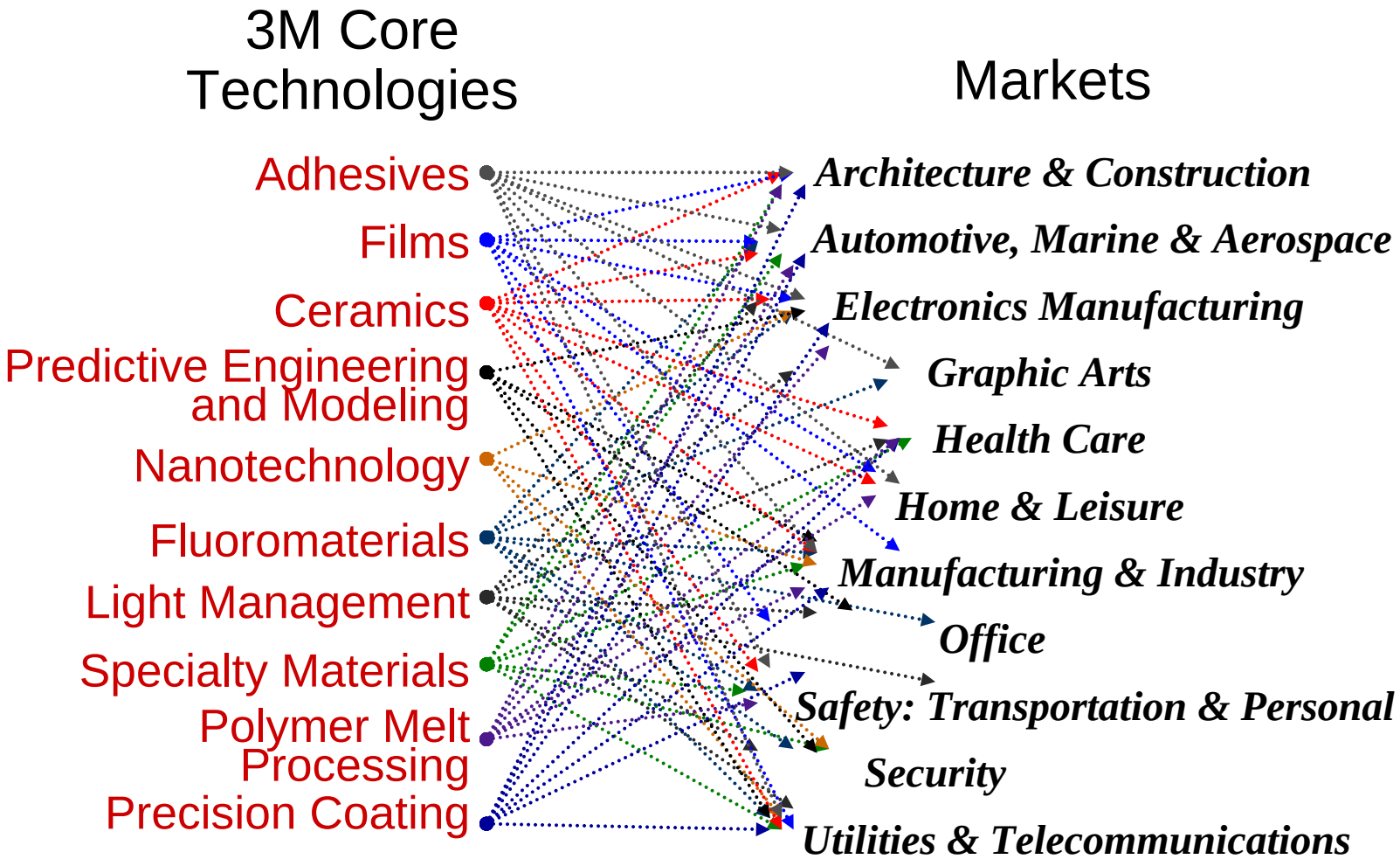
Trusted Technology

Protection for Work & Life

Leveraging Strengths



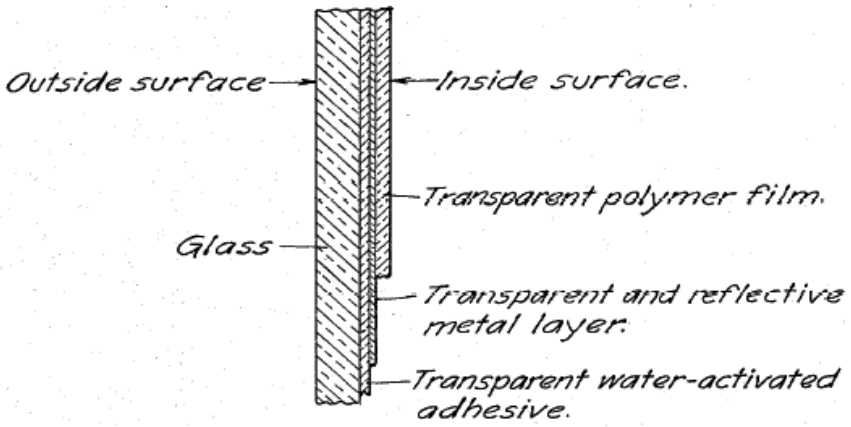
Original Window Film Patent

Dec. 6, 1966 D. L. ANTONSON ETAL 3,290,203

TRANSPARENT AND REFLECTING ARTICLES

Filed Feb. 8, 1965

FIG. 1



United States Patent Office 3,290,203 Patented Dec. 6, 1966

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3,290,203

TRANSPARENT AND REFLECTING ARTICLES

David L. Antonson, Woodbury Township, Washington County, and Gerald A. Berger, Maplewood, Minn., assignors to Minnesota Mining and Manufacturing Company, St. Paul, Minn., a corporation of Delaware

Filed Feb. 8, 1965, Ser. No. 430,833
10 Claims. (Cl. 161—4)

This application is a continuation-in-part of our copending application Serial No. 118,077, filed June 19, 1961, now abandoned.

This invention relates to new and useful transparent and reflective coverings for glass surfaces, such as windows. A preferred embodiment of this invention is a sheet material which when applied to the interior of a window, greatly reduces heat and glare, making the room interior more comfortable while retaining an adequate level of illumination and leaving the clarity of objects seen through the window substantially unchanged.

Although the sun provides life-giving light and heat, it frequently happens that one or both are present in annoying excess, and the problem of controlling solar radiation has plagued mankind from the beginning of time. Thus, windows have long been provided with tinted glass, venetian blinds, awnings, roller shades, louvers, drapes, coatings, etc., which absorb and/or reflect a portion of the sun's rays. Each of these techniques is effective to some extent, but each has serious disadvantages. For example, drapes, shades, blinds, and the like must constantly be adjusted as the position of the sun changes; further, such devices make it difficult, if not impossible to distinguish objects on the opposite side of the window. Pigmented coatings reduce glare, but they function principally by absorbing and re-radiating solar energy and thus fail to effectively lower room temperature. The few reflective materials available prior to the present invention have either been unsuitable for application to windows or have failed to provide a satisfactory degree of clarity. To the best of our knowledge, no one prior to our invention has ever provide a durable transparent reflective product which reduces solar energy transmission throughout the entire spectrum, which is free from undesirable distortion, which can be easily applied to any window and left in place for long periods of time, and which can be readily removed when desired. Our invention fulfills these objectives.

Our invention provides a product which reduces the transmission of ultra-violet light through a window, thereby minimizing such adverse effects as the fading of fabrics. Our novel product is particularly effective in reducing the transmission of infrared light, which is absorbed and irradiated by objects in a room. It likewise reduces the measured transmission of visible light, i.e., light in the 4,000–8,000 Angstrom unit wave length range, by as much as 86%; although heat and glare are greatly reduced, the apparent level of room illumination does not seem to be unpleasantly decreased. Without being bound thereby, we offer as possible explanation of this phenomenon, S. S. Stevens' discussion in Chapter 1 of Sensory Communication (John Wiley and Sons, Inc., New York, 1959), which states that the psychological magnitude of a physical stimulus ϕ is related to the physical magnitude ϕ by the formula

$$\psi = k\phi^n$$

where n varies with the type of stimulus, having the value of 0.33 for brightness of white light and 1.6 for warmth. Assuming these values to be correct, a measured reduction of 80% in light transmission affects the human eye as if light transmission were reduced approximately 40%, while a measured reduction of 98% in

2

heat transmission affects the human body as if heat transmission were reduced over 90%.

In accordance with our invention a flexible, transparent, metallized sheet material is adhered to the inside surface of a windowpane. This sheet material is prepared by vapor depositing a thin layer of metal such as aluminum on one surface of a transparent film, e.g., a polyester film, to reduce the transmission of solar energy to the desired extent. An adhesive which is soluble in water (or aqueous alkaline solutions) is coated over the metal layer, desirably with a water-insoluble protective layer interposed between the metallic layer and the adhesive.

Polyethylene terephthalate film about 0.5 to 2 mils thick is especially useful in this invention and is preferred because of its clarity, uniformity, toughness, strength, and dimensional stability in widely varying humidity and temperature; this film is also particularly receptive to vapor-deposited metal coats. Polymeric backing films may also be formed from rigid (unplasticized) polyvinyl chloride, cellulose acetate, cellulose acetate-propionate, cellulose acetate-butyrate, polystyrene, and polybutyl acrylate, among others. The stability of these films may be improved, if necessary or desirable, by known techniques, e.g., incorporating ultraviolet ray absorbers in the film itself or, preferably, in a coating applied over the vapor-deposited metal.

Vapor coating is carried out in the conventional manner, the amount of deposited metal being measured and controlled by the reduction in light transmission of the visible spectrum, such that at least 10% but not more than about 80%, of the visible portion of the spectrum is still transmitted, as measured by a spectrophotometer such as a Beckman DK–2. This generally results in a highly reflective metallic layer on the order of 25–125 angstroms thick. Suitable metals for vapor deposition include aluminum, zinc, copper, silver, and gold.

Such water-activated adhesives as casein, hide glue, polyvinyl alcohol, or vinyl ether polymers which are soluble in neutral or alkaline solutions (e.g., vinyl methyl ether-maleic acid copolymer or the neutral ammonium salt thereof), may be employed in the practice of our invention. For most adhesives it is highly desirable to provide a transparent water-insoluble protective coating between the metal surface and the adhesive to prevent corrosion of the very thin metal layer. The protective layer should be at least thick enough to minimize annoying interference colors, e.g., on the order of 10,000 angstroms or more, the upper limit of thickness being determined by economy, clarity, and convenience. Where such protective coatings do not firmly bond to the adhesives, suitable priming techniques may be employed; well known techniques as electrical discharge, ultraviolet irradiation and primer coatings (e.g., polyisocyanates) may be applied over the protective coat under appropriate circumstances. Adequacy of adhesion can be determined by hand-laminating a strip of conventional normally tacky and pressure-sensitive adhesive tape to the water-activatable adhesive surface and stripping it off quickly; if no "picking" occurs, adhesion is considered satisfactory. Alternatively, the finished product may be applied to a glass surface and removed after 16 hours; failure of a satisfactory product should occur either between the film and the metal vapor coat or by tearing of the film.

Our invention will be further illustrated by the accompanying drawing, which is not to scale and is for purposes of illustration only.

FIGURE 1 is a view in cross-section of a windowpane prepared in accordance with our invention, and

FIGURE 2 is a view in cross-section of a preferred embodiment of our novel solar energy reducing sheet material.

