SUBJECT:

Fire resistance test on a stainless steel refuse chute hopper submitted by Riben Renovation Contractor.

TESTED FOR:

Riben Renovation Contractor
Blk 925 #01-247
Yishun Central 1
Singapore 760925

Attn: Mr. Ricky Tay

DATE SUBMITTED:

21 December 2012

DATE OF TEST:

08 January 2013

PURPOSE OF TEST:

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 Loss of 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 an overall size of 533mm (width) x 533mm (height), erected onto the test furnace (PSB Asset No: 20009078) with brickwall constructed of ordinary brick of nominal size 215mm x 140mm x 100mm, with a 215mm overall wall thickness surrounding it. The test was conducted at TÜV SÜD PSB’s fire laboratory located at No. 10, Tuas Avenue 10, Singapore 639134.

11. The test specimen was mounted with the chute panel opening away from the furnace. This was taken as representing a more severe fire exposure, as gaps develop due to bowing of the panel were not concealed by the rebate of the hopper frame.

12. An inspection on the doorset was conducted by a TÜV SÜD PSB’s officer to verify on its dimensions and designs. Detailed drawings of the test specimen submitted by the sponsor of test are shown in drawing no. RS/CHUTE/001 to RS/CHUTE/008.

13. Installation of the test specimen onto the test furnace was arranged and carried out by Riben Renovation Contractor.

14. The unexposed face clearances between the chute panel and frame were as follows:

14.1 Top edge : 2.0 mm
14.2 Vertical edges : 1.0 mm to 2.5 mm
14.3 Bottom edge : 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 shows the deflection measured at mid-height of the specimen.

17. Figure 1 shows the actual time-temperature curve of furnace in relation to the specified time-temperature curve.

18. Photographs of the test are shown in Plates 1 to 4.

19. Observation were made during the test on the unexposed face of the test specimen and these are given in Appendix 1 of this report.

20. 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:

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

- Loss of Integrity : 68 minutes
- Insulation : Not measured (uninsulated system)
REMARKS:

22. Integrity

The specimen remained stable throughout the test. Therefore, the integrity of the specimen meets the standard for 68 minutes.

WITNESSES:

23. The test was witnessed by the following representatives:

Riben Renovation Contractor: Mr. Tay Boon Heng

: Ms. Pong Yen Loo

Rafiq Bin Abdullah

Engineer

Tan Kim Heng

Assistant Vice President
Fire Property
Mechanical Centre
Table 1: Comparison of area under the curve

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>Temperature rise (°C)</th>
<th>Area under curve (°C min)</th>
<th>Percentage difference (%)</th>
<th>Standard tolerance (± %)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standard</td>
<td>Furnace</td>
<td>Standard</td>
<td>Furnace</td>
</tr>
<tr>
<td>05.0</td>
<td>556.4</td>
<td>517.5</td>
<td>2188.1</td>
<td>2286.2</td>
</tr>
<tr>
<td>10.0</td>
<td>658.4</td>
<td>660.3</td>
<td>5402.7</td>
<td>5399.7</td>
</tr>
<tr>
<td>30.0</td>
<td>821.8</td>
<td>813.9</td>
<td>15692.6</td>
<td>15678.6</td>
</tr>
<tr>
<td>60.0</td>
<td>925.3</td>
<td>924.8</td>
<td>27284.3</td>
<td>27272.1</td>
</tr>
</tbody>
</table>

Table 2: Deflection measurement at mid-height of refuse chute hopper

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>Measurement of deflection (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>10.0</td>
<td>-5</td>
</tr>
<tr>
<td>20.0</td>
<td>-5</td>
</tr>
<tr>
<td>30.0</td>
<td>-5</td>
</tr>
<tr>
<td>45.0</td>
<td>-5</td>
</tr>
<tr>
<td>60.0</td>
<td>-5</td>
</tr>
</tbody>
</table>

Notes:
1) The deflection measuring points at mid-height are indicated in drawing no: RS/CHUTE/001.
2) A negative value indicates deflection away from the furnace.
Figure 1: Furnace Average Temperature
Photographs of test

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

Plate 2: At about 30 minutes of test.
Photographs of test (Cont’d)

**Plate 3:** At about 46 minutes of test.

**Plate 4:** At about 68 minutes of test.
Appendix 1

<table>
<thead>
<tr>
<th>Time (min:sec)</th>
<th>Observation on the unexposed face</th>
</tr>
</thead>
<tbody>
<tr>
<td>00:00</td>
<td>Test commenced.</td>
</tr>
<tr>
<td>02:00</td>
<td>Slight smoke emitted from the doorset.</td>
</tr>
<tr>
<td>10:00</td>
<td>Top left corner of chute panel deflected approximately 5mm away from the frame.</td>
</tr>
<tr>
<td>12:00</td>
<td>“Banging” sound was heard.</td>
</tr>
<tr>
<td>15:00</td>
<td>Chute panel distorted.</td>
</tr>
<tr>
<td>20:00</td>
<td>Excessive smoke emitted from the doorset.</td>
</tr>
<tr>
<td>25:00</td>
<td>Slight discolouration occurred on the chute panel.</td>
</tr>
<tr>
<td>30:00</td>
<td>“Banging” sound was heard.</td>
</tr>
<tr>
<td>40:00</td>
<td>Excessive smoke continued to emit from the doorset.</td>
</tr>
<tr>
<td>50:00</td>
<td>No significant changes were seen.</td>
</tr>
<tr>
<td>60:00</td>
<td>Chute panel exhibited a dull glow.</td>
</tr>
<tr>
<td>68:00</td>
<td>Test was discontinued at the request of sponsor.</td>
</tr>
</tbody>
</table>
Test Report No. 7191050685-MEC13-RAH
dated 11 Jan 2013

FULL WELD

GASKET

12 (w) X 4.0 (thk)

DRAWN BY:

CHECKED BY:

RUBBISH CHUTE HOPPER
RUBBISH (003)

CONTRACTOR:

Rhen Romanday Contractor

MATERIAL: SJS 304 2mm THICK

DRAWING TITLE:

QUALIFIED / GASKET
QUALIFIED / GASKET SIGNER

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July 2011