

ELECTRIC BOOSTING

& ELECTRODE HOLDERS

HORN
GLASS INDUSTRIES

innovation
ENGINEERED IN GERMANY

ELECTRIC BOOSTING SYSTEMS

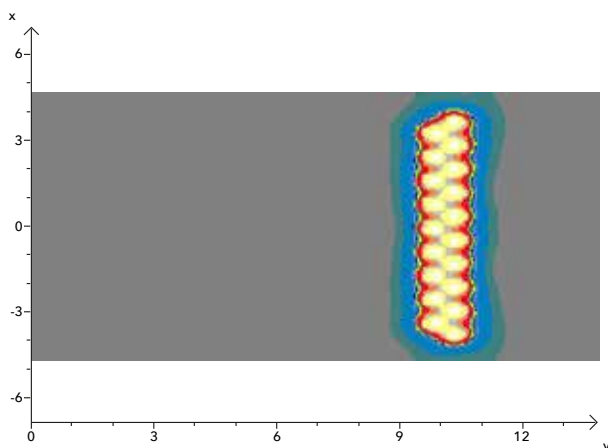
Electric furnace boosting systems have been effectively installed within the glass industry since 1970. With its boosting systems, HORN® provides different boosting applications to meet challenging demands during the glass melting process. The individual electric boosting systems are tailor-made for each furnace regarding the required effect on the melting process. Each boosting system is unique and contributes to the most efficient and flexible operation of the furnace.

Generally, the furnace is designed for an input of additional electric energy to melt up to 20% of the total output. Due to economic reasons a percentage of approximately 10% is regarded as appropriate. However, it depends largely on the required effect of the electric energy on the melting process.

At the beginning of each project, HORN® analyses the purpose of the boosting in detail with the customer and provides different solutions to optimise the furnace in terms of economical and ecological conditions. In addition, HORN® applies the latest technical aids as well as its comprehensive experience in boosting systems. The effect of the boosting system can be simulated on computers using modern software before starting with the detailed planning and manufacturing of the equipment.

HORN® electric boosting systems fulfil the highest requirements:

- Increased melting output of the aggregate
- Improved glass quality
- More efficient utilisation of fossil energy sources
- Emissions reduction



Barrier boosting

- More stable and flexible production
- Accelerated re-melting processes for colour changes
- Quicker change between the different products

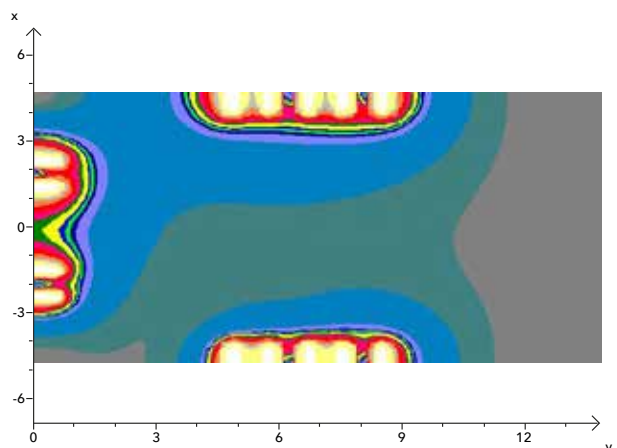
HORN® provides individual and tailor-made boosting systems:

- Melting boosting with side or bottom electrodes
- Barrier boosting
- Refining boosting
- Throat boosting
- Feeder boosting

Using state of the art machinery, HORN® manufactures most of the parts in workshops in-house with high quality primary materials.

The HORN® electric boosting system is a complete stand-alone system ready for operation and consists of:

- Electrodes and water-cooled electrode holders along with accessories, e.g. piping and cables
- Transformer units, e.g. single-, two-, or three-phase aggregates or thyristor controlled transformers
- Fully automatic instrumentation and control system
- Power and control cables
- Cooling water cycle with flow control station



Melting boosting with side electrodes

TRANSFORMERS

Two types of transformers can be used: oil-cooled regulation transformers or dry thyristor controlled transformers.

OIL-COOLED REGULATION TRANSFORMER

Regulation transformers are an elegant solution with a continuous tap on the secondary side, which can cover a voltage range as required.

The secondary side phases can either be adjusted individually or all three phases together. The advantage of the regulation transformer is the clean sinusoidal voltage curve over the entire control range.

