



Recommended Techniques for Washing Glass

Prologue

This document is a reproduction of the original publication, with only minor changes and updating. The original publication was introduced over 20 years ago and remains one of the most requested and helpful resources on techniques for washing glass. While most of the principles and recommendations for the machine washing of glass remain applicable, Table 1 has been deleted, since the glass cleaning product information shown was obviously dated. In addition, the introduction of new performance enhancing low-e coatings, such as Solarban[®] 60, *Solarban 70*, *Solarban 80* *Solarban z50* coated glass, have led to additional recommendations that are noted in this update.

Introduction

The durability and beauty of glass, coupled with its transparency, make it one of the world's most utilized building materials. Glass allows light to enter the building, while providing protection from the elements. And, it allows occupants the connection to the outside environment that has been proven to improve morale and productivity.

Glass is available in a wide variety of tints that provide aesthetic variety, as well as improved energy efficiency and occupant comfort. In addition, aesthetics, comfort and energy efficiency can be further enhanced through the use of the many types of coatings that have been developed for application to the glass.

Whatever the job and whichever glass product is chosen, the attractive and efficient use of glass requires a clean glass surface. With more than 120 years in glass manufacturing and fabrication, PPG offers the recommendations in this document to assist glass fabricators successfully wash the glass products that PPG is pleased to furnish them. The included recommendations are based on detailed research, years of first-hand production experience, and work in solving hundreds of customer related glass-cleaning problems.

Included in this document is a detailed review of:

- Dirt types that affect glass
- Glass surface protection
- Water and detergent requirements
- Mechanical washers
- Prewashing
- Requirements for Low-E glass
- Washing system maintenance
- Troubleshooting

Glass Surfaces: Cleanliness & Protection

Because dirt negatively affects glass undergoing any type of processing, glass surfaces must be clean. Proper cleanliness requires that the glass surfaces be washed effectively.



When glass is “dirty”, both its aesthetic and performance quality may be diminished. If dirt is not removed effectively, it will inhibit processes where the adhesion of other materials (sealants, coatings, etc.) to glass is necessary. For example, when glass is used for mirror and architectural coating applications, the surface must be clean in order to permit metals or metal oxides to bond to the glass. Insulating glass fabrication processes require clean glass for the sealants to adhere properly to the glass, since this bond provides the required long-term performance of the hermetic seal. Glass processes such as heat-strengthening, tempering, and bending require clean glass to minimize bull’s-eyes distortion, burn, and other “dirt” influenced effects.

What Makes Glass Dirty

“Dirt” on glass can best be defined as “any unwanted material on the glass surface”. Consider glass interleaving, for example. Interleaving materials are essential for the protection of glass surfaces and coatings during transport and storage. However, when glass is prepared for any fabricating process, the interleaving becomes an unwanted contaminant, or “dirt”, that must be removed from the glass surface.

The degree of “dirtiness” or cleanliness of glass that is acceptable is dependent on the end-use of the glass. For example, glass cleanliness that is sufficient for picture frame applications (in which the surface remains accessible for repeated future cleaning) may not be acceptable to the insulating glass fabricator, who permanently seals glass surfaces within insulating glass

units, or for fabricators who coat, temper, or etch glass and require exceptional glass cleanliness prior to final processing.

Dirt on glass surfaces can be grouped into four general categories:

- particulates
- surface residues
- reaction contaminants
- surface corrosion

Glass fabricators usually encounter only the first two types of dirt and these will be the primary focus of this document.

Particulates are solid materials, loosely deposited on the glass surface, that can best be removed with non-abrasive mechanical methods such as a high pressure water spray. Typical glass surface particulates include paper interleaving fibers, acrylic beads, wood flour and other powder interleaving materials, glass handling chips, wood splinters, cardboard pieces, and other packaging materials. See Figure 1 for an example of a typical particulate.

Surface residues are contaminants that may be cleaned from glass using detergent washing solutions and/or mechanical scrubbing techniques. Examples of such residues are fingerprints, paper scum, and cutting oils. An example of paper scum is shown in figure 2.



Reaction Contaminates are more tenacious than surface residues and may physically or chemically bond or interact with the glass surface. For this reason, their removal may require chemical “undercutting” with a cleaning solution tailored for specific dissolution or bondbreaking.

Hard-water salts are a commonly encountered reaction contaminant. In some parts of the country, water supplies contain

large quantities of inorganic compounds. If glass is washed with this water, care must be taken to rinse the glass surfaces thoroughly with demineralized water before drying or further processing (coating, tempering, etc.). The use of demineralized water to rinse the glass will prevent the deposition of hard-water salts that may be visible in the final product. If hard water is allowed to dry on glass surfaces, the chemical nature of these salts may require the use of off-line cleaning with acid solutions for their effective removal. This type of aggressive cleaning may not be safe, environmentally correct, or economically feasible in a production environment. In addition, with coated glasses, such cleaning procedures will most likely lead to coating damage.

Surface corrosion is not really a type of “dirtiness”, although a corroded glass surface will exhibit a semi-opaque appearance that can be and often is mistaken for deposited dirt. Surface corrosion is an irreparable physical degradation of the glass, usually resulting from inappropriate storage conditions of high temperature and humidity. To prevent surface corrosion, PPG strongly recommends that customers store glass properly, maintain a detailed

inventory, and practice stock rotation. With the increased use of MSVD low-e products, such as *Solarban 60* low-e coated glass, the proper storage of glass inventory becomes even more important, as these types of glass are more sensitive to moisture.

