



Surface Temperature Tests on an LST Fan Convector

BSRIA Report 59569/1 Edition 2
This report supersedes Report 59569/1 dated 29 July 2016

Carried out for
Smiths Environmental Products Ltd.

By Alf Russell

19 October 2016



Surface Temperature Tests on an LST Fan Convectector

Carried out for:

Smiths Environmental Products Ltd.

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PREFACE

This report supersedes Report Number 59569/1 dated 29th July 2016.

The following amendment has been made:

The model name has changed from Caspian Universal 120 to LST Caspian Universal 120.

SUMMARY

A fan assisted LST convector was supplied by Smiths Environmental Products Ltd., and submitted for the assessment of surface temperatures against the NHS Estates guideline 'Safe Hot Water and Surface Temperatures' (1998).

Full details of the tests and product can be found in the main body of this report.

The high fan speed dissipated heat away from the top grille well enough to maintain a grille temperature below 43°C with a water inlet temperature up to 84°C when in 'manual' configuration.

In low fan speed mode, a grille temperature of 43°C is exceeded with a water inlet temperature of 77°C in 'manual' configuration.

With the motorised valve set in LST mode and the normal operating condition established, the grille temperature is maintained below 43°C for a water inlet temperature of at least 86°C.

At both fan speeds, with the unit in normal automatic LST mode, this unit can comply with the NHS Estates health guidance note: 'Safe Hot Water and Surface Temperatures', albeit giving a reduced output compared to a 'manual' test.

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1 INTRODUCTION

A fan assisted LST convector was supplied by Smiths Environmental Products, for assessment against the NHS Estates guideline, 'Safe Hot Water and Surface Temperatures' published 1998. The work was requested by Smiths Environmental Products Ltd. and was carried out during the period 29 June to 5 July 2016.

The sample was received in good condition on 27 June 2016.

This report refers only to the item tested and no others.

2 DESCRIPTION OF SAMPLE

The test sample consisted of a fan assisted LST convector and was supplied by Smiths Environmental Products Ltd.

The sample was designated as follows: LST Caspian Universal 120

The sample was a fan assisted, LST convector, plumbed with top, bottom, same-end connectors, and was the largest size of a 3 model range of common height with varying length.

Further details of the test sample can be found in Appendix A.

3 TEST FACILITY

The test facility consists of a test room 4.0 m (l) x 4.0 m (w) x 3.0 m (h), which is constructed to the requirements contained in BS EN 442-2 : 2014 for radiator testing, i.e. five water cooled surfaces and one insulated surface against which the test radiator is installed.

Usually when steady state conditions are achieved the appliance output is determined from measurements of the water flow rate and inlet/outlet water temperature difference.

A standard rated output test consists of three test points. For all appliances a first test is carried out with a water supply temperature that produces a mean water temperature of 70°C with the water flow rate such that for radiators the inlet/outlet water temperature difference is 10°C. Two further tests are carried out at the water flow rate established in the first test but with different supply water temperatures. For all standard radiator tests the enclosure air temperature is controlled to maintain 20°C at the inner room reference point, which is 0.75 m from the floor in the centre of the room.

In this instance, when in LST mode, the fan convector used four internal sensors to control the operation of an internal 2 port valve and the fan, such that the 2 port valve did not open until water at 35°C+ was present, the heated air did not exceed 43°C and if the air temperature dropped below 32°C the fan shut down to avoid cold draughts. Three sensors had fixed set points and one (leaving air) was adjusted to 39°C. The unit was therefore constantly modulating the output by means of the 2 port valve and did not maintain the 'steady state' that would be required to conduct a standard rated output test. Similarly the position of the 2 port valve and bypass in LST mode meant that while the measured total water flow through the unit remained relatively stable, it was not possible to determine what proportion was going through the coil or the bypass at any one time.

An initial test was therefore conducted with the 2 port valve locked manually open (not LST mode) to obtain an estimate of the flowrate necessary to achieve a nominal 10°C drop with a supply of 86°C, as requested by Smiths with fan set at 'high speed' (8.6VDC). This test was conducted in the manner of a standard rated output test, but outside the normal tolerances used for radiators. This provided a minimum datum flow rate to be used during the tests in LST mode.

