When a new set of chains has been installed, or if the conveyor has been standing for a long time, it should be allowed to run unloaded for a few hours after the lubricant has been applied to allow it to work into the chain effectively.

Auto-Lub

The main types of auto-lub systems are drip feed, single shot and oil mist spray. All systems consist of a fixed set of pipes, an oil reservoir and the necessary control valves and pumps. The purpose of the system is to automatically deposit an amount of oil in the chain as it passes the oil discharge point. Drip feed systems are usually gravity fed, but the single shot and oil mist spray are usually pneumatic.

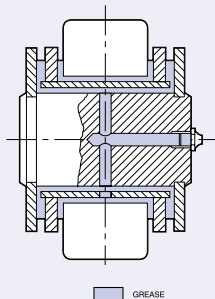
The system should be switched on once per day, once per week, or however necessary for one or two complete circuits of the chain to ensure the bearing surfaces are satisfactorily lubricated. Unless the conveyor is part of a process where the lubricant is continually being washed off the chain, the lubricator should not be run continually.

Grease Gun

In certain applications, chain is designed for grease gun lubrication. This chain has bearing pins and bushes cross drilled to allow the grease to penetrate into the bearing surfaces (see fig. 13) from within the chain. Grease nipples are fitted to the ends of the bearing pins to allow grease to be injected into the chain. This has the advantage that any dirt or contaminants that get into the chain are forced out as the grease is injected.

This type of chain is pregreased at the factory and can be re-lubricated either by manual grease gun or by an automatic grease lubrication system. As with other methods, the regularity of re-lubrication depends on the environment and application of the chain.

Fig. 13



Chain & Sprocket Storage

Chain

Before chain leaves the Renold factory it is pre-lubricated with a grease which acts as a corrosion protective and anti-fretting lubricant. For shipment they are either stacked on pallets and then shrink wrapped or packed into wooden boxes. If the chain is to be stored on site for weeks or months before use, it should be left in the packing for protection. It should not be stored in an open area where dust, dirt and water are present. If chain equipment is to be left idle for long periods, clean the chain and sprockets (i.e. brushing or steam cleaning) and then cover them with oil. If chain is removed from a machine for storage, try to store it in a container filled with old engine oil or similar. Where it is not possible to store chains in a lubricated environment, they should be lubricated on installation and run unloaded for at least 24 hours.

Sprockets

Sprockets usually leave the works shrink wrapped on pallets or in wooden boxes. All surfaces are painted before despatch except where they have been machined (i.e. cut teeth or bored and keywayed). If the sprockets are not to be used within a few days of receipt, then all machined surfaces should be painted with a heavy oil or grease to prevent corrosion. As stated for the chain, do not store in an open area where dust, dirt and water are present.

General Inspection

Chain

Chain needs to be checked on a regular basis throughout its life, to ensure any faults in the machine are detected at an early stage so that rectification work can be carried out to prevent further damage.

Chain Installation and Maintenance

Inspection of chain should not be left until a major breakdown has occurred. This may result in expensive replacement of major parts and long down time if the required new parts are not readily available.

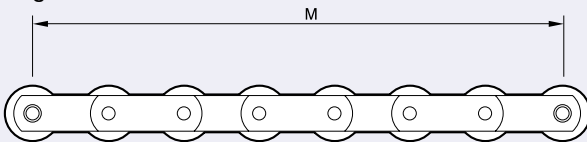
On drive chain the major factor determining chain life is extension due to wear between the bearing pin and bush. However, on a conveyor chain the life may be determined by wear on other components, depending on the environment in which the chain is used. Where accessible, the chain should be checked for wear as follows:-

Extension of Chain Pitch

A direct measure of chain wear is the extension in chain pitch due to the wear between bearing pin and bush. This is caused by the chain articulating under tension around the drive sprockets and can usually be obtained by direct measurement as follows:-

Measure a length of chain over as many pitches as possible. The chain must be on a straight section of track and under tension. This measured length "M" can then be applied to the following formula to obtain the percentage extension.

Fig. 14



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

Where M = Measuring length (mm)
 X = Number of pitches measured
 P = Chain pitch (mm)

The maximum allowable percentage extension is shown in the following tables for the relevant series of chains. When the chain extension has reached this figure, the chain is due for replacement. If regular measurements are taken and results recorded, it is possible to predict how long the chain will last and when replacement will be required. The necessary steps can then be taken to ensure the chain is available and avoid any sudden panic.

