higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

# MARKING GUIDELINE

## NATIONAL CERTIFICATE

## METAL WORKERS' THEORY N1

## 22 November 2022

**This marking guideline consists of 8 pages.**

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## QUESTION 1: SAFETY AND HOUSEKEEPING

1.1 False
1.2 True
1.3 False
1.4 True
1.5 True

(5 × 1) **[5]**

## QUESTION 2: CARE AND USE OF TOOLS

2.1 2.1.1 It is used to enlarge the punch mark for drilling or punching.

2.1.2 It is used to cut thin steel plates in the workshop.

2.1.3 It is used to enlarge or align holes for bolting or riveting work.

2.1.4 It is used to do heavy work or drive in wedges, posts or do forging work.

2.1.5 It is used for general filing work on flat surfaces.

(5 × 1) (5)

2.2 2.2.1 Outside callipers
2.2.2 Bevel gauge
2.2.3 Try square
2.2.4 Centre punch
2.2.5 Trammels

(5 × 1) (5)

2.3 2.3.1 Length
2.3.2 Roughness
2.3.3 Cut
2.3.4 Shape

(4 × 1) (4)

2.4 It is used to clamp the workpiece in position. (1)
**[15]**

## QUESTION 3: DEVELOPMENTS

- Dotted lines to indicate hidden details
- Bold lines to show the outline of the drawing
- Centre lines to indicate the centre of the drawing
- Short chain lines to show portions which have been cut away
- Construction lines which are feint lines not seen in the drawing (5 × 2) **[10]**

## QUESTION 4: METALS, PLATES AND SECTIONS

4.1

| | | MILD STEEL | HIGH-CARBON STEEL |
|---|---|---|---|
| 4.1.1 | Carbon content | Between 0,1% and 0,3% | Between 0,8 to 1,0% |
| 4.1.2 | Metal properties | Malleable, ductile, elastic, tough, fusible | Hard, brittle, tough, elastic |
| 4.1.3 | Uses | Used in the manufacturing of steel plates, bars, angle irons, H-beams, rivets bolts, nuts | Used in the manufacturing of shear blades, twist drills, metal cutting tools, files |

(3 × 2) (6)

4.2 A brittle metal has the tendency to brake before it deforms.

**OR**

A brittle metal is high in compressive strength but low in tensile strength. (1)

4.3 4.3.1 RSJ
4.3.2 DRG
4.3.3 OD

(3 × 1) (3)

4.4 Back mark = (70 + 6) ÷ 2✓
= 76 ÷ 2
= 38 mm✓

If you look at the back mark table, the back mark for a 70 mm flange is 40 mm, 45 mm for a 76 mm flange and 35 mm for a 64 mm flange. Therefore the average is 40 mm. (2)
**[12]**

## QUESTION 5: MACHINES

5.1

- Ensure that the steel section to be cut is firmly secured before starting the machine.
- Keep the area around the machine clean and tidy at all times.
- Only crop mild-steel angles.
- Wear clothing suitable for the workshop.
- Do not leave the machine unattended at any time during operation.
- Take note of the emergency switch.
- Make sure that the blades of the cropper are firmly tightened.
- Adjust the foot or stopper correctly to hold the angle section before any cropping is done.

**General:**

- Wear gloves to protect hands against sharp edges.
- Wear protective glasses to protect eyes, especially when punching.
- Wear earplugs or other hearing protection to protect ears against the noise the machine makes when it cuts or punches the metal.
- Get help when working with long, heavy or large steel sections.
- Ensure the area around the machine is clean and clear of all scrap and tripping hazards.

**Punching:**

- Ensure the punch and die are set and aligned properly.
- Ensure the die is inserted the right way up with the smaller hole on top.
- Ensure the punch is positioned correctly in the pop mark before attempting to punch the hole.
- Let the machine get up to full speed before attempting to punch a hole (flywheel-type machine).
- Ensure the plate stripper is in place before punching any holes.
- Keep fingers clear of the punch and die.

**Cropping:**

- Ensure no-one is on the other side of the machine or that they are standing clear when pushing the steel section through.
- Ensure the steel section is secured before cropping. If it is loose, it will whip and can injure a person in the vicinity.
- Keep hands and fingers clear of the cropping area and holding-down device.

**Shearing:**

- Keep fingers clear of shear blades and the holding-down device.
- Ensure the holding-down device is set for the thickness of plate to be cut.
- Ensure that the blades and surface area around the blades are clean and free of any oil or grease.
- Do not attempt to cut too small a piece of metal as you may injure your fingers.

**Notching:**

- Ensure the guard is secured and out of the way.
- Keep fingers clear of the blades.
- Ensure fingers are clear and not caught between the machine and material as fingers will be crushed.
- Ensure the guard is replaced when finished working/cropping the material.