The unit was then set to automatic operation, 'low speed' (4.5VDC) with the nominal 86°C supply temperature and the water temperatures, flow rate and surface temperatures logged at 100 second intervals.

4 INSTRUMENTATION

TEST RECORD SHEET TP21/7 : TEST EQUIPMENT / INSTRUMENTS

Contract Number	FM59569A
Test Engineer	Phil Stonard

	Instrument No.	Calibration expiry date
Weigh scales (water flow rate)	2026, 2027	23/03/17
Resistance thermometer (air) reference & radiant shield	329	13/08/16
Resistance thermometers (water) reference	1485 - 1488	21/08/16
Digital logging system (6½ digits)	266	21/08/16
Digital barometer	455	09/12/16
Electronic timer within PC 1	526	21/10/16
Steel rule (0 - 300mm)	218	01/03/17
Retractable steel rule (0-8m)	683	01/03/17
Digital caliper (0 – 300mm)	2057	04/02/18
Spring balance (0 – 100Kg res.)	393	01/04/17

Comments: None

Test Engineer

Phil Stonard

5 TEST RESULTS

TEST REPORT

Date of Test: 29-06-2016
 Manufacturer: Smiths Environmental
 Model Reference: LST Caspian Universal 120
 Test Reference Number: 59569A1PS
 Type of Heater: Fan assisted convector
 Pipework Connections: T.B.S.E.

HEATER DIMENSIONS

Overall Height: (mm) 660
 Overall Length: (mm) 1195
 Overall Depth: (mm) 245
 Convector Height: (mm) 50
 Convector Depth: (mm) 200
 Height above floor: (mm) 110
 Distance from wall: (mm) 0

Radiated heat factor Sk 0.00
 Barometer exponent np 0.40

MEAN TEST VALUES	TEST 1	TEST 2	TEST 3
Room air temperature 0.75m: (°C)	24.5	21.0	24.2
Flow rate (g/s)	78.4	79.1	73.2
Flow enthalpy (J/g)	316.9	233.9	346.1
Return enthalpy (J/g)	250.7	191.6	267.5
Flow temperature (°C)	75.7	55.9	82.7
Return temperature (°C)	59.9	45.8	63.9
Output (W)	5186.7	3350.3	5753.8
Mean water temperature (°C)	67.8	50.8	73.3
Temperature difference (°C)	43.3	29.9	49.1
Barometric pressure (mbar)	1000.4	1001.1	1001.5
Corrected output (W)	5212.7	3366.2	5780.1
Estimated output (W)	5108.1	3383.5	5868.5