Chain Series	Allowable % Extension	Chain Series	Allowable % Extension
BS Chains			
3000lb (13KN)	$\frac{40.6}{P}$	24000/30000lb (107KN/134KN)	$\frac{102}{P}$
4500lb (20KN)	$\frac{40.6}{P}$	36000/45000lb (160KN/200KN)	$\frac{102}{P}$
6000/7500lb (27KN/33KN)	$\frac{50.8}{P}$	60000lb (267KN)	$\frac{127}{P}$
12000/15000lb (54KN/67KN)	$\frac{76.2}{P}$	90000lb (400KN)	$\frac{127}{P}$
ISO Chains			
M40	$\frac{76}{P}$	MC224	$\frac{128}{P}$
M56	$\frac{88}{P}$	M315	$\frac{168}{P}$
MC56	$\frac{71}{P}$	M450	$\frac{180}{P}$
M80	$\frac{102}{P}$	M630	$\frac{203}{P}$
M112	$\frac{97}{P}$	M900	$\frac{230}{P}$
MC112	$\frac{97}{P}$		

Roller Wear

On long centred conveyors for example where the load is carried by the chain rollers running along a track, the rollers are continually turning under load against the bushes. The pin and bush only turn against each other four times per circuit of the conveyor (only one of these is under full load). Under these circumstances roller wear can be the limiting factor in chain life.

An idea of the amount of roller wear can be obtained by measuring the clearance between the bottom of the link plates and the track surface and comparing the result with that obtained on a new piece of chain. See Fig. 15.

If the rollers have worn to the point where the link plates are near to or are rubbing on the tracks, then replacement is necessary. If standard chain is fitted it is not possible to replace just the rollers, therefore the complete chain should be replaced. If outboard rollers are fitted then it may be possible to replace the rollers only.

Where bends occur in the tracks, extra care should be taken with roller wear assessment as less wear is allowable before the link plate edges contact the tracks. See Fig. 16.

Fig. 15

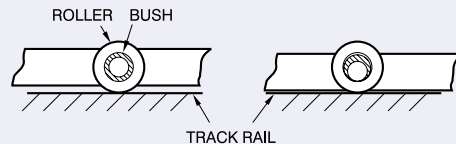
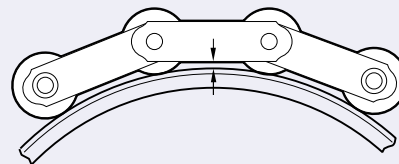


Fig. 16



Link Plate Wear

Wear on link plates can appear in various ways, due to a number of different causes and in some cases can mean premature chain replacement.

On scraper conveyors or conveyors where the chain runs on its link plate edges, wearing away of the plate edges can occur, which will reduce the plate depth and thus the tensile strength of the chain. (See Fig. 17).

This wear should not exceed more than half the original plate depth above the bush,

otherwise a chain breakage could occur. When wear has occurred to this extent the chain should be replaced.

In some cases, to extend chain life it may be possible to turn the chain over so that the unworn edge of the chain becomes the wearing surface. This will depend on the type of chain, fixtures on the chain and the make-up of the chain. (See Fig. 18).

Fig. 17

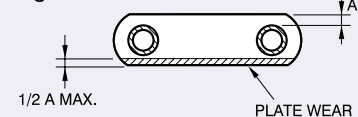
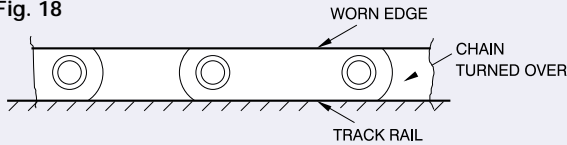


Fig. 18



The rubbing friction between the roller side face and the inside of the inner links can produce wear on the inner link plate. If this occurs before signs of wear on other components, it is a sign of misalignment in the conveyor. In this case, roller treads should also be checked for signs of tapered wear. (See Fig. 19).

Similar wear may occur between the inner and outer link plates (see Fig. 20) (although this is not common on the BS series of chains, due to the bush projection from the inner link plates which creates a gap between the inner and outer plates). Again, this is usually a sign of misalignment. In both cases, if the plate thickness has been reduced by more than 1/3 of its original thickness the chain strength is substantially reduced and the chain should be replaced after first rectifying the mis-alignments.

Fig. 19

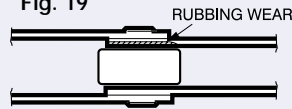
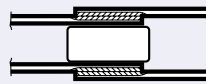


Fig. 20



i.e. Check the following:-

- A) Alignment of head and tail wheels.
- B) Shaft alignments.
- C) Level across tracks.

