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STANDARD FIRE ENDURANCE TEST PROGRAM

CONDUCTED ON

"SUPER PANEL"
CONCRETE PANELS IN A
NON-LOAD BEARING, UNSYMMETRICAL PARTITION

CLIENT

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REPORT PREPARED BY

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PREFACE

This report describes the tests, standards and details of "Super Panel" panels manufactured by Bed Roc Industries Ltd., as installed for this program.

The product has met the performance requirements to be eligible for a Warnock Hersey certification program. The report does not imply product certification. Product must bear "WHI certification marks" in order to demonstrate Warnock Hersey certification.



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PRETEST INSPECTION

The pretest inspection of "Super Panel" concrete panels was carried out on June 11, 1990 by Mr. John O'Donnell representing Warnock Hersey. The details of the inspection are on file at Warnock Hersey and will be used to form the basis for our follow-up Factory Inspection Program.



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INTRODUCTION

The Fire Laboratories Division of Warnock Hersey conducted full scale fire endurance and hose stream tests on non-loadbearing partition construction utilizing cement board panels manufactured by Bed-Roc Industries Ltd. Since the sheets were located on only one face of the partition, it was unsymmetrical, and three tests were required as follows; July 13, 1990, 60 minute fire endurance and hose stream tests with cement board face exposed, July 18, 1990, 30 minute fire endurance and hose stream tests with cement board face exposed, July 30, 1990, 60 minute fire endurance and hose stream tests with the gypsum wallboard face exposed. Testing was conducted in accordance with CAN4-S101 and ASTM E119 "Standard Method of Fire Endurance Tests of Building Construction and Materials".



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DESCRIPTION

"Bed-Roc" cement board sheets are constructed from a low density concrete mix, reinforced with fiberglass mesh on each side. They are 11 mm (7/16 in.) in thickness, 915 mm (36 in.) in width, and 1524 mm (60 in.) in length. The sheets are most commonly used as substrate for the application of ceramic tile.



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CONSTRUCTION OF TEST PARTITION

Each of the three test walls measured 108 in. in height by 171 in. in length. The wall framing consisted of 20 gauge 3-5/8 in. steel studs spaced 16 in. on centres with 18 gauge steel track top and bottom. One side of the wall was faced with 5/8 in. thick "Type X" gypsum wallboard installed vertically. The wallboard was fastened with 1-1/4 in. long "Type S" drywall screws spaced 8 in. on centres. The joints were taped and filled. The stud cavities were filled with mineral fibre blanket insulation having a thickness of 3-1/2 in. and an average density of 5 lbs. per cubic foot. The remaining side of the test wall was faced with Bed-Roc cement board sheets, installed horizontally, with board ends staggered and fastened with 1.25 in. drywall screws located 8 in. on centres and 2 in. from the board edges. All vertical and horizontal joints were finished with fibreglass tape, imbedded in thin tile set mortar. A finish coat of mortar was applied over the joints. The mortar was allowed to cure 5 to 7 days prior to testing.



THE FIRE TEST

Three tests were conducted on the wall construction. In tests 1 and 2 the cement board surface was exposed to the fire while in test 3 the gypsum wallboard was exposed. Tests 1 and 3 were exposed to the fire for one hour while test 2 was exposed for 30 minutes to provide a sample for the hose stream test.

In each test the moveable frame containing the test assembly was secured to the furnace. The pilot burners were ignited and burned until the temperature inside the furnace reached $20 \pm 2^{\circ}\text{C}$ ($70 \pm 3^{\circ}\text{F}$).

All burners were fired and timing was begun immediately upon achieving maximum high fire.

Observations were made throughout the fire exposure period and are included in this report.

The temperature inside the furnace was monitored by twelve uniformly distributed thermocouple. These reading were automatically plotted approximately once every minute. (See Figure 2, 3 and 4).

Deflections were measured at midheight on each stud location across the test assembly for test 1 and 3 (See Table A1 and A3).

