higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

MECHANOTECHNICS N4

26 JULY 2018

This marking guideline consists of 12 pages.

QUESTION 1

1.1
- Handling of workpieces✓
  Mechanised hoisting apparatus must be used to handle heavy workpieces during machining.✓

- Space around and above each machine✓
  Sufficient space around each machine is essential so that the operator can work unhindered. Provision must also be made for sufficient space above each machine to allow free movement of overhead hoisting apparatus (cranes) to handle workpieces.✓

- Transport route and aisles✓
  Transport route and aisles should not be used to store materials and they should always be kept open for the safe transport of materials and workpieces. Transport route and passages must be clearly marked and wide enough for the movement, handling and conveying of equipment.✓

- Carrying capacity of the floor✓
  Workshop floors must be reinforced to safely carry the weight of extremely heavy machinery. Floor areas where heavy cranes are used must be sufficiently reinforced to carry the additional burden.✓

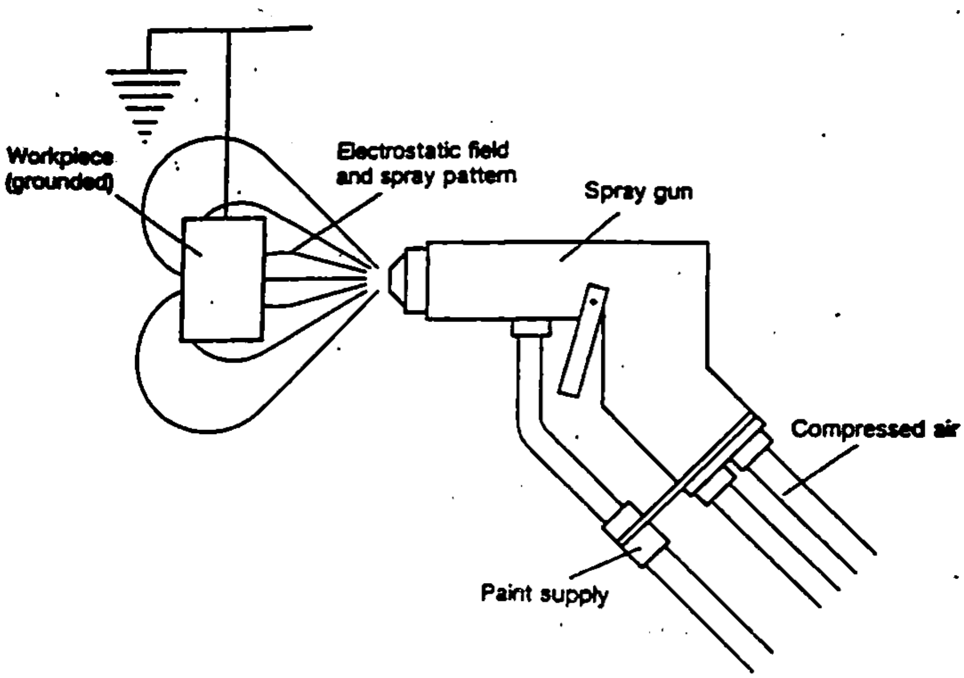
- Supply of services✓
  Supply routes and service points for electricity, water, gas, steam and compressed air must be within easy reach and should not obstruct the hoisting and conveying of workpieces. Supply routes and service points should preferably be housed in ducts in the floor or walls and should be protected by steel covers.✓

- Storage facilities✓
  Suitable storage facilities in the form of containers for workpieces before and after machining must be placed at convenient places near the machine so that the operator can reach them for placing workpieces into them or taking them out.✓ (Any 5 × 2) (10)

1.2
- Rolling bearings have lower torque resistance.
- They require less lubrication.
- They require very little maintenance.
- Rolling bearings can take heavy overloads for short periods.
- They give a warning by becoming noisy when they begin to fail.
- Rolling bearings can be pre-packed and sealed with a lubricant.
- Some rolling bearings can support both radial and axial loads.
- They are easy to replace.
- They can maintain high rotational speed.
- They require little axial space. (Any 5 × 1) (5)

1.3
- Insufficient lubrication
- Polluted oil which may cause wear
- The wrong type and grade of lubrication
- Excessive loading or too high working speed
- The bearing and the shaft are out of line.
- The bearing halves are pulled too tight.
- The bearing housing is not seated properly.
- The shaft upon which the bearing is mounted, is not completely round.
- The bearing surface is uneven. (Any 5 × 1) (5)

1.4 1.4.1



Sketch = 2
Any FOUR labelling = 4 (6)

1.4.2
- There are no problems with overlapping layers.
- The wrap-around effect is only possible with this method.
- There is less wastage of paint when compared to air spray painting and airless spray painting. (Any 2 × 1) (2)

1.4.3
- The capacity is lower than that of other methods.
- The costs are higher than that of other methods.
- Uneven surfaces are more difficult to spray than with air spray painting and airless spray painting. (Any 2 × 1) (2)