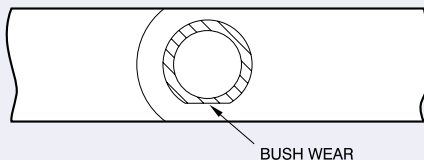
If possible, the chain should be checked for marking or damage to the inner plate edges and marking or wear on the inside faces of the inner links. This is due to the sprocket teeth rubbing on the plates as the chain engages with the sprocket. Light marking is usual, due to normal movement of chain. However, if wear is heavy and plate thickness is reducing, sprocket spacing or alignment should be checked and rectified and severely damaged links replaced.

Bush Wear

Unless the conveyor uses a bush chain (i.e. chain without rollers), it is not usually possible to detect bush wear or damage without dismantling a piece of chain into its component parts.

If a bush chain is used, checks should be made for wear on the outside of the bush. This wear could be due to either the bush sliding along the tracks or the bush gearing with the chain sprockets. If the bush is worn through so that the bearing pin is exposed, then the chain should be replaced. In certain circumstances it may be possible to turn the chain over and wear the opposite face of the bush to extend the chain life. (In this case, advice from Renold should be sought).

Fig. 21



Should any cracked or broken bushes be found, then the cause should be identified and rectified, then depending on the extent of the damage, either links or the complete chain should be replaced.

Bearing Pin Wear

Normal bearing pin wear shows up as pitch extension and can be detected as stated on page 65.

Wear of the bearing pin heads can be caused by either insufficient clearance between the chain and side guides, tracks not level across the conveyor causing the chain to run over to the lower level, chain twisted due to abuse, or bad chain guidance.

The cause should be identified and rectified. If the bearing pin heads have worn down level with the chain plates, then the rivet will be ineffective and either the bad links or the complete chain should be replaced.

General

General visual inspection of the chain should be carried out with the forgoing to detect broken components, broken or damaged attachments, severe corrosion, seized joints or any unusual occurrences. The causes of these should be identified and rectified and damaged chain replaced.

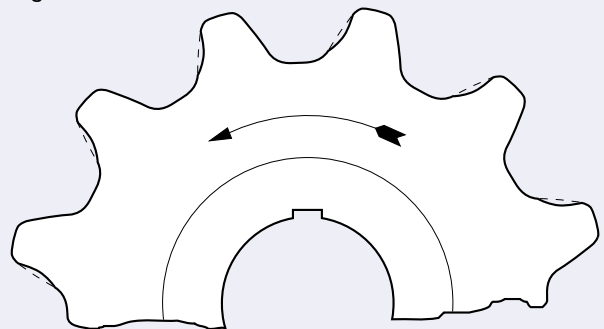
Sprockets

Tooth Wear

Normal wear takes place due to the engagement of the chain with the sprocket teeth and shows up as a polished or worn strip on the face of the tooth gap near the root (i.e. about the P.C.D.). Wear generally occurs faster on sprockets driving bush chains rather than roller chains. This is due to the sliding engagement of the bush on the tooth as opposed to the rolling engagement of the roller.

Usually as the sprocket wears, this shows up as a concavity or hooking of the tooth flank. If this is allowed to continue it will start to impede chain engagement/disengagement and on short pitch chains weaken the tooth. (See Fig. 22).

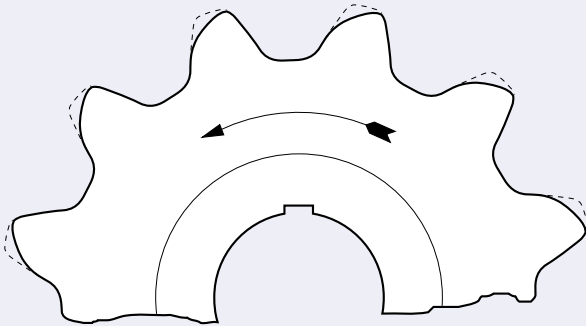
Fig. 22



Chain Installation and Maintenance

If the chain has not been kept in correct adjustment and runs slack it may tend to resonate and jump the teeth, causing the wear pattern shown in Fig 23. This can be rectified by correcting the chain adjustment and if necessary replacing the sprocket.

Fig. 23



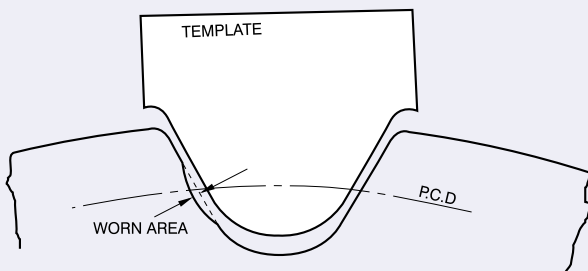
Given adequate lubrication and chain maintenance, the sprockets should last the life of the chain.

