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Project: **Cryogenic test of a thermal insulation system utilising AF/Armaflex intended for use on low temperature pipework and a thermal acoustic system utilising an Arma-Chek Sound system.**
Client: **Armacell UK Limited**

Office: **Southampton Office**

Clients Order Number: **PJ/OFF/LNG06L**

Date: **16 May 2006**

Order Status: **Complete**

Inspection Dates

First: **28 April 2006**

Final: **05 May 2006**

This certificate is issued to **Armacell UK Limited**

to certify that, at their request, the undersigned surveyor did attend the premises of Southampton University, Cryogenic Department for the purpose of witnessing testing upon:

3m Length Stainless steel pipe ASTM 312 grade 304L 169mm dia. Sch. 40S.
Arranged with means of introduction and venting of liquid nitrogen for cooling.
Insulated with Armacell system comprising:
One off layer AF/Armaflex wall thickness 32 ± 1mm.
One off layer aluminium foil of 60µ thickness (50mm overlap).
One off further layer AF/Armaflex wall thickness 32 ± 1mm.
One off layer Armacheck -R 1.0mm thickness.
All layers glue assembled with Armaflex 520 contact adhesive
(The first layer of insulation was made loose on the pipe and not bonded to it).

The insulation system was assembled such as to allow for the contraction expected at very low temperature. The materials were assembled such as to eliminate coincidence of joints (i.e. staggered joints). The pipe ends carried the same insulation system bonded to the main pipe insulation.

The insulation system was designed to prevent water vapour ingress and condensation on the metal pipe and insulating material to 51% ambient relative humidity at a pipe temperature of minus 196°C; reached by introduction of liquid nitrogen to the pipe at one end and venting it at the other.

The assembly was installed with thermocouples (T type) in order to determine steady state thermal conditions and indicate inter layer and ambient temperatures.

Relative humidity was largely uncontrolled and was monitored throughout the test utilising a portable Comark instrument bearing evidence of calibration. At the start of testing relative humidity was 47% and ambient temperature 22°C.

Relative humidity was typically 47% or less for the duration of the test.

Scope

1. Witness construction of the test piece complete verifying the materials, thickness and methods utilised.
2. Witness commencement of the first cooling cycle and satisfactory indication of the thermocouple devices and logging equipment.
3. Monitor further cycles (three off cooling and return to ambient total).
4. Intermediate visual examination of the insulation system for excessive movement or other deterioration
5. Verify steady state condition reached on final cycle warming stage.
6. Witness examination, by dismantling, of the test piece insulation system.

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7. Visual and tactile examination of the dismantled insulation system for physical deterioration.
8. Issue certification.

The construction of the test piece complied with the description given above. All materials were considered to be of Armacell standard manufacture and were marked with relevant identifiers. The generic insulation type and properties were not identified. The results of testing may be considered to relate to the specific Armacell products identified only.

The thermocouple devices and logging equipment were considered to provide suitable indication of steady state condition reached.

The test was considered conducted in a suitably controlled manner. Three off cooling to minus 196°C and warming to ambient (circa. 20°C) temperature cycles were satisfactorily concluded.

From the post temperature cycle examinations made, no deterioration to the insulating system was detected. Additionally no ingress of moisture to the insulation system or at the metal of the pipe itself was detected.

A related test to that above utilising the Arma-Chek Sound noise insulating system by using one layer of 25mm thick Class O Armaflex, 1 layer of 25mm Armafoam Sound 240, two additional layer of 25mm thick Class 0 Armaflex covered with Arma-Chek R Grey 2mm was conducted concurrent to that described above. The Arma-Chek Sound noise insulating system was found not to have been affected (by visual and tactile examination) by the similar temperature cycling regime experienced on this additional section of pipe.



P McKinnon
Surveyor to Lloyd's Register EMEA

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