

# Envelope Energy Codes - U.S.

## Metal Building Conditioned Space - ASHRAE 90.1

ASHRAE 90.1 2007		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	
Prescriptive Compliance	Roof	U-Factors	0.065 / HA 0.082	0.065 / HA 0.078	0.065 / HA 0.076	0.065	0.065	0.065	0.065	0.049
		Fiberglass with 1" TSB (Detail)	R-19 (RA.1) / HA R-13 (RA.1)	R-19 (RA.1) / HA R-13 (RA.1)	R-19 (RA.1) / HA R-16 (RA.1)	R-19 (RA.1)	R-19 (RA.1)	R-19 (RA.1)	R-19 (RA.1)	R-13 + R-19 (RB.1)
		Insulated Metal Panels (Detail)	2" (RD.1)	2" (RD.1)	2" (RD.1)	2" (RD.1)	2" (RD.1)	2" (RD.1)	2" (RD.1)	3" (RD.1)
	Walls	U-Factors	0.113	0.113	0.113	0.113	0.113	0.113	0.057	0.057
		Fiberglass (Detail)	R-13 (WA.1)	R-13 (WA.1)	R-13 (WA.1)	R-13 (WA.1)	R-13 (WA.1)	R-13 (WA.1)	R-19 (WC.1) OR R-13 + R-13 (WB.1)	R-19 (WC.1) OR R-13 + R-13 (WB.1)
		Insulated Metal Panels (Detail)	2" (WD.1)	2" (WD.1)	2" (WD.1)	2" (WD.1)	2" (WD.1)	2" (WD.1)	2.5" (WD.1)	2.5" (WD.1)

ASHRAE 90.1 2010		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	
Prescriptive Compliance	Roof	U-Factors	0.065 <sup>1</sup>	0.055	0.055	0.055	0.055	0.049	0.049	0.035
		Fiberglass with R-3.5 TSB UNO (Detail) Purlins spaced nominally 5' o/c	R-19 (RA.1)	R-25 <sup>2</sup> TRAP (RA.1) OR R-13 + R-13 (RB.1)	R-25 <sup>2</sup> TRAP (RA.1) OR R-13 + R-13 (RB.1)	R-25 <sup>2</sup> TRAP (RA.1) OR R-13 + R-13 (RB.1)	R-25 <sup>2</sup> TRAP (RA.1) OR R-13 + R-13 (RB.1)	R-30 <sup>2</sup> TRAP (RA.1) OR R-13 + R-19 (RB.1)	R-30 <sup>2</sup> TRAP (RA.1) OR R-13 + R-19 (RB.1)	R-19 + R-11 LS (RC.1) OR R-19 + R-19 + R-3.75 TSB (RE.1)
		Insulated Metal Panels (Detail)	2" (RD.1)	2.5" (RD.1)	2.5" (RD.1)	2.5" (RD.1)	2.5" (RD.1)	3" (RD.1)	3" (RD.1)	4" (RD.1)
	Walls	U-Factors	0.093	0.093	0.084	0.084	0.069	0.069	0.057	0.057
		Fiberglass (Detail)	R-16 (WC.1)	R-16 (WC.1)	R-19 (WC.1)	R-19 (WC.1)	R-25 + R-0.75 TSB (WC.2)	R-25 + R-0.75 TSB (WC.2)	R-30 + R-0.75 TSB (WC.2)	R-30 + R-0.75 TSB (WC.2)
		Insulated Metal Panels (Detail)	2" (WD.1)	2" (WD.1)	2" (WD.1)	2" (WD.1)	2" (WD.1)	2" (WD.1)	2.5" (WD.1)	2.5" (WD.1)