Measurement of Tooth Wear

Quite often it is only possible to make visual inspection of the tooth gap. However, if the sprockets are accessible during routine maintenance, then one of the following methods should be used to measure for wear.

- i) Clean the tooth gap of oil, grease or any other matter and apply to the tooth gap an "as new" template. (Fig. 24).

Fig. 24



- ii) Clean the tooth gap as above and apply a smear of grease around the face of the tooth gap. Hold a piece of stiff paper or card against the wheel and apply finger pressure all the way around the tooth gap to form an impression on the paper/card. This can then be compared to the original tooth gap profile. (Fig. 25).
- iii) On larger sprockets, wear can be measured by holding a straight edge against the tooth flank and measuring the worn gap. (Fig. 26).

Fig. 25

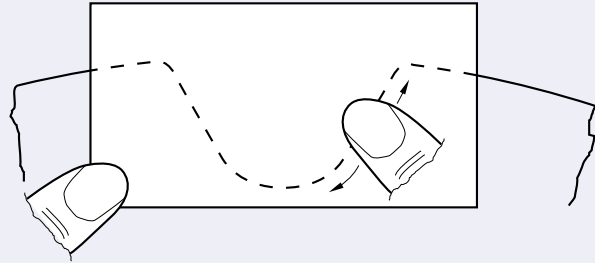
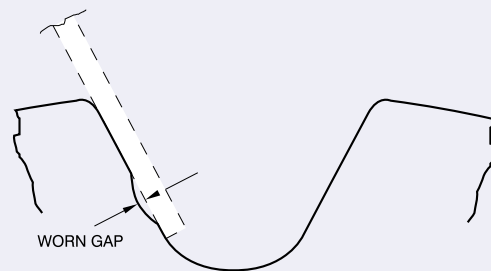


Fig. 26

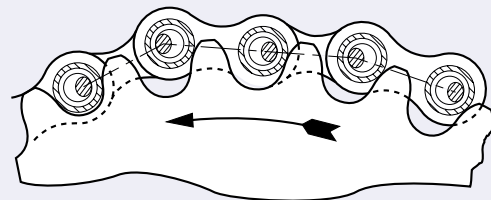


For most conveyor applications, the degree of wear should not exceed 8% to 10% of the gearing (roller or bush) diameter. In some cases, extended sprocket life can be obtained by turning the sprockets round and allowing the opposite face to wear (consult Renold for advice beforehand).

General

As a result of wear between the chain pin and bush, the distance between adjacent rollers increases more at the outer links than at the inner. In terms of sprocket engagement, this causes a greater proportion of the chain pull to be carried by the most highly loaded tooth. In the extreme the full chain pull would be carried by one tooth, with resulting accelerated tooth wear. For this reason it is bad practice to run worn chain on new sprockets or vice versa.

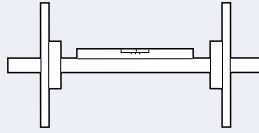
Fig. 27



As well as sprocket tooth gap, checks should be made for signs of unusual wear patterns, i.e. heavy wear or scoring on one side of the sprocket, tapered wear in the tooth gap, etc. These will indicate chain track, shaft or sprocket misalignments. The causes should be identified and rectified.

Shafts

Fig. 28



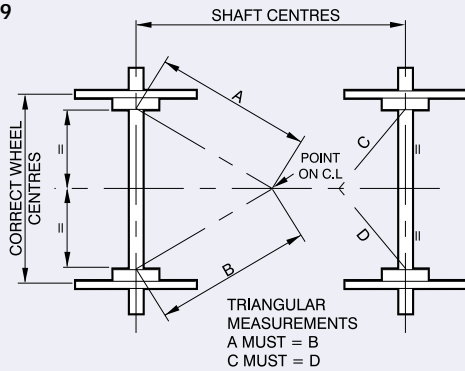
The correct alignment of sprockets, shafts and chain tracks is essential for smooth operation of conveyors and satisfactory life of chain and sprockets.

The following checks

should be carried out before a new conveyor is run, after chains and/or sprockets have been replaced, or unusual wear patterns are observed on the chain or sprockets. All shafts should be checked with a spirit level to make sure they are level. This should be within a gradient of 1/300.

