

Inventory of Fire Resistance-Tested Mass Timber Assemblies & Penetrations



Following is a list of mass timber assemblies and penetration fire stopping systems in mass timber assemblies that have been tested for fire-resistance. Sources are noted at the end of this document. For free technical assistance on any questions related to the fire-resistance design of mass timber assemblies, or free technical assistance related to any aspect of the design, engineering or construction of a commercial or multi-family wood building in the U.S., email help@woodworks.org or contact the WoodWorks Regional Director nearest you: <http://www.woodworks.org/project-assistance>

Contents:

Table 1: North American Fire Resistance Tests of Mass Timber Floor / Roof Assemblies

Table 2: North American Fire Resistance Tests of Mass Timber Wall Assemblies

Table 3: North American Fire Tests of Penetrations and Fire Stops in CLT Assemblies

Sources

Disclaimer

Table 1: North American Fire Resistance Tests of Mass Timber Floor / Roof Assemblies

Mass Timber Panel	Manufacturer	CLT Grade or Timber Grade	Ceiling Protection	Panel Connection	Floor Topping	Load Rating	Fire Resistance Achieved (Hours)	Source	Testing Lab
3-ply CLT (114mm 4.488 in)	Nordic	SPF 1650 Fb 1.5E MSR x SPF #3	2 layers 1/2" Type X gypsum	Half-Lap	None	Reduced 36% Moment Capacity	1	1 (Test 1)	NRC Fire Laboratory
3-ply CLT (105mm 4.133 in)	Structurlam	SPF #1/#2 x SPF #1/#2	1 layer 5/8" Type X gypsum	Half-Lap	None	Reduced 75% Moment Capacity	1	1 (Test 5)	NRC Fire Laboratory
5-ply CLT (175mm 6.875")	Nordic	E1	None	Topside Spline	2 staggered layers of 1/2" cement boards	Loaded, See Manufacturer	2	2	NRC Fire Laboratory March 2016
5-ply CLT (175mm 6.875")	Nordic	E1	1 layer of 5/8" Type X gypsum under Z-channels and furring strips with 3 5/8" fiberglass batts	Topside Spline	2 staggered layers of 1/2" cement boards	Loaded, See Manufacturer	2	5	NRC Fire Laboratory Nov 2014
5-ply CLT (175mm 6.875")	Nordic	E1	None	Topside Spline	3/4 in. proprietary gypcrete over Maxxon acoustical mat	Reduced 50% Moment Capacity	1.5	3	UL
5-ply CLT (175mm 6.875")	Nordic	E1	1 layer 5/8" normal gypsum	Topside Spline	3/4 in. proprietary gypcrete over Maxxon acoustical mat or proprietary sound board	Reduced 50% Moment Capacity	2	4	UL
5-ply CLT (175mm 6.875")	Nordic	E1	1 layer 5/8" Type X gyp under Resilient Channel under 7 7/8" I-Joists with 3 1/2" Mineral Wool between Joists	Half-Lap	None	Loaded, See Manufacturer	2	21	Intertek 8/24/2012
5-ply CLT (175mm 6.875")	Structurlam	E1M5 MSR 2100 x SPF #2	None	Topside Spline	1-1/2" Maxxon Cyp-Grete 2000 over Maxxon Reinforcing Mesh	Loaded, See Manufacturer	2.5	6	Intertek, 2/22/2016
5-ply CLT (175mm 6.875")	DR Johnson	V1	None	Half-Lap & Topside Spline	2" gypsum topping	Loaded, See Manufacturer	2	7	SwRI (May 2016)
5-ply CLT (175mm 6.875")	Nordic	SPF 1950 Fb MSR x SPF #3	None	Half-Lap	None	Reduced 59% Moment Capacity	1.5	1 (Test 3)	NRC Fire Laboratory
5-ply CLT (175mm 6.875")	Structurlam	SPF #1/#2 x SPF #1/#2	1 layer 5/8" Type X gypsum	Half-Lap	None	Unreduced 101% Moment Capacity	2	1 (Test 6)	NRC Fire Laboratory
7-ply CLT (245mm 9.65")	Structurlam	SPF #1/#2 x SPF #1/#2	None	Half-Lap	None	Unreduced 101% Moment Capacity	2.5	1 (Test 7)	NRC Fire Laboratory
5-ply CLT (175mm 6.875")	SmartLam	SL-V4	None	Half-Lap	1/2" plywood with 8d nails.	Loaded, See Manufacturer	2	12 (Test 4)	Western Fire Center 10/26/2016
5-ply CLT (175mm 6.875")	SmartLam	V1	None	Half-Lap	1/2" plywood with 8d nails.	Loaded, See Manufacturer	2	12 (Test 5)	Western Fire Center 10/28/2016
5-ply CLT (175mm 6.875")	DR Johnson	V1	None	Half-Lap	1/2" plywood with 8d nails.	Loaded, See Manufacturer	2	12 (Test 6)	Western Fire Center 11/01/2016
5-ply CLT (160mm 6.3")	KLH	CV3M1	None	Half-Lap & Topside spline	None	Loaded, See Manufacturer	1	18	SwRI May 10, 2018
5-ply CLT (130mm 5.1")	KLH	CV3M1	None	Half-Lap & Topside spline	TPO roof membrane over cover board over rigid insulation over vapor barrier	Loaded, See Manufacturer	1 (roof)	19	SwRI April 19, 2018

Table 1: North American Fire Resistance Tests of Mass Timber Floor / Roof Assemblies

