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DIESEL MECHANIC

MINING QUALIFICATIONS AUTHORITY

CODE: SPG - 2

FIT SEALS AND PACKING

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TRG 9

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INDEX

The following elements are contained in this learning guide:

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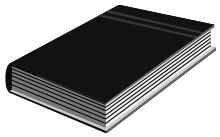

SOURCE REFERENCES

Demonstration by a competent person.

Manufacturers' catalogues and charts.

A display board in the training centre.

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OBJECTIVE

You will be learning towards the outcome “Cut and fit gasket”. Whilst learning towards the outcome you will be required to achieve the following:

- Fit oil seals, “O” rings and packing.

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

- Select and fit "O" rings in a cylinder and piston assembly.
- Remove and replace an oil seal in a housing.
- Remove and replace an oil seal in a cover with a bore without a shoulder.
- Measure, select and cut square braided packing and pack the stuffing box of a gate valve or pump.

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 practical test will be set at the end of the module and must be completed without using references.
- The learner will be required to:
  - select and fit “O” rings to a cylinder and piston assembly,
  - select and fit oil seals to given components, and
  - measure, select and cut square braided packing and pack the stuffing box of a gate valve or pump.

The following standards must be achieved:

- The piston and cylinder assembly must be airtight.
- The oil seals must be installed facing the correct way.
- The oil seals must be of the correct size.

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  - There must not be any leakage past the gland of the valve, or the initial seepage rate of 200 drops per minute at the pump gland must be reduced to between 50 to 70 drops per minute over a running-in period of 15 minutes. (If applicable)
  - There must be no damage to tools or equipment.

- All safety procedures must be adhered to.

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HAZARD IDENTIFICATION AND CONTROL (HIAC) FORM

SPG - 2

FIT SEALS AND PACKING

STEPS IN OPERATION / PROCESS	POTENTIAL ACCIDENT / INCIDENT	CONTROLS (BY RESPONSIBLE PERSON)
1. Use hand tools.	• Using damaged tools or wrong tools for the job can cause injury and damage to equipment.	• Always use the correct tool for the job. • Ensure tools are in good condition. • Use tools correctly. • Wear appropriate PPE where necessary. • Always take good care of tools. Maintain, clean and store it properly.

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: _____

Signature of Training Officer: _____

Date: _____

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1. FIT “O” RINGS

ITEM / TASK: Introduction.

DESCRIPTION:

To cater for all the different conditions that exist in the mining industry, a full range of synthetic rubber materials is used in the manufacture of "O" rings and oil seals.

The following factors will influence the type of "O" ring and oil seal chosen:

- The nature of application.
- The type of fluid or gas to be sealed.
- The minimum, maximum working pressures.
- The type of lubricant used.
- The minimum, maximum working temperatures.
- The speed of the shaft or frequency of reciprocation and stroke.
- The size and finish of the matching component parts.

ITEM / TASK: “O” rings.

DESCRIPTION:

A. "O" Rings are made of a synthetic material commonly known as "Neoprene". (Fig 1)
B. They range in size from a cross section diameter of 1mm and an internal diameter of 3mm to a cross section diameter of 8mm and more and an internal diameter of 500mm. (Fig 2)
C. A typical set of manufacturers’ tolerances on "O" rings are shown in Table 1 on the next page.
D. “O” rings are identified by reference numbers which reflect various prefixes and the internal diameter and width (cross section diameter) of the ring. For example, a ring with reference number RMT 20 X 2 indicates a ring with inside diameter of 20mm and a width of 2mm.
E. O" rings can be used for either static (stationary) sealing or dynamic (motion) sealing.

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FIG 1.

FIG 2.

TABLE 1 - "O" RING TOLERANCES

a	TOLERANCE (mm)	b	TOLERANCE (mm)
Up to 10	± 0.15	1.0	± 0.08
10 – 18	± 0.20	2.0	± 0.08
18 – 30	± 0.25	3.0	± 0.10
30 – 50	± 0.30	6.0	± 0.12
50 – 80	± 0.40	8.0	± 0.15
80 – 120	± 0.50		
120 – 180	± 0.60		
180 – 250	± 0.80		
250 – 300	± 1.00		
300 – 400	± 1.50		
400 – 500	± 2.00		

a = Inside diameter of "O" ring in mm

b = Cross section of "O" ring in mm.