Shafts should also be parallel to each other and perpendicular to the conveyor centre line. This can be checked by measuring between the shaft centres on each side of the conveyor, and also taking a triangular measurement from a point on the centre line to equidistant points on the shaft each side of the centre.

Fig. 29



Sprockets should be set at the correct centre distance on each shaft and equidistant about the conveyor centre.

Tracks

Tracks should be checked both individually and across the set with a spirit level. This should be carried out at regular intervals along the conveyor, i.e. every 1.5m to 2m.

The transverse distance between tracks should also be checked at similar distances along the conveyor, and with reference to a centre line to check for side bow.

At the ends of the conveyor, the transverse centres of the tracks and sprockets should match so that the chain has a smooth transition from one to the other.

Fig. 30

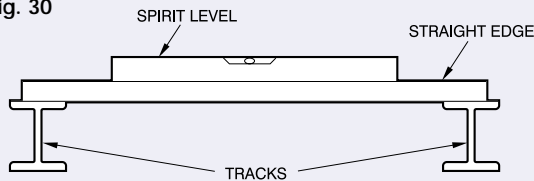
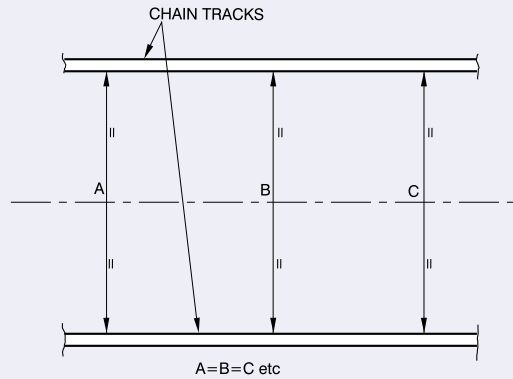


Fig. 31



Dismantling & Repair

Chain

When it becomes necessary to replace links, sections or complete chains, the following precautions are necessary:-

- All power to the conveyor should be isolated before any work is started on the chain.
- Make sure that the chain is identified and the correct replacement links are at hand before breaking the chain.
- The chain tension should be slackened off completely so that joints are loose.
- The sprockets should be prevented from rotating whilst working on the chain, especially on inclined conveyors or elevators.
- The chain should be suitably restrained both sides of the link to be broken, or connecting link to be removed.
- Make sure that the necessary safe working practices are employed at all times.

It is not recommended that the component parts of a chain be replaced individually. Repairs should be restricted to replacing complete links or lengths of chain only.

Removing a Connecting Link

Connecting links are usually of four main types.

- Links with thread and nut fastener on one or both sides.
- Links with circlip fasteners on one side.
- Links with split pin fasteners on one side.
- Riveting links.

To remove a connecting link, the chain should be solidly supported on the conveyor floor or on a bench and the fasteners removed from the bearing pins.

In the case of split pins, it may be necessary to cut them off flush with the O.D. of the pin.

Chain Installation and Maintenance

A sharp blow with a hammer and punch against the end of each bearing pin in turn will release the pins from the link plate and allow the other plate, complete with pins, to be removed. (See Fig. 32 & Fig. 33).

NOTE: If the chain is on a bench or lying on the floor, the plates should be supported.

Fig. 32

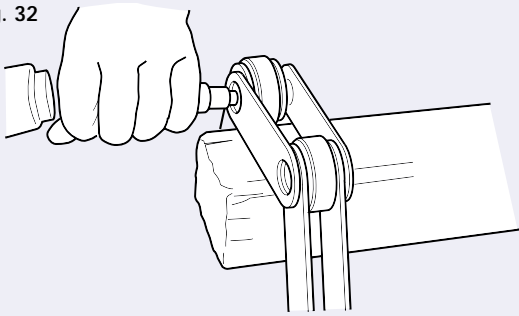
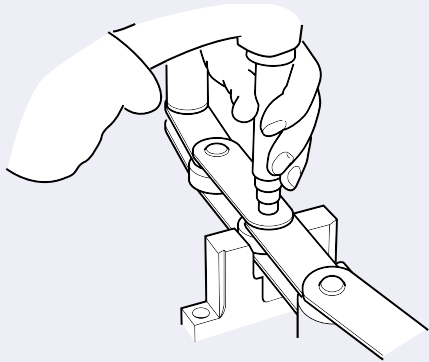


Fig. 33



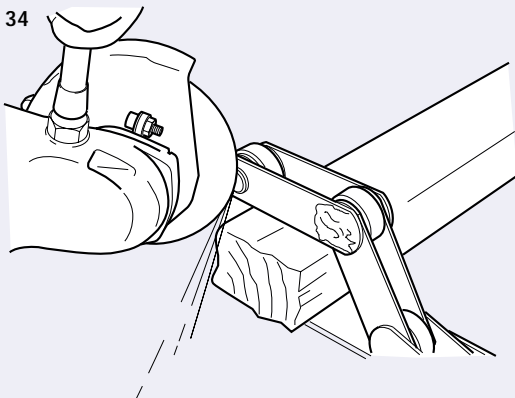
Removing a Riveting Link

Support the chain as stated for connecting links and grind the pin heads on one side of the link, flush with the link plate. (Fig. 34).

