Gas Industry Standard

GIS/EL8:2006

Specification for

The manufacture of gasholder modular antifreeze units

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Foreword

Gas Industry Standards (GIS) are revised, when necessary, by the issue of new editions. Users should ensure that they are in possession of the latest edition. Contractors and other users external to Gas Transporters should direct their requests for copies of a GIS to the department or group responsible for the initial issue of their contract documentation.

Comments and queries regarding the technical content of this document should be directed in the first instance to the contract department of the Gas Transporter responsible for the initial issue of their contract documentation.

This standard calls for the use of procedures that may be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

Compliance with this engineering document does not confer immunity from prosecution for breach of statutory or other legal obligations.

Mandatory and non-mandatory requirements

For the purposes of a GIS the following auxiliary verbs have the meanings indicated:

can indicates a physical possibility;

may indicates an option that is not mandatory;

shall indicates a GIS requirement;

should indicates best practice and is the preferred option. If an alternative method is used then a suitable and sufficient risk assessment needs to be completed to show that the alternative method delivers the same, or better, level of protection.

Disclaimer

This engineering document is provided for use by Gas Transporters and such of their contractors as are obliged by the terms of their contracts to comply with this engineering document. Where this engineering document is used by any other party, it is the responsibility of that party to ensure that the engineering document is correctly applied.

Brief history

First published as GBE/EL8 (previously designated PS/EAF1)	June 1993
Editorial update to reflect demerger November 2000	June 2001
Editorial update to reflect merger October 2002	November 2002
Editorial update to comply with GRM	July 2004
Edited by BSI in accordance with BS 0-3:1997	August 2006
Reviewed on behalf of the Gas Distribution Networks' Technical Standard Forum by BSI	September 2013
Reviewed by TSF	June 2018

Introduction

Modular antifreeze units having a low operating cost and ease of maintenance have been developed by Transco as a means of preventing the freezing of water in gasholder water seals. Two versions have been provided, each with the same performance characteristics which are specified in Annex A.

1 Scope

This Gas Industry Standard specifies the requirements for modular electrical antifreeze units suitable for use in Zone 2 hazardous areas (as defined in BS EN 60079-10) to circulate and heat, as necessary, the water contained in gasholder seal cups.

This standard covers only the manufacture, including works inspection and testing, of one particular type of modular electrical antifreeze unit in two versions to a pre-defined design which has been certified for use in flammable atmospheres.

It does not preclude the use of alternative systems of antifreeze.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Formal standards

BS EN 60079-10, *Electrical apparatus for explosive gas atmospheres — Classification of hazardous areas*.

BS EN 60529, *Specification for degrees of protection provided by enclosures (IP code)*.

3 Construction requirements

3.1 Basic assembly

The modular antifreeze unit comprises an electronic control box to IP 65 conforming to BS EN 60529, an electric motor driven pump, an electric water heater, pressure switches and temperature sensors, all mounted on a fabricated base and having an outer cover to IP 54. The base and outer cover shall be of 1.6 mm stainless steel sheet.

A general arrangement drawing for the modular antifreeze unit is shown in Figure 1. The overall dimensions of the unit are shown and indicate the maximum permitted size. These dimensions shall not be increased without the agreement of the gas transporter.

3.2 Modular antifreeze unit versions

Modular antifreeze units shall conform to either Mark 5B or Mark 6 as specified by the gas transporter.

NOTE Maintenance experience has indicated that the Mark 5B option is the preferred version of gasholder modular antifreeze unit. The Mark 6 option is a simplified version of the Mark 5B, without manual override (mode) switches and without heater supply current monitoring.

3.3 Suitability

Modular antifreeze units shall be suitable for use in zone 2 in accordance with BS EN 60079-10.

NOTE Attention is drawn to European Directive 94/9/EC [1], also known as “ATEX 100a” and “ATEX 95”, and the *Equipment and Protective Systems for Use in Potentially Explosive Atmospheres*. EPS

implements Directive 94/9/EC with minor deviations and together they provide the technical requirements to be applied to equipment intended for use in potentially explosive atmospheres.

4 Antifreeze test unit

A custom made antifreeze test unit shall be provided. The test values and functions on this unit are given in Table 1 and the circuit is shown schematically in Figure 3. The antifreeze test unit includes a band of operation at each switch level to allow for component tolerances.

5 Documentation

The contractor shall provide the following documentation with each modular antifreeze unit:

a) test certificates;

b) quality assurance release note.