The transformer is equipped with a Buchholz relay. If a short-circuit occurs in the transformer winding, the development of gas due to overpressure causes tripping of the relay and thus, an immediate shutdown.

A temperature sensor frequently monitors the temperature of the transformer. This process is part of the furnace safety cycle. The power unit is turned off if high temperature is attained in the transformer.

The transformer is housed to protect it against heat and dangerous electric voltage. The transformer is either built into a room intended for this purpose or must be sealed off with mesh.



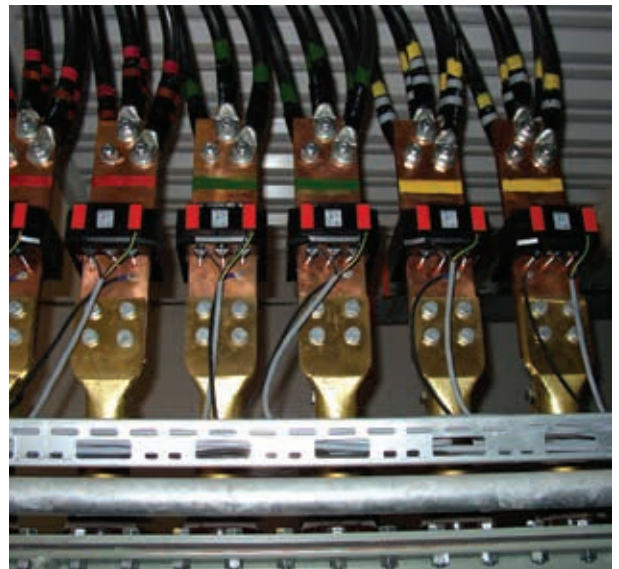
Coolant fins / radiators

DRY TRANSFORMER, THYRISTOR CONTROLLED

The dry transformers are used for both small boosting units (refiner boosting, throat boosting) and multiple zone thyristor controlled boosting systems as melting boosting and barrier. For high boosting capacities, a sophisticated thyristor solution with E-Power-Load tap changer is possible in order to reach high efficiency and reduce the influence on the network.

Using dry transformers with thyristor controllers has the following advantages:

- No oil cooling required
- Reduced cabling / busbar costs
- Fully solid-state design without any moving parts
- Less maintenance required
- High efficiency due to high voltage but low current flow in the system



Transformer terminals

Each transformer is monitored regarding temperature. This monitoring is integrated in the safety cycle of the

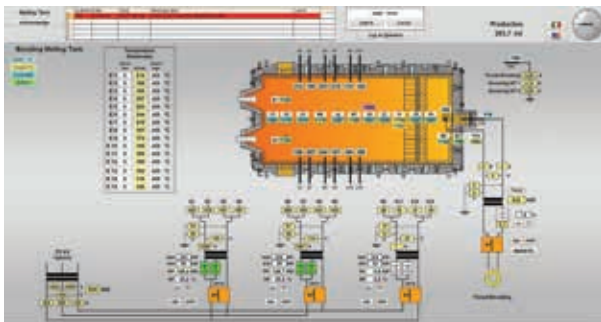


Thyristor controlled transformer

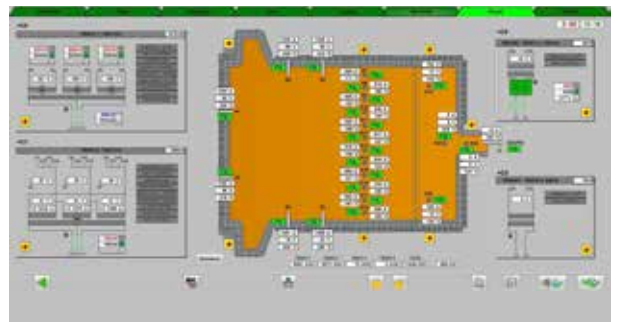
control system. The power unit is turned off if a high temperature is attained in the transformer.



Three phase regulation transformer



Thyristor controlled boosting system



Three phase controlled boosting system

INSTRUMENTATION

& CONTROL SYSTEM

Due to specially selected measuring and controlling instruments, the entire plant can be monitored. The main values are displayed on the front of the control panels.

