

TEST REPORT



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SUBJECT:

Fire resistance test on a stainless steel refuse chute hopper with "Superflex" board insulation material submitted by Riben Renovation Contractor.

TESTED FOR:

Riben Renovation Contractor
Blk 928 #01-153
Yishun Central 1
Singapore 760928

Attn: Mr Ricky Tay

DATE SUBMITTED:

14 Jan 2005

DATE OF TEST:

25 Jan 2005

PURPOSE OF TEST:

1. To determine the fire resistance of the specimen when tested in accordance with BS 476 Part 22: 1987 "Methods for Determination of the Fire Resistance of Non-loadbearing Elements of Construction - Determination of the Fire Resistance of un-insulated doorset and shutter assemblies."



LA-2001-0212-A
LA-2001-0213-F
LA-2001-0214-E
LA-2001-0215-B
LA-2001-0216-G
LA-2001-0217-G

The results reported herein have been performed in accordance with the laboratory's terms of accreditation under the Singapore Accreditation Council - Singapore Laboratory Accreditation Scheme

TEST PROCEDURE:

2. Before the commencement of test, the ambient temperature in the general vicinity of the test specimen construction was ensured to be not exceeding 35°C. The datum values for each individual temperature and deflection measurements were also taken not more than 15 minutes before the commencement of test.
3. During the test, with commencement of heating of the specimen, the furnace temperature and pressure were controlled to comply with the requirements specified in BS 476: Part 20: 1987: clause 3.1 and 3.2 respectively. The pressure was controlled such that a linear pressure gradient of 8.5 ± 2 Pa per 1000mm height exist above a neutral pressure axis at a height of approximately 1000mm above the notional floor level. However, the maximum pressure at the top of a vertical test construction shall not exceed 20Pa.
4. Throughout the heating period, the behaviour of the specimen was observed and monitored for compliance with the relevant performance criteria stated in clause 10 of BS 476: Part 20: 1987 (A summary is given in clause 9 of this report.) and the appropriate clause of BS 476: Part 22: 1987.
5. For insulated specimen, the mean temperature on the unexposed face were measured by five number of surface mounted thermocouples, with one placed approximately at the centre of specimen and one at centre of each quadrant. In the presence of stiffener, through member or jointing, the thermocouples were located at least 50mm away.
6. For insulated specimen, the maximum temperature on the unexposed face were measured by thermocouples placed on locations on door frame (one at mid-height on each vertical side member and one at mid-point of each door leaf on the horizontal top member), door leaf (or leaves) or stiffeners which may be hotter than the average on the face. The thermocouples were placed at least 50mm away from edge of door leaf (or leaves), door lockset, or any jointing.
7. Observations, on the behaviour of the test specimen throughout the heating period, were made and recorded. As appropriate, cotton pads, gap gauges and roving thermocouple were used to establish the occurrence of failure.
8. The test was terminated when one or more failures as stated in the performance criteria occurred, or otherwise at a time agreed between the sponsor of test and the test laboratory.



PERFORMANCE CRITERIA:

9. The specimen is assessed against the following test criteria:

9.1 Integrity

Failure shall be deemed to have occurred when one of the following occurs:-

- When collapse or sustained flaming for more than 10 seconds on the unexposed face.
- When the cotton pad test is conducted, flames and/or hot gases causing flaming or glowing of the cotton pad.
- Where the cotton pad test cannot be conducted because of the level of radiation from the specimen, a through gap into furnace exceeding 6mm in width by 150mm in length exists or develops in the specimen.
- When a through gap into furnace exceeding 25mm diameter exists or develops in the specimen.

9.2 Insulation

Failure shall be deemed to have occurred when one of the following occurs:-

- If the mean unexposed face temperature increases by more than 140°C above its initial value.
- If the temperature recorded of at any position on the unexposed face is in excess of 180°C above the initial mean unexposed face temperature.
- When integrity failures occur.



DESCRIPTION OF TEST SPECIMEN:

10. The test specimen consisted of a stainless steel refuse chute hopper with "Superflex" board insulation material, erected onto the test furnace (PSB Asset No: 20009078) with brickwall constructed of ordinary bricks of nominal size of 190 mm x 90 mm x 90 mm, with 2 layers of 90mm (overall 180mm) as the wall thickness, surrounding it. The bulk density of "Superflex" board insulation material was found to be 1412kg/m³. The test was conducted at test laboratory located at PSB Corporation Pte Ltd, 10 Tuas Avenue 10, Singapore 639134.
11. The hopper was mounted with the front cover panel opening away from the furnace. This was taken as representing a more severe fire exposure, as gaps development due to bowing of the door leaves were not concealed by the rebate of the hopper frame.
12. An inspection on the specimen was conducted by a PSB officer to verify on its dimensions and designs. Detail drawings of the hopper as submitted by the sponsor are shown in drawing no. RRC/CHUTE/001 – RRC/CHUTE/009.
13. Erection of the test specimens onto the test furnace was arranged and carried out by Riben Renovation Contractor.
14. The clearances between the Cover and frame were as follows:
 - 14.1 Top side : 1.5 mm
 - 14.2 Left hand vertical side : 1.0 mm
 - 14.3 Right hand vertical side : 1.0 mm