Mass Timber Panel	Manufacturer	CLT Grade or Timber Grade	Ceiling Protection	Panel Connection	Floor Topping	Load Rating	Fire Resistance Achieved (Hours)	Source	Testing Lab
5-ply CLT (175mm 6.875")	KLH	CV3M1	None	Topside Spline	None	Loaded, See Manufacturer	2	33	SwRI Mar 11, 2020
5-ply CLT (180mm 7.09")	KLH	CV3M1	None	Topside Spline	None	Loaded, See Manufacturer	2	36	SwRI Aug 13, 2020
6 " Thick MPP	Freres Lumber	F16	None	Half-Lap & Surface Spline	3/4" Plywood	Loaded, See Manufacturer	2	16	SwRI 9/11/2018
5-ply CLT (5.4")	Katerra	V2	None	Half-Lap & Surface Spline	None	Loaded, See Manufacturer	1	29	SwRI 7/2/2019
5-ply CLT (5.4")	Katerra	V2	None	Half-Lap & Surface Spline	TPO roof membrane over cover board over rigid insulation over vapor barrier	Loaded, See Manufacturer	1 (roof)	30	SwRI 7/10/2019
5-ply CLT (6.3")	Katerra	V2	None	Half-Lap & Surface Spline	None	Loaded, See Manufacturer	2	31	SwRI 7/18/2019
5 ply CLT (175mm 6.875")	Structurlam	V grade	None	Surface Spline	None	Loaded, See Manufacturer	2	43	SwRI 1/27/2022
5 ply CLT (175mm 6.875")	Structurlam	E grade	None	Surface Spline	None	Loaded, See Manufacturer	2	44	SwRI 1/31/2022
2x6 DLT (5.5" DLT)	StructureCraft Builders	2x6 SPF #2 DLT	None	Plywood Spline	2" Normal Weight (4000psi) Concrete over 1/2" Plywood	Loaded, See Manufacturer	2	15	SwRI 10/23/2018
2x6 NLT	N/A	2x6 SPF #2 NLT with 3" (75mm) Common Nails @ 18" o.c. (450mm)	None	Butt Joint with Screws	1/2" Plywood	Loaded, See Manufacturer	1.5	27	FPInnovations 10/11/2018
2x6 GLT (130mm 5 1/8")	Western Archrib	Spruce-Pine	None	A) 3.5" Surface Spline B) 2" Surface Spline C) Butt Joint	2 layers 1/2" cement board over 1 layer 1/2" Plywood	Loaded, See Manufacturer	2	28 (Test 4)	NRC Fire Laboratory 1/24/2019
2x8 GLT (175mm 6 7/8")	Western Archrib	Spruce-Pine	None	A) 3.5" Surface Spline B) 2" Surface Spline C) Butt Joint	2 layers 1/2" cement board over 1 layer 1/2" Plywood	Loaded, See Manufacturer	3	28 (Test 5)	NRC Fire Laboratory 3/4/2019

Table 2: North American Fire Resistance Tests of Mass Timber Wall Assemblies



Mass Timber Panel	Manufacturer	CLT Grade or Timber Grade	Exposed Side Protection	Panel Connection	Unexposed Side Protection	Load Rating	Fire Resistance Achieved (Hours)	Actual Fire Endurance	Source	Testing Lab
3-ply (114mm 4.488 in)	Nordic	SPF 1650 Fb 1.5E MSR x SPF #3	2 layers 1/2" Type X gypsum	Half-Lap	None	Reduced 76% Axial Capacity	1.5	106 min	1 (Test 2)	NRC Fire Laboratory
3-ply (3.78" 99mm)	Structurlam	V2	1 layer 5/8" Type X gypsum	Half-Lap	None	Reduced 60% Max Design Load	1	76 min	8	Intertek December 2013
3-ply (3.78" 99mm)	Structurlam	V2	1 layer 5/8" Type X gypsum	Half-Lap	None	Unreduced 100% Max Design Load	1	66 min	9	Intertek November 2014
3-ply (105mm)	Nordic	E1	1 layer 5/8" Type C or Type X gypsum	Half-Lap	1 layer 5/8" Type C or Type X gypsum	Reduced, 30% Allowable Compression Parallel to Grain	1	Not Provided	10	UL (V320)
3-ply (105mm)	Nordic	E1	None	Half-Lap	None	Loaded, See Manufacturer	0.5	32 min	20	Intertek 5/17/2012
