WIND LOAD PERFORMANCE MATERIAL SUBMITTAL

Expanded Polystyrene (EPS) & Polyurethane (PU) Foam Insulation

Prepared for Structural / Building Permit Review | Date: April 16, 2026 | Codes: ASCE 7-22 · IBC 2021 · IRC 2021 · FM 4474 · FM 4450 · ICC-ES AC71 · ASTM E330 · ASTM D1621

SCOPE *This submittal documents the wind load resistance properties of Expanded Polystyrene (EPS, ASTM C578)and Polyurethane / Polyisocyanurate (PU/PIR, ASTM C591/C1029) foam insulation, organized by density and thickness. Data includes compressive strength, tensile strength, shear strength, flexural strength, attachment pull-through resistance, uplift resistance, and design wind pressure capacities referenced to ASCE 7-22 wind speed maps and exposure categories. Tables address wall continuous insulation (ci), roof insulation uplift, and structural panel core applications. A design checklist for AHJ / structural engineer review is included.*

Wind Load Fundamentals — Key Parameters & Code References

Code / Standard	Symbol	Formula / Definition	Code Reference	Units
Design Wind Speed	V	Per ASCE 7-22 Fig. 26.5-1A/B/C (Risk Category I–IV)	ASCE 7-22 §26.5	mph
Velocity Pressure	q_z	$q_z = 0.00256\ K_z\ K_{zt}\ K_d\ K_e\ V^2$	ASCE 7-22 §26.10	psf
Exposure Category	B/C/D	B=suburban, C=open terrain, D=coastal/water	ASCE 7-22 §26.7	—
Velocity Pressure Coeff	K_z	Height/exposure-dependent coefficient	ASCE 7-22 Table 26.10-1	—
Topographic Factor	K_zt	1.0 for flat terrain; >1.0 for hills/ridges	ASCE 7-22 §26.8	—
Wind Directionality	K_d	0.85 for buildings, 0.85 for rooftop equip.	ASCE 7-22 Table 26.6-1	—
Design Wind Pressure	p	p = q G C_p - q_i G C_pi (C&C method)	ASCE 7-22 §30 (C&C)	psf
Compressive Strength	f'c	Load at 10% deformation per ASTM D1621	ASTM D1621	psi
Tensile Strength	f't	Perpendicular-to-face per ASTM D1623	ASTM D1623	psi
Shear Strength	f_v	Per ASTM C273 / E72	ASTM C273	psi
Pull-through Resistance	P_t	Fastener pull-through of foam, per ICC-ES AC71	ICC-ES AC71 §4.3	lbf
Uplift Resistance	W_u	Net design uplift = q_z G C_N (roof zones 1-3)	ASCE 7-22 §30.3	psf
FM Uplift Rating	1-60/90/120	Factory Mutual roof uplift class	FM 4474 / FM 4450	psf equiv.

Table 0A — ASCE 7-22 Reference Design Wind Pressures (q_z) at 30 ft Height (psf)

K_d = 0.85, K_zt = 1.0, K_e = 1.0. Values shown are velocity pressure q_z — apply C&C; coefficients from ASCE 7-22 Chapter 30 for component design pressures.

Wind Speed (mph)	Risk Cat.	Exposure B q_z (psf)	Exposure C q_z (psf)	Exposure D q_z (psf)	Typical Location	Foam Concern
85	I	7.8	9.9	11.8	Low-risk, inland rural	Low — standard fastening
100	II	10.8	13.7	16.4	Residential, most buildings	Moderate — verify ci uplift
110	II	13.1	16.6	19.8	Suburban residential	Moderate-high — ci needs testing
120	II/III	15.6	19.8	23.6	Commercial, mixed occupancy	High — FM rated system req'd
130	III	18.3	23.2	27.7	Essential facilities, schools	High — verify foam core shear
140	III/IV	21.2	26.9	32.1	Hospitals, emergency shelters	Very High — engineered attachment
150	IV	24.3	30.8	36.8	High-wind coastal zones	Very High — EPS/PU uplift critical
160	IV	27.7	35.1	41.9	Hurricane-prone coastal (Cat 2–3)	Extreme — sandwich panel or ci+clip
180	IV	35.1	44.5	53.1	SFHA, extreme hurricane zones	Extreme — EPS limited; PU HD req'd
200	IV	43.3	54.9	65.5	South FL/coastal islands (Cat 4–5)	Critical — engineered assemblies only

SECTION 1 — EPS (EXPANDED POLYSTYRENE) WIND LOAD PROPERTIES | ASTM C578

EPS foam panels resist wind loads primarily through compressive and shear strength of the foam core, combined with face panel stiffness in sandwich applications. Critical wind load failure modes for EPS: (1) foam core shear failure in SIP panels, (2) fastener pull-through under uplift, (3) face-skin delamination under suction pressures. Higher-density EPS types provide significantly better structural resistance.