Did you Know ?

3M is the inventor of window film and created the first, original window film patent nearly 40 years ago.

- **1968 - 3M Developed Safety/Security Window Films in late 1960's in response to IRA Terrorist Bombing in Europe**
- **1978 – Adhesive system invention for reusable applications**
- **1981 – 3M develops Abrasion Resistant coatings**
- **1995 - 3M Developed Co-Extruded Micro-layer High Tear Resistant ULTRA Safety/Security Window Films (Patented in 1995)**
- **3M Developed in 2004 RF/IR Attenuation Films combined with Co-Extruded Micro-Layer Safety Security Films (Patents pending)**

3M Technology

- **Ad** Adhesives
- **Pe** Predictive Engineering & Modeling
- **Fi** Films
- **Pm** Polymer Melt Processing
- **Lm** Light Mgmt
- **Nt** Nano Technology
- **Pd** Particle & Dispersion Processing
- **Sm** Specialty Materials
- **Rp** Radiation Processing
- **Pc** Precision Coating

Window Film Building

- Optical Films
- Adhesives
- Abrasion Resistant Coatings
- Nanoparticle Coatings
- Metallized & Pigmented Films

Products



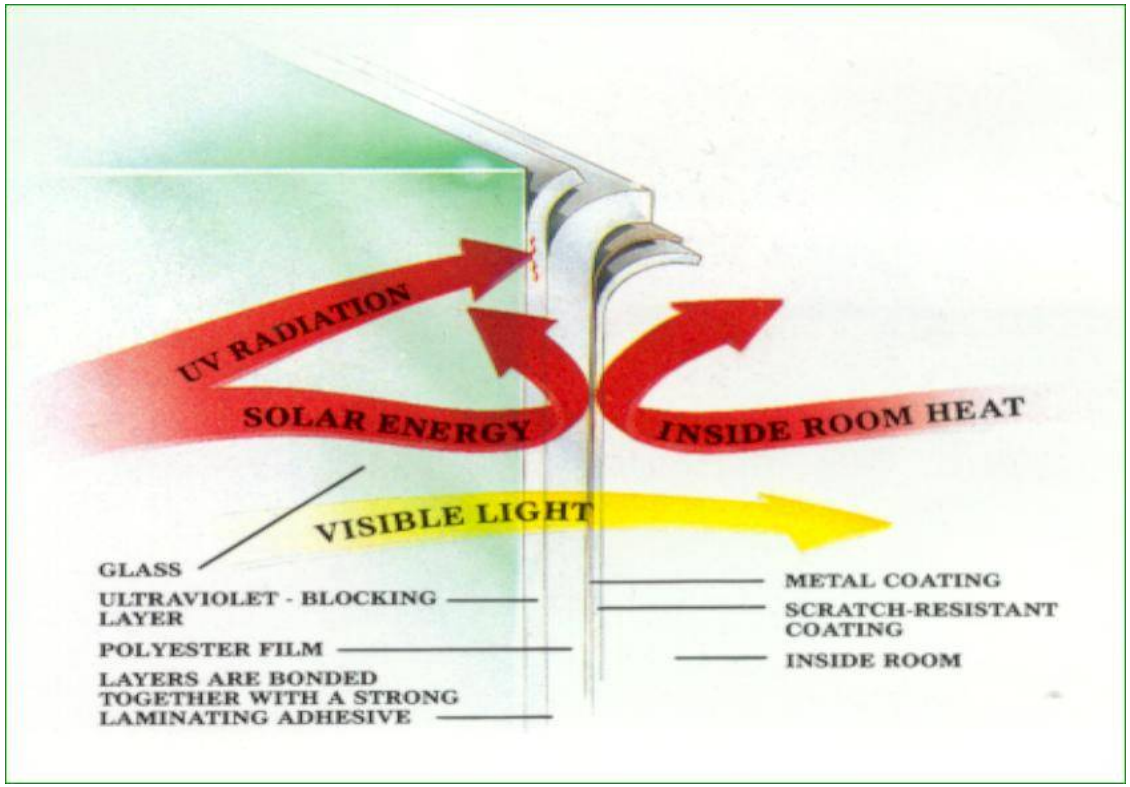



Features

- Energy Savings
- Comfort
- Glare Reduction
- Shatter Resistance
- UV
- Fade Resistance

Window Films can help

- **Dramatic solar heat reduction**
- **Up to 99% UV and IR block**
- **Better HVAC system management & lower air conditioning cost by reducing heat that comes into a building**



More uniform and aesthetically pleasing outside look.

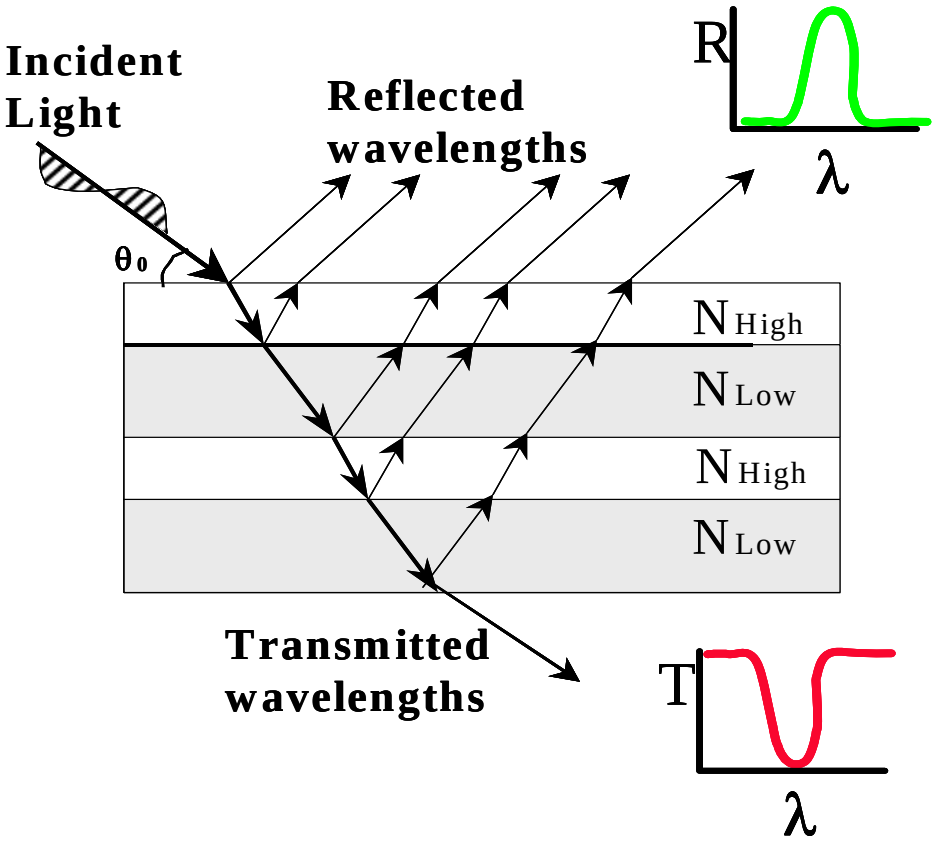
Prestige Clear Solar Control Window Films

prestige window films

- Two tinted versions (40, 50%) VLT
- Two clear versions (60, 70%) VLT.
- Patented, proprietary 3M technology.
- Multi-layer optical films, the same advanced technology used to make flat panel LCD TV's.
- Made with no metals, meaning **NO CORROSION** or interference with mobile phone signals!
- Less reflective than glass (< 8%)!
- Designed to provide top level heat rejecting capabilities, with unsurpassed infrared rejection!

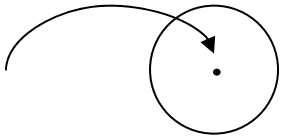
3M

Prestige - Multi-Layer Optical Films

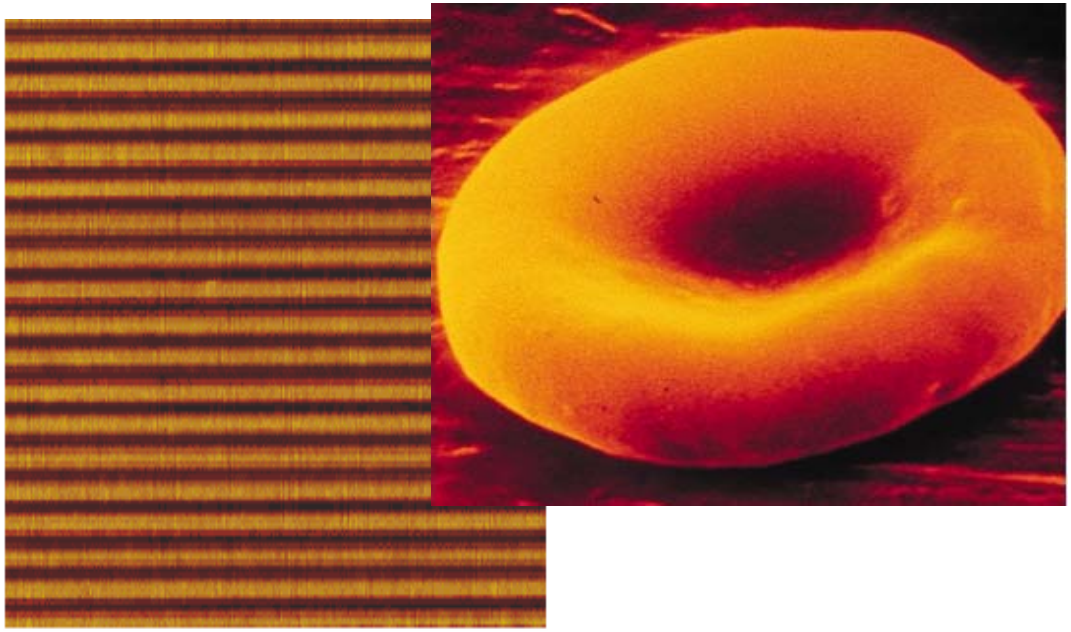


How Small is Nano?

Carbon particle

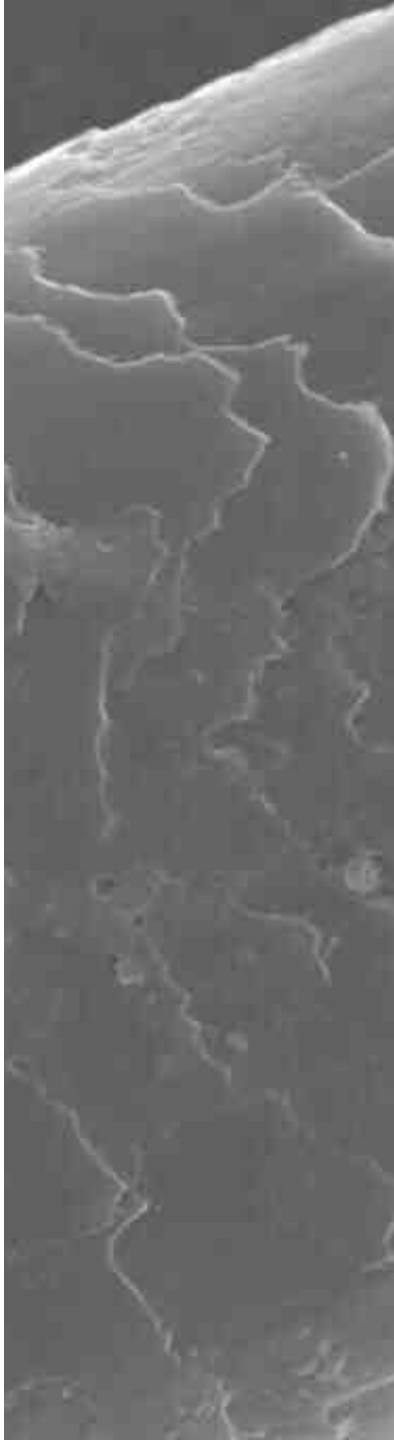


Human Hair

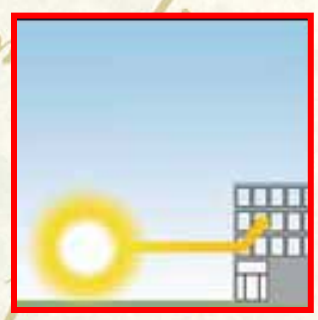


Multi-Layer Optical Film

Red Blood Cell



What About The Other Specifications?

