

ELECTRIC BOOSTING

& ELECTRODE HOLDERS

innovation
ENGINEERED IN GERMANY

HORN
GLASS INDUSTRIES

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. It does, however, depend largely upon the required effect of the electric energy on the melting process.

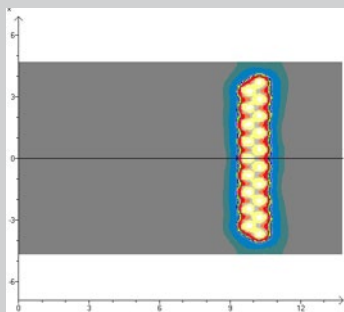
At the beginning of each project, HORN analyses the purpose of the boosting in detail with the customer and provides different solutions to optimise the furnace in terms of economical and ecological conditions. In addition, HORN applies the latest technical aids as well as its comprehensive experience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

HORN electric boosting systems fulfil the highest requirements:

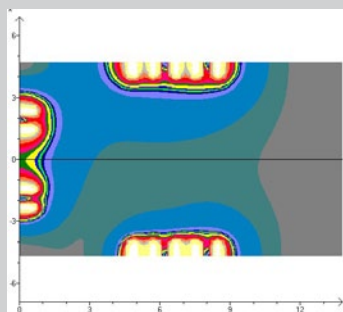
- Increased melting output of the aggregate
- Improved glass quality
- More efficient utilization of fossil energy sources
- Emissions reduction
- More stable and flexible production
- Accelerated re-melting processes for colour changes
- Quicker change between the different products

HORN provides individual and tailor-made boosting systems:

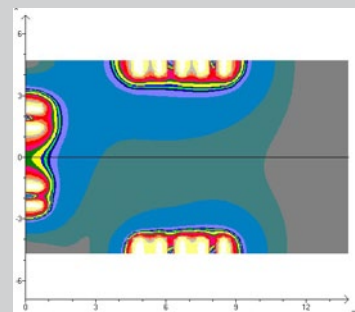
- Melting boosting with side or bottom electrodes
- Thermal barrier boosting
- Refining boosting
- Throat boosting
- Feeder boosting



Thermal barrier boosting



Melting boosting with side electrodes



Melting boosting and barrier boosting with bottom electrodes

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



TRANSFORMERS

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

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.

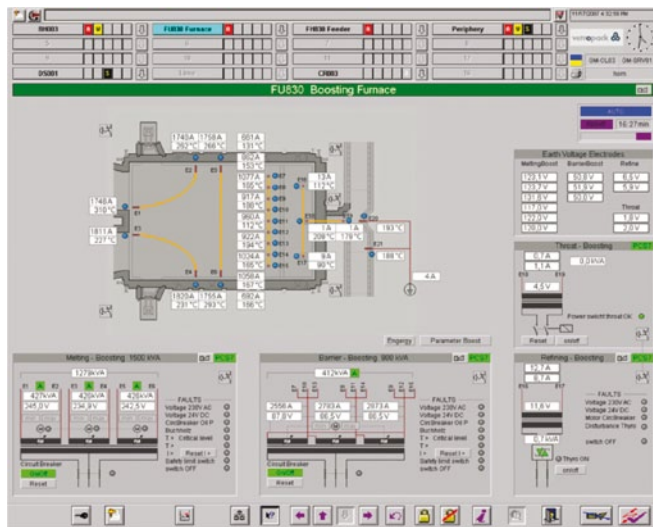
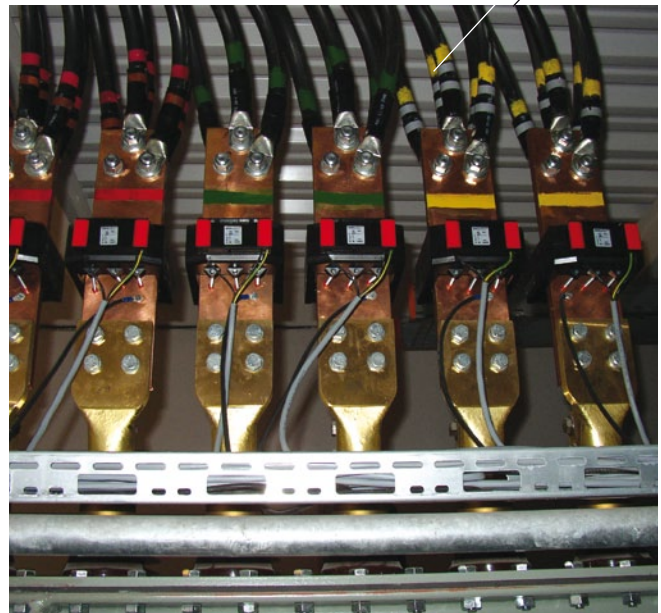
The transformer is housed to protect it against heat and dangerous electric voltage. The transformer is either built into a room intended for this purpose or must be sealed off with mesh.



