X030/301

NATIONAL QUALIFICATIONS 2007

MONDAY, 4 JUNE
9.00 AM – 12.00 NOON

FABRICATION AND WELDING ENGINEERING
HIGHER

100 marks are allocated to this paper.

The paper is based on a case study.

For this examination candidates should have the following:
(a) Worksheet for Q3(*c*)
(b) Resource Pack including extracts from EN 1011
(c) Drawing instruments.

Candidates should attempt **all** questions.

Marks for each question are shown in brackets after the question.

A candidate who uses a calculator in answering questions must ensure that the method employed and any intermediate steps in the calculation are sufficiently clear in the answer.

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SCOTTISH QUALIFICATIONS AUTHORITY

This paper consists of a case study with questions.

The case study is based on a sketch (Figure 1).

Attempt ALL questions, using the information provided in the Resource Pack where appropriate.

CASE STUDY

Figure 1, on Page 4, illustrates details of a fabricated Portal Knee that has to be manufactured from 10 mm thick carbon steel with a composition as shown in the table below.

Material Composition:

Carbon (C) %	Silicon (Si) %	Manganese (Mn) %	Nickel (Ni) %	Chromium (Cr) %	Molybdenum (Mo) %	Remainder Iron with acceptable limits of impurities
0·2	0·1	1·5	0·15	0·1	0·2	

The welds for the manufacture of the Portal Knee are to be produced in the flat position, with access from both sides, using the Manual Metal Arc (MMA) welding process.

Marks

1. (*a*) Explain why a constant current power source is necessary for the MMA process. **3**

(*b*) Explain why the electrode used in this process is described as being "consumable". **1**

(*c*) State **four** main functions of the coating on an MMA welding electrode. **4**

(8)

2. (*a*) List the information shown by the weld symbol for the joint between web and flanges. **5**

(*b*) Sketch the weld symbol for the welded joint shown at "x" between the two outer flanges "B". **3**

(8)

Marks

3. (*a*) Using the information detailed in the material composition table, calculate the Carbon equivalent for the material used for the manufacture of the Portal Knee. **5**

All steps in the calculation must be shown.

(*b*) Determine the pre-heat temperature, if required, for the weld between the outer flanges "B". **6**

Note: Assume a Hydrogen scale appropriate for a rutile electrode and an arc energy of 1·6 kJ/mm.

All steps must be shown in determining the pre-heat temperature.

(*c*) A partially completed Welding Procedure Qualification Record specification is provided in **Worksheet Q3(*c*)**. Complete this specification for the weld between the outer flanges B by inserting information required in the boxes marked with an asterisk (*). **17**

(28)

4. Produce a planning operations sheet for the manufacture of the Portal Knee. The operations sheet should include information on each of the following:

- correct sequence of operations **5**
- marking out **5**
- cutting and forming processes **8**
- assembly and joining processes **8**
- inspection **4**

and should be appropriately designed. **5**

(35)

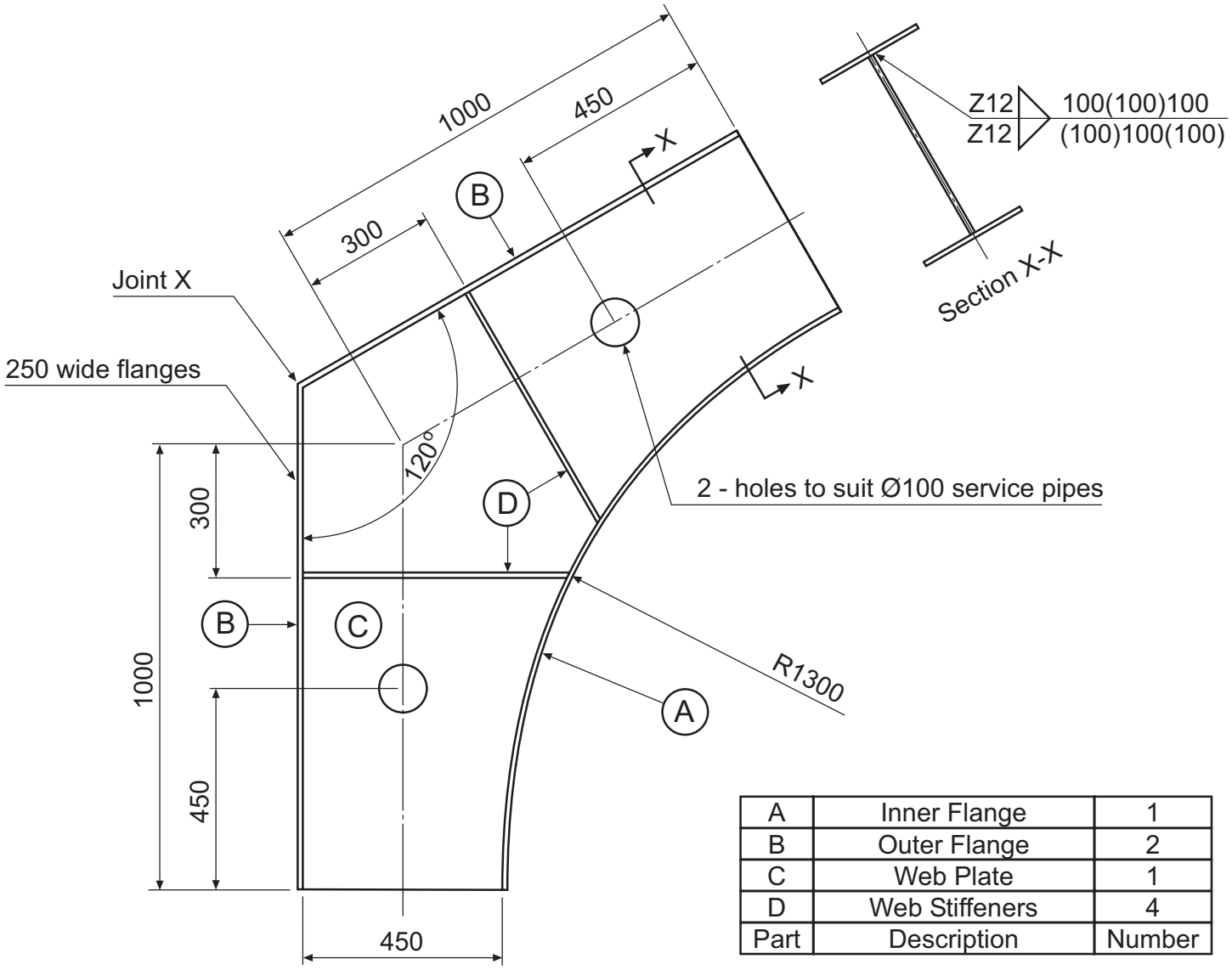
5. (*a*) Sketch the resultant grain structure of the **inner flange "A"** after forming. **5**