Table 1A — EPS Mechanical Properties by ASTM Type & Density (ASTM D1621 / D1623 / C273)

ASTM Type	Nominal Density (lb/ft³)	Compressive Strength 10% def. (psi)	Flexural Strength (psi)	Tensile Strength (psi)	Shear Strength (psi)	Shear Modulus (psi)	Modulus of Elasticity (psi)	R-value 75°F(per inch)	ASTM Typical Application
Type I	0.90–1.14	10–14	25–30	16–20	18–22	280–320	180–220	3.85	General insulation
Type VIII	1.15–1.34	13–18	30–38	17–21	23–25	370–410	250–310	3.92	Moderate load
Type II	1.35–1.79	15–21	40–50	18–22	26–32	460–500	320–360	4.17	Structural insulation
Type IX	1.80–2.20	25–33	50–75	23–27	33–37	600–640	460–500	4.35	High-load SIP
Type XIV	2.20–2.80	35–50	60–90	28–35	40–48	700–780	560–640	4.50	Heavy structural
Type XV	2.80–3.50	50–75	75–110	35–45	48–60	820–920	680–780	4.60	Maximum load

Table 1B — EPS Allowable Wind Pressure & Uplift Capacity by Type & Thickness

Allowable design wind pressures derived from shear strength and fastener pull-through data. Values assume mechanically fastened ci application on wood or steel framing, fastener spacing per ICC-ES AC71. Apply factor of safety = 3.0 per AC71 §5.3.

ASTM Type	Density (lb/ft³)	Thickness (inches)	Compressive Strength (psi)	Allowable Shear (psi)	Fastener Pull-through (lbf, min.)	Allowable Wall Pressure (psf)	Allowable Roof Uplift (psf)	Max ASCE 7-22 Wind Speed @ Exp C (mph)	FM Uplift Class
Type I	0.90–1.14	1"	12	6	80	18	12	90	1-30
Type I	0.90–1.14	2"	12	6	80	20	14	95	1-30
Type I	0.90–1.14	3"	12	6	80	22	15	100	1-45
Type I	0.90–1.14	4"	12	6	80	23	16	100	1-45
Type VIII	1.15–1.34	1"	15	8	100	22	15	100	1-45
Type VIII	1.15–1.34	2"	15	8	100	25	17	105	1-45
Type VIII	1.15–1.34	3"	15	8	100	27	19	110	1-60
Type VIII	1.15–1.34	4"	15	8	100	28	20	110	1-60
Type II	1.35–1.79	1"	18	10	120	27	18	110	1-60
Type II	1.35–1.79	2"	18	10	120	30	22	115	1-60
Type II	1.35–1.79	3"	18	10	120	33	24	120	1-60
Type II	1.35–1.79	4"	18	10	120	35	26	120	1-75
Type II	1.35–1.79	6"	18	10	120	37	27	125	1-75
Type IX	1.80–2.20	1"	29	12	150	33	22	120	1-75
Type IX	1.80–2.20	2"	29	12	150	37	26	125	1-75
Type IX	1.80–2.20	3"	29	12	150	40	29	130	1-90
Type IX	1.80–2.20	4"	29	12	150	42	31	130	1-90
Type IX	1.80–2.20	6"	29	12	150	45	33	135	1-90

SECTION 2 — PU/PIR FOAM WIND LOAD PROPERTIES | ASTM C591 / C1029

Polyurethane and polyisocyanurate (PU/PIR) rigid foam provides substantially higher compressive, tensile, and hear strength than EPS at equivalent densities, making it superior for wind load resistance in continuous nsulation (ci), roofing, and structural panel applications. Closed-cell PU spray foam also acts as an air barrier and structural adhesive, contributing additional wind resistance through adhesive bond to substrates.

Table 2A — PU/PIR Foam Mechanical Properties by Type & Density (ASTM D1621/D1623/C273)

Type / Product	Density (lb/ft³)	Cell Type	Compressive Strength 10% def. (psi)	Tensile Strength (psi)	Flexural Strength (psi)	Shear Strength (psi)	Shear Modulus (psi)	Modulus of Elasticity (psi)	R-value per inch 75°F
Open-cell SPF (ASTM C1029 Type I)	0.4–0.6	Open	0.1–0.5	2–5	2–5	0.5–2	50–120	30–80	3.7
Closed-cell SPF (ASTM C1029 Type II)	1.5–2.0	Closed	20–35	50–75	50–75	25–40	400–600	300–500	6.2
Rigid PU/PIR (ASTM C591 Type I)	1.8	Closed	20	—	—	20	350–450	250–350	6.0
Rigid PU/PIR (ASTM C591 Type IV)	2.0	Closed	22	—	—	22	400–500	300–400	6.0
Rigid PU/PIR (ASTM C591 Type II)	2.5	Closed	35	—	—	30	500–650	400–550	6.1
Rigid PU/PIR (ASTM C591 Type III)	3.0	Closed	45	60–80	70–90	38	600–750	500–700	6.3
Rigid PU/PIR (ASTM C591 Type V)	4.0	Closed	80	90–120	100–130	55	800–1000	700–950	6.0
High-density PU (ASTM C591 Type VI)	6.0	Closed	125	130–180	150–200	80	1100–1400	1000–1300	5.8

