USEFUL INFORMATION

Resistance of Heating Element

9" Z Mesh Resistance = 0.001367 ohms / l.f.
12" Z Mesh Resistance = 0.001262 ohms / l.f.
Tuff Cable Resistance = 0.00118 ohms/ l.f.
Cold Lead Resistance = 0.000129 ohms / l.f.

Helpful Formulas

V = Volts C = Cold Lead, Total Feet
I = Amps Z = Z Mesh Element, Total Feet
R = Resistance T = Tuff Cable Element, Total Feet

RZ = Resistance of Z Mesh
RZ = Total Resistance - (C x 0.000129)

RT = Resistance of Tuff Cable
RT = Total Resistance - (C x 0.000129)

V = I x R: Volts (V) = Amps (I) x Resistance (R)
W = V x I: Watts (W) = Volts(V) x Amps (I)
I = V ÷ R: Amps (I) = Volts(V) ÷ Resistance (R)
R = V ÷ I: Resistance (R) = Volts(V) ÷ Amps (I)

Determining Length of 12" Z Mesh Used:

(When Volts and Amps are known)

Total Resistance (R) = Volts (V) ÷ Amps (I)
RZ = R - (C x 0.000129)
Z = RZ ÷ 0.001262

Example: 3kVA Transformer on Tap #6
V = 30.3
I = 94
C = 50 feet
R = 30.3 ÷ 94
RZ = 0.32234 - (50 x 0.000129)
Z = 0.31589 ÷ 0.001262 = 250 l.f. 12" Z Mesh

Determining Operating Amperage of Z Mesh or Tuff Cable Heating Element:

(When Volts and lineal footage of Heating Element are known)

Amps (I) = Volts (V) ÷ Resistance (R)
R = Z or T x R per linear foot of Z Mesh or Tuff Cable element

Example: 3kVA Transformer on Tap #6, 12" Z Mesh
V = 30.3
Z = 250 l.f. of 12" Z Mesh
C = 50 feet
I = 30.3 ÷ (250 x 0.001262 + 50 x 0.000129)
I = 94

Determining Operating Costs

Watts = Volts (V) x Amps (I)
Kilowatts/hour (KWH) = W ÷ 1000
Operating Cost/hour = KWH x Cost per KWH

Example: 3kVA Transformer on tap #6

V = 30.3
I = 94
Cost Per Kilowatt Hour = $0.06

W = 30.3 x 94
KWH = 2848 ÷ 1000
Operating Cost/hour = 2.85 x $0.06 =
$0.17 per continuous hour of operation

Determining Length of Tuff Cable Used:

(When Volts and Amps are known)

RT = R - (C x 0.000129)
T = RT ÷ 0.00118

Example: 6kVA Transformer on Tap #3
V = 59.1
I = 90
C = 50 feet
R = 59.1 ÷ 90
RT = 0.656666 - (50 x 0.000129) = 0.65021
T = 0.65021 ÷ 0.00118 = 551 l.f. Tuff Cable

Determining Watts Per Square Foot

(When Volts and Amps are known)

W = V x I
Watts/ft^2 **=** Watts ÷ Square feet

Example: 6kVA Transformer on Tap #3
V = 59.1
I = 90
$Feet^2$ = 278
W = 59.1 x 90
Watts/ft^2 **=** 5319 ÷ 278
Watts per Square Foot = 19.13

Conversions

BTU's = Watts x 3.412
Calorie/hour = BTU/hour x 252
Degree F = Degree C x 1.8 + 32
Degree C = (Degree F - 32) x 0.556
Meters = Feet x 3.281
Feet = Meters x 0.3048

Note: Volts and amps readings should be taken on secondary taps on the transformer.

Comforming
to UL Standard 1693

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A Few Concrete Suggestions

Heatizon Systems is not an asphalt, concrete or pavers expert, but we have a few suggestions that you may wish to discuss with your contractor. We make these suggestions in an effort to increase the likelihood that Heatizon Systems' high quality Tuff Cable will be surrounded by products that are equal to it in both quality and expected longevity. In addition, we make these suggestions in an effort to reduce the possibility that your Tuff Cable heating element will get damaged or broken by the vertical or horizontal movement of asphalt, concrete, or pavers.

Dry Base: Make certain that the ground below where the new asphalt, concrete or pavers will be located is as dry as possible. It is recommended that it be covered whenever there is a risk of a storm for one to two weeks prior to the pour.

Excavation: Be sure that your excavation is deep enough to accommodate the thickness of the concrete, the thickness of the insulation, the depth of the aggregate base you will have below the concrete and a 1" sand bed if you elect to install the Tuff Cable below the concrete.

