



Western Fire Center, Inc.

2204 Parrott Way, Kelso, Washington 98626
Phone: 360-423-1400 | Fax: 360-423-5003 | Toll Free: 877-423-1401

Fire Resistance Testing of a
Floor/Ceiling Assembly in
Accordance with ASTM E119-
05a/UL 263: *Fire Tests of
Building Construction and
Materials*

Conducted For:

PAC International, Inc.
7310 Smoke Ranch Road, Suite E
Las Vegas, Nevada 89128

WFCi Report #07083

Test Performed: February 8, 2008

Report Issued: February 18, 2008



TABLE OF CONTENTS

TABLE OF CONTENTS	2
INTRODUCTION	3
SUMMARY OF TEST METHOD	4
FIGURE 1: LARGE-SCALE HORIZONTAL FURNACE FRONT VIEW	4
FIGURE 2: LARGE-SCALE HORIZONTAL FURNACE INTERIOR VIEW	4
FLOOR LOADING	5
FIGURE 3: BARRELS MOUNTED ON TEST ASSEMBLY	5
SAMPLE DESCRIPTION	6
GENERAL	6
FIGURE 4. REPRESENTATION OF FLOOR/CEILING TEST ASSEMBLY	6
MATERIALS	7
CONSTRUCTION OF TEST ASSEMBLY	8
THERMOCOUPLE PLACEMENT	10
FIGURE 5. THERMOCOUPLE PLACEMENT WITHIN ASSEMBLY	10
TEST OBSERVATIONS	12
TEST DATA SUMMARY	13
FURNACE TEMPERATURES	13
SAMPLE DEFLECTION	14
FINISH RATING TEMPERATURE	15
JOIST WEB THERMOCOUPLE READINGS	16
UNEXPOSED (FLOOR SURFACE) TEMPERATURES	17
TEST RESULTS AND CONCLUSION	18
SIGNATURES	19
APPENDIX A:	20
DRAWINGS	20
A1-9	20
APPENDIX B:	31
PHOTOGRAPHS	31

INTRODUCTION

This report documents the fire resistive testing of an unrestrained floor/ceiling assembly constructed of CEMCO Sure-Span® steel joists supporting a 23/32" thick plywood floor, protected with a ceiling membrane consisting of two layers of 5/8" PABCO® FLAME CURB® Super "C" gypsum board screw-attached to steel furring channels. The furring channels were attached to the underside of the joists using a proprietary resilient sound isolation clip.

Mike White and Howard Stacy of WFCi conducted the test with the assistance of Wayne Beres and Nick Martin (WFCi) on February 8, 2008.

The floor assembly was constructed by WFCi personnel to client specifications. A detailed description of the sample can be found beginning on page six of this report.

The construction and testing of the test assembly was witnessed by Elzo Gernhart, PAC International, and Rick Ladwig and Rob Davies, PABCO Gypsum.

The purpose of this test was to establish a fire-resistance classification of the referenced floor/ceiling assembly by means of fire endurance testing in accordance with the standard fire exposure and loading conditions specified in ASTM E119/UL 263.

SUMMARY OF TEST METHOD

This is a horizontal fire resistance test employing the fire endurance conditions described in ASTM E 119 "Fire Tests of Building Construction and Materials". The test conditions are also closely described by testing standards UL 263 and NFPA 251. A horizontal exposure furnace was used to subject the sample to a standard time-temperature curve as specified in the referenced test procedures.



Figure 1: Large-Scale Horizontal Furnace Front View



Figure 2: Large-Scale Horizontal Furnace Interior View

The furnace used in the test was a large-scale fire exposure apparatus (Figures 1 & 2), fueled by natural gas. The test assembly was installed onto the furnace horizontally. The exposed surface was subjected to the time-temperature curve, with temperature measurements taken inside the furnace using thermocouples connected to a computerized data acquisition system. The furnace valves are controlled based upon the average of the interior furnace temperature that is determined from these nine internal thermocouples. Windows allow viewing of the specimen surface and the taking of photographs during testing. Upon completion or early termination of a test, the main gas supply valve is closed and the specimen is extinguished, if necessary, and post-testing observations are made.

-For this fire endurance evaluation, the test was to be performed for a period of one hour or until failure of the test assembly occurred.

-The pressure in the furnace was measured by a pressure transducer along with a magnahelic gauge, with the neutral pressure plane measured at a point nominally 1 foot from the level of the exposed surface of the sample.

Floor Loading

The test assembly was loaded to a live load of 65 lbs/ft² for a total combined live and dead load of 75 lbs/ft² (10 lbs/ft² dead load). The load was applied in the form of 24 weighted, evenly-spaced barrels in a 6X4 arrangement (Figure 3). The sample area was 252 ft², and the barrels were each filled with sand to weigh 682 lbs for a superimposed load of 16,368 lbs. This loading produced 100% of the maximum bending deflection at midspan.



Figure 3: Barrels Mounted on Test Assembly

SAMPLE DESCRIPTION

GENERAL

The steel joist floor/ceiling test assembly depicted in Figure 4 was constructed in accordance with the specifications detailed in Drawings A1 through A9 provided in Appendix A and the description beginning on page 7. The system was constructed in place on the WFCi large scale horizontal furnace, with structural joist elements spanning the furnace width. The outside dimensions of the completed floor/ceiling system was 14' x 18' wide, and the nominal exposed ceiling area was 12'-6" x 17'.

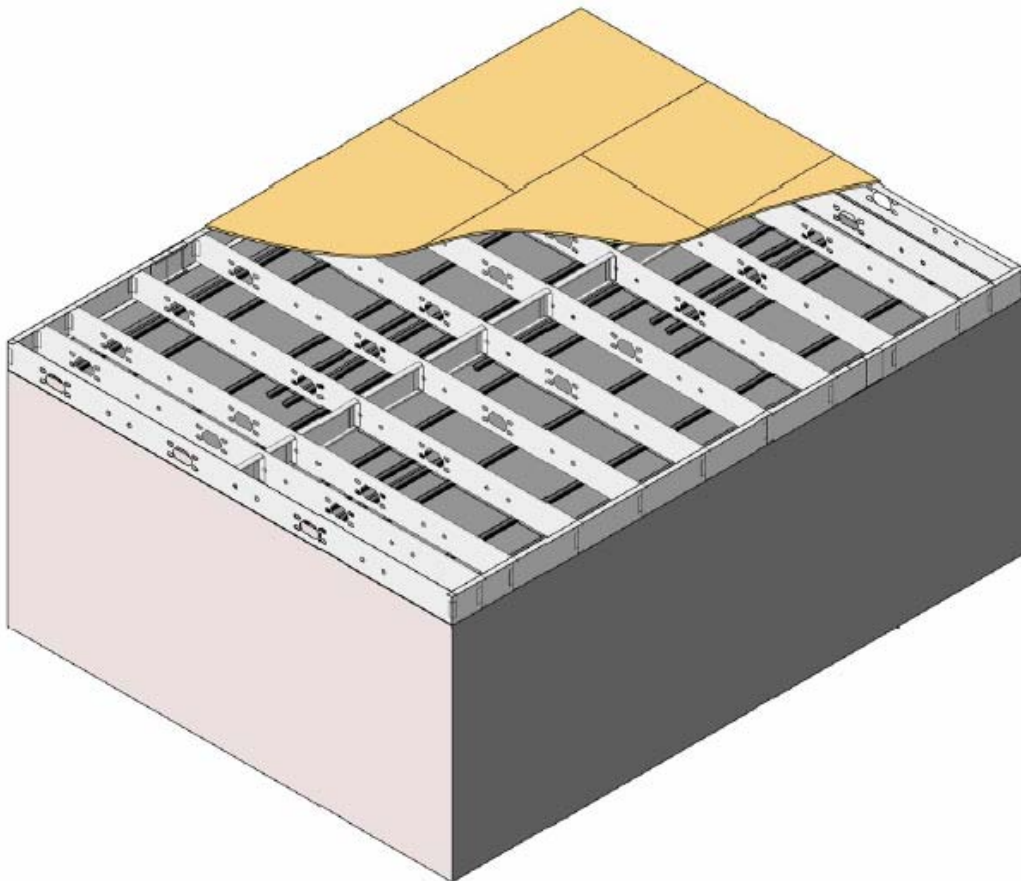


Figure 4. Representation of Floor/Ceiling Test Assembly

MATERIALS

Steel Floor Joists- UL labeled CEMCO Sure-Span® (925SSCJ175-54), channel-shaped, 16 ga. galvanized steel, 9-1/4" web depth, 13' 9" long and having an average weight of 34.1 lbs.

Rim Track- CEMCO Sure-Span® rim track (925SSRT200-54), 16 ga. galvanized steel, 9-3/8" deep, with web stiffening clips at 24" o.c.

Angle Clips- 16 ga. galvanized steel angles, 2" x 2" x 8".

Plywood (Subfloor)- APA rated 23/32" tongue and groove plywood underlayment supplied in 4'x8' sheets.

