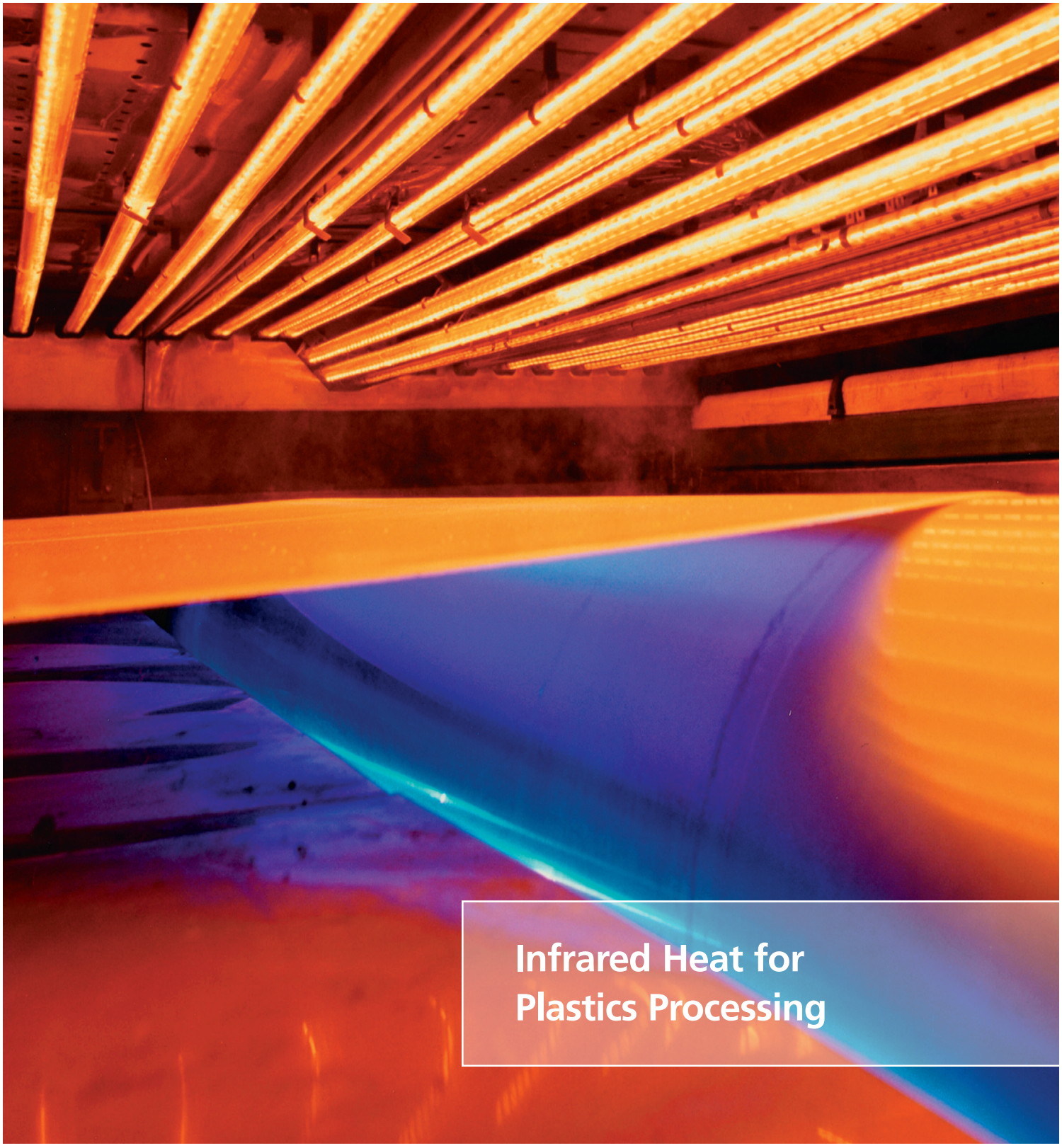


Infrared Heat for Plastics Processing

NobleLight

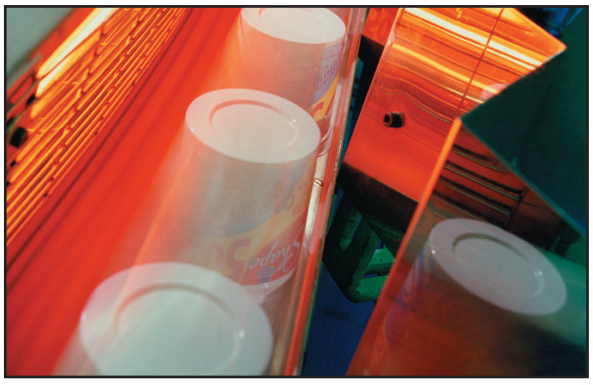
excelitas®

Heating for Plastics

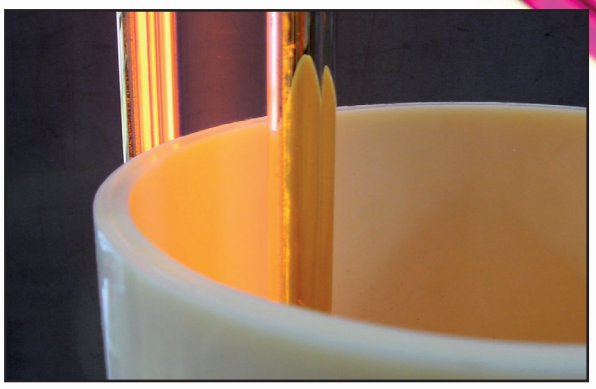
Commodities or objets d'art, high-tech equipment or toys, packaging materials or construction materials – we come across plastics today in all shapes and forms used in seemingly countless applications. In space exploration and in the house, in clothing and for food packaging, in medicine and for protecting the environment – plastics are not only used as a substitute for other materials but often provide the solutions to previously unsolvable problems. Heat plays a central role in forming and processing plastics, especially thermoplastics. Heat is used for softening and forming operations such as bending, stretching, blowing, deep drawing and stamping or for packaging materials with sterilised wrapping, shrink wrapping, heat sealing, laminating. Heating can also be used to temper, harden, glue and dry plastics. Heating processes are even used to separate plastic waste. The use of infrared radiation opens up many options for the direct transfer of heat into the manufacturing process.

Infrared heat meets all requirements

- Heat transfer is simple – it requires no contact with the material and no intermediate medium such as air or water.
- Infrared transmits high power – foils, plates and even irregular shapes are heated in seconds.
- The heating process fits in easily with the manufacturing process – by appropriate choice of emitter or emitter cassette, the heating can be matched to the speed of the process.
- Infrared heat can be targeted exactly where it is required Large surfaces can be heated in exactly the same way as small parts, curved surfaces or solid plastic materials.
- Infrared radiation is safe and can be easily switched on and off.
- The process is economical – the correct emitter selection allows high efficient heating. Moreover, the heat loss is small, since the radiation is directed at the process material.



Ink drying



Tube bending and forming

Infrared Radiation – natural heat

The heating power of the sun is the perfect natural example. Infrared radiation is the heat which we feel in sunlight. Like light, infrared radiation is electromagnetic radiation and is transmitted just as quickly and at virtually unlimited power. Infrared radiation is transformed into heat in the material itself. With infrared technology we use the infrared radiation energy in a controlled manner.

Infrared has many spectra

Noblelight Infrared emitters from Excelitas transfer heat without contact, which can be exactly adjusted to the characteristics of the material. Infrared heat matches the absorption spectrum of plastics perfectly, which eases plastic processing. Another advantage of infrared emitters is that they can targetedly heat the material only where needed and only as long is required for a particular process. This results in reproducible complicated heat processes and enables an automation of the process.

