

# **DIESEL MECHANIC**



**MINING QUALIFICATIONS AUTHORITY**

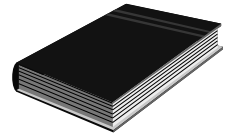
## **CODE: CSD**

# **REPLACE CHAINS AND SPROCKET WHEELS**

# INDEX

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## SOURCE REFERENCES

Demonstration by a competent person, e.g. a Training Officer.

Makers' catalogues and service manuals.

Display board in the training centre.

## OBJECTIVE

You will be learning towards the outcome “Replace chains and sprocket wheels”. Whilst learning towards the outcome you will be required to achieve the following:

- Replace, align and tension the chain on a chain drive
- Maintain chain drives.

On completion of this module, the learner must be able to:


- Identify roller chains and sprocket wheels by naming and matching the different types.
- Identify all the parts that make up a chain.
- Replace, align and tension the chain on a chain drive.
- List eight causes for chain drive malfunctions, failures and wear, and state their remedies.

During this process you must adhere to certain specified requirements as listed in the Module.

## ASSESSMENT AND EVALUATION CRITERIA

You will be assessed, when you are confident that you may achieve the outcomes as listed, to determine your competence as measured against the required criteria. This assessment will be in line with accepted best practices regarding assessment.

- A theory and practical test will be set at the end of the module and must be completed without using references.
- All the answers in the theory test must be correct and in accordance with the module notes.
- For the practical test, the learner will be given a selection of chains and sprocket wheels, a chain drive, and all the necessary tools and equipment and must remove and replace the old chain with another one.
- The following standards must be achieved:
  - a. The chain must wrap around the sprocket wheels with all teeth meshing.
  - b. The sprocket wheels must be aligned.
  - c. With the sprocket wheel centres between 500mm and 750mm, the slack must be 3% - 5% of the span and the slack to be on the return side of the drive.
  - d. There must not be any damage to tools and equipment.
- All safety procedures must be adhered to.

<b><u>HAZARD IDENTIFICATION AND CONTROL (HIAC) FORM</u></b>		
<div style="display: flex; justify-content: space-around; align-items: center;">  <div style="text-align: center;"> <b>CSD</b>  <b>REPLACE CHAINS AND SPROCKET WHEELS</b> </div> </div>		
STEPS IN OPERATION / PROCESS	POTENTIAL ACCIDENT / INCIDENT	CONTROLS (BY RESPONSIBLE PERSON)
1. Use hand tools.	<ul style="list-style-type: none"> <li>Using damaged tools or wrong tools for the job can cause injury and damage to equipment.</li> </ul>	<ul style="list-style-type: none"> <li>Always use the correct tool for the job.</li> <li>Ensure tools are in good condition.</li> <li>Use tools correctly.</li> <li>Wear appropriate PPE where necessary.</li> <li>Always take good care of tools. Maintain, clean and store it properly.</li> </ul>
2. Work on machinery.	<ul style="list-style-type: none"> <li>Injury to person if working on moving machinery.</li> </ul>	<ul style="list-style-type: none"> <li>Ensure that power to the machine is switched off, and if possible, physically locked out. Place a warning sign stating: "Men at work. Do not switch on" in a prominent position.</li> <li>Ensure that machinery is stationary before commencing work.</li> <li>Replace machine guards after completing the task and before starting the machine.</li> </ul>

**NOTE:** Before doing the practical work contained in this module, the learner must study the content of the above HIAC form again and then sign the statement below.

The above risks, which will be encountered in this module, are fully understood and will be controlled during the practical work.

Signature of learner:

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Signature of Training Officer:

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Date:

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## DICTIONARY

<b>Align</b>	:	To put in a straight line, or to bring into line.
<b>Chain</b>	:	A connected flexible series of metal links used to transfer power in a machine.
<b>Sprocket</b>	:	Any one of the teeth on a wheel (sprocket wheel) engaging with the links on a chain. Also commonly known as a sprocket wheel.
<b>Pitch (of a chain)</b>	:	The distance between the pin links of a chain. Also the distance between adjacent teeth of a sprocket wheel or cog-wheel.
<b>Span</b>	:	Distance between the centres of the driver and driven sprocket wheels.
<b>Chain tension</b>	:	Should be correctly called “chain slack” and is the deflection on the return side (slack side) of a chain drive, expressed as a percentage of the span of the drive.