Adhesive- Standard heavy duty subfloor and construction adhesive.

Furring Channels- CEMCO, 7/8" high x 1.5" wide furring "hat" channels, formed of 25 MSG galvanized steel.

Resilient Sound Insulation (RSIC) Clips- Type RSIC-1, manufactured by PAC International, bearing the UL classification mark.

Gypsum board- 5/8" PABCO® FLAME CURB® Super "C" gypsum board, supplied in 4' x 12' sheets, labeled by Underwriters Laboratories Inc. as Classified for fire resistance.

Insulation- R-19, unfaced fiberglass batts, 24" wide x 6-1/4" thick x 48" long.

Fasteners- Fasteners are as described in the construction assembly description and drawings provided in Appendix A.

Finishing System- Gypsum board joint compound, applied in two coats to joints and screw-heads. Nominal 2 in. wide paper tape embedded in first layer of compound over all joints.

CONSTRUCTION OF TEST ASSEMBLY

The floor-ceiling assembly was built in place atop the WFCi horizontal furnace in accordance with the method described by the client and as shown in drawings **A1 through A9 in Appendix A**. Photographs of the construction of the test assembly are provided in Appendix B. Ceramic fiber blanket insulated the unexposed perimeter of the assembly at the top edges of the furnace opening. The test assembly was constructed by WFCi technicians.

Ten joists were spaced outward symmetrically 24" on center starting 12" on either side of the east-west center line of the assembly. Two additional joists, not in the field of fire and spaced approximately 12" o.c. from the adjacent joists were placed at the north and south ends of the furnace, resting atop the furnace structure. The average bearing of each end of the joists was approximately 6". The joists were fastened to the rim track with #10-16 steel screws in accordance with the connection detail shown in drawing A8. Structural blocking was installed between the joists at mid span of the assembly as shown in drawings A2 and A9. The structural blocking elements consisted of joist sections cut to length and screw-attached to each joist web using angle clips. A strap of 1-1/2" wide 20 ga. steel was screw attached to the bottom flange of the blocking along the length of the assembly. The perimeter of the test assembly was enclosed with two layers of gypsum board sealed to the outboard side of the rim elements.

The plywood subfloor was installed as shown in drawing A6. A bead of adhesive was placed on the top flange of the joists and into the grooved edge of the plywood. The subfloor was placed on the joists so that the 8 ft. length was positioned perpendicular to the joists and the ends butted, with adjacent end joints staggered 4 ft. Each piece was screw attached to the

joists at 6" o.c. and to the top flange of the structural blocking as shown in drawing A6.

R-19 fiberglass batt insulation was installed in the joist cavities flush with the bottom of the joist flanges and supported by 18 ga. wire as shown in drawing A2.1.

For the ceiling, furring "hat" channels were installed perpendicular to the joists using RSIC-1 clips attached to the bottom of the joists using 1-5/8" long No. 8 self-drilling, self-tapping wafer head screws through the center grommet. Adjoining channels were overlapped 6" and secured together with one 1/2" long self-tapping screw at the midpoint of the overlap. The location of the RSIC-1 clips and orientation of the furring channel is depicted in drawing A3. The channels were spaced 24" o.c. starting at 12" on either side of the north-south center line of the assembly, and the RSIC-1 clips were installed 48" o.c.

Two layers of 5/8" thick by 48" wide sheets of PABCO® FLAME CURB® Super "C" gypsum board gypsum were installed with the long dimension perpendicular to the furring channels as depicted in drawings A4 and A5. The upper (base) layer was attached to the furring channels with 1-1/8" long No. 6 Type S drywall screws spaced 12" o.c. in the field and located 2" from the long edges of the board and 3" from the butt joint. The butt joints were centered under furring channels spaced 6" o.c. apart. See drawing A4 for the base layer layout. The face layer was attached to furring channels through the upper (base) layer with 1-5/8" Type S drywall screws spaced 12" o.c. in the field and 2" from the side edges of the boards. All joints in the face layer boards were offset from the joints in the upper layer by a minimum of 16". Butt joints of the face layer occurred between furring channels with each end of the butted boards attached to the upper layer

board with 1-1/2" No. 10. Type G bugle head laminating drywall screws spaced 8" o.c. along the butt joint and 3" from the board ends.

Joint compound was applied in two coats to joints and screwheads, with 2" wide paper tape was embedded in the first layer of compound over all joints.

Thermocouple Placement

SCALE: 1/2" = 1'-0"

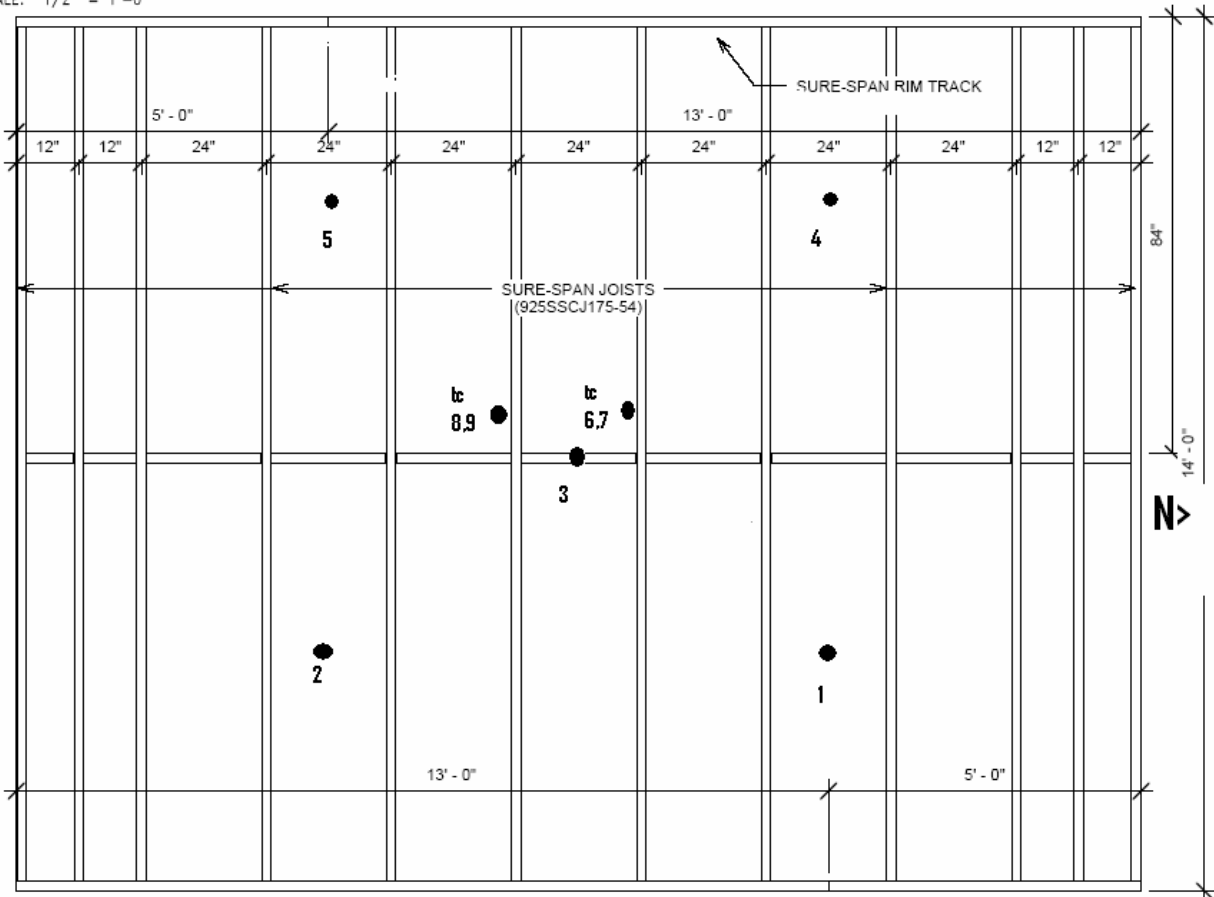


Figure 5. Thermocouple placement within assembly

Eighteen thermocouples (TCs) were placed in and on the floor assembly to monitor temperatures during the test.

- Thermocouples 1-5 were placed between the face of the furring channel and the ceiling membrane at sample center and quarter-points to determine the finish rating of the sample.
- Thermocouples 6 & 8 were placed on the joist web at the nominal center point of the assembly, 1" down from the underlayment; TCs 7 & 9 were located 3" up from the bottom joist flange, directly below TCs 6 & 8.
- Thermocouples 10-18 were placed in an evenly spaced 3X3 grid on the unexposed sample surface and located over plywood joints where appropriate to monitor temperatures throughout the test.