1

2

1. Coolant fins / radiators
2. Transformer terminals



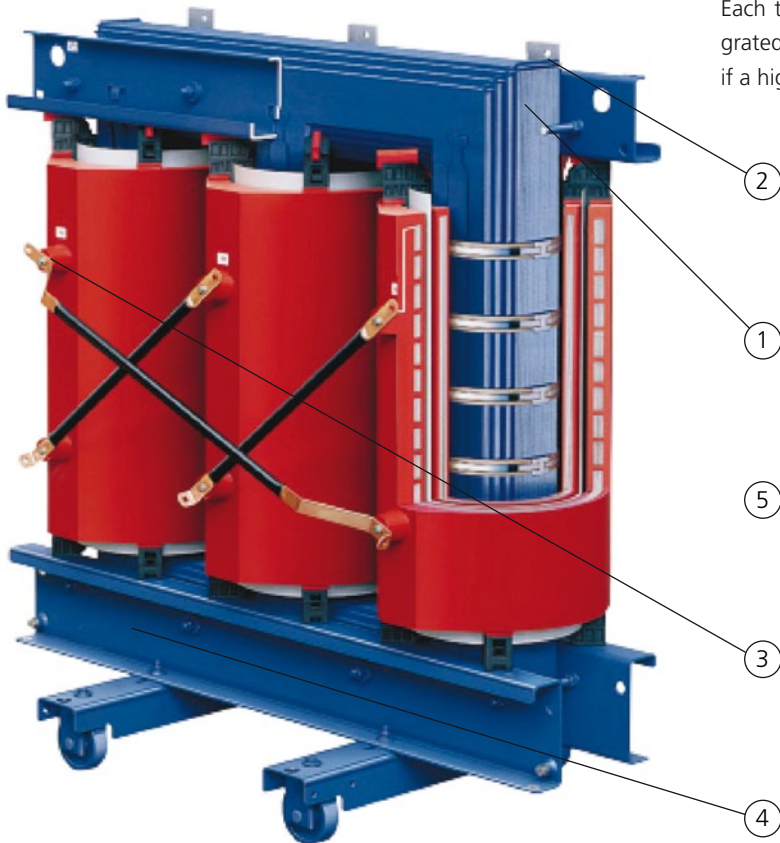
Side wall melting boosting and barrier boosting with regulation transformer

Dry transformer, thyristor controlled

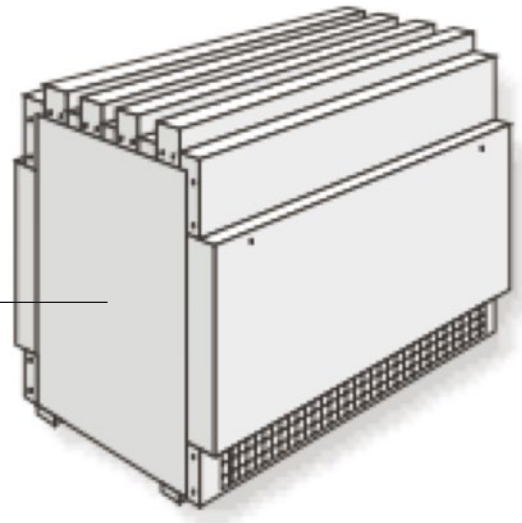
The dry transformers are used for both small boosting units (refiner boosting, throat boosting) and multiple zone thyristor controlled boosting systems as melting boosting. For high boosting capacities, a sophisticated thyristor solution with E-Power-Load tap changer is possible in order to reach high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

Using dry transformers with thyristor controllers has the following advantages:

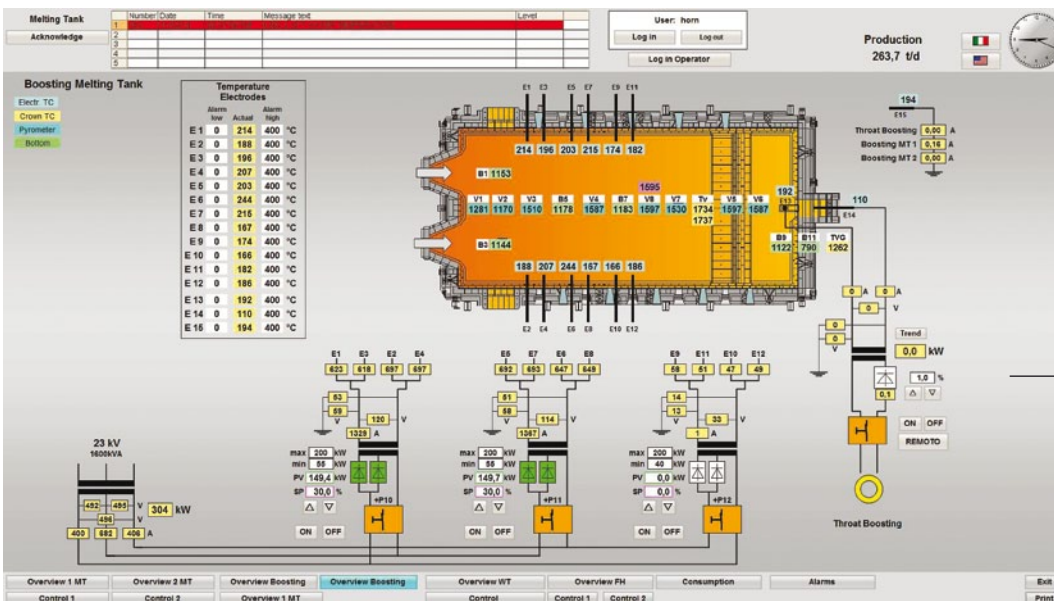
- No oil cooling is required
- Reduced cabling / busbar costs
- Fully solid-state design without any moving parts
- Less maintenance required
- High efficiency due to high voltage but low current flow in the system



Each transformer is temperature-controlled; such monitoring is integrated in the safety cycle of the furnace. The power unit is turned off if a high temperature is attained in the transformer.



The transformer is housed to protect it against heat and dangerous electric voltage.



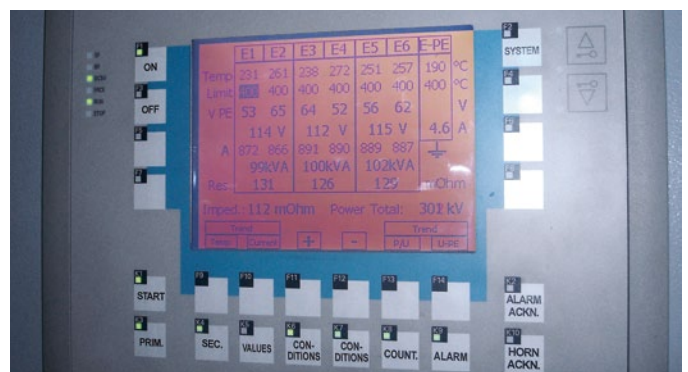
1. Three-legged core
2. US ports
3. OS ports
4. Press frame and chassis
5. Housing
6. Thyristor controlled boosting system

INSTRUMENTATION AND CONTROL SYSTEM

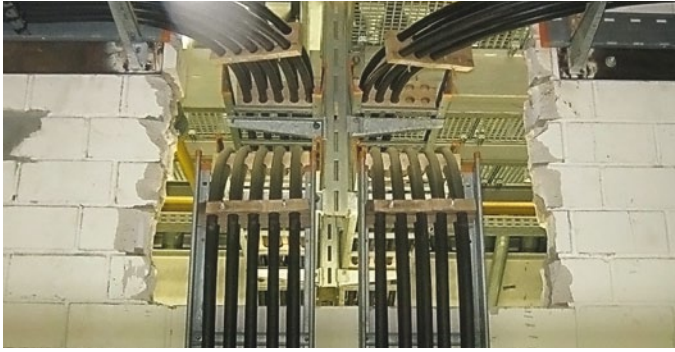
The total control of the plant is possible, thanks to specially selected measuring and controlling instruments. The main values are displayed on the front of the control panels.

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 signaling plant



CABLING



From the secondary side transformer clamps single-wire copper cables are used 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:

- Increased melting output and stabilization 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
- Individual solutions with regulation transformer or thyristor controlled transformer
- Manufacture of main components in HORN's own workshops, guaranteeing highest quality standards
- Many years of experience from numerous installations
- Computer modelling – establishing optimum dimensions and positioning of the boosting system

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. From a cooling water flow control cabinet the cooling water is distributed to each of the electrodes. The flow volume to each electrode 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.