TEST RESULTS:

15. Table 1 shows the temperature rise for the furnace and the standard curve. In addition, the table shows the percentage difference between the area under the standard curve and the area under the furnace curve compared with the percentage tolerance allowable within the standards.
16. Table 2 and 3 show the mean and maximum unexposed face temperature above the initial temperature respectively.
17. Table 4 shows the deflection measured at the mid-height of the specimen.
18. Figure 1 shows the actual time-temperature curve of the furnace in relation to the specified time-temperature curve.
19. Photographs of the test are shown from Plate 1 to 10.
20. Observations were made during the test on the unexposed face of the test specimen and these are given in Appendix 1 of this report.
21. The results only relate to the behaviour of the specimen of the element of construction under the particular conditions of the test. They are not intended to be the sole criteria for assessing the potential fire performance of the element in use nor do they reflect the actual behaviour in fires.

CONCLUSION:

22. The specimen satisfied the requirements of the BS 476: Part 22:1987 for the periods stated below:

Integrity	:	260 minutes
Insulation	:	24 minutes



REMARKS:

23. Integrity

The system remained stable throughout the test. Therefore, the integrity of the specimen meets the standard for 260 minutes.

24. Insulation

At 25 minutes of test, the maximum mean temperature and maximum temperature rise above the initial temperature, measured on the unexposed face of the specimen, were 144.6°C and 161.3°C respectively. As the maximum mean temperature rise above initial temperature were 140.0°C, which exceeded the maximum permissible temperature of 140°C. Therefore, the insulation of the specimen meets the standard for 24 minutes.

WITNESSES:

25. The test was witnessed by the following representatives:

Riben Renovation Contractor	:	Mr Tay Boon Heng
	:	Mr Lee Aik Koon



Goh Cheng Poh
Associate Engineer



Tan Kim Heng
Product Manager
(Fire Safety & Security Products)
Mechanical

Table 1 : Comparison of area under the curve

Time (min)	Temperature rise (°C)		Area under curve (°C min)		Percentage difference (%)	Standard tolerance (±%)
	Standard	Furnace	Standard	Furnace		
05.0	556.4	518.4	2038.1	1909.4	-6.3	15.0
10.0	658.4	661.3	5102.7	4948.9	-3.0	
15.0	718.6	711.2	8554.8	8409.7	-1.7	10.0
30.0	821.8	827.5	20195.3	20055.3	-0.7	
60.0	925.3	931.1	46579.6	46444.0	-0.3	5.0
90.0	986.0	980.6	75310.7	75169.1	-0.2	
180.0	1089.7	1091.8	169252.9	169111.2	-0.1	
240.0	1132.8	1131.9	235991.4	235847.5	-0.1	

Table 2: Unexposed face temperature of the hopper door panel

Time (min)	Thermocouple no.		Mean temp (°C)	Above initial mean temp (°C)	
	100	101		Mean temp	Max. Temp
0.0	28.4	28.5	28.5	-	-
5.0	39.0	41.5	40.3	11.8	13.1
10.0	71.7	74.4	73.1	44.6	46.0
25.0	184.2	162.0	173.1	144.6	155.8

Table 3: Unexposed face temperature of the hopper frame

Time (min)	Thermocouple no.			Max. temp above initial temp (°C)
	102	104	105	
0.0	28.6	28.8	28.3	-
5.0	49.7	33.2	40.5	21.1
10.0	82.9	54.5	57.2	54.3
25.0	189.9	109.4	112.7	161.3

Note:

- The thermocouple points are indicated in drawing no. RRC/CHUTE/001.

Table 4 : Deflection of the door panel towards the furnace.

Time (min)	Measurement of deflection (mm)		
	A	B	C
10.0	-3	-1	-1
20.0	3	2	1
30.0	4	2	4
45.0	3	1	4
60.0	3	0	4
90.0	3	-2	2
120.0	3	-2	2
150.0	3	-2	2
180.0	3	-2	2
240.0	0	-2	2

Note:

1. The measuring points at mid-height are indicated in drawing no. RRC/CHUTE/001.
2. A negative value indicates deflection away from the furnace.