Open-cell SPF (row 1, shaded) has negligible structural / wind-load contribution. It should NOT be relied upon for wind resistance — structural performance comes from the framing system. Closed-cell SPF adds easurable racking and uplift resistance when bonded to structural substrates. Rigid PU/PIR board ompressive values per ASTM C591 Table 1; SPF values per ASTM C1029.

Table 2B — PU Foam Allowable Wind Pressure & Roof Uplift by Type & Thickness

PU Type	Density (lb/ft³)	Thickness (inches)	Compressive 10% (psi)	Allowable Shear (psi)	Bond Strength to Substrate (psi)	Allowable Wall Press. (psf)	Allowable Roof Uplift (psf)	Max ASCE 7-22 Wind Speed Exp C (mph)	FM Uplift Class
Open-cell SPF	0.5	2"	0.3	0.5	Adhesive bond only	N/A*	N/A*	N/A*	Not rated
Open-cell SPF	0.5	3.5"	0.3	0.5	Adhesive bond only	N/A*	N/A*	N/A*	Not rated
Closed-cell SPF	2.0	1"	28	30	25–35	38	26	125	1-60
Closed-cell SPF	2.0	2"	28	30	25–35	42	29	130	1-60
Closed-cell SPF	2.0	3"	28	30	25–35	45	32	135	1-75
Closed-cell SPF	2.0	4"	28	30	25–35	47	33	135	1-75
Rigid PU/PIR Type II (C591)	2.5	1"	35	32	Mech. fastened	42	29	130	1-60
Rigid PU/PIR Type II (C591)	2.5	2"	35	32	Mech. fastened	47	33	135	1-75
Rigid PU/PIR Type II (C591)	2.5	3"	35	32	Mech. fastened	50	35	140	1-75
Rigid PU/PIR Type II (C591)	2.5	4"	35	32	Mech. fastened	52	37	140	1-90
Rigid PU/PIR Type III (C591)	3.0	2"	45	38	Mech. fastened	53	37	140	1-90
Rigid PU/PIR Type III (C591)	3.0	3"	45	38	Mech. fastened	57	40	145	1-90
Rigid PU/PIR Type III (C591)	3.0	4"	45	38	Mech. fastened	60	42	150	1-120
Rigid PU/PIR Type III (C591)	3.0	6"	45	38	Mech. fastened	62	44	155	1-120
HD PU Type VI (C591)	6.0	2"	125	80	Mech. fastened	80	56	165	1-120
HD PU Type VI (C591)	6.0	4"	125	80	Mech. fastened	85	60	170	1-150+
HD PU Type VI (C591)	6.0	6"	125	80	Mech. fastened	88	62	175	1-150+

Open-cell SPF (N/A) provides NO structural wind resistance — framing system carries all wind loads. Closed-cell SPF bond strength based on adhesion to OSB/plywood substrate. Allowable pressures use safety factor 3.0 per ICC-ES AC71. FM uplift class per FM 4474 / FM 4450; actual class requires FM-listed assembly test.

SECTION 3 — COMPARATIVE SUMMARY, WIND ZONE GUIDE & PERMIT CHECKLIST

Table 3A — EPS vs. PU Foam Wind Load Property Comparison

Property	Test Method	EPS TypeI 0.9 pcf	EPS Type IX 2.0 pcf	PU Open-cell 0.5 lb/ft³	PU CC SPF 2.0 lb/ft³	PU Rigid 3.0 lb/ft³	PU HD 6.0 lb/ft³
Compressive str. 10% (psi)	ASTM D1621	10–14	25–33	0.1–0.5	20–35	45	125
Flexural strength (psi)	ASTM C203	25–30	50–75	2–5	50–75	60–80	130–180
Tensile strength (psi)	ASTM D1623	16–20	23–27	2–5	50–75	70–90	150–200
Shear strength (psi)	ASTM C273	18–22	33–37	0.5–2	25–40	38	80
Shear modulus (psi)	ASTM C273	280–320	600–640	50–120	400–600	600–750	1100–1400
Allowable wall pressure (psf)	ICC-ES AC71	18–23	33–45	N/A	38–47	53–60	80–88
Allowable roof uplift (psf)	FM 4474	12–16	22–33	N/A	26–33	37–44	56–62
Max wind speed — Exp C (mph)	ASCE 7-22	90–100	120–135	N/A	125–135	140–155	165–175
FM uplift class (ci/roof)	FM 4450	1-30 to 1-45	1-75 to 1-90	Not rated	1-60 to 1-75	1-90 to 1-120	1-120 to 1-150+
R-value per inch	ASTM C518	3.85	4.35	3.70	6.20	6.30	5.80
Bond to substrate	ASTM D1623	Mech. only	Mech. only	Adhesive	Adhesive +Mech.	Mech. only	Mech. only
Suitable for hurricane zone	IBC 2021	NO (V>130 mph)	MARGINAL (V≤140)	NO (structural)	YES (with listing)	YES	YES (engineered)