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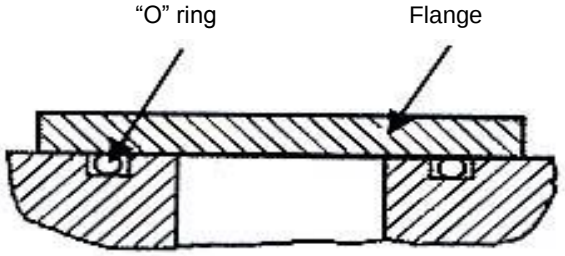
ITEM / TASK: Examples of “O” ring applications.

DESCRIPTION:

A. The following are a few typical examples of ‘O” ring applications.

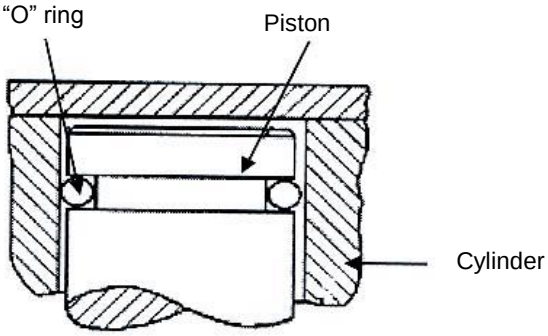
- Fig 3 shows a **flange application** for "O" rings.



Flange application

FIG 3.

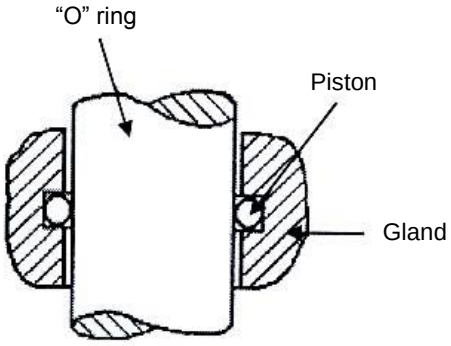
- Fig 4 shows the **piston application** for "O" rings.



Piston application

FIG 4.

- Fig 5 shows the **piston rod gland application** for "O" rings. This application can also be used as a gland seal for slow rotating shafts.



Gland application

FIG 5.

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- Fig 6 shows the **chamfer and radius type of sealing** and is the same as that shown in Fig 1 of Module SPG-1 for round rubber gaskets.

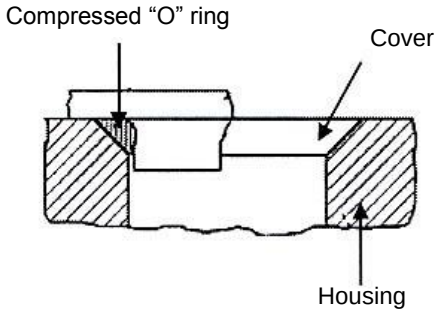

FIG 6.

- Fig 7 shows the **lead-in chamfer application**. This must be machined on the shaft or in the housing to allow the parts to be assembled without causing damage to the "O" ring.

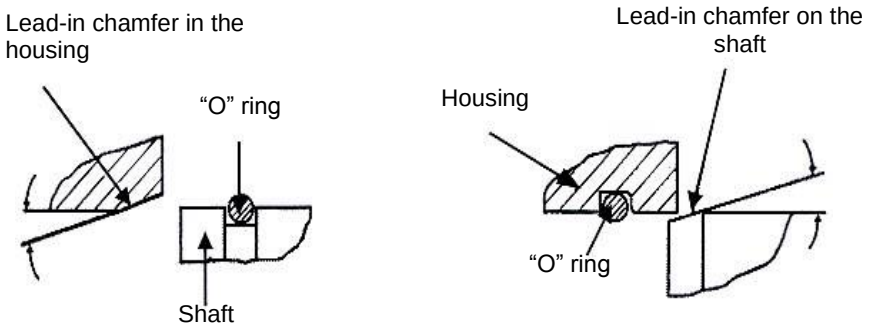

FIG 7.

