ANSI/APA PRG 320-2018 (Recirculation Ballot 2018-1-R1)

Ballot issue date: 01/08/2018 **Ballot closing date: 01/16/2018**

Ballot Instructions (Please Read):

1) This is a **7-day recirculation ballot for Ballot 2018-1** that was issued on 11/27/17 and closed 12/28/17.

2) Ballot 2018-1 received no negative votes and passed. However, there were affirmative comments. The ExSub reviewed those comments and suggested some editorial changes and clarifications. **ANSI requires the changes be recirculated, as included in this Recirculation Ballot 2018-1-R1, to afford all members of the Committee an opportunity to respond, reaffirm, or change their vote.**

3) If this recirculation ballot do not affect your previous vote on Ballot 2018-1, you can either confirm your vote by returning this ballot or do nothing (your previous vote will be considered as your vote on this recirculation ballot). However, it is encouraged that you return this ballot to avoid any ambiguity.

4) If the changes in this recirculation ballot do affect your previous vote, you must cast your new vote by returning this ballot. A written explanation and proposed resolution is not required, but encouraged, if you vote "Negative" or "Affirmative-with-Comment." If you would like to provide comments, please use the comment form.

5) Please return your ballot by e-mail to borjen.yeh@apawood.org.

Committee Member Name	Signature (not required with e-mail)	Date

Ballot (Aff = affirmative; Aw/C = affirmative with comment; Neg = negative; Abst = abstention)

Item	Description	Aff	Aw/C	Neg	Abst
2018-1-R1-01	Revise adhesive requirements as marked in this ballot (Recirculation Ballot)				

Ballot Comment Form for ANSI/APA PRG 320-2018 (Recirculation Ballot 2018-1-R1)
NOT required, but encouraged, for a "Negative" or "Affirmative-with-Comment" vote
Please attach this page to the e-mail ballot return

Item	Comments
2018-1-R1-01	

Adhesive Requirement Revisions
Recirculation Ballot 2018-1-R1 (1 item)

Notations: Inserted Text — New Text (**based on Ballot 2018-1**)
Deleted Text — ~~Old Text~~ (**based on Ballot 2018-1**)

Item 2018-1-R1-01: Revise Sections 2.1 and 6.3 as follows:

Rationale: This recirculation ballot addresses affirmative comments from Ballot 2018-1. See the attached resolutions to the ballot comments for rationale.

Ballot:
2.1 U.S. Standards
ANSI 405-2018 Standard for Adhesives for Use in Structural Glued Laminated Timber

6.3 Adhesives
Adhesives used for CLT manufacturing shall meet the requirements specified in this section.

6.3.1 Requirements in the U.S.
Adhesives used in CLT shall meet the requirements of ANSI 405 ~~(including ASTM D7247 heat durability and CSA O177 small-scale flame tests)~~ with the following exceptions:

a) Section 2.1.6 of ANSI 405 ~~(either ASTM D3434 or CSA O112.9)~~ is not required, and
b) The CSA O177 small-scale flame test~~s~~ (Sections 2.1.7 and 3.7 of ANSI 405) shall be conducted using CLT specimens of the same size and geometry ~~to replace~~ as the structural glued laminated timber specimens.

6.3.2 Requirements in Canada
Adhesives used in CLT shall meet the requirements of CSA O112.10, and Sections 2.1.3, 2.1.7, ~~and~~ 3.3 ~~(ASTM D7247 heat durability), and Sections 2.1.7~~ and 3.7 ~~(CSA O177 small-scale flame tests)~~ of ANSI 405 with the following exception:

a) The CSA O177 small-scale flame test~~s~~ (Sections 2.1.7 and 3.7 of ANSI 405) shall be conducted using CLT specimens of the same size and geometry ~~to replace~~ as the structural glued laminated timber specimens.

Note 6: The CSA O177 small-scale specimens should be made with orthogonal 0.78-inch (20-mm) laminations to replicate a CLT configuration, resulting in 8 laminations (6.3 inches or 160 mm) in height, and approximately 6 inches (150 mm) in width and 1.6 inches (40 mm) in thickness. There should be no edge joints within the inner 6 laminations. Whenever possible, the pith should be centered along the lamination.

6.3.3 Elevated temperature performance requirements in the U.S. ~~or~~ and Canada
Adhesives shall be evaluated and comply with the requirements for elevated temperature performance in accordance with Annex B.

~~Note 6. The intent of the elevated temperature performance evaluation is to determine whether an adhesive will exhibit fire re-growth characteristics.~~

Note 7. The intent of the elevated temperature performance evaluation is to identify and exclude use of adhesives that permit CLT char layer fall-off resulting in fire re-growth during the cooling phase of a fully developed fire.

Add a new mandatory Annex B and non-mandatory Appendix X2 as attached.

Editorial Notes: The Current Appendix A in PRG 320-2017 will be editorially renumbered as Appendix X1 and the current Appendix B will be editorially renumbered as Appendix X3. The new Appendix included in this ballot (below) will be numbered as Appendix X2. The paragraphs in Annex B and Appendix X2 will have a prefix of B and X2, respectively (not marked as changes).

Annex B. Practice for Evaluating Elevated Temperature Performance of Adhesives Used in Cross-Laminated Timber (Mandatory)

B1. Scope

B1.1 This ~~standard practice~~ annex is to be used to evaluate the elevated temperature performance of adhesives used in cross-laminated timber (CLT).

B1.2 An unprotected CLT floor-ceiling slab is exposed to specified fire conditions representative of a real fire scenario.

B1.3 The unprotected CLT floor-ceiling slab shall sustain the applied load during the specified fire exposure for a period of 240 minutes without char layer fall-off ~~that results in a significant temperature rise~~ resulting in fire re-growth during the cooling phase of a fully developed fire.