TEST OBSERVATIONS

Test Date: 2/8/08

Specimen Tested: 14'X18' Floor/Ceiling Joist Assembly

Furnace: Large-Scale E119 Horizontal Exposure Furnace

Laboratory Temp: 16°C **Relative Humidity:** 55%

Cameras: 1 digital still camera and 2 video cameras

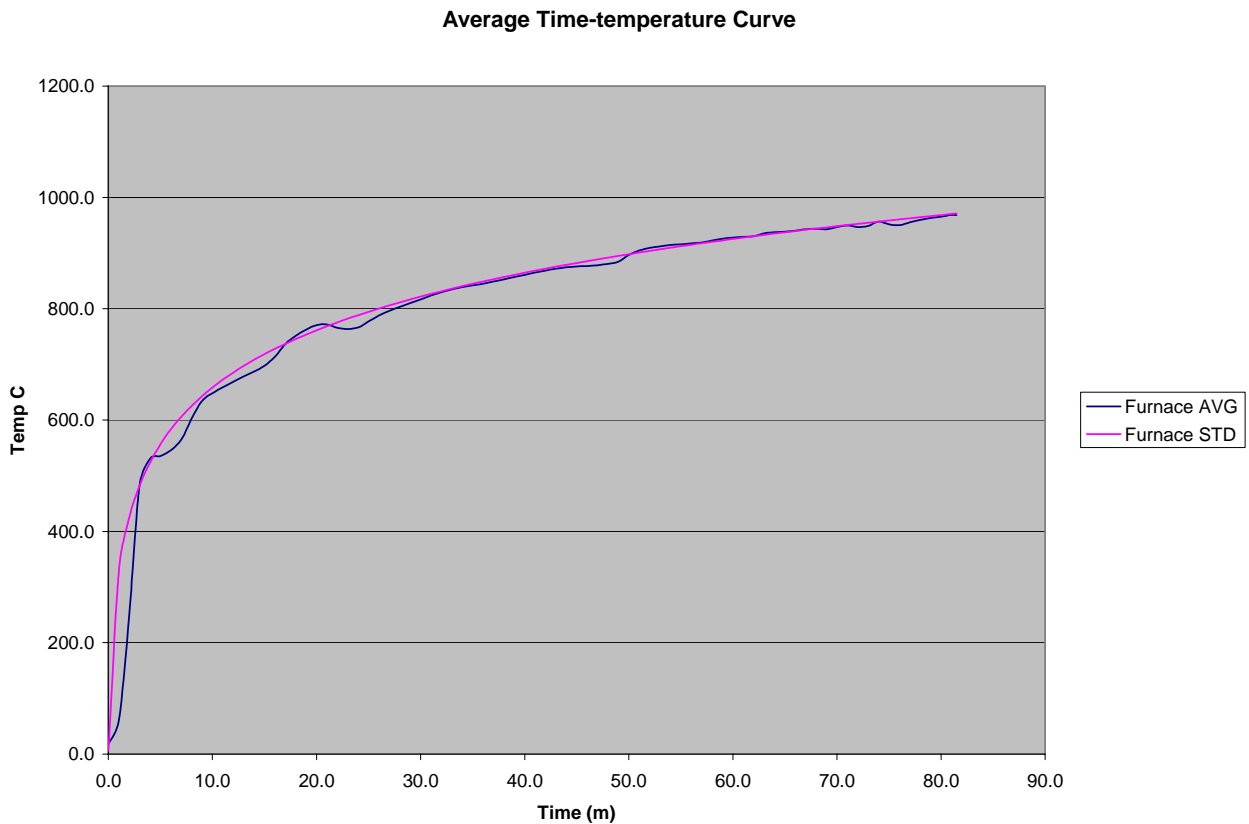
Observations

Test Time (h:mm:ss)	Event
0:00:00	Start Test
:53	Ignition of face paper
1:27	Flame out
6:30	Joint compound loosening and falling from ceiling in some places
8:00	Approximately 1 foot of southeast butt joint exposed
10:00	Progressive fall-off of joint compound, more joints becoming exposed
15:00	1/8" gaps visible at E-W joints at the N and S ends of the furnace
18:00	Joints mostly exposed; gaps open at joints approx. 1/8"
23:00	Some waviness along E-W joint at N end of furnace
30:00	Waviness along board edges more pronounced; all butt joints remain tight
37:00	Avg. temp. unexp'd surface of GWB= 115°C
45:00	Board edges increasingly wavy
58:36	Finish rating attained (avg.)>156°C; face layer remains solidly fastened
60:00	Pass one hour fire resistance classification
1:05:00	Pronounced sag (up to 2") between fasteners along board edges; butt joints remain solid
1:05:30	Flame emitting from S-E butt joint
1:07:00	Flame W-center butt joint
1:08:20	4x5' section of face layer board falls from center of ceiling
1:11:00	More large pcs. face layer fall off
1:21:00	Base layer begins falling off, openings to joist cavities appearing
1:21:30	Test Terminated, load failure criteria exceeded indicating imminent structural failure
Post Test	No indication of flame/hot gas penetration of floor; fiberglass insulation remains in place; 65-70% base layer remains fastened

TEST DATA SUMMARY

Photographs of the assembly during and after testing are provided in Appendix B.

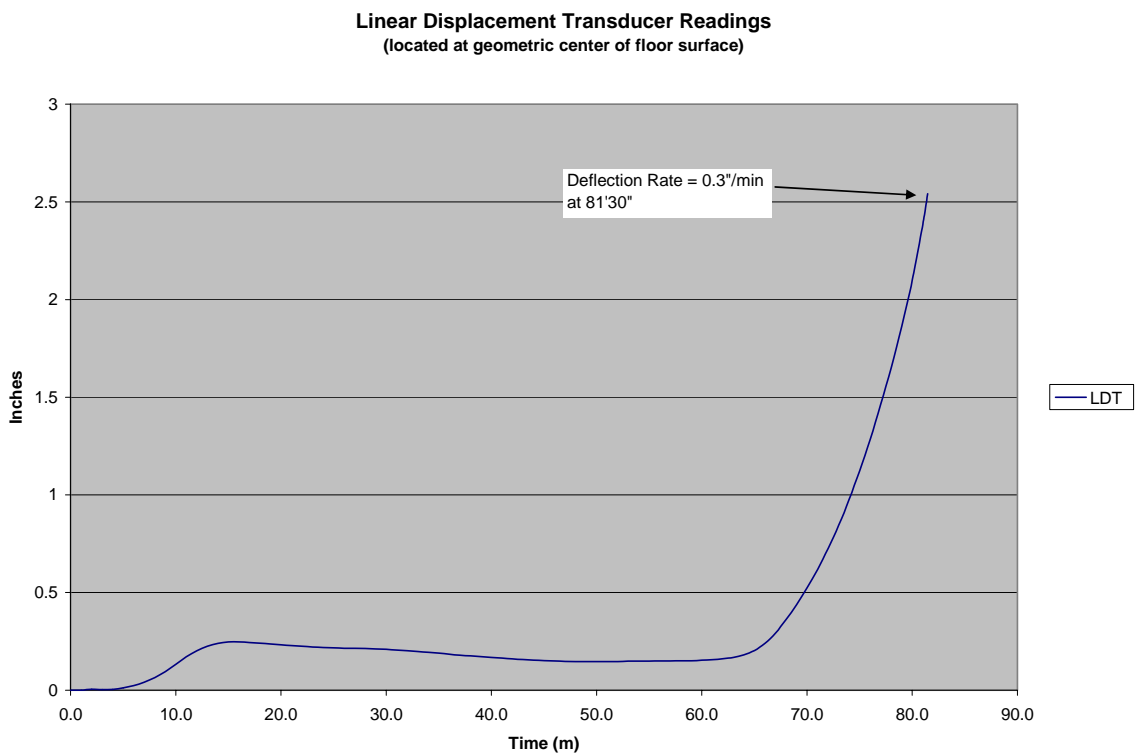
Furnace Temperatures



The area under the actual furnace curve was within 99.5% of the standard time-temperature at test termination.