ASHRAE 90.1 2010		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	
Prescriptive Compliance	Roof	U-Factors	0.167	0.097	0.097	0.097	0.083	0.072	0.072	0.065
		Fiberglass with R-3.5 TSB (Detail)	R-6 (RA.1)	R-10 (RA.1)	R-10 (RA.1)	R-10 (RA.1)	R-13 (RA.1)	R-16 (RA.1)	R-16 (RA.1)	R-19 (RA.1)
		Insulated Metal Panels (Detail)	2" (RD.1)	2" (RD.1)	2" (RD.1)	2" (RD.1)	2" (RD.1)	2" (RD.1)	2" (RD.1)	2" (RD.1)
	Walls	U-Factors	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113
		Fiberglass (Detail)	R-13 (WA.1)	R-13 (WA.1)	R-13 (WA.1)	R-13 (WA.1)	R-13 (WA.1)	R-13 (WA.1)	R-13 (WA.1)	R-13 (WA.1)
		Insulated Metal Panels (Detail)	2" (WD.1)	2" (WD.1)	2" (WD.1)	2" (WD.1)	2" (WD.1)	2" (WD.1)	2" (WD.1)	2" (WD.1)

ASHRAE 90.1 2013-2022		Zone 0 <sup>3</sup>	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	
Prescriptive Compliance	Roof	U-Factors	0.115	0.115	0.096	0.096	0.082	0.082	0.060	0.037	0.037
		Fiberglass with R-3 TSB (Detail)	R-10 (RA.1)	R-10 (RA.1)	R-16 (RA.1)	R-16 (RA.1)	R-19 (RA.1)	R-19 (RA.1)	R-19 + R-19 (RB.1)	R-19 + R-11 LS (RC.1) OR R-25 + R-8 LS (RC.1)	R-19 + R-11 LS (RC.1) OR R-25 + R-8 LS (RC.1)
		Insulated Metal Panels (Detail)	2" (RD.1)	2" (RD.1)	2" (RD.1)	2" (RD.1)	2" (RD.1)	2" (RD.1)	2.5" (RD.1)	4" (RD.1)	4" (RD.1)
	Walls	U-Factors	0.352	0.352	0.162	0.162	0.162	0.094	0.094	0.072	0.060
		Fiberglass (Detail)	NR	NR	R-13 (WA.1)	R-13 (WA.1)	R-13 (WA.1)	R-19 <sup>2</sup> RR/A (WA.1) OR R-25 + R-0.75 TSB (WC.2)	R-19 <sup>2</sup> RR/A (WA.1) OR R-25 + R-0.75 TSB (WC.2)	R-25 + R-0.75 TSB (WC.2)	R-25 + R-0.75 TSB (WC.2)
		Insulated Metal Panels (Detail)	NR	NR	2" (WD.1)	2" (WD.1)	2" (WD.1)	2" (WD.1)	2" (WD.1)	2" (WD.1)	2" (WD.1)

See pages 22 - 25 for roof and wall details illustrating the insulation solutions

RR/A – Reverse R-Panels or A-Panels are required to achieve the performance indicated

# Metal Building Conditioned Space - IECC

2009		Zone 1	Zone 2	Zone 3	Zone 4 Except Marine	Zone 5 & Marine 4	Zone 6	Zone 7	Zone 8	
Prescriptive Compliance	Roof	U-Factors	0.065	0.055	0.055	0.055	0.055	0.049	0.049	0.035
		Fiberglass with R-3.5 TSB UNO (Detail)	R-19 (RA.1)	R-25 <sup>2</sup> TRAP (RA.1) OR R-13 +R-13 (RB.1)	R-25 <sup>2</sup> TRAP (RA.1) OR R-13 +R-13 (RB.1)	R-25 <sup>2</sup> TRAP (RA.1) OR R-13 +R-13 (RB.1)	R-25 <sup>2</sup> TRAP (RA.1) OR R-13 +R-13 (RB.1)	R-30 <sup>2</sup> TRAP (RA.1) OR R-13 +R-19 (RB.1)	R-30 <sup>2</sup> TRAP (RA.1) OR R-13 +R-19 (RB.1)	R-19 + R-11 LS (RC.1)
		Insulated Metal Panels (Detail)	2" (RD.1)	2.5" (RD.1)	2.5" (RD.1)	2.5" (RD.1)	2.5" (RD.1)	3" (RD.1)	3" (RD.1)	4" (RD.1)
	Walls	U-Factors	0.093	0.093	0.084	0.084	0.069	0.069	0.057	0.057
		Fiberglass (Detail)	R-16 (WA.1)	R-16 (WA.1)	R-19 (WA.1)	R-19 (WA.1)	R-25 + R-0.75 TSB (WC.2)	R-25 + R-0.75 TSB (WC.2)	R-30 + R-3 TSB (WC.2)	R-30 + R-3 TSB (WC.2)
		Insulated Metal Panels (Detail)	2" (WD.1)	2" (WD.1)	2" (WD.1)	2" (WD.1)	2" (WD.1)	2" (WD.1)	2.5" (WD.1)	2.5" (WD.1)

