-SQA- SCOTTISH QUALIFICATIONS AUTHORITY

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NATIONAL CERTIFICATE MODULE DESCRIPTOR

-Module Number- **4281080** **-Session-1990-91**
-Superclass- **YC**

-Title- **GAS DISTRIBUTION: CORROSION CONTROL OF METALLIC GAS PIPES (x $^{1}/_{2}$)**

-DESCRIPTION-

Purpose

This module is designed to develop the knowledge and skills required to protect underground metallic gas pipework from corrosive elements and use pipe coating defect detection equipment to prolong the integrity of the gas distribution system.

It is aimed at those following a career in the distribution sector of the gas industry and receiving complementary industrial experience.

Preferred Entry Level

No formal entry requirements.

Outcomes

The student should:

1. outline the basic principles of corrosion control;
2. construct a protective coating on metallic gas pipes;
3. perform quality control checks on metallic pipe protective coatings;
4. construct and maintain sacrificial anode system.

Assessment Procedures

Acceptable performance in the module will be satisfactory achievement of all the Performance Criteria specified for each Outcome.

Unless otherwise indicated, the student may be assisted by one or more students in carrying out the practical exercises. However, each student in turn must be assessed as being responsible for the completion of the tasks specified.

The following abbreviations are used below:

PC Performance Criteria
IA Instrument of Assessment

Note: The Outcomes and PCs are mandatory and cannot be altered. The IA may be altered by arrangement with SQA. (Where a range of performance is indicated, this should be regarded as an extension of the PCs and is therefore mandatory.)

OUTCOME 1 OUTLINE THE BASIC PRINCIPLES OF CORROSION CONTROL

PCs

(a) The description of the corrosion process of metallic gas pipes is correct in terms of electrical current flow.
(b) The selection of a range of corrosion control methods is correct and in accordance with gas industry requirements.
(c) The description of the types of corrosion liable to occur to metallic gas pipes is correct in terms of:

(i) metal impurity;
(ii) oxygen differentials;
(iii) bi-metals;
(iv) stray currents;
(v) rectifier interference;
(vi) scarred surfaces.

IA Restricted Response

The student will be presented with an exercise consisting of restricted response questions to test comprehension of the basic principles of corrosion control.

The exercise will consist of 5 questions as folllows:

(a)	corrosion process	- 1
(b)	corrosion control methods	- 3
(c)	causes of corrosion	- 1

Satisfactory achievement of the Outcome will be based on all Performance Criteria being met. This will be demonstrated by the student producing one correct response to each of (a) and (c) and two correct responses to (b).

OUTCOME 2 **CONSTRUCT A PROTECTIVE COATING ON METALLIC GAS PIPES**

PCs

(a) The selection for the use of a range of wrapping/coating materials is correct and in accordance with gas industry requirements in terms of:

(i) site conditions;
(ii) conformability over a range of pipe diameters and configuration;
(iii) resistance to mechanical damage;
(iv) chemical and bacteriological resistance;
(v) moisture permeability;
(vi) required kilo volt range protection.

(b) The procedures adopted to paint on protective coatings to control the corrosive process are correct and in accordance with manufacturer's instructions and gas industry requirements.

(c) The procedures adopted to apply a range of pipe coatings are correct and in accordance with manufacturer's instructions and gas industry requirements in terms of:

(i) overlap;
(ii) weather protection;
(iii) preparation of surface to be wrapped;
(iv) temperature control;
(v) specials and bends.

IA Practical Exercise

The student will be set an exercise consisting of a series of practical tasks to test the application of knowledge and skills required to construct a protective coating on metallic gas pipes.

The exercise will consist of 2 tasks allocated as follows:

(i) selection of suitable materials and painting of protective coating
(ii) application of wrapping to metallic gas pipes

For tasks (i) and (ii) the student will be presented with a section of metallic pipework incorporating at least one directional change and one special fitting of length at least 2m and a range of tools and equipment appropriate for the completion of the given tasks.