Sample Deflection

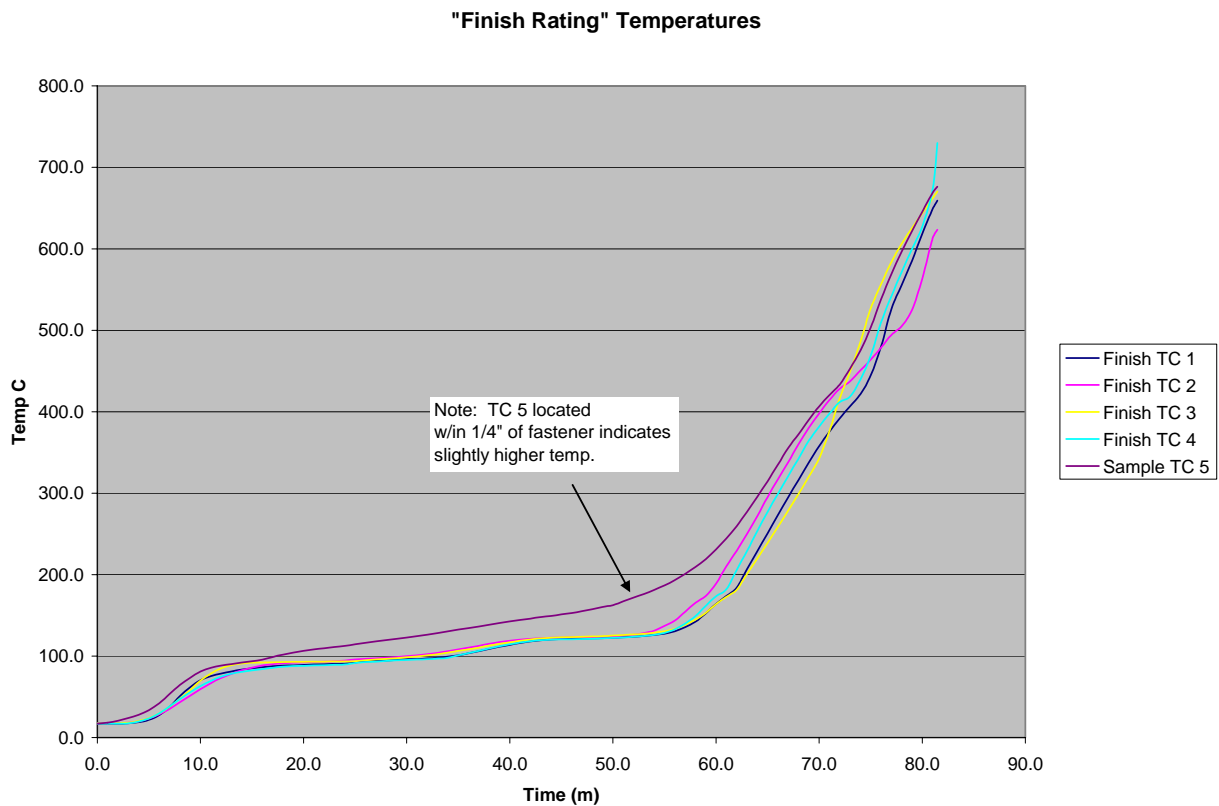
Sample deflection was measured during this test by one linear displacement transducer mounted at the center of the unexposed floor side of the test assembly.



The test was terminated at **81 minutes, 30 seconds**. The rate of deflection of the assembly was 0.3"/minute, indicating imminent load failure of the assembly.

Finish Rating Temperature

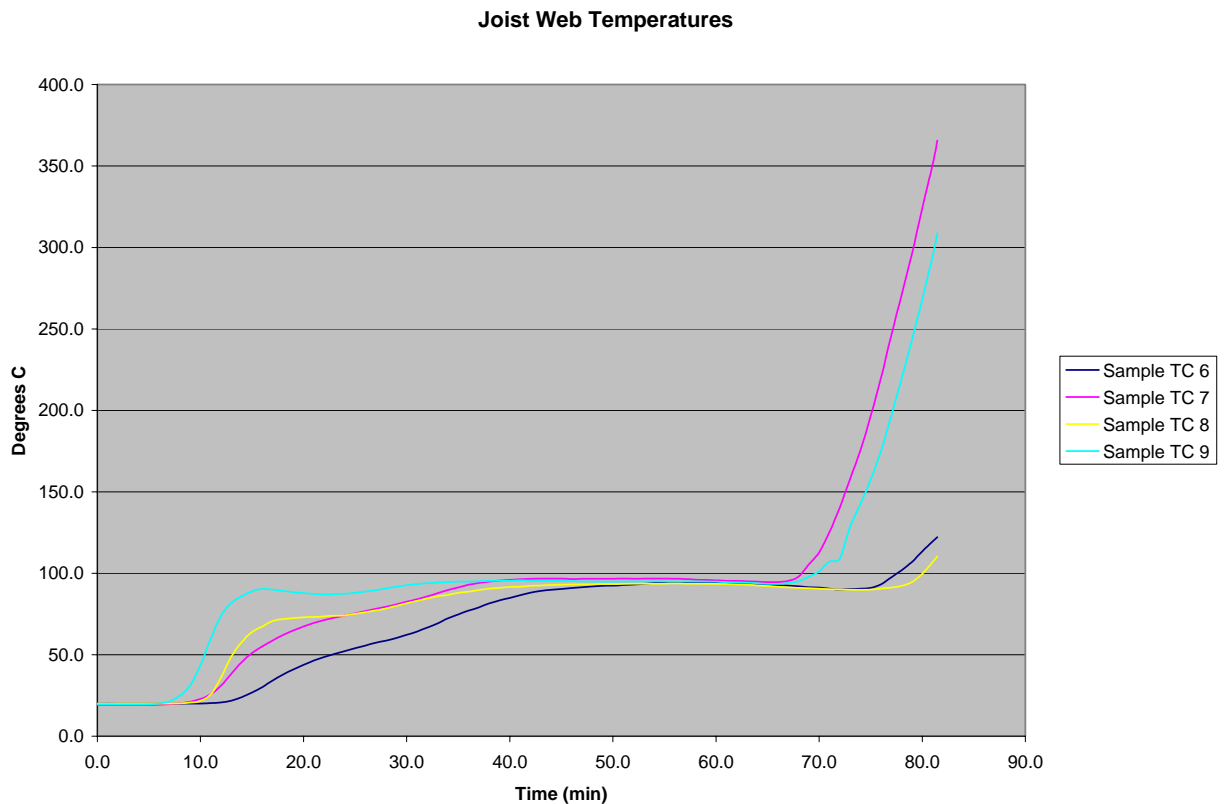
Thermocouples 1-5 were placed between the undersides of furring channel and the exposed ceiling membrane at the sample center and quarter-points to determine the finish rating of the gypsum ceiling membrane. The finish rating was recorded at 58 minutes, 36 seconds when the average temperature rise of thermocouples 1-4 exceeded 139°C.



For this test, the reading from TC No. 5 was disregarded. The close (~1/4") proximity of a screw fastener to the TC 5 location caused this thermocouple to read elevated temperature readings.

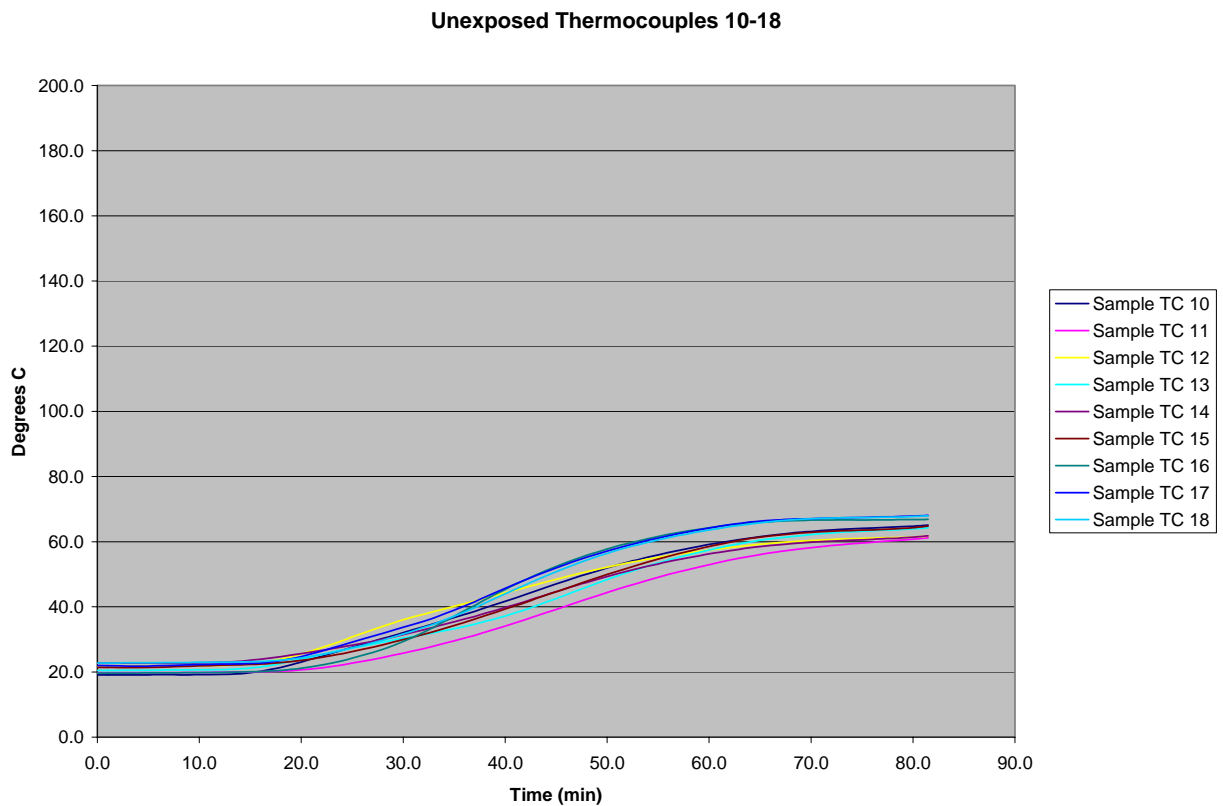
Joist Web Thermocouple Readings

Thermocouples 6-9 were welded to the hard side of the joist web of the two central joists spanning the width of the furnace. Thermocouples 6 & 8 were located on the joist web near the nominal center point of the assembly, above the insulation layer and 1" down from the plywood underlayment; TCs 7 & 9 were located 3" up from the bottom joist flange, directly below TCs 6 & 8, and within the insulation layer.



