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**NATIONAL CERTIFICATE**

**FITTING AND MACHINING THEORY N2**

**April 2020**

**6**

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



**MARKING GUIDELINE**

-2-

**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.

* + 1. Used where the outside diameter of a pipe is threaded to prevent any flow of liquid passing that point.

* + 1. Used where two pipes are to be connected, both having internal threads.

* + 1. 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)

* 1. Reciprocating pumps (1)

* 1. • 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)

* 1. A gear drive is referred to as a positive drive because no slip occurs between

the gears in mesh. (1)

* 1. It has no effect on the velocity ratio. (1)

* 1. • 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.

* + 1. The pressure relief valve protects the system from excessive pressure. 

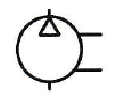
* + 1. The primary function of a control valve is to alert, generate or cancel signals for the purpose of sensing processing and controlling. 

* + 1. The actuators change the hydraulic liquid pressure into mechanical movement. 

* + 1. 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

* + 1. Cone mandrel
    2. Screw mandrel

(3 × 1) (3)

11.3 • Long tapers can be turned.

* A cross-slide can be automatically fed. (2)

11.4 𝑆𝑆 = 𝜋𝜋𝜋𝜋𝜋𝜋

𝑆𝑆

# 𝜋𝜋 = 

𝜋𝜋×𝑁𝑁

95

= 𝜋𝜋 × 2 100

𝜋𝜋 = 0,0144 𝑚𝑚

OR

## 𝜋𝜋 = 14,4 𝑚𝑚𝑚𝑚 (3)

11.5 11.5.1 𝐿𝐿𝐿𝐿𝐿𝐿𝐿𝐿 = 𝜋𝜋𝑁𝑁. 𝑁𝑁𝑜𝑜 𝑠𝑠𝑠𝑠𝐿𝐿𝑠𝑠𝑠𝑠𝑠𝑠 × 𝑃𝑃𝑃𝑃𝑠𝑠𝑃𝑃ℎ 𝑁𝑁𝑜𝑜 𝑠𝑠ℎ𝑠𝑠𝐿𝐿𝐿𝐿𝐿𝐿

= 2 × 14

## 𝐿𝐿𝐿𝐿𝐿𝐿𝐿𝐿 = 28 𝑚𝑚𝑚𝑚 

𝑀𝑀𝐿𝐿𝐿𝐿𝑀𝑀 𝐿𝐿𝑃𝑃𝐿𝐿𝑚𝑚𝐿𝐿𝑠𝑠𝐿𝐿𝑠𝑠 (𝜋𝜋𝑚𝑚) = 𝑂𝑂𝑂𝑂𝑠𝑠𝑠𝑠𝑃𝑃𝐿𝐿𝐿𝐿 𝐿𝐿𝑃𝑃𝐿𝐿𝑚𝑚𝐿𝐿𝑠𝑠𝐿𝐿𝑠𝑠 − 𝜋𝜋𝐿𝐿𝐷𝐷𝑠𝑠ℎ

𝑃𝑃𝑃𝑃𝑠𝑠𝑃𝑃ℎ

= 𝑂𝑂𝑂𝑂𝑠𝑠𝑠𝑠𝑃𝑃𝐿𝐿𝐿𝐿 𝐿𝐿𝑃𝑃𝐿𝐿𝑚𝑚𝐿𝐿𝑠𝑠𝐿𝐿𝑠𝑠 − 2

# = 56 − 

= 56 − 7

## 𝑀𝑀𝐿𝐿𝐿𝐿𝑀𝑀 𝐿𝐿𝑃𝑃𝐿𝐿𝑚𝑚𝐿𝐿𝑠𝑠𝐿𝐿𝑠𝑠 (𝜋𝜋𝑚𝑚) = 49 𝑚𝑚𝑚𝑚 

𝐿𝐿𝐿𝐿𝐿𝐿𝐿𝐿

tan 𝜃𝜃 =

𝜋𝜋𝜋𝜋𝑚𝑚

28

tan 𝜃𝜃 =

𝜋𝜋 × 49

𝜃𝜃 = 𝑠𝑠𝐿𝐿𝑀𝑀−10,18189

## 𝜃𝜃 = 10° 19′  (4)

11.5.2 𝐿𝐿𝐿𝐿𝐿𝐿𝐿𝐿𝑃𝑃𝑀𝑀𝐿𝐿 𝑠𝑠𝑁𝑁𝑁𝑁𝑡𝑡 𝐿𝐿𝑀𝑀𝐿𝐿𝑡𝑡𝐿𝐿 = 90° − (𝐻𝐻𝐿𝐿𝑡𝑡𝑃𝑃𝐻𝐻 𝐿𝐿𝑀𝑀𝐿𝐿𝑡𝑡𝐿𝐿 + 𝐶𝐶𝑡𝑡𝐿𝐿𝐿𝐿𝑠𝑠𝐿𝐿𝑀𝑀𝑃𝑃𝐿𝐿 𝐿𝐿𝑀𝑀𝐿𝐿𝑡𝑡𝐿𝐿)