Only the infrared radiation which matches the processed material is absorbed

Just like visible light, a part of the broad infrared radiation spectrum is reflected from the surface of the material while the rest is either absorbed within the material or passes through the material. Every material consists of molecules and molecular structures that absorb specific radiation wavelengths. The radiation wavelength that is absorbed by a material coincides with the wavelength of the molecular oscillation in that material. The absorbed radiation releases energy to the molecule generating heat in the material. For instance, plastics generally absorb infrared radiation in the wavelength range above 2 µm. C-H-bonds are especially efficient because they absorb wavelengths between 3.2 µm and 3.5 µm.

Wavelength fitting to the material

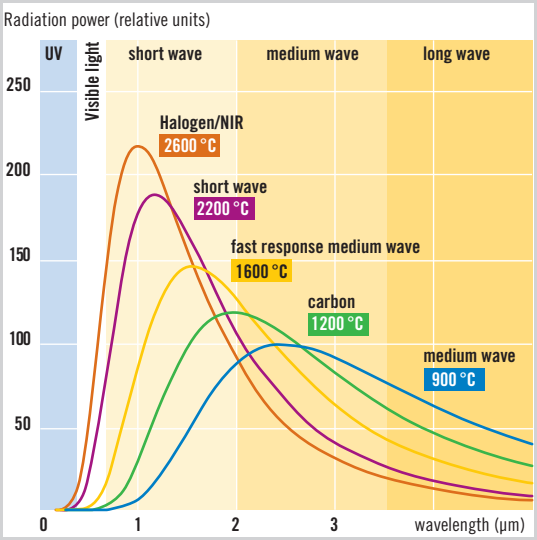
Thin materials such as foils are difficult to heat with short wave infrared because only a small component of the short wave radiation matches the absorption spectrum of the material. Thin materials are transparent to the infrared radiation and short wave IR is not efficient. Medium wave radiation, on the other hand, is absorbed more readily and the result is that the foil heats significantly faster at the same electrical power input.

To avoid the loss of radiation Excelitas Noblelight offers a **wavelength converter**, consisting of a plate with mineral fibers. This absorbs the radiation which has passed through the material and radiates it back into the material at a different wavelength. The wavelength converter absorbs transmitted infrared radiation, heats up to 500 – 600 °C and then radiates back medium- and long wave radiation.

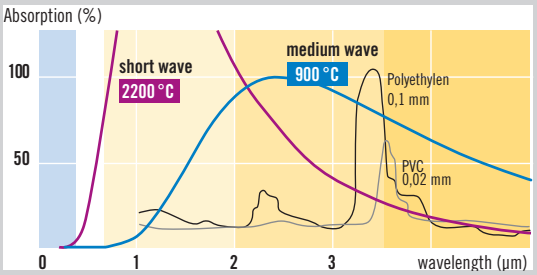
For solid materials, because of low absorption rates, short wave infrared penetrates deep into the material and provides uniform volumetric heating. Medium wave radiation is absorbed in the material's outer layer and generally heats only the surface. With the correct infrared emitters, heating plastics can be controlled according to very specific requirements. Pigments in coloured plastics increase the infrared absorption.

The power density determines the amount of heat transferred

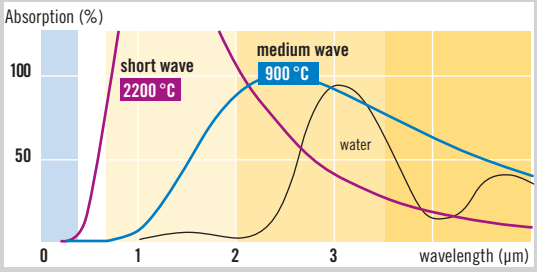
In turn, the amount of heat transferred to the material depends on the emitter's power, its temperature and distance from the material. Once the product material has determined the spectrum, the spectrum fixes the temperature and thus the electrical power of the emitter. Therefore, to increase the amount of heat transferred, the power density (radiation output per unit surface area) has to be increased. This is achieved by physically arranging the emitters, by using twin tube emitters and by additional reflectors.