PERFORMANCE EQUATION

Output (W) = K_M (mean water temperature - room air temperature) n

From test results $K_M = 78.1764$
 $n = 1.1091$

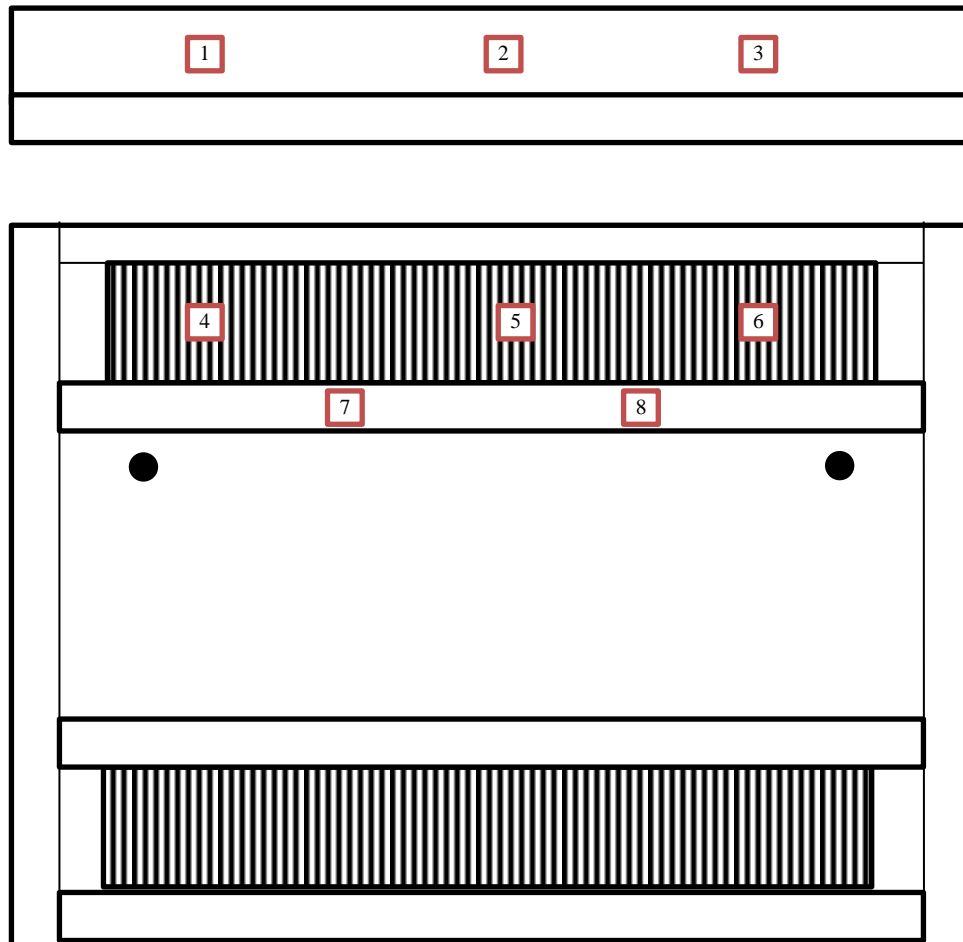
VARIATION OF OUTPUT WITH TEMPERATURE DIFFERENCE

TEMPERATURE DIFFERENCE °C	HEAT OUTPUT W
20	2168
30	3400
40	4677
50	5991
60	7333

Note: Estimated output only. Fan set to high with manual output.
 This extracted test data does not comply with the tolerances set by EN442 or EN16430 and is for manufacturer's guidance only.

5.1 SURFACE TEMPERATURES

Position of surface temperature thermocouples



Note: Drawing not to scale

5.2 RESULTS

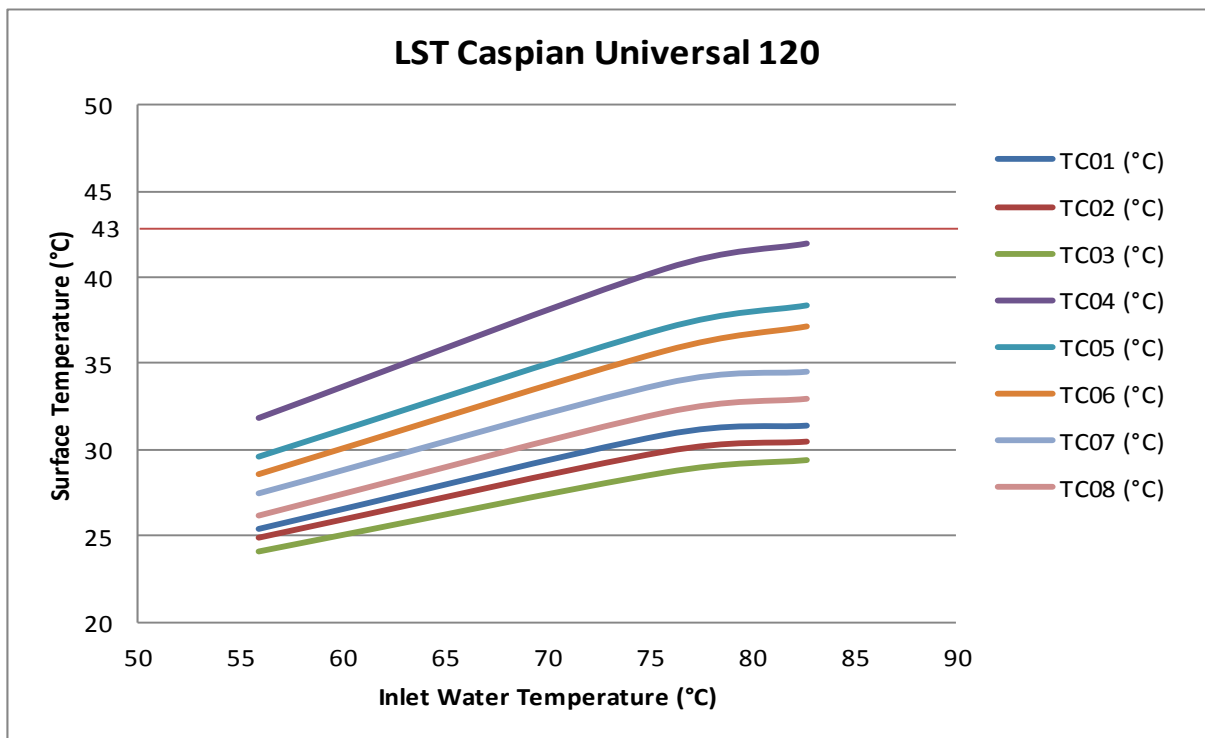
The following chart shows surface temperatures plotted against inlet water flow temperatures with 2 port valves set to 'manual' (open). Tabular data is shown for both 'manual' and LST configurations.

