



**Glossary of Terms**  
**Abrisa Technologies**  
***Your Single Source Optics Partner!***

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### Acid Etching

This process for the decoration of glass involves the application of hydrofluoric acid to the glass surface. Hydrofluoric acid vapors or baths of hydrofluoric acid salts may be used to give glass a matte, frosted appearance (similar to that obtained by surface sandblasting), as found in lighting glass. Glass designs can be produced by coating the glass with wax and then inscribing the desired pattern through the wax layer. When applied, the acid will corrode the glass but not attack the wax-covered areas.

### Alumina-silicate Glass

Alumina (aluminum oxide  $Al_2O_3$ ) is added to the glass batch in the form of commonly found feldspars containing alkalis in order to help improve chemical resistance and mechanical strength, and to increase viscosity at lower temperatures.

### Angle of Incidence

The angle formed between a ray of light striking a surface and the normal line (the line perpendicular to the surface at that point).

### Annealing

Under natural conditions, the surface of molten glass will cool more rapidly than the center. This results in internal stresses which may cause the glass sheet or object to crack, shatter or even explode some time later. The annealing process is designed to eliminate or limit such stresses by submitting the glass to strictly controlled cooling in a special oven known as a "lehr". Inside the lehr, the glass is allowed to cool to a temperature known as the "annealing point". When the glass reaches this point, the lehr temperature is stabilized for a specific length of time (depending on the glass type, its thickness, its coefficient of expansion and the amount of residual stress required) to allow stresses present in the glass to relax. This phase is followed by a period of cooling with a pre-defined temperature gradient.

### Anti-Fog Coating

A coating applied to glass that provides a non-fogging surface, it is an opaque, aqueous solution – hydrophilic and hydrophobic coatings fall into this category.

### Anti-Glare Glass

Anti-glare glass is manufactured via an acid etch process providing for uniform diffusion. Varying levels of can be specified for reducing levels of reduced glare. A lower gloss reading denotes a more diffuse panel. The more diffuse the panel surface, the more glare reduction it provides.  $60^\circ$  is the highest level of etching which provides the least amount of glare and reflectivity while  $140^\circ$  is the lowest gloss level and is the closest to untreated glass.

### Anti-Reflective (AR) Glass

Anti-reflective glass is created by bonding specially selected optically designed coatings to the surface of the glass. The coating bonds to the surface of the glass cutting the surface reflectivity from approximately 4% to less than 0.1% in some cases. The purpose is reflection reduction, improving brightness or sharpening image contrast. A/R coatings can be specified on one or two sides.

### Armor Plate Glass

Laminated glass, resistant to mechanical shock, composed of at least four panes of glass and usually at least 25 mm thick.

### Arris Edge Treatment

A flat polished edge with polished chamfers.

### B 270®

Manufactured by SCHOTT, B 270® is an ultra-clear crown glass with high transmittance, and a crystal-like appearance. Available in thicknesses of 0.9mm to 10mm.

### BBAR Coating

BBAR refers to high efficiency broadband anti-reflective coating. It improves light transmission while mitigating ghosting.

### **Band Pass Filter**

A band pass filter transmits varying wavelength bands determined by two cutoff wavelengths. A band pass filter can be made at any given wavelength from near ultraviolet UV to near IR infrared.

### **Beam Splitter**

A beam splitter is an optical device that splits a beam of light in two. In its most common form, a cube made from two triangular glass prisms that are glued together at their base.

### **Beveling**

The production, by abrasion, of a sloping edge on the glass sheet. Commonly used on mirror glass.

### **Blackeye Filter**

A unique IR filter that consists of a two piece optically coated substrate designed to block the visible output of a light source from as close as 3 feet. Suited for night vision equipment, CCD cameras for short and long surveillance applications.

### **Blocking Filter**

A blocking filter is used to manage or minimize UV or ultraviolet light exposure.