The infrared spectrum of different Noblelight emitters. The curves show the radiation intensity in the different wavelength ranges at the same electrical power ratings. While the halogen emitter in the short wavelength region provides the highest power output, carbon emitters and medium wave emitters have significantly higher outputs at wavelengths above 2 µm.



The absorption spectra for polyethylene and polyvinylchloride (PVC) show strong absorption for infrared radiation between 2.5 and 4 µm. For these materials medium wave emitters have a greater efficiency than short wave and halogen emitters.



This overlay of the absorption spectrum of water demonstrates that medium wave emitters also have a significantly higher efficiency than short wave emitters for drying applications.

Infrared Emitters – for every application

Every Noblelight emitter can be adjusted to the appropriate shape, length and spectrum for the required process. This makes even complicated heat processing reproducible and enables an automation of the process.

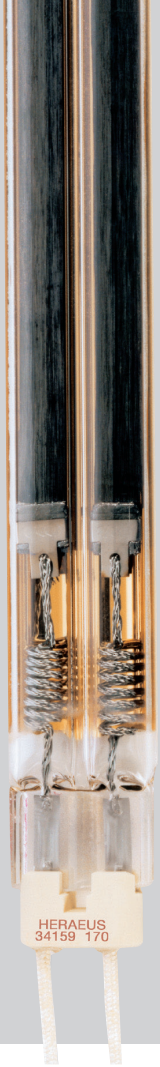
Selection criteria for infrared emitters

Infrared spectra define the heat distribution in plastics. By matching the infrared spectrum to a specific application, the process flow rate, heating time and energy used are optimised.

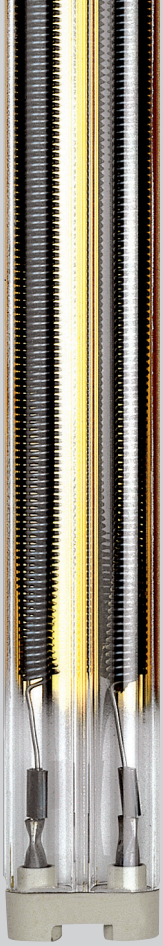
The emitter's rates of heating and cooling are important for control, cycling process stages and process safety. Short wave emitters, fast response medium wave emitters and carbon emitters have the quickest response times and therefore the most favorable control characteristics.

Length and physical strength – Halogen emitters are manufactured with a heated length of up to 1 m and carbon emitters with a heated length of up to 3 m. Because of their high physical strength, twin tube infrared emitters can be supplied in any length required up to 6 m.

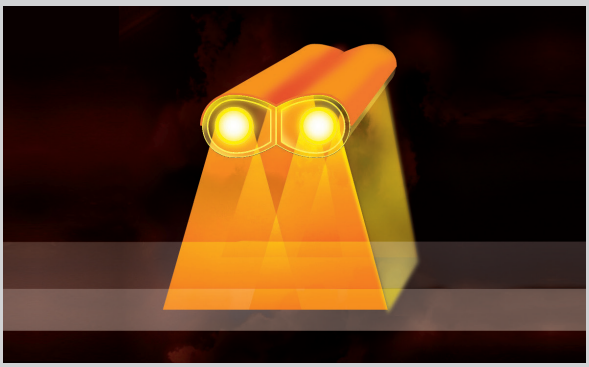
Reflector – On request Excelitas Noblelight offers emitters with gold reflectors. With a gold coating approximately 95 % of the IR-radiation can be absorbed, which doubles the effective intensity.