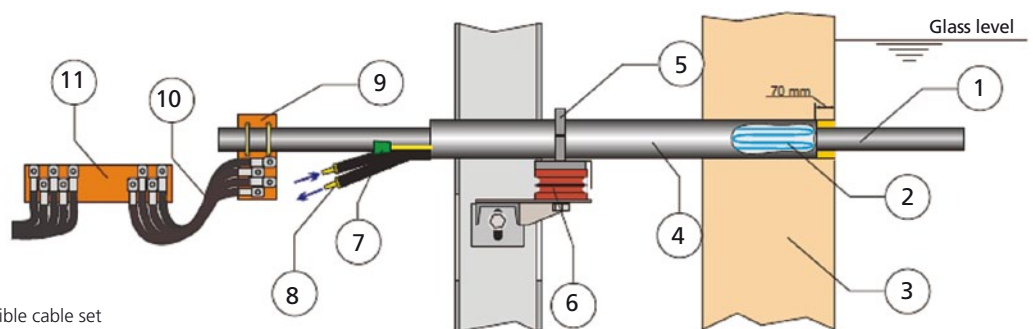
ELECTRODES & ELECTRODE HOLDERS

Reliable and high-quality electrode holders are the basis for safe operation of a boosting system. HORN offers electrode holders for molybdenum and for tin oxide 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 channeling system which avoids local overheating of the holder and features a long life cycle.

Side Electrode Holders

1. Molybdenum electrode 2"
2. Cooling cycle (within the electrode holder)
3. Refractory material
4. Electrode holder 2"
5. Terminal for electrode
6. Insulator
7. Thermocouple type K
8. Cooling water connections 1/4"
9. Electrode terminal
10. Flexible cable set
11. Terminal bus

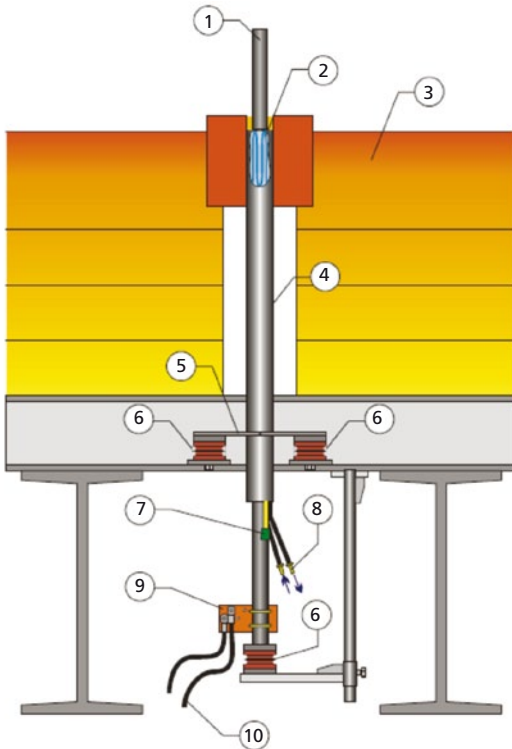


Each holder is equipped with two cooling water connections, one for forward and one for back flow. The connections can be turned on and off separately.

In order to increase operational safety, a thermocouple for temperature control is integrated in the electrode holder head. The temperature must be constantly monitored and may not exceed 650°C.

Bottom Electrode Holders

1. Molybdenum electrode 2"
2. Cooling cycle (within the electrode holder)
3. Refractory material
4. Electrode holder 2"
5. Terminal for electrode
6. Insulator
7. Thermocouple type K
8. Cooling water connections ¼"
9. Terminal bus for electrodes
10. Flexible cable set



Bottom electrode holder



Side holder with protection housing

Electrode Ø	Type	Molybdenum Ø	inner Ø	outer Ø	Refractory Ø
1 ¼"	Throat and earth	31,75 mm	34 mm	65 mm	68 mm
1 ¼"	Throat and earth	31,75 mm	34 mm	65 mm	68 mm
2"	Furnace	50,8 mm	55 mm	90 mm	93 mm
2 ½"	Furnace	63,5 mm	70 mm	105 mm	108 mm
3"	Furnace	76,2 mm	80 mm	115 mm	118 mm
n/a	Forehearth	45,0 mm	n/a	n/a	60 mm



Facts:

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

HORN also supplies adjustable tin oxide electrode holders with a special adjusting mechanism. These are used in electric furnaces with excellent results.