NB:

There are obviously many other applications, which are not shown but will be encountered in practice.

B. Manufacturers’ charts and tables must be consulted to select the correct "O" ring to suit the dimensions of a particular groove or machining a groove to suit a particular "O" ring. Fig 8 on the next page shows the standard format of the "O" ring groove.

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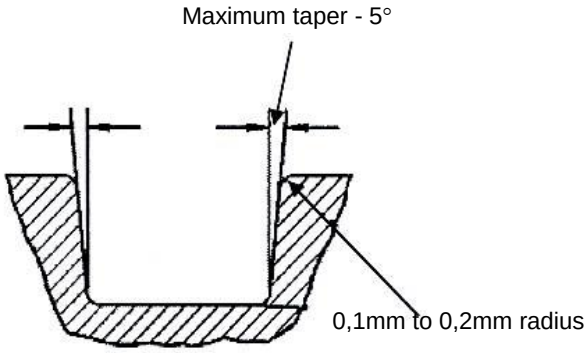
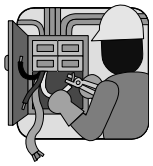


"O" ring groove

FIG 8.



ITEM / TASK: Fit an "O" ring in a groove.

DESCRIPTION:

Use the following method:

- Clean all the matching parts.
- Examine the groove for damage and remove all burrs.
- Measure the width and diameter of the groove.
- Consult "O" ring charts and select the recommended "O" ring.
- Wipe clean oil or grease onto the "O" ring to make it easier to install.
- Fit the "O" ring into the groove.
- Wipe clean oil onto or into the matching part.
- Assemble the parts with the "O" ring in position, making sure that it doesn't become dislodged.

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

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SELF TEST 1

1. Give four applications for “O” rings.

- _____
- _____
- _____
- _____

2. Name the material “O” rings are made of.

_____

3. Write in the sizes of the following “O” rings.

REF NO.	INTERNAL DIAMETER	CROSS SECTION DIAMETER
RMT 14 x 2		
RMT 18 x 3		
RMT 32 x 5		
RMT 48 x 1		
RMT 62 x 5		

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

LEARNER	TRAINING OFFICER
DATE :	DATE :
SIGNATURE :	SIGNATURE :

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2. FIT OIL SEALS

ITEM / TASK: Introduction.

DESCRIPTION:

A. Oil seals serve a double purpose, firstly they keep lubricants in, and secondly they keep contaminants out.

B. The basic design (Fig 9) of oil seals is the same although there are many different types for different applications.

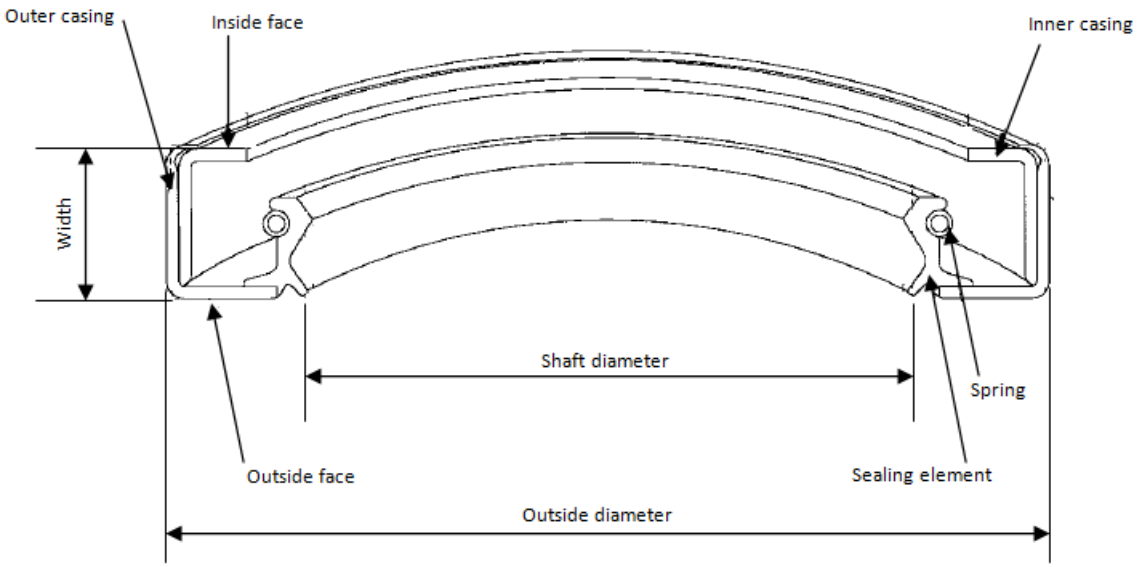

FIG 9.

Fig 10 shows commonly used oil seals, which are all fitted with tension springs known as "coil garter springs". These springs ensure that an even pressure is applied on the lip of the oil seal and cause positive contact with the shaft. The different types are described below.

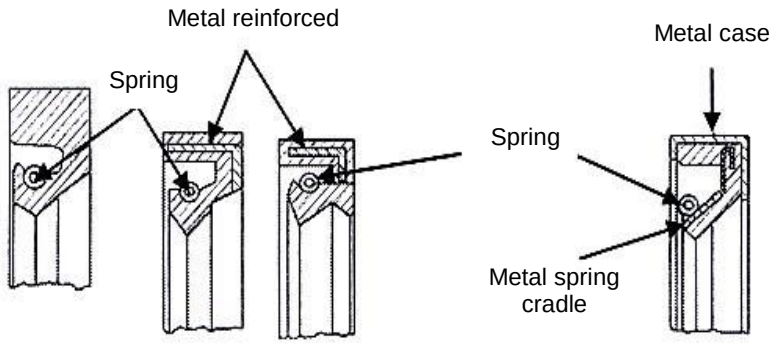

FIG 10.

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DIFFERENT TYPES OF OIL SEALS.

This is a split type of oil seal and is made of synthetic rubber.

This is a conventional oil seal and is made of synthetic rubber reinforced with metal.

This is a double lipped oil seal and is made of synthetic rubber reinforced with metal.

This is a metal encased synthetic rubber seal with a spring, which reinforces the lip of the oil seal. This seal is especially suitable for heavy duty work.

This is a metal encased synthetic rubber seal with thin metal strips, which reinforces the lip of the oil seal. This seal is especially suitable for heavy duty work.

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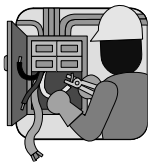

ITEM / TASK: Fit an oil seal in a housing.

DESCRIPTION:

- Measure the bore of the housing, the depth of the oil seal landing and the diameter of the shaft.
- Select an oil seal of the matching size.
- Inspect the bore of the housing and make sure there are no burrs or any other damage and that it has a lead-in chamfer.
- Inspect the shaft to make sure that there are no scratches or burrs, which can damage the lip of the oil seal.
- Push the seal over the lead-in chamfer up to the housing with the spring facing in. (Fig 11)

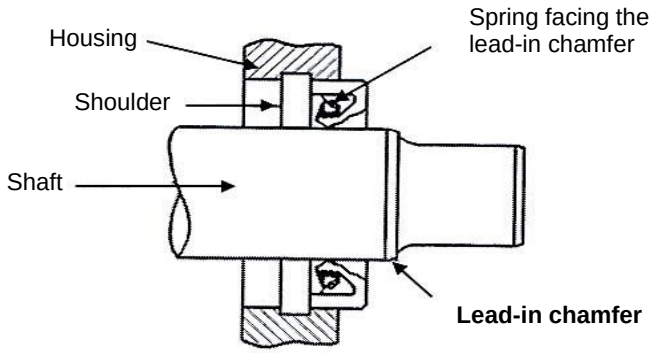

FIG 11.