B1.4 This ~~practice~~ annex is used to evaluate the performance of adhesives used in CLT to heat and flame under controlled conditions, but does not by itself incorporate all factors required for fire hazard or fire risk assessment under actual fire conditions.

B1.5 This ~~standard~~ annex does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this ~~standard~~ annex to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

B2. Referenced Documents

See Section 2 of the standard for referenced ~~standards~~ documents. Referenced standards specific to this annex ~~is~~ are listed below.

ASTM C1396/C1396M-17 Standard Specification for Gypsum Board
ASTM E176-15ae1 Standard Terminology of Fire Standards

B3. Terminology

B3.1 *Definitions*- Definitions used in this ~~practice~~ annex are in accordance with Section 3 of the standard, and the terminology standards ASTM D9 and ASTM E176, unless otherwise indicated.

B3.1.1 *Superimposed Load*—the additional external load needed to be applied to the slab to result in the specified calculated stresses within the slab when any dead load of the assembly itself is accounted for in the calculations.

B4. Summary of Practice

B4.1 This ~~practice~~ annex shall be used to evaluate adhesives intended for use in ~~unprotected~~ CLT by fire testing a floor-ceiling slab under a vertical load associated with 25% of the effective ASD reference flatwise bending moment of the CLT. The unprotected CLT floor-ceiling slab shall sustain the applied load during the specified fire exposure for a period of 240 minutes

without char layer fall-off ~~that results~~ resulting in a significant temperature increase at the compartment ceiling during the cooling phase of a fully developed fire. The temperature increase is considered significant if, ~~After~~ after 150 minutes, ~~the~~ any room interior thermocouple~~s~~ at the compartment ceiling ~~shall not~~ exceed~~s~~ 950 °F (510 °C) at any time before termination of the test.

B5. Significance and Use

B5.1 CLT used in fire resistance-rated assemblies shall be able to support the superimposed design load for the specified time under the specified fire exposure without char layer fall-off resulting in ~~significant secondary fire growth after the room contents have been substantially consumed by fire.~~ fire re-growth during the cooling phase of a fully developed fire.

B6. Sample Description

B6.1 ~~Sample~~ Dimensions – CLT floor-ceiling sample shall be approximately 8 feet by 16 feet (2438 mm by 4877 mm), with the ~~strong axis spanning in the~~ long dimension spanning in the major strength direction. Clear distance between the supports shall be at least 15 feet (4572 mm).

B6.2 ~~Sample~~ Fabrication – CLT floor-ceiling test sample shall be at least 5-ply CLT with maximum lamination thickness~~es~~ of 1 3/8 inches (35 mm) and maximum lamination widths of 7 1/4 inches (184 mm). The edge joints in the laminations shall be tight, but shall not be edge-glued.

B6.3 ~~Sample~~ Adhesive – CLT floor-ceiling test sample shall be fabricated using ~~use~~ the adhesive being evaluated ~~between each lamination~~.

B6.4 Moisture Content – The moisture content of the CLT floor-ceiling test sample shall be not greater than the moisture content specified in Section 6.1.4 of this standard at the time of the fire test.

B7. Test Room Description

B7.1 Test Room Dimensions – A test room shall have interior dimensions of 9 feet ± 4 inches (2743 mm ± 102 mm) in width by 19 feet ± 4 inches (~~2743~~5791 mm ± 102 mm) in depth by 8 feet ± 2 inches (2438 mm ± 51 mm) in height. The test room shall consist of two sections separated by a protected beam across the width of the room, located at approximately 15 feet (4572 mm) from the interior of the front wall ~~(interior dimension)~~. The CLT floor-ceiling sample shall be located in the front section of the room. A propane or natural gas diffusion burner shall be used to create the exposing fire. The burner shall be located in the back section of the test room (referred to hereafter as the burner compartment).

Note B1: A steel frame structure protected with three layers of 5/8-inch (15.9-mm) type X gypsum board conforming to ASTM C1396/C1396M and three layers of 6 pcf (96 kg/m^3) ceramic fiber blanket (four layers of each in the back section) has been found suitable (see Appendix X2 ~~B~~ for a detailed description of the test structure that was used in the development of the method described in this ~~standard~~ annex).

B7.2 Floor-Ceiling Support – The CLT floor-ceiling slab shall be supported across the full 8-foot (2438-mm) width of the room by the front wall at one end and by a protected beam at the other end. The beam shall be located at a sufficient distance from the front wall to result in a clear span of at least 15 feet (4572 mm). The remaining portion of the ceiling over the burner shall be protected.

B7.3 Front Wall – The 8-foot (2438-mm) tall bearing wall at the front end of the room shall be capable of supporting the CLT floor-ceiling slab for the ~~full~~ duration of the fire test.

B7.4 Back Wall – The 8-foot (2438-mm) tall bearing wall at the back end of the room shall be capable of supporting the protected ceiling over the burner ~~at one end~~ for the duration of the fire test. ~~The ceiling over the burner shall be supported by the protected beam at the other end.~~

B7.5 Non-Loadbearing Side Walls – The 10-foot (3048 mm) tall, 19-foot (5791-mm) long side walls of the test room shall be capable of remaining in place without deflection for the ~~full~~ duration of the fire test. A narrow gap along each of the side walls shall permit the floor-ceiling slab to deflect freely without contacting the side walls. The gap between the side wall and the CLT floor-ceiling slab shall be covered with ceramic fiber blanket to prevent smoke and hot gases from leaking and exposing the long edges of the CLT slab.

B7.6 Wall Opening Dimensions – All four walls shall be enclosed except for a ventilation opening in the front 8-foot (2438-mm) wall, which shall have dimensions of 36 ± 2 inches (914 ± 51 mm) in width by 75 ± 2 inches (1905 ± 51 mm) in height.

