



Science of window films (tints): Choosing the right window film for our cars in Malaysia

This is the second part of the series on the science of car window films. [Read Part 1 of this series.](#)

The [first part](#) of this series discussed about how the car cabin warms up due to trapped heat from the Sun, and the various methods that we could use to cool our car cabin temperature. One of these methods is the installation of car window films or tints which have been showed by several studies that it is the overall most effective heat rejection, as well as the most practical, method.

How window films works

Window films of the past were just vapor deposition of aluminum or silver metals. These metals were effective against blocking heat because they were very reflective, but because these films were very reflective, they also blocked out a large part of the visible light (VL) spectrum. These reflective films also had a “tin foil” look and were thus less aesthetically pleasing.



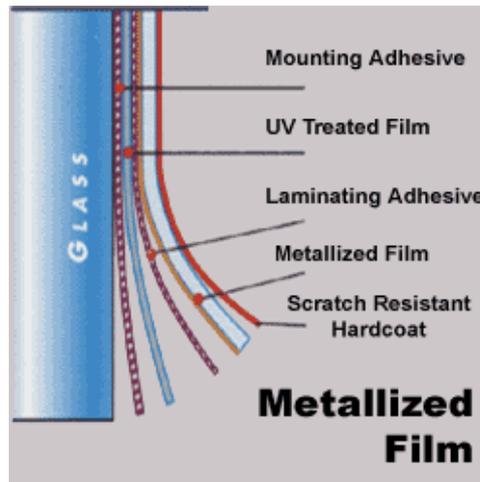
What are window films made of?
(photo from sunshinetinting.com).

Window films have since changed rapidly. Modern window films today are lighter, longer lasting, and have high heat rejection rates but yet allowing in high visibility and reducing glare.

The key goal of window films is to reduce the transmission of solar radiation through the glass without impairing visibility. The more the window film can reflect the solar radiation, the more energy efficient the film is. The film can also absorb the solar radiation to reduce transmission, but this is undesired because the absorbed energy can radiate inward and contribute to warming.

Window films today have UV (ultraviolet) inhibitors in them because the film's polyester base can be destroyed by UV. That window films today have nearly 100% UV rejection rate is a double advantage because by blocking nearly all of the incoming UV, the window films will last longer (e.g., fade less) and the car occupants and car interior surfaces will be protected against UV harm.

Different manufacturers may use different ingredients and additives but the basic method of making a window film remains the same. A window film might look like a single layer, but it is actually made up of several layers.



A car window film actually consists of several layers. The layers are typically the protective liner (discarded prior to installation), adhesive layer, polyester layer (which itself can consist of several layers), and a scratch-resistance coat (photo from cloud.tintcenter.com).

The first layer is the protective liner. Although not important once the film is installed, the protective liner protects the adhesive layer of the film to ensure the window film will adhere to the glass firmly.

The next layer is the adhesive layer, which is protected by a liner, as mentioned earlier. This adhesive layer helps to affix the film to the glass. Different films will have different stickability: some will adhere strongly to the glass, whereas others less so. This adhesive layer is very important because a film with poor adhesive properties will cause the appearance of bubbles, peeling, or waves in the film shortly after installation.



Appearance of bubbles is one

common side-effect when a low quality window film is used.

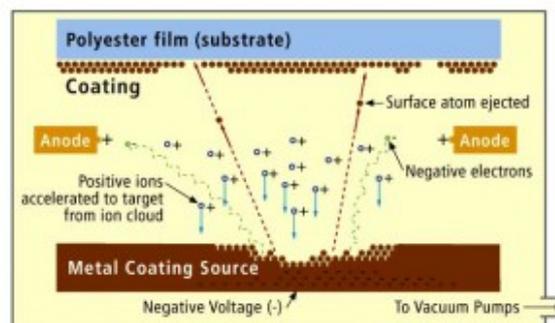


Likewise, a poor quality window film may eventually produce wave-like appearance on the glass which distorts viewing and make driving dangerous. This appearance is also known as the orange peeling effect (photo from kereta.info).

The third layer is made from polyester and which can comprise several layers. This polyester layer is the most important layer because it functions to block out heat but yet allow in sufficient visibility. This layer may also contain various add-ons such as metals and dyes to enhance the film heat rejection and appearance properties.

The last layer is the scratch-resistant acrylic coating that is placed over the polyester layer to protect the film from scratches and tearing. This layer helps to maintain a distortion-free viewing and allows the glass to look as natural as possible from the inside.

Once the ingredients of a window film reach the manufacturing floor, the processes the film undergoes can vary. Laminating occurs when layers of the film are bonded together using adhesive. Other common manufacturing processes are such as metallizing and dyeing, where metallizing is where a metal is adhered to the polyester base film to give the film reflective properties, and dyeing is where dyes are mixed with the film to give the film varying shades of darkness. Metallized films have higher heat rejection rates than dyed films because metallized films will reflect more and absorb less heat than that by dyed films. Recall that absorbed heat can radiate inward into the car cabin to warm the interior, whereas reflected heat radiates away and does not contribute to warming.



Metallizing is a process to deposit or adhere metals on the window film for higher reflectance (photo from www.johnsonwindowfilms.com).