### **Borofloat®**

Borofloat is a floated borosilicate glass manufactured by SCHOTT®. It has excellent flatness with outstanding thermal, optical, chemical and mechanical features. Borofloat offers excellent light transmission in the visible wavelength range. Its high transparency in the near IR and UV range also means that BOROFLOAT® is the perfect specialty glass for high precision components and solutions used in the fields of optics, photonics and opto-electronics.

### **Borosilicate Glass**

This glass all contains Boron as a component material. It is characterized by its resistance to heat, chemicals, and specific coefficients of thermal expansion. Borofloat® is a registered name for a type of borosilicate glass.

### **Broadband AR Coating**

A Transparent conductive coating anti-reflective that improves optical throughput and reduces stray light noise while providing low reflectance.

### **Bubbles**

Gaseous inclusions in the glass melt which are removed by refining. Fining agents are introduced to encourage the formation of larger bubbles which rise more rapidly to the surface of the melt, attracting smaller bubbles on their way. Larger bubbles which are not removed by fining are known as "blisters", smaller ones as "seeds" and longitudinally stretched bubbles as "air-lines". Bubbles in glass are generally considered as defects but may also be intentionally created and used as a form of decoration.

### **Bulletproof Glass**

Armor plate glass which is more than 60 mm thick and which resists penetration by bullets.

### **Bullnose Edge**

An edge treatment with a full radius curve where the diameter matches the thickness of the glass. Similar to a pencil edge. Can be specified as a half or full bullnose.

### **Bus Bar**

A bus bar is a thick strip of silver, chrome-nickel-gold, or silver epoxy that conducts electricity. Bus bars are used to carry very large currents, or to distribute current to multiple devices within switchgear or equipment.

### **Ceramic Glass**

This glass is mechanically very strong material with almost no expansion or contraction when exposed to repeated and quick temperature changes, even up to 800-1000° C. Besides common uses such as Corning Ware® and ceramic stove tops, ceramic glass is used in electronics and sensors applications.

### **Cerium Oxide**

The oxide of the rare earth, cerium, used alone or together with other substances as a polishing agent for glass.

### **Chamfer**

A ground beveled edge on an optic. Used to prevent chipping and/or to allow mechanical fit.

### **Chemical Strengthening**

This type of glass strengthening increases the thermal and mechanical strengths of glass without affecting the optical properties. This method is appropriate for thin glass, complex shaped parts or where minimal optical or mechanical distortion is desired. It is strengthened through an ion exchange process and produces up to 5 times the strength of annealed glass. Glass strengthened by this process will not "dice".

### **CleanVue™ PRO**

CleanVue™ PRO is a series of protective, repelling and oleophobic products that are optical abrasion resistant coatings that repel dirt, dust, water, grease and oil to enhance display glass performance and longevity.

### **Coating**

A thin layer which covers the surface of an object. Coatings may be applied to glass in order to alter the appearance or performance of the product in question e.g. anti-reflective coatings applied to auto mirrors to aid vision, coatings with photo-catalytic and hydrophilic properties to make self-cleaning windows.

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### **Cold Mirror**

A cold mirror reflects visible energy and transmits the infrared (heat energy). Cold mirror coatings are vacuum deposited multi-layer dielectric films that can operate in temperatures of  $\geq 400^{\circ}\text{C}$  and are durable and easy-to-clean.

### **Color Correction Filter**

Color correction filters alter the overall color of light to achieve a specific color and sometimes to obtain a specific color temperature. Color correction filters have the advantage of reflecting unwanted light instead of absorbing the energy. The color filter glass can be provided in polished and unpolished versions and can be thermally strengthened as well. Additionally, the filter glass can have a range of thin film coatings applied such as AR or UV.

### **Conductive Coating**

A glass coating which is electrically conductive. Conductive coatings have been used to produce frost-free windshield, and in a range of electro-optical applications.

### **Covert Filter**

This filter enables light sources and imaging devices to emit and receive IR energy while absorbing visible light.