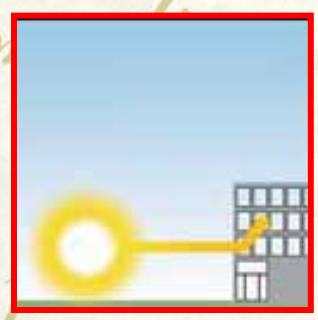


The new specification will enhance the heat rejection characteristics on all four new films!

- TSER is calculated on a straight-line basis, meaning perpendicular to the window unit.
- When the sun is up in the sky and at an angle to the window, our four new films have a significantly increased TSER performance.
- That means the films are giving the customer maximum TSER performance at a time when the sun is most intense!
- Expectation is Prestige films will pick up roughly a **10+% TSER increase versus competition.**

3M

Benefits of 3M Prestige



PR70 has 70% VLT for 50-59% TSER*

What does this mean for you;

Clear appearance – Won't change external look of facility Allowing to see in through glass during the day.

Natural Light Transmission – No need for additional internal lighting (energy saving)

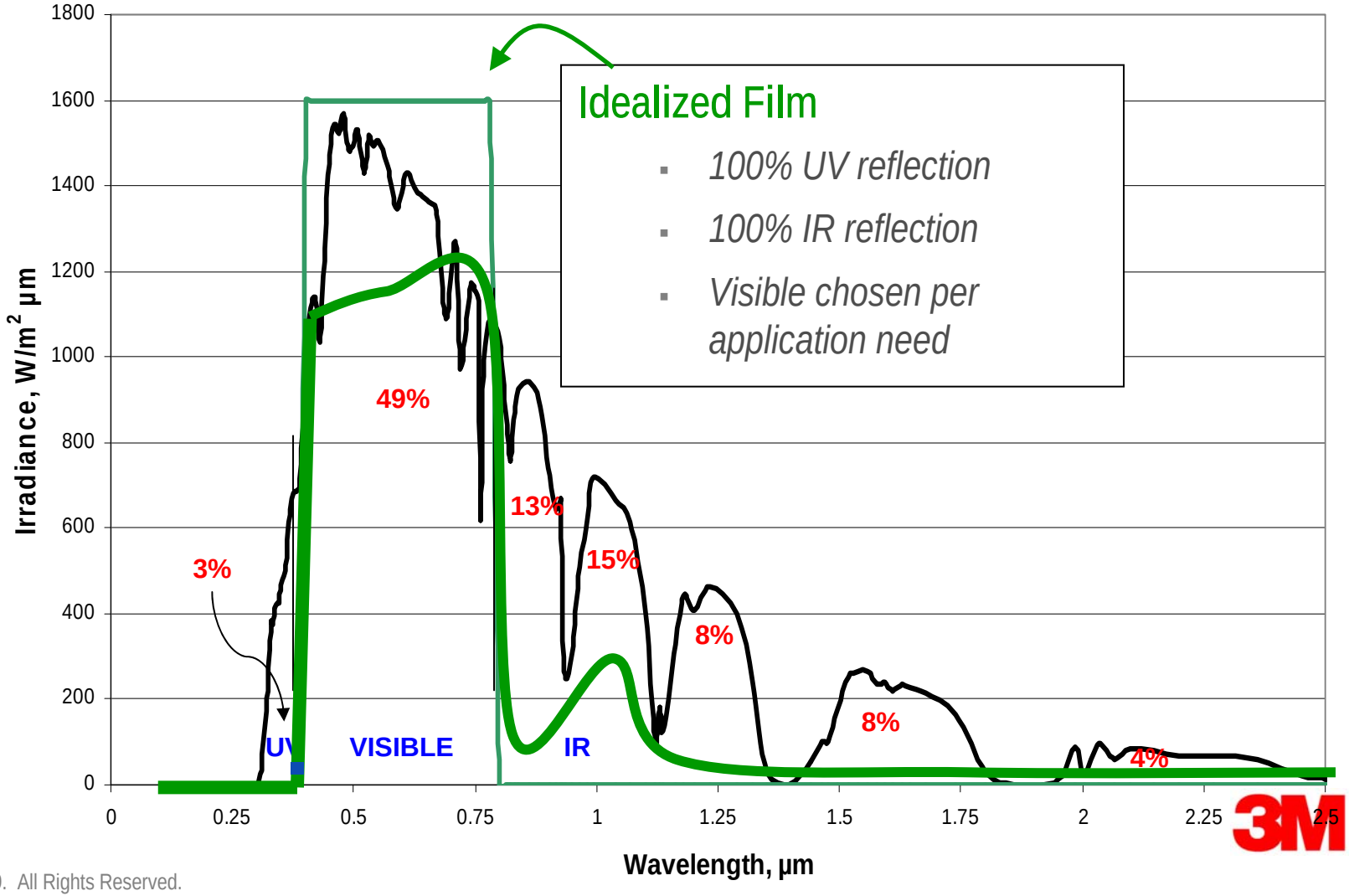
Low internal reflectivity – Ability to see out at night (won't spoil views)

No Corrosion, Easy to Clean

15 year 3M Warranty

- Prestige 70 - achieves 59% TSER at 60° angle to the window, therefore working best when the sun is at its hottest).

Solar Energy Spectrum

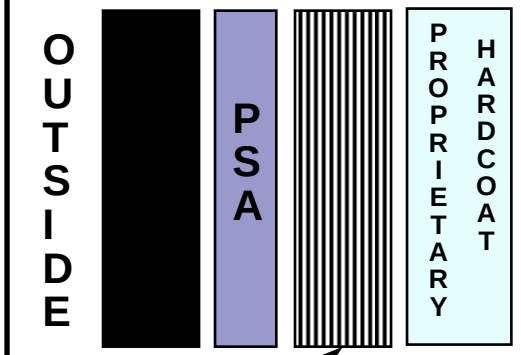


Prestige Series Films

PERFORMANCE

	VLT	TSER % 60º / 0º	Reflect Interior	Reflect Exterior	UV Reject
PR-40	39%	66 / 59	6%	7%	99.9%
PR-50	50%	63 / 56	7%	8%	99.9%
PR-60	61%	61 / 52	8%	8%	99.9%
PR-70	68%	59 / 50	9%	9%	99.9%

CONSTRUCTION



*** No overcoat**

- 72” width capability
- Very strong differentiation against metallized films

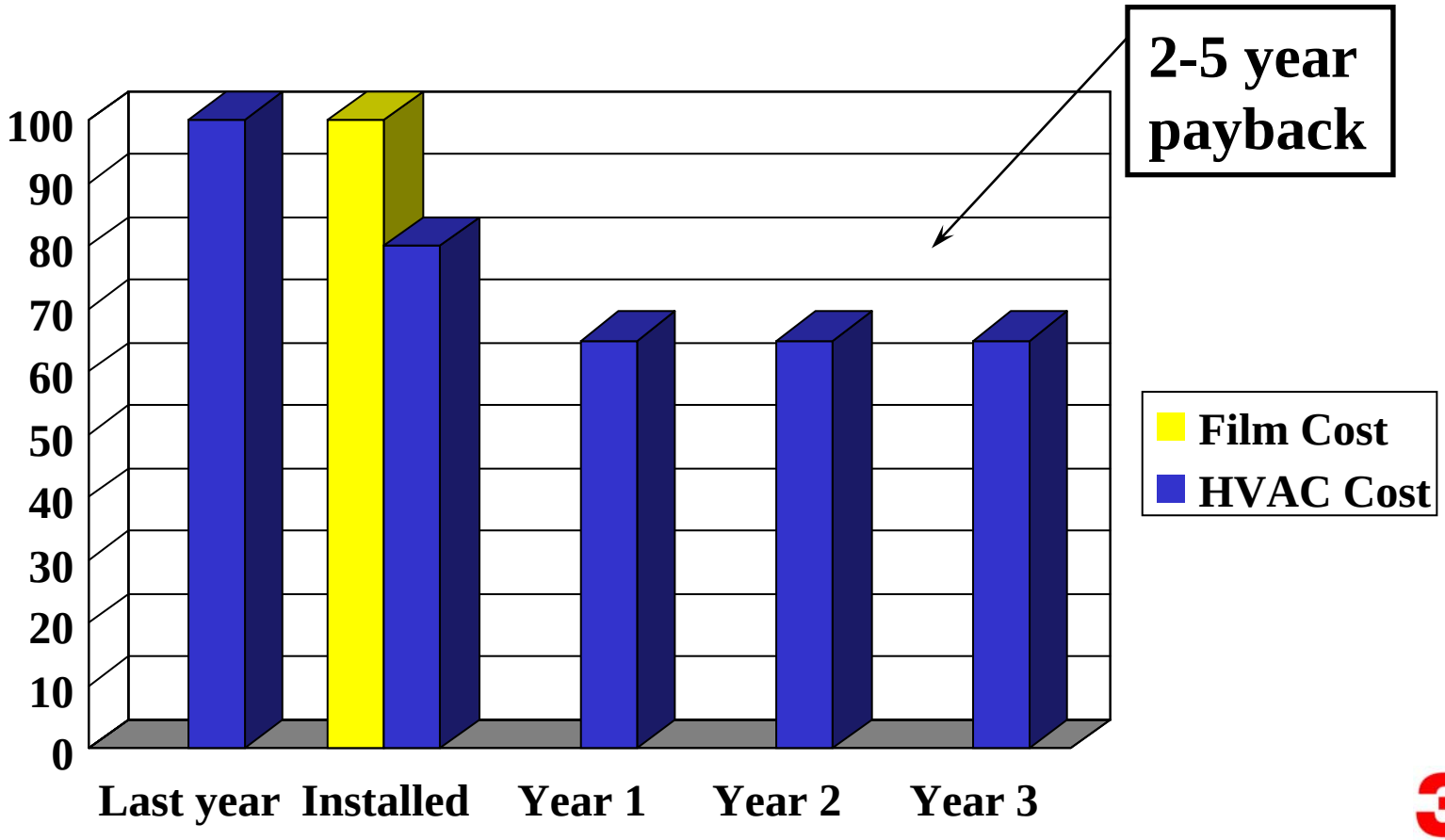
Prestige Solar Control Benefits

- Energy Savings
- Improved Comfort
- Very high UV rejection
  - *Protection of family and furnishings*
- Visual appearance (or lack thereof)
  - *Clarity*
  - *Low reflectivity*
- Daylighting
- Better visibility
  - *Less interior lighting*
- No signal interference
- Easy clean features
- Human skin is tuned to be sensitive to IR wavelengths

Did you Know ?

