



December 3, 2018

Mike Evans
Bartile Roofs, Inc.
725 N. 1000 W.
Centerville, Utah. 84014
800-933-5038
801-295-3443 x 105
Mevans@bartile.com

RE: NBS 23 Ice Sphere Impact Testing
JDK 60-48-2

Dear Mr. Evans,

The Factory Mutual very severe hail test indicates that targets are to be impacted with 2" ice spheres. The very severe (VS) hail test however does not list a kinetic energy for the ice spheres. The National Bureau of Standards indicates that for a 2" hail stone, the impact energy shall be 22-foot pounds.

TABLE 1. Terminal velocities and energies of hailstones^a

Diameter		Terminal velocity			Approximate impact energy	
<i>inches</i>	<i>cm</i>	<i>ft/s</i>	<i>mi/hr</i>	<i>(m/sec)</i>	<i>ft lbs</i>	<i>Joules</i>
1	(2.5)	73	50	(22.3)	< 1	(< 1.36)
1¼	(3.2)	82	56	(25.0)	4	(5.42)
1½	(3.8)	90	61	(27.4)	8	(10.85)
1¾	(4.5)	97	66	(29.6)	14	(18.96)
2	(5.1)	105	72	(32.0)	22	(29.80)
2½	(6.4)	117	80	(35.7)	53	(71.9)
2¾	(7.0)	124	85	(37.8)	81	(109.8)
3	(7.6)	130	88	(39.6)	120	(162.7)

^a Read from graphs in reference [9].

The 2" hail shot by JDKA all had an impact energy that exceeded 22-foot pounds. The average impact energy ranged from a low of 24.1-foot pounds to a high of 24.91-foot pounds.

Based upon the review of the NBS and the Factory Mutual VS hail test, it does appear that your tile is in compliance with the VS hail test of Factory Mutual.

Please call our office if you have any questions.

Sincerely,

Jim D. Koontz, P.E., RRO
President

Bartile Roofing

Concrete Tile Testing

October 24, 2018

JDK #20-95-43

NBS 23 Hail Impact Testing			
Client Sample Type	Hail Size, in.	Velocity, fps	Impact Energy, lbf/in²
Bartile	2"	109.23	24.79
		104.28	22.63
		108.52	24.51
		108.05	24.54
Average		107.52	24.12
Bartile Legendary	2"	108.23	24.74
		110.31	25.29
		107.12	24.28
		107.53	25.33
Average		108.30	24.91
Sierra Mission	2"	107.41	25.16
		104.66	24.15
		107.12	25.06
		108.81	24.85
		107.3	24.51
Average		106.97	24.64
European	2"	107.01	24.34
		107.12	24.08
		108.58	24.7
		106.95	25.02
		107.47	24.51
		106.16	24.07
Average		107.29	24.58