### **Cut-off Filter**

Cut-off filters are often referred to as IR filters or heat-absorbing filters and reflect or block mid-infrared wavelengths while passing visible light.

### Cutting

The technique whereby glass is removed from the surface of an object by grinding it with a rotating wheel made of stone, wood, or metal, and an abrasive suspended in liquid.

### D 263®

SCHOTT D263 is a colorless thin borosilicate glass with low alkali content produced with extremely pure raw materials making it highly chemical resistant. It is produced in a special draw process that results in excellent surface quality that can be coated without any post-process surface work.

### Dark Mirror

A front surface dark mirror design is one for which the reflectance is intended to be very low when viewed from the side coated. In contrast a back surface dark mirror design is intended to be viewed through the glass substrate. It is helpful to remember that a front surface dark mirror may be moderately or highly reflective when viewed from the back surface. And similarly a back surface dark mirror design may be quite reflective when viewed from the front surface.

### Diamond Tool

Natural and synthetic diamonds are used on drills, saws, cutting wheels, abrasive discs and belts. The higher cutting rates achievable than with previous tools have stimulated the development of very precise, high-speed machinery. A constant flow of coolant is required to avoid the diamonds burning out and to wash away glass particles which build up on the working surface of the tool.

### Diamond Wheels

Abrasive tools coated with diamond powder, used for a range of operations including grinding, milling, sawing, drilling, edging, and polishing.

### Dichroic Filters

Dichroic filters are most commonly 1.75mm, coated on Borofloat® glass, and useful when high heat resistance is required. Color filters can be heat treated up to 152mm diameter for additional heat resistance. These work by blocking out certain color wavelengths of light. Both type of filters can help control temperature, enhance or change light colors. These filters are used mainly in lighting applications.

### Dielectric Coating

High-reflectance or low-reflectance coating composed of alternating layers of non-conducting inorganic materials with higher and lower indices of refraction than the substrate. Generally produced via electron beam gun, resistive heating or sputtered evaporation (deposition).

### Dimensional Tolerance

This is described as the amount of variation a piece of cut glass may have from the specification. This tolerance will depend upon the thickness of the glass, the cutting method performed, and the accuracy of the system performing the operation.

### Dragontrail™ Glass

Dragontrail is manufactured by Asahi Glass Corporation. It is an ultra-thin glass that is scratch resistant, crack resistant, and is chemically strengthened via a high ion-exchange process.

### Drawn Glass

A process for making sheet glass by drawing the molten glass as a sheet directly from the furnace. The thickness of the glass is determined by the drawing rate.

### Dual Notch Filter

A type of color correcting filter that improves Color Rendering Index (CRI) for output from a metal halide arc lamp.

### **Duran®**

SCHOTT Duran® is general-purpose borosilicate glass tubing. Duran® has identical chemical and thermal properties as Schott's Borofloat® 33, as it is made from the same material. Duran's high resistance to chemicals and heat makes it ideal for laboratory glassware.

### **Eagle XG®**

Corning® Eagle XG® is a borosilicate glass specifically designed for high performance LCD's. It is considered environmentally friendly as it contains no heavy metals (arsenic, antimony, barium, or halides). The glass also features high surface quality, excellent thermal properties, low density, and high resistance to chemicals.

### **Edge Chips**

An edge chip is defined as a flaw or blemish in the glass caused by processing and handling. The flaw will not cause the glass to break or fail. Edge chip requirements adhere to the [Abrisa Technologies inspection standard AS1001](#).

Chip depth – measured from the face of the glass into the thickness

Chip width – perpendicular distance from the edge of the glass to the inner edge of the chip

Chip length – distance parallel to the edge of the glass from one edge of the chip to another

### **Edging**

The shaping or finishing of the edges of a glass surface, usually by grinding with an abrasive wheel.

### **Fabricated Glass**

This describes the customization of glass for the OEM market. It could include strengthening, coatings, machining, cutting, edging, surface grinding, polishing, specialty packaging.