- Tap the oil seal in lightly with a hammer and a flat bottom punch until it is fully seated against the shoulder of the seal landing.
- A dolly, which is also known as a bell piece, and a hammer may be used. (Fig 12)

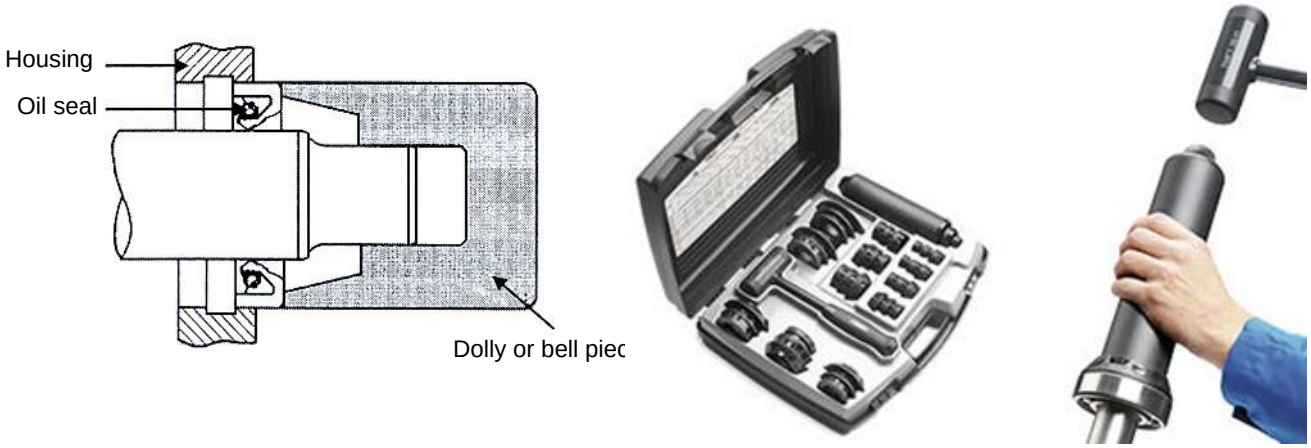

FIG 12.

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- If there is no shoulder for the oil seal to seat on, the seal must be tapped in squarely until the outer face is flush and square with the outer face of the housing. (Fig 13)

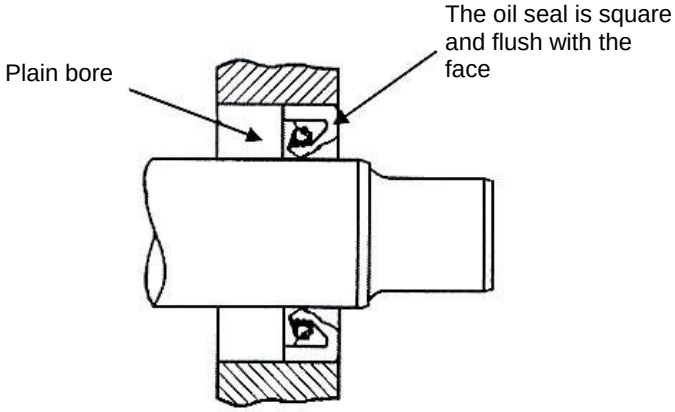
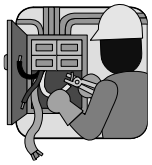


FIG 13.



ITEM / TASK: Remove an oil seal from a housing.

DESCRIPTION:

- If the seal is accessible from the inside, tap it out with a hammer and a punch.
- If the seal is not accessible from the inside, then it must be wedged out by driving a narrow and flat pointed tool between the oil seal and the bore. (Fig 14) The wedging should be done at more than one point.

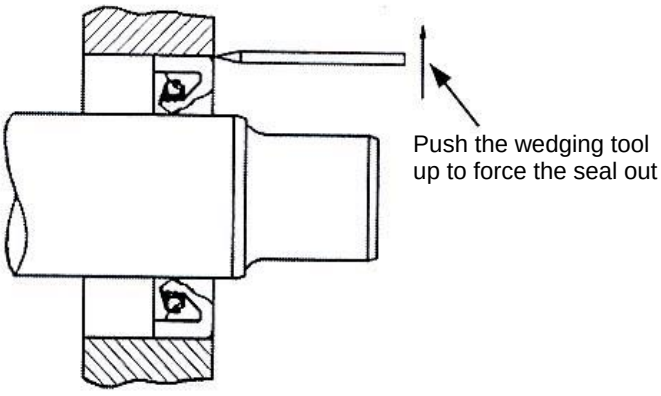


FIG 14.