In its initial stage, glass surface corrosion is visible only under critical light (or occasionally after coating application) and cannot be observed by the naked eye. At this stage, with uncoated glass, it may be possible to remove the corroded glass layer(s) with an abrasive such as cerium oxide. Obviously, coated glass that is corroded – even in its earliest stage - cannot be cleaned without destroying the coating.

Once glass corrosion becomes severe, a heavy blue or white stain is visible on the glass surface, the glass matrix has undergone degradation, and glass transparency cannot be restored. The only practical remedy at this stage of surface damage is to replace the glass.

Figures 1 – 4 are examples of the different types of “dirt” discussed.

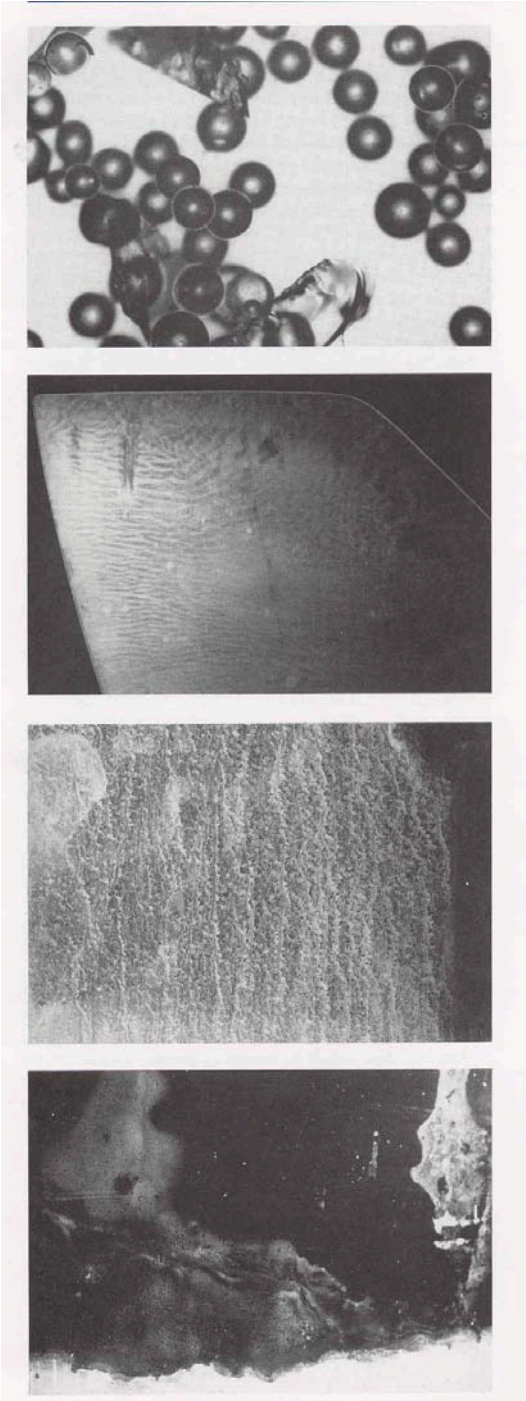


Figure 1 – Particulates
A magnified (40x) view of particulates removed from incoming primary glass by a prewash system. Interleaving beads and glass chips are seen here.

Figure 2 – Surface Residue
Typical paper scum on glass (note the duplication of the paper ridges and wrinkles in the scum pattern.) This residue can be removed using a 50/50 isopropanol alcohol and water mixture, or a detergent solution.

Figure 3 – Reaction Contaminant
Acid rain/masonry/glazing material run-down on the glass surface. Removal requires an acidic solution, or may not be practically possible.

Figure 4 – Surface Corrosion
Glass corrosion is typically caused by prolonged exposure to high humidity and temperature and is often not removable.



PROTECTING GLASS

To protect glass surfaces from corrosion and scratching, a chemical and physical barrier must be maintained between adjacent lites of glass when stacked for shipment and storage. This dual function is performed by an interleaving material. While other types of interleaving (such as paper) are still occasionally used, the major form of interleaving currently used in the flat glass industry for uncoated glass consists of plastic beads to provide the physical separation, combined with acidic corrosion inhibitors on the glass surface. ***With PPG MSVD coated glass, corrosion inhibitors are not applied to the glass. Interleaving consists of only the plastic separator beads.***

PPG's powder interleaving (with or without the corrosion inhibitors) is compatible with mechanical packing, which reduces packaging related glass surface issues such as scratches, handling chips and packing rubs encountered with manual packing procedures. The powder interleaving is also compatible with automated "pick" equipment used by many glass optimizer lines.

At some point in glass processing, any interleaving becomes an undesirable surface contaminate that must be removed. Powder interleaving can be removed by cleaning procedures previously recommended for particulate contaminants, namely, non-abrasive mechanical action (e.g. high pressure water spray). The water soluble corrosion inhibitors will dissolve and be carried away, along with the separator beads

MECHANICAL GLASS WASHING

The key elements involved in mechanically cleaning glass are:

- Water Quality
- Detergent
- The Washer System

All of these critical elements must be carefully selected so that they will work together effectively to clean the glass.

Water

Water is the foundation of the washer system. Used at high pressures, it physically removes particulates. When mixed with an appropriate detergent, it removes surface residues, acts as a "lubricant" between the washer brushes and the glass surface, and ultimately carries away dirt and debris.

Because water plays many important roles in the cleaning system, ***water quality*** is critical. Water used in glass cleaning should have minimal turbidity (solid material content), and a suitable hardness or softness for two reasons:

- To allow detergent dissolution and easy rinsing
- To prevent build-up of excessive washer scale

If required, water treatment equipment should be installed to furnish water with suitable quality. The initial investment will ultimately provide more efficient glass cleaning and reduce the potential for the formation of reaction contaminants on glass surfaces.