Unexposed (Floor Surface) Temperatures

Thermocouples 10-18 were placed in an evenly spaced 3X3 grid on the unexposed sample surface to monitor temperatures throughout the test. Temperatures measured on the unexposed surface were well below limiting temperature rise criteria.



Temperatures measured on the unexposed surface of the floor assembly reached a maximum of 68°C during the fire resistance test. There were no signs of the passage of heat or hot gases during the test, and the use of the cotton pad was not indicated.

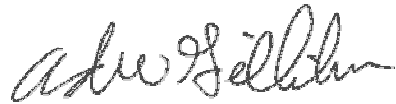
TEST RESULTS AND CONCLUSION

The floor/ceiling test assembly described in this report met the ASTM E119 conditions of acceptance for a minimum 60-minute fire resistance period, successfully carrying the applied load without passage of flame or heat sufficient to ignite cotton waste and staying within the limiting temperature rise criteria throughout the test.

- Finish (Membrane Protection) Rating: **58 minutes, 36 seconds**
- The test assembly supported the applied load for **81.5 minutes**.
- Temperatures on the unexposed face remained well below the allowed single-point temperature rise of 181°C (325°F) above the starting temperature throughout the test. The use of the cotton pad was not indicated due to low surface temperature readings and the absence of visual indications of transmission of hot gases.
- The average temperature rise for the unexposed face thermocouples remained well below the allowable limit of 139°C (250°F) above the starting temperature throughout the test.

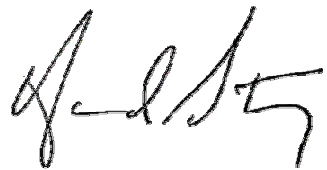
SIGNATURES

Prepared by,



Andrew Gillihan
Technical Writer

Reviewed and approved by,



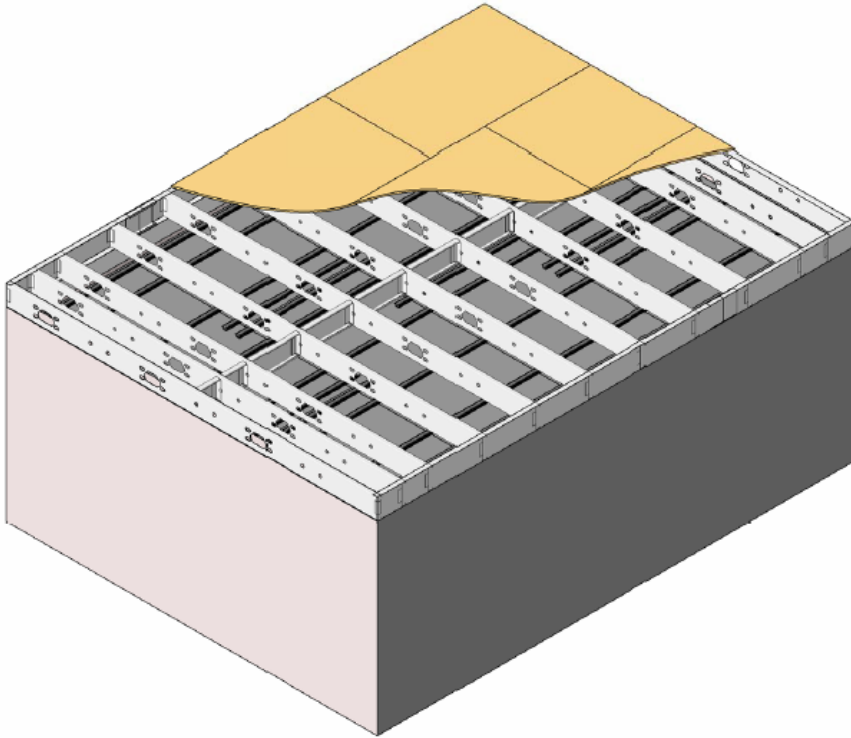
Howard Stacy
Director, Testing Services

**WESTERN FIRE CENTER AUTHORIZES THE CLIENT NAMED HEREIN TO REPRODUCE
THIS REPORT ONLY IF REPRODUCED IN ITS ENTIRETY**

APPENDIX A:
Drawings
A1-9

A1 ISOMETRIC VIEW

DATE PLOTTED: 2/11/2008 5:53:58 PM
SCALE:



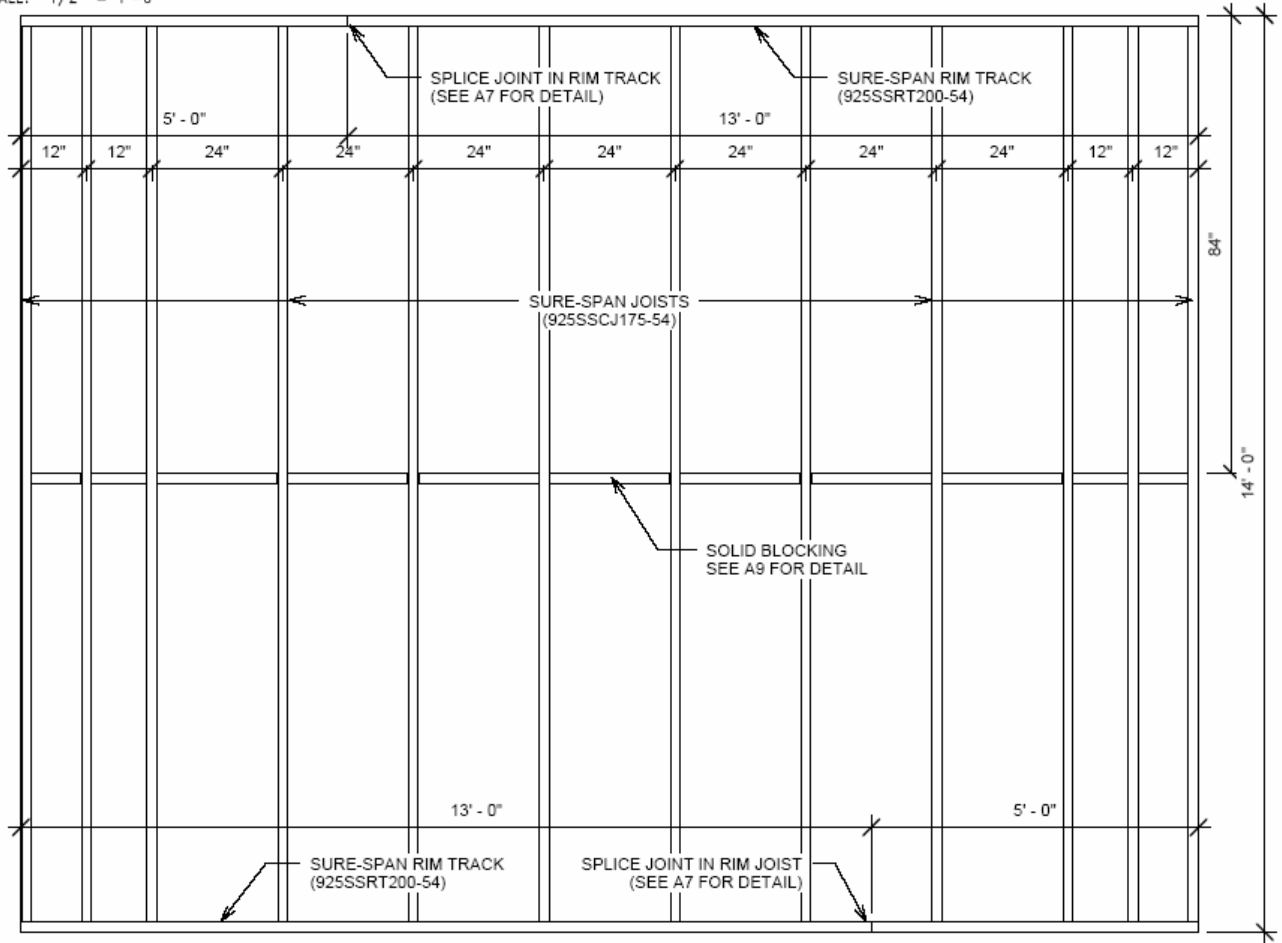
DETAIL INDEX

A1	ISOMETRIC VIEW
A2	JOIST & RIM TRACK LOCATIONS
A2.1	INSULATION
A3	RSIC-1 CLIP / TRACK LOCATION
A4	BASE LAYER LAYOUT
A5	SECOND LAYER LAYOUT
A6	TOP SHEETING LAYOUT
A7	SECTION DETAILS
A8	ISO DETAIL - CONNECTION @ RIM JOIST
A9	ISO DETAIL - BLOCKING

