higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

FITTING AND MACHINING THEORY N2

7 February 2022

This marking guideline consists of 9 pages.

SECTION A

QUESTION 1: OCCUPATIONAL SAFETY

1.1

- Do not allow cylinders to slide or come into contact with sharp edges.
- Cylinders may be rolled but not dragged.
- Do not drop cylinders or allow it to come into violent contact with each other or with other hard objects.
- Never load or offload cylinders with electromagnetic cranes or chain slings. A cage or lifting basket, made especially for the task, should be used.
- Do not tamper with the safety devices on valves.
- Do not use cylinders as roller beds for moving heavy articles.
- Use a special cylinder trolley or hand truck where possible.
- Mark empty cylinders by using chalk or any other marking material to distinguish between empty cylinders and full cylinders.
- Always handle cylinders as if it is full.
- Remove pressure regulators and equipment and replace valve guards before transporting cylinders.
- Use warm, but not boiling, water to free frozen valves as the fusible plug on acetylene cylinders melt at boiling temperature of water.
- Store cylinders containing oxygen away from flammable products.
- Store cylinders in well-ventilated areas and away from direct heat/sunlight.
- Keep empty and full cylinders apart.
- Secure cylinders with a chain or in racks in an upright position.

(Any 5 × 1) **[5]**

OR

1.2

- Do not leave any item that can cause a fire near any combustible materials.
- Calcium carbide is not to be taken underground unless it is in a water-tight container and authorised by the manager.
- Do not leave calcium carbide underground.
- The installation, operation and construction of a machine must not cause dangerous heat.
- Do not smoke in mines, cages, skips or lifts and elevator cars.
- No welding, flame cutting or flame heating may take place without precautionary measures such as the availability of fire extinguishers, etc.
- No waste material of a combustible nature may be stored anywhere in quantities sufficient to create a fire hazard.

(Any 5 × 1) **[5]**

QUESTION 2: COUPLINGS

2.1 2.1.1 Spider coupling

2.1.2 Flexible coupling

2.1.3 Rubber spider

(3 × 1) (3)

2.1 2.2.1 Rigid/Permanent/Fixed coupling

2.2.2 Flexible coupling

2.2 2.2.3 Self-aligning coupling

(3 × 1) (3)

[6]

QUESTION 3: LIMITS AND FITS

3.1 In a hole-basis system, the size of the hole is kept standard and the required fit is obtained by varying the size of the shaft✓ whereas in a shaft-basis system, the size of the shaft is kept standard and the required fit is obtained by varying the size of the hole.✓ (2)

3.2
- Clearance fits
- Interference fits
- Transition fits

(3)

3.3 3.3.1 Tolerance is the total allowable variance in dimensions between high limit and the low limit.

3.3.2 Basic size is the dimension to which a part should ideally be manufactured.

(2 × 1) (2)

[7]

QUESTION 4: BEARINGS

4.1
- Ball
- Spherical
- Cylindrical
- Needle
- Taper

(Any 3 × 1) (3)

4.2 4.2.1 Load capacity is the ability of a material to withstand the pressure it experiences under loaded conditions.

4.2.2 Conformability is the ability of the bearing material to adapt to irregularities in the shape of the mating parts during the running-in process.

(2 × 1) (2)
[5]

QUESTION 5: LUBRICATION AND VALVES

5.1 5.1.1 Viscosity is the resistance to flow or internal friction offered by a lubricant and commonly regarded as its fluid thickness.

5.1.2 Cohesion is the ability of the molecules of a lubricant to stick together.

(2 × 1) (2)

5.2 A butterfly valve consists of a circular disc that rotates about its diameter in a flow passage operated by a lever✓. The disc is rotated to the closed position to shut off the flow or to control the flow of fluid.✓ (2)

5.3 A rubber diaphragm is moved down by a screw on a metal plate✓ to shut off the flow completely or to control the flow of fluid.✓ (2)
[6]

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

6.1
- Plastic pipes are relatively cheap
- They are easy to handle
- No machining is required on plastic pipes
- Plastic is corrosion resistant
- Joining of plastic pipes is easy
- Plastic pipes are good insulators when used with electricity

(Any 4 × 1) (4)

6.2
- Butt- and strap- joint
- Fillet welded joint
- Screwed joint
- Flanged joint

(4 × 1) (4)

6.3 A stuffing box prevents gas or liquid in a cylinder from escaping past the piston rod (1)
[9]

QUESTION 7: PUMPS

7.1 A pump is a mechanical device used to transport a fluid from one location to another. (1)

7.2 7.2.1 Reciprocating pumps (1)

7.2.2 A – Inlet/Intake valve

B – Inside Packing/Packing valve

C – Discharge/Outlet valve

D – Plunger

(4 × 1) (4)
[6]

QUESTION 8: COMPRESSORS

8.1 Air receiver/tank

8.2 Pressure gauge

8.3 Drain valve/Cock

8.4 Draining water/removing moisture from the receiver

(4 × 1) **[4]**

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

9.1
- Do not repair a chain drive while the machine is in motion.
- Never use a new chain on worn-out sprockets.
- Make sure that the chain drives are lubricated at all times.
- Check chain elongation and replace links to take up the slack before they break.
- Fit covers around chain drives.
- Ensure that shafts and sprockets are aligned to prevent damage.