Appropriate filters installed on main water supply lines and within the wash system flow lines will remove inherent water turbidity and internally generated washer debris (broken brush bristles, scale, glass chips, etc.). Based on PPG production experience, a 25 micron replaceable cartridge filter is recommended. These filters will reduce glass surface scratches, recontamination in the washer, and lower the incidence of nozzle blockage from water borne particulates.

The pH (acidity/alkalinity) of the water used in the wash section of glass washers will be altered if a detergent is used. Therefore, the pH range of the incoming wash water cannot be practically specified. However, PPG has traditionally recommended that detergents be used that maintain a wash solution pH that is slightly acidic to achieve the best glass cleaning. While this recommendation remains valid, there are detergents that yield slightly basic solutions that are successfully used. Detergents that yield a pH of 11 or higher should be used with care, as they can lead to scale and deposits in the washer, as well as on the glass. If a water soluble cutting fluid is used, the use of a detergent is not always necessary.

Warm water dissolves detergents more readily, and enhances cleaning efficiency. Wash water temperature recommendations for various washer equipment is typically in the 100 to 140°F. range.

The rinse section water quality is extremely important because it is the last liquid to contact the glass before final processing. The use of water treatment systems such as reverse osmosis (RO) or Deionized (DI) is recommended to provide high quality, low mineral content water to the rinse section of

the washer, since such water minimizes or eliminates the possible streaking/spotting that occurs from mineral residue deposits. However, this type of water treatment sometimes increases water corrosiveness that may damage some metal parts in the washer. PPG recommends that the washer manufacturer be consulted prior to installing and using such water treatment systems.

Generally, heated rinse water provides a more effective rinse and facilitates drying. However, rinse water should not be heated beyond 140°F. and, if the rinse water is treated, it should not be heated beyond 110°F.

Detergent

The use of a detergent, while recommended, is not necessary in all washer systems.

- Surface residues are removed most effectively with detergent solutions, not plain water. In addition, detergents decrease the potential for glass surface scratching in washing systems.
- It is important that the correct concentration of detergent in water is used for the wash solution. Most detergent suppliers recommend optimum concentrations for their products.
- Introducing detergents into previously water only systems will initially liberate accumulated dirt and scale. Therefore, it should be done during non-production periods. Draining and refilling the wash tank may have to be done more than once in



order to “flush out” the system before beginning actual production processing.

There is no universally effective glass cleaning detergent! A detergent that works well at one facility may be inappropriate at another due to differences in water hardness or temperature. Therefore, specific detergent recommendations are not practical. Rather, trials by the fabricator will provide more specific results and useful information for his operation.

For a given water type and operating temperature, the selection of a suitable detergent requires answers to the following questions:

- **Solubility:** Will the detergent foam excessively in your washer? A quick, easy method to screen detergents for foaming characteristics involves pouring 50cc of a one-percent detergent solution into a 250cc graduated cylinder, agitating vigorously, and observing the resulting foam volume. For a low-foaming detergent, the total foam volume should not exceed 80cc.
- **Rinsing Characteristics:** If a small (12” x 12” is suitable) glass sample is hand washed with a one-percent detergent solution, is excessive rinsing necessary to remove all traces of the detergent?
- **Environmental/Safety Considerations:** Does the chemical composition of the detergent serve the specific environmental requirements for your water treatment area (e.g., phosphates,

acidity)? Does the resulting discharge comply with local, state and federal EPA requirements? Will it be necessary for washer personnel to wear protective equipment (gloves, face shield, etc.)?

- **Local Availability:** Is the detergent locally or readily available, or is a large inventory required?
- **Supplier reliability:** Will the supplier go out of business or change the detergent formulation without notifying customers?

In general, acidic detergents are more readily rinsed from glass surfaces than those that are basic (or alkaline). However, acidic detergents may cause etching of some metal components of the washer, and perhaps an all-stainless steel construction would be required. PPG recommends that the washer manufacturer be consulted to determine if this acid condition will have an adverse effect on the washer equipment.

Some coated glass products may be acid (or base) sensitive and require special detergent consideration. See Precautions for Coated Glass on p. 17

After a detergent has been selected, PPG recommends trial runs in the washer. Full scale production should not be attempted until the user is satisfied from these trials that the detergent will perform satisfactorily.

Detergents that are currently in use in the fabricator’s washer may be perfectly acceptable.



While PPG continues to recommend the use of detergents, the increased use of MSVD low-e coated glass products (Solarban 60, Solarban 70, etc.) has allowed many fabricators to successfully clean glass without the use of detergents. As previously mentioned, PPG's MSVD coated glass products are shipped with only the separator beads as interleaving. The glass is typically very clean when it is shipped and does not typically remain in inventory, either at PPG or the customer's shop, for extended periods. In addition, the glass may be protected with a plastic wrap, which minimizes incidental accumulations of dirt and contaminants. For these reasons, a detergent free wash can be successful, provided that the washer is well maintained and adequate water flow is used. The use of high quality, low mineral content water in the rinse section is recommended for all glass, but it is critical when processing PPG's MSVD low-e coated glass products.

It is important to understand that detergents that are used be evaluated for compatibility with PPG's MSVD low e coated products. PPG offers a behavioral evaluation of the detergent as a service to its customers.