A2 JOIST & RIM TRACK LOCATIONS

DATE PLOTTED: 2/11/2008 5:54:02 PM

SCALE: 1/2" = 1'-0"



A2.1 INSULATION

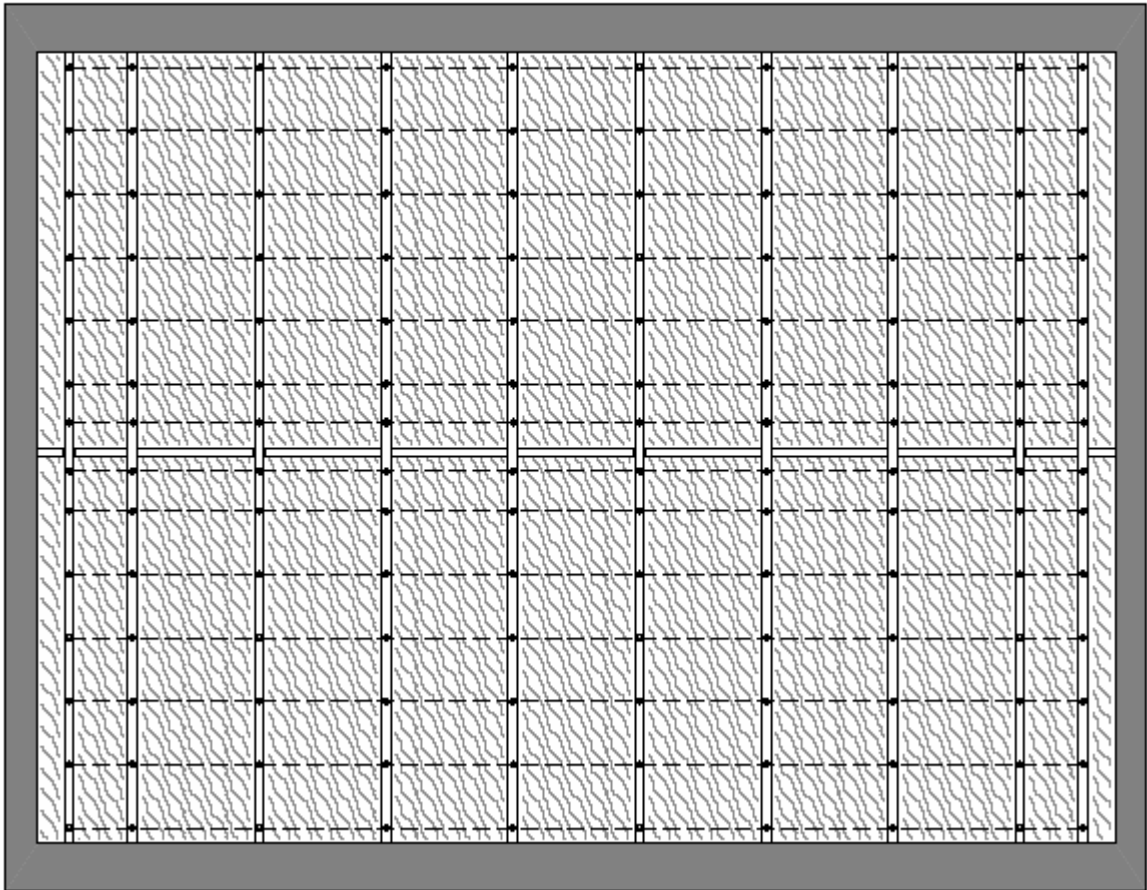
DATE PLOTTED: 2/11/2008 5:54:07 PM
SCALE: 1/2" = 1'-0"