2012		Zone 1	Zone 2	Zone 3	Zone 4 Except Marine	Zone 5 & Marine 4	Zone 6	Zone 7	Zone 8	
Prescriptive Compliance	Roof	U-Factors	0.044 <sup>5</sup>	0.035 <sup>5</sup>	0.035 <sup>5</sup>	0.035	0.035	0.031	0.029	0.029
		Fiberglass with R-5 TSB (Detail)	R-30 <sup>2</sup> TRAP (RA.1) OR R-19 + R11 LS (RC.1)	R-19 + R-11 LS (RC.1)	R-19 + R-11 LS (RC.1)	R-19 + R-11 LS (RC.1)	R-19 + R-11 LS (RC.1)	R-25 + R11 LS (RC.1)	R-30 + R-11 LS (RC.1)	R-30 + R-11 LS (RC.1)
		Insulated Metal Panels (Detail)	3" (RD.1)	4" (RD.1)	4" (RD.1)	4" (RD.1)	4" (RD.1)	5" (RD.1)	5" (RD.1)	5" (RD.1)
	Walls	U-Factors	0.079	0.079	0.079	0.052	0.052	0.052	0.052	0.052
		Fiberglass (Detail)	R-25 + R-0.75 TSB (WC.2)	R-25 + R-0.75 TSB (WC.2)	R-25 + R-0.75 TSB (WC.2)	R-30 + R-0.75 TSB (WC.2)	R-30 + R-0.75 TSB (WC.2)	R-30 + R-0.75 TSB (WC.2)	R-30 + R-0.75 TSB (WC.2)	R-30 + R-0.75 TSB (WC.2)
		Insulated Metal Panels (Detail)	2" (WD.1)	2" (WD.1)	2" (WD.1)	2.5" (WD.1)	2.5" (WD.1)	2.5" (WD.1)	2.5" (WD.1)	2.5" (WD.1)

2015-2018		Zone 1	Zone 2	Zone 3	Zone 4 Except Marine	Zone 5 & Marine 4	Zone 6	Zone 7	Zone 8	
Prescriptive Compliance	Roof	U-Factors	0.044 <sup>6</sup>	0.035 <sup>6</sup>	0.035 <sup>6</sup>	0.035	0.035	0.031	0.029	0.029
		Fiberglass with TSB (Detail)	R-30 <sup>2</sup> TRAP (RA.1) OR R-19 + R11 LS (RC.1)	R-19 + R-11 LS (RC.1)	R-19 + R-11 LS (RC.1)	R-19 + R-11 LS (RC.1)	R-19 + R-11 LS (RC.1)	R-25 + R11 LS (RC.1)	R-30 + R-11 LS (RC.1)	R-30 + R-11 LS (RC.1)
		Insulated Metal Panels (Detail)	3" (RD.1)	4" (RD.1)	4" (RD.1)	4" (RD.1)	4" (RD.1)	5" (RD.1)	5" (RD.1)	5" (RD.1)
	Walls	U-Factors	0.079	0.079	0.079	0.052	0.052	0.052	0.052	0.052
		Fiberglass (Detail)	R-25 + R-0.75 TSB (WC.2)	R-25 + R-0.75 TSB (WC.2)	R-25 + R-0.75 TSB (WC.2)	R-30 + R-0.75 TSB (WC.2)	R-30 + R-0.75 TSB (WC.2)	R-30 + R-0.75 TSB (WC.2)	R-30 + R-0.75 TSB (WC.2)	R-30 + R-0.75 TSB (WC.2)
		Insulated Metal Panels (Detail)	2" (WD.1)	2" (WD.1)	2" (WD.1)	2.5" (WD.1)	2.5" (WD.1)	2.5" (WD.1)	2.5" (WD.1)	2.5" (WD.1)