### **Fire-Resisting Glass**

Flat glass with a wire inlay which helps retard shattering in the event of fire and thus delays the spread of smoke and flames. Such glazing is classified as class G (which resists fire and prevents the spread of smoke and flames for specified periods of time) or class F (which has the characteristics of class G but also impedes the spreading of radiant heat for specified periods). New developments include pre-stressed wire-free borosilicate glass and double glazing with the inner space filled with an intumescent material which acts as a heat shield.

### **Firing**

The process of bringing a glass furnace up to its operational temperature and then maintaining the temperature.

### **First Surface Mirror**

A first surface mirror is a mirror with the reflective surface above a backing as opposed to a second surface or conventional mirror with the reflective surface behind a transparent substrate such as glass. First surface mirrors are used in applications where there can be no ghosting effect.

### **Flat Glass**

All types of glass (rolled, float, plate, etc.) produced in a flat form, regardless of the method of production.

### **Float Glass**

Float glass is a name for common window or plate glass. It is named float glass because the most common method for producing glass is using molten tin, where the molten glass floats on top of the tin, thus giving the name "float glass". It is graded to meet specific applications from commercial to optical quality.

### **Float Process**

A method for the production of high-quality sheet glass whereby a ribbon of molten glass is fed across a bath of heated liquid, usually molten tin, in a carefully controlled atmosphere.

### **Frit**

Batch material that is melted with other materials and then ground into powder form before being added to the batch. Lead oxide, which can produce harmful dust, may be melted with silica, for example, and then ground down as a lead silicate.

### **Frit Ink**

Frit is a durable, temperature resistant ink that is composed of glass and ceramic particles. The composition of frit helps the adhesion of the ink to the glass, which is tempered onto a substrate at high temperatures, thus making it more abrasion resistant.

### **Front Surface Mirror**

This is a special glass with a mirror coating on the front surface of the glass. These can meet specific reflectivity, flatness, thickness requirements. Additional coatings such as anti-reflective coatings may also be applied. These mirrors are primarily used in rear projection display applications, television, photography, as well as special applications in the optical field.

### **Frosting**

The process of giving a glass surface a matte finish, thus reducing transparency. Frosting may be done by a means of acid treatment (pouring hydrofluoric acid onto the glass), sandblasting, special glue applications and subsequent removal, or mechanical etching with a grinding wheel.

### **Furnace**

An enclosed structure for the production and application of heat. In glassmaking, furnaces are used for melting the batch, maintaining pots of glass in a molten state, and reheating partly formed objects at the glory hole.

### **Fused Silica/Quartz**

A single-component glass ( $\text{SiO}_2$ ) with very low thermal expansion, great thermal stability and very high ultraviolet transmission. The glass is expensive and difficult to produce since it has to be melted at  $2,000^\circ\text{C}$ .

### **Fusing**

(1) The process of founding or melting the batch; (2) heating pieces of glass in a kiln or furnace until they bond; (3) heating enameled glass until the enamel bonds with the surface of the object.

### **Fusing Glass-to-Glass**

Glasses of different compositions can be fused together for decorative purposes and also in the sealing of electrical, medical, and industrial components. The fusion temperature for soda-lime glasses is generally between  $760^\circ\text{C}$  and  $820^\circ\text{C}$ . Particular attention must be paid to the thermal expansion coefficients of different glass types.

### **Glass**

A homogeneous material with a random, liquid-like (non-crystalline) molecular structure. The manufacturing process requires that raw materials be heated to a temperature sufficient to produce a completely used melt, which, when cooled rapidly, becomes rigid without crystalizing.

### **Glass/Ceramics**

Materials produced from glass that have a polycrystalline structure. Most offer advantages of low thermal expansion, making them suitable for uses such as cookware. Others have high physical strength and can be machined like metals.

### **Glass Coating**

Glass coatings provide added features and benefits to glass. There are standard coatings as well as custom coatings. Each coating has specific characteristics which must be matched to the glass substrate and the desired end result.