The following detergents have been evaluated and found to be acceptable:

- Dart 210
- Billco Glass Washing Detergent
- Basic H
- I.G.S. 55:1
- Sommer & Maca Low E Detergent
- Buckeye Blue



TYPICAL MECHANICAL GLASS WASHING SYSTEMS

NOTE:

Automatic glass washers cannot remove all water insoluble surface residues. Sometimes, identification of a contaminant's chemical nature can save production time wasted by repeatedly washing glass in attempts to remove such residues. For example, deposition of an adhesive from tape or a label on glass surfaces may require special off-line pre-cleaning with organic solvents to remove this water insoluble tacky residue prior to line washer entry.

Automatic glass washers are designed to remove water-soluble surface residues. These washers consist of a detergent application (or washing) section, one or more rinse sections, and a drying section (e.g., air knives). In the washing section of a system, cylindrical or oscillating cup brushes provide mechanical action that operates with the detergent's chemical action to clean the glass.

Optimum washer performance requires proper glass loading. Glass spacing should be greater than the roll circumference. Conveyor speeds should provide suitable washer dwell time, and conveyors should not be stopped while glass is under the brushes or air knives. In fact, it is best to not stop glass in any part of the washer.

CAUTION:

Mechanical brush action may be detrimental to PPG's MSVD low e coated glass that may be easily scratched.

PPG recommends that brushes with a bristle diameter between 0.006" and 0.009" be used to process its MSVD low e coated glass. In addition, brushes must be properly adjusted to avoid excessive brush contact.

The washer conveyor system should never be stopped while these coated glasses are beneath the brushes.

See "precautions for Coated Glass on p. 17

While a typical glass washer is appropriate for cleaning surface residues from glass, particulate "dirt" can cause significant system problems, especially in re-circulating washers that are not equipped with appropriate water-flow filters. Glass handling chips or other gritty particulates that enter the washing section will be mobilized on the glass surface by the washer brushes causing scratches. Even non-abrasive particulates pose a problem as they accumulate on washer brushes and in solution tanks, decreasing cleaning efficiency and increasing the need for washer maintenance.



PPG PRE-WASH SYSTEM

Recognizing the need to optimize washer performance by preventing particulate entry, PPG conducted research in glass cleaning that led to the development of a simple, compact, economical washer add-on that is called the “pre-wash”.

Just as optimum performance is obtained from automatic dishwashers by rinsing solid foods from dishes prior to loading the washer, the pre-wash system provides optimum glass washer performance by effectively removing all particulates from the glass surface prior to entry into a standard line washer.

The PPG pre-wash is a two-phase system. In the first phase, a dilute detergent solution is applied to the glass surface, as shown in Figure 5. In the second phase, this detergent residue and particulate debris are removed with a high pressure, filtered water rinse, also shown in Figure 5.

Figure 6 provides a schematic of the PPG pre-wash system.

The dilute, filtered detergent solution can be applied with a low pressure (10 to 15psi) spray as shown in figure 7, or a gravity-feed drip pipe. The choice depends on conveyor line speed. The detergent solution must completely cover (wet) the glass surface. If conveyor speeds are slow enough to accomplish this coverage through drip-pipe application, no pumps are necessary.

Detergent solution application is essential to the pre-wash system. It serves two purposes. Most important, it “wets” the glass so that the following high pressure water rinse will flow readily over the entire glass surface (plain water applied to dry

glass forms narrow streams and channels). Second, the detergent solution decreases attractive forces the particulates may have for one another (e.g., interleaving plastic bead static charges) or for the glass surface or system components. This facilitates particulate removal and ultimate disposal.

There is no minimum specified time that the detergent must remain on the glass to accomplish these actions, which are instantaneous. Glass surfaces do not have to soak in this solution, since its purpose is to “wet”, not clean; therefore, the distance between the detergent pipe and high pressure rinse can be as little as 24 inches. Any typical glass-cleaning detergent designed for the production line washer may be used for this pre-wash wetting solution.

If the pre-wash is installed on a production line that is not continuously loaded with glass, the wetting detergent delivery system can be designed to conserve detergent solution by the installation of a feedback loop, conveyor limit switch, and solenoid valves. The detergent solution will then pump through hoses, bypass the delivery pipe, and return to solution holding tanks when no glass is on the conveyor. When glass moves under the delivery pipe, the limit switch activates solenoid valves to close the bypass circuit and divert the flow of solution into the pipe, spraying the glass surface.

In the second phase of the pre-wash shown in figure 5, the glass enters a metal sheeting enclosure fitted with spray-pipes delivering



filtered water at a pressure of around 150 psi. If water is recirculated in the production washer that follows the pre-wash, it may be necessary to place a high pressure pipe below the conveyor to remove the few particulates that transfer to the bottom surface of the glass during stacking. This prevents the potential accumulation of these particulates in a re-circulated system. Otherwise, one or two high pressure pipes spraying only on the glass top surface will suffice for the pre-wash on a line with a non re-circulating washer.

Water used in the high pressure spray may be from any convenient source (well, tap, washer rinse overflow), as long as it is filtered through at least a 25 micron replaceable cartridge filter before being pumped through the delivery pipes. This room temperature water must be particulate-free to prevent glass surface recontamination and nozzle blockage. If the water source is acidic (e.g., some demineralized water), stainless steel pipes, nozzles, and pumps are recommended to prevent corrosion of these system components.

The spray pipes shown in Figure 8 in the high pressure enclosure are mounted 3 to 4 inches* from the glass surface in an orientation to provide the spray with a 45 degree angle of incidence with the incoming glass surface. Stainless steel nozzles (fan type 65 to 110 degrees, orifice diameter 0.026 inch) are suitable for use in both the detergent and high pressure spray pipes. These nozzles are spaced on 3 or 4 inch centers across the width of the conveyor.