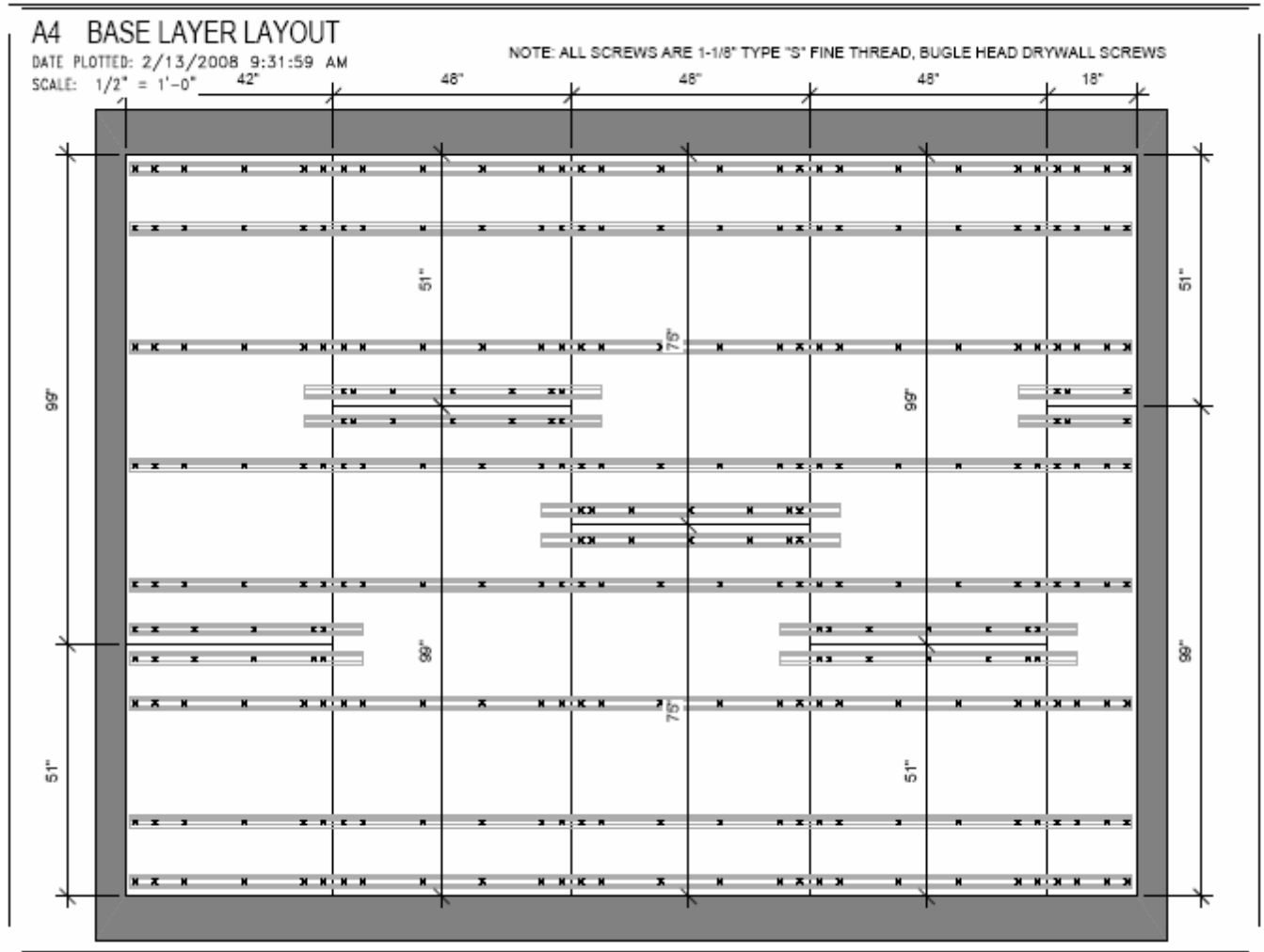


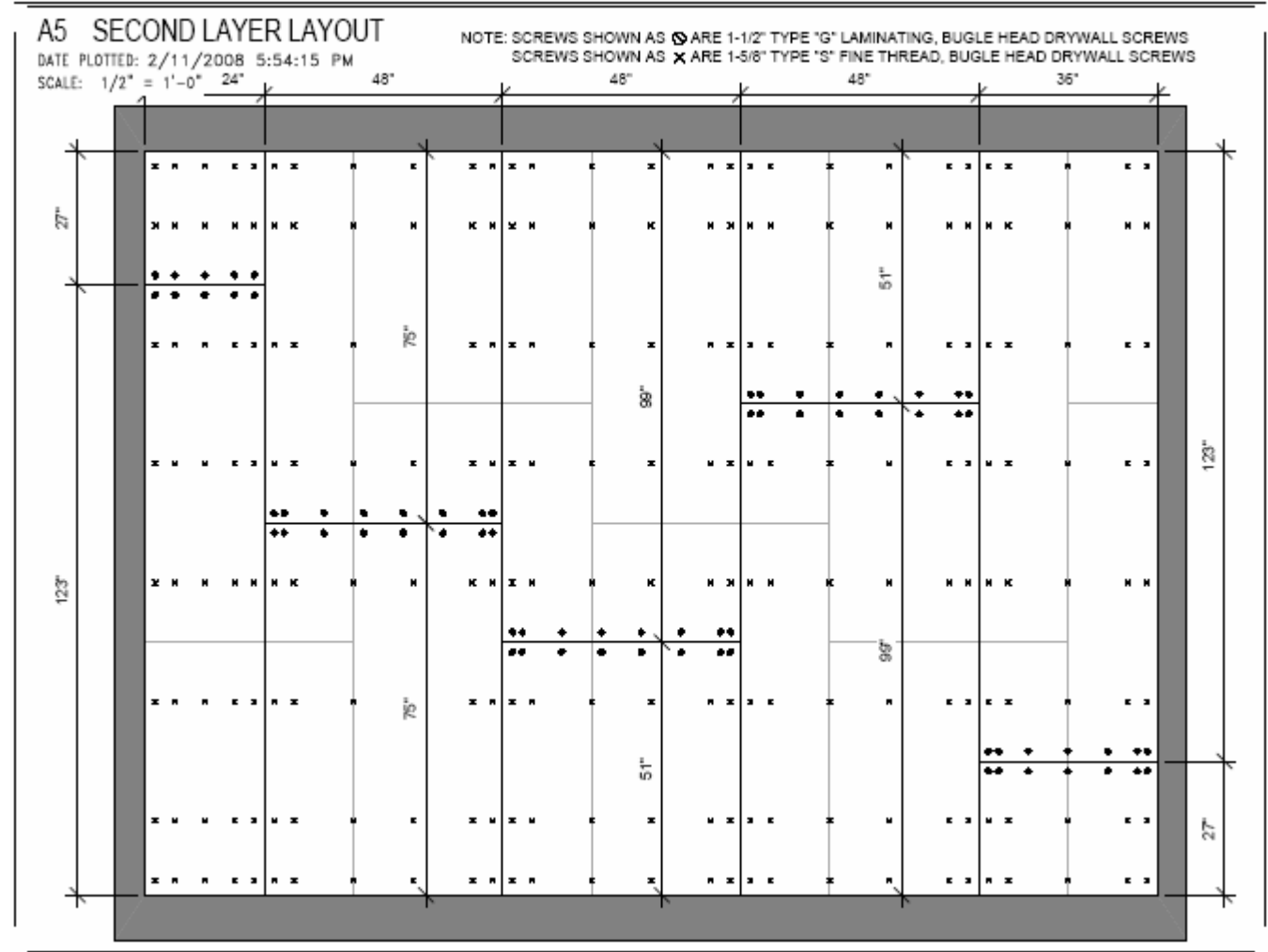
INDICATES R-19 BATT INSULATION IN EACH CAVITY (SUPPORTED BY TIE WIRE)



INDICATES MINIMUM 18 GAUGE WIRE SPACED AT 12" OC. FRAMING SCREW TO BE INSTALLED IN THE LOCATIONS SHOWN BELOW. SCREW SHALL BE INSTALLED ONLY HALFWAY AND CENTERED IN EACH JOIST TO ALLOW TIE WIRE TO WRAP AROUND EACH SCREW