3-ply (78mm)	Nordic	E1	5/8" Type X gypsum over 2x3 SPF Studs @ 24" oc with 2 1/5" mineral wool between studs	Half-Lap	None	Loaded, See Manufacturer	1	83 min	22	Intertek 12/30/2011
5-ply (131 mm)	Nordic	E1	2 layers 5/8" Type C or Type X gypsum	Half-Lap	2 layers 5/8" Type C or Type X gypsum	Reduced, 30% Allowable Compression Parallel to Grain	2	Not Provided	10	UL (V320)
5-ply (175mm)	Nordic	E1	1 layer 5/8" Type C or Type X gypsum	Half-Lap	1 layer 5/8" Type C or Type X gypsum	Reduced, 30% Allowable Compression Parallel to Grain	2	Not Provided	10	UL (V320)
5-ply (175mm)	Nordic	E1	None	Half-Lap	None	Reduced, 30% Allowable Compression Parallel to Grain	1	Not Provided	10	UL (V320)
5-ply (175mm)	Nordic	E1	2 layers 5/8" Type X gypsum	Spline	2 layers 5/8" Type X gypsum	Loaded, See Manufacturer	3.5	219 min	5	NRC Fire Laboratory Nov 2014
5 ply (6 7/8")	Smartlam	SL-V4	None	Half-Lap	None	Loaded, See Manufacturer	2	120 min	11	Western Fire Center 5/25/2017
5-ply (175mm 6.875")	Nordic	SPF 1950 Fb MSR x SPF #3	None	Half-Lap	None	Reduced 37% Axial Capacity	1.5	113 min	1 (Test 4)	NRC Fire Laboratory
5 ply (105mm)	Structurlam	SPF #1/#2 x SPF #1/#2	None	Half-Lap	None	Reduced 25% Axial Capacity	< 1	57 min	1 (Test 8)	NRC Fire Laboratory
5-ply (175mm 6.875")	DR Johnson	V1	None	Half-Lap	None	Loaded, See Manufacturer	2	120 min	13 (Test 1)	Western Fire Center 9/28/2016
5-ply (175mm 6.875")	SmartLam	SL-V4	None	Half-Lap	None	Loaded, See Manufacturer	1.5	101 min	13 (Test 2)	Western Fire Center 9/30/2016
5-ply (175mm 6.875")	Smartlam	V1	None	Half-Lap	None	Loaded, See Manufacturer	2	120 min	13 (Test 7)	Western Fire Center 1/26/2017
5-ply (175mm 6.875")	Nordic	E1	1 layer 5/8" Type X gypsum	Half-Lap	1 layer 5/8" Type X gypsum	Loaded, See Manufacturer	3	186 min	14	NGC Testing 10/4/2012
5-ply CLT (175mm 6.875")	KLH	CV3M1	None	Surface Spline	None	Loaded, See Manufacturer	2	120 min	34	SwRI 2/12/2020
6-layer MPP (6.0")	Freres Lumber	F16	3/4" plywood	Half-Lap and Surface Spline	3/4" plywood	Loaded, See Manufacturer	1.5	112 min	17	SwRI 9/13/2018
4-ply X-LVL (180mm 7.0")	FPInnovations	2580Fb-1.55E LVL	2 layers 1/2" Type C gypsum	Tounge & Groove	2 layers 1/2" Type C gypsum	Loaded	3	234 min	28 (Test 1)	NRC Fire Laboratory 12/11/2018
2x6 NLT	N/A	2x6 SPF #2 NLT with 3" (75mm) Common Nails @ 18" o.c. (450mm)	None	Butt Joint with Screws	1 layer 1/2" plywood	Loaded	0.5	33 min	27	FPInnovations 10/18/2018
2x8 NLT	N/A	2x8 SPF #2 NLT with 3" (75mm) Common Nails @ 18" o.c. (450mm)	2 layers 1/2" Type C gypsum	Butt Joint with Screws	2 layers 1/2" Type C Gypsum	Loaded	3	207 min	27	FPInnovations 10/26/2018
2x8 DLT (181 mm)	StructureCraft Builders	SPF #2 with 650mm x 20mm beach dowels at 400mm (15.75") o.c.	1 layer 1/2" Type C gypsum	Butt Joint with Screws	1 layer 1/2" Type C gypsum	Loaded	3	200 min	28 (Test 2)	NRC Fire Laboratory 11/6/2018
2x6 DLT (137mm)	StructureCraft Builders	SPF #2 with 650mm x 20mm beach dowels at 400mm (15.75") o.c.	None	Butt Joint with Screws	1 layer 1/2" Plywood & 1 layer 5/8" Type X gypsum	Loaded	2	128 min	28 (Test 3)	QAI Laboratories