***Prewash parameters relating to pipe position/alignment, nozzle spray pattern, orifice size and spacing, etc. are given as guidelines based on PPG experience. Since all line configurations vary for a given production facility, experimentation with these parameters must be conducted to devise the most effective system for a specific installation.**

When the pre-wash water is discarded, it can be included with all other plant effluent for normal sewage disposal. The particulates suspended in the water will require normal solid-waste treatment (as would cerium oxide, for example). If operators are concerned with particulates in their effluent, a screen (or tandem series of screens) can be placed beneath the high pressure enclosure to retain solid matter rinsed from the glass surfaces. Based on the particle size distribution of PPG's typical powder interleaving, a 120-mesh screen will retain approximately 99 percent of this material for alternative disposal. These screens should be installed so that they can be easily removed for cleaning as necessary. These effluent collection methods are not necessarily complete or comprehensive. EPA, state and local requirements should be considered before dumping any effluent.

There are no brushes in the pre-wash system. They are unwarranted since the system performs well without them. More importantly, particulates can collect on a brush and re-deposit on a glass surface, defeating the purpose of the pre-wash.

Use of a pre-wash system provides a debris-free glass surface for subsequent line washer cleaning.

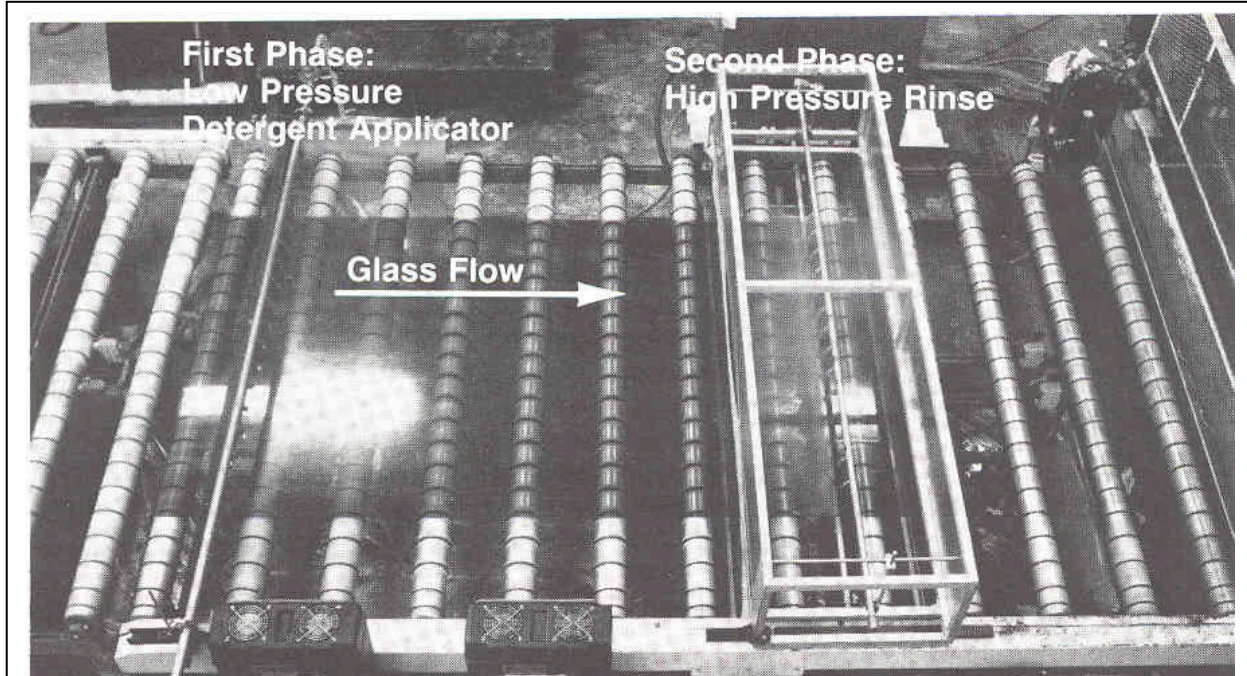


Figure 5 – Pre-wash System in Operation. Detergent Application and High Pressure Rinse sections. Distance between detergent and rinse sections is for clarity only; they can be as little as two feet apart.