Complete and proven Cost Analysis with 3M Demand Analyzer software

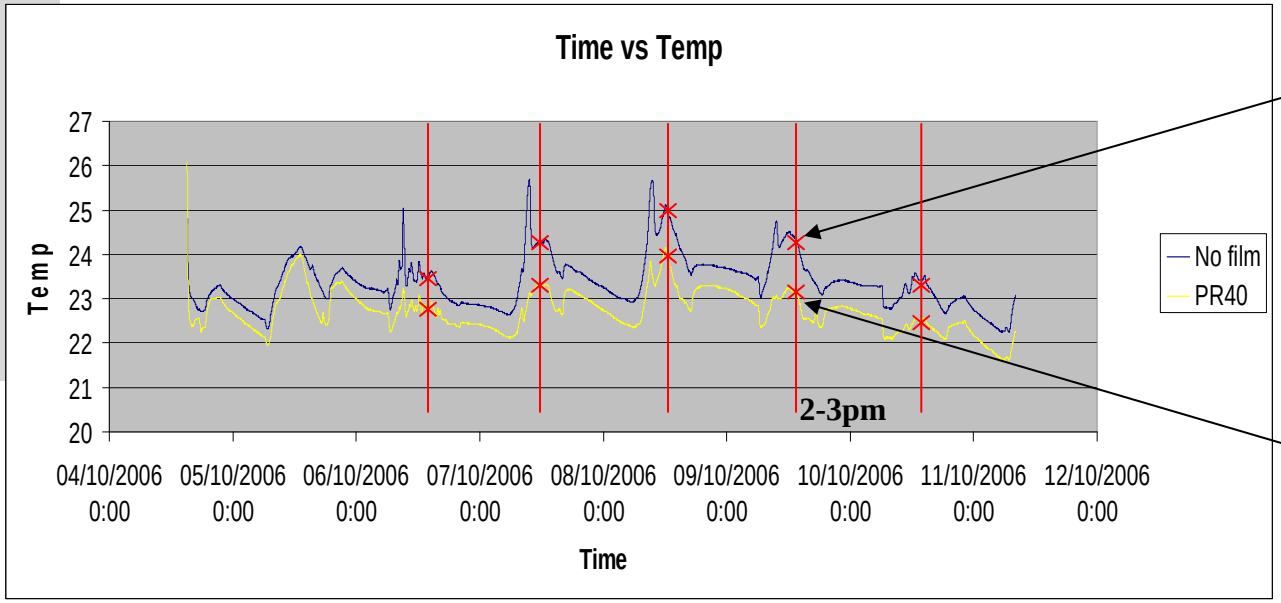
3M Window Film installation pays for itself after a period of time



Sample Prestige & Monitor

3M can install samples & monitor the temperature differences from a similar office with no film.

BTU Meter



Blue line No Film Office 1 - Higher Peak temperature

Yellow line PR40 Office 2 - Lower Peak Temperature

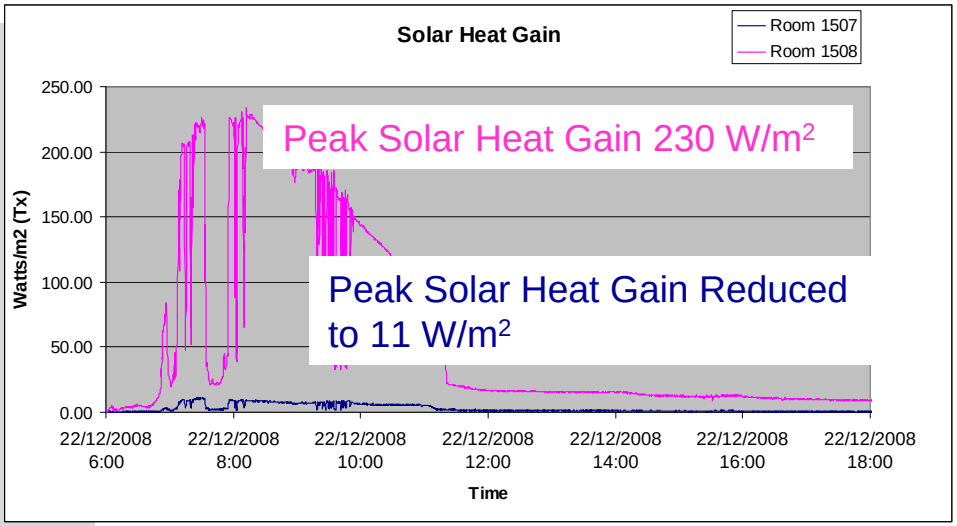
***Actual Facility; Sydney, Australia.**

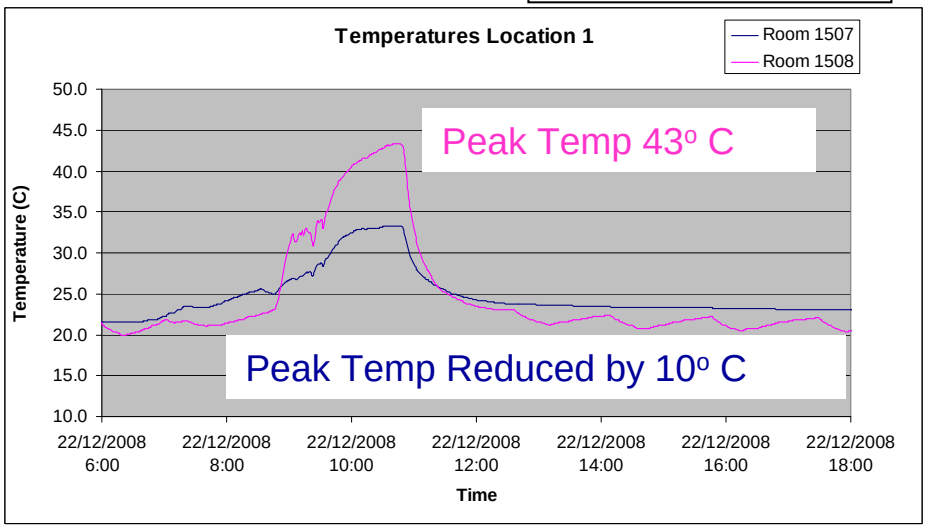
3M Prestige Sun Control Film Trial Summary

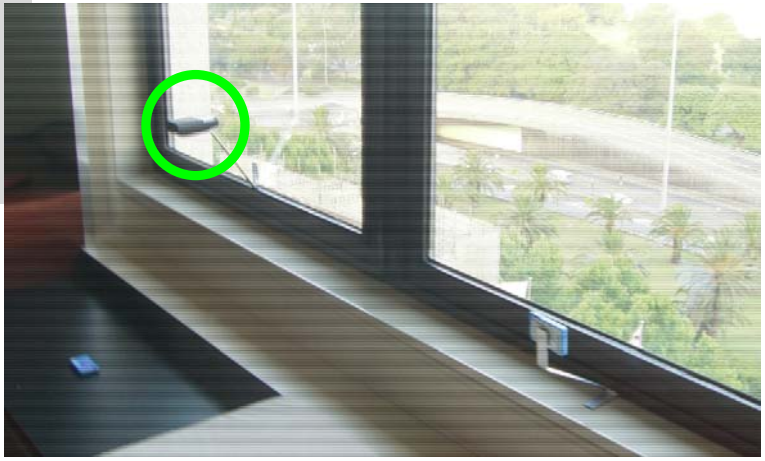
- 3M Prestige 70 was applied to one room with the second left unfilmed.
- Glass was Clear 10mm TTG (Each room had 2.4 Sq. m ;1300mm x 930mm x 2 panels)
- Data loggers were installed in identical locations in both rooms to monitor Temperature and Solar Heat Gain
- AC thermostats were set to the same level in each room
- Rooms were left unoccupied over the duration of the trial from 18th Dec to 26th Dec 2008.
- The Following data was logged on 22nd Dec 2008 between the hours of 6am and 6pm (additional data from the 21St).