# 1. TYPES OF CHAIN

**ITEM / TASK:** Introduction.

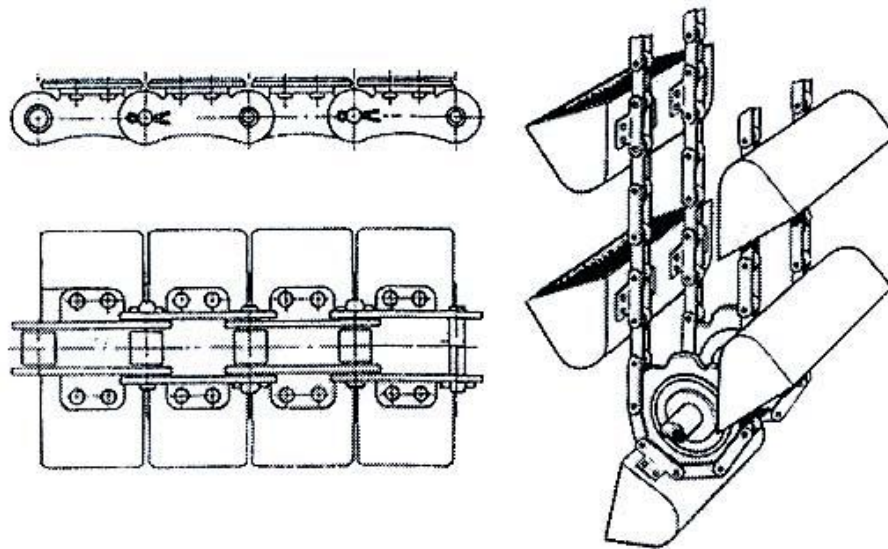
**DESCRIPTION:**

- A. There are many different types of chains available and they are designed to cater for various applications in different industries. Some of them are mentioned below.
- B. The **standard roller chain** is the type most often encountered in the industry and is, therefore, the only chain that will be fully discussed in this module.

**ITEM / TASK:** Types of chains.

**DESCRIPTION:**

- A. Fig 1 shows a **flat top conveyor chain**. It is used on assembly lines and as conveyors in factories. It can also be adapted for use as mechanical stokers on coal fired boilers or bucket elevators.



**FIG 1.**

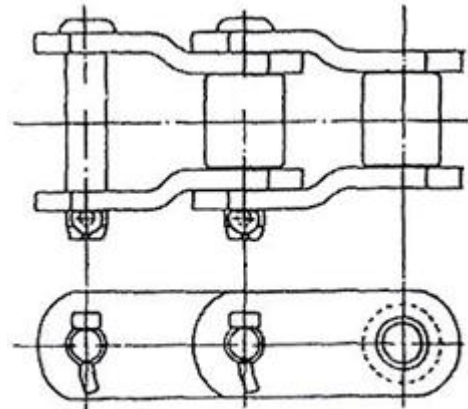
B. Fig 2 shows a **heavy duty, offset side bar chain** which is the type mostly used in heavy industries.

The dimensions shown range as follows:

Pitch (P) = 50mm - 150mm

Width (W) = 30mm - 75mm

Roller Dia (D) = 28mm - 75mm



Heavy duty, offset side bar chain

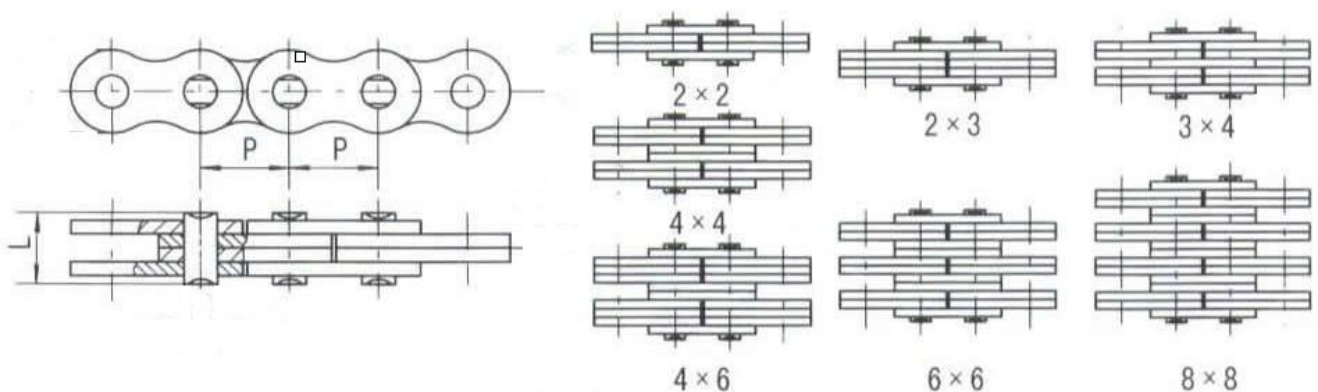
**FIG 2.**

C. Fig 3 shows a **leaf chain**. It is used mostly in forklifts and to suspend a counter balance. It runs over a roller and not a sprocket wheel.