2021		Zone 0	Zone 1	Zone 2	Zone 3	Zone 4 Except Marine	Zone 5 & Marine 4	Zone 6	Zone 7	Zone 8	
Prescriptive Compliance	Roof	U-Factors	0.035 <sup>6</sup>	0.035 <sup>6</sup>	0.035 <sup>6</sup>	0.035 <sup>6</sup>	0.035	0.035	0.031	0.029	0.026
		Fiberglass with TSB (detail)	R-19 + R-11 LS (RC.1)	R-19 + R-11 LS (RC.1)	R-19 + R-11 LS (RC.1)	R-19 + R-11 LS (RC.1)	R-19 + R-11 LS (RC.1)	R-19 + R-11 LS (RC.1)	R-25 + R11 LS (RC.1)	R-30 + R11 LS (RC.1)	R-25 + R-11 + R-11 LS (RC.5)
		Insulated Metal Panels (Detail)	4" (RD.1)	4" (RD.1)	4" (RD.1)	4" (RD.1)	4" (RD.1)	4" (RD.1)	5" (RD.1)	5" (RD.1)	6" (RD.1)
	Walls	U-Factors	0.079	0.079	0.079	0.079	0.052	0.050	0.050	0.044	0.039
		Fiberglass (Detail)	R-25 + R-0.75 TSB (WC.2)	R-25 + R-0.75 TSB (WC.2)	R-25 + R-0.75 TSB (WC.2)	R-25 + R-0.75 TSB (WC.2)	R-30 + R-0.75 TSB (WC.2) OR R-25 + R-10 (WB.1)	R-25 + R-10 (WB.1)	R-25 + R-10 (WB.1)	R-25 + R-16 (WB.1)	R-30 + R-16 (WB.1) OR R-25 + R-10 + R-3 TSB (WB.2)
		Insulated Metal Panels (Detail)	2" (WD.1)	2" (WD.1)	2" (WD.1)	2" (WD.1)	2.5" (WD.1)	2.5" (WD.1)	2.5" (WD.1)	4" (WD.1)	4" (WD.1)

See pages 22 - 25 for roof and wall details illustrating the insulation solutions

Trap – NBG trapezoidal panel with R-3.75 TSB is required to achieve the performance indicated

## Chart Notes:

- 1) For ASHRAE 90.1-2010 thru 2022 in Zones 0 and 1, roof U-Factors are realized if panel color utilized has:
  - (A) minimum three-year aged solar reflectance of 0.55 and minimum three-year aged thermal emittance of 0.75; or
  - (B) minimum three-year aged Solar Reflectance Index of 64. Otherwise, an increased roof insulation to U-0.028 is required. This can be accomplished by using
    - a. Fiberglass R-19 + R-38 + R-3.75 TSB (RE.1) with CFR panel or,
    - b. Fiberglass R-25 + R-38 + R-3.75 TSB (RE.1) with SS360 panel or,
    - c. Fiberglass R-25 + R-11 + R-11 (RC.5) or,
    - d. 5" Insulated Metal Panel (RD.1).
- 2) The system performance has been validated through the use of either hot box testing or finite element modeling.
- 3) Zone 0 was introduced by ASHRAE in 2016.
- 4) Loc Seam panels have not been tested with the R-Boost™ Elevated Insulation System. Detail RE.1 only applies to trapezoidal panels.
- 5) For IECC 2012 in Zones 1, 2, and 3, roof U-Factors are realized if panel color utilized has:
  - (A) minimum three-year-aged solar reflectance of 0.55 and minimum three-year-aged thermal emittance of 0.75;
  - (B) minimum three-year-aged Solar Reflectance Index of 64;
  - (C) minimum initial solar reflectance of 0.70 and minimum initial thermal emittance of 0.75; or
  - (D) minimum initial Solar Reflectance Index of 82.
- 6) For IECC 2015 — 2021 in Zones 0, 1, 2, and 3, roof U-Factors are realized if panel color utilized has:
  - (A) minimum three-year-aged solar reflectance of 0.55 and minimum three-year-aged thermal emittance of 0.75; or
  - (B) minimum three-year-aged Solar Reflectance Index of 64.