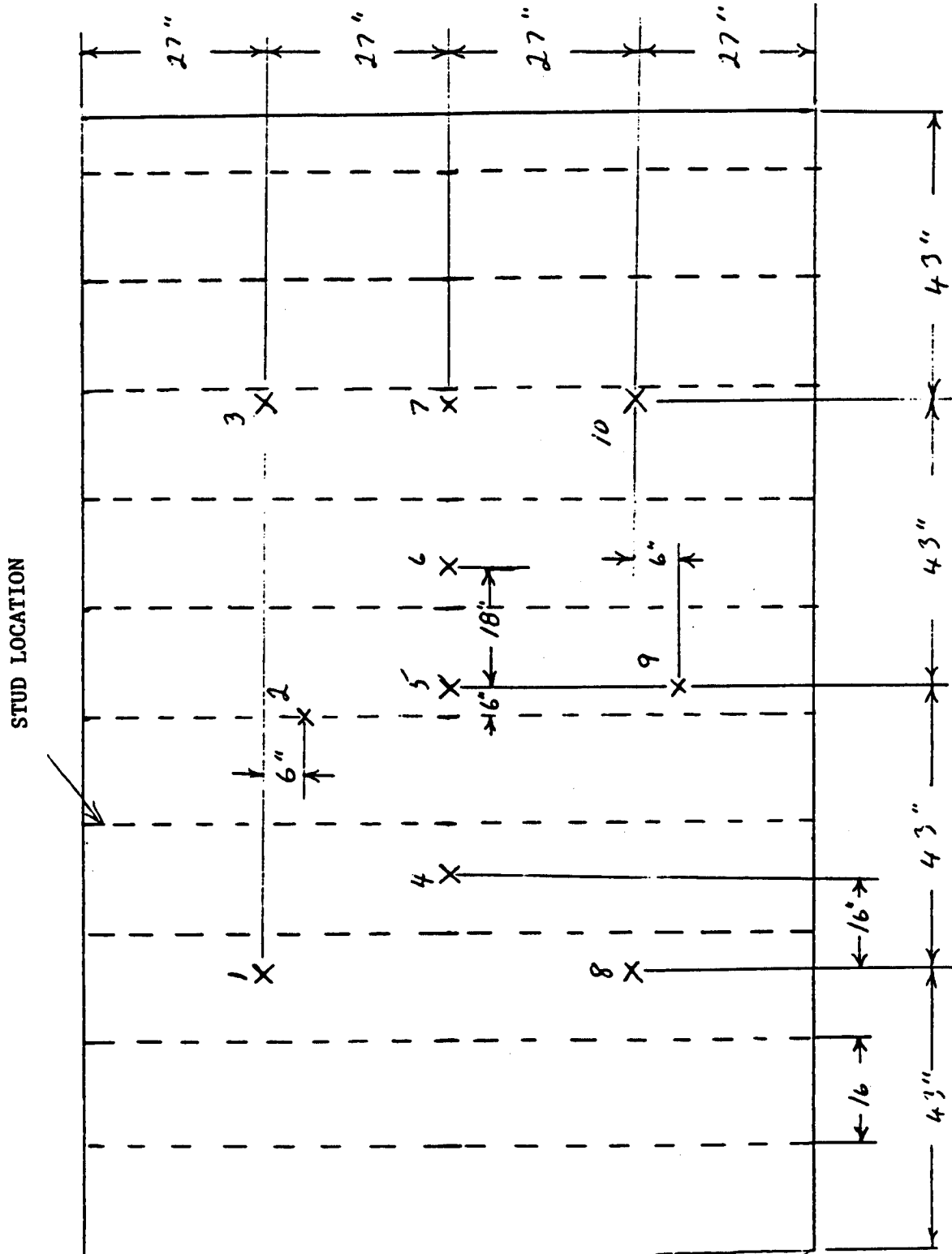
Temperatures on the unexposed surface of the wall were obtained according to the test standard in tests 1 and 3. The location of each thermocouple is shown in Figure I. The temperature rise at each point was calculated. A summary of this data is shown in Table B1 and B3.