The dimensions shown range as follows:

The pitch (P) = 12mm - 45mm

Width (L) = 7mm - 70mm,  
depending on the arrangement of the leaves.



**FIG 3.**



D. Fig 4 shows a **conveyor chain with standard double pitch rollers** and straight side plates. It is used mainly in farming implements and in the baking, food processing, packaging and bottling industries. This type of chain is available with a standard size and oversize roller.

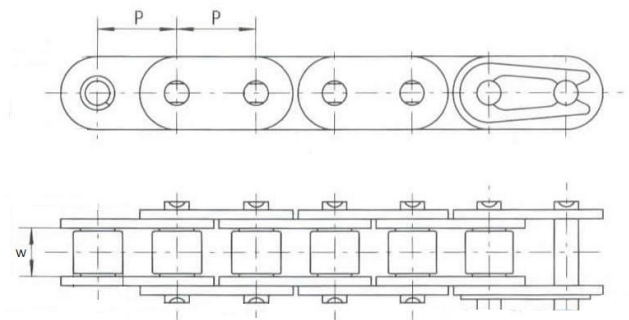
The dimensions shown range as follows:

The pitch (P) = 25mm - 50mm

The width (W) = 7mm - 16mm

The standard roller diameter = 7mm - 16mm

The oversize roller diameter = 16mm - 28mm



**FIG 4.**

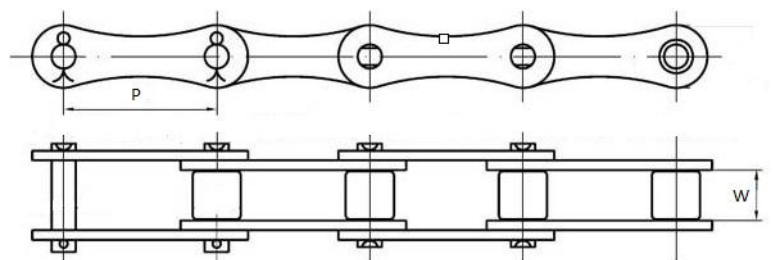
E. Fig 5 shows a **transmission chain with standard double pitched rollers** and side plates in the shape of a figure eight. The advantage of this chain over the standard roller chain is that it is lighter and more economical. The chain is excellent for use where speeds are not high, loads are moderate and the span of the chain is long.

The dimensions shown range as follows:

The pitch (P) = 25mm - 50mm

The width (W) = 7mm - 16mm

The roller diameter = 7mm - 16mm



**FIG 5.**

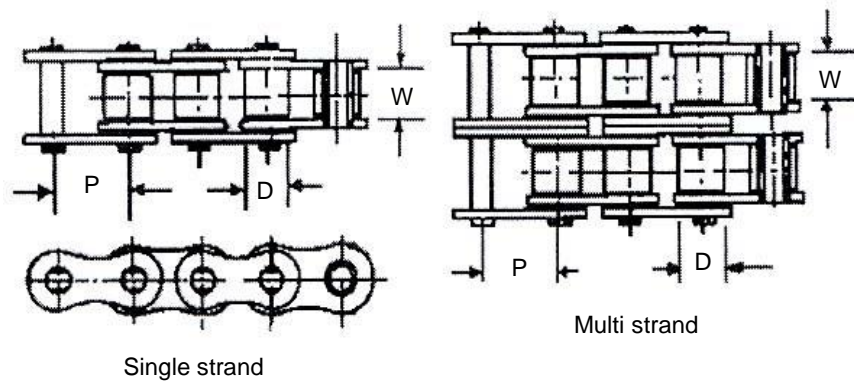
F. Fig 6 shows a **standard roller chain** in single and multi-strand. This is the most commonly used type of chain in the mining industry, and will be dealt with in detail in this module.

The dimensions shown range as follows:

Pitch (P) = 6mm - 50mm

Width (W) = 3mm - 30mm

Roller dia (D) = 4mm - 28mm

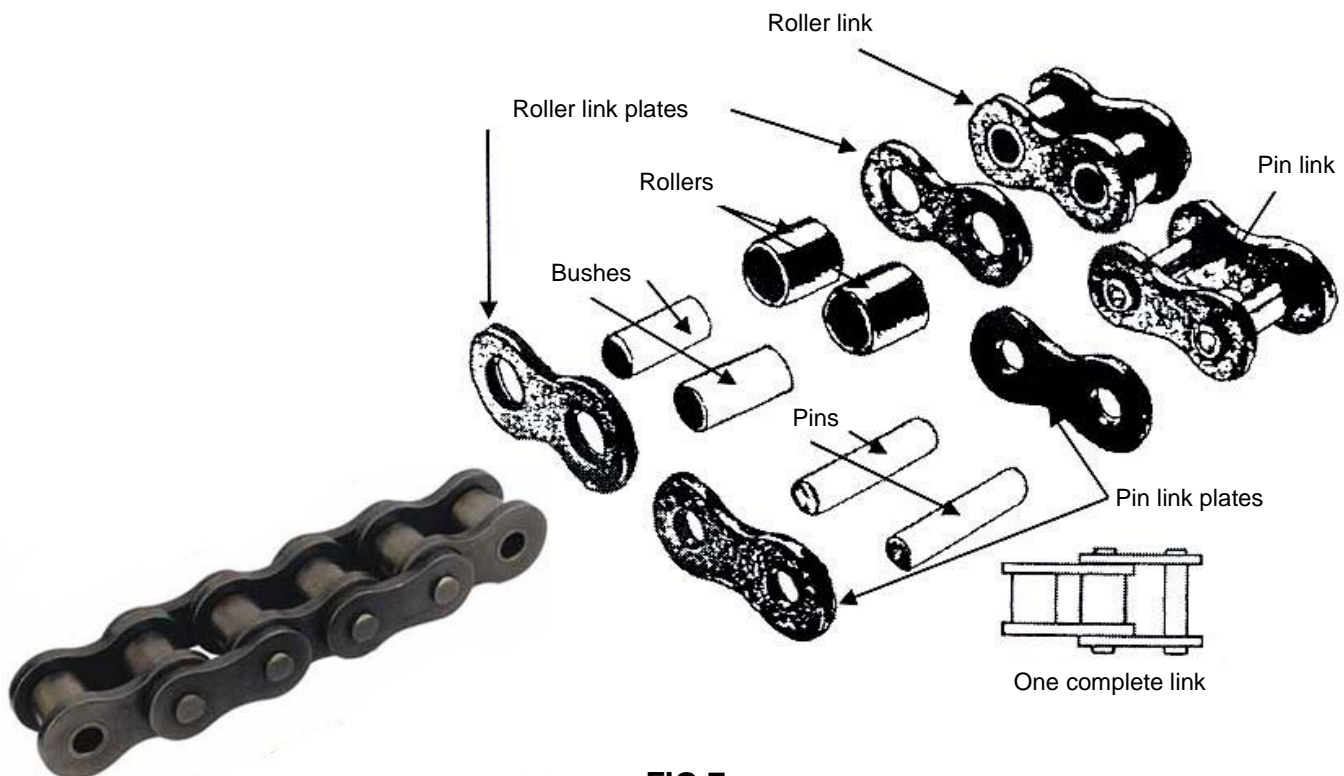


## 2. THE STANDARD ROLLER CHAIN

**ITEM / TASK:** Construction.

**DESCRIPTION:**

- A. A roller chain is a series of alternate pin links and roller links in which the pins are free to pivot within the bushings of the roller links. The rollers are free to turn on the bushings.
- B. Fig 7 shows all the parts that go into making up a roller link and pin link. A single link in a roller chain is a combination of a pin link and a roller link.



**FIG 7.**

**DO SELF-TEST 1 ON THE FOLLOWING  
PAGE BEFORE CONTINUING WITH THE REST OF THE MODULE.**



## SELF TEST 1

1. List the two components that make up a single chain link.

- a. \_\_\_\_\_
- b. \_\_\_\_\_

2. List the three parts that make up a roller link.

- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_

3. List the two parts that make up a pin link.

- a. \_\_\_\_\_
- b. \_\_\_\_\_

Ask your Training Officer to check your work and if it is correct, to sign below and then go on to the next section.

LEARNER	TRAINING OFFICER
DATE :	DATE :
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**ITEM / TASK:** Match a roller chain and a sprocket wheel.

**DESCRIPTION:**

A. The roller chain is a perfect match with the sprocket wheel when the chain pitch and width fit over the sprocket wheel. When the chain is wrapped around it, all the teeth will mesh in the chain. (Fig 8)



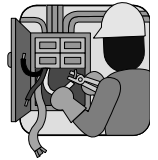
**FIG 8.**

B. To obtain this perfect match, the following steps should be followed :

- Measure the tooth pitch and width on the sprocket wheel.
- Compare the sizes with the selection of chains of different sizes.
- Select the matching chain.
- Match the chain on the sprocket wheel.

**DO THE PRACTICE ON THE FOLLOWING**

**PAGE BEFORE CONTINUING WITH THE REST OF THE MODULE.**



## PRACTICE

Practice measuring all the given chains and matching them with the correct sprocket wheels.

Ask your Training Officer to check your work and if it is correct, to sign below and then go on to the next section.