This enables comparison with the NHS Estates Health Guidance Note, "Safe hot water and surface temperatures", which states '...the maximum surface temperature of space heating devices should not exceed 43°C when the system is running at the maximum design output'

Average Surface Temperatures at High Fan Speed (8.6v) (Manual Output)								
	Top Cover			Top Grille			Front below Grille	
Inlet (°C)	TC01 (°C)	TC02 (°C)	TC03 (°C)	TC04 (°C)	TC05 (°C)	TC06 (°C)	TC07 (°C)	TC08 (°C)
55.9	25.4	24.9	24.1	31.8	29.6	28.6	27.5	26.2
75.7	30.9	29.9	28.7	40.5	37.0	35.7	33.8	32.1
82.7	31.4	30.5	29.4	42.0	38.4	37.1	34.5	33.0

Estimated Surface Temperatures for an Input Temperature of 86°C								
	Top Cover			Top Grille			Front below Grille	
Inlet (°C)	TC01 (°C)	TC02 (°C)	TC03 (°C)	TC04 (°C)	TC05 (°C)	TC06 (°C)	TC07 (°C)	TC08 (°C)
86.0	32.6	31.6	30.4	43.8	39.9	38.6	36.0	34.3

Estimated Inlet Water Temperature for a Maximum Surface Temperature of 43°C								
	Top Cover			Top Grille			Front below Grille	
Inlet (°C)	TC01 (°C)	TC02 (°C)	TC03 (°C)	TC04 (°C)	TC05 (°C)	TC06 (°C)	TC07 (°C)	TC08 (°C)
84.0	32.2	31.2	30.0	43.0	39.2	37.9	35.4	33.7



The above chart is based on data from 59569A1PS. This test was run with the fan speed set to high (8.6VDC) and the motorised valve set to manual. The flow rate during this test varied between 73 and 79 g/s. As the LST mode was disabled, this is not for the unit in its normal operating mode, but to establish a target water flow rate for use in subsequent tests.

Two single water temperature tests were conducted with the fan speed set to low, at nominal water inlet temperatures of 77°C and 86°C and in manual and LST mode for comparison.