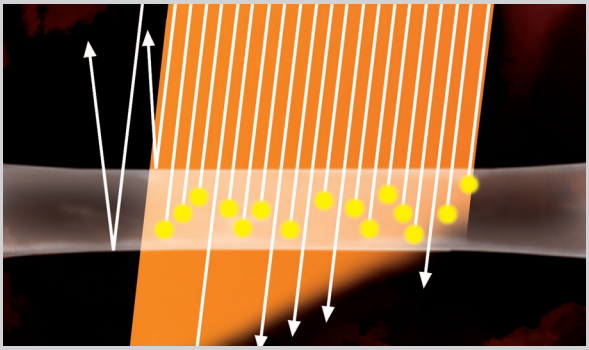
Carbon Twin



Medium Wave



Twin tube emitters achieve a particularly high radiation strength.



According to their material properties, plastics absorb some of the infrared radiation, reflect some at the surface and allow some of the radiation to pass through. By carefully selecting emitters to match their spectra to the material being processed, the majority of the radiation is absorbed and converted to heat creating an efficient operation.

Non-dazzle IR emitters – for safety reasons with some applications it makes sense to filter out intense light radiation. This is achieved by applying an antiglare coating**.**

Emitter shapes – As a producer of quartz material, Excelitas also offers twin and round tube emitters in curved forms. Consequently, the heating method can be matched exactly to different manufacturing processes.

Infrared emitters and their characteristics

NIR InfraLight halogen emitters are cost-effective emitters produced to standard commercial dimensions used in many infrared systems. Noblelight gold reflectors increase the efficiency of the halogen infrared emitters. This short wave, high light component emitter is used to heat thick sheets and solid plastic materials.

Short wave, twin tube emitters are comparable in spectrum to halogen emitters. They are used in processes where rapid heating is important. Because of their stable construction, twin tube emitters can be supplied in larger lengths. They offer virtually double the life compared to halogen emitters because of their stronger heating elements.

Fast response, medium wave emitters are twin tube emitters with a spectrum between short wave and standard medium wave emitters. These emitters can be supplied in lengths up to 6.4 m so they are ideally suited to be used in large modules. They achieve a significantly higher area heating power than standard medium wave emitters.

Carbon infrared emitters CIR® are a recent development. These emitters use a carbon ribbon as the heating element. They have very fast heating times (1 – 2 sec) which means they are especially suitable for processes where the heat must be switched on and off quickly. The spectrum is the same as medium wave emitters so carbon emitters are efficient for heating plastics and for drying processes. They are produced in lengths up to 3 m.

Medium wave emitters distinguish themselves by being highly efficient and stable while having a long operating life. The medium wave emitter spectrum is well suited for heating processes with most materials and the emitters are available in lengths up to 6 m.

Infrared Modules – process heating to order

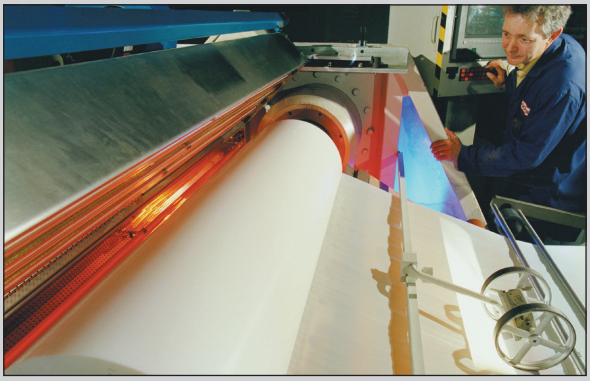
Noblelight Infrared modules from Excelitas are complete emitter arrays that comprise small and large emitter cassettes, mobile drying systems or IR dryers combined with an intensive air flow.

Modules – manufactured for the process
The Noblelight KR-module is the infrared building block for every application. The modules are tuned and equipped to suit your particular process and come in a variety of sizes to accommodate a range of customer systems. The module systems have custom built infrared emitters and are designed to supply exactly the required power for your process. The module design also takes into account issues specific to infrared technology such as emitter design, mounting, thermal and mechanical stability, visual and contact protection and ventilation. These modules are ready for immediate connection, either for retrofitting or for installing in new projects.