Table 3: North American Fire Tests of Penetrations and Fire Stops in CLT Assemblies



CLT Panel	Exposed Side Protection	Penetrating Item	Penetrant Centered or Offset in Hole	Firestopping System Description	F Rating	T Rating	Test Protocol	Source	Testing Lab
3-ply (78mm 3.07")	None	1.5" diameter data cable bunch	Centered	3.5 in diameter hole. Mineral wool was installed in the 1 in. annular space around the data cables to a total depth of approximately 2 – 5/64in. The remaining 1 in. annular space from the top of the mineral wool to the top of the floor assembly was filled with Hilti FS-One Max caulking.	1 hour	0.5 hour	CAN ULC S115	26	Intertek March 30, 2016
3-ply (78mm 3.07")	None	2" copper pipe	Centered	4.375 in diameter hole. Pipe wrap was installed around the copper pipe to a total depth of approximately 2 – 5/64in. The remaining 1 in. annular space starting at the top of the mineral wool to the top of the floor assembly was filled with Hilti FS-One Max caulking.	1 hour	N.A.	CAN ULC S115	26	Intertek March 30, 2016
3-ply (78mm 3.07")	None	2.5" sched. 40 pipe	Centered	4.92 in diameter hole. Pipe wrap was installed around the schedule 40 pipe to a total depth of approximately 2 – 5/64in. The remaining 1 in. annular space starting at the top of the pipe wrap to the top of the floor assembly was filled with Hilti FS-One Max caulking.	1 hour	N.A.	CAN ULC S115	26	Intertek March 30, 2016
3-ply (78mm 3.07")	None	6" cast iron pipe	Centered	8.35 in diameter hole. Mineral wool was installed in the 1 in. annular space around the cast iron pipe to a total depth of approximately 2 – 5/64in. The remaining 1 in. annular space starting at the top of the pipe wrap to the top of the floor assembly was filled with Hilti FS- One Max caulking.	1 hour	N.A.	CAN ULC S115	26	Intertek March 30, 2016
3-ply (78mm 3.07")	None	Hilti 6 in drop in device. System No.: F- B-2049	Centered	9.01" diameter hole. Mineral wool was installed in the 1 – 1/4in. annular space around the drop-in device to a total depth of approximately 1 – 7/64in and the remaining 1 in. annular space from the top of the mineral wool to the top edge of the 9 – 1/64in. hole in the CLT was filled with Hilti FS-One Max caulking.	1 hour	0.75 hour	CAN ULC S115	26	Intertek March 30, 2016
3-ply (100mm 3.94")	1 layer 5/8" Type X gypsum	4" sched. 40 pipe	Centered or offset up to 9/16 in.	Maximum 5 inch diameter opening. One stack of three layers STI BLU2 Wrapstrip with SSWRC Collar secured to underside of floor or both sides of wall. 1/2 inch depth of SpecSeal® LCI Intumescent sealant on top of floor or both sides of wall with a 1/4 inch bead at point contact.	2 hours	0.75 hour	ASTM E814 and CAN/ULC S115	45	Intertek March 28, 2022
3-ply (100mm 3.94")	1 layer 5/8" Type X gypsum	AC Lineset with max 1 inch copper condensate, 1 inch insulated copper ith 3/4 in AB/PVC insulation, two No. 18 conductor control wires	Centered or offset. Offset may range from 1/2 in. to 1-3/4 in.	Maximum 5 inch diameter opening. 4pcf mineral wool packed to fill opening and recessed 3/4 inch from the top of the floor. 3/4 inch depth of SpecSeal® LCI Intumescent sealant on top of floor.	2 hours	0.25 hour	ASTM E814 and CAN/ULC S115	45	Intertek March 28, 2022
3-ply (100mm 3.94")	1 layer 5/8" Type X gypsum	Cable bundle	Centered or offset. Offset may range from 1/2 in. to 1-1/2 in.	Maximum 6 inch diameter opening. 4pcf mineral wool packed to fill opening and recessed 3/4 inch from the top of the floor or both sides of the wall. 3/4 inch depth of SpecSeal® LCI Intumescent sealant on top of floor.	2 hours	0.5 hour	ASTM E814 and CAN/ULC S115	45	Intertek March 28, 2022
3-ply (100mm 3.94")	1 layer 5/8" Type X gypsum	None	NA	Maximum 5 inch diameter opening. 4pcf mineral wool packed to fill opening and recessed 3/4 inch from the top of the floor. 3/4 inch depth of SpecSeal® LCI Intumescent sealant on top of floor.	2 hours	2 hours	ASTM E814 and CAN/ULC S115	45	Intertek March 28, 2022
3-ply (100mm 3.94")	1 layer 5/8" Type X gypsum	6" copper pipe	Centered or offset. Offset may range from 1/2 in. to 1-3/8 in.	Maximum 8 inch diameter opening. 4pcf mineral wool packed to fill opening and recessed 3/4 inch from the top of the floor. 3/4 inch depth of SpecSeal® LCI Intumescent sealant on top of floor.	2 hours	0 hour	ASTM E814 and CAN/ULC S115	45	Intertek March 28, 2022
5-ply CLT (131mm 5.16")	None	1.5" diameter data cable bunch	Centered	3.5" diameter hole. Mineral wool was installed in the 1 in. annular space around the data cables to a total depth of approximately 4 – 5/32 in. The remaining 1 in. annular space from the top of the mineral wool to the top of the floor assembly was filled with Hilti FS-One Max caulking.	2 hours	1.5 hours	CAN ULC S115	26	Intertek March 30, 2016
5-ply CLT (131mm 5.16")	None	2" copper pipe	Centered	4.375 in diameter hole. Pipe wrap was installed around the copper pipe to a total depth of approximately 4 – 5/32 in. The remaining 1 in. annular space starting at the top of the mineral wool to the top of the floor assembly was filled with Hilti FS-One Max caulking.	2 hours	N.A.	CAN ULC S115	26	Intertek March 30, 2016
5-ply CLT (131mm 5.16")	None	2.5" sched. 40 pipe	Centered	4.92 in diameter hole. Pipe wrap was installed around the schedule 40 pipe to a total depth of approximately 4 – 5/32 in. The remaining 1 in. annular space starting at the top of the pipe wrap to the top of the floor assembly was filled with Hilti FS-One Max caulking.	2 hours	0.5 hour	CAN ULC S115	26	Intertek March 30, 2016
5-ply CLT (131mm 5.16")	None	6" cast iron pipe	Centered	8.35 in diameter hole. Mineral wool was installed in the 1 in. annular space around the cast iron pipe to a total depth of approximately 4 – 5/32 in. The remaining 1 in. annular space starting at the top of the pipe wrap to the top of the floor assembly was filled with Hilti FS- One Max caulking.	2 hours	N.A.	CAN ULC S115	26	Intertek March 30, 2016