For tasks (i) and (ii) various wrapping materials and paints shall be available, and the student will be expected to select those most suitable for satisfactory completion of given tasks.

Satisfactory achievement of the Outcome will be demonstrated by the student performing the tasks in accordance with the Performance Criteria above.

OUTCOME 3 **PERFORM QUALITY CONTROL CHECKS ON METALLIC PIPE PROTECTIVE COATINGS**

PCs

(a) The procedures adopted to carry out the inspection and pre-assembly maintenance of holiday detection equipment are in accordance with gas industry requirements in terms of:

(i) spark generation;
(ii) battery checks;
(iii) earth wiring;
(iv) insulated wire tipped brush.

(b) The procedures adopted to identify pipe coating defects are in accordance with manufacturer's instructions and gas industry requirements in terms of holiday detection and Pearson Survey.

(c) The selection and operation of half cell equipment are correct in terms of pipe to soil potential measurement.

IA Practical Exercise

The student will be set an exercise consisting of a series of practical tasks to test the application of knowledge and skills required to perform quality control checks on metallic pipe protective coatings.

The exercise will consist of 3 tasks allocated as folllows:

(i) checking, testing and assembly of 'holiday' detector and inspection of pipeline;
(ii) checking, testing and assembly of Pearson Survey equipment and inspecting of pipeline;
(iii) measuring of pipe to soil potentials.

For tasks (i) and (ii) the student will be presented with a section of metallic pipeline of minimum length 2m for (i) and 50m for (ii) and a range of tools and fittings appropriate for the completion of the given tasks. For task (iii) the student will be presented with a transformer rectifier attached to metallic pipeline and a range of tools and equipment appropriate for the completion of the given task.

Satisfactory achievement of the Outcome will be demonstrated by the student performing the tasks in accordance with the Performance Criteria above.

OUTCOME 4 **CONSTRUCT AND MAINTAIN SACRIFICIAL ANODE SYSTEM**

PCs

(a) The selection and positioning of a range of insulation fittings are correct in terms of gas industry requirements.
(b) The selection for the use of a range of methods to assess soil resistivity is correct and in accordance with gas industry requirements.
(c) The procedures adopted to attach cathodic protection cable to metallic gas pipes are correct and in accordance with gas industry requirements.
(d) The positioning and assembly of sacrificial anodes to metallic gas pipes are correct and in accordance with gas industry requirements.
(e) The monitoring and maintenance of sacrificial anode systems are carried out in accordance with gas industry requirements.

IA Practical Exercise

The student will be set an exercise consisting of a series of practical tasks to test the application of knowledge and skills required to fit insulation fittings and construct a sacrificial anode protection system.

The exercise will consist of 3 tasks as follows:

(i) positioning and fitting of insulators;
(ii) thermite brazing;
(iii) positioning, installing and monitoring of sacrificial anode systems.

For tasks (i) - (iii) the student will be presented with a section of metallic pipework of diameter range 3/4" - 8" and a range of tools, fittings and equipment appropriate for the completion of the given tasks.

Thermite brazing equipment and sacrificial anodes will be made available for use by the student to ensure completion of the tasks (ii) and (iii).

Satisfactory achievement of the Outcome will be demonstrated by the student performing the tasks in accordance with the Performance Criteria above.

The following sections of the descriptor are offered as guidance.
They are not mandatory.

CONTENT/CONTEXT

Safety regulations and safe working practices and procedures should be adhered to at all times.

Corresponding to Outcomes 1-4:

1. The student should understand the corrosion process of metallic gas pipes to include:

   - flow of electric currents;
   - cathodes;
   - anodes;
   - corrosion return paths.

   Factors relating to the control of the corrosion processes on metallic gas pipes to include:

   - wrapping/coating;
   - sacrificial anodes;
   - impressed current methods;
   - electrical insulation.