The pressure at the top of furnace was controlled between -0.03 and -0.05 in. H_2O throughout all three tests.

Photographs of the test wall are included in Appendix of this report.



FIGURE 1
LOCATION OF TEMPERATURE MEASUREMENTS
ON THE UNEXPOSED SURFACE





FIRE TEST OBSERVATIONS

TEST 1, JULY 13, 1990, CONCRETE PANELS EXPOSED TO FIRE

TIME MIN:SEC	EXPOSED FACE	UNEXPOSED FACE
1:00		Slight bowing
7:30	Surface color becoming brighter	More bowing
9:24	Small flame along joints	Panels warming over studs
14:26		More bowing
15:20	Tape and grout starting peeling Cracks along panels	
18:30	Wall glowing orange	
20:00		No change
24:00	Tape and grout peeling more.	
26:00	Most tape has peeled off	
35:00	Cracks opening up	
49:00		Area around screw head turning brown
52:00	Panel at mid bottom is pulling away from studs	
60:00	Fire test complete	Fire test complete

Post Test Summary

- No passage of flames or gases hot enough to ignite cotton waste.
- As shown on Table BI the unexposed surface average temperature did not exceed 139°C and individual temperatures did not exceed 180°C.



FIGURE 2
FURNACE TEMPERATURES TEST 1
TIME VS TEMPERATURE (°C)

