



**higher education  
& training**

Department:  
Higher Education and Training  
**REPUBLIC OF SOUTH AFRICA**

# **MARKING GUIDELINE**

**NATIONAL CERTIFICATE**

**FITTING AND MACHINING THEORY N2**

**6 April 2020**

**This marking guideline consists of 9 pages.**

**SECTION A****QUESTION 1: OCCUPATIONAL SAFETY**

Answer QUESTION 1.1 OR QUESTION 1.2.

- 1.1
- Provides maximum positive protection.
  - Blocks access to danger zones during operation.
  - Corrosion and fire resistant.
  - Does not create hazards such as splinters and pinch points.
  - Is a permanent part of the machine
  - Is easily repairable.
  - Complies with the requirements of the Departments of Labour and Mineral Resources.
  - Does not affect the efficient operation of the machine.
  - Is hinged if it is bulky, to allow for the servicing of belts and gears.
- (Any 5 × 1)

OR

- 1.2
- No person should place, throw or leave any naked light or flame on or near any combustible material or inflammable substances.
  - No combustible waste material shall be stored anywhere in quantity.
  - No combustible waste material shall be stored or kept in the immediate vicinity where any electrical apparatus or heating apparatus is installed.
  - No welding, flame cutting or flame heating shall take place unless adequate means to extinguish the fire immediately is available.
  - No person shall smoke or carry an open light in any cage, skip or other conveyance in any shaft or winch or in any elevator car in a hatchway.
  - Calcium carbide is not to be taken underground unless it is in a lamp provided by the manager or in a water-tight container approved by the regional manager.
  - All machinery must be constructed, installed, operated and maintained so as to prevent any dangerous heating.
- (Any 5 × 1)

**[5]**

**QUESTION 2: COUPLINGS**

- |     |   |
|-----|---|
| 2.1 | D |
| 2.2 | B |
| 2.3 | F |
| 2.4 | A |
| 2.5 | H |
| 2.6 | E |

(6 × 1)

**[6]**

**QUESTION 3: LIMITS AND FITS**

- 3.1      3.1.1      b – deviation/tolerance on shafts  
              3.1.2      A – deviation/tolerance on holes  
(2 × 1)      (2)
- 3.2      • Clearance fit  
              • Interference fit  
              • Transition fit  
(3)
- 3.3      • The fit must be of a permanent nature.  
              • The fit, like keying, can also be of a semipermanent nature.  
(2)  
[7]

**QUESTION 4: BEARINGS**

- Water contamination
  - Lack of lubrication
  - Excessive operating temperature
  - Foreign material in oil supply
  - Unsuitable lubricants
  - Corrosion of bearing material
  - Design faults
  - Fatigue of bearing material
  - Incorrect assembly and maintenance
- (Any 5 × 1)      **[5]**

**QUESTION 5 : LUBRICATION AND VALVES**

- 5.1      5.1.1      It is the pressure that is generated between a bearing and a shaft.      (1)
- 5.1.2      It is the lowest temperature at which a lubricant will pour or flow at an adequate rate to fulfil its function.      (1)
- 5.1.3      It is the ability of a substance to cling to another material or substance      (1)
- 5.2      5.2.1      Diaphragm valve      (1)
- 5.2.2      It has a rubber diaphragm which is moved down by a screw ✓ onto a metal bridge to close off liquid flow. ✓  
(2)  
**[6]**

**QUESTION 6: PACKING, STUFFING BOXES, JOINTS AND WATER PIPE SYSTEMS**

- 6.1
- It is strong.
  - It can bond with other materials.
  - It is resilient.
  - It can be deformed in different directions.
  - It is resistant to fatigue and abrasion.
- (5)
- 6.2
- 6.2.1 Used where the hole is threaded to prevent any flow of liquid passing that point.
- 6.2.2 Used where the outside diameter of a pipe is threaded to prevent any flow of liquid passing that point.
- 6.2.3 Used where two pipes are to be connected, both having internal threads.
- 6.2.4 Used to connect two pipes having an external thread on its diameter.
- (4 × 1) (4)
- [9]**

**QUESTION 7: PUMPS**

- 7.1
- Gear pump
  - Helical screw gear pump
  - Herringbone gear pump
  - Screw pump
  - Vane pump
- (Any two) (2)
- 7.2 Reciprocating pumps (1)
- 7.3
- Shaft
  - Impeller
  - Volute casing
- (3)
- [6]**

**QUESTION 8: COMPRESSORS**

- 8.1 A – Inlet valve  
B – Discharge/Outlet valve (2)
- 8.2 The piston moves upwards causing the inlet valve to close and the air is compressed.  
The outlet valve opens and the compressed air is forced out into the air receiver. (2)
- [4]**

**QUESTION 9: V-BELTS, GEAR DRIVES, CHAIN DRIVES AND REDUCTION GEARBOXES**

- 9.1
- They are less noisy.
  - Require no lubrication.
  - Slip occurs to prevent damage to the machine if there is a problem
  - Require little attention.
  - With a multiple V-belt drive the machine may still run when one belt breaks.
- (Any 4 × 1) (4)
- 9.2 A gear drive is referred to as a positive drive because no slip occurs between the gears in mesh. (1)
- 9.3 It has no effect on the velocity ratio. (1)
- 9.4
- Chain pitch
  - The number of teeth per sprocket
  - Distance between the sprockets
  - The arc of contact on the sprockets
- (4)
- 9.5 The main function of a reduction gearbox is to reduce the speed between a motor and the driven part or machine.✓ At the same time a reduction in speed allows for an increase in torque thus allowing heavier loads to be driven.✓ (2)
- [12]**

**TOTAL SECTION A: 60**

**SECTION B**

Answer any TWO of the three questions in SECTION B.