The system consists of:

- Control of transformer
- Capacity measuring and counting
- Current measuring of each single electrode
- Voltage measuring
- Control of cooling water plant
- Protecting and signalling plant

CABLING

Single-wire copper cables are used from the secondary side transformer clamps to each single electrode. The transition between cable and electrode is enabled by a short busbar and a flexible copper connection to the electrode connecting clip.

FACTS ABOUT BOOSTING

- **Increased melting output and stabilisation of glass flow**
- **Reduced emissions**
- **Increased glass quality**
- **Retroactive installation in melting ends already operating**
- **Prevention of critical situations in case of pull change**
- **Constant furnace temperatures**



HORN® manufactures the main components of its boosting systems in its own workshops, thereby guaranteeing the highest quality standards. With many years of experience from numerous installations, HORN® uses computer modelling to establish the optimal dimensions and positioning of the boosting system, and offers tailor-made solutions with either regulation transformers or thyristor controlled transformers.

COOLING WATER CYCLE

A monitored cooling water cycle per electrode prevents the overheating of the electrode holder. Therefore, a cooling water circuit is installed around and beneath the furnace. The cooling water is distributed to each electrode holder from a cooling water flow control station. The flow volume to each electrode holder can be adjusted by a manual control valve installed at the inlet pipe of the holder. The water outlet of the electrode holder is directed back to the cooling water circuit via a flow control instrument and bimetal thermometer. Thus, each electrode jacket is monitored in terms of flow and temperature.



ELECTRODES

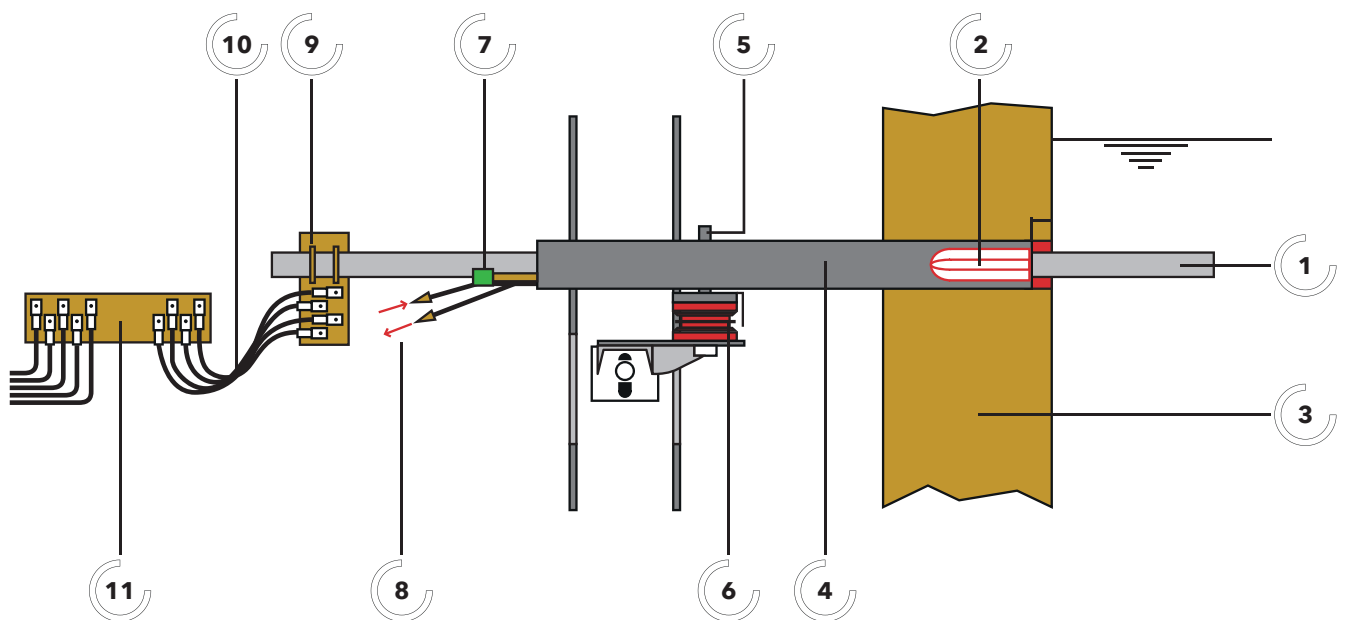
& ELECTRODE HOLDERS

Reliable and high-quality electrode holders are the basis for the safe operation of a boosting system. HORN® offers electrode holders for molybdenum electrodes.