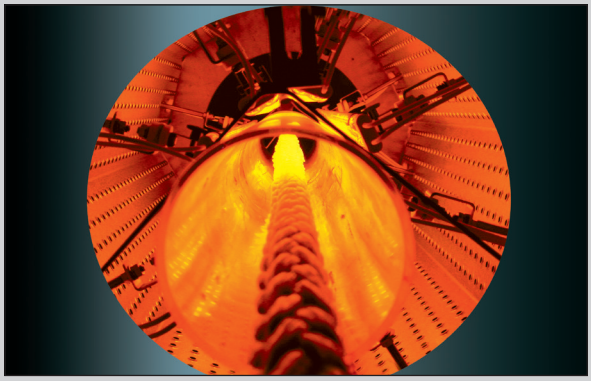
Infrared systems – complete thermal processes
If needed, Excelitas can supply complete infrared systems with automatic emitter output and product temperature control. Our systems are a combination of infrared modules and come complete with a switchboard cabinet. Every module and system combines comprehensive infrared technology and Noblelight application know-how.

All possibilities
In designing a heating module, the most important consideration is developing a productive solution for the specific heating requirement. Because of our modular concept, Excelitas can provide heating for practically any size application. Our flexibility with emitter length, design, and control means that virtually every industry process requiring thermal technology can be accommodated. Situations having production lines with varying widths, specific temperature profiles, high power density requirements are easily handled including control specifications.

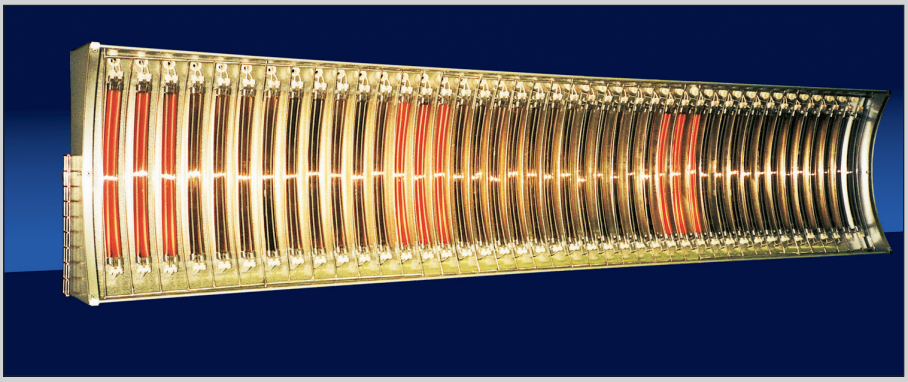
Applications
Welding plastic containers, forming interior parts, thermoforming or deburing. No matter if continuous material or several parts, every infrared module can look different. The one thing, all emitters have in common is the possibility to match the infrared system perfectly to the required material and process. The type, thickness or color of plastic parts can have a large influence on the heating process. Wavelength, power and even the shape of the emitter can play a role in the process. It is worth, taking a closer look at the process parameters before installing a new plant. Perfectly fitted infrared emitters can save energy and time. **Please contact us!**



