Glass Production Market

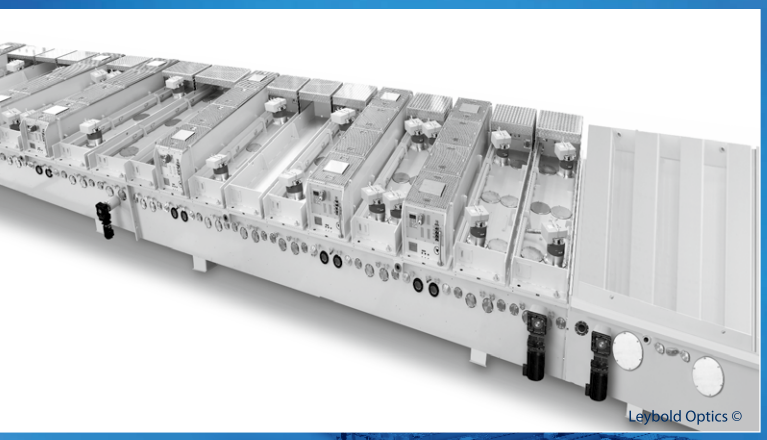
Mass flow and pressure measurement and control

Bronkhorst®

An introduction to Bronkhorst High-Tech

Bronkhorst High-Tech BV, the European leader in Thermal Mass Flow Meters / Controllers and Electronic Pressure Controllers, has many years experience in designing and manufacturing precise and reliable measurement and control devices. With the widest range of instruments available on the market Bronkhorst offers innovative solutions for many different applications across a great many different markets. Our instruments are manufactured to customer specifications with models that are suitable for use in Laboratory, Industrial and Hazardous Area environments. In addition, the company provides tailor-made, complete fluid control solutions for O.E.M. systems. Bronkhorst has a wealth of knowledge and an enviable world-wide reputation within the glass production market. In this leaflet we will illustrate that by presenting some typical applications.

Process Gas Flow Control in Glass Coating Systems



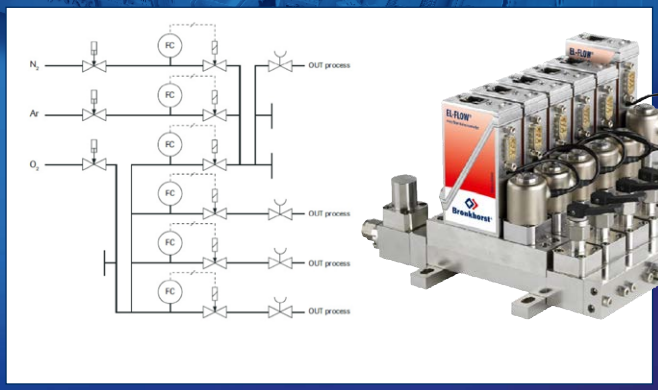
In line coating machine for architectural glass.

Glass coatings are made for modifying optical properties of glass, to improve solar transmission characteristics or just for changing its aesthetic appearance. Whether for solar and energetic control or architectural purposes only, glass coating is a very demanding process.

Superior layer uniformity, high yields and reduced cost of ownership are among the demands of the Glass Coating Industry. By individually controlling process gas segments, film thickness uniformity improvements are achieved. Additionally, if the control is made by instruments capable of securing a stable flow profile, reproducibility and fast response time, optimal performance can be reached. In order to reduce the cost of ownership, instruments must be reliable and endure working 24 hours a day, 7 days a week.

Sputtering is a physical vapor deposition **(PVD)** process which involves bombarding the surface of the coating material (target) with gas ions under high voltage acceleration, in order to promote the ejection of atoms from the target. The ejected atoms will be propelled towards the substrate, forming a thin-film coating over its surface. Plasma Enhanced PVD, like magnetron sputtering, is considered to be the most efficient technology. For this process an inert gas is required: Argon is the most commonly used, however some sputtering processes may involve oxide or nitride film coatings; if so O_2 and/or N_2 are added to the inert sputtering gas.

According to its nature, the process requires low pressures. Nevertheless, the process gas flow must be sufficient for allowing the ionic bombardment process to take place, otherwise it becomes impossible to maintain the plasma. Hence, the process gas flow must be meticulously controlled. If not, the quality and optimal homogeneity of the coating may be severely compromised. Due to its unique proportional electromagnetic control valve, Bronkhorst High-Tech mass flow controllers are ideal for this application. The instruments allow simultaneously an extremely fast and smooth control, providing excellent stability and repeatability.



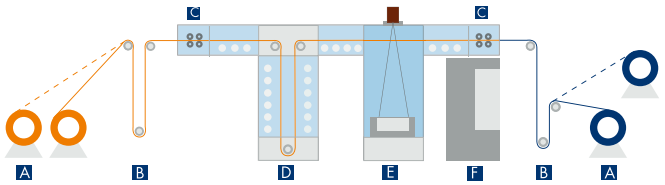
For attaining thin-film coatings compliant with the highest quality standards the process gas system must be capable of providing superior layer uniformities. Easy maintenance is also a major concern when large area coaters are involved. Bronkhorst fully understands the Glass Coating Industry's demands and has therefore developed sophisticated solutions specially address ed to meet the demands of state of the art large area glass coating applications.