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- Care must be taken not to damage the housing or shaft.
- Any damage caused should be repaired before fitting a new oil seal.

Note:

Another way of removing the oil seal is to collapse it with a hammer and a small flat chisel.

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

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SELF TEST 2

1. State two purposes of an oil seal.

- _____
- _____

2. Name four types of oil seals

- _____
- _____
- _____
- _____

3. Identify the four types of oil seals named above on the display board.

Ask your Training Officer to check your work and if it is correct, to sign below before you do the practice on the next page.

LEARNER	TRAINING OFFICER
DATE :	DATE :
SIGNATURE :	SIGNATURE :

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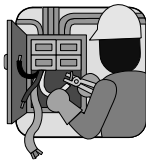

PRACTICE

Practice fitting an used oil seal in a housing with the shaft still in position and then remove the oil seal again by wedging it out.

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 :

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3. FIT SQUARE BRAIDED PACKING

ITEM / TASK: Introduction.

DESCRIPTION:

A. There are many varieties of this packing on the market and they suit many different applications. Two most commonly used in the mining industry are –
   - graphite coated square braided packing. (Fig 15)
   - tallow / wax coated square braided packing. (Fig 16)

FIG 15.

FIG 16.

B. The packing can range in size from 3mm square to 50mm square.

C. It is suitable for use as gland packing in valves, reciprocating with speeds up to 600 metre per min, and rotary pumps with speeds up to 3600 RPM.

Figures 17 and 18 show examples of this packing.

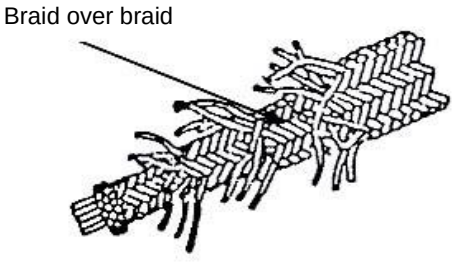

FIG 17.

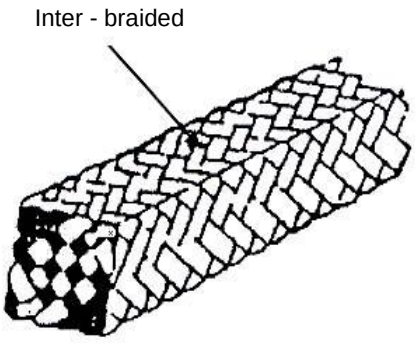

FIG 18.

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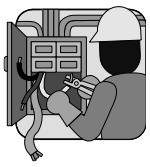

ITEM / TASK: Cut a packing ring for a gland.

DESCRIPTION:

- Measure the stuffing box bore and the shaft or packing sleeve diameter.
- Subtract the shaft diameter from the bore and divide by two to get the packing thickness.
- Select the correct thickness of packing.
- Wind the packing around a piece of shafting which has the same diameter as the shaft or packing sleeves.
- Cut through each turn either parallel or at an angle of 45°. The latter cut is called a "skive" joint. (Fig 19)

