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Solar Control, Safety and Security Window Films **Tech Bulletin**

Electromagnetic Interference (EMI)

Electric and magnetic energy emitted by many electronic devices may interfere with the function of other electronic devices. The majority of electromagnetic interference (EMI) problems originate in the radio frequency (RF) bandwidth of the spectrum from 30 KHz to 10GHz. Some of the common bandwidths used in communication are listed in Table 1.

Table 1: Bandwidth allocation (US frequency allocation table is available at www.ntia.doc.gov)

Bandwidth description	Frequency range
AM radio	540 KHz - 1630 KHz
TV channels 2-13 and FM radio (VHF)	30 MHz - 300 MHz
Mobile/fixed radio & TV (super band)	216 MHz - 600 MHz
Cell phone, PCS and XM radio	806 MHZ - 2.3 GHz
Ultra-high frequency (UHF)	300 MHz - 6 GHz
Mobile, fixed satellites, radio location/navigation	6 GHz - 10 GHz

EMI and/or RF shielding is required, in many instances, for the following reasons:

1. To exclude unwanted EM or RF signals.
2. To contain unwanted EM or RF signals that may interfere with neighboring electronic devices, such as computers and cordless communication devices.
3. To prevent the unauthorized interception of microwave and radio signals.

Many solar control window films are manufactured from the application of various metals onto a film surface. These metals provide the solar energy and visible light rejection desired of these products. In addition to solar and light energy rejection, the communication and/or radio frequencies of the electromagnetic spectrum are also reduced or attenuated. These frequencies include all UHF and VHF TV broadcast channels, AM and FM radio, cell and cordless phones, satellite GPS navigation and communication frequencies.

Shielding effectiveness (N)

The ability of a material to attenuate EM and RF signals is called shielding effectiveness. Shielding effectiveness (N) is a ratio of the proportion of an electromagnetic field incident on the shield to that which is transmitted through it. It is expressed as:

$$N = 20 \text{ Log}_{10} (E_i / E_t)_{(dB)}$$

- Where N is shielding effectiveness in dB
- E_i is the electromagnetic field incident on the film
- E_t is the electromagnetic energy that transmitted though the film

Solar Gard has tested several window films containing various amounts of gold, silver, copper and aluminium for their shielding effectiveness.
Tables 2 and 3 show the shielding effectiveness for some of Solar Gard's metalized

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Table 2: Shielding effectiveness 30-600MHz (All values in dB)

Film type	30MHz	40MHz	60MHz	80MHz	100MHz	200MHz	400MHz	600MHz
LX 70	48	25	46	37	37	32	35	33
Panorama Sterling 20	31	40	36	32	23	42	37	32
Panorama Sterling 50	33	15	17	17	23	29	25	24
Panorama Sterling 60	14	7	8	10	14	15	20	20
Panorama Sterling 70	8	3	7	15	11	15	16	17
Solar Bronze 20	29	7	15	8	14	10	34	36
Solar Bronze 35	17	1	8	3	9	6	33	33
Solar Bronze 50	20	26	18	28	14	20	32	26
Silver 20	24	16	27	23	12	28	26	25
Silver 35	37	16	18	16	25	20	18	17
Silver 50	30	13	20	9	12	20	16	14

Table 3: Shielding effectiveness 0.8-10GHz (All values in dB)

Film type	800MHz	1GHz	2GHz	4GHz	6GHz	8GHz	10GHz
LX 70	34	36	48	29	36	31	29
Panorama Sterling 20	33	37	27	28	28	29	30
Panorama Sterling 50	25	27	39	21	23	22	14
Panorama Sterling 60	20	22	32	20	19	14	17
Panorama Sterling 70	17	19	32	17	14	13	11
Solar Bronze 20	35	38	40	31	34	36	28
Solar Bronze 35	33	34	38	30	30	31	26
Solar Bronze 50	30	32	28	30	24	28	21
Silver 20	28	28	39	21	22	23	16
Silver 35	18	19	34	15	16	18	13
Silver 50	16	16	32	13	13	12	7

solar control window films.

A quick look at the formula for shielding effectiveness shows that every 6dB of attenuation corresponds to a 50 percent signal reduction. Therefore, any value shown in the table above that has an attenuation level of 25dB or greater is effective in shielding at that frequency.

A film such as Solar Gard LX 70 is more effective at all frequencies while a film such as Panorama Sterling 70 is not very effective at all frequencies.

It is important to note that the films tested were not grounded to the test structure. The window film products from Solar Gard are constructed such that the metal is laminated between layers of optically clear polyester film. Therefore, the metal in the film does not come in contact with the test fixture.

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