### **Gorilla® Glass**

Corning® Gorilla® Glass is an environmentally friendly alkali-aluminosilicate thin sheet glass. Its superior composition allows a deeper layer of chemical strengthening than is possible with most other chemically strengthened glasses, making it durable and damage resistant.

### **Gray Glass**

Gray glass is a tinted soda lime glass that is primarily used to restrict or reduce light transmission (transfer) as well as for decorative applications. Gray glass can be specified in various transmission ranges depending upon the amount of visible light desired to be passed or restricted. The lower the transmission value, the darker the tint and the least amount of transmission.

### **Grinding**

The removal of glass with abrasives or abrasive (grinding) wheels in order to shape, polish, or otherwise finish both flat and hollow glass. Grinding processes include milling, sawing, edging, and drilling.

### **Heat Resistant Glass**

Glass which has a low coefficient of expansion and which is therefore less liable to thermal shock. Borosilicate glass is the most common type of heat resistant glass.

### **Hot Mirror and Cold Mirror**

Hot Mirrors reflect UV light while allowing visible light to be transmitted. Common uses are lighting in museum displays, store windows, light sources where UV standards are specified.

Cold Mirrors reflect greater than 95% of visible light while transmitting 90% of the infrared light (heat energy). Common uses are movie projectors, photo copiers, dental illuminators.

### **Hydrophobic Coatings**

Hydrophobic coatings are "water averse" these coatings bond with the glass to create a barrier against dirt, repelling dust, grease and liquid. The hydrophobic coating will not optically change the glass plate. It is extremely durable water repellent that not only repels water, but any other undesirable matter, including salt spray.

### **Hydrophilic Coatings**

Hydrophilic coatings are "water loving" these coatings reduce distortion on optics by interacting positively with water, causing condensates to spread uniformly over the surface of the coated glass; sheeting water rather than forming droplets that scatter light.

### **Infrared (IR)**

The long wavelength invisible portion of the electromagnetic spectrum between ~2.5  $\mu\text{m}$  and 14.0  $\mu\text{m}$ .

### **Ion-Exchange Strengthening**

The principle on which the chemical pre-stressing of glass is based. Through ion exchange, the surface composition of the glass can be modified without altering the glasses inner structure. In a molten salt bath (of potassium, for example), larger alkali ions take the place of smaller ions (sodium, for example) in the glass surface. The resulting compression of the larger ions leads to greater toughening of the glass than is possible by thermal strengthening. Glass thus treated is used in particular in the aircraft industry and other sectors where safety is all-important.

### **Industrial Glass**

This term describes glass fabrications supporting the industrial market sector. Some of the industrial applications include fabricated glass for: ATM machines, warehouse inventory barcode readers, mobile tracking units, bio-medical tools, security lighting, night vision products, and touch screens.

### **Index-Matched Indium Tin Oxide (IMITO)**

Index-Matched ITO coatings provide a combination of low resistivity and extra transmission in the visible spectrum (400-700 nm) within an average transmittance of 94%.



**Indium Tin Oxide (ITO)**

ITO is a solid solution of indium (III) oxide ( $\text{In}_2\text{O}_3$ ) and tin (IV) oxide ( $\text{SnO}_2$ ), typically 90%  $\text{In}_2\text{O}_3$ , 10%  $\text{SnO}_2$  by weight. It is transparent and colorless in thin layers while in bulk form it is yellowish to grey. In the infrared region of the spectrum it is a metal-like mirror. Indium tin oxide is one of the most widely used transparent conducting oxides because of its two chief properties, because of its electrical conductivity and optical transparency, as well as the ease with which it can be deposited as a thin film. Thin films of indium tin oxide are most commonly deposited on surfaces by electron beam evaporation, physical vapor deposition, or a range of sputter deposition techniques.

**IR Filter**

IR or heat-absorbing filters reflect or block mid-infrared wavelengths while passing visible light.

