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Reflectivity of Prefinished Sheet Steel

It's a fact that buildings consume two thirds of all the electricity produced in North America and one third of all the energy produced in North America. While it is recognized that cooling and heating costs can be reduced by adding insulation under the roof surface, there is a diminishing return on the strategy of increasing insulation to conserve energy costs. This is where "cool roofing" can play a role in further reducing the energy consumed, and in minimizing the Heat Island effect created in the big urban cities. Cool roofing relies on the properties of reflectivity and emissivity of the roofing material.

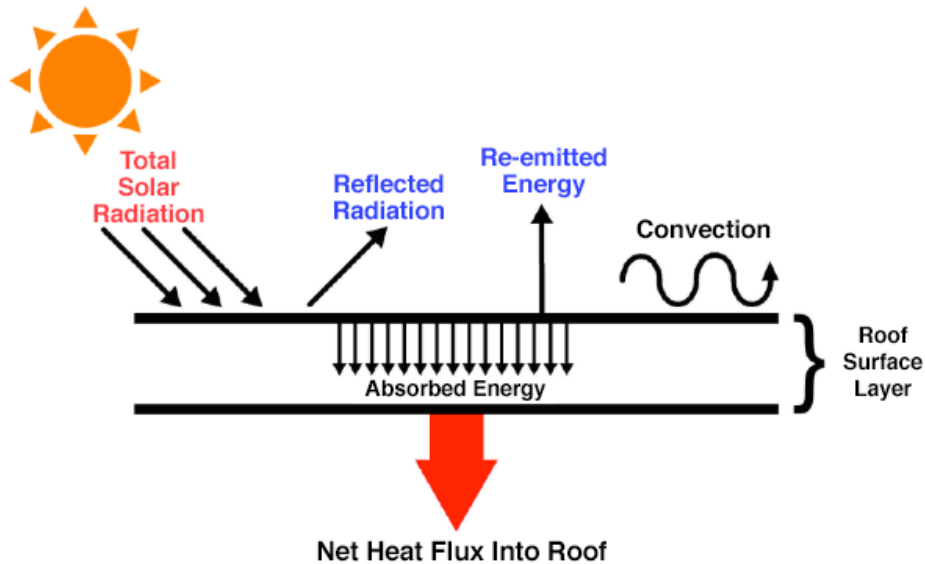
Reflectivity

Reflectivity is the ability of the roof to reflect solar radiation back into the atmosphere. Its primary measure is solar reflectance - the proportion of the total solar radiation that is reflected back to the atmosphere. Any solar radiation that is not reflected is absorbed into the building envelope, requiring further energy to cool the building; or partially convected into the atmosphere increasing the ambient air temperature in the surrounding environment (Heat Island effect).

The measure of reflectivity is the Solar Reflectance Index (SRI) which takes into account the properties of the material as well as the cooling effect of wind passing over the roof. The SRI for a low slope roof will be 0 for standard black (reflectance 0.05, emittance 0.90) and 100 for standard white (reflectance 0.80, emittance 0.90).

Emissivity

Emissivity is the ability of the roof to re-radiate absorbed solar infrared radiation back to the atmosphere. This takes place at all times, but mostly at night. Its measure is Infrared Emittance - the proportion of absorbed infrared solar radiation that is re-emitted back to the atmosphere. For prepainted sheet steel colours, the emissivity is generally high and close to 0.90.



Properties of Prefinished Sheet Steel

Prefinished sheet steel is a coil-coated product manufactured under stringent quality control in a modern coating factory. Coil coating is a precise, multi-step process that applies paint coatings to specially prepared sheet steel in a continuous operation. There are a variety of paint systems available (e.g. polyesters, fluorocarbons, plastisols) to suit the needs of the consumer and the environmental conditions. In Canada the most popular paint systems are the Perspectra Series, a modified silicon polyester, and the 10 000 Series, a fluorocarbon. Each paint system and colour can have different reflectivity depending mostly on pigment quality. 50% of sunlight is visible (colour vision) and 50% invisible (UV and near infrared). The reflectivity can then be improved by modifying the thermal property of the paint in the invisible part of the sunlight without modifying the colour. Listed in Tables 1 and 2 are the properties of some common Perspectra Series and 10 000 Series colours respectively. The following definitions apply to these tables.