(Any 5 × 1) (5)

5.2
- Make sure that the table is clean and free from grease or oil.
- Wear safety goggles.
- Check that the metal to be cut is mild steel.
- Only one person may operate the machine.
- Ensure that the area behind the guillotine is clear before cutting a plate.
- Do not overload the machine.
- Wear suitable gloves to protect hands against sharp edges of the plate.
- Before using the machine, ensure that no one is behind the machine and ensure that there is not a lot of scrap lying behind the machine.
- Ensure that the working area around the machine is free of any scrap or items that could be a tripping hazard.
- Check and ensure the machine is set to cut the thickness plate required or that it is able to cut the thickness of plate required.
- Ensure the guards in front of the blades are in place and in a good condition.
- When cutting ensure that fingers are not near the blade or under the plate. Keep hands and fingers clear when cutting.
- Get help when working with heavy or big plates.
- Only one person may operate the machine and give instructions during the cutting process.
- Always wear gloves to protect hands against the sharp edges of the plate.
- Clear all scrap away from behind the machine when finished cutting all the required material.
- When cutting small pieces of material make sure the clamp will secure the metal when been cut or use another piece of flat metal placed on top of it to ensure the clamp will secure when been cut. (Any 5 × 1) (5)

**[10]**

## QUESTION 6: JOINTS AND BOLTED JOINTS

6.1
- Flat washer: Used under the nut to prevent damage to the surface of the metal
- Spring washer: Used under the nut to exert additional tension
- Taper washer: Used to ensure that the contact surfaces of the bolt and head are square (Any 2 × 2) (4)

6.2 6.2.1 Landing is the distance measured from the centre of the hole to the edge of the plate or the centre of the bolt to the edge of the plate.

6.2.2 Pitch is the distance between two centre holes on the same line. (2 × 1) (2)

6.3 6.3.1
- Black bolts are commonly used where less stress is experienced such as in structural work.
- Black bolts are adequate for most direct bearing situations where bolt shearing is minimal.
- Black bolts are used in general steel work and structures.

(Any TWO)

6.3.2 Countersunk bolts are used where the bolt is to be set flush or be in line with the surface of the plate.

(2 × 2) (4)
**[10]**

## QUESTION 7: OXY-ACETYLENE AND LPG CUTTING AND WELDING

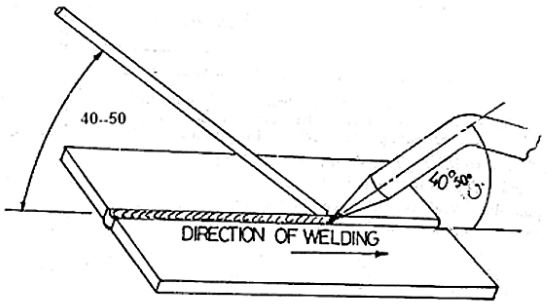
7.1 7.1.1 Oxygen
7.1.2 Right-hand thread
7.1.3 Maroon
7.1.4 Liquid petroleum gas
7.1.5 Left-hand thread

(5 × 1) (5)

7.2 To test for gas leaks a soapy solution mixture must be used.✓ Mix the soap solution properly✓ and apply it to all joints of the oxy-acetylene equipment by using a paintbrush.✓ If there is a leak, the soap solution will start to bubble.✓ Do not continue using the equipment until the leak is repaired.✓ Do not use matches, bodied plastic lighters or the nose to smell for gas leaks.✓

- Open the cylinder valves slowly and adjust the regulator to the required pressure.
- Open the torch valve for 3 to 4 seconds and close to purge the pipes/hoses.
- Spray an approved leak-detecting solution directly onto all joints and connections.
- Leaks will be indicated by foaming/bubbles at the point of the leak.
- Tighten the fastener/clip or nut and test again.
- This test can be done by testing the acetylene and oxygen simultaneously or separately. (5)

7.3




Rightward Welding Technique (3)

7.4
- Safety/Long leather gloves
- Leather apron
- Leather spats
- Safety boots
- Overalls
- Gas-welding/Safety glasses/goggles (Any 2 × 1) (2)

**[15]**

## QUESTION 8: METAL ARC WELDING

8.1 8.1.1 For welding purposes

8.1.2 For cleaning of welding joints or metal to be welded

8.1.3
- To earth the metal and complete the electrical circuit when the arc is struck allowing the weld to be made
- To prevent electric shock
- To complete the electrical circuit (Any ONE) (3 × 1) (3)

8.2
- The transformer is cheaper as compared to a DC welding machine.
- It has no rotating parts to wear out.
- It is more efficient than the generator.
- It does not produce any appreciable noise when welding is done.
- Arc blow does not occur when welding with a transformer. (5)

8.3
- To facilitate the welding process by increasing the melting speed
- To stabilise the current
- To create slag
- To melt away the impurities on the metal surface
- To shield the arc during the welding process (Any 3 × 1) (3)

8.4 8.4.1 The electrode holder is connected to the positive pole and the workpiece. The piece being welded is connected to the negative pole by means of an earth clamp in a DC welding machine.

**OR**

In reverse polarity the electrode holder cable is connected to the positive pole and the earth clamp cable is connected to the negative pole of the power source. The electrons flow from the workpiece to the electrode. The electrode is superheated allowing the rod material to travel across the arc stream with a high velocity digging into the metal causing deeper penetration. Two-thirds of the heat is directed to the electrode and one-third to the workpiece.

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8.4.2 In metal inert gas welding, an inert gas such as argon, helium or carbon dioxide is used to protect the molten metal from the atmosphere. The filler material is supplied by a continuous wire electrode feed.

**OR**

Metal inert gas welding is a welding process in which the wire runs through the liner, which also has a gas feeding through the same cable to the point of arc to protect the weld from the air. An electric arc is formed between the consumable wire (electrode) and the workpiece causing them to melt and join like in shielded metal arc welding. The shielding gas acts the same as the flux.

(2 × 2) (4)
**[15]**

## QUESTION 9: CALCULATIONS AND PLANNING

9.1 Mean diameter = 840 mm – 12 mm✓
= 828 mm✓

Circumference = 828 mm × 3,142✓
= 2 601,576 mm✓

9.2 Mean diameter = 840 mm + 20 mm +12 mm✓
= 872 mm✓

Circumference = 872 mm × 3,142✓
= 2 983,112 mm✓

(2 × 4) **[8]**

**TOTAL: 100**

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