[30]

QUESTION 2

2.1 $$T_1 = \frac{\delta}{1} xA$$

= 350 000 × 0,0015

T1 = 525 N

$$\frac{T_1}{T_2} = 2,5$$

$$T_2 = \frac{T_1}{2,5} \checkmark$$

$$= \frac{525}{2,5} \checkmark$$

$$T_2 = 210\ N \checkmark$$

$$v = \frac{\pi(D+t)N}{60}$$

$$= \frac{\pi(1,5+0,006)150}{60} \checkmark$$

$$v = 11,828\ m/s \checkmark$$

$$P = (T_1 - T_2)v$$

$$= (525 - 210)11,828 \checkmark$$

$$P = 3725,82\ W \checkmark$$

(10)

2.2 $$L = \frac{\pi}{2}(D-d) + \frac{(D-d)^2}{4C} + 2C$$

$$= \frac{\pi}{2}(1,5+0,5) + \frac{(1,5-0,5)^2}{4 \times 2} + 2 \times 2 \checkmark$$

$$= 7,267\ m \checkmark$$

(2)

2.3 $$L = \frac{\pi}{2}(D+d) + \frac{(D+d)^2}{4C} + 2C$$

$$= \frac{\pi}{2}(1,5+0,5) + \frac{(1,5+0,5)^2}{4 \times 2} + 2 \times 2 \checkmark$$

$$= 7,642\ m \checkmark$$

(2)
[14]

QUESTION 3

3.1 3.1.1

$$A = depth\ x\ \ feed$$
$$= 5 \times 0{,}5$$
$$= 2{,}5\ mm^2 \checkmark$$
$$P = \frac{F}{A}$$
$$= \frac{2\ 500}{2{,}5} \checkmark$$
$$= 1\ 000\ N/mm^2 \checkmark$$

(3)

3.1.2

$$v = \frac{\pi.D.N}{60}$$
$$= \frac{\pi \times 0{,}25 \times 200}{60}$$
$$= 2{,}618\ m/s \checkmark$$
$$P = Fxv$$
$$= 2\ 500 \times 2{,}618 \checkmark$$
$$= 6545\ W$$
$$= 6{,}545\ kW \checkmark$$

(3)

3.1.3

$$\eta\ = \frac{P_o}{P_i}$$
$$P_{in} = \frac{P_o}{\eta}$$
$$= \frac{6545}{0{,}8} \checkmark$$
$$= 8\ 181{,}25 W$$
$$= 8{,}181\ kW \checkmark$$

(2)

3.2 3.2.1

$$T_{mach} = Fxr$$
$$= 800 \times \frac{0{,}25}{2} \checkmark$$
$$= 100\ N.m \checkmark$$

(2)

3.2.2 $T_{mach} = T_u + T_{avail}$

$$T_{avail} = T_{mach} - T_u$$
$$= 100 - 8 \checkmark$$
$$= 92\ N.m \checkmark$$

(2)

3.2.3 $T_{mach} = Fxr$

$$F = \frac{T}{r}$$
$$= \frac{92}{0{,}0575} \checkmark$$
$$F = 1\,600\ N \checkmark$$

(2)
[14]

QUESTION 4

4.1

$$d_o = d_e + 0{,}65P$$

$$= 30 + 0{,}65(3{,}5)\ \checkmark$$

$$d_o = 32{,}275\ mm\ \checkmark$$

$$d\ = 0{,}577P$$

$$= 0{,}577 \times 3{,}5\ \checkmark$$

$$d\ = 2{,}0195\ mm\ \checkmark$$

$$w = d_o + 3d - 1{,}515P$$

$$= 32{,}275 + 392{,}0195 - 1{,}515(3{,}2)\ \checkmark$$

$$w = 33{,}031\ mm\ \checkmark$$

(6)

4.2 4.2.1 *Step 1*

Set the vertical scale of the vernier caliper to the calculated chordal height.✓

Step 2

Place the vernier caliper over the tooth to be measured.✓

Step 3

Close the horizontal scale until it touches the gear firmly. Take the reading and compare it with the chordal width you have calculated.

$$w = \frac{\pi m}{2}.\cos^2\theta.\ \checkmark$$

(3)

4.2.2

$$w = \frac{\pi m}{2}.\cos^2\theta$$

$$= \frac{\pi \times 10}{2}.(\cos\ \ 20)^2\ \checkmark$$

$$w = 13{,}872\ mm\ \checkmark$$

$$h = m\ \ [1\frac{\pi}{4}(\sin\theta.\cos\theta)]$$

$$h = 10\ \ [1\frac{\pi}{4}(\sin 20° \times \cos 20°)]\ \checkmark\checkmark$$

$$= 7{,}425\ mm\ \checkmark$$

(5)

[14]