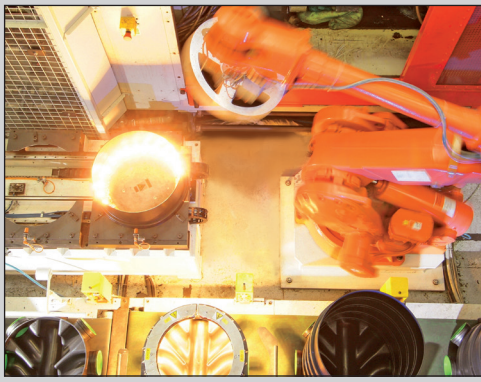
Cutting PTFE foil



Tunnel oven



IR modules with curved emitters for laminating and embossing

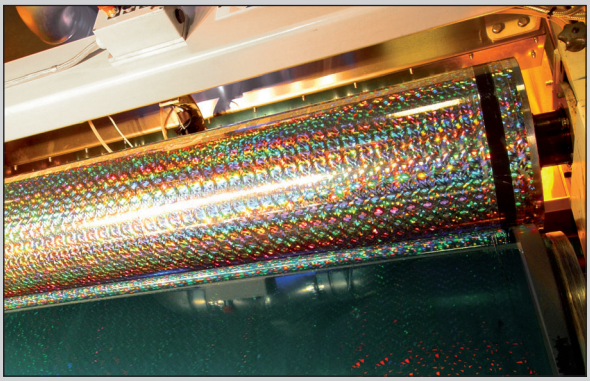


3D welding

Coating of synthetic fabric

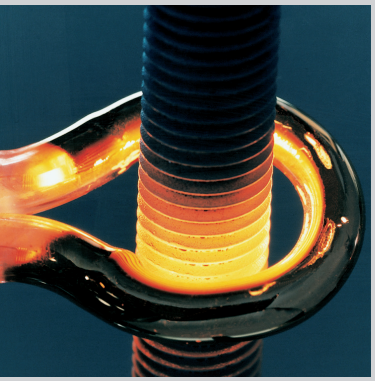
Welding of transport boxes

Crease removal of synthetic fabric

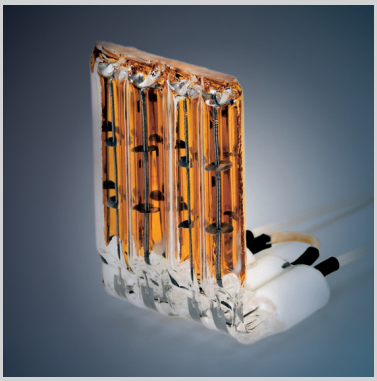


Embossing foils

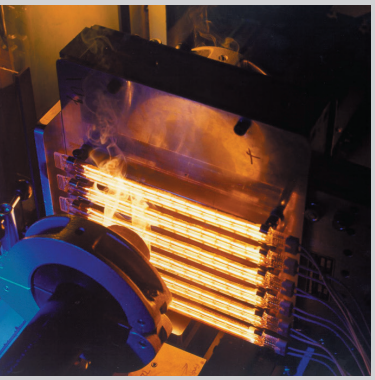
Relaxation of plastic pipes



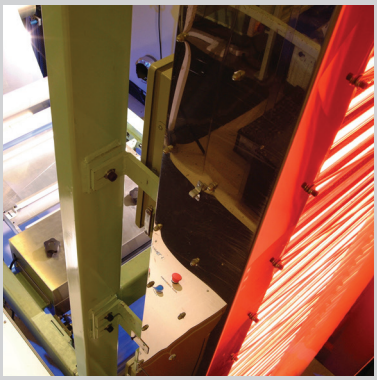
Plastic heating with
an Omega emitter



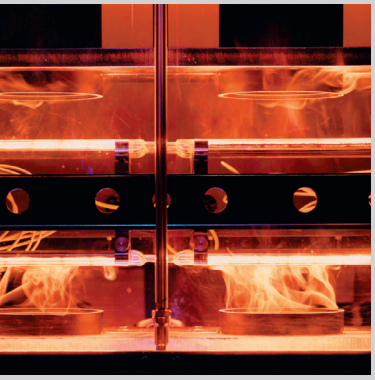
Small surface emitter



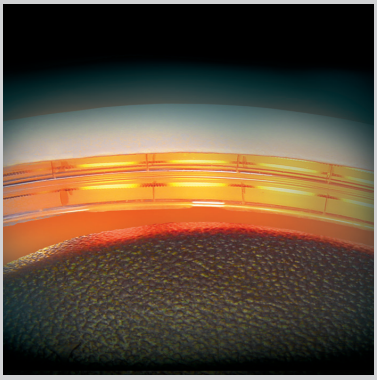
Plastic welding



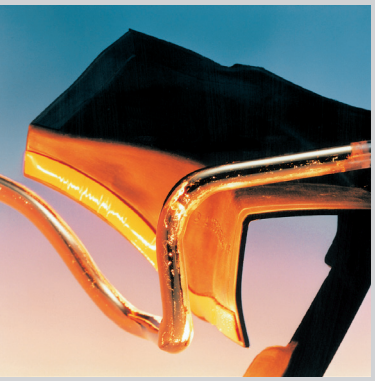
Preshrinking of PET film



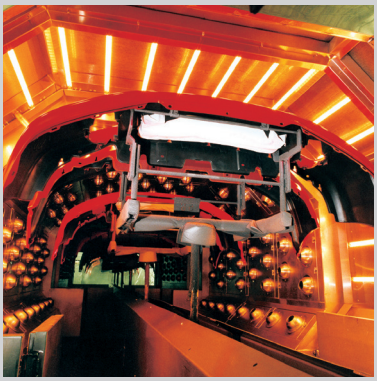
Welding of glass-filled
polypropylene cylinders



QRC® infrared emitter with nano reflector



Activating adhesive on a rubber
sleeve with contour infrared emitters



Curing paint on plastic bumpers

Targeted Heating –
the innovative Infrared Technology

There is a real challenge in those processes where only very small or curved surfaces, corners, edges or specific contours of a product need to be heated.

Contour emitters are individually formed to replicate corners or edges of work pieces and so allow targeted bending processes or localised activation of adhesives.

Small surface emitters heat complex geometries.

Omega emitters and Rivet heaters are perfect for hot staking, hot riveting or tube forming.

The new QRC® infrared emitters (QRC = quartz reflective coating) have a nano reflector made of quartz material, so they can contoured exactly to components. This is especially advantageous for processes like deburing, welding or adhesive activation.

All of these emitters are matched to the particular process in terms of shape, size and spectrum. Heat is totally targeted where it is required. Consequently, energy losses are as small as possible.

Noblelight provides solutions which fit into your process and are completely tuned to your requirements.

The development of the emitters revolves around the requirements of the customer and makes use of the latest state of the art technology.

Tests in the Application Center