Solar Heat Gain and Temperature Location 1

All Graph's Film Use
= No Film
= With PR70

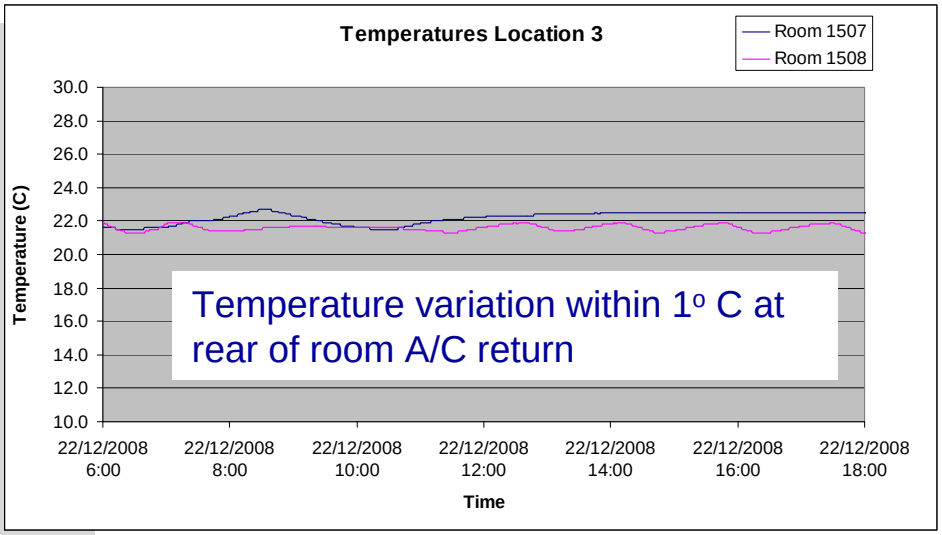


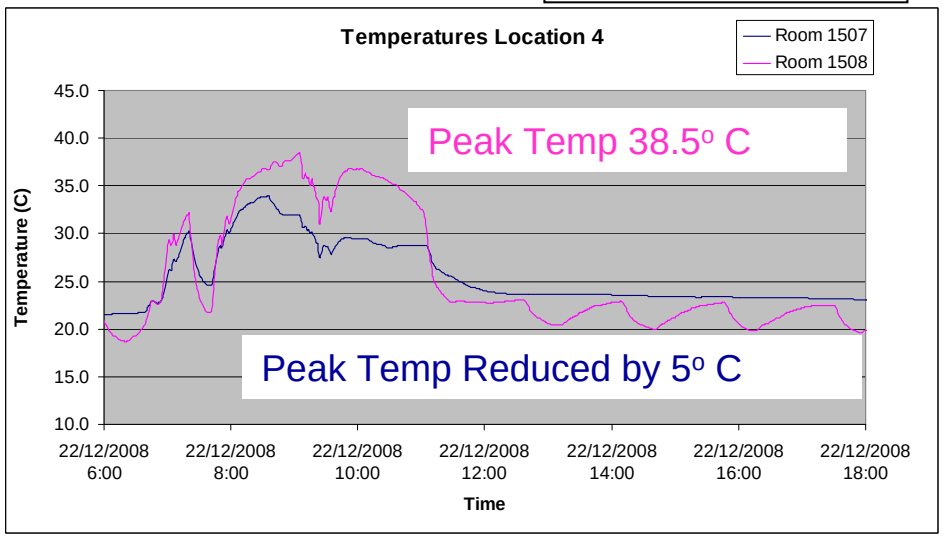




Temperature Location 3 & 4

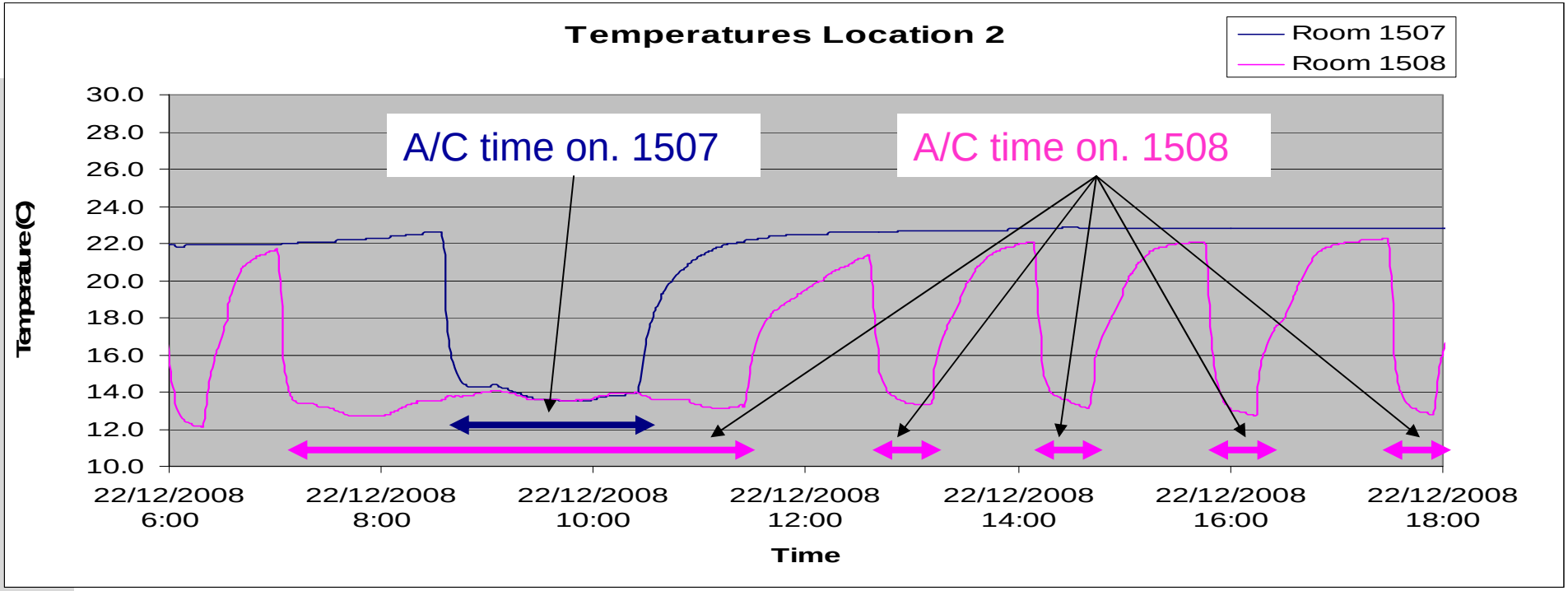
All Graph's Film Use
= No Film
= With PR70





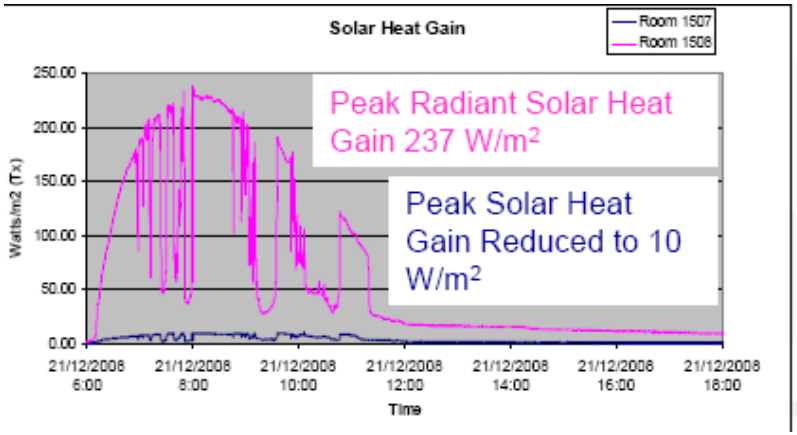
A/C Outlet Air temp

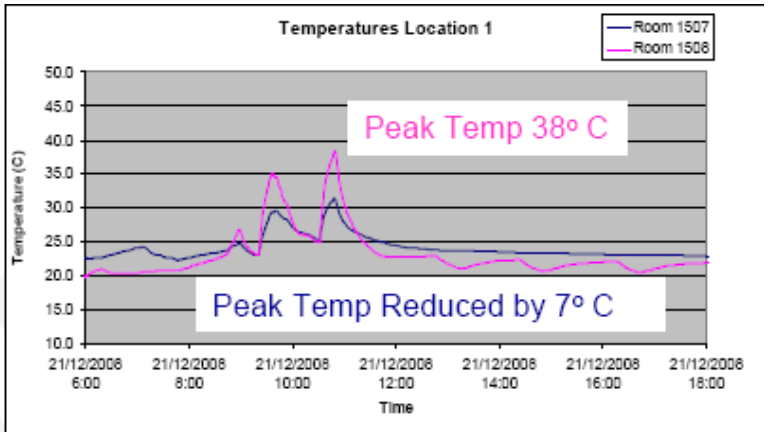
All Graph's Film Use
= No Film
= With PR70

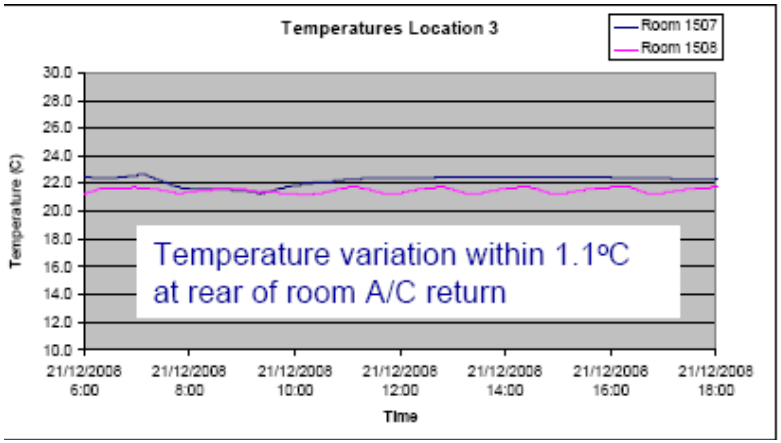


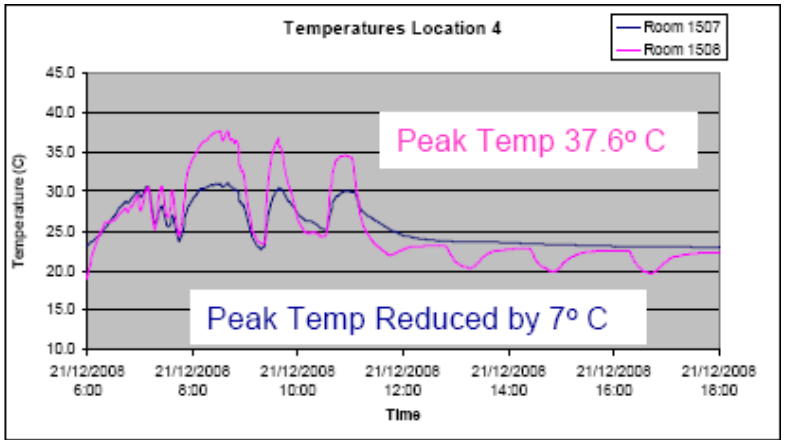
- This graph indicates A/C activity 6am to 6pm on 22nd Dec 2008
- A/C active for 7hrs in room 1508 without film
- A/C active for 2hrs in room 1507 with film

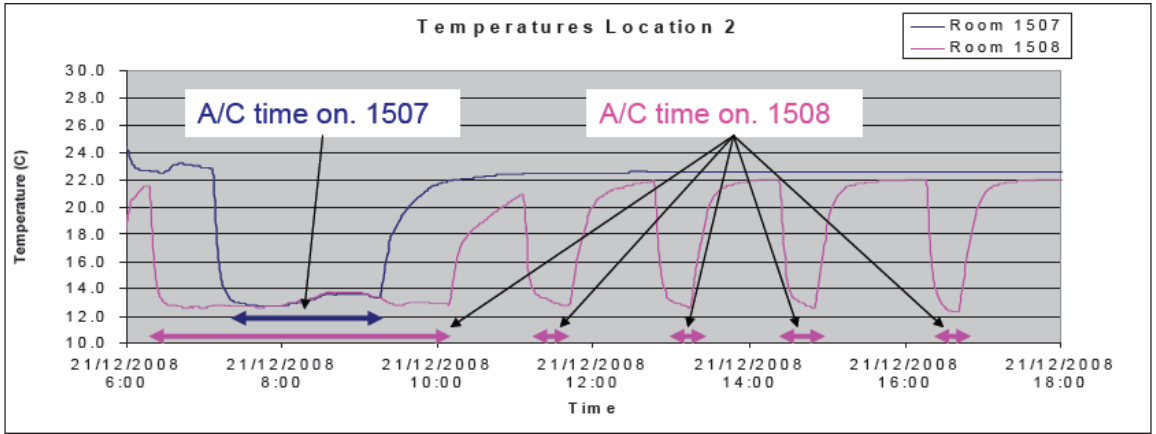
Another Days Statistics - Similar Pattern











PR70 Trial Summary

- Greater Thermal Comfort for occupants
  - *Peak temperature reduction of up to 10^{o}C*
  - *more 'even' room temperatures.*
- Reduction in Energy usage
  - *A/C usage reduction (dependant on HVAC type, Glass type, façade orientation, weather etc.)*
- Analog thermostats were equal in both rooms, some variation & drift could be seen.
- Energy Savings Discussion
  - *$ Savings*
  - *CO^2 Reduction*

KFC – Store Design

- Large Façade Glazing panels
- Allowing more light to enter
- Ensuring greater store visibility

Need; Control Heat Load

increase comfort.