**Laminated Glass**

Laminated (or compound) glass consists of two or more sheets of glass with one or more viscous plastic layers "sandwiched" between the glass panes. The solid joining of the glasses takes place in a pressurized vessel called an autoclave. In the autoclave, under simultaneous heating of the already processed layers of glass and special plastic, lamination occurs. When laminated safety glass breaks, the pieces remain attached to the internal plastic layer and the glass remains transparent.

**Long Pass Filter**

A long pass (LP) Filter is an optical interference or colored glass filter that attenuates shorter wavelengths and transmits (passes) longer wavelengths over the active range of the target spectrum (ultraviolet, visible, or infrared). Long pass filters, which can have a very sharp slope (referred to as edge filters), are described by the cut-on wavelength at 50 percent of peak transmission.

**Low Emissivity Glass**

Commonly known as "low-E" glass and often used in double and triple glazing units, this window glass has a special thin-film metallic or oxide coating which allows the passage of short-wave solar energy into a building but prevents long-wave energy produced by heating systems and lighting from escaping outside. Low-E glass thus allows light to enter while also providing thermal insulation.

**Minus Filter**

Also known as a notch filter; blocks a relatively narrow band of wavelengths between shorter and longer pass bands.

**Multi-Layer Coating**

Coating made up of several layers of materials with alternating high and low refractive indices. Varying combinations will produce a variety of coating properties.

**Near Infrared (NIR)**

The short wavelength violet to invisible portion of the electromagnetic spectrum between ~400 nm and ~200 nm.

**Non-Glare Glass**

Non-glare glass is specified when the goal is to reduce the percentage of reflected light. To achieve this, the surface of the glass is chemically etched to break up reflection patterns and scatter reflected light. Glare reduction can be specified on either single or double surfaces. It is available in several quality and etching levels: from picture frame quality to display quality, and from 1- to 140 gloss units.

**Notch Filter**

Also known as a minus filter; notch filters block a relatively narrow band of wavelengths between shorter and longer pass bands.

**Oleophilic**

Having an affinity for oils and not for water – "oil attracting"

### Optical Coatings

This coating is a thin layer of material placed on a glass lens or mirror which alters the way light passes through, or is reflected off the glass. Precision optical coatings are used in applications requiring high quality light and image transmission, such as medical imaging, instrumentation, microscopy and such. The following are some of these types of coatings:

- **Anti-reflective:** for glare reduction, improved transmission
- **Anti-fog:** for reducing moisture build-up on glass
- **Bandpass Filters:** Transmission of specific wavelengths of lightwaves for a specific end result. Can be a shortpass or longpass filter.
- **Cold Mirrors:** Transmit IR and block some or all visible light. This filter is useful in applications to block heat transmission.
- **Colored Filters:** allow only certain wavelengths to pass through glass
- **Conductive/Anti-static:** light transmission with <20 ohms of receptivity
- **Front or First Surface Mirrors:** for image projection
- **Heat Absorption or IR:** blocks IR, but passes visible light
- **Heat Reflection:** Hot Mirrors, Infrared (IR) blocking filter
- **ITO:** provides light transmission of approximately 89% with <20 ohms of resistivity
- **UV filters:** controls the transmission of UV light.

### Optical Glass

Glass is termed "Optical Glass" when its properties are conducive to applications requiring high quality light transmission, and is pure and clear in appearance. This includes all applications concerned with the quality of imaging.

### Optical Window

Typically flat polished glass or fused silica materials. Generally used for view ports or sealing and or protecting other components within an optical assembly, instrument or laser.

### Plate Glass

Flat glass made by the casting or rolling of molten glass which is then mechanically ground and polished to produce a smooth and transparent sheet.

### Polishing

Smoothing the surface of an object when it is cold by holding it against a rotating wheel fed with a fine abrasive. Glass can also be polished with hand-held tools

### Polishing Wheels

Traditionally made of wood or bristle and more recently of cork, polyurethane and bonded cloth, these discs are used in conjunction with abrasive pastes to polish glass surfaces. Felt wheels with materials such as cerium oxide and other commercially-produced powders are now widely used for fine polishing. In the polishing process, the wheel is rotated at speed by means of a motor and applied to the glass to be polished.

