Drying and Sterilizing Tunnel HQL Series
The dry heat sterilization process operating with the Laminar Flow principle meets all requirements of the pharmaceutical industry.

In cooperation with leading pharmaceutical companies, an economical process for the sterilization of containers for parenteral drugs was developed which is for industrial use, biologically definable and can be validated. This process has found worldwide acceptance for many years.

Dry heat sterilization by the Laminar Flow principle.

In scientific tests, both in laboratories as well as in standard Bosch sterilizing tunnels, the biological effectiveness of the process was verified with bio-indicators. A variety of containers was used to define their sterilization effects and the de-pyrogenization. This was developed into a logarithmic model stating that under the influence of heat for a defined period of time an initial count of bio-indicators will reduce by a defined value. Premise is a defined temperature progression curve at the sterilization object in a defined time sequence and the control of the biological effect of the heat influence (see diagram, Page 3).
Method of operation with high process security

Method of operation:
Stable and non-stable containers arriving from the washing machine are fed under Laminar Flow into the infeed section of the tunnel and are pre-heated. The containers are sterilized and de-pyro-genized in the heating section and then transferred to the cooling section. At the tunnel outfeed, the containers are bulk-fed onto the infeed belt of the downstream machine.

Validation of sterilizing tunnel by measuring the temperature and inactivation of bio-indicators (spores and pyrogenes) on the sterilization object.

Process validation:
For proof and documentation that the applied process reliably leads to the required results within the specified limits, validation must set in as early as in the stage of product development. When determining the process conditions, the margin later required for process control must be taken into account. The system should be developed in such a way that the process parameters are within meaningful, controllable and reproducible tolerances for future recourse in actual production and qualification to validation results obtained during the developmental stage.

Additional advantages of the LF sterilization process:
- No incorrect temperature readings during heating of sterilization objects in air flow.
- Excellent, uniform heat distribution,
- Possibility to determine, precisely keep and reproduce optimum parameters, without the need for extra safety margins, for various container shapes and glass qualities.
- Inactivation of bio-indicators, use of temperature (energy savings).
- Economical, container-protecting sterilization process.

Published research results on Hot Air LF Sterilization:
- "Validation of Dry Heat Sterilizers" in "Die Pharmazeutische Industrie" 6/1982, by Dr. L. Gail, K. H. Wallhäuser, M. Klavehn,
- "Practice-Oriented Requirements for Temperature Programs for Dry Heat Sterilization" in "Die Pharmazeutische Industrie" 5/1984 by Dr. H. P. Hortig and Dr. L. Gail.

Checking and monitoring facilities:
- Pre-filter monitoring
- Differential pressure indicator for particulate air filters
- Multi-channel recorder for temperature and other process parameters
- Trailing thermocouple for the temperature measuring in the container
- Conveyor belt stop in case of low operating temperature
- Temperature-controlled interlock of the fans
- Protection against overheating for each heating register
HQL 2000 – 3000 – 4000 modular system

The HQL modular system: For each container the appropriate sterilization program.
The various containers sizes and glass qualities mandate individual treatment times for the sterilization and de-pyrogenization process. After scientific acknowledgement of the LF sterilization process and singularly unanimous approval in production application, Bosch developed a modular system for individual applications which includes also a comprehensive program of additional modular assemblies.
The energy-saving air recirculation system

The energy-saving air recirculation system – with Laminar Flow principle.

The choice of tunnel is determined by the size of the containers as well as by the required output. These parameters thus define the configuration of the tunnel with one, two, three or more heating and cooling sections, respectively.

It goes without saying that the HQL tunnels work synchronously in compact lines for the processing of ampoules and other injectables:
- With upstream washing machines for ampoules, cartridges or vials
- With downstream filling and closing machines for ampoules, dental cartridges or vials for injection.

Through a filter, make-up air is fed into the tunnel. Within the tunnel, air, drawn in by fans, feeds in the infeed and cooling section through pre-filters and particulate air filters into the separate zones of the tunnel. By way of the Laminar Flow principle, the air flow is directed vertically onto the containers. Below the conveyor belt, the air is again directed through a recirculation duct to the fan.

Fans serve to take in fresh air for the heating section - Laminar Flow unit. Heating elements in the recirculation duct serve to heat the recirculated air to the preset temperature. Below the particulate air filters are thermal elements with output to a temperature control device and recording.

The cooling section operates with Laminar Flow.