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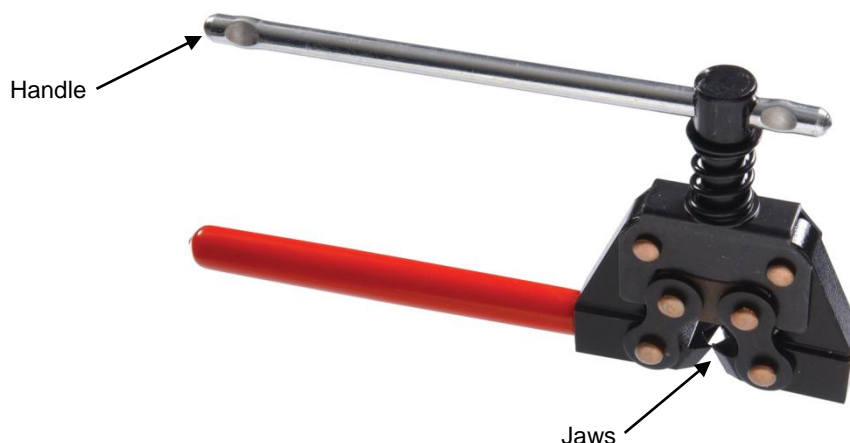


**ITEM / TASK:** Replace a roller chain on a chain drive.

**DESCRIPTION:**

**A. Break and remove the chain.**

If the chain that has to be replaced is still in position, it will have to be broken. This is done by either removing the master link, if fitted, or if one is not fitted, by using a tool called a chain breaker. Fig 9 shows a chain breaker and the method of using it described below.



**FIG 9.**

***Use a chain breaker to break a chain:***

- Select the link where the chain is to be broken.
- Unscrew the shearing bolt to allow the jaws of the chain breaker to pass over the link plate.
- Engage the jaws that they fit behind the link plate and are up against the roller.
- Turn the handle until the riveted head of the pin is sheared off and pushed flush with the link plate.
- Unscrew the handle and move the chain breaker to the next pin of the pin link.
- Repeat the above steps.
- Remove the chain breaker when both pins of the link are flush with the link plate.
- Select a pin punch slightly smaller in diameter than the link pin.
- Support the chain at the back.
- Tap the two pins of the link alternately with the punch and a hammer and remove the link evenly.

***An alternative method to break a chain:***

- Shear (cut) the riveted heads of the link pins with a hammer and chisel.
- File the sheared ends of the pins flush with the link plate.
- Support the chain and remove the link by tapping it with a pin punch and hammer.

**B. Measure the chain.**

- Measure the pitch, width and roller diameter of the old chain.
- Count the links of the old chain. Do not measure its length with a measuring tape as it is likely to have stretched.
- Cut the chain to the required length.

**C. Install and join the new chain.**

When joining a new chain a master link should be used rather than riveting the links.

Fig 10 shows two types of master links, with a spring clip, and with split pins.



**FIG 10.**



One-pitch and two-pitch offset links (Fig 11) are used if the chain has **an odd number of links** and is used with a master link. Note that the one-pitch link has one roller and the two-pitch link has three rollers. Offset links are used when the distance between the sprocket wheels can't be adjusted to suit the length of chain.



One-pitch offset link

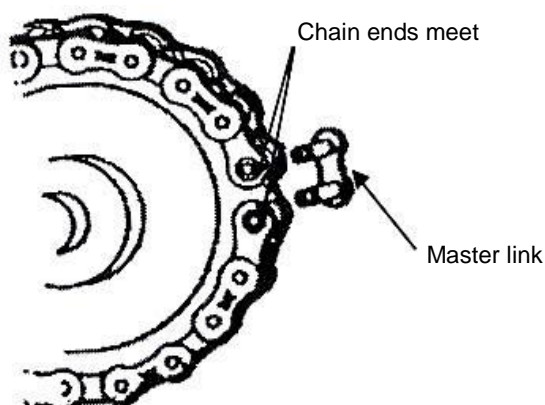


Two-pitch offset link

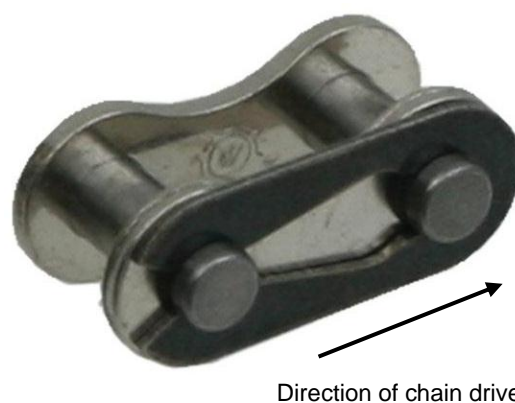
**FIG 11.**

***Method used to join a chain.***

- Wrap the chain around the sprocket wheels of the drive so that the ends meet as shown in Fig 12.
- Push in the master link, fit the link plate and snap on the spring clip, or insert the split pins.
- When installing the spring clip on a master link, ensure that the closed side of the spring clip follows the direction of the chain drive. (Fig 13)