Colour Description = the name for the particular colour, which can vary between the different manufacturers of sheet steel products.

QC number = the identification number that is unique to the paint system and colour produced in Canada.

TSR = Total Solar Reflectance

SRI = Solar Reflectance Index calculated at the Medium wind condition per ASTM E1980, *Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low Sloped Opaque Surfaces*.

Properties of Asphalt Shingles

Asphalt shingles are a common roofing product for residential buildings and come in a large variety of colours and compositions. The solar reflectance of the shingles is uniformly low, varying from around 4% (black) to 31% (white). In general the white and grey specimens have the highest reflectance followed by the light brown colours. In all cases the emissivity is around 0.9. Given the large number of asphalt shingle manufacturers and products it is impractical to give a list of the specific properties. However, the information is generally available through an internet search.



Table 1: Solar Reflectance of Perspectra Series Prefinished Sheet Steel

Colour Description	QC number	TSR	SRI
WHITE WHITE	18317	0.56	65
BONE WHITE	18273	0.49	56
USDA WHITE	18464	0.60	71
BRIGHT WHITE	18783	0.66	79
CAMBRIDGE WHITE	18695	0.63	75
ANTIQUE LINEN	18696	0.59	69
IVORY	18802	0.58	68
BAMBOO IVORY	18784	0.60	71
PUTNAM IVORY	18076	0.55	64
BLACK COFFEE	18326	0.26	24
STONE GREY	18305	0.46	51
BLACK	18262	0.05	-1
DARK BROWN	18229	0.15	10
CHARCOAL	18306	0.30	30
TAN	18315	0.34	35
REGENT GREY	18730	0.37	39
TILE RED	18259	0.31	31
METRO BROWN	18228	0.27	26
MAHOGANY BROWN	18719	0.31	31
BEIGE	18021	0.57	66
BISCUIT	18119	0.53	61
CANNERS BROWN	18014	0.30	30
SABLE	18641	0.23	20
BUCKSKIN	18055	0.36	38
BLACK COFFEE	18326	0.26	24
MELCHERS GREEN	18307	0.09	3
SLATE BLUE	18260	0.28	27
HERON BLUE	18330	0.11	6
DARK RED	18250	0.26	24
GREEN	18329	0.27	26
ROYAL BLUE	18790	0.24	21
PACIFIC TURQUOISE	18258	0.27	26
MIST GREEN	18256	0.36	38
TURQUOISE	18310	0.30	30
DEEP WATER GREEN	18684	0.23	20
SAPPHIRE BLUE	18261	0.45	50
NAVY BLUE	18107	0.12	6
CORDOVAN	18643	0.27	26
BRIGHT RED	18386	0.36	38



Table 2: Solar Reflectance of 10 000 Series Prefinished Sheet Steel

Colour Description	QC number	TSR	SRI
OFF WHITE	7394	0.61	72
L/S REGAL WHITE	8953	0.67	81
L/S WARM WHITE	8954	0.60	71
ARCTIC WHITE	195	0.59	69
ANTIQUÉ LINEN	7441	0.45	50
CHARCOAL	690	0.13	6
REGENT GRAY	7602	0.27	26
TIMBER WOLF GREY	9264	0.13	10
CHARCOAL	8974	0.33	34
L/S PEARL GRAY	8957	0.44	49
TUSCAN SLATE	9307	0.29	29
SLATE GRAY	9384	0.37	40
SURREY BEIGE	7601	0.36	38
SANDSTONE	9306	0.59	70
TAN	9398	0.40	43
GREYBERRY	3659	0.16	10
DARK BRONZE	7135	0.08	-1
PEBBLE	3661	0.37	38
LH BLACK	9400	0.04	-1
STONE GREY	998	0.31	30
BLACK	193	0.06	-3
METRO BROWN	196	0.10	2
SAND BEIGE	3654	0.51	57
SLATE BLUE	184	0.17	12
HART GREEN	7134	0.09	1
TWILIGHT BLUE	3644	0.17	11
WINTER GREEN	3651	0.12	6
HOME DEPOT ORANGE	6270	0.46	52
CORDOVAN	3643	0.18	13
COLONIAL RED	5636	0.21	17