Table 3: North American Fire Tests of Penetrations and Fire Stops in CLT Assemblies



CLT Panel	Exposed Side Protection	Penetrating Item	Penetrant Centered or Offset in Hole	Firestopping System Description	F Rating	T Rating	Test Protocol	Source	Testing Lab
5-ply CLT (131mm 5.16")	None	Hilti 6 in drop in device, System No.: F-B-2049	Centered	9.01" diameter hole. Mineral wool was installed in the 1 – 1/4in. annular space around the drop-in device to a total depth of approximately 1 – 7/64in and the remaining 1in. annular space from the top of the mineral wool to the top edge of the 9 – 1/64in. hole in the CLT was filled with Hilti FS-One Max caulking.	2 hours	1.5 hours	CAN ULC S115	26	Intertek March 30, 2016
5-ply (175mm 6.875")	None	1" nominal PVC pipe	Centered	4.21 in diameter with a 3/4 in plywood reducer flush with the top of the slab reducing the opening to 2.28 in. Two wraps of Hilti CP 648-E W45/1-3/4" Firestop wrap strip at two locations with a 30 gauge steel sleeve which extended from the top of the slab to 1 in below the slab. The first location was with the bottom of the wrap strip flush with the bottom of the steel sleeve and the second was with the bottom of the wrap strip 3 in. from the bottom of the slab. The void between the steel sleeve and the CLT and between the steel sleeve and pipe at the top was filled with Roxul Safe mineral wool leaving a 3/4 in deep void at the top of the assembly. Hilti FS-One Max Intumescent Firestop Sealant was applied to a depth of 3/4 in on the top of the assembly between the plywood and steel sleeve as well as the steel sleeve and pipe.	2 hours	2 hours	ASTM E814	24	QAI Laboratories March 3, 2017
5-ply (175mm 6.875")	2 layers 5/8" Type X gypsum	1.5 inch O.D. closed PVC pipe	Centered	Hilti System C-AJ-2109 modified: no steel sleeve, 3.5" long wood screws used to attach the collar; pipe placed concentrically within hole; 2.5" sealant depth	2 hours	2 hours	ASTM E814	23	SwRI September 30, 2015
5-ply (175mm 6.875")	2 layers 5/8" Type X gypsum	1.5 inch O.D. closed PVC pipe	Centered	Hilti System C-AJ-2419 modified: 2" sealant depth	2 hours	2 hours	ASTM E814	23	SwRI September 30, 2015
5-ply (175mm 6.875")	None	2" nominal PVC pipe	Centered	6.14 in diameter hole with a 3/4 in plywood reducer flush with the top of the slab reducing the opening to 3.35 in. One wrap of Hilti CP 648-E W45/1-3/4" Firestop wrap strip at two locations with a 30 gauge steel sleeve which extended from the top of the slab to 1 in below the slab. The first location was with the bottom of the wrap strip flush with the bottom of the steel sleeve and the second was with the bottom of the wrap strip 3 in. from the bottom of the slab. The void between the steel sleeve and the CLT and between the steel sleeve and pipe at the top was filled with Roxul Safe mineral wool leaving a 3/4 in deep void at the top of the assembly. Hilti FS-One Max Intumescent Firestop Sealant was applied to a depth of 3/4 in on the top of the assembly between the plywood and steel sleeve as well as the steel sleeve and pipe.	2 hours	N.A.	ASTM E814	24	QAI Laboratories March 3, 2017
5-ply (175mm 6.875")	None	2" nominal PVC pipe	Centered	6.14 in diameter hole with a 3/4 in plywood reducer flush with the top of the slab reducing the opening to 3.35 in. Two wraps of Hilti CP 648-E W45/1-3/4" Firestop wrap strip at two locations with a 30 gauge steel sleeve which extended from the top of the slab to 1 in below the slab. The first location was with the bottom of the wrap strip flush with the bottom of the steel sleeve and the second was with the bottom of the wrap strip 3 in. from the bottom of the slab. The void between the steel sleeve and the CLT and between the steel sleeve and pipe at the top was filled with Roxul Safe mineral wool leaving a 3/4 in deep void at the top of the assembly. Hilti FS-One Max Intumescent Firestop Sealant was applied to a depth of 3/4 in on the top of the assembly between the plywood and steel sleeve as well as the steel sleeve and pipe.	2 hours	2 hours	ASTM E814	24	QAI Laboratories March 3, 2017
5-ply (175mm 6.875")	None	3" nominal PVC pipe	Centered	8.31 in diameter hole with a 3/4 in plywood reducer flush with the top of the slab reducing the opening to 4.49 in. Two wraps of Hilti CP 648-E W45/1-3/4" Firestop wrap strip at two locations with a 30 gauge steel sleeve which extended from the top of the slab to 1 in below the slab. The first location was with the bottom of the wrap strip flush with the bottom of the steel sleeve and the second was with the bottom of the wrap strip 3 in. from the bottom of the slab. The void between the steel sleeve and the CLT and between the steel sleeve and pipe at the top was filled with Roxul Safe mineral wool leaving a 3/4 in deep void at the top of the assembly. Hilti FS-One Max Intumescent Firestop Sealant was applied to a depth of 3/4 in on the top of the assembly between the plywood and steel sleeve as well as the steel sleeve and pipe.	2 hours	N.A.	ASTM E814	24	QAI Laboratories March 3, 2017
5-ply (175mm 6.875")	None	1" nominal PEX pipe	Centered	4.29 in diameter hole with 3/4 in plywood reducer flush with the top of the slab reducing the opening to 2.13 in. Two wraps of Hilti CP 648-E W45/1-3/4" Firestop wrap strip at two locations with a 30 gauge steel sleeve which extended from the top of the slab to 1 in below the slab. The first location was with the bottom of the wrap strip flush with the bottom of the steel sleeve and the second was with the bottom of the wrap strip 3 in. from the bottom of the slab. The void between the steel sleeve and the CLT and between the steel sleeve and pipe at the top was filled with Roxul Safe mineral wool leaving a 3/4 in deep void at the top of the assembly. Hilti FS-One Max Intumescent Firestop Sealant was applied to a depth of 3/4 in on the top of the assembly between the plywood and steel sleeve as well as the steel sleeve and pipe.	2 hours	2 hours	ASTM E814	24	QAI Laboratories March 3, 2017
5-ply (175mm 6.875")	None	1" nominal PEX pipe	Centered	1.75 in diameter hole. One wrap of Hilti CP 648-E W45/1-3/4" Firestop wrap strip at two locations with a foil tape holding it in place. The first location was with the bottom of the wrap strip flush with the bottom of the slab and the second was with the bottom of the wrap strip 3 in. from the bottom of the slab. Hilti FS-One Max Intumescent Firestop Sealant was applied to a depth of 1/2 in on the top of the assembly between the CLT and the pipe.	2 hours	N.A.	ASTM E814	24	QAI Laboratories March 3, 2017
5-ply (175mm 6.875")	None	1" nominal PEX pipe	Centered	2.0 in diameter hole. Two wraps of Hilti CP 648-E W45/1-3/4" Firestop wrap strip at two locations with a foil tape holding it in place. The first location was with the bottom of the wrap strip flush with the bottom of the slab and the second was with the bottom of the wrap strip 3 in. from the bottom of the slab. Hilti FS-One Max Intumescent Firestop Sealant was applied to a depth of 1/2 in on the top of the assembly between the CLT and the pipe.	2 hours	2 hours	ASTM E814	24	QAI Laboratories March 3, 2017

Table 3: North American Fire Tests of Penetrations and Fire Stops in CLT Assemblies