KFC - Design

KFC Morriset - PR40

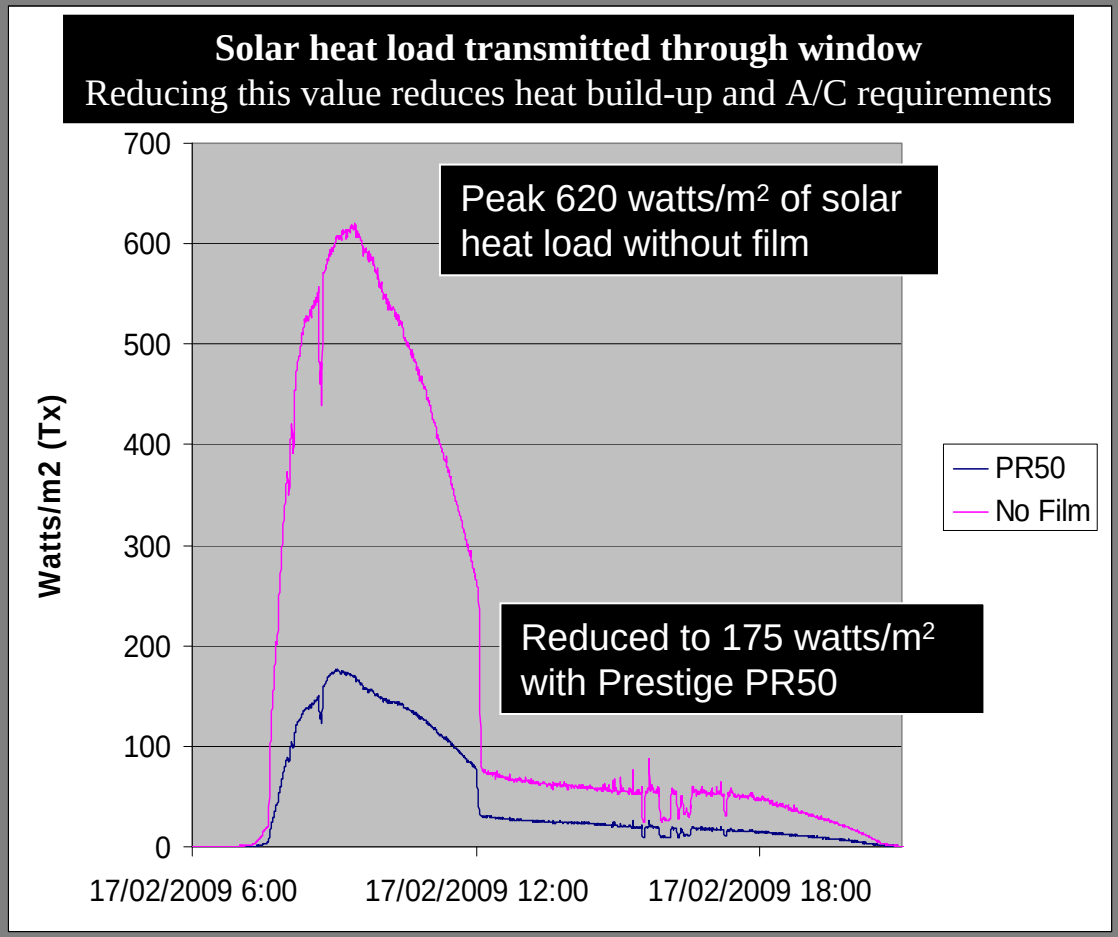
KFC Raymond Terrace - PR40

Replace ‘ugly’ Solar Blind with permanent solution

KFC - Design

Solar Energy Transmission

Study Conducted at KFC Preston, 6am to 9pm 17th 9pm 17th Feb



Solar Energy Transmission

Study Conducted at KFC Preston, 6am to 9pm 17th 9pm 17th Feb

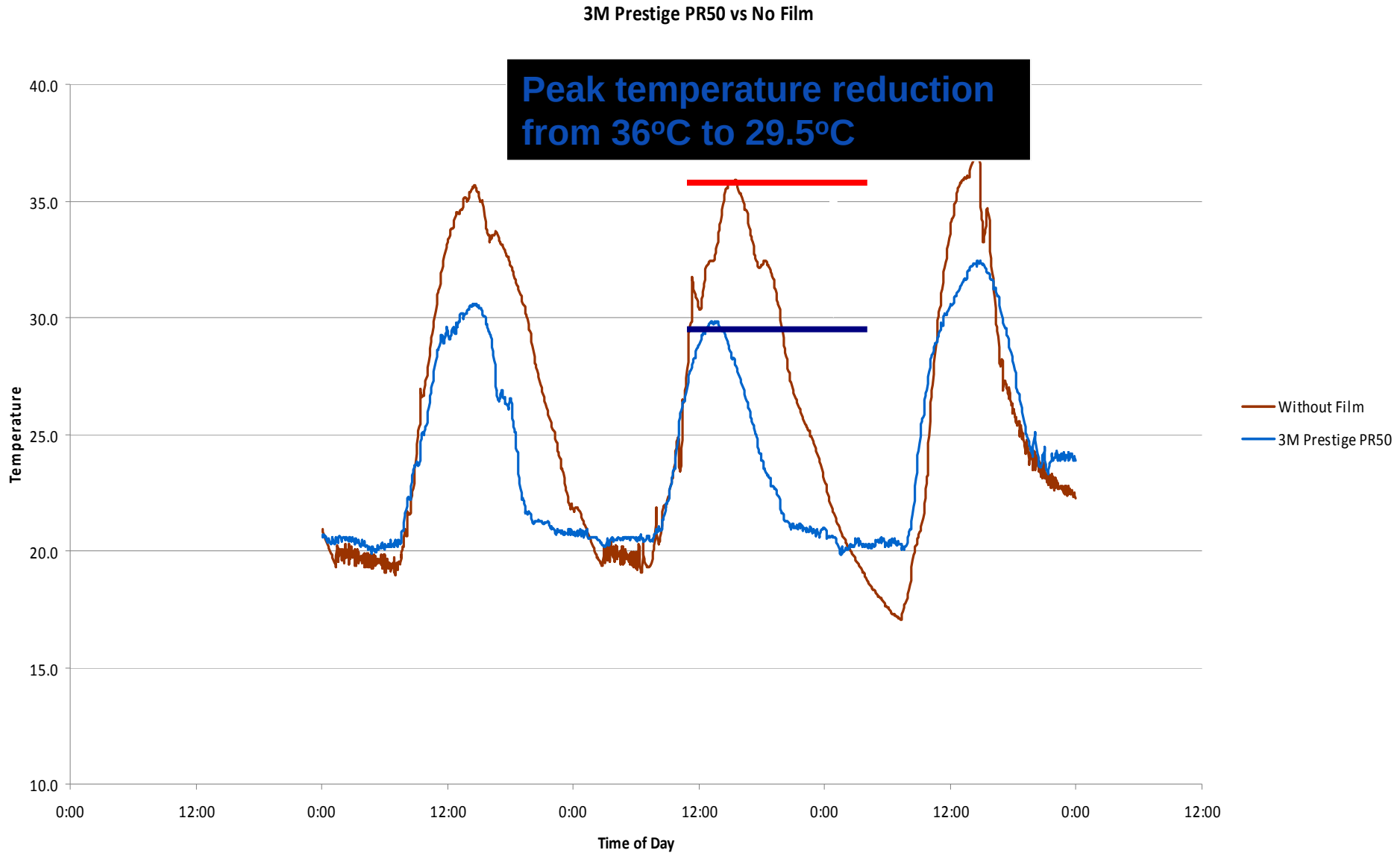
- Peak solar energy transmission without film: 620 watts/m^2
- Peak with Prestige PR50: 175 watts/m^2

- This equates to a peak reduction of almost half a kilowatt of solar heat load for each square metre of glazing

3M Window Films

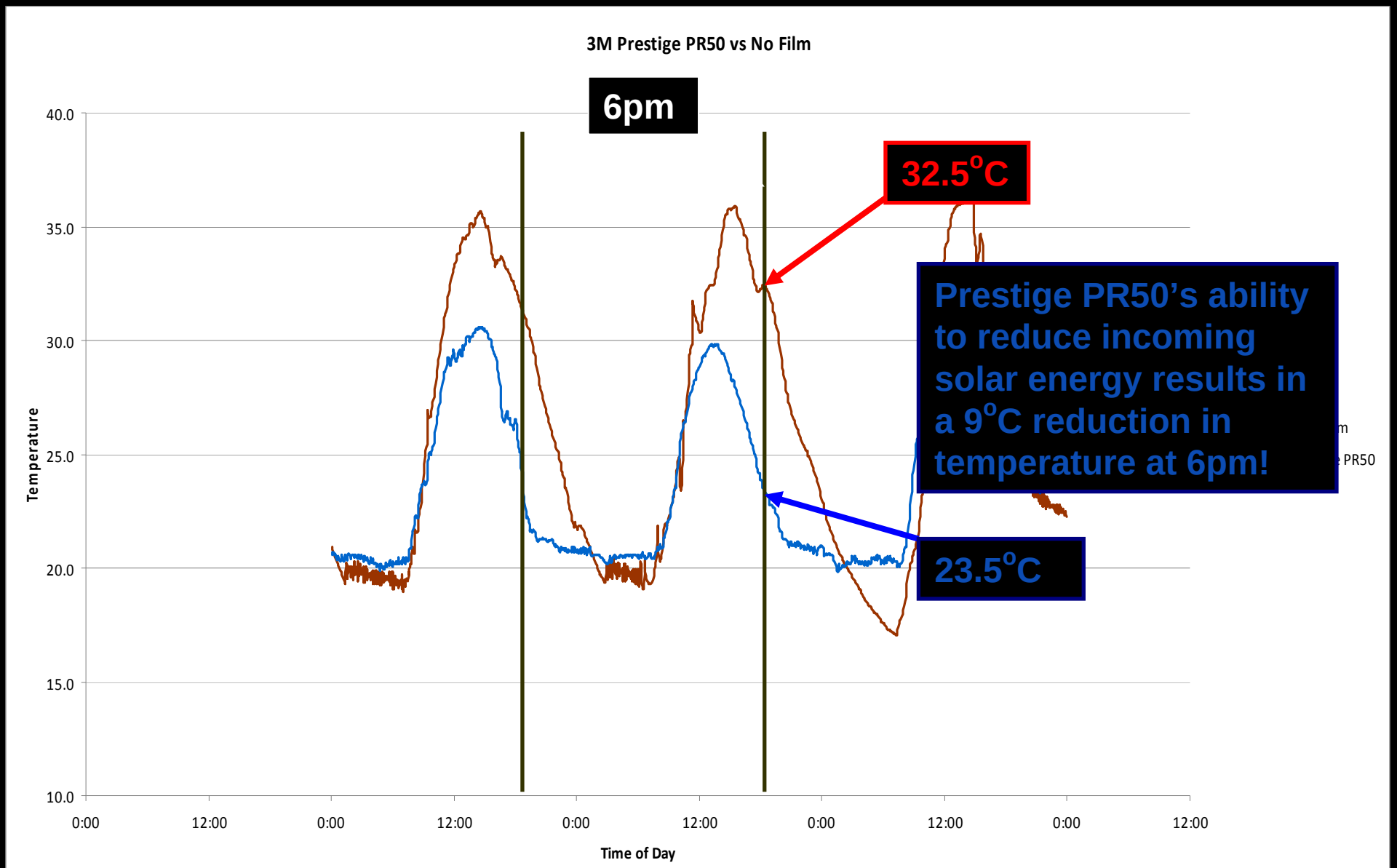
Temperature Monitoring

Study Conducted at KFC Preston in February and March 2009



Temperature Monitoring

Study Conducted at KFC Preston in February and March 2009



Temperature Monitoring

Study Conducted at KFC Preston in February and March 2009

- Thermal Comfort

  Significant Improvement in comfort for customers with reductions in temperature of up to 9^{o}C

- Reduced Air Conditioning Demand

  Reduction in incoming heat results in less load on AC system

Temperature Monitoring

Study Conducted at KFC Preston in February and March 2009

- Data without film was collected from 17th to 19th February 2009 Average outside peak temperature 29.3°C
- Data with PR50 applied was collected from 19th to 21th March 2009 Average outside peak temperature 30.5°C

