NATURAL SCIENCE MARKING GUIDELINES

November 2010
FITTING AND MACHINING THEORY N2
11022032

November 2010
PAS-EN MASJINEERTEORIE N2
MARKING GUIDELINE

N2
NOVEMBER

NATIONAL CERTIFICATE

SUBJECT NAME
(Fitting and Machining N2)

November (IX-Paper)
09:00 – 12:00

This marking guideline consists of 8 pages.
DEPARTMENT OF EDUCATION  
REPUBLIC OF SOUTH AFRICA  
NATIONAL CERTIFICATE  
FITTING AND MACHINING THEORY N2  
TIME: 3 HOURS  
MARKS: 100

SECTION A - ALL QUESTIONS ARE TO BE MARKED IN THIS SECTION

QUESTION 1  
OCCUPATIONAL SAFETY

NOTE: Candidates need ONLY QUESTION 1.1 or QUESTION 1.2

<table>
<thead>
<tr>
<th>1.1. Use the correct equipment</th>
<th>(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No person must be in the path or underneath the load during the lifting or moving of a load</td>
<td>(1)</td>
</tr>
<tr>
<td>Do not leave a load unattended — it must rest in a stable condition on a suitable support</td>
<td>(1)</td>
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<tr>
<td>Use equipment within its Safe Working Load (SWL) marked on all mechanical handling equipment</td>
<td>(1)</td>
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<tr>
<td>The load must be less than the SWL</td>
<td>(1)</td>
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<tr>
<td>Only trained personnel in mechanical handling are allowed to use the lifting equipment</td>
<td>(1)</td>
</tr>
<tr>
<td>Standard signals are to be used</td>
<td>(1)</td>
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<tr>
<td>Mechanical handling equipment should be inspected and tested regularly and a register should record the findings (should be done by an authorised person)</td>
<td>(1)</td>
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<tr>
<td>Avoid electrical power lines</td>
<td>(1)</td>
</tr>
<tr>
<td>Wear a hard hat when working overhead</td>
<td>(1)</td>
</tr>
<tr>
<td>Safety devices such as warning bells, sirens should be maintained regularly when dealing with overhead cranes and gantry cranes</td>
<td>(1)</td>
</tr>
</tbody>
</table>

| 1.2.1 False | (1) |
| 1.2.2 True | (1) |
| 1.2.3 True | (1) |
| 1.2.4 False | (1) |
| 1.2.5 True | (1) |

QUESTION 2  
COUPLINGS

| 2.1 Drive flange | (1) | [5] |
### QUESTION 3  LIMITS AND FITS

<p>| | | | | | | |</p>
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</thead>
<tbody>
<tr>
<td>3.1</td>
<td>When the tolerance of size is on ONLY ONE side of the NOMINAL or BASIC Size.</td>
<td>(1)</td>
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<td>3.2</td>
<td>The MAXIMUM allowable difference between TWO mating components, OR The biggest gap between the hole and the shaft.</td>
<td>(4)</td>
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<tr>
<td>3.3</td>
<td>A fit in which the shaft is always LARGER OR SMALLER than the hole diameter while remaining within the limits of tolerance.</td>
<td>(1)</td>
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<tr>
<td>3.4</td>
<td>SHAFT IS KEPT STANDARD OR FIXED - THE HOLE VARIES</td>
<td>(1)</td>
<td></td>
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<tr>
<td>3.5</td>
<td>AN INTERFERENCE FIT - BUSH IS HEATED AND EXPANDS TO FIT SHAFT THEN ALLOWED TO COOL (SHRINKS) - PERMANENT FIT</td>
<td>(1)</td>
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### QUESTION 4  BEARINGS

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<tbody>
<tr>
<td>4.1</td>
<td>EMBEDDABILITY</td>
<td>(5)</td>
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<tr>
<td></td>
<td>COST</td>
<td></td>
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<tr>
<td></td>
<td>THERMAL CONDUCTIVITY</td>
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<td></td>
<td>CONFORMABILITY</td>
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<tr>
<td></td>
<td>LOAD CARRYING CAPACITY</td>
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<tr>
<td></td>
<td>COMPATABILITY</td>
<td></td>
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<tr>
<td></td>
<td>CORROSION RESISTANCE</td>
<td>(MARK EACH)</td>
<td></td>
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<tr>
<td>4.2</td>
<td>Supports the shaft</td>
<td>(2)</td>
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<td></td>
<td>Reduces friction</td>
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<td></td>
<td>Aligns and associated components</td>
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<td></td>
<td>Assists the movement of rotating components</td>
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<td>Reduces the start-up torque</td>
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<td></td>
<td>Assists in reducing power consumption</td>
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### QUESTION 5  LUBRICATION AND VALVES