6 Marking

Modular antifreeze units conforming to GIS/EL8 shall be permanently marked in 24 gauge stainless steel 304 B letters etc. chemically etched and filled black with the following information:

a) the number and date of this standard, i.e. GIS/EL8:2006 [1)];

b) the name or trademark of the manufacturer or their appointed agent;

c) the manufacturer's contact details;

d) where authorized, the product conformity mark of a third party certification body, e.g. BSI Kitemark.

NOTE Attention is drawn to the advantages of using third party certification of conformance to a standard.

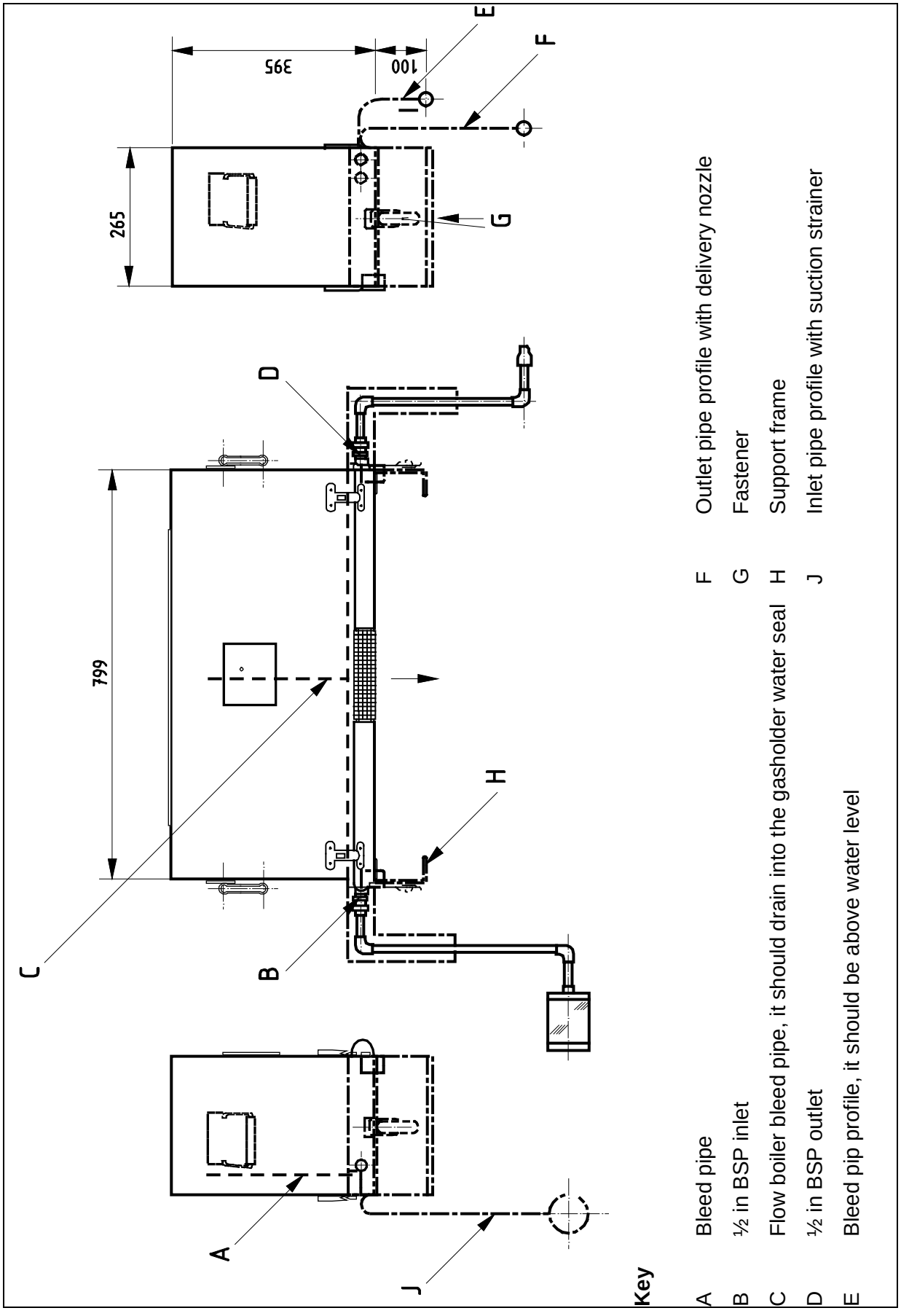
[1)] Marking GIS/EL8:2006 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is therefore solely the responsibility of the person making the claim. Such a declaration is not to be confused with third party certification of conformity, which may also be desirable.

