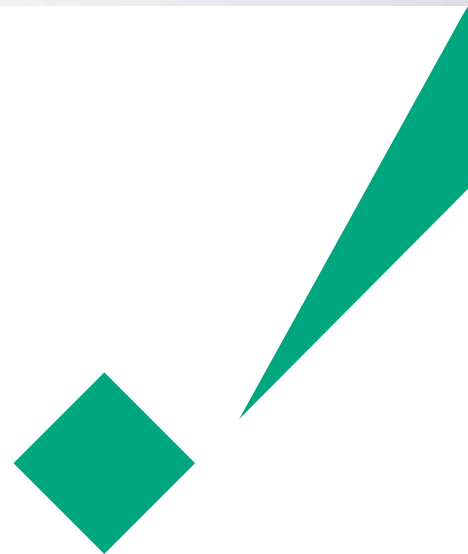


Infrared Lamps

for diverse industrial applications



Defining Infrared Radiation

The heating of a material like a substrate or its surface is possible through the application of several thermodynamic mechanisms:

Conduction

Heat transmission by direct contact between a heat source and a material with a lower temperature

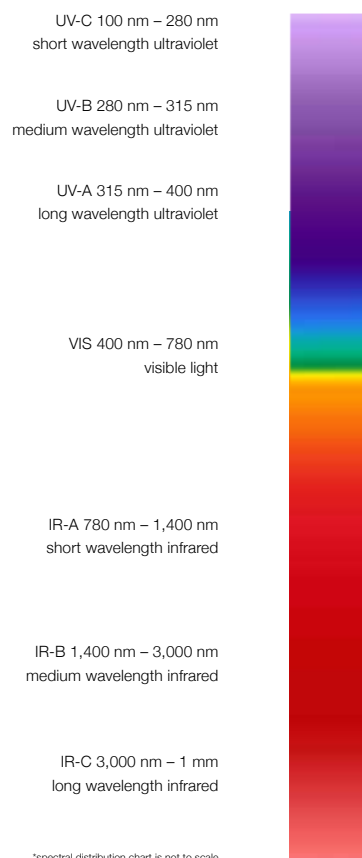
Convection

Indirect heat transfer through a transfer medium such as air or water

Radiation

Contact-free transmittance through absorption of electromagnetic radiation

Infrared On The EMR Spectrum



What Is Infrared?

Infrared (IR) is electromagnetic radiation (EMR) occupying a wavelength range of approximately 780 nanometre (nm) to 1 millimetre (mm). Ushio's IR emitters are divided into three categories: IR-A, IR-B, and IR-C, as depicted in the spectral distribution diagram below.

Herschel's Discovery of IR light

In 1800, the German astronomer Frederick William Herschel carried out temperature measurements of visible light and proved that temperatures increase from violet to red. In his subsequent investigations beyond the visible spectrum, he discovered a region with the highest temperature, which led to the discovery of infrared radiation. This crucial experiment was groundbreaking as it revealed the existence of light wavelengths beyond human perception.

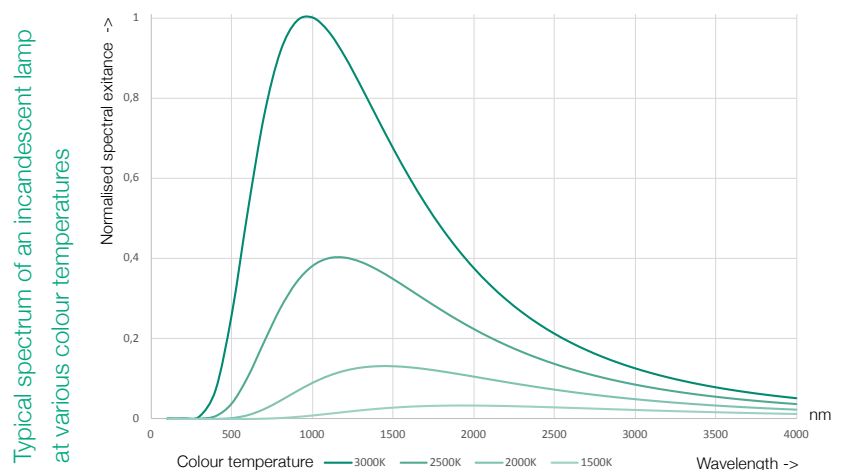
Energy Efficiency

Efficient infrared lamps can convert more than 90% of the total electrical input power into radiation. For maximum process efficiency, the target material must possess an absorption comparable to the spectrum emitted by the IR lamp. The absorbed radiation is primarily converted into thermal energy, i.e. it heats the target material. Ushio has a long track record of supporting customers find the most suitable lamp for their application.

Spectral behaviour of IR Lamps

It is customary to use the terms short wave, medium wave, and long wave to classify IR lamps. These definitions are easily remembered, but from a technical point of view they are inaccurate:

Infrared lamps (as black body emitters or Planckian emitters) are broadband emitters whose spectrum can be controlled via the filament temperature, which is related to the color temperature. This means that the emission (spectrum) can be adapted to the material to be heated, as shown in the diagram below.