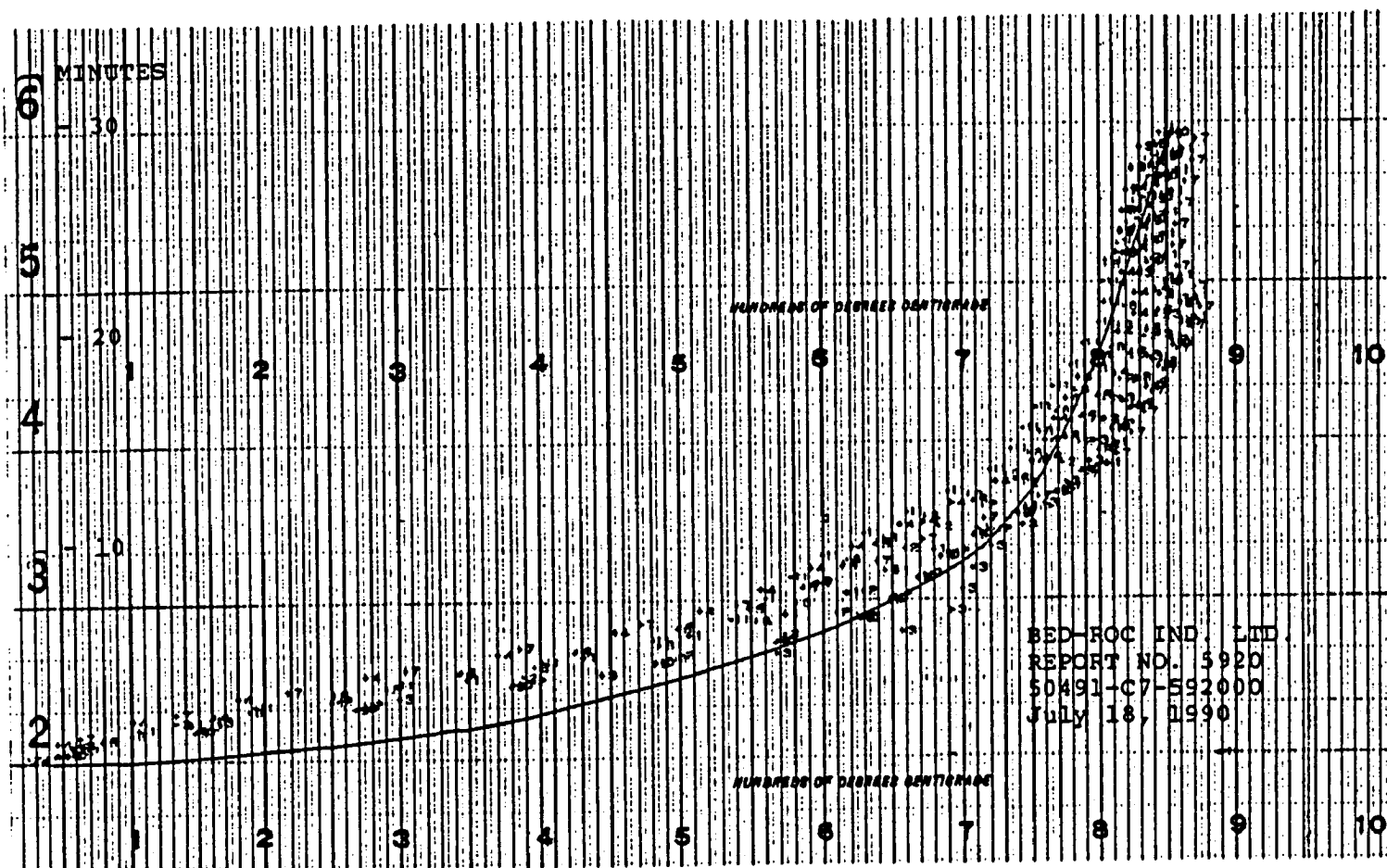




TABLE A1

TEST 1

DEFLECTION OF WALL (MM)

Note: (-) is away from fire.

TIME (MIN.)	15	30	45	60
LOCATION				
A	32	35	39	42
B	46	61	66	74
C	46	66	68	75
D	47	71	70	76
E	48	73	70	78
F	43	68	68	78
G	39	59	59	74
H	40	57	54	74
I	35	33	47	51
J	17	1	1	6



TABLE B1
TEST 1
UNEXPOSED SURFACE TEMPERATURE RISE (°C)

LOCATION	1	2	3	4	5	6	7	8	9	10
TIME (MIN.)										
10	20	28	47	36	32	39	12	27	15	45
17	37	36	45	41	36	41	21	33	22	45
21	37	44	41	40	38	42	28	35	29	44
25	34	55	40	35	36	39	31	33	30	44
30	32	62	43	32	34	36	31	31	31	45
35	38	69	49	32	37	35	31	31	40	50
40	45	74	59	40	43	39	36	31	49	57
45	52	80	72	47	47	46	45	45	55	67
50	61	86	83	52	55	53	48	51	63	75
55	67	89	91	61	62	61	56	61	69	80
59	69	90	94	62	64	63	59	63	71	82