= 90° − (10° 19′ + 3°)  = 90° − 13° 19′

## 𝐿𝐿𝐿𝐿𝐿𝐿𝐿𝐿𝑃𝑃𝑀𝑀𝐿𝐿 𝑠𝑠𝑁𝑁𝑁𝑁𝑡𝑡 𝐿𝐿𝑀𝑀𝐿𝐿𝑡𝑡𝐿𝐿 = 76° 19′ 

(2)

11.5.3 𝐹𝐹𝑁𝑁𝑡𝑡𝑡𝑡𝑁𝑁𝐹𝐹𝑃𝑃𝑀𝑀𝐿𝐿 𝑠𝑠𝑁𝑁𝑁𝑁𝑡𝑡 𝐿𝐿𝑀𝑀𝐿𝐿𝑡𝑡𝐿𝐿 = 90° + (𝐻𝐻𝐿𝐿𝑡𝑡𝑃𝑃𝐻𝐻 𝐿𝐿𝑀𝑀𝐿𝐿𝑡𝑡𝐿𝐿 − 𝐶𝐶𝑡𝑡𝐿𝐿𝐿𝐿𝑠𝑠𝐿𝐿𝑀𝑀𝑃𝑃𝐿𝐿 𝐿𝐿𝑀𝑀𝐿𝐿𝑡𝑡𝐿𝐿)

= 90° + (10° 19′ − 3°)  = 90° + 7° 19′

## 𝐹𝐹𝑁𝑁𝑡𝑡𝑡𝑡𝑁𝑁𝐹𝐹𝑃𝑃𝑀𝑀𝐿𝐿 𝑠𝑠𝑁𝑁𝑁𝑁𝑡𝑡 𝐿𝐿𝑀𝑀𝐿𝐿𝑡𝑡𝐿𝐿 = 97° 19′

(2)

11.6 11.6.1 Absolute programming

11.6.2 Incremental programming

(2 × 1) (2)

**[20]**

## **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.

1. – A slitting cutter is used for cutting material to length or cutting narrow grooves or slots.
2. – A side-and-face cutter is used for cutting slots and used in

pairs for straddle milling. (3)

12.3 40

𝐼𝐼𝑀𝑀𝐿𝐿𝐿𝐿𝐻𝐻𝑃𝑃𝑀𝑀𝐿𝐿 =

𝜋𝜋



=



= 2 

4 3

= 2 ×

18 3

|  |  |
| --- | --- |
| 𝐼𝐼𝑀𝑀𝐿𝐿𝐿𝐿𝐻𝐻𝑃𝑃𝑀𝑀𝐿𝐿 = 2 𝑜𝑜𝑂𝑂𝑡𝑡𝑡𝑡 𝑠𝑠𝑂𝑂𝑠𝑠𝑀𝑀𝑠𝑠 𝑁𝑁𝑜𝑜 𝑠𝑠ℎ𝐿𝐿 𝑃𝑃𝑠𝑠𝐿𝐿𝑀𝑀𝑐𝑐 ℎ𝐿𝐿𝑀𝑀𝐿𝐿𝑡𝑡𝐿𝐿 𝐿𝐿𝑀𝑀𝐿𝐿 12 ℎ𝑁𝑁𝑡𝑡𝐿𝐿𝑠𝑠 𝑃𝑃𝑀𝑀 𝐿𝐿 54 ℎ𝑁𝑁𝑡𝑡𝐿𝐿 𝐷𝐷𝑡𝑡𝐿𝐿𝑠𝑠𝐿𝐿 | (3) |

 = 2 

12.4 𝑉𝑉 = 𝜋𝜋𝜋𝜋𝜋𝜋

𝑉𝑉

# 𝜋𝜋 = 

𝜋𝜋𝜋𝜋

25

# = 

𝜋𝜋×0,075

## 𝜋𝜋 = 106,103 𝑠𝑠/𝑚𝑚𝑃𝑃𝑀𝑀

𝑜𝑜 = 𝑜𝑜𝑡𝑡 × 𝑇𝑇 × 𝜋𝜋

= 0,08 × 14 × 106,103 

## 𝑜𝑜 = 118,836 𝑚𝑚𝑚𝑚/𝑚𝑚𝑃𝑃𝑀𝑀  (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**