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<tbody>
<tr>
<td>5.1.1</td>
<td>Glass Bottle-lubricator</td>
<td>(1)</td>
<td></td>
<td></td>
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<tr>
<td>5.1.2</td>
<td>Liquid lubricant</td>
<td>(1)</td>
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<td>5.1.3</td>
<td>The device consists of an inverted glass bottle (1) filled with oil, closed off with a tapered plug (1) that houses a loose fitting needle (1). The lower end of the stopper is fitted into the bearing and it is directed to the lubricated area or journal of shaft. Used on plunger block bearings on shafts rotating at medium speeds (1) under moderate load</td>
<td>(3)</td>
<td></td>
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</table>

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| Condition (1) |
|--------------|---|
| Bottle       | (1) |
| Loose fitting needle | (1) |
| Oil          | (1) |
| Bearing housing | (1) |

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

6.1 ELBOW - TEE-PIECE - SIDE ENTRY ELBOW - SIDE ENTRY TEE - EQUAL CROSS - EQUAL SIDE ENTRY CROSS - SOCKET - REDUCING SOCKET - BARREL NIPPLE (MARK each)

6.2 NYLON (1) GRAPHITE (1)
- ASBESTOS (1) ALUMINUM (1)
- RUBBER (1) WHITE METAL (1)
- NEOPRENE (1) CORK (1)
- COTTON (1)
- TEFLOW (1)
[MARK EACH] (1)

6.3 Heat conditions cause plastic to melt
- UV-light conditions cause plastic to become brittle
- Difficult to repair when broken / cracked
- Cannot be used for most acids (4)

**QUESTION 7**  PUMPS

7.1.1 RECIPROCATING (1)

7.1.2 A DELIVERY (1)
B PUMPING SEALS / STUFFING BOX (1)
C INLET VALVE (1)
D PLUNGER (1) (4)

**QUESTION 8**  COMPRESSORS

8.1 SWITCHES THE COMPRESSOR OFF ELECTRICALLY AFTER THE DESIRED PRESSURE HAS BEEN REACHED
- PREVENTS THE COMPRESSOR FROM BEING OVERWORKED

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8.2 SAFETY VALVE

8.3 BELT ADJUSTMENT AND TENSION
CHECK CRANKCASE OIL-LEVEL
DRAIN WATER FROM RECEIVER
CHECK CONDITION OF BELT
CHECK CUT-OUT PRESSURE ON GAUGE AND RESET
CLEAN FILTERS OR REPLACE

QUESTION 9  V-BELT, GEAR AND CHAIN DRIVES

9.1 - Protect persons working in the vicinity
- Protects the machinery in case of chain breakage
- Contains the lubrication
- Prevents dirt and moisture from entering

9.2.1 DOUBLE PITCH CHAIN DRIVE

9.2.2 A WIDTH ROLLER
B CHAIN PITCH
C ROLLER DIAMETER
D PIN DIAMETER

END OF SECTION A - TOTAL 60 MARKS

SECTION B
CANDIDATES NEED ONLY ANSWER TWO QUESTIONS IN THIS SECTION - SECTION B

QUESTION 10  HYDRAULICS AND PNEUMATICS

10.1 TO PRODUCE NEGATIVE PRESSURE / SUCTION / VACUUM –
Usually used in lift or "pick-up" functions within a pneumatic circuits

10.2.1

10.2.2 dryer

10.2.3 double-acting cylinder

10.2.4 pressure gauge

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10.3 - Electric motor
- Pump
- Actuator
- Filter
- Directional Control Valve
- Pressure Relief Valve
- Accumulator
- Pressure gauge
- Pipes
- Pressure sensor
- Flow control valve
- Pressure reducing valve

10.4 - check oil-level in reservoir
- ensure the environment is free of dirt and dust
- check condition AND replace filter elements regularly
- leaking fittings - REPLACE
- CHECK RELIEF PRESSURE TO GAUGE

10.5 - Controls direction of flow
- Controls the energy of flow
- Opens or closes the path of flow

