Thermal Design

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WHAT IS LOW-E?

“Low-e” is a buzz word in construction and especially in the construction of ice rinks. Many people are confused, are getting misleading information, or just don’t understand the purpose of low-e materials. We hope to clear up some of the questions with the following fact sheet, starting with the definition of emissivity *(ee-muh-siv-ity)*: "A physical property of the surface of an object and is the ratio of the energy which is absorbed and emitted from its surface in the form of infrared radiation to the total energy hitting the object."

It has been experienced that in poorly insulated indoor ice arenas with a large amount of radiation emitting from the ceiling surfaces that suspending a ceiling with a low-e surface between the ice sheet and the hot upper ceiling surfaces causes a reduction in refrigeration costs. This is the result of blocking the infrared energy from reaching the ice sheet. This experience is frequently misrepresented as a better alternative to providing a well insulated ceiling; however this is not true. This surface material makes a difference because the original roof is poorly insulated. With the advent of the permanent high R-value Simple Saver System® for new and existing buildings, there is a superior alternative to suspending short lived low-e ceilings in poorly insulated buildings.

The low-e properties of the secondary ceiling are seldom what they claim to be and always deteriorate as the surface becomes dirty or corroded, resulting in higher energy costs. Installing a low-e ceiling in a well insulated building will not result in substantial energy savings because the well insulated ceiling assembly will itself minimize heat transfer into the building from all three modes (conduction, convection and radiation). Consequently there is little energy left to be blocked by the low-e ceiling. The insulation performance is not effected by dirt or corrosion and is superior to the performance of the low-e with little or no insulation. Use of a low-e ceiling exclusively is no substitute for a good insulation system.

A well insulated building will result in superior ice quality, significantly less refrigeration loads and a smaller investment in refrigeration equipment, while installing a reflective low-e surface facing the ice sheet may actually increase the refrigeration load in well insulated buildings because it reflects a much higher percentage of the internally generated heat back toward the ice sheet.

> **Fact:** A highly polished aluminum sheet is measured to have an emissivity as low as 0.05 or 5% at normal test temperatures. Foil facings laminated to insulation are not highly polished aluminum sheets, so we had its emissivity tested at a lab along with our own products. FSK or Foil Scrim Kraft, commonly used as insulation facings, had a tested emissivity of 0.09 or 9% in its new condition before laminating and handling it. The Simple Saver System’s low-e metalized liner has a tested emissivity of 0.10 or 10%. Another product promoted specifically for indoor ice arenas which claims to have an emissivity of 0.03 actually has a tested emissivity of 0.20.
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> **Conclusion:** These low-e products will by themselves absorb, conduct and radiate up to 21% of the heat contacting it. The other 79% is either reflected away or absorbed through conduction and convection and transferred to the air or other objects via conduction and convection. As the low-e surface gets dirty or corrodes, the surface emissivity will increase thereby increasing the refrigeration loads. Linear light reflectivity of foil surfaces is good, but light dispersion is poor. Buildings appear much darker inside with foil ceilings than with light reflective white ceilings with good dispersion.

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Fact: Our R-30 super duty Simple Saver System is a low-e system even without a low-e surface material. Mass insulation such as fiberglass in an opaque cavity resists transfer of heat by all three heat transfer modes. Our R-30 system will stop over 90% of the all heat transferring through a unit of time. Our super duty white ceiling fabric has a tested emissivity of 0.15 or 15%. Not too different from the foil facings. It could also get dirty which will affect the surface emissivity, but it will not corrode or become dull like exposed foil. The heat transference will not increase because the mass insulation is not significantly effected by changes in the surface emissivity. Our materials are also washable and will restore to its new appearance.

Conclusion: The thermal performance of an assembly stopping 90%+ of the heat from going through it results in a maximum of 10% of the heat that could be emitted on the inside. Consequently, even if the ceiling surface materials emitted 100% of the 10% coming through, the emissivity of the assembly would only be 0.10 or 10%. Since over 70% of the refrigeration loads in ice rinks come from the solar effects on the exterior of the roof and walls, it is most effectiveto insulate both roof and walls as high as practical with mass insulation that performs with all three heat transfer modes. In addition, the Simple Saver Systems also have several options of exposed surface materials available. The Syseal SW FP (Super White) liner fabric is the most popular for indoor arenas because of the attractive appearance and high diffuse light reflectance. A low-e metalized polyester-coated liner is also available with the Simple Saver System if desired. The acoustics of the Simple Saver System with fiberglass insulation is superior to a low-e ceiling system without insulation.

A low-e ceiling surface also will reflect about 79% of the interior generated heat from light, people, zambonies, etc. back down toward the ice sheet. Refrigeration costs would be lower if the interior heat hitting the ceiling is absorbed rather than reflected. The ceiling surface temperatures will always be similar to the interior air temperature. With the Simple Saver System your customer will get low-e, high R-values, excellent light reflectivity and excellent acoustics.

Thermal Design can perforate any of our liner fabrics to destroy the vapor barrier quality. There is some seasonal risk of humidity migrating into the system from the inside if it is warmer inside than outside or from positive interior air pressures forcing air into the insulation system. On the other hand, perforation of the liner fabric will be beneficial by preventing the accumulation of condensed water on the back side of the vapor barrier liner if the building exterior is not well sealed. In general, using a perforated liner is not likely to result in an accumulation of condensed water.

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