To release the pins from the side plate either use a punch and hammer as previously stated, or alternatively, wedge or prise the link plate free of the pin ends. The other plate, complete with pins, can then be removed from the chain.

NOTE: On agricultural chains or small conveyor chains it may be possible to use a transmission chain type chain breaker.

Fig. 34



Complete Chain Replacement

If a chain is worn out and is to be replaced entirely, then either the procedure on page 61 can be followed to remove each connecting link and thus each successive handling length, or the chain can be cut through with a torch into handleable sections for disposal.

NOTE: When cutting the chain with a torch, the necessary safety precautions should be followed.

Sprockets

Sprockets are usually of three main types.

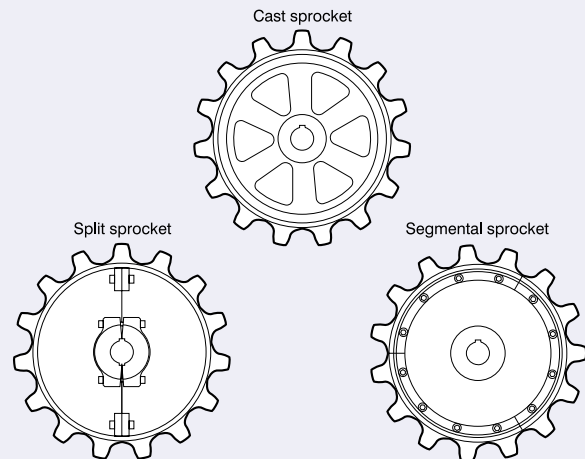
- i) One piece sprockets of steel or cast iron.
- ii) Two piece split sprockets.
- iii) Sprockets with bolt-on tooth segments.

The vast majority of sprockets in use are of the one piece cast iron or fabricated steel design and are usually parallel or taper keyed to a through shaft. In this case it is necessary to remove the complete shaft to be able to remove the sprockets. If the sprockets and shaft have been in place for a number of years or the shaft is in hostile conditions, it may be more economical to replace the complete shaft assembly, rather than try to remove the sprockets from the existing shaft.

Where split sprockets are used it is not necessary to remove the shaft to be able to replace a sprocket. After removal of the chain, the sprocket can be dismantled and a new one assembled around the shaft. This type of sprocket is particularly useful on multistrand conveyors where long through shafts are used. Considerable expense can be saved in sprocket replacement time.

Sprockets with removeable tooth segments are particularly useful where sprocket tooth wear is much more rapid than chain wear. With this type of sprocket, segments of teeth can be replaced one at a time without having to disconnect or remove the chain from the sprockets, thus considerable expense and downtime can be saved.

Fig. 35



Wear Strips and Tracks

Wear strips and tracks have an important influence on chain performance and life, as badly aligned or badly worn wear strips can cause abnormal wear on the conveyor chain. Therefore, it is important that when replacing chain the wear strips are checked and renewed if necessary. Running new chain on worn tracks or wear strips will reduce the life of the chain.

When replacing wear strips, the following should be considered:-

- i) It is desirable that the chains are slower wearing than the wear strips as they are the more critical and expensive items in the conveyor.
- ii) The wear strips should not be as hard as the chain that is running on it. Bright mild steel flats are satisfactory for most applications. However, under more arduous conditions a harder material can be used.
- iii) Wear strips should be flat and level when installed (check with a spirit level). If this is not the case then chain life will be reduced and conveyor operation could be impaired. (See Fig. 30).
- iv) Joints in wear strips or tracks should be smooth so that no sharp edges protrude.
- v) Weld spatter, slag, metal filings, scale etc. Should be eliminated from the conveyor.
- vi) Chain entry and exit points should be radiused to allow smooth transfer of chains from sprockets to tracks.
- vii) Non metallic materials such as low friction plastics can be used where chains are sliding on the chain plate edges, but should not be used where severe impact loads or abrasive conditions exist.