FIRE TEST OBSERVATIONS

TEST 2, JULY 18, 1990, CONCRETE PANELS EXPOSED TO FIRE

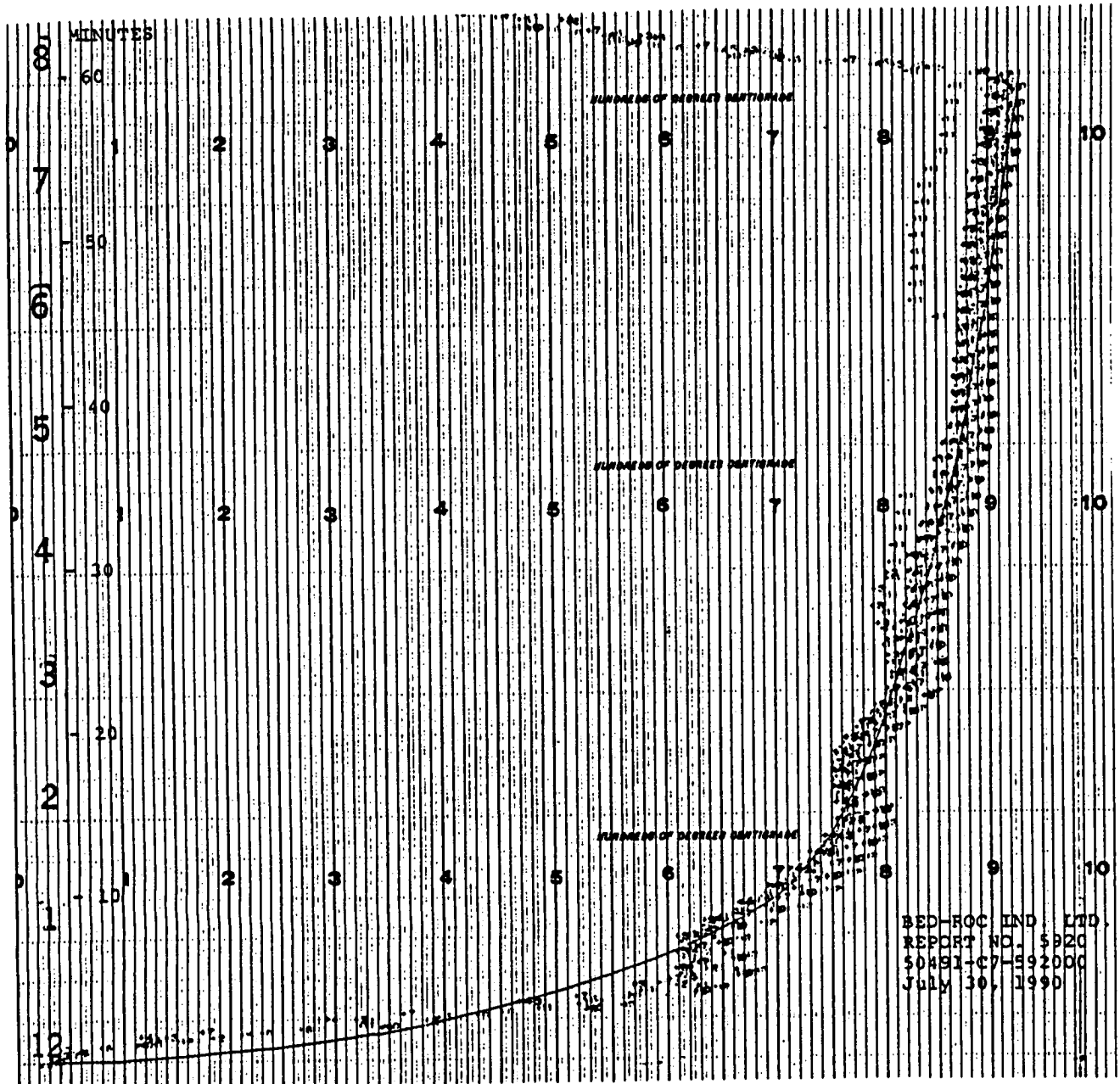
TIME MIN:SEC	EXPOSED FACE	UNEXPOSED FACE
3:30	Slight discoloration	
4:00	Discoloration	
5:00		Wall warming
6:15	Joints showing through mortar	Wall bowing into furnace
8:20	Left side glowing	
11:00	Cracks along panel joints	
12:30	Flaming at some joints	
12:47	Flaming at all joints	Bowing increasing
14:30	Cracks in lower panels	
16:30	Cracks opening up	
18:00	Flaming continues	
19:30	Wall glowing orange	
21:00	Increased opening of cracks	Bowing increasing
30:00	Fire test complete.	

Post Test Summary

- This test was conducted for half the rated duration to determine hose stream test performance, as defined in the test standard.