Single temperature test at $\Delta 50^{\circ}\text{C}$ - Motorised valve on manual, fan set to low (4.6v)								
	Top Cover			Top Grille			Front below Grille	
Inlet ($^{\circ}\text{C}$)	TC01 ($^{\circ}\text{C}$)	TC02 ($^{\circ}\text{C}$)	TC03 ($^{\circ}\text{C}$)	TC04 ($^{\circ}\text{C}$)	TC05 ($^{\circ}\text{C}$)	TC06 ($^{\circ}\text{C}$)	TC07 ($^{\circ}\text{C}$)	TC08 ($^{\circ}\text{C}$)
77.2	34.0	32.6	31.8	48.2	43.4	43.9	38.1	36.2

Single temperature test at 86°C - Motorised valve on auto, fan set to low (4.6v)								
	Top Cover			Top Grille			Front below Grille	
Inlet ($^{\circ}\text{C}$)	TC01 ($^{\circ}\text{C}$)	TC02 ($^{\circ}\text{C}$)	TC03 ($^{\circ}\text{C}$)	TC04 ($^{\circ}\text{C}$)	TC05 ($^{\circ}\text{C}$)	TC06 ($^{\circ}\text{C}$)	TC07 ($^{\circ}\text{C}$)	TC08 ($^{\circ}\text{C}$)
85.9	25.9	24.8	23.8	32.2	29.9	27.4	27.5	25.8

In the first of these two tests the water flow rate was 94 g/s. In the second test the overall water flow rate was 100 g/s. However, as the motorised valve was set to auto on the second test, it was impossible to determine the percentage of water directed through the bypass and emitter, at any one time.

6 CONCLUSION

The high fan speed dissipated heat away from the top grille well enough to maintain a grille temperature below 43°C with a water inlet temperature up to 84°C when in ‘manual’ configuration.

In low fan speed mode, a grille temperature of 43°C is exceeded with a water inlet temperature of 77°C in ‘manual’ configuration.

With the motorised valve set in LST mode and the normal operating condition established, the grille temperature is maintained below 43°C for a water inlet temperature of at least 86°C.

At both fan speeds, with the unit in normal automatic LST mode, this unit can comply with the NHS Estates health guidance note: ‘Safe Hot Water and Surface Temperatures’, albeit giving a reduced output compared to a ‘manual’ test.

The LST Caspian Universal is available in three lengths: model 120 (1195mm), model 90 (895mm) and model 60 (595mm). The model tested was the longest, 1195mm. As these units are identical in every way bar length, it is logical to assume that the surface temperatures, on all three models, would be maintained below 43°C in normal, automatic, operating conditions.

APPENDIX: A TEST ITEMS**TEST RECORD SHEET TP21/1: TEST ITEMS**

Contract number

FM59569A

Sheet number

1 of 1

Date of receipt	Test Engineer initials	Full description of test item	Test item reference number
27/06/2016	PS	A fined tube emitter with two axial fans assembled in a steel case with inlet and outlet grilles. 660 x 1195 x 245mm	59569A1AR

Comments:- Automatic control of LST function by means of 2 port valve & integral sensors.

Test Engineer

Phil Stonard

TEST RECORD SHEET TP21/2 : PRODUCT INFORMATION

BSRIA test reference number		59569A1PS
Client		Smiths Environmental Products Ltd
Manufacturer		Smiths Environmental Products Ltd
Product reference number		LST Caspian Universal 120
Product style		Fan convector
Material of construction		Steel, aluminium and copper tubing
Date of receipt		27/06/2016
Product or packaging markings		Type and size
Test start date		01/07/2016
Weight (dry)	(kg)	N/A
Water content	(kg)	N/A

DIMENSIONAL MEASUREMENTS

Measurement Parameter	Measured value (mm)	Manufacturer's stated value (mm)	EN 442-2 dimensional tolerance	Pass / Fail
Overall height	660			
Overall depth	245			
Overall length	1195		See Comments	
Convector height	44			
Convector depth	203			

Emitter configuration		2 rows, 4 tubes
Emitter overall length	(mm)	1050
Emitter finned length	(mm)	950
Distance between centres	(mm)	20 (row 1 – 2)
Tube diameter	(mm)	22 (connectors)
Emitter height from floor	(mm)	480
Fin thickness	(mm)	0.2
Fin pitch	(mm)	2.4
Additional information		T.B.S.E. with automatic control of LST function by 2 port valve & integral sensors

Comments : Not required for LST surface temperature measurement.

TEST ENGINEER

Phil Stonard

LST Caspian Universal 120