CLT Panel	Exposed Side Protection	Penetrating Item	Penetrant Centered or Offset in Hole	Firestopping System Description	F Rating	T Rating	Test Protocol	Source	Testing Lab
5-ply (175mm 6.875")	None	1.5" nominal PEX pipe	Centered	2.5 in diameter hole. Two wraps of Hilti CP 648-E W45/1-3/4" Firestop wrap strip at two locations with a foil tape holding it in place. The first location was with the bottom of the wrap strip flush with the bottom of the slab and the second was with the bottom of the wrap strip 3 in. from the bottom of the slab. Hilti FS-One Max Intumescent Firestop Sealant was applied to a depth of 1/2 in on the top of the assembly between the CLT and the pipe.	2 hours	N.A.	ASTM E814	24	QAI Laboratories March 3, 2017
5-ply (175mm 6.875")	None	2" nominal PEX pipe	Centered	6.14 in diameter hole with a 3/4 in plywood reducer flush with the top of the slab reducing the opening to 3.11 in. Two wraps of Hilti CP 648-E W45/1-3/4" Firestop wrap strip at two locations with a 30 gauge steel sleeve which extended from the top of the slab to 1 in below the slab. The first location was with the bottom of the wrap strip flush with the bottom of the steel sleeve and the second was with the bottom of the wrap strip 3 in. from the bottom of the slab. The void between the steel sleeve and the CLT and between the steel sleeve and pipe at the top was filled with Roxul Safe mineral wool leaving a 3/4 in deep void at the top of the assembly. Hilti FS-One Max Intumescent Firestop Sealant was applied to a depth of 3/4 in on the top of the assembly between the plywood and steel sleeve as well as the steel sleeve and pipe.	2 hours	N.A.	ASTM E814	24	QAI Laboratories March 3, 2017
5-ply (175mm 6.875")	None	2" nominal PEX pipe	Centered	6.14 in diameter hole with a 3/4 in plywood reducer flush with the top of the slab reducing the opening to 3.11 in. One wrap of Hilti CP 648-E W45/1-3/4" Firestop wrap strip at two locations with a 30 gauge steel sleeve which extended from the top of the slab to 1 in below the slab. The first location was with the bottom of the wrap strip flush with the bottom of the steel sleeve and the second was with the bottom of the wrap strip 3 in. from the bottom of the slab. The void between the steel sleeve and the CLT and between the steel sleeve and pipe at the top was filled with Roxul Safe mineral wool leaving a 3/4 in deep void at the top of the assembly. Hilti FS-One Max Intumescent Firestop Sealant was applied to a depth of 3/4 in on the top of the assembly between the plywood and steel sleeve as well as the steel sleeve and pipe.	2 hours	N.A.	ASTM E814	24	QAI Laboratories March 3, 2017
5-ply (175mm 6.875")	None	3" nominal PEX pipe	Centered	8.31 in diameter hole with a 3/4 in plywood reducer flush with the top of the slab reducing the opening to 4.09 in. Two wraps of Hilti CP 648-E W45/1-3/4" Firestop wrap strip at two locations with a 30 gauge steel sleeve which extended from the top of the slab to 1 in below the slab. The first location was with the bottom of the wrap strip flush with the bottom of the steel sleeve and the second was with the bottom of the wrap strip 3 in. from the bottom of the slab. The void between the steel sleeve and the CLT and between the steel sleeve and pipe at the top was filled with Roxul Safe mineral wool leaving a 3/4 in deep void at the top of the assembly. Hilti FS-One Max Intumescent Firestop Sealant was applied to a depth of 3/4 in on the top of the assembly between the plywood and steel sleeve as well as the steel sleeve and pipe.	2 hours	N.A.	ASTM E814	24	QAI Laboratories March 3, 2017
5-ply (175mm 6.875")	2 layers 5/8" Type X gypsum	Cables	Centered	Hilti System C-AJ-3096 modified: no annular gap between collar and bundle of cables; no steel sleeve; 0.5" sealant depth applied between collar and gypsum board	2 hours	2 hours	ASTM E814	23	SwRI September 30, 2015
5-ply (175mm 6.875")	None	4" nominal copper pipe	0.5" offset from center	6 in diameter hole. The void between the CLT and pipe at the top was filled with Roxul Safe mineral wool leaving a 1/2 in deep void at the top of the assembly. Hilti FS-One Max Intumescent Firestop Sealant was applied to a depth of 1/2 in on the top of the assembly between the CLT and pipe. Pipe insulated with Roxul ProRox for 5' beyond non-exposed face.	2 hours	N.A.	ASTM E814	25	QAI Laboratories January 24, 2017
5-ply (175mm 6.875")	None	4" nominal copper pipe	0.5" offset from center	6 in diameter hole. The void between the CLT and pipe at the top was filled with Roxul Safe mineral wool leaving a 1/2 in deep void at the top of the assembly. Hilti FS-One Max Intumescent Firestop Sealant was applied to a depth of 1/2 in on the top of the assembly between the CLT and pipe.	2 hours	N.A.	ASTM E814	25	QAI Laboratories January 24, 2017
5-ply (175mm 6.875")	None	2" nominal cast iron pipe	0.5" offset from center	4 in diameter hole. The void between the CLT and pipe at the top was filled with Roxul Safe mineral wool leaving a 1/2 in deep void at the top of the assembly. Hilti FS-One Max Intumescent Firestop Sealant was applied to a depth of 1/2 in on the top of the assembly between the CLT and pipe. Pipe insulated with Roxul ProRox for 24" beyond non-exposed face.	2 hours	N.A.	ASTM E814	25	QAI Laboratories January 24, 2017
5-ply (175mm 6.875")	None	6" nominal cast iron pipe	0.5" offset from center	8.21 in diameter hole. The void between the CLT and pipe at the top was filled with Roxul Safe mineral wool leaving a 1/2 in deep void at the top of the assembly. Hilti FS-One Max Intumescent Firestop Sealant was applied to a depth of 1/2 in on the top of the assembly between the CLT and pipe. Pipe insulated with Roxul ProRox for 24" beyond non-exposed face.	2 hours	N.A.	ASTM E814	25	QAI Laboratories January 24, 2017
5-ply (175mm 6.875")	None	6" nominal cast iron pipe	0.5" offset from center	8.31 in diameter hole. The void between the CLT and pipe at the top was filled with Roxul Safe mineral wool leaving a 1/2 in deep void at the top of the assembly. Hilti FS-One Max Intumescent Firestop Sealant was applied to a depth of 1/2 in on the top of the assembly between the CLT and pipe.	2 hours	N.A.	ASTM E814	25	QAI Laboratories January 24, 2017

Table 3: North American Fire Tests of Penetrations and Fire Stops in CLT Assemblies