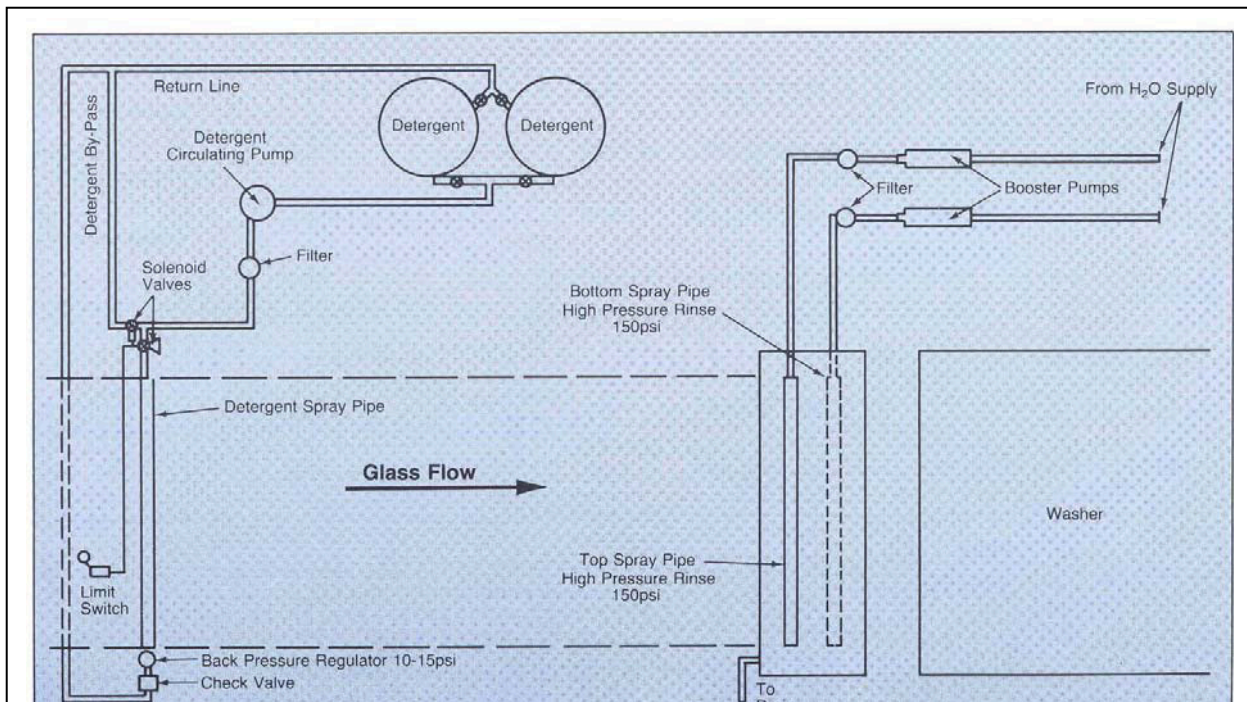


Figure 6 – Schematic of Pre-Wash System

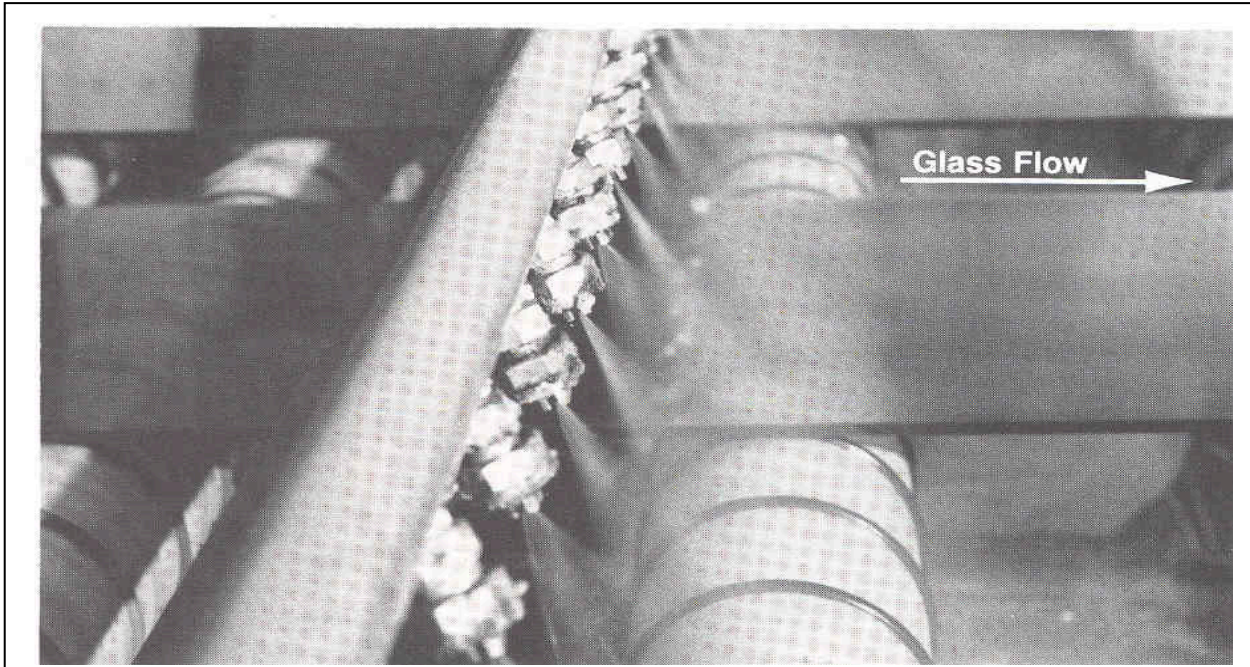


Figure 7 – Close-up of Low Pressure Detergent Application

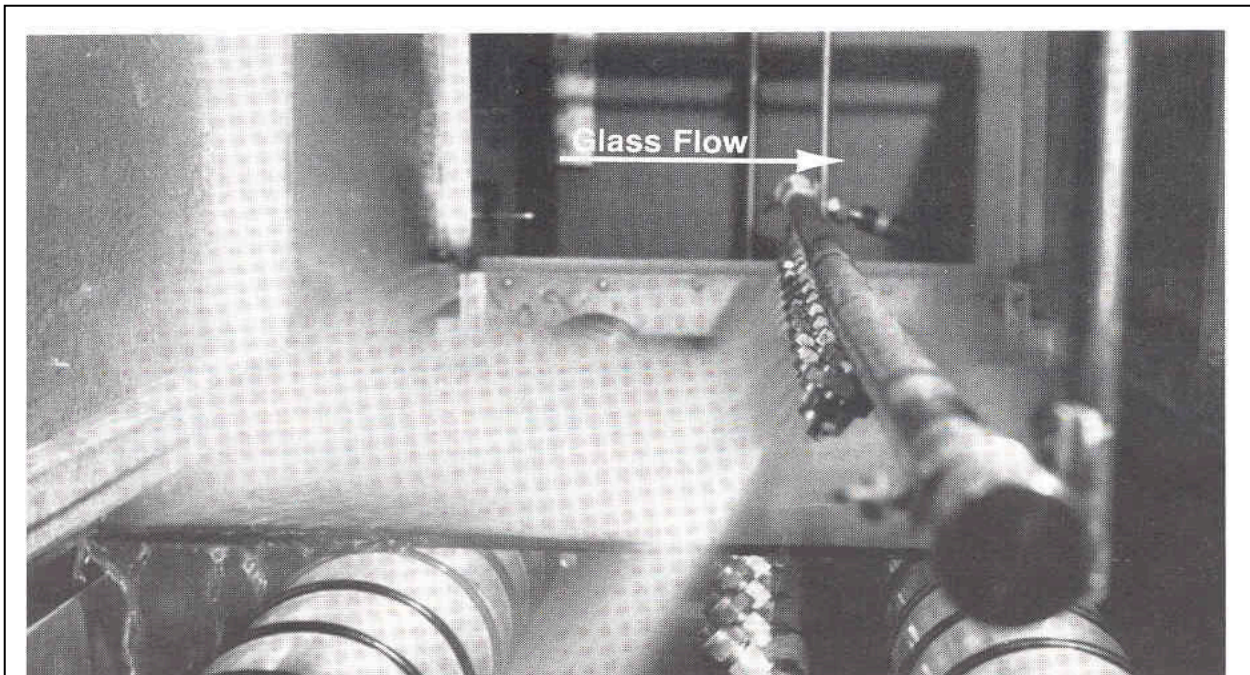


Figure 8- High Pressure Section of the Pre-Wash System



RECOMMENDATIONS FOR PRE-WASH AND WASHER SYSTEM MAINTENANCE

Routine maintenance of all washing system components is essential for providing optimum glass cleanliness. While some maintenance functions will be performed on a demand basis, others should be scheduled periodically or in response to production volume.

Pre-wash

PPG's recommended pre-wash system requires only three basic maintenance procedures:

1. Filter cartridges on detergent solution and high pressure water lines must be changed whenever exhausted. Filter replacement frequency is based on several parameters, including supplier recommended pressure differential across filter sumps, visual filter inspection, or as dictated by production experience.
2. Occasional cleaning or replacement of blocked or corroded nozzles may be required; a visual system inspection will generally reveal the need. If nozzles are not stainless steel, a general system pressure drop may occur after prolonged production. This pressure change could indicate aperture corrosion or enlargement.
3. For a pre-wash system using re-circulating high pressure rinse water, holding tanks must be drained and rinsed at least every 24 hours.

Main Line Washer

Note:

The best source for maintenance requirements and procedures is from your equipment manufacturer. PPG offers the following recommendations in good faith and in an effort to provide some useful information, NOT as a replacement for the equipment manufacturer's recommendations.

Daily

- Replenish the detergent and rinsing tanks with fresh solution and water
- Rinse out inline filters (Replace as necessary)