Absorber Coating for Thermal Solar Collectors

Solar energy use is playing an increasingly important role in meeting the energy needs of the industrial and domestic sectors. Today, thermal solar collectors are an indispensable technology for producing hot water and providing support for building heating systems. However, the share of renewable energy sources is also increasing with respect to process heat generation in industry or thermal power generation.

A highly selective absorber coating is required in order for modern thermal solar collectors to work effectively. The absorber layer is built up in the form of a thin optical-gradient layer system with radiation-selective properties expressed in the form of a high level of solar absorption and low level of thermal emissions.

Selective absorber layers are predominantly produced using the physical vacuum-coating process **(PVD)**, which enables efficient layers of a consistently high quality to be deposited over a large area in continuous industrial processes. The process is environmentally friendly (no emission of harmful gases or chemicals) and uses energy and raw materials efficiently which also makes it cost-effective. Layers with long-term stability can be produced for the various types of collector systems.
Industrial **air-to-air** strip coating mills enable the continuous coating of metal strips during the through-feed process and can be used to produce absorbers which meet the most exacting demands for efficiency, resistance and aesthetic quality.



Decoiler/coiler	A	Abwickler/Aufwickler	Sputter compartment	D	Sputterkammer
Band storage	B	Bandspeicher	EB evaporation compartment	E	EB Verdampferkammer
Roller lock chambre	C	Rollenschleuse	Control station	F	Leitstand

Schematic representation of an air-to-air strip coating mill.
*(Diagram provided by BlueTec GmbH & Co. KG **www.bluetec.eu**).*

During the production of highly selective absorber coatings by means of **physical vapour deposition (PVD)**, the method of magnetic field-based **cathode sputtering (magnetron sputtering)** is used. The metal substrate, usually a copper or aluminium strip between 0.1 mm and 0.5 mm thick, is removed from the atmosphere and fed into the coating chamber via a differential roller lock system and, after coating, it is fed out again via a similar type of system. The difference in pressure between the atmosphere and the working pressure in the coating chamber is reduced during a series of pressure stages. Another **PVD process** used to produce highly selective absorber coatings, particularly the dielectric anti-reflection coating, is **electron beam evaporation**. During this process, the energy required for the evaporation of the coating material in the high vacuum is provided by means of bundled electron beams. The kinetic energy from the accelerated electrons is converted into thermal energy with a high degree of efficiency at the point of impingement on the material to be evaporated. Even refractory elements such as titanium or chromium can be evaporated using this method. **CERMETs (CERamic METal components)** and dielectric layers can be produced by adding reactive gases or through the direct evaporation of ceramic metals.

Dielectric layers can also be produced using plasma-activated **CVD processes (PECVD)** during which plasma is generated using medium-frequency or microwave generators and deposition results from the dissociation of molecules in the plasma containing a layer component such as organosilicate or amorphous hydrocarbon depositions from a mixture of methane and argon.

During the coating process, gas is supplied by Bronkhorst® mass flow controllers.

Bronkhorst® products used in glass production and glass coating

- Mass flow and (differential) pressure meters and controllers
- CEM liquid dosing system with controlled evaporation
- CORI-FLOW™ high-precision mass flow meters/controllers for liquids and gases

Why not take advantage of our many years of experience and let us help you find a solution to your problems? We would be pleased to provide you with advice.

Assured quality of gas burners

To realize burner control via mass flow controllers has many advantages. In conventional systems the flow rate is set "by eye" using needle valves. If nozzles clog or when the gas pressure fluctuates in the supply lines, this should be detected and corrected using revised valve settings. This will result in an uneven process quality.

Mass flow controllers provide an absolutely constant burner flame and immediately and automatically compensate for pressure and temperature fluctuations. Even in case of impact pressure increase in the burner, the gas flow will be corrected.

Due to the possibility of connection to higher-level controllers (eg PLC), it is possible to switch products and to use automatically preset burner settings on recipes. By recording the measured and controlled flows, quality assurance and documentation of the production line is guaranteed at all times.

Bronkhorst® has extensive experience with burner applications, for instance in the fabrication of lighting systems, and offers a number of unique solutions for this market such as control valves that can cope with very low pressure differences and compact, customized gas control modules for burner gas control.

Gas mixer MFC with flame arrestor.

Industrial burner control

Bronkhorst offers **Mass-Stream™** series mass flow meters with external motor regulated valves to control high flows up to 5000 ln/min of Air (equivalent). The control valve is mechanically and electrically connected to the flow meter. No additional external power supply is needed.

The electronics with the control motor can be stripped and replaced while the valve remains in its mounted position within the application.

The valve stays in position when power line fails.

In glass burner control applications customers need to maintain the gas supply even in case of complete power failures to avoid expensive oven shut-downs etc.
These applications often do not need a very high control speed from 'fully closed' to 'fully open' due to 365 days - 24 hour steady continuous process so the control speed is sufficient in comparison to direct operated valves. These control valves are not shut-off valves and they are not 100% gastight. The valves are available in two variations for standard gases and Oxygen. The pressure rating goes up to 16 bar (g).

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