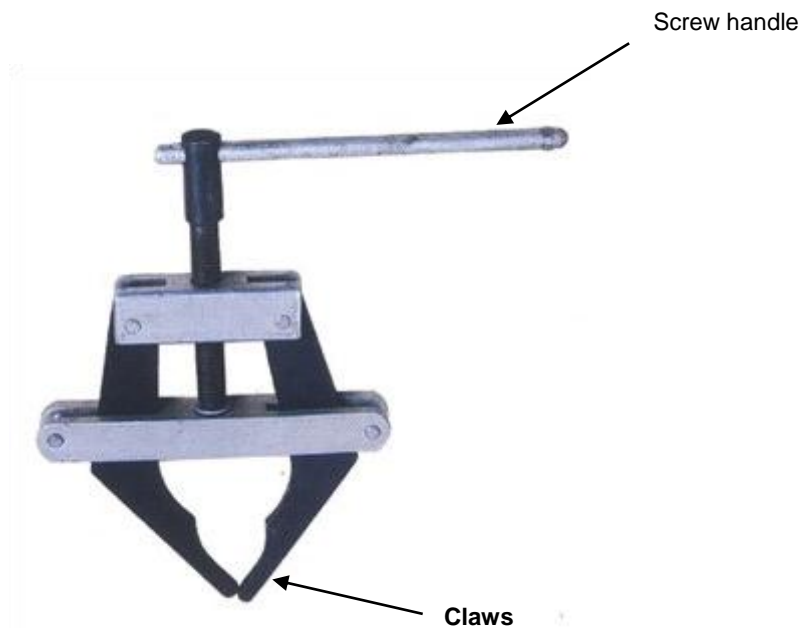
**FIG 12.**



**FIG 13.**

***Alternative method to join a chain using a chain puller. (Fig 14)***

- Locate the claws of the puller in the links at each end of the chain.
- Tighten the screw handle until the ends of the chain have been pulled close enough so that the master link can slid into the chain.
- Fit the link plate and snap on the spring clip, or fit the split pins.
- Unscrew and remove the chain puller.



**FIG 14.**

**DO SELF-TEST 2 AND THE PRACTICE ON THE NEXT PAGES  
BEFORE CONTINUING WITH THE REST OF THE MODULE.**



## SELF TEST 2

1. When is an off - set link used?

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2. Name two types of master links. (Connecting links)

a. 

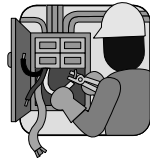
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b. 

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Ask your Training Officer to check your work and if it is correct, to sign below and then go on to the next section.

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## PRACTICE

Practice the following:

1. Breaking and removing a chain using:
  - Chain breaker, and
  - Hammer and chisel (shear) method.
2. Measuring the length of a chain.
3. Installing and joining a new chain using a:
  - Master link, and
  - Off – set link with a master link.
4. Check the amount of stretch in an old chain by counting the same number of links on the new chain. Measure and compare the lengths of the old and new chains.

Ask your Training Officer to check your work and if it is correct, to sign below and then go on to the next section.

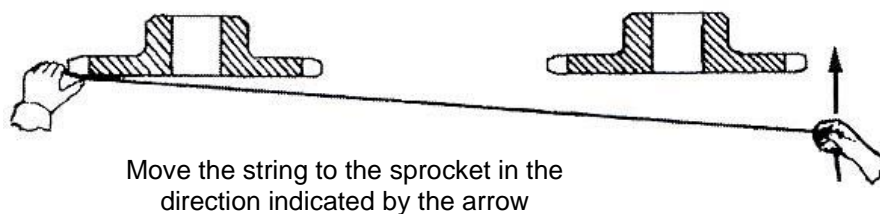
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**ITEM / TASK:** Align a chain drive.

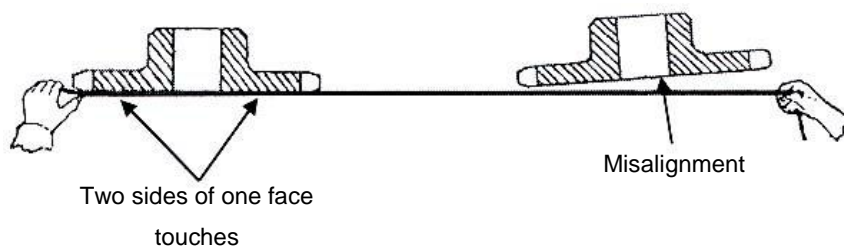
**DESCRIPTION:**

- A. Stretch a piece of string across the faces of the sprocket wheels as shown in Fig 15. A straight edge can also be used instead of the string.