- Check rubber rollers and ensure that they are free of dirt and oil
- Check spray pipes to ensure that they are not clogged

Weekly

- Replace air filters in the airknife blower unit
- Clean the spray pipe nozzles
- Clean airknife slots
- Lubricate necessary components per manufacturer's guidelines. Avoid lubricant contact with pinch rolls

Monthly

- Clean all water pipes with a wire brush
- Thoroughly inspect all moving parts
- Completely clean the washer, inside and out, with a high pressure washer.



If production problems occur that seem related to glass cleanliness, an unscheduled check of some or all of these system parameters may be indicated. In addition, a quick reference to the following troubleshooting guide may prove helpful.

TROUBLESHOOTING GUIDE

There are a variety of washer associated cleaning defects that can be readily resolved by taking appropriate corrective action.

The guide shown on p. 16 is provided as a convenient reference for locating potential causes of observed washer system-related defects. Although this guide is based on PPG's experience and is offered in good faith, it is only a guide. PPG cannot accept any responsibility for its effectiveness in solving specific individual glass washer problems. PPG recommends that the guide be used to supplement the manufacturer's instructions for washer operation.

When production rejects occur, an effort should be made to examine glass that has passed through the line washer, but has not yet experienced further processing. If this examination reveals any of the glass conditions listed below, the corresponding potential causes should be investigated. This procedure should identify those production problems originating in the washing section of the processing line. Since abnormal surface conditions on incoming glass (i.e., stain or corrosion) will also be discerned in this examination, these have been included in the list of potential causes.