B7.7 Protected Beam – The ~~A~~ beam shall be located 15 feet ± 4 inches (4572 ± 102 mm) from the interior of the front wall, and shall be capable of supporting the CLT floor-ceiling slab and the protected ceiling over the burner for the ~~full~~ duration of the fire test.

7.8 Burner Compartment – The back part of the test room shall consist of a 9 feet ± 4 inches (2743 mm ± 102 mm) wide by 7 feet ± 2 inches (2134 mm ± 51 mm) high burner compartment, and shall be open to the front part of the test room where the CLT floor-ceiling slab is located. The burner compartment shall be protected to ensure that its walls and ceiling remain in place without deflection for the duration of the fire test.

B8. Instrumentation

B8.1 Hot Gas Layer (Ceiling) Thermocouples – five 1/8-inch- (3.2-mm-) diameter exposed junction Inconel-sheathed type K thermocouples shall be located 4 inches (102 mm) below the ceiling in the following locations: at the center of the exposed ceiling and at the center of each of the four quadrants of the CLT floor-ceiling slab.

Note B2: To obtain an indication of the temperature evolution at the glue-lines, 1/16-inch- (1.6-mm-) diameter grounded junction Inconel-sheathed type K thermocouples can be inserted from the unexposed side of the CLT. Since the thermal exposure conditions vary somewhat between the front and the back of the test room, it is recommended that embedded thermocouples be installed at three locations along the long ~~axis~~ dimension of the CLT floor-ceiling slab, i.e., at the center and the quarter points of the clear span. It is further recommended that thermocouples be located at the bottom first, second, and third gluelines, and as far as possible from joints and edges. For example, for CLT made with 1 3/8-in (35-mm) thick laminations, the following thermocouple locations apply: 1.38, 2.75, and 4.13 inches (35, 70, and 105 mm) from the exposed side (bottom) of the CLT floor-ceiling slab. The measurement uncertainty of the embedded thermocouples is due to the error associated with the assumed depth at which the thermocouple is located, heat conduction along the thermocouple wires, the potential presence

of gaps and/or local density variations (such as knots) in the vicinity of the thermocouple…, etc. Consequently, the optional embedded thermocouple measurements are indicative, and are not part of the acceptance criteria.

B8.2 Gaseous fuel shall be supplied to the burner at a time-varying rate to obtain the heat release rate profile established from calibration testing (see Section B10).

B8.3 Temperatures and the fuel flow rate shall be recorded throughout the test.

B9. Loading

B9.1 The superimposed load on the CLT floor-ceiling slab shall result in 25% of the effective ASD reference flatwise bending moment.

B10. Calibration Test Method

B10.1 Calibration testing shall be conducted to determine the fuel flow rate for the qualification tests. The fuel flow rate shall provide an average temperature of the five ceiling thermocouple temperatures as shown in Figure B1. The time-temperature curve in Figure B1 is achieved by using a diffusion burner placed in the back of the test room, and by changing the burner fuel flow rate in steps at 0, 13, 38, 58, and 88 min. The average ceiling thermocouple temperature at those times shall be within the tolerances given in Table B1. The temperatures at other times in Table B1 are provided for guidance. In no case shall any ceiling thermocouple temperature drop more than 10% below the average of the recorded ceiling thermocouple temperatures.

Note B3: A burner consisting of a 2- by 6- by 1-foot (610- by 1829- by 305-mm) tall steel box with open top, filled with gravel and supplied with propane gas has been found suitable. See Appendix X2 ~~B~~ for a detailed description of the burner that was used in the development of the method described in this ~~standard~~ annex.

B10.2 The CLT floor-ceiling slab shall be protected from the bottom with three layers of 5/8-inch (15.9-mm) Type X gypsum wallboard conforming to ASTM C1396/C1396M. The gypsum wallboard shall be attached with Type S drywall screws every 12 inches (305 mm) o.c. with a minimum penetration into the wood of at least 1 inch (25.4 mm).

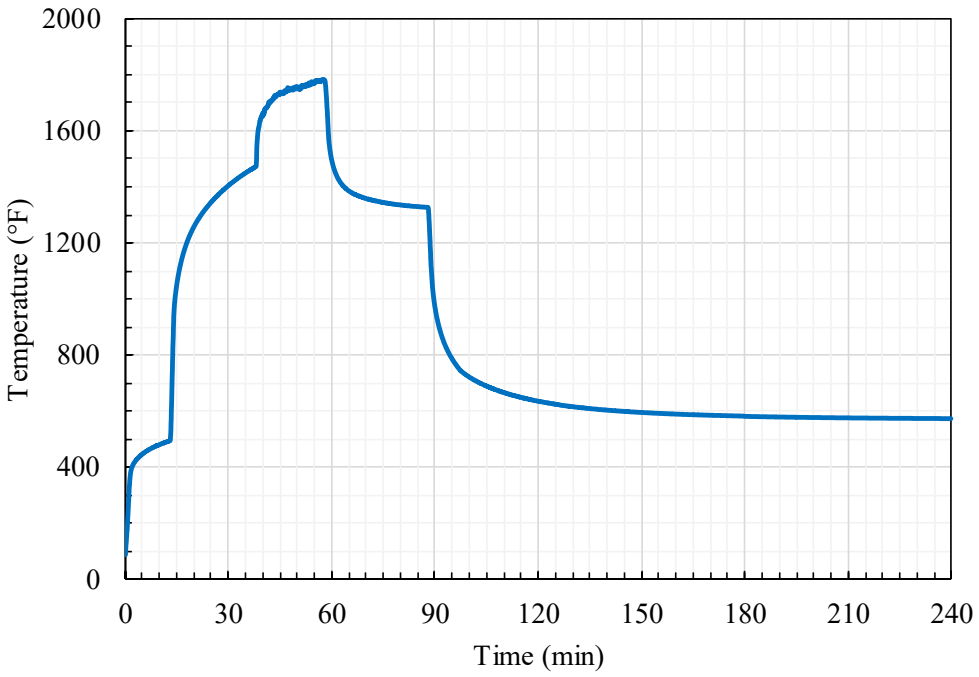


Figure B1. Calibration Time-Temperature Curve

Table B1. Calibration Temperatures and Tolerances at Specific Times

Time (min.)	Temperature (°F)	Tolerance (°F)	Temperature (°C)	Tolerance (°C)
13	493	±36	256	±20
28	1383		751	
38	1472	±45	800	±25
48	1746		952	
58	1778	±54	970	±30
68	1366		741	
78	1338		725	
88	1326	±45	719	±25
120	634		335	
150	594		312	
180	581	±36	305	±20
240	572		300	