Table 1 — Antifreeze test unit - functional requirements

Switch position	Air sensor (kΩ / °C)	Water sensor (kΩ / °C)	Correct antifreeze module response		
0	10.909 kΩ 2.93 °C	11.5 kΩ 1.88 °C	Unit should 'self test' on power up, (see NOTE 2). After 'self test' and delay period, both pump and heater remain off at this switch position		
1	11.406 kΩ 2.04 °C	11.5 kΩ 1.88 °C	Air sensor above threshold. Pump remains off Water sensor above threshold. Heater remains off		
2	11.453 kΩ 1.96 °C	11.5 kΩ 1.88 °C	Tolerance band for air sensor threshold	Pump may run.	Heater remains off
3	11.509 kΩ 1.86 °C	11.5 kΩ 1.88 °C		Pump may run. This position used for calibration of air sensor threshold	Heater remains off
4	11.548 kΩ 1.79 °C	11.5 kΩ 1.88 °C		Pump shall run.	Heater remains off
5	11.595 kΩ 1.71 °C	12.011 kΩ 1.02 °C	Air sensor below threshold. Water sensor above threshold.		Pump runs Heater off
6	11.595 kΩ 1.71 °C	12.054 kΩ 0.95 °C	Tolerance band for water sensor threshold	Heater may run.	Pump runs
7	11.595 kΩ 1.71 °C	12.11 kΩ 0.85 °C		Heater may run. This position used for calibration of water sensor threshold	Pump runs
8	11.595 kΩ 1.71 °C	12.149 kΩ 0.79 °C		Heater shall run.	Pump runs
9	11.595 kΩ 1.71 °C	12.196 kΩ 0.72 °C	Air sensor below threshold. Water sensor below threshold.		Pump runs Heater runs
10	11.009 kΩ 2.75 °C	12.196 kΩ 0.72 °C	Air sensor above threshold. Water sensor below threshold. Wait 3 min before switching to position 11		Water sensor overrides Heater and pump run
11	11.009 kΩ 2.75 °C	11.6 kΩ 1.7 °C	Air sensor above threshold. Water sensor above threshold.		Pump stops Heater stops Delay lamp lights for 2 min

NOTES

1. Test shall be in correct sequence, turning back to previous position to check does not give valid result.
2. Whenever power is first applied, the antifreeze module enters a self test routine:
   a) Both pump and heater start.
   b) After approximately 2 min heater stops.
   c) After approximately 2.5 min pump stops.
   d) Module enters 'delay' mode for a further 2 min. During this period restart is not possible and testing cannot proceed.
   e) Module returns to normal mode, total time approximately 5 min since power-up.



Key

A	Bleed pipe	F	Outlet pipe profile with delivery nozzle
B	½ in BSP inlet	G	Fastener
C	Flow boiler bleed pipe, it should drain into the gasholder water seal	H	Support frame
D	½ in BSP outlet	J	Inlet pipe profile with suction strainer
E	Bleed pip profile, it should be above water level		