General

- a) New chains are usually supplied from the factory in handling lengths and coiled with one loose joining link per length, so that the lengths can be assembled into a complete endless chain. When installing chains the notes on chain reconnection should be followed for joining the handling lengths together.
- b) If the chains have been matched, then one end of a handling length will be tagged with a strand letter and connection number (i.e. A3, A4, B3, B4 etc.). Great care should be taken when assembling the chains that like ends are joined (i.e. A2 to A3, B2 to B3 etc.), and also that like numbers are on opposite strands (i.e. A3 opposite B3, A4 opposite B4 etc.). If short lengths are supplied to make the correct number of pitches, these are marked X and Y. The length marked X is assembled on the end of the A chains and the Y on the B chains. Do not remove the tags until the ends are joined correctly.
- c) When handling chains, great care should be taken so that the chains do not get a permanent twist or side bow. This will have an adverse affect on chain operation and life.
- d) When chains are supplied with attachments as handed strands (i.e. right hand and left hand) make sure that the chains are connected in the correct orientation.
- e) Make sure that connecting links are installed with the connector on the correct side of the chain.

Safety Warning

HEALTH AND SAFETY WARNING

1. Always isolate the power source from the drive or equipment.
2. Always wear safety glasses.
3. Always wear appropriate protective clothing, hats, gloves and safety shoes as warranted by the circumstances.
4. Always ensure tools are in good working condition and used in the proper manner.
5. Always loosen tensioning devices.
6. Always support the chain to avoid sudden unexpected movement of chain or components.
7. Never attempt to disconnect or reconnect a chain unless the chain construction is fully understood.
8. Always ensure that directions for the correct use of any tools are followed.
9. Never reuse individual components.
10. Never reuse a damaged chain or chain part.

Chain Installation and Maintenance

Troubleshooting

PROBLEM

PROBABLE CAUSE

SOLUTION

EXCESSIVE WEAR IN THE ROLLER BORE

- HIGH UNIT LOAD
- TWISTED SLATS OR CARRIERS
- PACKING OF ABRASIVE PARTICLES

- UNSATISFACTORY ROLLER BORE LUBRICATION AND CORROSION

- DISTRIBUTE LOAD - ALTER PITCH
- RECTIFY & CHECK FOR FLATNESS
- MINIMISE CHAIN/MATERIAL CONTACT - CONSIDER CHAIN AS PULLING MEDIUM ONLY
- IMPROVE LUBRICATION; CHANGE TO GREASE GUN DESIGN IF POSSIBLE

3

FRACTURED BUSHES

- SPEED TOO HIGH FOR PITCH
- HEAVY SHOCK LOAD APPLIED
- CORROSION PITTING

- CHAIN OF SHORTER PITCH BUT EQUIVALENT STRENGTH
- INVESTIGATE ON-LOADING IN ATTEMPT TO MINIMISE SHOCK
- CONSIDER SPECIAL MATERIALS OR IMPROVE LUBRICATION

**FRACTURED PLATE
FRACTURED BEARING PIN
ELONGATED HOLES**

- OVERLOAD ABOVE MAXIMUM BREAKING STRENGTH

- INVESTIGATE FOR FOREIGN OBJECTS CAUSING JAMS
- PROTECT CHAIN - SHEAR PIN DEVICE
- REVIEW LOADING

LOOSE OR DAMAGED ATTACHMENTS

- HIGH UNIT SHOCK LOADING
- INCORRECT SLAT OR CARRIER ASSEMBLY
- TWISTED CHAIN CAUSING FLEXURE OF PLATFORM BY CONTINUAL SLAT OR CARRIER MOVEMENT

- MINIMISE SHOCK BY MODIFYING LOADING SEQUENCE
- RE-ALIGN TO ENSURE CORRECT PHASING OF CHAINS
- EMPHASISE CARE AT ASSEMBLY STAGE IN MOVEMENT OF HANDLING LENGTHS

ROLLER FLATTING DUE TO SKIDDING

- TOO LIGHTLY LOADED SYSTEM
- HEAVY LOAD WHERE FRICTION BETWEEN BUSH AND ROLLER BORE OVERCOMES LEVER EFFECT OF FRICTION AT ROLLER PERIPHERY
- EXCESSIVE LUBRICANT ON TRACK
- CANTING OF CHAIN DUE TO LOAD