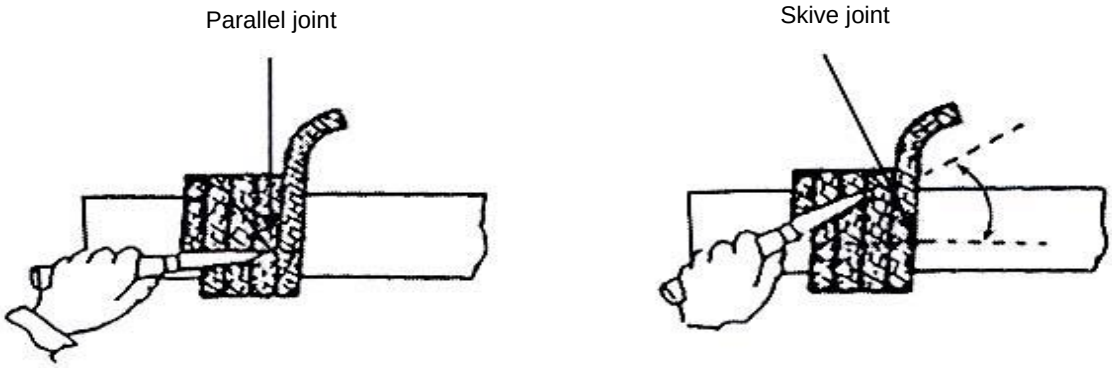

FIG 19.

NB:

A correct butt joint of a ring will result if the packing is cut as described above. See Fig 20 below. But, if the packing was cut to length while stretched and straight, it will appear as shown on the right in the figure, and the butt joints will be incorrect.

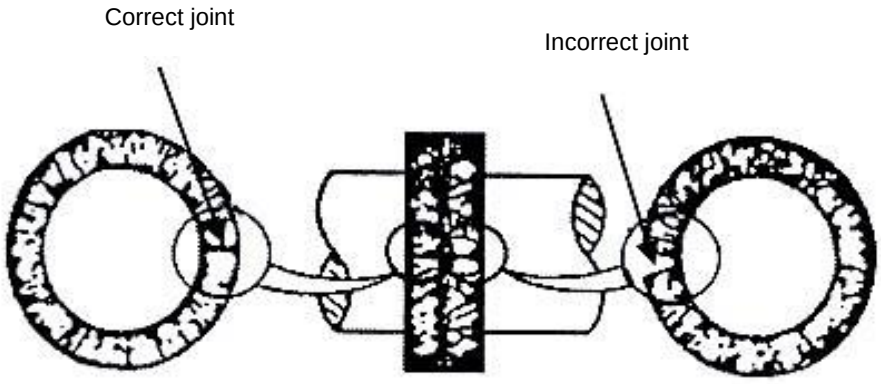

FIG 20.

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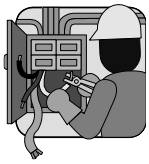

ITEM / TASK: Pack a gland.

DESCRIPTION:

- Remove all the old packing with a flexible corkscrew packing extractor. (Fig 21)

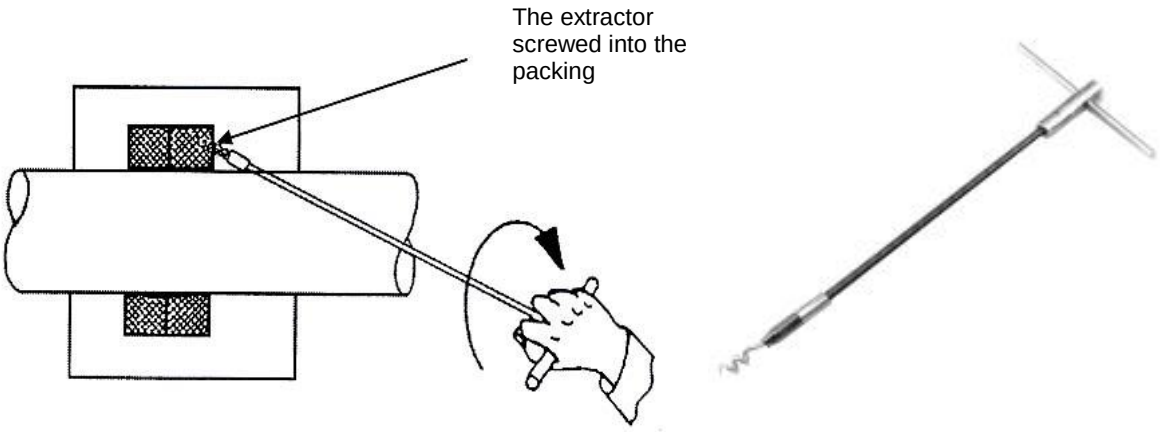

FIG 21.