Figure 1a) — Modular antifreeze unit – general arrangement drawing

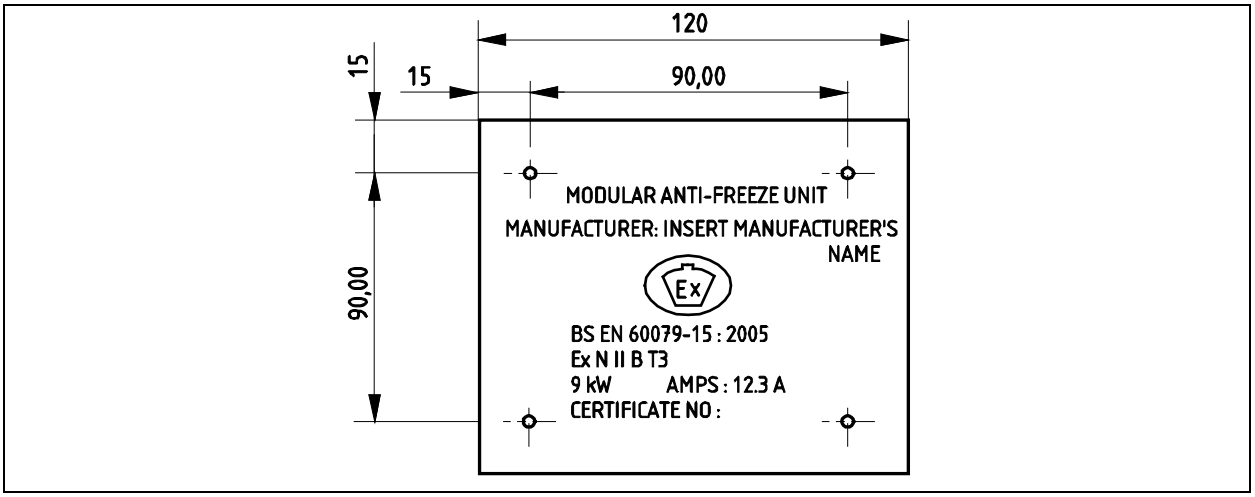


Figure 1b) — Detail of nameplate on modular antifreeze unit

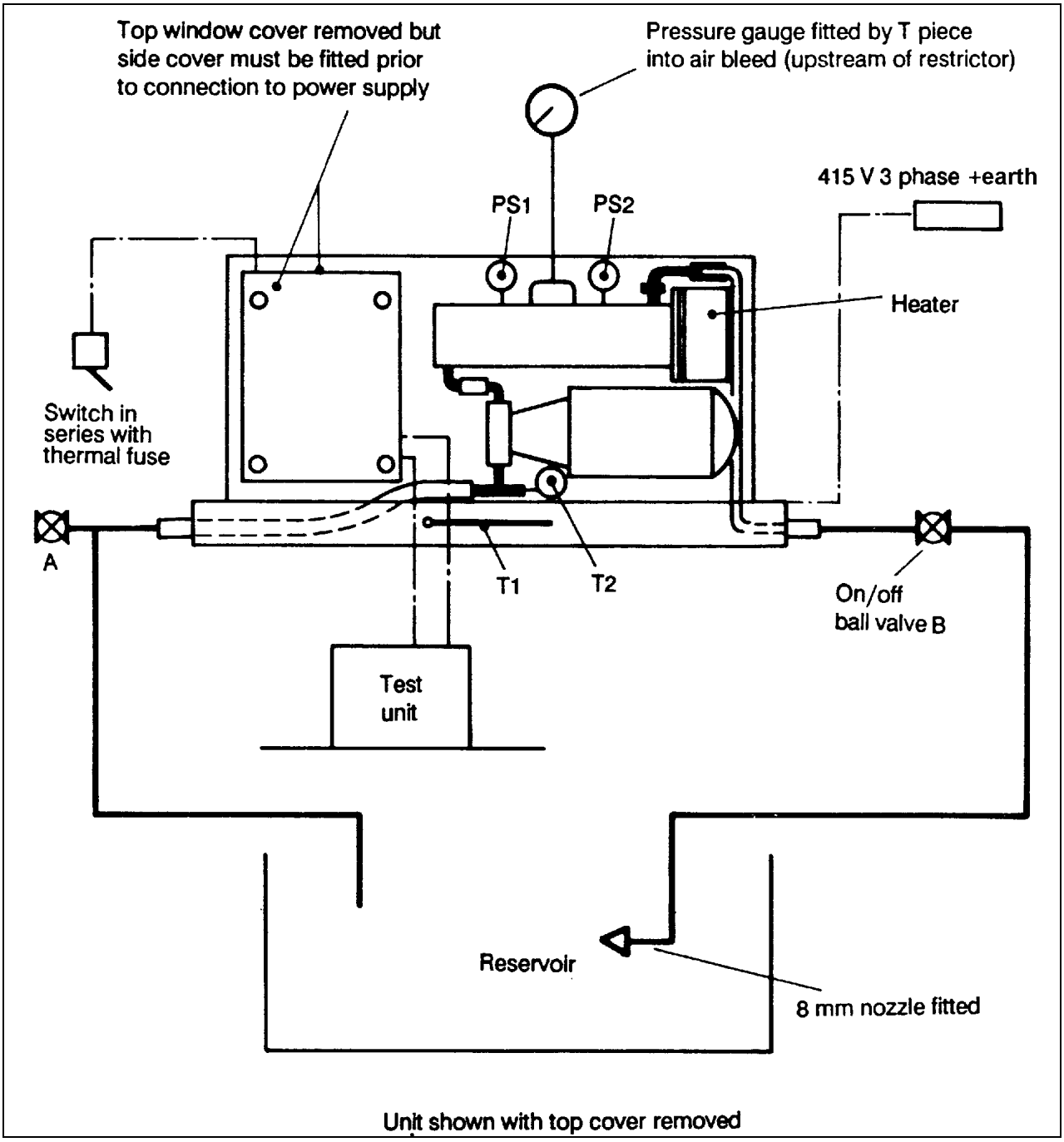


Figure 2 — Antifreeze unit test rig

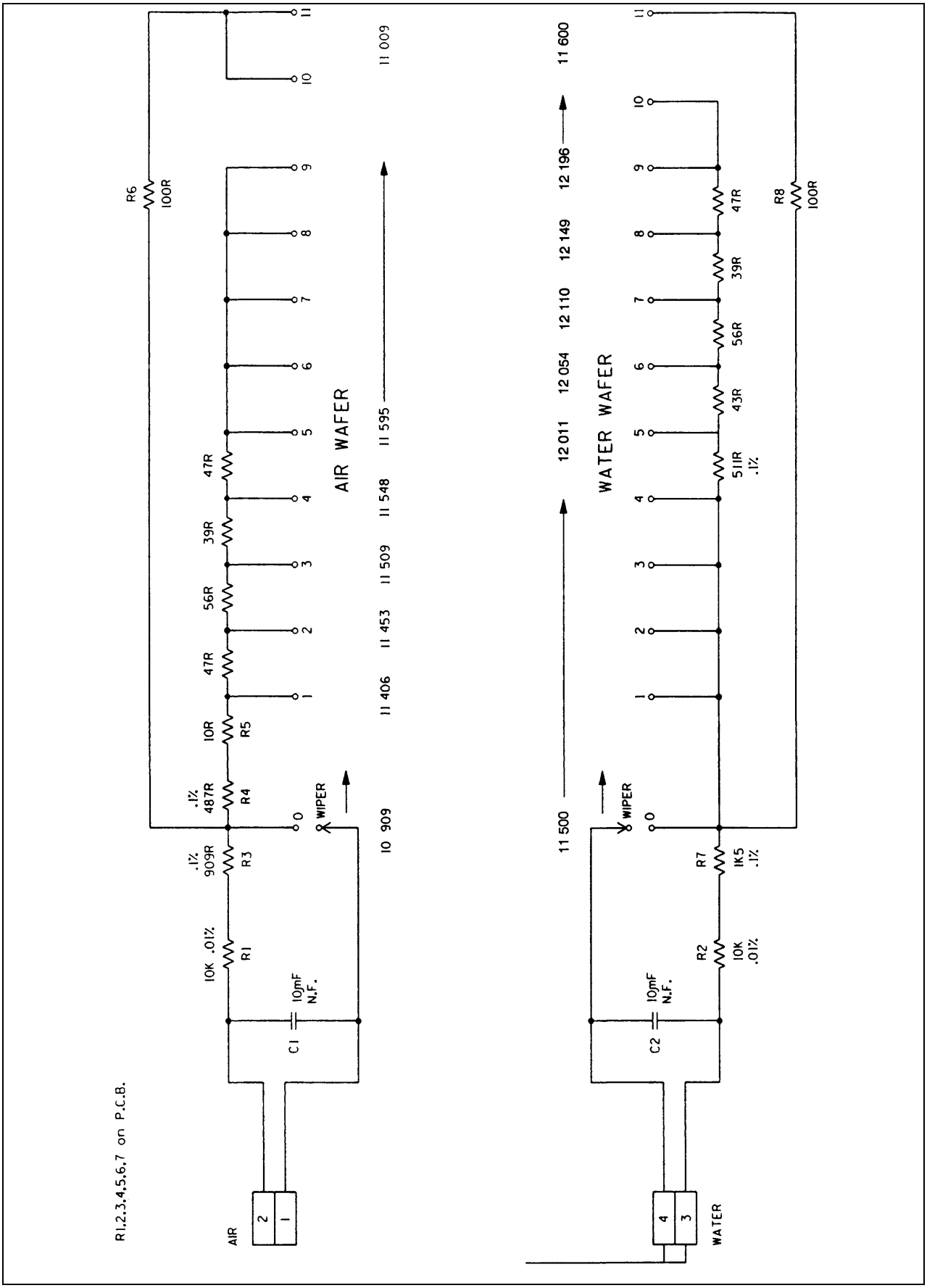


Figure 3 — Antifreeze test unit schematic diagram

Annex A (normative)
Performance characteristics

A.1 General

The performance characteristics detailing the mode of operation and the relevant tolerances are specified in **A.2** to **A.7**.

A.2 Start up

On initial energization, the pump motor starts and the low pressure switch closes on a rising pressure of 138 mbar ± 17 mbar (2 lbf/in^2 ± 0.25 lbf/in^2), indicating water flow, allowing the heater contactor to close. The heater switches off after approximately 2 min and the pump after approximately 2.5 min.