CLT Panel	Exposed Side Protection	Penetrating Item	Penetrant Centered or Offset in Hole	Firestopping System Description	F Rating	T Rating	Test Protocol	Source	Testing Lab
5-ply (175mm 6.875")	None	2" nominal electrical metal tubing (EMT)	0.5" offset from center	4.21 in diameter hole. The void between the CLT and pipe at the top was filled with Roxul Safe mineral wool leaving a 1/2 in deep void at the top of the assembly. Hilti FS-One Max Intumescent Firestop Sealant was applied to a depth of 1/2 in on the top of the assembly between the CLT and pipe. Pipe insulated with Roxul ProRox for 24" beyond non-exposed face.	1.5 hours	1.5 hours	ASTM E814	25	QAI Laboratories January 24, 2017
5-ply (175mm 6.875")	None	3" PVC pipe	Not noted in test report	4.5 in diameter hole. Firestopping installation and products based on UL System C-AJ-2228.	2 hours	2 hours	ASTM E814	37	WFCi September 6-8, 2017
5-ply (175mm 6.875")	None	4" Aquatherm Green Pipe (SDR7.4)	Not noted in test report	6 in diameter hole. Firestopping installation and products based on UL System C-AJ-1551.	1 hour	1 hour	ASTM E814	37	WFCi September 6-8, 2017
5-ply (175mm 6.875")	None	4" cast iron pipe	Not noted in test report	5.375 in diameter hole. Firestopping installation and products based on UL System C-AJ-1427.	2 hours	0.5 hour	ASTM E814	37	WFCi September 6-8, 2017
5-ply (175mm 6.875")	None	4" Aquatherm Green Pipe (SDR7.4)	Not noted in test report	3.5 in diameter hole. Firestopping installation and products based on UL System C-AJ-2228.	2 hours	2 hours	ASTM E814	37	WFCi September 6-8, 2017
5-ply (175mm 6.875")	None	1-3/4" threaded steel rod (A722 GR 150)	Not noted in test report	3.125 in diameter hole. Threaded rod inserted into 2.5 in diameter steel sleeve (Sch. 40). Firestopping installation and products based on UL System C-AJ-1551.	2 hours	2 hours	ASTM E814	37	WFCi September 6-8, 2017
5-ply (175mm 6.875")	None	3" PVC pipe	Not noted in test report	4.5 in diameter hole. Firestopping installation and products based on UL System C-AJ-2228.	2 hours	2 hours	ASTM E814	37	WFCi September 6-8, 2017
5-ply (175mm 6.875")	None	4" Aquatherm Green Pipe (SDR7.4)	Not noted in test report	6 in diameter hole. Firestopping installation and products based on UL System C-AJ-1551.	2 hours	2 hours	ASTM E814	37	WFCi September 6-8, 2017
5-ply (175mm 6.875")	None	4" cast iron pipe	Not noted in test report	5.375 in diameter hole. Firestopping installation and products based on UL System C-AJ-1427.	2 hours	1 hour	ASTM E814	37	WFCi September 6-8, 2017
5-ply (175mm 6.875")	None	4" Aquatherm Green Pipe (SDR7.4)	Not noted in test report	3.5 in diameter hole. Firestopping installation and products based on UL System C-AJ-2228.	2 hours	2 hours	ASTM E814	37	WFCi September 6-8, 2017
5-ply (175mm 6.875")	None	1-3/4" threaded steel rod (A722 GR 150)	Not noted in test report	3.125 in diameter hole. Threaded rod inserted into 2.5 in diameter steel sleeve (Sch. 40). Firestopping installation and products based on UL System C-AJ-1551.	2 hours	1.5 hours	ASTM E814	37	WFCi September 6-8, 2017
5-ply (175mm 6.875")	None	Metallic pipe with insulation or cable	May be centered or offset. Offset may range from 1/2 in to 2-9/16 in	Max 6 in diameter hole. Fill annular space with min. 5 in thick layer of mineral wool insulation. For wall applications, apply 3/4 in thick layer of Hilti FS-ONE MAX firestop intumescent sealant on both sides of the wall assembly. For floor applications, apply 3/4 in thick layer of Hilti FS-ONE MAX firestop intumescent sealant on the top side of the floor/ceiling assembly.	2 hours	0.25 hours	ASTM E814	38	Intertek October 26, 2021
5-ply (175mm 6.875")	None	Max. 4 in diameter cable bundle with nominal 44% visual fill of cables within opening	May be centered or offset. Offset may range from 1/2 in to 1 in	Max 6 in diameter hole. Fill annular space with min. 5 in thick layer of mineral wool insulation. For wall applications, apply 3/4 in thick layer of Hilti FS-ONE MAX firestop intumescent sealant on both sides of the wall assembly. For floor applications, apply 3/4 in thick layer of Hilti FS-ONE MAX firestop intumescent sealant on the top side of the floor/ceiling assembly.	2 hours	0.25 hours	ASTM E814	39	Intertek October 26, 2021
5-ply (175mm 6.875")	None	Nominal 2 in diameter Sched. 40 PVC pipe	May be centered or offset. Offset may range from 1/2 in to 1 in	Max 4 in diameter hole. Fill annular space with min. 5 in thick layer of mineral wool insulation. For wall applications, apply 3/4 in thick layer of Hilti FS-ONE MAX firestop intumescent sealant on both sides of the wall assembly. For floor applications, apply 3/4 in thick layer of Hilti FS-ONE MAX firestop intumescent sealant on the top side of the floor/ceiling assembly.	2 hours	0.75 hours	ASTM E814	40	Intertek October 26, 2021
5-ply (175mm 6.875")	None	Nominal 6 in diameter metallic pipe with 2 in pipe insulation	May be centered or offset. Annular space around pipe insulation may range from 1/4 in to 1-1/16 in	Max 12 in diameter hole. Fill annular space with min. 5 in thick layer of mineral wool insulation. For wall applications, apply 3/4 in thick layer of Hilti FS-ONE MAX firestop intumescent sealant on both sides of the wall assembly. For floor applications, apply 3/4 in thick layer of Hilti FS-ONE MAX firestop intumescent sealant on the top side of the floor/ceiling assembly.	2 hours	N.A.	ASTM E814	41	Intertek October 26, 2021
5-ply (175mm 6.875")	None	Nominal 6 in diameter steel, iron or copper pipe	May be centered or offset. Offset may range from 1/2 in to 1-7/16 in	Max 8 in diameter hole. Fill annular space with min. 5 in thick layer of mineral wool insulation. For wall applications, apply 3/4 in thick layer of Hilti FS-ONE MAX firestop intumescent sealant on both sides of the wall assembly. For floor applications, apply 3/4 in thick layer of Hilti FS-ONE MAX firestop intumescent sealant on the top side of the floor/ceiling assembly.	2 hours	N.A.	ASTM E814	42	Intertek October 26, 2021