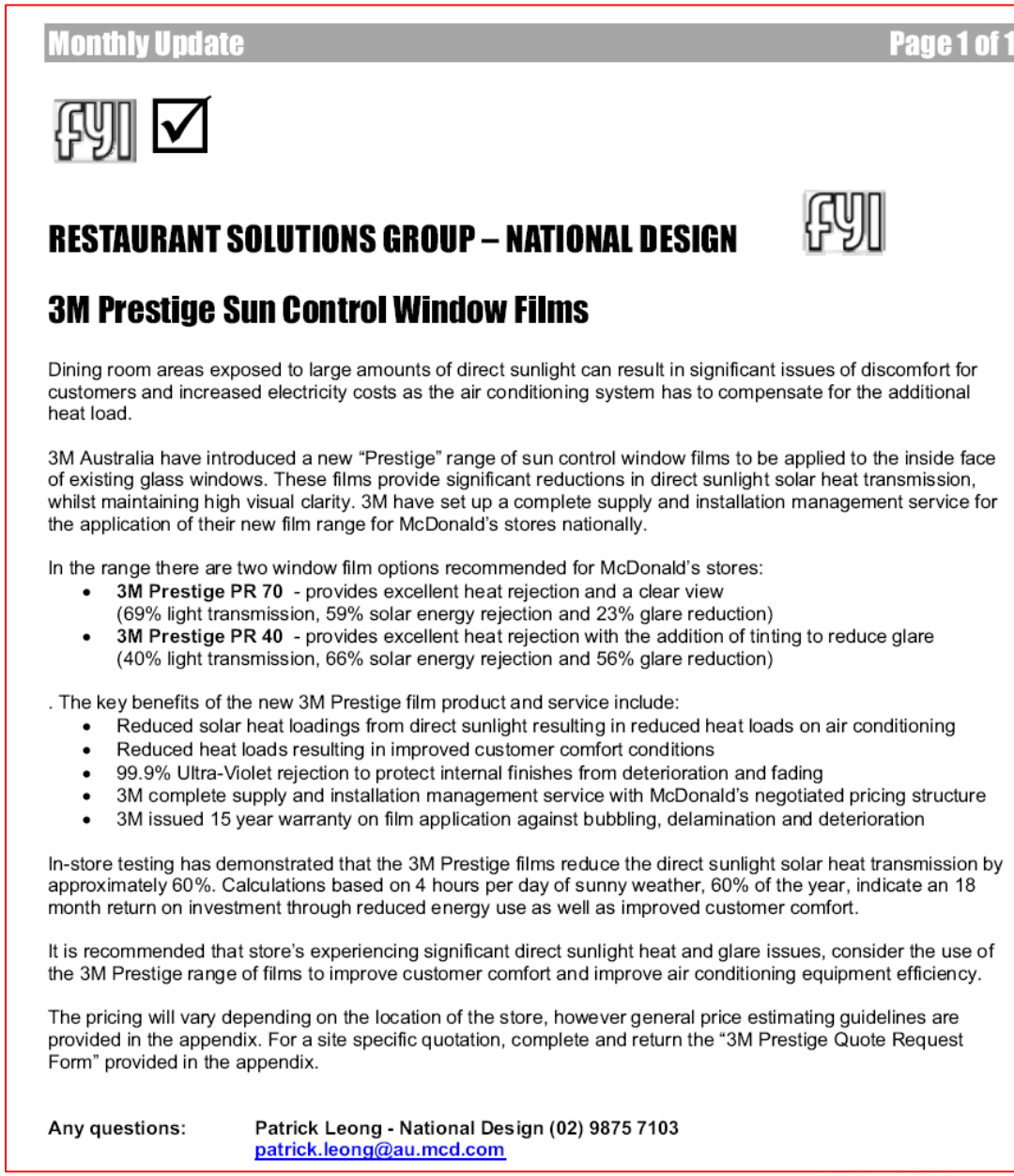
These dates were chosen because of the very similar weather patterns, based on Bureau of Meteorology data, the average peak temperature 17th to 19th February 2009 was 29.3°C while from 19th to 21st March 2009 (when the film was installed) it was higher at 30.5°C

McDonald's Australia Prestige Spec

- Prestige Window films selected by McDonald's Design Manager 3M & McDonald's Technical looked at performance, including energy savings, TSER, VLT, Low Reflectivity, Glare reduction.
- Exclusive McDonald's 3M Turnkey Service.
- Specification for either Prestige 70 & 40, based on level of glare
- Basis need to allow light to enter, with views in and out preserved both day & night.

McDonald's Australia confirm 3M PR70 & PR40 for Solar Control & Heat issues in restaurants throughout Australia.

Release from McDonald's to all Australian restaurants



Monthly Update Page 1 of 1

fyi ☑

RESTAURANT SOLUTIONS GROUP – NATIONAL DESIGN

fyi

3M Prestige Sun Control Window Films

Dining room areas exposed to large amounts of direct sunlight can result in significant issues of discomfort for customers and increased electricity costs as the air conditioning system has to compensate for the additional heat load.

3M Australia have introduced a new "Prestige" range of sun control window films to be applied to the inside face of existing glass windows. These films provide significant reductions in direct sunlight solar heat transmission, whilst maintaining high visual clarity. 3M have set up a complete supply and installation management service for the application of their new film range for McDonald's stores nationally.

In the range there are two window film options recommended for McDonald's stores:

- **3M Prestige PR 70** - provides excellent heat rejection and a clear view (69% light transmission, 59% solar energy rejection and 23% glare reduction)
- **3M Prestige PR 40** - provides excellent heat rejection with the addition of tinting to reduce glare (40% light transmission, 66% solar energy rejection and 56% glare reduction)

. The key benefits of the new 3M Prestige film product and service include:

- Reduced solar heat loadings from direct sunlight resulting in reduced heat loads on air conditioning
- Reduced heat loads resulting in improved customer comfort conditions
- 99.9% Ultra-Violet rejection to protect internal finishes from deterioration and fading
- 3M complete supply and installation management service with McDonald's negotiated pricing structure
- 3M issued 15 year warranty on film application against bubbling, delamination and deterioration

In-store testing has demonstrated that the 3M Prestige films reduce the direct sunlight solar heat transmission by approximately 60%. Calculations based on 4 hours per day of sunny weather, 60% of the year, indicate an 18 month return on investment through reduced energy use as well as improved customer comfort.

It is recommended that store's experiencing significant direct sunlight heat and glare issues, consider the use of the 3M Prestige range of films to improve customer comfort and improve air conditioning equipment efficiency.

The pricing will vary depending on the location of the store, however general price estimating guidelines are provided in the appendix. For a site specific quotation, complete and return the "3M Prestige Quote Request Form" provided in the appendix.

Any questions: **Patrick Leong - National Design (02) 9875 7103**
patrick.leong@au.mcd.com

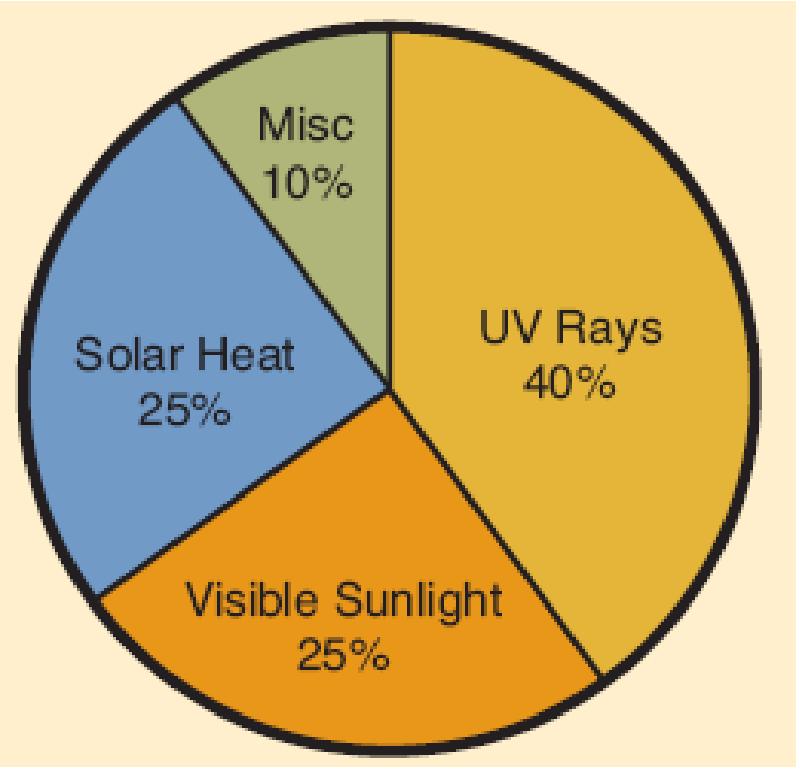
3M

Fading

Window Films address the three major causes of fading.

Reducing the effects of;

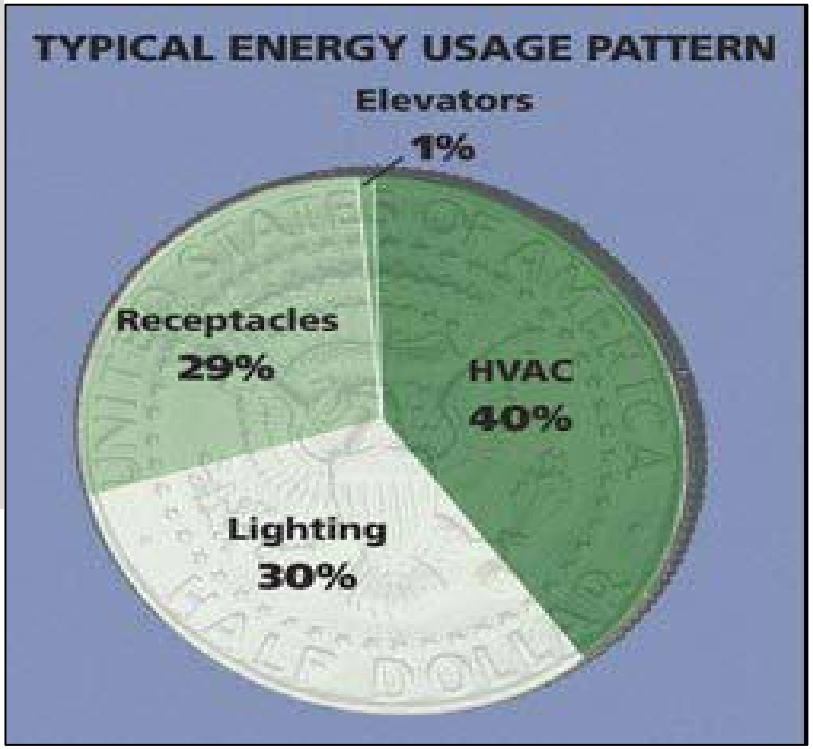
- Ultraviolet UV Radiation, largest cause of fading.
- Solar heat
- Visible light on your furnishings and will block up to 99% of the sun's harmful
- While no film can stop fading completely, our films dramatically slow the progress of fading to keep your home looking beautiful.



Solar Control Films

Turn windows into high performance glass systems

- **"Green" Buildings**



"3M Window films can reduce solar heat gain in a building by as much as 65%. This can account for 1/3 of a building's cooling load.

Single-pane, tinted glass is the most common glazing for existing office buildings.

BEFORE

AFTER

Case Studies - 3M Sun Control Films

AON Center. Los Angeles, USA – 2002

Issue: purplish tint on windows,
view to outside, building cooling cost

Application: 3M Night Vision 25

Result: $200,000 in energy savings per year
(2 years pay back).