A.3 Falling temperature

When the air temperature sensor registers 1.9 °C ± 0.1 °C, the pump starts.

The heater is energized when the water temperature sensor is registering less than 0.9 °C ± 0.1 °C. The pump starts and continues to run, irrespective of the air temperature whilst the heater is energized.

A.4 Rising temperature

When the water temperature rises above 1.5 °C ± 0.1 °C, the heater switches off.

When the air temperature rises above 2.5 °C ± 0.1 °C and provided the heater is de-energized, the pump stops.

A.5 Low pressure

If a low pump discharge pressure is detected [i.e. less than 138 mbar ± 17 mbar (2 lbf/in^2 ± 0.25 lbf/in^2)] the pump runs on initial start up for 18 s to 24 s and then stops. After approximately 2 min, another start attempt is made automatically and, if unsuccessful, the pump locks out. The system is reset by switching off and then on again.

As an alternative, the unit may provide for six unsuccessful start attempts before the pump locks out.

A.6 High pressure

If a high pump discharge pressure is detected [i.e. greater than 1034 mbar ± 34 mbar (15 lbf/in^2 ± 0.5 lbf/in^2)] the pump stops. After approximately 2 min, the pump restarts. If high pressure is again detected, the pump stops after 18 s to 24 s. Attempts to start are repeated every 2 min without limit.

A.7 Thermal fuse

If the thermal fuse ruptures, the heater is de-energized and locks out. The pump continues to operate under the control of the air temperature sensor.

Annex B (normative)
Works inspection and test

B.1 General

The contractor shall carry out, on each unit unless otherwise specified in this standard, the inspection and test procedure specified in **B.2** to **B.6**.

B.2 Electrical

B.2.1 *Principle*

Low voltage electrical equipment is inspected and tested to ensure that it has been designed and constructed such that it does not present a risk of electric shock or burns when properly installed and used. The electrical insulation properties of the control wiring is determined by undertaking a strength test and an insulation resistance test.

B.2.2 *Apparatus*

B.2.2.1 *Insulation resistance ohmmeter*, 1 000 V.

B.2.2.2 *Applied voltage tester*, 3 750 V.

B.2.3 *Procedure*

B.2.3.1 Before installation of the mercury-wetted relays, apply an electrical strength test at 2 500 V ac rms for 1 min, across each pair of the 3-phase, 415 V terminals of each relay.

B.2.3.2 Visually examine the wiring to ensure conformity with the design and with the latest drawing issue.

B.2.3.3 With the control printed circuit board (PCB) removed and the plug shorted, carry out a 500 V dc insulation test between the 24 V system and the earthed frame.

B.2.3.4 With the control PCB removed, the 24 V system earthed, and with the unit lying on its side, carry out a 1 000 V dc insulation test on the 415 V system between each phase and the earthed frame.

B.2.3.5 Check that the motor overload trip printed circuit card is fitted and that the correct fuses (F) are fitted in the fuseholders as follows:

a) F1,F2,F3 3 A, 480 V (T) Belling Lee or equivalent;

b) F4, F5 Ferraz type E98122, 0.25 A.

B.2.3.6 Fit the control card and the record serial number.

B.2.4 *Expression of results*

Record and report the following:

a) strength test – Ohms;

b) confirm the wiring is correct;

c) insulation resistance test – Ohms;

d) check the correct fuse sizes;

e) record the control card serial number.

B.3 Functional checks

B.3.1 *Principle*

Using the test rig, the modular antifreeze unit is tested to ensure that that the pump performance is correct and that the protection systems operate properly.

B.3.2 *Apparatus*

B.3.2.1 *Antifreeze unit test rig.*

B.3.2.2 *Antifreeze test unit or decade resistance box*.

B.3.2.3 *Stop watch.*

B.3.2.4 *24 V test lamp.*

B.3.3 *Procedure*

B.3.3.1 To carry out functional tests, connect the unit to the test rig as shown in Figure 2.

B.3.3.2 Resistor values may be applied using calibrated potentiometers or using a commercially available antifreeze test unit, (see Clause **4**).

B.3.3.3 Ensure that the phase rotation of the supply is correct, i.e. brown-blue-black.