### Precision Glass

This is a high-technology glass that lighter, lower-density with advanced attributes and superior surface quality. The surfaces are clean, ultra-flat, and dimensionally stable. Common applications are leading edge displays, instrumentation, gauges, heavy equipment monitors and displays.

### Pyran®

Manufactured by SCHOTT, Pyran® is a transparent ceramic glass that is fire-protection rated and is available in a thickness of 5mm.

### Quartz/Fused Silica

These two types of glasses are virtually identical but have different methods of manufacture and slightly different material properties. They are used in applications where high ultraviolet light transmission, good thermal stability, or chemical inertness is required. Advances in raw material beneficiation permit transparent fusions from sand as well as from crystal. When naturally occurring crystalline silica (sand or rock) is melted, the material is called fused quartz. When silicon dioxide is synthetically derived, the material is referred to as synthetic fused silica. These materials can withstand temperatures to 1093° C. Abrisa Technologies offers several grades of Quartz and Fused Silica.

### Reflection

The return of light from a surface with no change in its wavelength(s).

### Refractive Index

A standard of measurement used particularly to establish the qualities of optical glass. The index is the ratio of the sine of the angle of incidence of a ray of light to the sine of the angle of refraction (the change in direction when a ray of light passes from one medium to another) by the glass. The second medium normally used to establish the index is a vacuum.

### Robax®

Manufactured by SCHOTT, Robax® is a transparent ceramic glass with exceptional heat resistance and good optical transmission. Block UV.

### Rolled Glass

Rolled (or cast) glass is a translucent glass with 50-80% light transmission, depending on its thickness and type of surface. It is used where transparency of the glass sheet is not important or not desired. To produce rolled glass, molten glass pours from the melting tank over a refractory barrier (the "weir") and onto the machine slab where it flows under a refractory gate (the "tweel"), which regulates the volume of glass, and then between two water-cooled rollers. The distance between the rollers determines the thickness of the glass.

### Safety Glass

Glass which does not disintegrate into sharp and potentially dangerous splinters when it is broken. Safety glass may be produced by laminating or by tempering.

### Sandblasting

A method for giving glass surfaces a matt finish either for decoration or to reduce transparency. The method was invented in 1870 by an American, Benjamin C. Tilghman, who is thought to have been inspired by the effect of sand being blown against windows on the American prairies. Compressed air forces the abrasive material through the nozzle of a sandblasting gun and onto the glass surface. Although sand can be used, more effective abrasives with less toxic effects are now available. Silicon carbide is commonly used, as is electro-corundum (aluminum oxide). The glass is normally placed inside a special cabinet with arm holes, a viewing window and dust extraction facilities.

### Sawing

The cutting and shaping of glass using a diamond blade mounted on a motorized saw .

### Screen Printing

A process for the decoration of glass whereby colored ink is forced by a flexible "squeegee" through a fine-mesh screen, or "mask", (traditionally made of silk, now also made of nylon, polyester and stainless steel) onto the glass surface. A separate mask is used for the application of each color. Considerable automation of the process has been developed, thus allowing extremely high printing speeds for even complex designs.

### Short Pass Filter

An SP filter or short pass filter is an optical interference or colored glass filter that attenuates longer wavelengths and transmits (passes) shorter wavelengths over the active range of the target spectrum (usually the ultraviolet and visible region).

### Soda Lime Glass

The most common type of industrially produced glass. A typical soda-lime glass is composed of silica (71-75%), soda (12-16%) and lime (10-15%), plus small amounts of other materials to provide particular properties such as color.

### Sputtering

The process in which, by passing an electric current through an ionized gas and thus bombarding the surface of a metal cathode with ions, atoms of the desired metal are vaporized and then deposited in a thin film on the surface of glass.