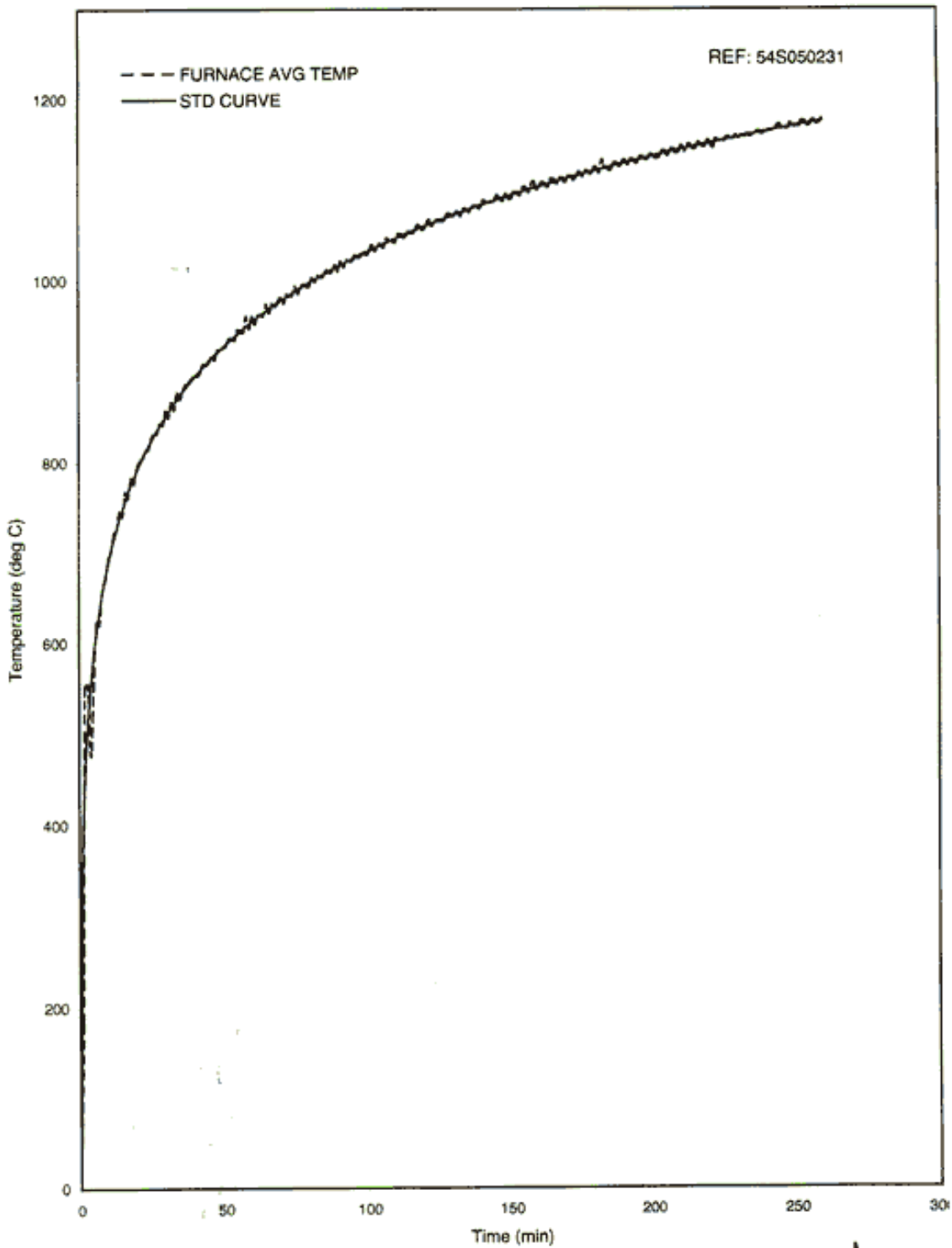


FIGURE 1: FURNACE AVERAGE TEMPERATURE



Plate 1 : The unexposed face of the specimen before the test.



Plate 2 : At about 30 minute of test.

A handwritten signature in black ink, consisting of several loops and a long horizontal stroke.



Plate 3 : At about 62 minute of test.



Plate 4 : At about 90 minute of test.



Plate 5 : At about 127 minute of test.



Plate 6 : At about 151 minute of test.



Plate 7 : At about 180 minute of test.



Plate 8 : At about 210 minute of test.



Plate 9 : At about 240 minute of test.



Plate 10 : At about 260 minutes of test.

APPENDIX 1

Time (min:sec)	Observation on the unexposed face
00:00	Test commenced.
05:00	Door leaf deflected approximately 5mm away from the main frame along the top edge.
13:15	Smoke emission was observed on the specimen.
14:35	Slight discoloration was observed at the top left corner of the main frame.
16:50	Smoke emission was observed at the bottom of the door leaf.
20:02	Discoloration was observed on the meeting edge of the door leaf and left vertical main frame at approximately 100mm away from the top edge of the door leaf.
30:15	Discoloration was observed on the latch handle.
60:00	Integrity remained intact.
72:00	Deflection mentioned at 5 minutes of test increased to approximately 10mm.
84:55	Discoloration was observed on the door leaf.
120:00	Integrity remained intact.
180:00	No significant changes were observed.
260:00	Integrity remained intact. Test was discontinued at the request of the sponsor.



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June 2004