B.3.3.4 Set the air sensor resistance on the test box to 10.909 kΩ (2.93 °C) and the water sensor resistance to 11.5 kΩ (1.88 °C) or less (switch position 0). When power is applied to the unit, the pump should switch on, followed approximately 15 s later by the heater. Check that the heater is energized. The heater should switch off approximately 15 s before the pump stops. The pump should run for a total of approximately 2.5 min. During this period, the unit output should be greater than 20 l/min. After the pump stops, check that the self draining system operates. The pump and heater switching on and off should be indicated on the circuit board. Check the operation of the elapsed hours meter, if fitted. Disconnect wire 46 at the terminal board. Connect a 24 V test lamp to simulate the heater operation for the remaining tests, avoiding overheating of the test tank water.

B.3.3.5 Wait 2 min after the pump shuts down.

B.3.3.6 Set the air sensor resistance on the test box to 11.548 kΩ (1.79 °C) (switch position 4). Observe pump start up and that the “pump on” light emitting diode (LED) on the control card is illuminated.

B.3.3.7 Set the water sensor resistance on the test box to 12.149 kΩ (0.79 °C) (switch position 8). Observe heater operation and that the “heater on” LED on the control card is illuminated. Allow to run for not less than 2 min.

B.3.3.8 Decrease the air sensor resistance on the test box to 11.009 kΩ (2.75 °C) (switch position 10). The water temperature demand should override the air temperature control and both heater and pump should remain on. Wait 3 min before proceeding to the next test.

B.3.3.9 Decrease the water sensor resistance to 11.6 kΩ (1.7 °C) (switch position 11). Heater and pump should switch off.

B.3.3.10 Wait 2 min after the pump switches off or until the delay LED extinguishes before proceeding to further tests.

B.3.4 *Expression of results*

Record and report the following:

a) the correct phase rotation;

b) heater energization;

c) the time heater switches off prior to the pump;

d) the self-draining system;

e) the correct operation of temperature start/stop functions.

B.4 Test of fault conditions

B.4.1 *Low pressure*

B.4.1.1 *Principle*

Using the test rig, the modular antifreeze unit is tested to ensure that that the pump performance is correct and that the protection systems operate properly.

B.4.1.2 *Apparatus*

B.4.1.2.1 *Antifreeze unit test rig.*

B.4.1.2.2 *Antifreeze test unit or decade resistance box*.

B.4.1.2.3 *Stop watch.*

B.4.1.3 *Procedure.*

Set the air sensor resistance on the test box to 11.548 kΩ (1.79 °C). Set the water sensor resistance on the test box to 11.5 kΩ (1.88 °C) (switch position 4). Open the valve on the inlet line to allow air into the system and check that the pump stops.

Close the valve on the inlet line and the pump should start after 2 min and run normally.

B.4.1.4 *Expression of results*

Record and report the following:

a) whether the pump stops on low pressure;

b) whether the pump restarts on return to correct configuration.

B.4.2 *High pressure*

B.4.2.1 *Principle*

Using the test rig, the modular antifreeze unit is tested to ensure that that the pump performance is correct and that the protection systems operate properly.

B.4.2.2 *Apparatus*

B.4.2.2.1 *Antifreeze unit test rig.*

B.4.2.2.2 *Antifreeze test unit or decade resistance box.*

B.4.2.2.3 *Pressure gauge and "T" piece.*

B.4.2.2.4 *Stop watch.*

B.4.2.3 *Procedure*

With the pump running from the previous test [air sensor set at 11.548 kΩ (1.79 °C)], set the water sensor on the test box to 12.149 kΩ (0.79 °C). This should bring the heater on. Restrict the outlet of the unit by slowly closing the outlet valve. The pressure should increase up to the high pressure limit of (1034 ± 34) mbar (15 ± 0.5 lbf/in^2) at which point the heater and pump should immediately switch off. Open the outlet valve and, after 2 min, the pump and heater should switch on and run normally.

B.4.2.4 *Expression of results*

Record and report the following:

a) whether the heater and pump switch off on high pressure;

b) whether the heater and pump restart on return to the correct flow rate.

B.4.3 ***Thermal fuse ruptured***

B.4.3.1 *Principle*

Using the test rig, the modular antifreeze unit is tested to ensure that that the pump performance is correct and that the protection systems operate properly.

B.4.3.2 *Apparatus*

B.4.3.2.1 *Antifreeze unit test rig.*

B.4.3.2.2 *Antifreeze test unit or decade resistance box*.

B.4.3.2.3 *Toggle switch.*

B.4.3.3 *Procedure.*

With the unit running from the high pressure test (see **B.4.2.3**), open the switch which is in series with the thermal fuse, and the heater “lock out” LED should light and the heater should switch off. This should not affect pump operation and, when the switch is made again, the heater should operate.