### Surface Quality

A specification of allowable flaws in the surface of an optic indicated by a number such as 60/40, 80/50, or 120/80. The first number referred to is the scratch number and quantifies defects of a scratch which is defined as any linear "tearing" of the surface of the glass. The scratch number refers to the width of the reference scratch. The second number is the dig number and indicates round defects such as pits and dents. Digs are defined by their diameter. Scratch/Dig numbers for surface quality conform to Abrisatechnologies inspection standard AS1001D.

### Technical Glass

This term describes sheet glass and flat glass with good optical properties and high thermal resistance. This glass is appropriate for optical coatings, electronic displays and components, sensor technology, biotechnology uses, and harsh environments.

### Tempered Glass

This is a method of strengthening glass when small shards or "dicing" is required when the glass is broken. Heat tempering will cause some optical distortion.

### Thin Glass

This glass is a clear technical glass made of very pure raw ingredients, and is characterized by low thermal expansion and thermal resistivity, good chemical resistance, high surface quality, good optical transmission, and flatness.

### Toughening

Special process of solidification of a glass sheet in order to make it particularly resistant to breakages. The process may be physical (thermal) or chemical. In the former, the glass sheet is heated to a temperature just below its softening point and then immediately cooled by special jets of cold-air. These harden the surface of the glass, giving the inside more time to cool. This allows the external layer to crystallize into a wider lattice while the inside solidifies with greater compression than in the crystal lattice. The result is a sheet of glass which is two or three times stronger than untempered glass and which, upon breakage, shatters into tiny pieces with blunt edges (the most common applications are for automotive glass). The chemical process, on the other hand, is based on the so-called ion-stuffing technique. Different chemical elements possess different ionic radii and therefore different densities. Hence, if glass containing sodium is cooled slowly in a salt bath of molten potassium, the sodium ions will migrate from the glass to the salt, while the potassium ions will move to the surface of the glass where, due to their wider radius, they create a denser and therefore stronger surface layer (of no less than 0.1 mm). Glass sheets which have been chemically tempered are five to eight times stronger than those which have not undergone any tempering process.

### Transmittance

The admission of light into a medium with passage of this light through the medium without reflection back to the source or absorption in the medium.

### **Tubing**

Made of borosilicate glass, tubing and rods can be cut to the required shape and size. Abrisa carries the entire SCHOTT line of tubing and rods

### **Ultraviolet (UV)**

The short wavelength violet to invisible portion of the electromagnetic spectrum between ~400 nm and ~200 nm.

### **Ultra-violet Absorbing Float Glass**

Ultra-violet radiation is absorbed by normal glass. Where ultra-violet transmission is required, quartz glass is used.

### **UV Filter**

UV filters manage and prevent ultraviolet (UV) light from passing to prevent damage from too much exposure to UV rays.

### **Vapor Deposition of Thin Films**

The term covers a wide range of techniques for applying a thin film on the surface of the glass to change its technical or aesthetic properties e.g. scratch resistance, solar control. The methods employed to deposit the film include spraying onto hot glass, condensation in a vacuum and evaporation of the film material by heating.

### **Visible (VIS)**

The region of the electromagnetic spectrum that can be seen by the human eye. Generally considered to be the ~400 nm to ~700 nm wavelength portion of the spectrum.

### **Wafers**

A wafer is a thin slice of semiconducting glass material, upon which microcircuits are constructed by combining various materials. Wafers are of key importance in the fabrication of semiconductor devices such as integrated circuits, and appropriate for micro optical products. Wafers are custom manufactured by size and thickness for each application.

### **Wavelength**

The physical distance that light travels in one wave cycle. All electromagnetic energy is transmitted (or travels) in waves.

### **Willow® Glass**

Manufactured by Corning®, Willow® Glass is an alkali-free borosilicate thin glass that is available in sheets or rolls, and is inherently flexible. The glass can be processed at temperatures up to 500° C. Glass is extremely strong, excellent choice for displays.