(*b*) Describe a suitable heat treatment process for re-establishing a uniform grain structure for inner flange "A" after forming. **4**

(*c*) The welded structure is to be subjected to Magnetic Particle Inspection (MPI) on completion of manufacture. Describe the procedure for this method of testing. **8**

(*d*) Describe **one** method of surface protection used for fabricated structures. **4**

(21)



A	Inner Flange	1
B	Outer Flange	2
C	Web Plate	1
D	Web Stiffeners	4
Part	Description	Number

Figure 1
Note: All plates 10 mm thick

[*END OF QUESTION PAPER*]

FOR OFFICIAL USE

Mark

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HIGHER
Worksheet for Question 3(*c*)

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Date of birth
Day Month Year

Scottish candidate number

Number of seat

To be inserted inside the front cover of the candidate's answer book and returned with it.

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WELDING PROCEDURE QUALIFICATION RECORD (PQR)

Date of issue	June 2007
LR Office	Glasgow
Qualification: Code/Standards	FOR EDUCATIONAL PURPOSES ONLY
PQR Certificate number	SQA 07

PWPS No. SQA 07 Rev.	Date of welding 06-06-2007	Manufacturer's name and address: Easyweld Ltd
Test place/location shop/site: Workshop		
RANGE OF APPROVAL		
Welding process(es): MMA	Single pass/multipass: *	
Joint types(s): Butt/Fillets	Parent metal group(s): 01	Test joint details (sketch with dimensions) of weld preparation: *
Plate thickness range: 5 mm to 20 mm	Pipe outside diameter range: N/A	
Filler metal type/designation: E6013	Heat treatment: N/A	
Gas/flux: *	Type of welding current: AC/DC	
Welding positions: Flat/HV	Progression (up/down): N/A	
WELD AND FILLER METAL DETAILS		
Parent materials: Carbon Steel	Test piece positions: *	
Welding process: MMA	Joint type: *	Bead sequence detail (sketch to include weld metal thickness and back gouging where applicable): *
Filler material: Philarc R	Shielding gas/flux flow rate: N/A	
Make/Type/Diameter: Philarc	Gas composition: N/A	
Composition: Carbon Manganese	Flux type: *	
Other information: None		
Preheat and interpass temperature (method) and control: *		
Postweld heat treatment temperature (method) and control: N/A		

PROCEDURE DETAIL

RUN NUMBER	PROCESS	SIZE OF FILLER MATERIAL	CURRENT A	VOLTAGE V	AC/DC POLARITY	WIRE FEED/ TRAVEL SPEED	HEAT INPUT kJ/mm
1	MMA	2.5	*	22	AC/DC	1.0 mm/sec	1.6
2	MMA	3.2	*	23	AC/DC	1.5 mm/sec	1.5
3 others	MMA	4.0	*	23	AC/DC	1.7 mm/sec	2.0

Date: 06-06-2007	Welder's name: Davie Gordon	WPQ Certificate No.: SQA 07

[*END OF WORKSHEET*]