B11. Qualification Test Method

B11.1 The fuel flow rate determined in Section B10.1 shall be used for the qualification tests.

B11.2 The unprotected CLT floor-ceiling slab, complying with Section B6, shall be tested for 240 minutes.

Note B4: If the CLT floor-ceiling slab clearly fails prior to 240 minutes, the test ~~shall~~ should be permitted to be terminated early.

B12. Acceptance Criteria

B12.1 The unprotected CLT floor-ceiling slab shall sustain the applied load during the specified fire exposure for a period of 240 minutes.

B12.2 After 150 minutes, none of the ceiling thermocouples shall exceed 950 °F (510 °C).

B13. Report

B13.1 The report shall contain the following minimum information:

B13.1.1 Description of the CLT floor-ceiling sample including the lamination species, lamination dimensions, ~~and~~ slab thickness, and the manufacturer;

B13.1.2 Adhesive manufacturer, adhesive type, and adhesive formulation identification;

B13.1.3 Description of the test room construction;

B13.1.4 Description of the loading method;

B13.1.5 Results of the calibration test including the fuel flow rates and thermocouple data;

B13.1.6 Time-temperature curve for the ceiling thermocouples; and

B13.1.7 Visual observations during and after the test.

Appendix X2~~B~~. Test Setup Used in the Development of Annex B ~~the Standard for Evaluating Elevated Temperature Performance of Adhesives Used in Cross-Laminated Timber~~ (Non-Mandatory)

X2-1 Introduction

This appendix provides a detailed description of the room that was used in the development of the test method described in ~~this standard~~ Annex B.

X2-2 Test Room

A test room was constructed with nominal interior dimensions 9 feet 4 inches (2845 mm) in width, 19 feet (5791 mm) in length, and 8 feet (2438 mm) in height. The ventilation opening in the front ~~narrow~~ wall was nominally 36 inches (914 mm) in width by 75 inches (1905 mm) in height. The test room was built directly on the concrete floor of the laboratory, but the test room floor was protected with several layers of type X gypsum board. Drawings of the finished test room can be found in Figures X2-1 through X2-4. A detailed description follows.

Two steel I-beams of 12 inches (305 mm) in height and 41 lbf/foot (0.6 kN/m) by weight welded together were located at approximately 15 feet (4572 mm) from the front wall to subdivide the test room into two sections. The ceiling of the front section was left open and allowed for the exposure of a 16-foot (4877-mm) long by 8-foot (2438-mm) wide mass timber ceiling panel. The panel was simply supported by the front wall at one end (bearing length ≈ 6 inches or 152 mm), and by the steel I-beam at the other end (bearing length ≈ 5 1/4 inches or 133 mm). The sides of the panel were not supported, and the panel was allowed to deflect freely between the two side walls. A gas burner to create the desired fire exposure was located in the back section of the room, as shown in Figure X2-5. Construction details for the test room walls, floor and ceiling are as follows:

X2-2.1 Front Wall—The front wall of the test room consisted of 8-foot (2438-mm) tall and 6-inch (152-mm) deep, 16-gauge steel studs at 12 inches (305 mm) on center, and with 16-gauge track top and bottom. The interior surface of the frame was covered with three layers of 5/8-inch (15.9-mm) type X gypsum board (National Gypsum Fire-Shield®), 20-gauge galvanized sheet steel, and three layers of 1-inch (25.4-mm) thick ceramic fiber blanket (Morgan Thermal Ceramics 6 pcf or 96 kg/m^3 Cerablanket®). The exterior surface was covered with two layers of 5/8-inch (15.9-mm) type X gypsum board, 20-gauge galvanized sheet steel (top half only), and one layer of 1-inch (25.4-mm) thick ceramic fiber blanket (additional layers of blanket were used at the soffit and above the ventilation opening).

X2-2.2 Side Walls—The side walls of the test room consisted of three layers of 4-foot (1219-mm) wide by 10-foot (3048-mm) tall 5/8-inch (15.9-mm) type X gypsum board attached to steel racks. The interior surface of the gypsum board was covered with three layers of 1-inch (25.4-mm) thick ceramic fiber blanket. An additional layer of blanket was attached to the side walls in the back section of the test room. In the front section of the test room, the web of a 6-inch (152-mm) deep steel stud covered with 16-gauge track was attached to the side walls at 8 feet (2438 mm) above the floor. The bottom of the covered studs was protected with three layers of 5/8-inch (15.9-mm) type X gypsum board. Two layers were used to protect the vertical and top surfaces. The studs and track mounted along the side walls were covered with four layers of ceramic fiber blanket to reduce the width of the opening in the front section of the test room from 9 feet 4 inches (2845

mm) to 8 feet 5 inches (2565 mm), as shown in Figure X2-5. The gaps along the edges of the panel were filled with ceramic fiber blanket, and the top and bottom of the gaps were then covered with a strip ceramic fiber blanket attached to the panel and a side wall of the test room, as shown in Figure X2-6.