- Clean the inside of the stuffing box thoroughly.
- Examine the shaft or packing sleeve for wear or damage.
- Check the shaft for run-out with a dial test indicator.
- If the shaft runs out more than 0.08mm, the bearings must be checked or the shaft straightened.
- Stagger the joints of the packing rings as follows:
    a. Two rings, joints at 180°.
    b. Three rings, joints at 120°.
    c. Four or more rings, joints at 90°.
- The joint of the first ring must always be at the top.
- The packing must be installed in such a way as to position the lantern ring to line up with the gland water service opening. (Fig 22 on the next page)
- Install as many packing rings as will almost completely fill the stuffing box.
- Push the gland into the stuffing box against the packing.
- Finger-tighten the gland bolt nuts, ensuring that the gland is square to the shaft.

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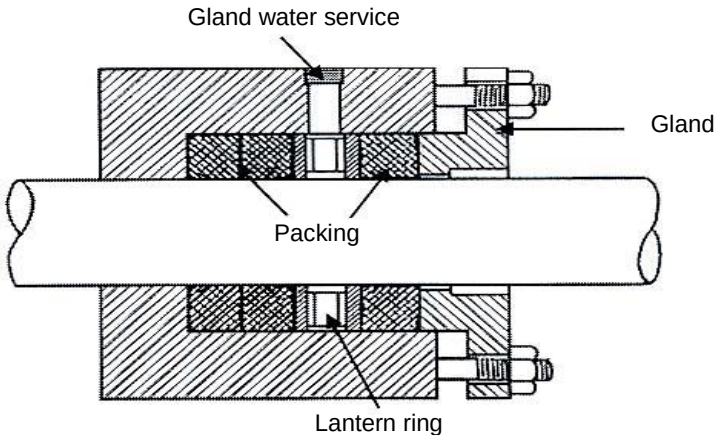

FIG 22.

- Tighten each gland bolt nut by one sixth of a turn with a spanner.
- If it is a valve gland, and it leaks after the valve has been opened, tighten each gland nut by one sixth of a turn until the leaking stops.
- If it is a pump gland, the drip rate at the initial starting of the pump must be checked.

NB:

An initial seepage of up to 200 drops per minute is normal.

- Pull up the gland gradually by one sixth of a turn of each nut over a running-in period of about 15 minutes until the seepage rate drops to between 50-70 drops per minute. (If applicable) The new packing can take up to one hour to seat properly.

NB:

The most critical period of any packing is the initial start-up after installation.

Note:

There are obviously many other types of packing and seals which you will encounter, but they will not be dealt with because:

a. they are basically the same as those discussed,
b. they are too expensive and complicated, and require specialised training, and
c. you will encounter them in other modules.

DO SELF-TEST 3 AND PRACTICE ON THE FOLLOWING PAGES BEFORE ATTEMPTING THE ASSESSMENT.

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SELF TEST 3

1. Name the two most common types of gland packing in the mining industry.

- _____
- _____

2. Name three gland applications for this type of packing.

- _____
- _____
- _____

3. Calculate the thickness of packing to be used in a gland with the following dimensions

   Stuffing box bore = 74 mm
   Shaft diameter = 50 mm

_____

_____

_____

_____

4. Describe how the joints of the packing rings must be staggered.

   a. _____
   b. _____
   c. _____

5. What is an acceptable initial drip rate?

_____

6. What is the acceptable drip rate after the running-in period?

_____

7. What is the most critical period for any packing?

_____

Ask your Training Officer to check your work and if it is correct, to sign below before you do the practice on the next page.

LEARNER	TRAINING OFFICER
DATE :	DATE :
SIGNATURE :	SIGNATURE :

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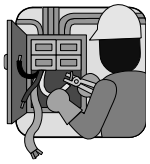

PRACTICE

Practice removing the old packing from a stuffing box and re-packing it with new packing.

Note:

In modules VO, PMO-1 and PMO-2 you will get further practice in packing glands.

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.