FIGURE 3
FURNACE TEMPERATURES TEST 2
TIME VS TEMPERATURE (°C)





FIRE TEST OBSERVATIONS

TEST 3

TIME MIN:SEC	EXPOSED FACE	UNEXPOSED FACE
0:35	Paper on gypsum wallboard ignited	
1:15	Paper completely burned	
19:00	Tape coming loose	Smoke venting along top edge
21:00	Flaming at taped joints	
23:00	Flaming stopped	Smoke venting stopped
30:00	Wall bowing into furnace	Slight separation of horizontal joint in panels
40:00	Openings developing between wallboard sheets	
50:00	Bowing at least 3 in. into furnace.	
60:00	No change	Fire test complete

Post Test Summary

- Passage of flames or gases hot enough to ignite cotton waste did not occur.
- The average temperature of the unexposed surface of the assembly did not exceed 139°C.

FIGURE 4
FURNACE TEMPERATURES TEST 3
TIME VS TEMPERATURE (°C)

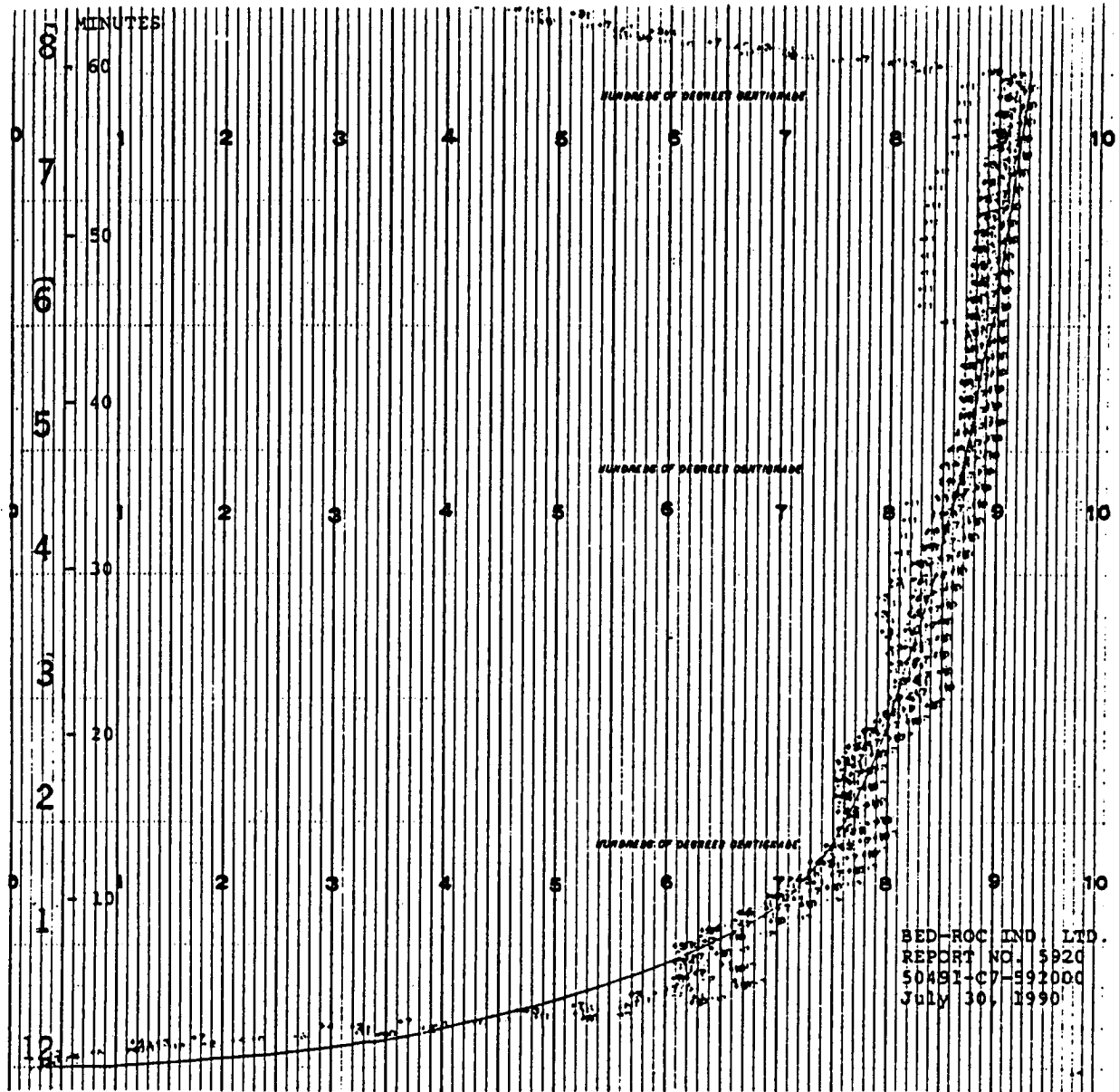




TABLE A3

TEST 3

DEFLECTION OF WALL (MM)

Note: (-) is away from fire.

TIME (MIN.)	15	30	45	60
LOCATION				
A	4	42	49	48
B	5	55	75	74
C	5	57	78	80
D	5	57	83	84
E	4	60	84	83
F	7	57	82	83
G	5	53	68	82
H	5	53	78	82
I	6	47	62	65
J	3	29	25	64



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TABLE B3

TEST 3

UNEXPOSED SURFACE TEMPERATURE RISE (°C)

LOCATION	1	2	3	4	5	6	7	8	9	10
TIME (MIN.)										
10	10	6	18	5	6	5	22	3	4	11
15	23	15	30	13	19	19	35	12	16	26
20	32	23	--	21	26	26	41	22	28	34
25	33	28	39	23	26	27	42	24	30	36
30	32	40	47	24	25	27	46	25	29	41
35	32	65	64	22	24	27	53	27	28	55
40	33	69	70	22	23	27	59	27	27	67
45	38	75	70	29	26	28	70	30	33	65
50	47	100	74	42	31	32	87	41	48	69
55	57	129	90	48	40	38	105	48	60	71
57	60	135	98	48	42	40	117	50	68	73
60	--	146	115	50	46	44	155	51	71	76

THE HOSE STREAM TEST

Immediately following each Fire Endurance test, the moveable test wall was uncoupled from the furnace and positioned for a standard Hose Stream test on the fire exposed face.