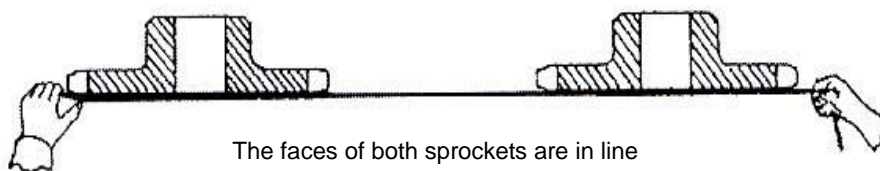
**FIG 15.**

- B. Move the string in the direction of the arrow until it touches the two sides of the sprocket wheel face. (Fig 16)



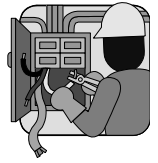
**FIG 16.**

- C. Note the direction of misalignment. (Fig 16)
- D. Loosen the clamping bolts of the misaligned assembly.
- E. Move the assembly until both sprocket wheel faces are in line. (Fig 17)
- F. Tighten the clamping bolts and check the alignment.



**FIG 17.**

**DO THE PRACTICE ON THE NEXT PAGES BEFORE  
CONTINUING WITH THE REST OF THE MODULE.**



## PRACTICE

Practice lining up two sprocket wheels in a chain drive.

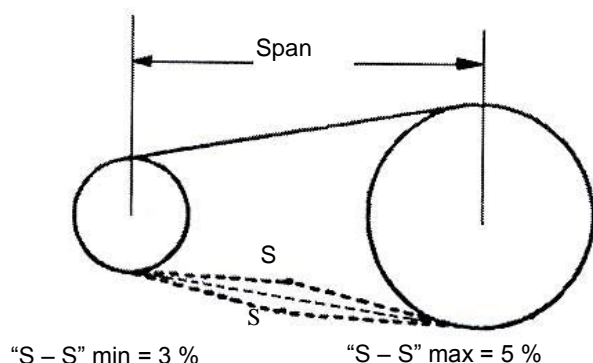
Ask your Training Officer to check your work and if it is correct, to sign below and then go on to the next section.

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DATE :	DATE :
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**ITEM / TASK:** Adjust the tension (slack) in the chain of a chain drive.

**DESCRIPTION:**

- A. As a chain has no elasticity, i.e. it does not stretch, therefore it is incorrect to talk about chain tension. It should rather be referred to as chain slack.
- B. Slack in a chain is measured in terms of the deflection ("SS" in Fig 18) in the slack side of the chain. It is expressed as a percentage of the span of the drive, where the span is the distance between the centres of the two sprocket wheels. See Fig 18.



Example:

If the deflection "SS" is 16mm and the span of the drive is 400mm then the slack is  $(16 \div 400) \times 100 \% \text{ i.e. } 4\%$ .

**FIG 18.**

- C. Ideally the slack should be between 3 and 5 %, and **it must be on the lower side (slack side) of the drive.**



**NB.**

***If the drive is at an angle between 45° and vertical, more than one metre long or if the chain operates under heavy loads, 2% slack is adequate.***

- D. To adjust the tension (slack) of a chain drive:

- Check the amount of deflection.
- Slacken the clamp bolts and screw the adjusting bolts in or out.
- Check the amount of slack in the chain. It is acceptable when between 3% and 5% of the span.
- Tighten the clamping bolts.

**DO SELF-TEST 3 AND THE PRACTICE ON THE NEXT PAGES BEFORE  
CONTINUING WITH THE REST OF THE MODULE.**



## SELF TEST 3

1. State the three conditions where chain slack may be 2%.

- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_

2. What is the accepted slack on a horizontal chain drive with an 800mm span?

- a. \_\_\_\_\_

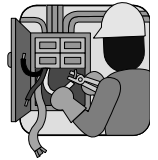
3. Where must the slack be on a chain drive?

\_\_\_\_\_

Ask your Training Officer to check your work and if it is correct, to sign below and then go on to the next section.

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DATE :	DATE :
SIGNATURE :	SIGNATURE :





## PRACTICE

Practice adjusting the slack on a chain drive with a span of 1 metre to within:

- a. 2% of the span
- b. 3% of the span
- c. 4% of the span, and
- d. 5% of the span.

Ask your Training Officer to check your work and if it is correct, to sign below and then go on to the next section.

LEARNER	TRAINING OFFICER
DATE :	DATE :
SIGNATURE :	SIGNATURE :

### 3. TROUBLESHOOT AND MAINTAIN CHAIN DRIVES

The eight possible chain malfunctions and their remedies are listed below.