X2-2.3 Back Wall—The back wall of the test room consisted of 8-foot (2440-mm) tall, 3 5/8-inch (92-mm) deep, 18-gauge steel studs at 12 inches (305 mm) on center and with 18-gauge track top and bottom. The interior surface of the frame was covered with four layers of 5/8-inch (15.9-mm) type X gypsum board and three layers of 1-inch (25.4-mm) thick ceramic fiber blanket. The exterior surface was not finished. An opening at the bottom of the back wall allowed the 2-inch- (50.8-mm-) diameter propane pipe nipple from the burner to pass-through to connect to the supply hose outside the test room. The opening was sealed with ceramic fiber blanket.

X2-2.4 I-beams—The space between the exposed surfaces of the flanges and web were filled with several layers of 5/8-inch (15.9-mm) type X gypsum board, and the beams were then wrapped with four layers of 1-inch (25.4-mm) thick ceramic fiber blanket.

X2-2.5 Back Section Ceiling—The ceiling above the burner consisted of a spare 4.5-foot (1372-mm) by 8-foot (2438-mm) CLT panel, protected with four layers of 5/8-inch (15.9-mm) type X gypsum board and four layers of 1-inch (25.4-mm) thick ceramic fiber blanket. The front edge of the CLT panel was supported by one of the two I-beams. At the back edge, the CLT panel was attached to a 3 1/2-inch (89-mm) by 3 1/2-inch (89-mm) by 1/4-inch (6.4-mm) angle iron welded to the racks supporting the side walls.

Fastener details are as follows:

- First layer of gypsum board: 1 7/8-inch (48-mm) #6 type S bugle head drywall screws.
- Second layer of gypsum board: 2 1/2-inch (64-mm) #6 type S bugle head drywall screws.
- Third and fourth layer of gypsum board: 3-inch (76-mm) #8 type S bugle head drywall screws.
- First and second layer of ceramic fiber blanket: 4 1/2-inch (114-mm) coarse thread screws with 1-inch (25.4-mm) washers.
- Third and fourth layer of ceramic fiber blanket: 12-gauge galvanized steel wire bent into horseshoe shape.

Screw spacing was approximately 12 inches (305 mm). Wires were used where needed. All joints were staggered with at least 1 foot (305 mm) separation.

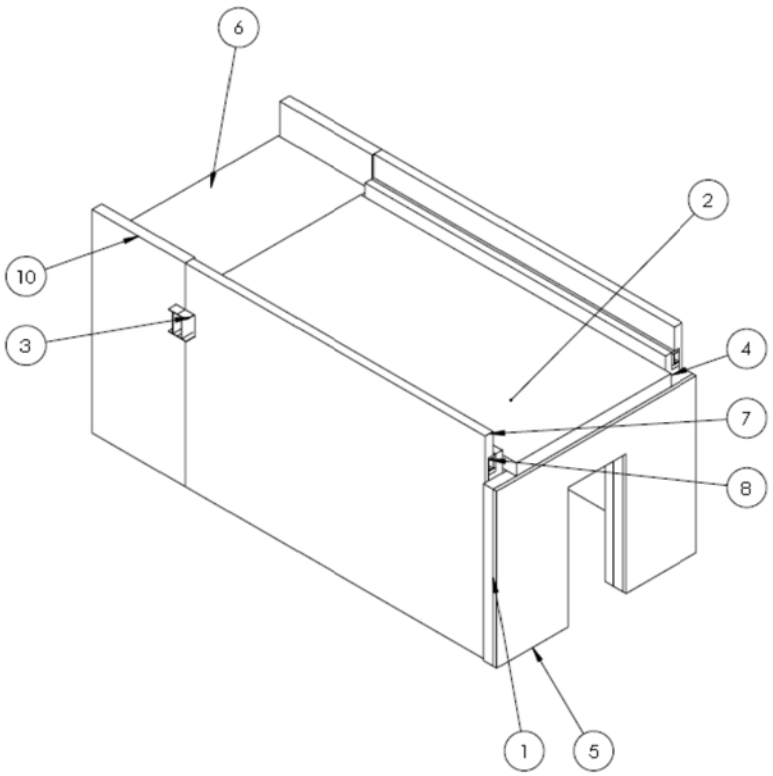
X2-3. Gas Burner

X2-3.1 Burner Construction—A gas burner was constructed to create the exposing fire. The burner consisted of a 6-foot (1829-mm) long by 2-foot (610-mm) wide by 1-foot (305-mm) tall steel box with open top. Five pieces of 2-inch (51-mm) by 3-inch (76 mm) steel rectangle tube were welded to the bottom plate, elevating the burner approximately 2 inches (51 mm) above the floor (see Figure X2-5). The burner was supplied with propane through a 2-inch- (51-mm-) diameter pipe. The gas flow was evenly distributed to eight downward-facing release points as shown in Figure X2-7. The burner was filled with coarse gravel to ensure relatively uniform propane flow at the top surface (see Figure X2-5).

X2-3.2 Burner Heat Release Rate Profile—Propane was supplied from two tanks via a vaporizer, a regulator, and a 2-inch- (51-mm-) diameter pipe with several shut-off valves and a control valve. The propane flow rate was manually controlled, and measured with a Coriolis mass flow sensor. The burner profile is shown in Table X2-1 and Figure X2-8.

Table X2-1. Burner HRR Step Profile.