Table 4: North American Fire Resistance Tests of Connections

Connection Type	Connection Style	Assembly Description	Connection Details	Loaded	Applied Load	Fire Resistance Achieved (Hours)	Test Protocol*	Source	Testing Lab
Beam to Column	Concealed	CLT Floor over 8.75"x18" Glulam Beam with concealed connector to 16.5" x 14.25" Glulam Column	Ricon S VS 290x80 (Steel)	Yes	3905 lbs	1 hour	ASTM E119	32	SwRI Test Date: Mar 6, 2017
Beam to Column	Concealed	CLT Floor over 10.75"x24" Glulam Beam with concealed connector to 16.5" x 14.25" Glulam Column	Double Ricon S VS 200x80 (Steel)	Yes	16,620 lbs	1.5 hour	ASTM E119	32	SwRI Test Date: Mar 7, 2017
Beam to Column	Concealed	CLT Floor over 10.75"x24" Glulam Beam with concealed connector to 16.5" x 14.25" Glulam Column	Megant 430 x 150 (Aluminum)	Yes	16,620 lbs	1.5 hour	ASTM E119	32	SwRI Test Date: Mar 9, 2017
Beam to Column	Concealed	CLT Floor over 9.78" x 18" Glulam Beam with 1 concealed connector to 16" x 16" Glulam Column	Single Simpson Strong-Tie CBH2.37x9.97	Yes	9,000 lbs	2 hours	ASTM E119	35	SwRI Test Date: July 1, 2020
Beam to Column	Concealed	CLT Floor over 14.25" x 27" Glulam Beam with 4 concealed connectors to 16" x 16" Glulam Column	Four Simpson Strong-Tie CBH2.37x9.97	Yes	36,000 lbs	2 hours	ASTM E119	35	SwRI Test Date: July 6, 2020
Beam to Column	Concealed	CLT Floor over 6.75" x 14.25" Glulam Beam with 1 concealed connector to 16" x 16" Glulam Column	Single Simpson Strong-Tie CBH2.37x9.97	Yes	9,000 lbs	1 hour	ASTM E119	35	SwRI Test Date: July 8, 2020
Beam to Column	Concealed	CLT Floor over 12.75" x 27" Glulam Beam with 4 concealed connectors to 16" x 16" Glulam Column	Four Simpson Strong-Tie CBH2.37x9.97	Yes	36,000 lbs	1 hour	ASTM E119	35	SwRI Test Date: July 10, 2020

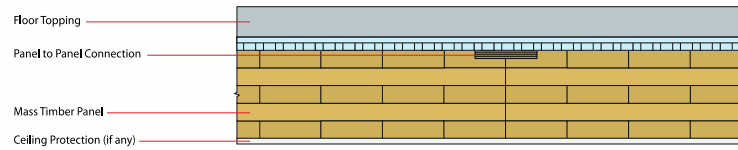
* ASTM E119 does not explicitly include provisions for testing of connections, however the standard time temperature curves were used

Sources

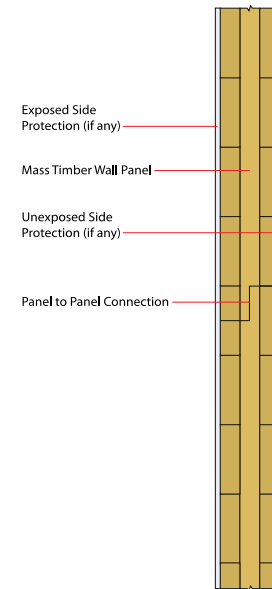
- 1 [AWC CLT Fire Test Report, July 2012](#)
- 2 Mar 2016 NRCAN Test from Nordic
- 3 [UL L901](#)
- 4 [UL M533](#)
- 5 [NRCAN Test date: Nov 5, 2014.](#)
- 6 Feb 2017 Intertek Test from Structurlam
- 7 May 2016, SwRI Test from DR Johnson
- 8 [Canadian-Wood-Council-G100585447SAT-002B-Final-Report.pdf \(Dec 2013\)](#)
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- 11 May 2017 Western Fire Center test from SmartLam
- 12 Nov 2016 Western Fire Center floor tests for OSU
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- 15 December 2018, SwRI Test from StructureCraft
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- 23 [AWC Test, SwRI Project No. 01.21428.01.001a, Test Date 9/30/15](#)
- 24 QAI Laboratories Test Report No: T895-5b Rev. 3
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- 26 [Intertek Test Report No. 102389123COQ-006](#)
- 27 Mar 2019 FPInnovations Report-Evaluating Fire Performance of Nail-Laminated Timber
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- 29 July 2019 SwRI Test Report from Kattera
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- 37 September 2017 Western Fire Center test report 17064 for Oregon State University
- 38 October 2021 Intertek Design No. HI/PF 120-07
- 39 October 2021 Intertek Design No. HI/PF 120-08
- 40 October 2021 Intertek Design No. HI/PF 120-09
- 41 October 2021 Intertek Design No. HI/PF 120-10
- 42 October 2021 Intertek Design No. HI/PF 120-11
- 43 [March 2022 SwRI report of Test on 27 Jan 2022 from Structurlam Mass Timber](#)
- 44 [March 2022 SwRI report of Test on 31 Jan 2022 from Structurlam Mass Timber](#)
- 45 March 2022 Intertek Test Report 104953841SAT-004 R0



Mass Timber Floor/Roof Fire-Resistance Tests (section view)



Mass Timber Wall Fire-Resistance Tests (plan view)



See also AWC Technical Report 10 Section 3.7 for a comparison of tested fire endurance ratings to the NDS Chapter 16 Calculated structural fire endurance ratings.

Disclaimer

The information in this inventory, including, without limitation, references to information contained in other publications, test reports or made available by other sources (collectively “information”) should not be used or relied upon for any application without competent professional examination and verification of its accuracy, suitability, code compliance and applicability by a licensed engineer, architect or other professional. Neither the Wood Products Council nor its employees, consultants, nor any other individuals or entities who contributed to the information make any warranty, representative or guarantee, expressed or implied, that the information is suitable for any general or particular use, that it is compliant with applicable law, codes or ordinances, or that it is free from infringement of any patent(s), nor do they assume any legal liability or responsibility for the use, application of and/or reference to the information. Anyone making use of the information in any manner assumes all liability arising from such use.

This inventory is intended to be a design aid in the design of mass timber floor/roof and wall assemblies for the purpose of demonstrating code-compliance related to fire-resistance. The referenced test reports and manufacturer’s information should be consulted as the final source for the specific conditions, materials and installation processes used for all components referenced herein.

The designer is responsible for confirming that all materials used in an assembly meet code requirements for fire-resistance as well as other performance criteria such as acoustics, structural loadings, and durability.

For free project assistance or for any questions related to the assemblies referenced in this inventory, contact help@woodworks.org.