- INCREASE LOAD WITHIN LIMITS OF CHAIN
- INCREASE CHAIN SIZE IF NO LOAD REDUCTION POSSIBLE

- CLEAN AND SCOUR TRACK
- STRENGTHEN CARRYING MEDIUM

TIGHT CHAIN JOINTS

- MATERIAL PACKED IN CHAIN
- MATERIAL FROZEN IN JOINTS

- INCORRECT LUBRICATION (GUMMY)

- CORROSION

- MALALIGNMENT
- PLATE MOVEMENT AFTER BUSH TURNING IN HOLES

- CLEAN AND RE-LUBRICATE
- REDUCE CHAIN/MATERIAL CONTACT. RUN CONTINUOUSLY
- CLEAN AND LUBRICATE WITH CORRECT TYPE OF LUBRICANT
- INVESTIGATE CAUSE AND CONSIDER SPECIAL MATERIALS
- CHECK ALIGNMENT OF STRUCTURE
- IMPROVE PIN/BUSH LUBRICATION
- ADJUST CORRECTLY

PROBLEM	PROBABLE CAUSE	SOLUTION
CHAIN CLIMBS SPROCKETS	<ul style="list-style-type: none"> ■ EXCESSIVE TOOTH WEAR ■ BUILD-UP OF EXCESSIVE SLACK ■ CHAIN ELONGATION ■ SEVERE OVERLOADS ■ MATERIAL PACKING BETWEEN CHAIN AND SPROCKETS ■ HEAVY LOAD CARRIED UNDER SPROCKET 	<ul style="list-style-type: none"> ■ REPLACE SPROCKETS ■ ADJUST CHAIN CORRECTLY ■ REPLACE CHAIN ■ REDUCE LOADING - STRENGTHEN CARRIERS - CONSIDER SPECIAL TOOTH FORM ■ RELIEVED TEETH ■ CONSTRAIN CHAIN AROUND SPROCKET
CHAIN CLINGS TO SPROCKETS	<ul style="list-style-type: none"> ■ INCORRECT TOOTH FORM ■ WORN TOOTH FORM ■ HEAVY AND TACKY LUBRICANTS ■ STIFF CHAIN JOINTS 	<ul style="list-style-type: none"> ■ REPLACE ■ REVERSE SPROCKETS ■ CLEAN AND RE-LUBRICATE ■ SEE "TIGHT CHAIN JOINTS"

3

GENERAL FAULT FINDING

CHAIN WHIP	<ul style="list-style-type: none"> ■ EXCESSIVE SLACK ■ LONG CENTRES WITH PERIODIC ON-LOADING OF MATERIAL CAUSING PULSATING ACTION 	<ul style="list-style-type: none"> ■ FULLY GUIDE RETURN STRAND
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PROBLEM	PROBABLE CAUSE	SOLUTION
EXCESSIVE NOISE	<ul style="list-style-type: none"> ■ MALALIGNMENT OF TRACK JOINTS ■ TOO LITTLE OR TOO MUCH SLACK ■ HIGH SPEED ■ CHAIN OR SPROCKETS WORN ■ INEFFECTIVE LUBRICATION ■ INCORRECT POSITIONING OF GUIDE TRACKS ADJACENT TO SPROCKETS 	<ul style="list-style-type: none"> ■ CHECK ALIGNMENT OF STRUCTURE ■ ADJUST CORRECTLY ■ CONSIDER SHORTER PITCH ■ REPLACE ■ LUBRICATE ■ REPOSITION

UNEVEN RUNNING	<ul style="list-style-type: none"> ■ HEAVY LOAD AND LOW SPEED CAUSING ROLLERS TO "STICK - SLIP" ■ VERY LIGHT LOAD AND LUBRICANT ON TRACK CAUSING ROLLERS TO "STICK - SLIP" ■ POLYGONAL ACTION OF CLOSELY SPACED WHEELS IN COMPLEX CIRCUIT ■ HIGH FRICTION OF IDLER SPROCKETS ■ POLYGONAL ACTION ON SPROCKETS 	<ul style="list-style-type: none"> ■ SEE "ROLLER FLATTING". CONSIDER ADDITIONAL DRIVE POINT. CHECK SURGE AT DRIVE DUE TO INADEQUATE POWER RESERVE OR SHAFT/BEARING RIGIDITY ■ GUIDES TO BE CLEANED TO REMOVE EXCESS LUBRICANT AND CHAIN LUBRICATED ON ROUND PART CONTACT POINTS ONLY ■ INCREASE SPROCKET CENTRES OR REPOSITION SPROCKETS ■ LUBRICATE CORRECTLY OR FIT LOW FRICTION BEARINGS ■ INTRODUCE SPROCKETS WITH A LARGER NUMBER OF TEETH
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