Compaction: Once the excavation is complete, it is highly recommended that a great deal of care be given to completely and properly compact the entire area where the asphalt, concrete or pavers will be located.

Drainage: In order to have proper drainage and to reduce the likelihood of vertical shifting of your asphalt, concrete, or pavers Heatizon Systems recommends that a minimum of 6 inches of high quality aggregate be laid over the entire area where the asphalt, concrete, or pavers are to be installed, plus one foot around all edges.

Reinforcement: In order to enhance the integrity of your asphalt, concrete or pavers, Heatizon Systems recommends that reinforcement be considered. Most of the time concrete can be reinforced with number 4 gauge welded wire fabric or ½ inch re-bar placed at least 2 inches from the top and bottom surfaces of the concrete.

Insulation: Insulation is a two edged sword. On the one hand, it acts as a good moisture barrier, reduces the response time of your snow melt or heating system, and saves money by reducing operating time. On the other hand ,insulation does not allow the heat from the ground to get into the asphalt, concrete, or pavers.

Maximum Area: Heatizon Systems recommends that concrete be poured in square sections no larger than 9.5 feet X 9.5 feet. Pouring other geometric shapes without additional joints almost always results in cracking. Each square must always have a joint on each of its four sides.

Jumpers: It does not matter what kind of joint is in the asphalt or concrete, Tuff Cable should never be allowed to run through it. Always use a Heatizon Systems jumper under any and all joints. Remember, if it is a joint of any kind it must be jumpered under with a jumper kit.

Thickness: Heatizon Systems always recommends the following thickness be observed:

Concrete	5 or more inches
Asphalt	4 or more inches
Pavers	4 or less inches

Suggested Mix: Heatizon Systems recommends that a six-bag mix with fiber or steel fibers always be used when pouring concrete.

COMPARATIVE R-VALUES OF FLOORING AND SUBFLOORS

Material	Typical R-Value	R-Value Per Inch	Typical Thickness
Plywood	0.825	1.10	0.750
OSB	1.050	1.40	0.750
Softwood	0.825	1.10	0.750
Sheet Vinyl	0.200	1.60	0.125
Vinyl Composition Tile (VCT)	0.200	1.60	0.125
Linoleum	0.400	1.60	0.250
Linoleum	0.200	1.60	0.125
Dense Rubber Flooring	0.250	1.30	0.325
Recycled Rubber Flooring	1.100	2.20	0.500
Cork	1.125	3.00	0.375
Cork/MDF/Laminate	1.175	2.35	0.500
Brick	3.375	2.25	1.500
Marble	0.400	0.80	0.500
Ceramic Tile	0.250	1.00	0.250
Thinset Mortar	0.050	0.40	0.125
MDF/Plastic Laminate	0.500	1.00	0.500
Laminate Floor Pad	0.300	1.92	0.160
Engineered Wood	0.250	1.00	0.250
Engineered Wood	0.375	1.00	0.375
Engineered Wood	0.625	1.00	0.625
Engineered Wood	0.750	1.00	0.750
Engineered Wood Flooring Pad	0.200	1.60	0.125
Engineered Bamboo	0.720	0.96	0.750
Oak	0.638	0.85	0.750
Ash	0.750	1.00	0.750
Maple	0.750	1.00	0.750
Pine	0.975	1.30	0.750
Fir	0.900	1.20	0.750
Carpet Pad/ Slab Rubber 33 lb.	0.320	1.28	0.250
Carpet Pad/ Slab Rubber 33 lb.	0.480	1.28	0.375
Carpet Pad/ Slab Rubber 33 lb.	0.640	1.28	0.500
Carpet Pad/ Waffle Rubber 25 lb.	0.620	2.48	0.250
Carpet Pad/ Waffle Rubber 25 lb.	1.240	2.48	0.500
Hair Jute	1.940	3.88	0.500
Hair Jute	1.250	3.88	0.325
Prime Urethane	1.400	4.30	0.325
Prime Urethane	2.150	4.30	0.500
Bonded Urethane	1.350	4.20	0.325
Bonded Urethane	2.100	4.20	0.500
Carpet	0.700	2.80	0.250
Carpet	1.050	2.80	0.375
Carpet	1.400	2.80	0.500
Carpet	1.750	2.80	0.625
Carpet	2.100	2.80	0.750
Wool Carpet	15.75	4.20	0.375
Wool Carpet	2.100	4.20	0.500

R-Values are approximate. Check with manufacturer for individual products.
Excerpted from Radiant Panel Association *Radiant Flooring Guide.*