QUESTION 5

5.1

CONDITION	GEAR A	GEAR S	GEAR P	ARM D
Fix arm D and rotate gear A by +1 rev.	$+1$ ✓	$\frac{T_A}{T_P} \times \frac{T_P}{T_S}$ $\frac{100}{+30} \times \frac{+30}{40} = \ 2{,}5$ ✓	$\frac{T_A}{T_P} = \frac{+100}{+30}$ $= 3{,}333$ ✓	0 ✓
Multiply by x and add y	$x + y$ ✓	$-2{,}5x + y$ ✓	$3{,}333x + y$ ✓	$+y$ ✓
$N_S = ?$ $N_A = 0\ r/\min$ $N_D = +30\ r/\min$	$N_A = 0\ r/\min$ ✓	$N_S = ?$ ✓		$N_D = +30\ r/\min$ ✓
$N_A = ?$ $N_S = 0\ r/\min$ $N_D = +30\ r/\min$	$N_A = ?$ ✓	$N_S = 0\ r/\min$ ✓		$N_D = +30\ r/\min$ ✓

$x + y = 0 \ldots\ldots\ldots\ldots 1$ ✓

$y = 30 \ldots\ldots\ldots\ldots\ldots 2$

substitute ...2 *in* 1

$x + y = 0$

$x + 30 = 0$

$x = -30$ ✓

$-2{,}5x + y = N_S$

$N_S = -2{,}5(-30) + 30$

$N_S = +105\ r/\min$ ✓

(9)

5.2 $y = 30 \ldots\ldots\ldots\ldots\ldots 1$

$2{,}5x + y = 0 \ldots\ldots\ldots 2$ ✓

$substitute \quad \ldots 1 \quad in \quad \ldots. 2$

$2{,}5x + 30 = 0$

$2{,}5x = \quad 30$

$x = \dfrac{30}{2{,}5}$

$x = 12$ ✓

$N_A = x + y$

$N_A = 12 + 30$ ✓

$N_A = +\,42\ r/\min$ ✓

(5)
[14]

QUESTION 6

6.1

$$h_f = \frac{4 \times f \times l \times v^2}{2 \times g \times d}$$

$$h_f = \frac{4 \times 0{,}005 \times 50 \times (2{,}5)^2}{2 \times 9{,}81 \times 0{,}025} \checkmark$$

$$= 12{,}742\ m \checkmark$$

$$h_f = \frac{k \times l \times v^2}{m}$$

$$m = \frac{d}{4}$$

$$= \frac{0{,}025}{4}$$

$$= 0{,}00625 \checkmark$$

$$c^2 = \frac{2g}{f}$$

$$= \frac{2 \times 9{,}81}{0{,}005}$$

$$= 3\,924 \checkmark$$

$$v = c\sqrt{mi}$$

$$v^2 = c^2 \times m \times i$$

$$i = \frac{v^2}{c^2 m}$$

$$i = \frac{(2{,}5)^2}{3\,924 \times 0{,}00625}$$

$$= 0{,}255 \checkmark$$

$$v^2 = \frac{mi}{k}$$

$$k = \frac{mi}{v^2}$$

$$= \frac{0{,}00625 \times 0{,}255}{(2{,}5)^2} \checkmark$$

$$k = 2{,}548 \times 10^{\ 4} \checkmark$$

$$h_f = \frac{k \times l \times v^2}{m}$$

$$= \frac{2{,}548 \times 10^{\ 4} \div 50 \times (2{,}5)^2}{0{,}00625} \checkmark$$

$$h_f = 12{,}742\ m \checkmark$$

(9)

ALTERNATIVE METHOD

$$V = C\sqrt{mi}$$

$$C = \sqrt{2 \times g/f}$$

$$C = \sqrt{2 \times 9{,}81/0{,}005}$$

$$C = 62{,}64$$

$$m = \frac{d}{4}$$

$$m = \frac{0{,}025}{4}$$

$$m = 0{,}00625$$

$$v^2/c2 = \frac{0{,}00625 \times Hf}{l}$$

$$h_f = \frac{2{,}5 \times 2{,}5 \times 50}{62{,}64 \times 62{,}64 \times 0{,}00625}$$

$$h_f = 12{,}742\ m$$

6.2

$$h_f = \frac{f \times l \times Q^2}{3{,}026 \times d^5}$$

$$h_f = \frac{p}{Rho \times g}$$

$$h_f = \frac{50 \times 10^3}{10^3 \times 9{,}81} \checkmark$$

$$= 5{,}097m \checkmark$$

$$f = \frac{h_f \times 3{,}026 \times d^5}{l \times Q^2}$$

$$= \frac{5{,}097 \times 3{,}026 \times (0{,}075)^5}{30 \times (0{,}015)^2} \checkmark\checkmark$$

$$= 0{,}0054 \checkmark$$

(5)
[14]

TOTAL: 100