Start (min.)	End (min.)	HRR (kW)
0	13	250
13	38	1075
38	58	1377
58	88	834
88	End of Test	250



ITEM NO.	DESCRIPTION	QTY.
1	Front Wall	1
2	CLT Panel	1
3	IBeam 12x41	2
4	Front Wall_Interior Insulation	1
5	Front Wall_Exterior Insulation	1
6	Burner Section_Ceiling Insulation	1
7	SideWall_CLT Section	2
8	Sidewall_Studs and Track	4
9	SideWall_Stud Insulation Blanket	2
10	Burner Section_SideWall	2
11	Burner	1
12	Burner Section_Back Wall	1
13	Burner Section_CLT Panel	1
14	Burner Section_Outside Gyp	1
15	Sidewall_Stud-side Gyp	2
16	SideWall_Stud Under-Gyp	2
17	SideWall_Stud Top-Gyp	2

Figure X2-1. 3-D View of Test Room

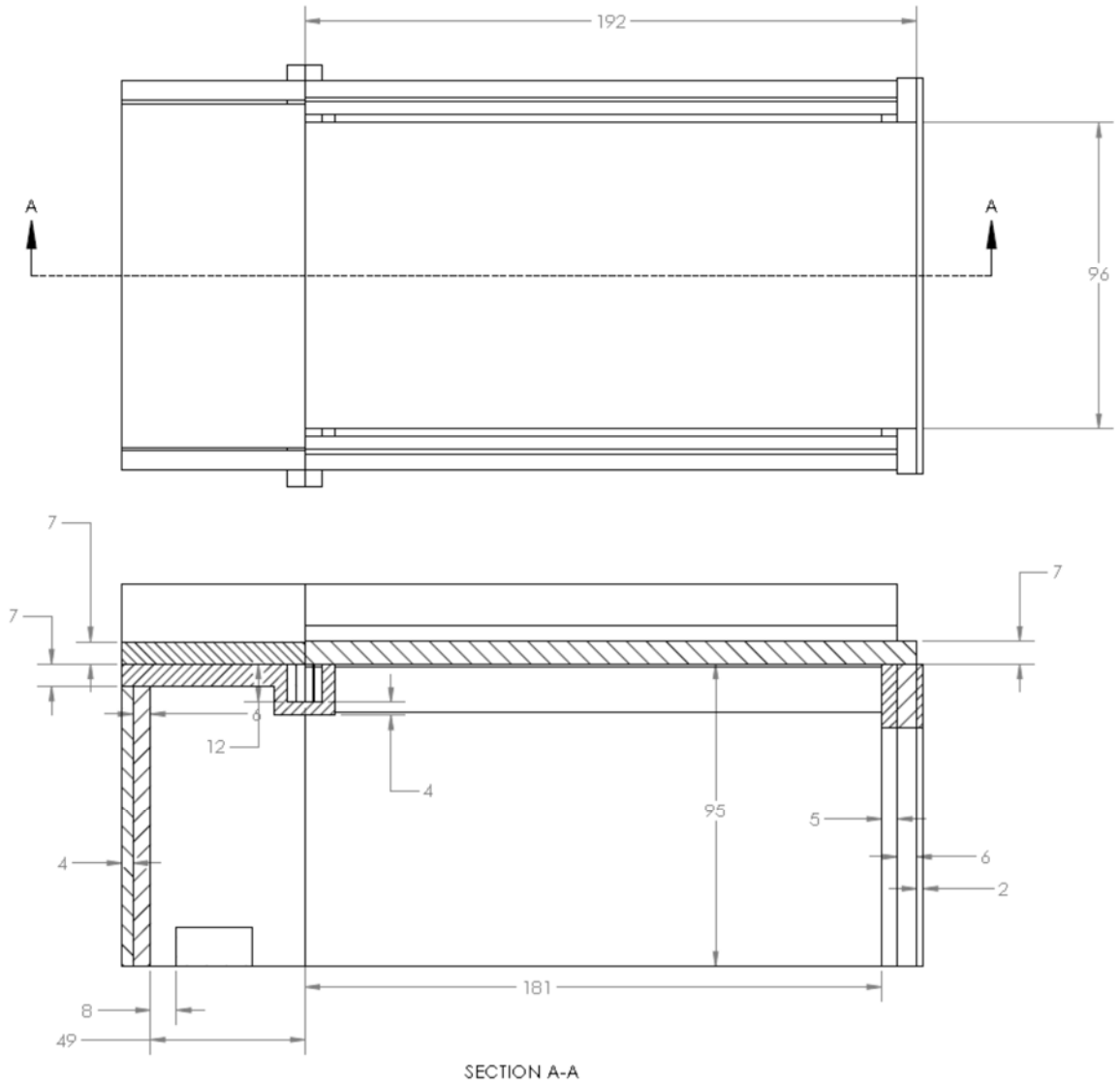


Figure X2-2. Plan View and Side Elevation (Section) of Test Room (Units in inches)