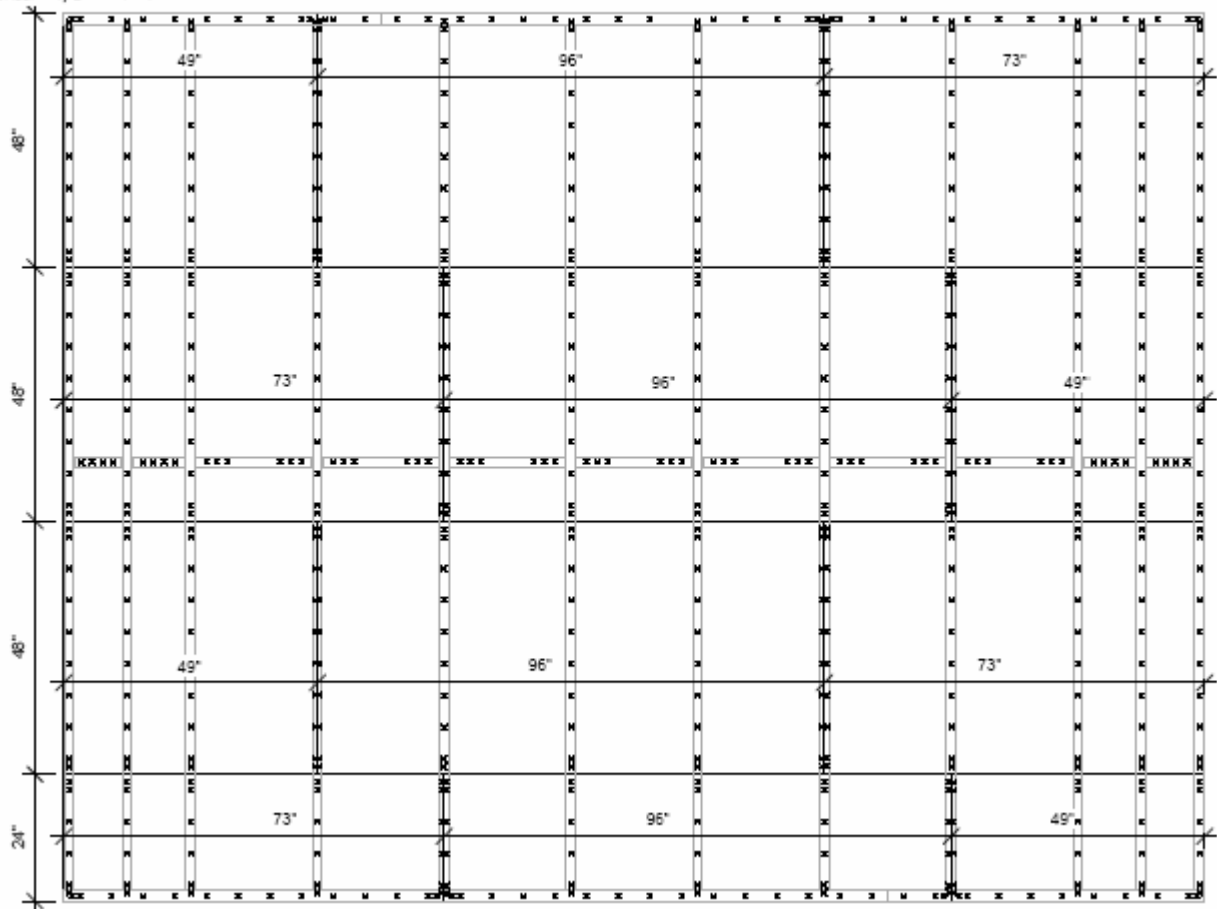


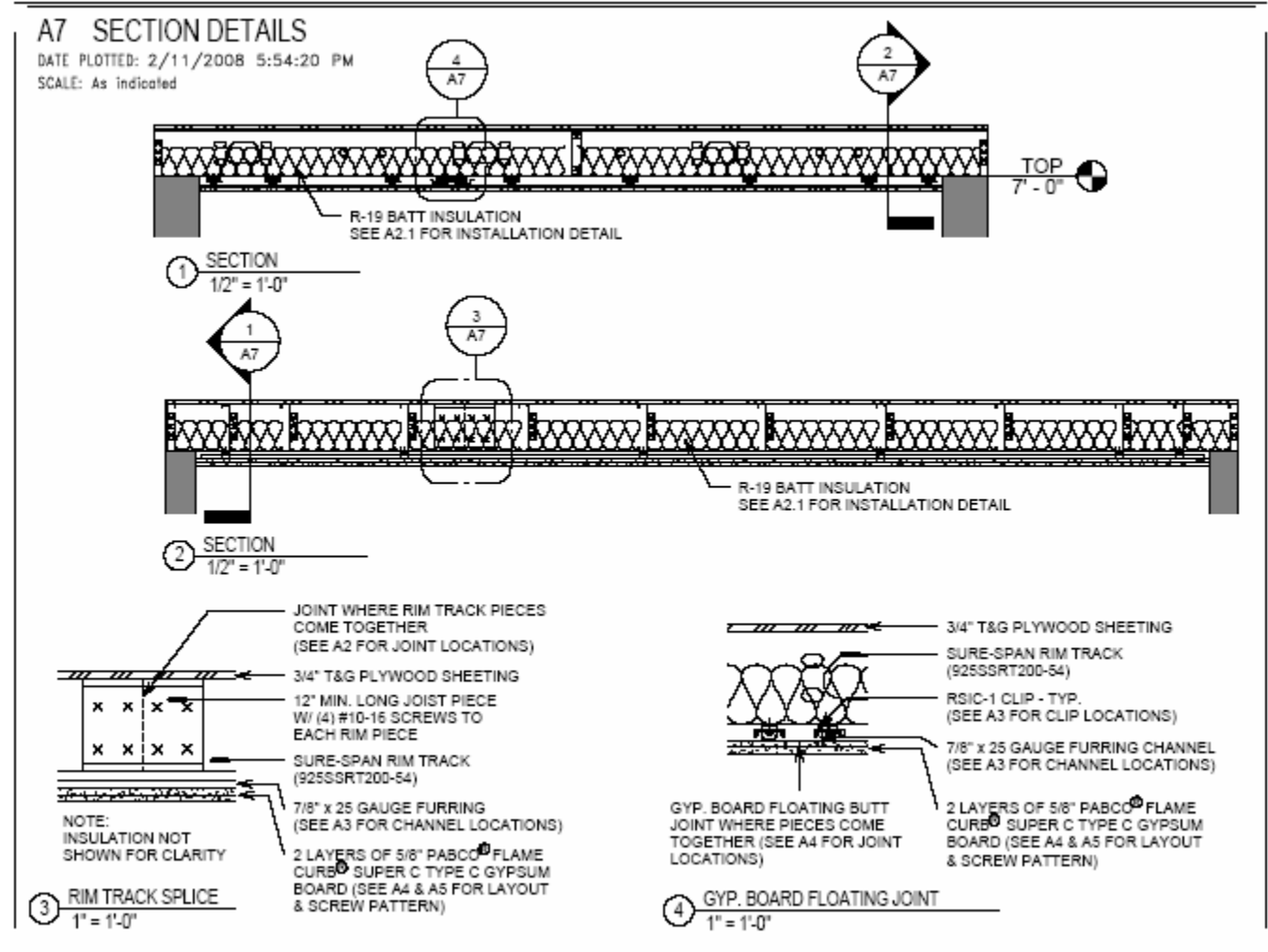


A6 TOP SHEETING LAYOUT

DATE PLOTTED: 2/11/2008 5:54:18 PM
SCALE: 1/2" = 1'-0"

NOTE: ALL SCREWS ARE GRABBER BRAND ITEM NUMBER
12200FW3 FLAT HEAD WINGED DRILLER T-2 POINT #12 X 2"

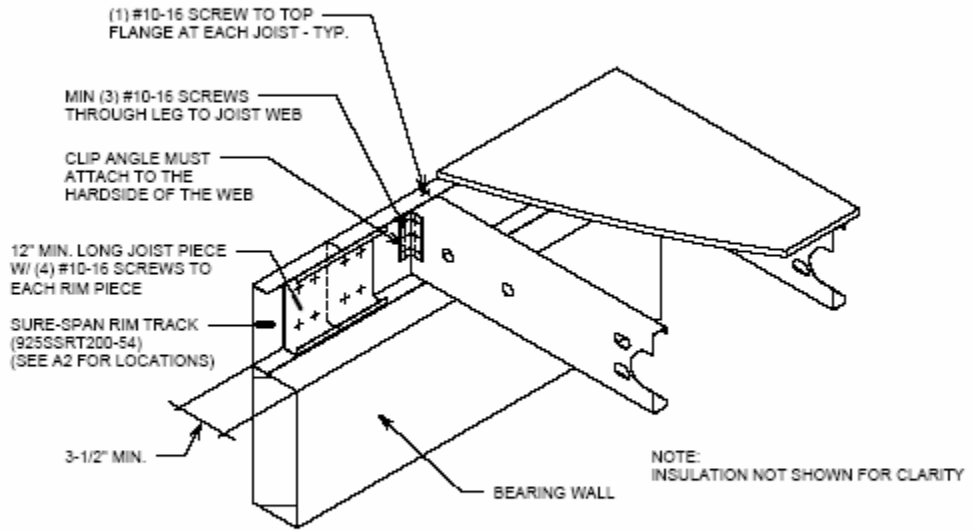




A8 ISO DETAIL - CONNECTION @ RIM JOIST

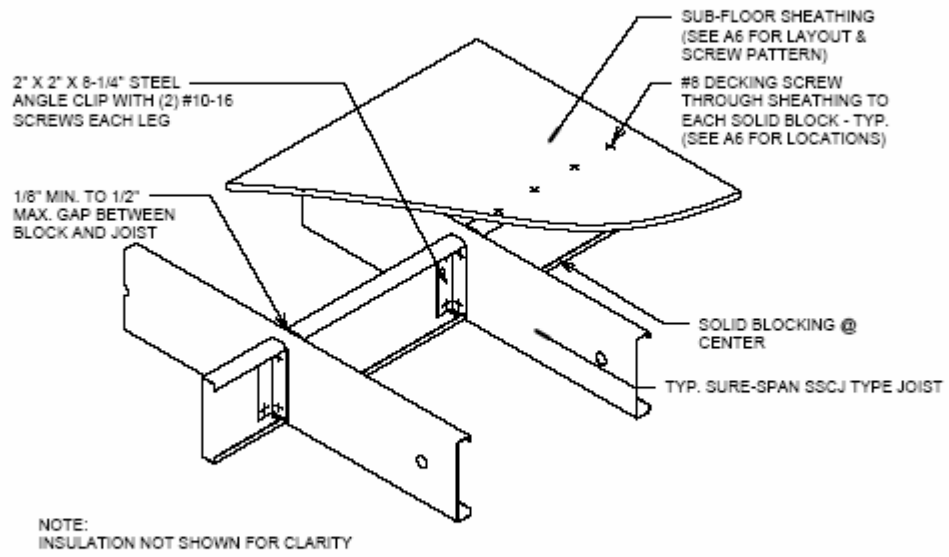
DATE PLOTTED: 2/11/2008 5:54:20 PM

SCALE: 1" = 1'-0"



A9 ISO DETAIL - BLOCKING

DATE PLOTTED: 2/11/2008 5:54:21 PM
SCALE: 1" = 1'-0"



APPENDIX B:
PHOTOGRAPHS



Placement of Subflooring Atop Steel Joists



Location of Cavity Thermocouples



Structural Blocking



RSIC-1 Clip



Insulation and Furring Channel Placement



Base (Upper) Layer Butt Joint



Application of Face Layer



Finished Ceiling



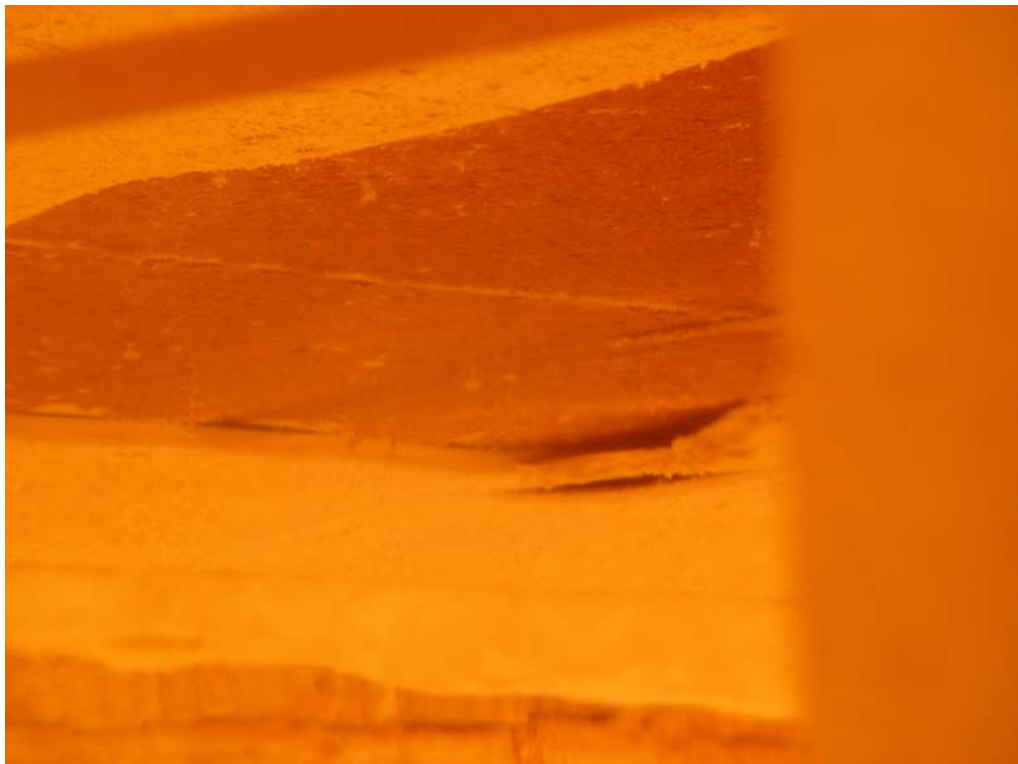
15 minutes- tape falling from E-W joint at N end of furnace



30 minutes: E-W joint at N end of furnace



65 minutes: E-W joint at N end of furnace



1 hour, 9 minutes: face layer falloff exposes base layer



1 hour, 20 minutes: immediately prior to test termination



Immediately after test termination



Post test: center section of ceiling



NW quarter section



NW qtr section with furring channel and insulation exposed



RSIC-1 clips with channel removed