General Troubleshooting Guide

Observed Glass Condition	Primary Potential Causes	Key
Washing has failed to remove spots/streaks of dirt visible on glass as received	d, g, j, k, o, p, r, w	a - Air Knife: poor alignment insufficient air velocity b - Air Knife: dirty filters and/or ductwork c - Air Knife: conveyors stopped while glass under blowers d - Brushes: dirty, poor contact, non-uniformly worn, losing bristles e - Conveyor Rolls: dirty f - Conveyor Loading: glass too close together g - Conveyor Speed: too fast h - Detergent: too much being used i - Detergent: solubility/rinsing inappropriate for water conditions j - Detergent: substandard cleaning capability k - Detergent – none in use l - Detergent: contains de-foaming agent m - Detergent: recent change to new detergent causing release of accumulated dirt (scale) n - Filters (Pre-wash, Washer, Air Knife): expended, wrong size, or not in place o - Nozzles (Pre-wash, Washer, Rinse): blocked or corroded Resulting in insufficient water Volume or velocity p - Organic solvent pre-cleaning necessary to remove water insoluble contaminants q - Particulate contamination of washer system r - Reaction contaminant dirt on glass requiring alternative cleaning procedures s - Rinse Water Quality: high turbidity or hard water salts content t - Rinse Water Temperature: too cold u - Rinse Water Volume: insufficient v - Solution Hold Tanks (Pre-wash or Washer): dirty, scrubbing and/or steam cleaning needed w - Stained (corroded) glass x - Water in Pre-wash: dirty from prolonged re-circulation
Surface scratches	e, k, n, o, q	
Washing has deposited particulate contaminants on the glass surfaces	b, d, e, h, I, m, n, o q, s, t, u	
Water droplets on surface(s)	a, f, g, t	
Spot defects on surface(s)	a, b, e, f, g, h, I k, l, m, n, o, p, r, s, t, u, v, w, x	
Surface streaks that are random in occurrence and orientation	a, b, c, h, i, k, l, m, n, o, p, r, s, t, u, v, w, x	
Relatively uniform surface streaks oriented parallel to direction of glass travel	b, d, e, o, s, u	
Surface streaks oriented perpendicular to direction of glass travel	c, e, f	
Visible film or haze over glass surface(s) or subsurface(s) exhibiting poor wetting/adhesion indicative of an invisible surface film	b, d, h, I, j, k, l, m, n, o, s, t, u, v, w, x	



PRECAUTIONS FOR WASHING COATED GLASS PRODUCTS

Coated glass can act differently from uncoated glass in a washing system. Precautions will be necessary when washing coated glass products.

Pyrolytic coated glass, such as PPG Solarcool®, Vistacool®, or Sungate® 500 coated glass incorporate coatings that are “fired” onto the glass surface by a pyrolytic method at elevated temperatures. These products, when cleaned in a washer system as outlined in this document, can be treated in the washer the same as uncoated glass.

Magnetic Sputtered Vacuum Deposition (MSVD) coatings such as PPG *SUNGATE* 100, Solarban® 60, *SOLARBAN* 65, *SOLARBAN* 70, *SOLARBAN* 80, and *SOLARBAN* z50 coated glass are not as durable as pyrolytic coatings. In addition, these coatings involve materials that may be more chemically reactive than pyrolytic coatings.

The following recommendations are offered to aid in the successful washing of MSVD coated glass. While all of the following recommendations are important, those that are in **bold** print are considered critical. And, of course, implementing these recommendations will also improve the efficiency and quality involved with all glass products.

RECOMMENDATIONS FOR WASHING PPG MSVD COATED GLASS

- **Install brushes that have a bristle diameter between 0.006 and 0.009”.** When ordering brushes, specify the actual bristle diameter size; do not simply order “low-e brushes”.
- **Keep washer brushes clean and free of grit and abrasives.**
- Use minimum brush pressure required to provide effective cleaning.
- If a detergent is used, select one that maintains a wash water pH that it is not excessively low or high.
- **Never allow glass to be stopped in a fixed position beneath the washer brushes.**
- **All brushes must have sufficient water flow in order to prevent the brush from scratching the coating.** A “rule of thumb” is to have ¾ GPM per foot of pipe for each pipe within the washer. Flow meters on each header should be installed to monitor the water flow.
- **Keep pinch rolls clean and free of debris such as process labels.**
- **Do not allow washer components, such as splash curtains, to drag on the coated surface.**
- **The total dissolved solids in the final rinse water must be 20ppm or less.**
- If remedial hand-cleaning is necessary, use a solution of 50 -50 demineralized water and isopropyl alcohol and a clean cotton cloth. Patting, rather than rubbing, is recommended to avoid coating damage.
- **Implement a regular and comprehensive preventive maintenance program for the washer.**



GLOSSARY

These definitions pertain to the words as they are used in this document.

Adhesion Chips – chips of glass bonded to the glass surface

Alkaline – having the properties of an alkali: capable of neutralizing an acid. Having a pH greater than 7; also referred to as basic.

Deionize – the process by which ion exchange resins are used to remove hard water salts.

Demineralize – the removal of mineral constituents from water

Esters – any of a class of organic compounds formed by the reaction of an acid with an alcohol

Hardness – the amount of calcium carbonate dissolved in water.

Hermetic Seal – an airtight seal.

Interleaving - a packaging material that is placed between adjacent lites of glass.

pH – a scale of 1 through 14 that designates relative acidity or alkalinity of liquids. 7 is neutral, 1 is the acidic extreme, and 14 is the alkaline extreme.

Paper Interleaving – paper that is used to separate two lites of glass.

Paper Scum – a glass surface residue resulting from the transfer of paper interleaving esters to the glass surface during storage. If this residue is allowed to remain on the glass, reaction with surface alkali may result in formation of permanent reaction contaminants.

Particulates – solid material loosely deposited on a surface. They can be removed by using non-abrasive, mechanical methods such as high pressure water.

Powder Interleaving – granular particles purposely placed on the glass to act as a mechanical separator that may or may not contain acidic compounds to prevent corrosion between lites of glass. Acrylic beads and wood flour are examples.

Reaction Contaminants – residues that have some degree of physical or chemical bonding or interaction with the glass surface. These cannot be removed with practical, standard washing procedures.

Scale - a deposit of mineral compounds present in water.

Softness – the degree to which magnesium and calcium ions have been removed from water.

Solubility – the ability of a substance such as detergent, to dissolve in water.

Surface Corrosion – irreparable, moisture initiated, chemical erosion of a glass surface.

Turbidity – Opaqueness or cloudiness of a liquid caused by suspended particles.



HISTORY TABLE		
ITEM	DATE	DESCRIPTION
TD-144	11/6/2006	Electronic version of "Recommended Techniques for Washing Glass" with minor modifications and additons..

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