For side wall or bottom installation, HORN® provides molybdenum electrode holders made of special heat-resistant steel. The front end of the holder is cooled by means of a special water channelling system which avoids local overheating of the holder and features a long life cycle.

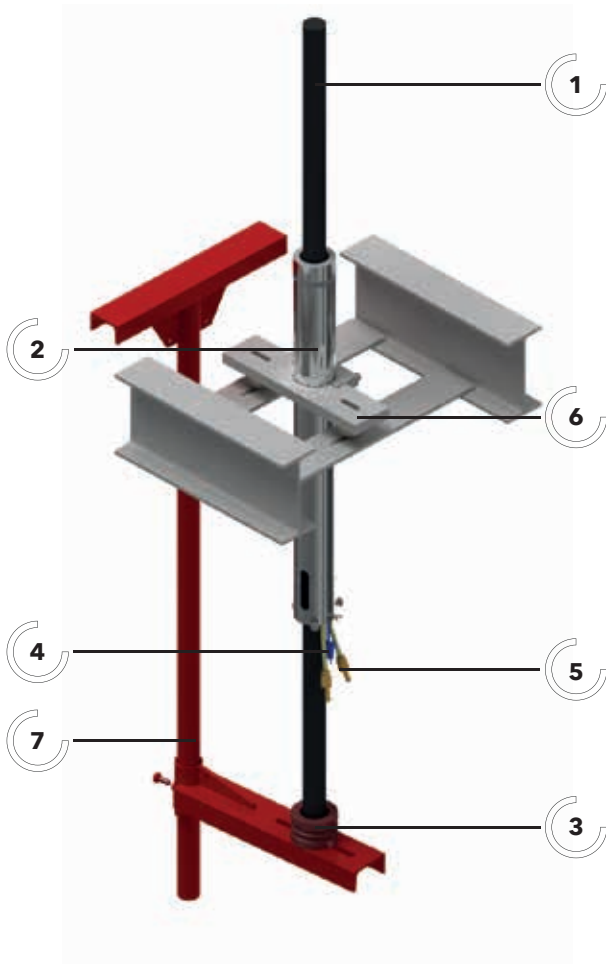
Each holder is equipped with two cooling water connections, one for forward and one for back flow. The connections can be turned on and off separately.

In order to increase operational safety, a thermocouple for temperature observation is integrated in the electrode holder head. The temperature must be constantly monitored.



SIDE ELECTRODE HOLDERS

1. Molybdenum electrode
2. Cooling cycle (within the electrode holder)
3. Refractory material
4. Electrode holder
5. Electrode holder support
6. Insulator
7. Thermocouple type K
8. Cooling water connections
9. Electrode connection clamp
10. Flexible cable set
11. Copper bus bar



BOTTOM ELECTRODE HOLDERS

1. Molybdenum electrode
2. Electrode holder
3. Insulator
4. Thermocouple type K
5. Cooling water connections
6. Bottom electrode holder support
7. Fixing bottom installation

FACTS

- Long life due to precise manufacturing
- Use of high-quality materials
- Special cooling water channelling system in the electrode holder head
- Full service - installation also possible during operation
- Manufacturing in own workshops, guaranteeing highest quality standards



Bottom electrode holders

HOLDER / MOLYBDENUM	TYPE	INNER Ø	OUTER Ø
31.75 mm / 1 ¼"	Throat and earth	34 mm	65 mm
48.0 mm	Furnace	52 mm	82.55 mm
50.8 mm / 2"	Furnace	55 mm	90 mm
63.5 mm / 2,5"	Furnace	70 mm	105 mm
76.2 mm / 3"	Furnace	80 mm	117 mm
45.0 mm	Forehearth		

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The key to HORN®'s extensive expertise in all fields of glass melting technology is the profound understanding of each detail within the entire process, making HORN® the specialist for technological progress and innovation for each aspect of a glass plant. In addition to its knowhow about individual elements such as furnaces, HORN® has expanded its services to become a one-stop supplier for turn-key plants. From initial planning to full operation - HORN® stands by you all the way.



**PLANNING +
ENGINEERING**



MANUFACTURING



**SERVICE /
INSTALLATION +
SUPPORT**



**LET'S GO
FULL CIRCLE.**

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04/2020