B.4.3.4 *Expression of results*

Record and report the following:

a) confirm whether or not the heater lock-out indication functions during simulation of thermal fuse failure;

b) confirm that the pump operation is unaffected.

B.4.4 ***Stalled motor***

B.4.4.1 *Principle*

Using the test rig, the modular antifreeze unit is tested to ensure that that the pump performance is correct and that the protection systems operate properly.

B.4.4.2 *Apparatus*

B.4.4.2.1 *Antifreeze unit test rig.*

B.4.4.2.2 *Antifreeze test unit or decade resistance box.*

B.4.4.2.3 *Stop watch.*

B.4.4.3 *Procedure*

Switch off at the power supply and wait for 2 min. Remove one motor fuse.

Switch the unit on and observe that the pump relay closes but that the motor fails to operate. After 10 s the motor overload trip should operate, illuminating the “motor trip” LED and opening the pump relay.

Switch off, at the power supply, replace the motor fuse and switch on (within 2 min). The “motor trip” LED should light immediately showing that the trip is locked out. The pump should not attempt to start. Switch off, wait for 5 min or more and then switch on. The pump should operate as in normal self test on power-up.

B.4.4.4 *Expression of results*

Record and report the following:

a) confirm whether or not the motor lock-out functions under supply failure condition;

b) confirm after 5 min whether or not the motor returns to normal operation.

B.4.5 ***Pump lock out sequence***

B.4.5.1 *Principle*

Using the test rig, the modular antifreeze unit is tested to ensure that that the pump performance is correct and that the protection systems operate properly. The pump lock-out sequence is tested on a sample of 1 in 10 units.

B.4.5.2 *Apparatus*

B.4.5.2.1 *Antifreeze unit test rig.*

B.4.5.2.2 *Antifreeze test unit or decade resistance box.*

B.4.5.2.3 *Stop watch.*

B.4.5.3 *Procedure*

Switch the unit off at the power supply and remove the motor fuses.

Set the air sensor to 11.548 kΩ (1.79 °C) and set the water sensor to 11.5 kΩ (1.88 °C). (MACS switch position 4). Switch the unit on and the pump relay should close for a period of between 18 s and 24 s and then open. This cycle will be repeated after a 2 min interval (optionally, five further starts at 2 min intervals – see **A.5**), then the unit should lock out with red “pump lock out” LED illuminated, which should remain on until the unit is switched off.

On satisfactory completion of the test, switch off the supply and replace the motor fuses.

B.4.5.4 *Expression of results*

Record and report the following: confirm whether or not the pump lock-out functions after the specified number of restart intervals.

B.5 Full functional cycle test

B.5.1 ***Principle***

Using the test rig, the modular antifreeze unit is tested to ensure that that the pump performance is correct and that the protection systems operate properly.

B.5.2 ***Apparatus***

B.5.2.1 *Antifreeze unit test rig.*

B.5.2.2 *Antifreeze test unit or decade resistance box.*

B.5.3 ***Procedure***

Following the checks and tests specified in **B.2** to **B.4**, carry out a full functional test on each unit, equipped and set ready for delivery and installation, to demonstrate its capability for service under the specified conditions

B.5.4 ***Expression of results***

Record and report the following: confirm the correct full functional test is carried out.

B.6 General inspection

B.6.1 ***Principle***

Using the test rig, the modular antifreeze unit is tested to ensure that that the pump performance is correct and that the protection systems operate properly.

B.6.2 ***Apparatus***

B.6.2.1 *Antifreeze unit test rig.*

B.6.2.2 *Antifreeze test unit or decade resistance box.*

B.6.3 ***Procedure***

B.6.3.1 Check all joints for leakage during high pressure running test. Leakage of air into the suction side piping is indicated by bubbles in the internal, transparent plastics piping on the outlet side.

B.6.3.2 Check that all fixings are tight and that all cable runs are neat.

B.6.3.3 Check that the thermal fuse has been fitted.

B.6.3.4 Check that labels are fitted.

B.6.3.5 Check that all covers are fitted and tightened down.

B.6.4 ***Expression of results***

Record and report the following: confirm that unit meets a satisfactory general inspection in accordance with **B.6.3**.

Bibliography

[1] EUROPEAN COMMUNITIES. Directive 94/9/EC of the European Parliament and the Council of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres. Luxembourg: Office for Official Publications of the European Communities.

[2] GREAT BRITAIN. Equipment and Protective Systems For use in potentially Explosive Atmospheres. SI 1996 No 192. London:TSO.