Tested, Checked and Proven

Know-how with tradition
Excelitas Noblelight has many years' experience in infrared heating technology and provides individual advice and service. Excelitas Noblelight offers its customers the capability for proving trials in its in-house Application Center or on-site with experienced technical assistance. Excelitas Noblelight has Application Centers all over the world.

Research into the impact of infrared emitters, the influence of different spectra, measurement of the temperature distribution, determination of the required power and other parameters. All these steps are part of the conception of a new heating process. Noblelight sales engineers provide advice in the designing of the heating process, help to evaluate the required technical power and choose the ideal emitter. For on- site investigations we provide test modules.

Areas of application
- Heating
- Drying
- Coating
- Laminating
- Annealing

Excelitas Noblelight is your partner for industrial heating processes in
- Glass
- Plastics
- Textiles
- Automotive
- Semi-conductor manufacture
- Food processing
- Print and Paper
- Elektronics
- Metals

Excelitas sales engineers use 30 years of company experience from all major industries to give you expert guidance during the initial stages of your thermal process design.

About Excelitas Technologies

Excelitas is a leading provider of advanced, life-enriching technologies that make a difference, serving global market leaders in the life sciences, advanced industrial, next-generation semiconductor, aerospace and defense end markets. Headquartered in Pittsburgh, PA, USA, Excelitas is an essential partner in the design, development and manufacture of photonic technologies, offering leading-edge innovation in sensing, detection, imaging, optics, and specialty illumination for customers worldwide. Excelitas is at the forefront of addressing many of the relevant megatrends impacting the world today, including precision medicine, industrial automation, artificial intelligence, connected devices (IoT) and military modernization.

Contact us here:

Phone +49 (6023) 405-9600
hng-infrared@excelitas.com
hng-contact@excelitas.com

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