   The student should show an awareness and recognition of the causes of corrosion to include:

   - metallic contact;
   - differential aeration;
   - soil chemicals;
   - scarred surfaces;
   - bacteria;
   - stress assistance.

   Factors relating to the authorisation of the control of the corrosion of metallic gas pipes to include:

   - British Gas Distribution Codes of Practice;
   - British Gas Engineering Standards.

2. Legislation that may affect the application of protective coatings to metallic gas pipes to include:

   - BGC/PS/CW5; selection and application of field applied external pipework coatings;
   - BGC/PS/PA3; external protection of steel line pipe and fittings;
   - BGC/PS/PA3; spec. for painting at site of new components for long term protection;
   - BGC/PS/PA6; spec. for new and maintenance painting of above ground installations.

Factors relating to the selection of wrapping/coating material to include:

- pipe diameter;
- resistance to mechanical damage;
- durability;
- waterproof;
- electrical qualities.

The student should apply a range of wrapping and coating to metallic pipes taking cognisance of the following:

- percentage overlap;
- weather protection;
- temperature limitations;
- surface preparation.

3. The student should be familiar with the term 'holiday' to include holes, breaks or other discontinuity in the coating on a pipeline.

Factors relating to the inspection and maintenance of holiday detection equipment to include:

- spark generator;
- batteries;
- wiring defects;
- insulation;
- earthing of equipment;
- indicator lamps;
- insulated wire tipped brush.

The student must be aware of the procedures adopted to inspect and identify pipe coating defects using the holiday detector.

Factors relating to the inspection and maintenance of Pearson Survey equipment to include:

- transmitter;
- receiver;
- cleated boots/ski sticks;
- 12v car battery leads;
- transmitter to pipe lead;
- transmitter earth lead;
- aluminium earth rod;
- length of cable;
- headphones;
- belts/markers.

Appreciation of the Pearson Survey transmitter and receiver operation to include adjustment of output and frequency.

The student should be aware of the procedures to be followed to carry out a Pearson Survey on a section of underground metallic gas main.

Appreciation of the operation of equipment used to carry out condition monitoring of gas pipeline to include:

- huskey microcomputer;
- HP85 computer;
- copper/copper sulphate reference electrode;
- timers;
- transformer rectifiers.

4. Factors relating to the selection and position of insulation fittings to include:

- service entry points;
- service pipe to main;
- flanges.

The student should appreciate the methods used to carry out testing of insulation joints and flanges.

The student should be aware of the methods of operation of the Wenner Four Pin equipment to measure the resistivity of the soil surrounding metallic pipelines.

Appreciation of the method of cable attachment to metallic gas mains to include:

- atmosphere checks;
- thermite brazing;
- pipe preparation;
- wrapping of connection.

Factors relating to the selection and fitting of sacrificial anodes to include:

- pipe diameters;
- length of pipe;
- weight of anode;
- anode spacing;
- ground bed dimensions;
- monitoring maintenance.

Appreciation of the methods of calculating the number and life of sacrificial anodes for systems with varying design life.

Operational regulating procedures to include:

- British Gas Engineering Standards;
- British Gas Codes of Practice;
- Regional Distribution Instructions.

SUGGESTED LEARNING AND TEACHING APPROACHES

Outcomes 1-4 could be introduced through formal discussion and then reinforced by workshop practice. Most instruction could be given in a workshop situation supported by practical demonstrations, followed by student participation.

The safety element should be constantly stressed and assessed.

Outcomes should also be achieved by use of:

Film	Outcomes 2 and 3
Slides	Outcomes 1, 2, 3 and 4
Group Discussions	Outcomes 1 and 4
Practical and Simulated exercises	Outcomes 2 and 3
Questionnaires	Outcomes 1, 2, 3 and 4

Adequate time should be allocated to practical and theory sessions with every consideration being given to the subject being taught in proper subject progression.

The individual's contribution to any group activities should be stressed throughout.

It is recommended that a reference manual or handout is made available and issued to the student.