**QUESTION 10: HYDRAULICS AND PNEUMATICS**

- 10.1
- Control valves
  - Cylinder
  - Compressor
  - Tank
  - Piping
  - Service unit (filter, pressure valve and lubricator)
  - Filter with water trap
  - Pressure reducing valve
  - Lubricator
- (Any five) (5)
- 10.2
- Power transmission
  - Lubrication
  - Cooling
- (3)
- 10.3
- Pressure






- Volume

(2)

- 10.4    10.4.1    The reservoir stores hydraulic fluid until it is ready for the operation of the system. ✓  
OR It also dissipates heat.
- 10.4.2    The pressure relief valve protects the system from excessive pressure. ✓
- 10.4.3    The primary function of a control valve is to alert, generate or cancel signals for the purpose of sensing processing and controlling. ✓
- 10.4.4    The actuators change the hydraulic liquid pressure into mechanical movement. ✓
- 10.4.5    Piping is necessary to channel fluid under pressure from the pump to the actuators. ✓

(5 × 1)

(5)

- 10.5    10.5.1    
- 10.5.2    
- 10.5.3    
- 10.5.4    
- 10.5.5    

(5 × 1)

(5)

**QUESTION 11: CENTRE LATHES**

- 11.1
  - Fixed steady
  - Travelling steady (2)
- 11.2    11.2.1    Expanding mandrel
- 11.2.2    Cone mandrel
- 11.2.3    Screw mandrel (3 × 1) (3)
- 11.3
  - Long tapers can be turned.
  - A cross-slide can be automatically fed. (2)

11.4  $S = \pi DN$

$$D = \frac{S}{\pi \times N} \checkmark$$

$$= \frac{95}{\pi \times 2100} \checkmark$$

$$\underline{D = 0,0144 \text{ m}} \checkmark$$

OR

$$\underline{D = 14,4 \text{ mm}}$$

(3)

11.5 11.5.1  $\text{Lead} = \text{No. of starts} \times \text{Pitch of thread}$   
 $= 2 \times 14$

$$\underline{\text{Lead} = 28 \text{ mm}} \checkmark$$

$$\text{Mean diameter (Dm)} = \text{Outside diameter} - \text{Depth}$$

$$= \text{Outside diameter} - \frac{\text{Pitch}}{2}$$

$$= 56 - \frac{14}{2} \checkmark$$

$$= 56 - 7$$

$$\underline{\text{Mean diameter (Dm)} = 49 \text{ mm}} \checkmark$$

$$\tan \theta = \frac{\text{Lead}}{\pi Dm}$$

$$\tan \theta = \frac{28}{\pi \times 49}$$

$$\theta = \tan^{-1} 0,18189$$

$$\underline{\theta = 10^\circ 19'} \checkmark$$

(4)

11.5.2  $\text{Leading tool angle} = 90^\circ - (\text{Helix angle} + \text{Clearance angle})$   
 $= 90^\circ - (10^\circ 19' + 3^\circ) \checkmark$   
 $= 90^\circ - 13^\circ 19'$

$$\underline{\text{Leading tool angle} = 76^\circ 19'} \checkmark$$

(2)

11.5.3  $\text{Following tool angle} = 90^\circ + (\text{Helix angle} - \text{Clearance angle})$   
 $= 90^\circ + (10^\circ 19' - 3^\circ) \checkmark$   
 $= 90^\circ + 7^\circ 19'$

$$\underline{\text{Following tool angle} = 97^\circ 19'} \checkmark$$

(2)

11.6	11.6.1	Absolute programming		
	11.6.2	Incremental programming	(2 × 1)	(2)
				<b>[20]</b>

**QUESTION 12: MILLING MACHINES AND SURFACE GRINDERS**

12.1	An index pin is used to turn the spindle through the worm gearing			(1)
12.2	12.2.1	A – Helical cutter B – Slitting cutter C – Side-and-face cutter		(3)
	12.2.2	A – A helical cutter is used for slab milling. B – A slitting cutter is used for cutting material to length or cutting narrow grooves or slots. C – A side-and-face cutter is used for cutting slots and used in pairs for straddle milling.		(3)
12.3	$Indexing = \frac{40}{N}$ $= \frac{40}{18}$ $= 2 \frac{4}{18} \checkmark$ $= 2 \left[ \frac{4}{18} \times \frac{3}{3} \right]$ $= 2 \frac{12}{54} \checkmark$ <p><i>Indexing = 2 full turns of the crank handle and 12 holes in a 54 hole plate✓</i></p>			(3)



12.4  $V = \pi DN$

$$N = \frac{V}{\pi D} \checkmark$$

$$= \frac{25}{\pi \times 0,075} \checkmark$$

$$N = 106,103 \text{ r/min} \checkmark$$

$$f = f_t \times T \times N$$

$$= 0,08 \times 14 \times 106,103 \checkmark$$

$$f = 118,836 \text{ mm/min} \checkmark \quad (5)$$

- 12.5
- The dividing head divides the circumference of a work-piece equally into a number of parts.
  - It also holds the work-piece in the required position while work is done. (2)

- 12.6
- Wider cutters may be used
  - Deeper cuts may be taken at once
  - Less power is required (3)
- [20]**

**TOTAL SECTION B: 40**  
**GRAND TOTAL: 100**