NSG GROUP

Technical Bulletin

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PREVENTING MOISTURE STAINS ON STORED GLASS

Summary

Moisture stains on stored glass can occur whenever the glass is exposed to wetting and drying of its surfaces. Wetting a glass surface causes a leaching of the alkaline materials in glass. As long as the alkaline concentration of the resulting solution remains low, staining does not occur. However, as evaporation takes place, the concentration of the solution increases. If the evaporation rate is very slow, the glass becomes exposed to high alkaline concentrations for long periods of time. This typically causes permanent glass staining or etching. Two primary sources of moisture stains are: direct exposure to liquid water and moisture condensation on glass surfaces.

Exposure to Liquid Water

In this situation, wetting can result from contact with leaky pipes and roofs or, if the glass is stored outside, from rain, snow, and ground water. Preventing damage from these sources is not difficult.

Glass expected to be exposed to liquid water should be protected with a lightweight roofing paper or canvas tarp covering. These materials are preferred to non-permeable materials such as polyethylene sheet because they will prevent the passage of liquid water but will allow water vapor to pass through. Non-permeable materials can be effective if they completely enclose the case and the air inside is dry, but this is generally impractical.

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The protective cover should be in addition to any packaging found inside the glass case. It should be positioned so that water drains from it and is not allowed to collect near the glass. This is particularly true for glass in cases to be stored outside at a job site.

Condensation

A more subtle cause of glass staining results from moisture condensation on glass surfaces. Condensation occurs on a surface when the temperature of that surface falls below the dew point temperature of the surrounding air. This condition may exist during transportation, or when the glass is stored outdoors, in unconditioned warehouses, or in improperly designed or maintained storage areas. Glass will usually become cooler at night and because of its mass and heat-storage capacity will not heat up as rapidly as the surrounding air during the day. When the relative humidity is high, daytime condensation can readily occur as the air next to the glass is cooled. Later in the day, as the glass temperature rises, the condensation will usually evaporate. In some climates this cycle of wetting and drying may occur frequently during humid seasons.

To prevent staining from condensation, the air at the glass surface must be kept at a temperature above the dew point of the ambient air, or the glass temperature must always be kept above the worst expected dew point. This can be accomplished by storage in a well-heated warehouse. The chart below lists some typical conditions for which condensation may occur. This would apply in instances where many lights are stored together, such as in a shipping crate.

Minimum Nighttime Temperature to Which Glass is Exposed	Maximum Daytime Temperature to Which Glass is Exposed	Critical Daytime Relative Humidity*
-18°C (0°F)	-7°C (20°F) 4°C (40°F)	38% 16%
-4°C (25°F)	7°C (45°F) 18°C (65°F)	44% 21%
10°C (50°F)	21°C (70°F) 32°C (90°F)	50% 25%

*If the relative humidity exceeds this value during the day, condensation on the glass is probable.

A clear conclusion from this table is that glass in crates cannot be stored outdoors in humid climates without condensation and resulting staining. Generally, there should not be problems if the night-to-day variation in the air temperature for the glass storage area can be maintained at less than 10°F, and the daytime relative humidity is 70% or less. If the storage area is kept warmer than the highest outdoor air temperature during the day, condensation is unlikely. However, varying humidity conditions must also be considered to ensure that glass temperatures lower than the dew point temperature are never reached.

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As mentioned above, non-permeable materials such as polyethylene should not be used to cover the glass as they can prevent water evaporating. This can lead to condensation and staining.

Proper Storage Technique

Glass subjected to cyclic wetting and drying during storage can become stained or etched. The slower the rate of evaporation and the higher the number of wetting/drying cycles, the greater the possibility and severity of staining. The following storage tips will help you eliminate moisture damage to your glass whether it is being stored at a warehouse, job site or your cutting area - even while the glass is still in the shipping case.

Staining tends to be more pronounced when the glass is stored in racks or crates with little or no space between panes. Care should be taken to avoid these conditions. Glass taken out of the case should always be stored with interleaving or spacing between individual lites.

In instances where the chances of the glass being exposed to liquid water are eliminated, steps that will increase the air circulation around the glass should be considered to minimize the harmful effects of condensed moisture. This might be accomplished with large fans, increased separation of glass crates, and other means. When fans are used, care should be taken to assure that warm humid air is not drawn into the glass storage area. On a job site, glass should be stored indoors and should be protected from driving rain. Outdoor storage is always risky because of the strong chance of moisture condensation and periods of outdoor storage should be kept to a minimum.

In general, glass should not be stored in locations where the relative humidity exceeds 80%. Further information on the protection of flat glass surfaces can be found in ATS bulletin 104.

Stain Removal

Should stain be evident on the glass and it is not removable using normal window washing procedures, two procedures can be tested to attempt to remove stains from uncoated glass surfaces. The two stain removal procedures are: cerium oxide blocking; or rubbing with a buffered HF acid solution.

A non-critical, test area of stained glass should be masked off and subjected to a timed cleaning with the cerium oxide first. A second area should then be subjected to a timed cleaning with buffered HF acid such as Winsol 550. The results of each trial should then be compared. In some instances, if stain has advanced to the point where the two methods above will not remove the stain, glass may be damaged beyond repair.

Stain removal procedures should never be conducted on the coated surface of Pilkington coated products.

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