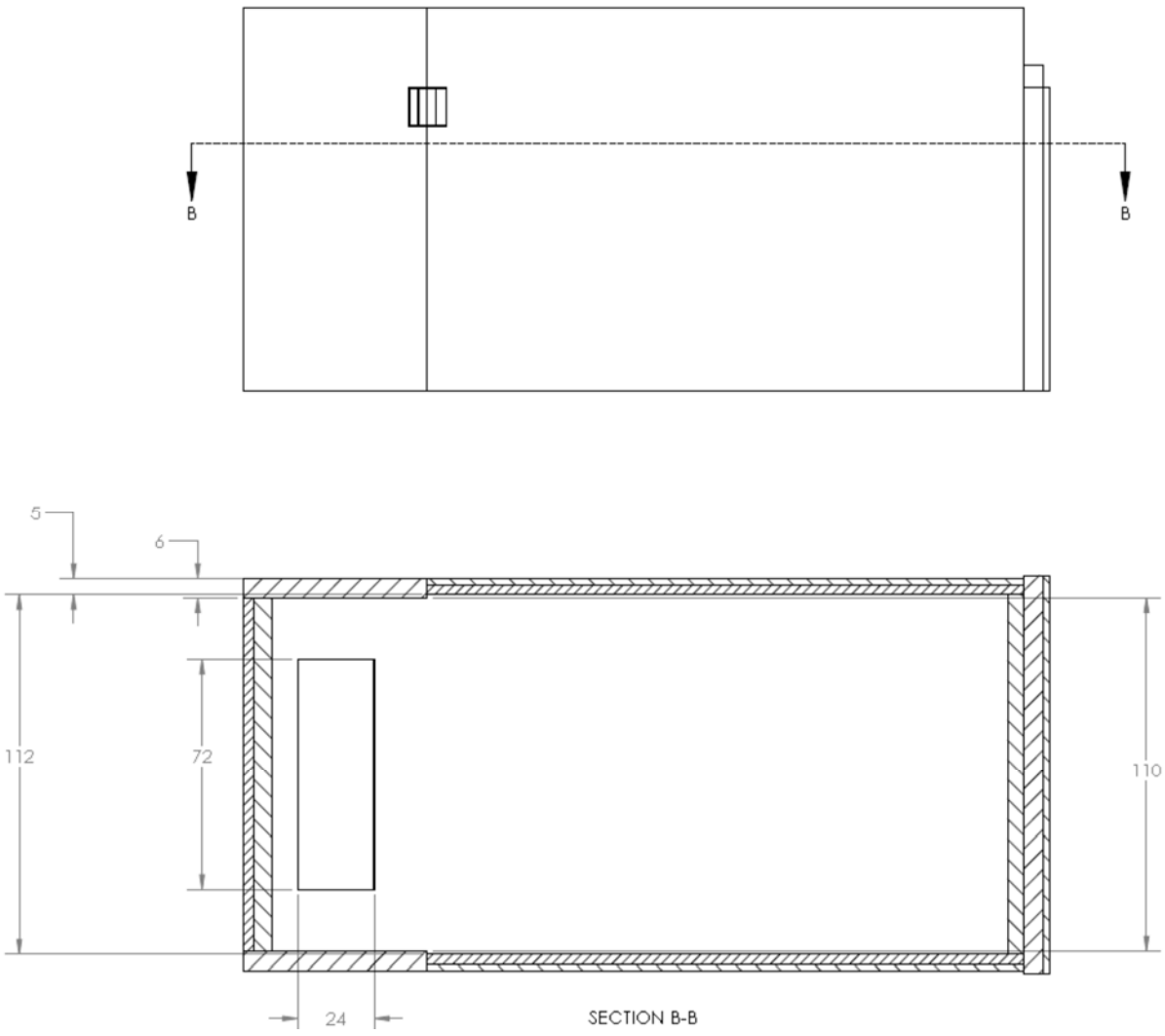


Figure X2-3. Plan View (Section) and Side Elevation (Section) of Test Room (Units in inches)

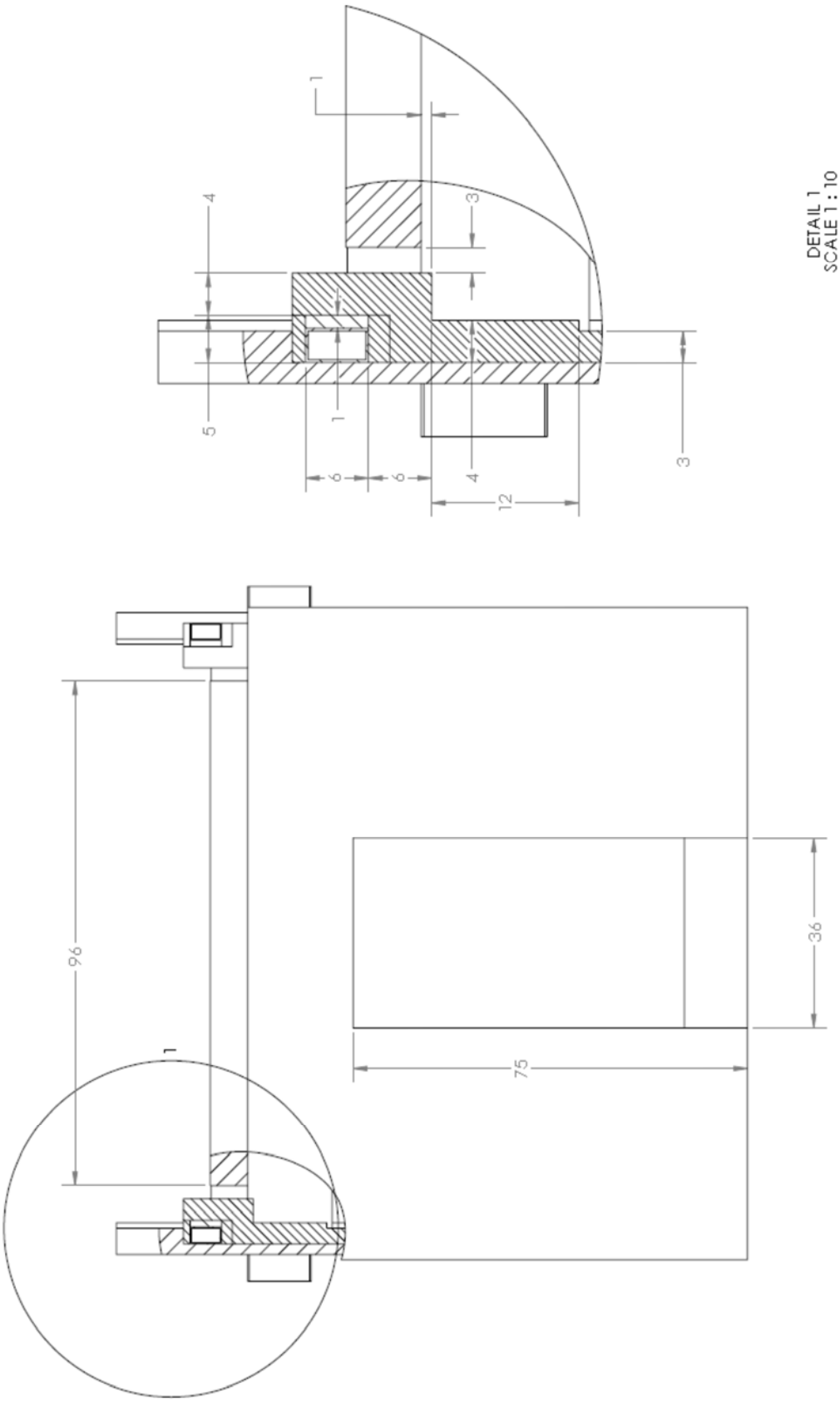


Figure X2-4. Front Elevation and Construction Detail to Narrow Gap along Sides of CLT Sample (Units in inches)