With 3M Sun Control application:

- **Cool building using outside air for more months out of the year**
- **Run HVAC with one less chiller**

Case Studies - 3M Sun Control Films

Embarcadero Center. San Francisco, USA – 2004

Issue: building cooling cost, excessive heat in offices, glare, tenant comfort

Application: 3M Night Vision 25

Result: est. $350,000 in energy savings per year

3M Window Films

External Film for protection against vandalism.

Anti-Scratch and Graffiti films

SH4CLARXL (External 4 year Warranty)

SH7CLARL, SH8CLARL

Ideal For use in;

- *External security applications*
- *External graffiti applications*

Easily replaced after attack

Will prolong the life of the expensive glass in susceptible areas and hold together toughened glass.

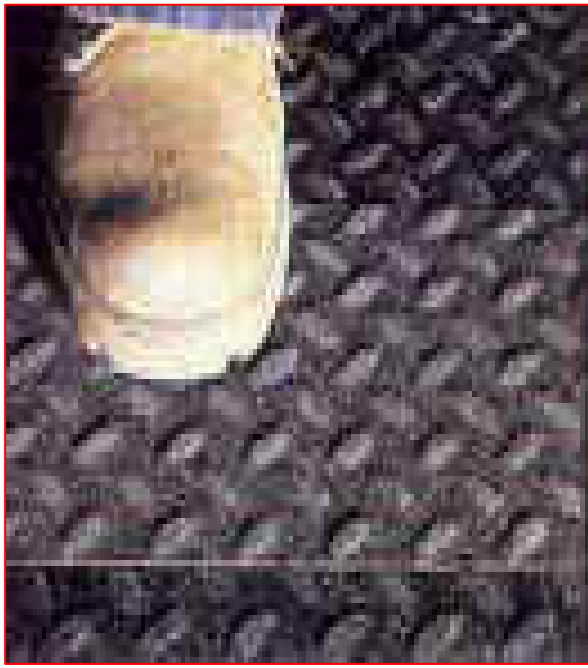
Current application to Trains (anti scratch & graffiti) and Buses (external projectile attack)

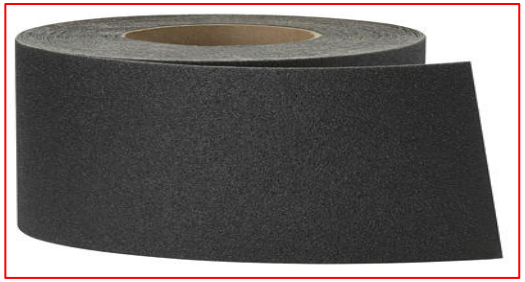
3M™Safety-Walk™ Slip Resistant Tape

- Relatively cheap OH&S solution, when compared to potential compensation claim
- Provides a safe, slip resistant surface
- Is strong and very durable
- Is resistant to chemicals
- Easy to install
- Excellent bond to most dry, clean, smooth surfaces

3M™Safety-Walk™ Slip Resistant Tape

- What is it?
  - *Top layer - Slip resistant particles bonded with a durable polymer to a dimensionally stable plastic film.*
  - *Bottom Layer - Coated with a proprietary formulated adhesive, covered by a removable protective liner.*
- Conditions to use?
  - *Dry, wet & oily floors in industrial & commercial applications*
  - *Intensive pedestrian or light vehicle traffic*
  - *corridors, production and storage rooms, ramps, stairways, ladders, footplates on machines, emergency exits……*
- Colours available
  - *Black, Clear or Yellow*
  - *Primer May be required*

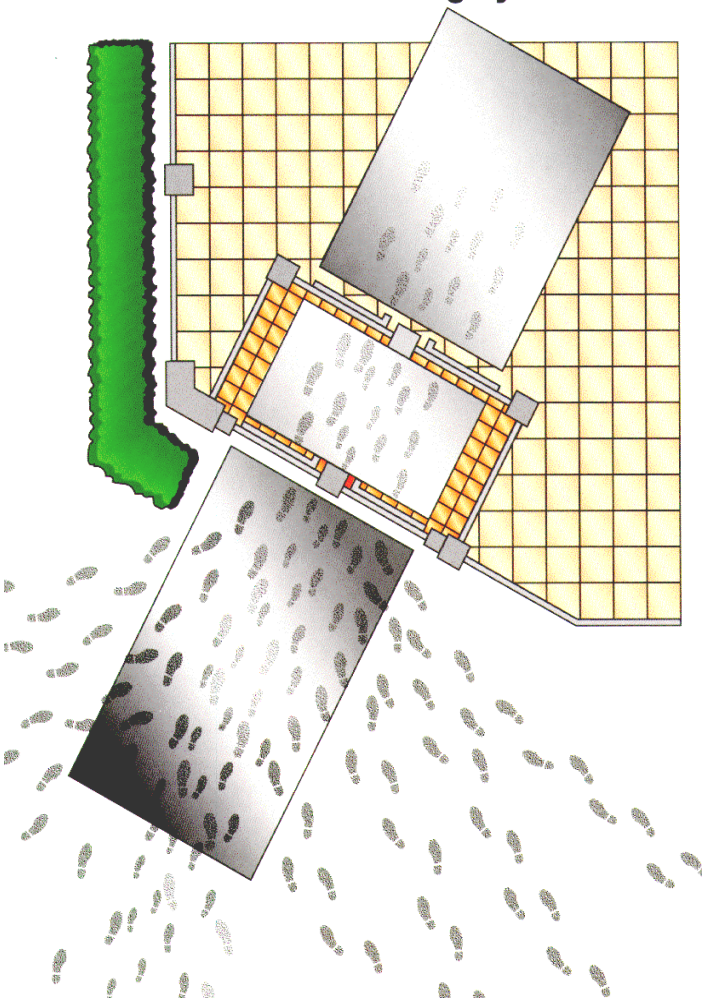




3M Commercial Care

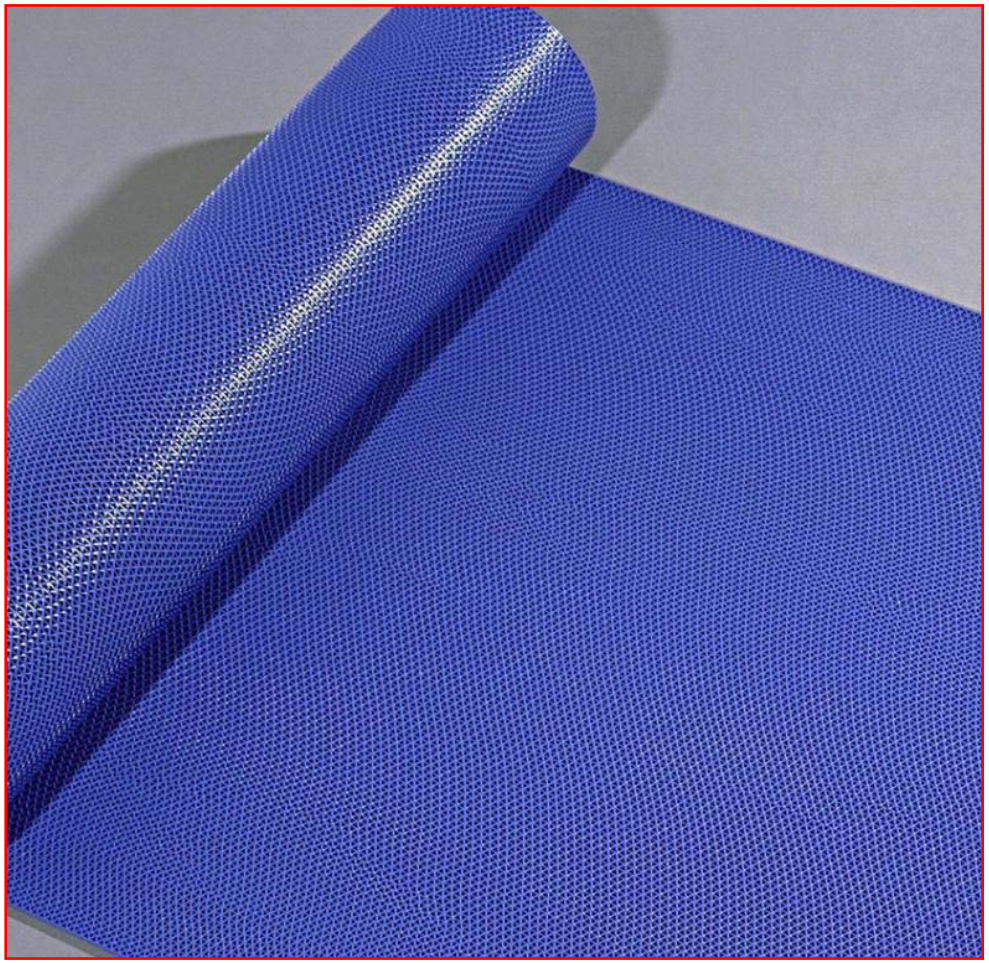
Why have a matting system?

- 80% Dirt walked in the entrance
- 3 metres of high quality mat stops more dirt than 6 metres of poor quality mat
- 100 grams of dirt deposited for every 1000 people (10x in the wet)



Anti-fatigue & non-slip matting

Why have a matting system?

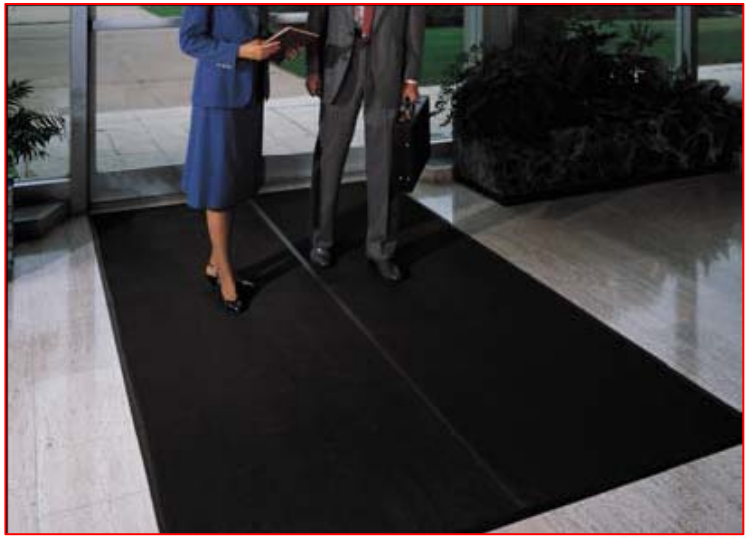


Non-slip matting
- Wet Areas
- Pools
- Kitchens

3M™ Nomad™ Medium Traffic Scraper Matting 6050

Resilient vinyl loop construction traps, holds and hides dirt and sand so the surface stays neat and clean. Foam backing reduces creeping, provides added foot comfort.

Environmental/Energy Advantage:
Removes up to 72% more dirt and water than other traditional carpet matting
improving overall interior appearance
extending life of floor surfaces
reducing interior maintenance cost
helps reduce costly slip and fall accidents.



Fasara™ Decorative Films

A Full Line of Glass Decorative Films with Many Functional Applications and Beautiful Aesthetic Appeal

- **Create new visual effects with glass**

Crosshatch patterns
Rice-paper styling
Frosted/Dusted
Misty cloud distortion
Textured fog
Opaque
Structured patterns
Custom

Quality Company

Trusted Brand Name

Local Turn Key Project Management

Unique Product Features

Adhesive Clarity & Longevity

Product Quality

Warranty

Sales & Technical Support