(Any 3 × 1) (3)

9.2
- Single-reduction gearbox
- Double-reduction gearbox
- Worm and worm-wheel gearbox (3)

9.3
- Protects workers working on and around the machine
- Prevents dirt from entering the drive
- Allows for adequate lubrication during operation (3)

9.4 9.4.1 Portion of the pulley that is in contact with the belt along its circumference

9.4.2 Length of the belt measured along the effective pitch line of the V belt

9.4.3 The ratio of the rotational speeds of the driven pulley to the driving pulley.

(3 × 1) (3)
[12]

TOTAL SECTION A: 60

SECTION B

QUESTION 10: HYDRAULIC AND PNUEMATICS

10.1
- Hydraulic motor
- Pressure-relief valve
- Reservoir
- Electric motor
- Pressure gauge
- Check/Non-return valve
- Hydraulic pump
- Actuator
- Piping
- Directional control valves

(Any 2 × 1) (2)

10.2 10.2.1 Piping channels the fluid under pressure from the pump to the components.

10.2.2 The pump provides mechanical energy to the hydraulic fluid.

10.2.3 The actuator converts hydraulic liquid pressure into mechanical movement.

10.2.4 The reservoir stores the hydraulic fluid in the system until it is required.

(4 × 1) (4)

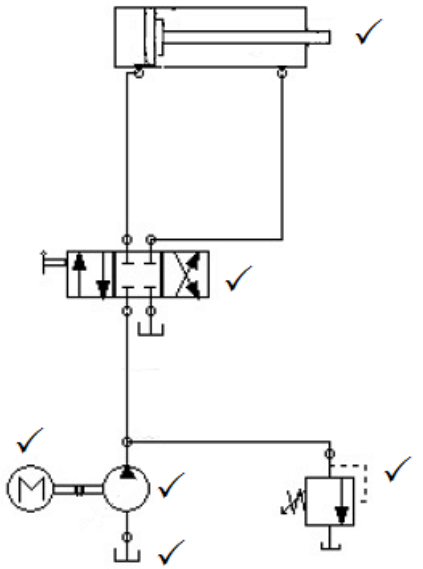
10.3
- Pressure✓ in Pascals (Pa)✓
- Area✓ in square metres (m^2)✓ (4)

10.4
- Directional control valves (4)

- Regulator valve
- Pressure relief/Safety valve
- Sequence valve
- Non-return/Check valve
- Flow-control valve

(Any 4 × 1)

10.5



(ONE mark per component)
(Any correct drawing) (6)
[20]

QUESTION 11: CENTRE LATHE

11.1 Computerised numerical control (1)

11.2
- Material type
- Specific information from drawing
- Types of operations to be performed
- Sequence of operations to be performed
- Tools required
- Coolant application
- Cutting speed

(Any 5 × 1) (5)

11.3
- No setting up is required.
- Work-pieces are easily mounted and dismounted.
- Setting is simple.
- External turning is true to internal turning.
- They can accommodate a large variety of work-pieces.
- Large quantities of similar work-pieces can be produced easily.

(Any 4 × 1) (4)

11.4
- Supporting long, slender work-pieces between centres

- Maintaining concentricity of long work-pieces while machining
- Reducing vibration or chatter, ensuring a better finish of the work-piece
- Supporting work-pieces against the pressure of heavy machining (4)

(4 × 1)

11.5 11.5.1 $\text{Lead} = \text{Number of starts} \times \text{pitch of thread}$

$= 2 \times 10$

$= 20 \text{ mm}$✓

$\text{Mean diameter (Dm)} = \text{Outside diameter} - \frac{\text{pitch}}{2}$

$= 70 - \frac{10}{2}$

$= 65 \text{ mm}$✓

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

$= \frac{20}{\pi \times 65}$

$= 0{,}0979$ ✓

$\theta = 5{,}59°$ ✓ (4)

11.5.2 Leading angle = 90 – (helix angle + clearance angle)

= 90 – (5,59 + 3)

= 81,41° ✓ (1)

11.5.3 Following angle = 90 + (helix angle – clearance angle)

= 90 + (5,59 – 3)

= 92,59° ✓ (1)

[20]

QUESTION 12: MILLING MACHINES AND SURFACE GRINDERS

12.1 12.1.1 Dividing head (1)

12.1.2 It divides the circumference of a workpiece equally into the required number of parts. (1)

12.1.3 A – Index plate
B – Crank handle
C – Sector arms
(3 × 1) (3)

12.2 Indexing = $\frac{N}{9}$

$= \frac{65}{9}$ ✓

$= 7\frac{2}{9}$ ✓

$= 4\left[\frac{2}{9} \times \frac{6}{6}\right]$ ✓

$= 7\ \frac{12}{54}$ ✓

Indexing = 7 full turns of the crank handle and 12 holes in a 54 hole circle ✓ (5)

12.3 12.3.1 Indexing is the process in which a work-piece rotates✓ in such a way that a number of equally spaced divisions can be machined✓.

12.3.2 It is a slot machined on a work-piece✓ and does not go all the way through the work-piece.✓
(2 × 2) (4)

12.4
- Reciprocating table
- Rotating table (2)

12.5
- Dirty coolant
- Dirt underneath the wheel guard
- Grinding wheel too soft
- Incorrect wheel dressing
- Workpiece sliding off the magnetic chuck

(Any 4 × 1) (4)
[20]

TOTAL SECTION B: 40

GRAND TOTAL: 100