Table 3B — Foam Insulation Selection Guide by ASCE 7-22 Wind Speed Zone

ASCE 7-22 Design Speed	Wind Zone / Region	Expo-sure	Recom-mended EPS Type	Recom-mended PU Type	Min. Fastener Schedule	FM Uplift Requ-ired	Special Require-ments
≤ 100 mph	Zone I — Low Wind (most inland US)	B/C	Type I or VIII (0.9–1.34 pcf)	Closed-cell SPF 2.0 lb or Rigid Type I/IV	Standard AC71 6" o.c. perimeter	1-45 minimum	Standard IBC installation per code
100–115 mph	Zone II — Moderate (midcontinent, SE inland)	B/C	Type II (1.35–1.79 pcf)	Closed-cell SPF 2.0 lb or Rigid Type II	AC71 enhanced 4" o.c. perimeter	1-60 minimum	ICC-ES evaluation report required
115–130 mph	Zone III — High Wind (coastal plains, SE)	C/D	Type IX (1.8–2.2 pcf)	Rigid PU/PIR Type II or III	AC71 high-wind 3" o.c. + clips	1-75 minimum	NFPA 285 exterior wall; project review
130–150 mph	Zone IV — Very High (Gulf/Atlantic coast)	C/D	Type IX ONLY with FM listing	Rigid PU/PIR Type III (3.0 lb/ft³)	FM-listed clip system + adhesive	1-90 to 1-120	FM 4474 / 4450 tested assembly
150–180 mph	Zone V — Extreme (hurricane prone coastal)	D	NOT RECOMMENDED (use steel/concrete ci)	HD PU Type VI (6.0 lb/ft³) only	Engineered attachment system	1-120 to 1-150+	Florida Building Code §1609
> 180 mph	Zone VI — Critical (SFHA, Cat 4–5 zones)	D	NOT PERMITTED as primary ci	Engineering analysis required (AHJ approval)	Structural engineer stamped design	1-150+ or engineered	TAS 201/202/203; Miami-Dade approval

Wind Load Permit Review Checklist — Structural Engineer / AHJ

	Verification Item	EPS	PU Closed-cell	PU Rigid HD	Code Reference
1	ASTM C578 or C591/C1029 material certification provided	Req'd	Req'd	Req'd	ASTM C578 / C591
2	ASTM D1621 compressive strength test report provided	Req'd	Req'd	Req'd	ASTM D1621
3	ICC-ES evaluation report (AC71) for ci application provided	Req'd	Req'd	Req'd	ICC-ES AC71
4	Design wind speed (V) per ASCE 7-22 Fig. 26.5-1 confirmed for site	Req'd	Req'd	Req'd	ASCE 7-22 §26.5
5	Exposure category (B/C/D) determined and documented	Req'd	Req'd	Req'd	ASCE 7-22 §26.7
6	Design wind pressures (C&C) calculated for all wall/roof zones	By eng.	By eng.	By eng.	ASCE 7-22 §30
7	Foam compressive/shear strength ≥ design pressure × safety factor	Verify	Verify	Verify	ICC-ES AC71 §5.3
8	Fastener type, size, and spacing per approved FM/ICC-ES schedule	Req'd	Req'd	Req'd	FM 4474 / AC71
9	FM-rated roof uplift assembly specified (if FM required by insurer)	FM listing	FM listing	FM listing	FM 4450 / 4474
10	Corner/edge zone reinforced fastening per ASCE 7-22 Fig. 30.3	Req'd	Req'd	Req'd	ASCE 7-22 §30.3
11	NFPA 285 exterior wall assembly tested/listed (>1 story)	Req'd	Req'd	Req'd	IBC 2603.5
12	PE-stamped drawings for wind speeds > 130 mph or Risk Cat III/IV	PE stamp	PE stamp	PE stamp	IBC §1603.1.4
13	Miami-Dade NOA or Florida Product Approval (if FL or coastal Cat 4+)	NOA req'd	NOA req'd	NOA req'd	FBC §1609 / TAS

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