<b><u>FAULT</u></b>	<b><u>REMEDY</u></b>
<b>1. Excessive noise.</b>	
<ul style="list-style-type: none"> <li>• Misalignment of sprocket wheels.</li> <li>• Too little or too much slack.</li> <li>• Inadequate lubrication.</li> <li>• Loose mountings or bearings.</li> <li>• Chain and/or sprocket wheels are worn out.</li> <li>• Chain and sprocket pitch not matching.</li> </ul>	<ul style="list-style-type: none"> <li>• Check and correct alignment.</li> <li>• Adjust span for proper slack.</li> <li>• Lubricate properly &amp; check lubricators.</li> <li>• Tighten all bolts.</li> <li>• Replace chain and/or sprocket wheels.</li> <li>• Measure and refer to chain drive recommendation chart.</li> </ul>
<b>2. Chain or sprocket wheel wear.</b>	
<ul style="list-style-type: none"> <li>• Misalignment.</li> </ul>	<ul style="list-style-type: none"> <li>• Realign sprocket wheels and shafts.</li> </ul>
<b>3. Chain climbs sprockets.</b>	
<ul style="list-style-type: none"> <li>• Chain and/or sprocket wheels worn out.</li> <li>• Insufficient chain wrap.</li> <li>• Excessive chain slack.</li> <li>• Dirt build up in sprocket wheel pockets.</li> </ul>	<ul style="list-style-type: none"> <li>• Replace chain and/or sprocket wheels.</li> <li>• Install an idler.</li> <li>• Adjust span.</li> <li>• Remove dirt build up.</li> </ul>
<b>4. Broken pins, bushing or rollers.</b>	
<ul style="list-style-type: none"> <li>• Dirt build up in sprocket wheel pockets.</li> <li>• Inadequate lubrication.</li> <li>• Chain or sprocket wheel corrosion.</li> <li>• Poor chain match on sprocket wheels.</li> </ul>	<ul style="list-style-type: none"> <li>• Remove dirt build up.</li> <li>• Lubricate properly.</li> <li>• Protect from corrosion by using a suitable lubricant.</li> <li>• Check sprocket wheels for wear.</li> </ul>
<b>5. Chain clings to sprocket wheels.</b>	
<ul style="list-style-type: none"> <li>• Incorrect pitch or width chain.</li> <li>• Heavy or tacky lubricants used.</li> </ul>	<ul style="list-style-type: none"> <li>• Measure and replace chain.</li> <li>• Clean and lubricate with recommended lubricant.</li> </ul>

<b><u>FAULT</u></b>	<b><u>REMEDY</u></b>
<b>6. Chain whip.</b>	
<ul style="list-style-type: none"> <li>• Excessive chain slack.</li> <li>• One or more stiff joints.</li> </ul>	<ul style="list-style-type: none"> <li>• Adjust span.</li> <li>• Remove stiff links.</li> </ul>
<b>7. Chain gets stiff.</b>	
<ul style="list-style-type: none"> <li>• Inadequate lubrication.</li> <li>• Corrosion.</li> <li>• Dirt build up in chain joints.</li> <li>• Peening of side plate edges.</li> </ul>	<ul style="list-style-type: none"> <li>• Lubricate properly.</li> <li>• Lubricate properly.</li> <li>• Clean chain properly.</li> <li>• Check for chain interference and remove obstruction.</li> </ul>
<b>8. Broken sprockets.</b>	
<ul style="list-style-type: none"> <li>• Obstruction or foreign material in chain tooth pockets.</li> </ul>	<ul style="list-style-type: none"> <li>• Check chain and sprocket wheel clearance and remove foreign material.</li> </ul>

**DO SELF-TEST 4 ON THE NEXT PAGE.**



## SELF TEST 4

1. Name eight chain malfunctions.

- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_
- d. \_\_\_\_\_
- e. \_\_\_\_\_
- f. \_\_\_\_\_
- g. \_\_\_\_\_
- h. \_\_\_\_\_

2. What effect will the following faults have on a roller chain drive?

a. Dirt build up in chain joints.

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b. Corrosion.

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c. Lack of lubrication.

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d. Excessive chain slack.

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e. Misalignment of sprocket wheels.

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f. Chain too tight.

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g. Material build-up in sprocket wheel tooth pockets.

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Ask your Training Officer to check your work and if it is correct, to sign below.

LEARNER	TRAINING OFFICER
DATE :	DATE :
SIGNATURE :	SIGNATURE :



### **REMEMBER ALWAYS WORK SAFE**

Once you have passed the entire self-tests and practices, you are now at liberty to request a Formative Assessment from your Assessor.