QUESTION 11  CENTRE LATHES

11.1 - TAILSTOCK SETOVERRIDE
- COMPOUND SLIDE
- TAPER ATTACHMENT

11.2 - WEAR OF THE CENTRE
- TIME TAKEN TO SET UP
- VIBRATION ON THE WORKPIECE AND TOOL
- INACCURATE METHOD; MANY TRIALS REQUIRED (TWO ONLY)

11.3 GROUP MANDREL; SCREW MANDREL; EXPANSION MANDREL;
DOUBLE-ENDED MANDREL; PLAIN/SOLID MANDREL.

11.4 Material type; stock length; information from drawing;
sequence of operation; cutting tools required; dwell, delay or
pause during elements of one cycle; coolant application;
dimensioning or sizes.  1 MARK EACH

11.5 ABSOLUTE PROGRAMMING
This system measures all tool movement from a fixed point, origin or
zero.

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Please turn over
INCREMENTAL PROGRAMMING
This system allows each tool movement to be made with reference to the previous or last position.

11.6

\[ L = f \times N \times t \]

\[ t = \frac{L}{f \times N} \]

\[ = \frac{250}{0.5 \times 199} \]

\[ = 2\text{min 30.7 secs} \]

11.7
- PITCH OF THREAD
- LEAD
- PITCH CIRCUMFERENCE
- PITCH DIAMETER
- OUTSIDE DIAMETER OF THREAD

QUESTION 12
MILLING MACHINES AND SURFACE GRINDERS

12.1
- SLOWER FEED IS NECESSARY
- DIFFICULT TO PREVENT VIBRATION.

12.2.1.1

\[ \frac{40}{N} = \frac{40}{33} \]

\[ N = 33 \]

1 and \(\frac{7}{33}\)

12.2.1.2
The required indexing is therefore 1 and \(\frac{7}{33}\) turns of the crank handle.

12.2.1.3
To calculate \(\frac{7}{33}\) of a turn, we select the 66 hole circle

\[ \frac{7}{33} \times \frac{2}{2} = \frac{14}{66} \]

14 hole circle of side 2 of the Cincinnati index plate

12.2.1.4
1 full turn of the crank handle and 14 holes in a 66 hole circle
12.2.2.1 Use the formula \[ N = \frac{55}{9} \]

12.2.2.2 \[ 55^\circ = \frac{55}{9} = 6 \frac{1}{9} \text{ turns} \]

12.2.2.3 3. 6 full turn of the crank and \(\frac{1}{9}\) of a turn

Selecting the 54 hole circle

\[ \frac{1 \times 6}{2 \times 6} = 54 \]

12.2.2.4 The solution to indexing for 55° is:

6 full turn of the crank and 6 holes in a 54 hole circle using the Cincinnati indexing plate.

12.3.1 END MILLING CUTTER
USED – MILLING THE SIDE SURFACE OF FLAT MATERIALS, SLOTS AND GROOVES/KEYWAYS

12.3.2 SIDE AND FACE CUTTER
- SIDE SURFACES; FACE SURFACES; GROOVED, KEYWAYS; AND USED IN STRADDLE AND GANG MILLING PROCESSES

12.4 - STRAIGHT
- STRAIGHT CUP
- FLARING CUP

12.5 - MATERIAL
- SURFACE AREA
- DEGREE OF PRECISION
- MACHINE CAPACITY

The Cincinnati Dividing Head

<table>
<thead>
<tr>
<th>Side</th>
<th>24</th>
<th>25</th>
<th>28</th>
<th>30</th>
<th>34</th>
<th>37</th>
<th>38</th>
<th>39</th>
<th>41</th>
<th>42</th>
<th>43</th>
</tr>
</thead>
<tbody>
<tr>
<td>Side 1</td>
<td>24</td>
<td>25</td>
<td>28</td>
<td>30</td>
<td>34</td>
<td>37</td>
<td>38</td>
<td>39</td>
<td>41</td>
<td>42</td>
<td>43</td>
</tr>
<tr>
<td>Side 2</td>
<td>46</td>
<td>47</td>
<td>49</td>
<td>51</td>
<td>53</td>
<td>57</td>
<td>58</td>
<td>59</td>
<td>62</td>
<td>66</td>
<td>62</td>
</tr>
</tbody>
</table>

TOTAL SECTION B: GRAND TOTAL: 100