How to choose the right window film

There are many types of window films and many manufacturers out there. Consequently, it can be confusing to choose the correct window film for our cars.

[One website](#) that offers good advice on how to select good quality car window films is by [Raytech](#). Essentially, in choosing the correct window film for our cars, the following should be our guide.



How can we choose the right window film for our cars? (photo from raytech.com.my).

1. Choose a reputable window film company

A good reputation has to be earned, so a window film company with a good reputation means its window films have been used widely and for long periods, and the films have been tested and reviewed. Detailed information about the company and its film products must be easily available and accessible, notably through the net. The specifications about the company's various film products can also be easily checked and compared.

Choosing a window film company with a good international reputation is the first and most important step in choosing the right window film.

2. Choose the right window film installer or dealer

Avoid unscrupulous dealers or car tint shops. Some unscrupulous activities include selling rebranded, fake, or so-called house brand window films, installing a different window film from what was earlier chosen, reporting false window film specifications, and presenting false demonstrations during window film selection.

Do not be cheated by "House-Brand" products

Some dealers, who may also sell good brands, are unethical by selling fake brand products to their customers. Do not be cheated with "house-brand" or fake (not original) products. These products are brought in from unknown suppliers (i.e., not from original brand suppliers), labelled a new name, sold as if original just to make more profit, then given the shop's warranty card.

Normally, customers recognise brand names, but they may not know the various products under a given brand name. Customers can search via online the product's details and specifications. Customers will face warranty claim problems in the future if they are using "house-brand" products.



Avoid unscrupulous dealers or car tint shops which practise selling fake or house-brand film products (modified from raytech.com.my).

Consequently, we should only go to car-tinting shops that are officially authorized (with visible proof of authorization such as a certificate) by the window film manufacturers.

Moreover, all window films must be original with its brand name and trademark, name of manufacturer, and place of origin clearly marked on the film.

3. Choose the window film with the highest heat rejection rate

Once the window film company and the film dealer or installer have been selected, the next is to choose the film with the highest heat rejection rate. Two common heat rejection indexes used are IRR (Infrared Rejection) and TSER (Total Solar Energy Rejection). IRR measures only the amount of IR (infrared) component that is rejected by the window film. So, if a film has a 65% IR, it means the film rejects 65% (but lets in 35%) IR. However, IRR does not measure the total amount of heat that is rejected. Recall that all three components (UV, VL, and IR) of the solar radiation contribute to warming, not just the IR component.

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A more holistic measure of total heat rejection is the TSER index. It measures how much UV, VL, and IR are rejected by a window film. Consequently, a film with 60% TSER means the film rejects 60% of total heat (as contributed by all three solar radiation components). The opposite of TSER is SHGC (Solar Heat Gain Coefficient). So, a film with a 60% TSER is equivalent to 40% SHGC which means 40% of total heat is not rejected or allowed in by the film.

Obviously then, we want a window film with a high TSER (or low SHGC) value for high heat rejection levels. Unfortunately, confusions persist among many consumers who are still guided to select window films based on IRR values. Moreover, many car-tinting shops only report IRR values but not the more valuable TSER values for their window films. In the website of one well-known window film company, for instance, even erroneously advocated the use of IRR values as the guide to choose between window films.

This situation is compounded when even the reported IRR values are inaccurate because the heat rejection measurements were only done on one narrow part rather than the whole IR spectrum range. The reported IRR values are thus overestimated because other parts of the IR spectrum are not accounted for in the heat rejection evaluations.

Consequently, we need to choose window films with high TSER (or equivalently, low SHGC) values. Ignore shops that do not report TSER or SHGC values for their tints. Also, ignore IRR values (regardless of how high their values may be) because they do not represent the total heat rejection levels.

In the US, an estimated 20% of the population understand the benefits of window films and know how to choose the correct window film for their needs. In Malaysia, the number of such informed people is unknown, but the number could also be low if the estimate by one window film company is correct that 80% of Malaysians choose low quality window films for their cars.

Some common misconceptions among Malaysians are that good quality window

films are unnecessary, over-hyped, or over-priced without appreciating that good quality films adhere better to the glass, last longer, and reject high levels of heat; thus, saving costs in the long run in terms of lower fuel consumption as well as being more environmentally friendly. As stated in [Part 1](#) of this series, a cooler car cabin in a Honda Civic can lower the car's fuel consumption by 0.21 L per 100 km and lower carbon dioxide and nitrous oxides emissions by 4.9 g per km and 9.9 mg per km, respectively.



A good quality window tint is not expensive when we consider the long term benefits they give (photo from www.groupon.com).

In a hot country like Malaysia, tinting our car windows with a window film is essential. A good quality film will give good thermal comfort, protect us and our car interior from UV harm, and because a good quality tint lasts longer, the film will save us money in the long run in terms of lower fuel consumption, as well as enabling our cars to be more environmentally friendly.

References

1. Hodge, K. 2011. Back to basics: A lesson in light. Members of the window film industry share the science behind window film. *Window Film*, 15(3): 26-31.
2. O'Mara, K. 2012. Back to basics: Peeling the onion. A look at the components of window film and how they work. *Window Film*, 16(3): 18-19.