A fan in the cooling section extracts the heated air below the conveyor belt. The exhaust air volume is adjusted automatically. The tunnel is equipped with an automatic excess pressure control in the cooling section.
Special transport system for reliable and gentle through-conveyance even of complicated container shapes

The conveyor system consists of a horizontally revolving conveyor belt with two synchronized side guide belts and is made of stainless steel mesh. It provides friction-free, gentle container conveyance through the operating section. Three different conveyor widths can be supplied. The conveyor system is controlled by the container accumulation at the infeed. Return travel of the belts is enclosed, outside of the operating section.

Conveying system for non-stable containers.
Easy access for service and maintenance.

The heating section is equipped with one or several service doors. Electric heating rods are located at the inside of the doors. All filters are installed without gaskets into low pressure chambers thus facilitating assembly and disassembly.
Optional equipment HQL 2000 – 3000 - 4000

- Container-controlled partition wall
- Air recirculation cooling system with heat exchanger
- Air exhaust system below the tunnel outfeed section
- Fresh air cooling system with refrigerated air connection, air conditioning unit
- Sterilizable cooling section (with hot air)

Other optional equipment (not illustrated):
- Combination with compact line for Aka-septic or Isolator
- Additional thermoelements
- Air flow meter in the cooling section with display unit
- Display of the conveyor speed
- Automatic timer for night mode operation.
- Isokinetic nozzles for particle measuring.
HQL 5000 – for large-volume vials

HQL 5000: The vial sterilizing tunnel from the Bosch HQL modular system. The qualified sterilization program for every container size.

Operating method: Stable and non-stable containers arriving from the washing machine are fed into the infeed section of the tunnel underneath a Laminar Flow unit and then pre-heated. The containers are sterilized and de-pyrogenized in the heating section and then transferred to the cooling section. At the tunnel outfeed, the containers are bulk-fed onto the infeed belt of the downstream machine.
The HQL 5000 transport system

Special transport system for safe and gentle through-conveyance even of complicated container shapes:
The conveyor belt is made of stainless steel mesh. It provides friction-free, gentle container conveyance through the operating section.
The energy-saving air recirculation system – with Laminar Flow principle. The sterilizing tunnel HQL 5000 is designed for larger size vials. Functionally and with regard to all advantages it corresponds to the high technical standards of Bosch to the HQL 2000 – 3000 – 4000 series.

Through a filter, make-up air is taken in from both sides and fed into the tunnel. The heating section is equipped with doors on both sides, containing the heating registers. Within the tunnel, air which feeds into the infeed and cooling section through pre-filters and particulate air filters into the separate zones of the tunnel is drawn off by fans. By way of the Laminar Flow principle, the air flow is directed vertically onto the containers. Below the conveyor belt, the air is again directed through a recirculation duct to the fan.

Electric heating elements in the recirculation duct serve to heat the recirculated air to the preset temperature. Below the filters are thermoelements PT 100 with output for temperature control and recording.

The cooling section operates with Laminar Flow. A fan in the cooling section extracts the heated air from below the conveyor belt. The exhaust air volume is automatically adjusted. The tunnel is equipped with an automatic excess pressure control in the cooling section.
Optional equipment HQL 5000

Further optional equipment:
- Transport system for non-stable containers
- Cooling section with air recirculation cooling system
- Sterilizable cooling section (with hot air)
- Combination with compact line, also with Isolator technology
- Additional thermoelements
- Air flow meter in the cooling section with display unit
- Display of the conveyor speed
- Automatic timer for night mode operation.
- Isokinetic nozzles for particle measuring.

Overpressure control, cooling section

Transport system for non-stable containers

Sterilizable cooling section (recirculating air)

Sterilizable cooling section (recirculating air)

Cooling section with air recirculation cooling system
### Technical data HQL series

#### Dimensions LF tunnel

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Subject to technical modifications.

Graphic illustrations in this leaflet are examples only! Determinant for the final execution, including technical specifications, is our individual quotation exclusively.
Compact lines for vials

With competence and responsibility, Bosch is leading in the manufacture of complete lines: From function-compliant, technically matured individual machines and their interlinkage, to documentable production. The pharmaceutical industry relies more and more on the capacity of the strong partner Bosch in development, quality, know-how and service.
Compact lines in Isolator technology

Vial compact line in Isolator technology

Ampoule compact line in Isolator technology