Figure X2-5. Propane Diffusion Burner

Figure X2-6. Picture Illustrating Ceramic Fiber Cover around Panel Perimeter

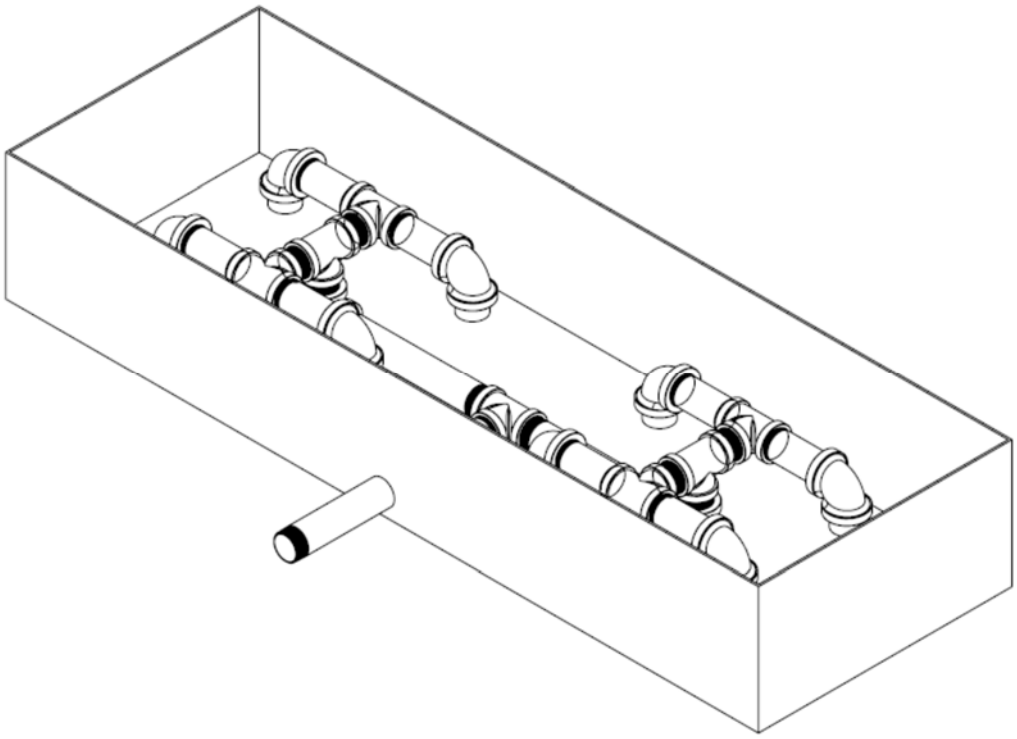


Figure X2-7. Schematic of Burner Illustrating Distribution of Propane Flow

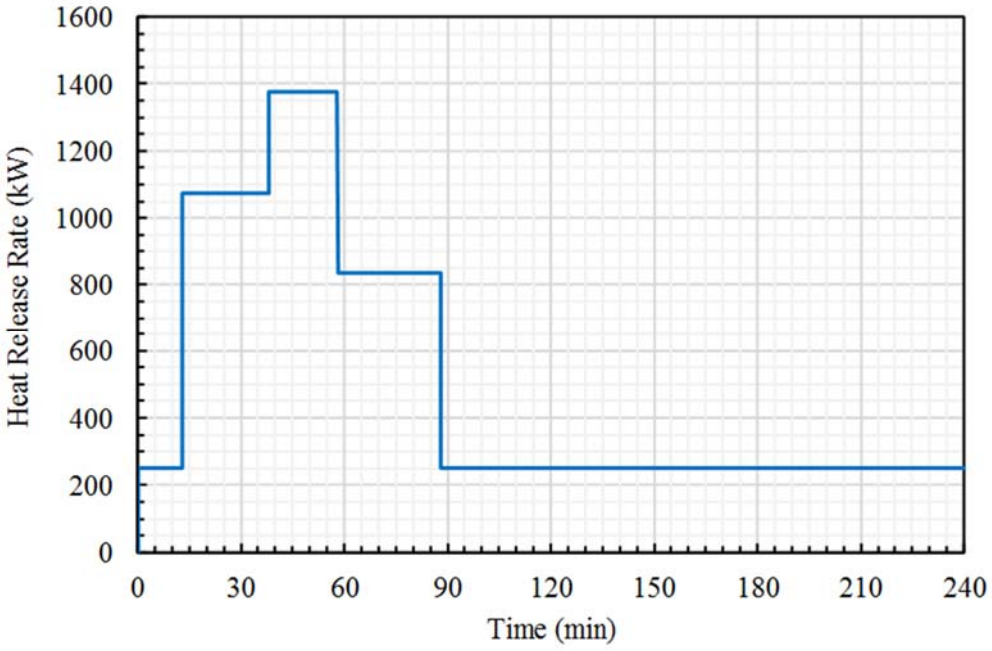


Figure X2-8. Burner Heat Release Rate Profile