In accordance with the test standards, the fire assembly was subjected to the impact, erosion, and cooling effects of the hose stream.

The hose stream was delivered through a 65 mm (2 1/2") hose discharging through a National Standard Playpipe of corresponding size equipped with a 20 mm (1 1/8") discharge tip of the standard-taper smooth bore pattern without shoulder at the orifice. The water pressure at the nozzle was 205 kPa (30 psi).

The hose stream was applied for a period of 75 seconds per 10m² of exposed area. The hose stream was directed first at the middle of the doors and then at all parts of the exposed surface, changing direction slowly.

HOSE STREAM OBSERVATIONS**Test 1**

The water washed away the remains of the concrete panels and the insulation. After 50 seconds of hose stream, the wallboard panels fell away and allowed passage of water, thus failing to meet the requirements for the hose stream test. The standard permits a hose stream to be conducted on a duplicate wall, after being exposed to fire for 30 minutes. This procedure was followed in test 2.

Test 2 and 3

In these tests the fire exposed surface and the insulation were eroded away but the unexposed surface remained in place, preventing the passage of water through the partition.



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CONCLUSIONS

The non-load-bearing partition, constructed as described in this report met the requirements of CAN4-S101 and ASTM E119 for a one hour rating.

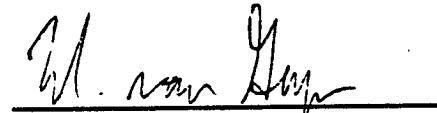
Therefore the "Super Panel" concrete panels manufactured by Bed-Roc Industries Ltd. are eligible for listing and certification under the factory inspection program of Warnock Hersey.

WARNOCK HERSEY PROFESSIONAL SERVICES LTD.

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