Expertly Applied To Your Field

- ◆ Additive Manufacturing / 3D
- ◆ Activation of Adhesives / Glues
- ◆ Annealing
- ◆ Catering
- ◆ Chemical Processing
- ◆ Copy Toner Fixing
- ◆ Curing of Coatings
- ◆ Development of Films
- ◆ Deburring of Plastic Parts
- ◆ Drying of Fillers and Varnishes
- ◆ Embossing
- ◆ Evaporation of Solvents
- ◆ Evaporation of Water
- ◆ Epitaxy
- ◆ Food and Beverage Packaging
- ◆ Food Processing and Manufacturing
- ◆ Furnacing
- ◆ Germicide by Heat
- ◆ Glass Processing
- ◆ Hardening of Resins and Cements
- ◆ Heating
- ◆ Humidity Control
- ◆ Lamination
- ◆ Material Testing & Inspection
- ◆ Medical Treatment / Wellness
- ◆ Metal Welding
- ◆ Microelectronic Circuit Integration
- ◆ PET Blow Moulding
- ◆ Plastic Welding
- ◆ Preheating of Composite Materials
- ◆ Print Drying
- ◆ Printed Circuit Boards Processing (PCB)
- ◆ Rapid Thermal Processing (RTP)
- ◆ Sintering of Printed Electronics
- ◆ Solar Cell Production
- ◆ Solder Reflow (PCB)
- ◆ Spot Welding
- ◆ Shrinking of Foils
- ◆ Temperature Regulation
- ◆ Tempering
- ◆ Thermal Oxidation
- ◆ Thermoforming
- ◆ Vacuum Forming
- ◆ Wafer Cleaning
- and many more...



Ushio is the premier manufacturer of customisable IR lamps. We have spent over 60 years developing our cutting edge technology and tailoring it to the needs of each unique client. With a legendary commitment to quality and flexibility, we have remained unsurpassed as the world leading manufacturer of specialist lighting solutions since our foundation in Tokyo, 1964.

Our specially trained engineers at Ushio's R&D and production facilities in Germany and Poland devise, build and test every lamp. This ethos results in products that are perfectly matched to customer requirements every time.

Single Tube

At Ushio, we offer more than just high-quality lamps. We offer qualified engineering consultancy and expertise. As a partner at our customers' side, we are there to design customised lamps that fit perfectly into the specific processes. Our claim to develop lamps "Beyond Standard" is not an empty phrase, but a summary of what we do.

Ushio's single tube double-ended infrared lamps are used in a vast majority of industrial applications. This product category offers most options with regard to Ushio's full in-house customization service.

All lamps are available with a range of base configurations, filaments, quartz types to choose from, in various shapes, sizes, colour temperatures and power levels, and can be delivered with or without various reflective coatings.

Ushio also offers the opportunity to select 'doped' ruby quartz glass which minimises visible wavelengths. This is especially effective as a safety measure in applications where the lamp operator may otherwise suffer prolonged exposure to high brightness, visible wavelength lamp glare.

Applications

- ◆ Catering
- ◆ Stretch Blow Moulding
- ◆ Ink and Paint Drying
- ◆ Rapid Thermal Processing (RTP)
- ◆ Soldering
- ◆ Terrace Heating
- ◆ Thermoforming
- ◆ Wellness Therapies

Benefits

- ◆ Wide range of customisable design possibilities
- ◆ Simple power & mechanical connection possible with EmitFit
- ◆ Can be fitted with an optional reflective coating



Outer Jacket

Ushio manufactures a series of double ended single tube IR lamps which feature an additional outer tube 'jacket'. These lamps find their primary application in commercial food service environments. The outer casing, resembling a protective jacket, shields the lamp from splashes of food liquids and debris, thereby preventing premature failure and accidental damage.

Moreover, these lamps exhibit greater resilience against impact, minimizing the risk of food contamination by breakage. Given the demanding conditions they endure, jacketed heat lamps are ideal for serveries and outlets where hot food is served.



Applications

- ◆ Catering
- ◆ Food Processing

Pin Type Lamps and Reflectors

Our single-ended, pin type IR lamps are a series of powerful yet compact IR radiation sources. They can be delivered with different reflective coatings which focus the radiation towards the desired direction.

Pin style lamps are particularly useful for the treatment of small shapes, to overcome spatial restrictions, for complex heating patterns and as an alternative to customised, bent IR lamps.

Ushio also developed a series of matching reflectors that offer improved precision and maximum efficiency. Uniform irradiance can be achieved in any shape, pattern, or layout, from a single spot to a linear beam profile.

Pin lamps and accompanying reflector have been designed to accommodate universal burning positions. And, there is no limit to the number of reflectors that can be linked together.



Applications

- ◆ 3D Printing
- ◆ Contour Heating
- ◆ Rapid Heating
- ◆ Riveting
- ◆ Spot Welding
- ◆ Deburring

Twin Tube

Twin tube lamps can be single or double ended and are special IR emitters consisting of two quartz tubes, that have been fused together. Due to this design these lamps have an improved mechanical robustness and stability, and offer the possibility to enhance the applied power density. They are available from short (SWIR) to medium-wave infrared (MWIR) emitters.

In addition, twin-tube lamps offer special customisation options: Each tube can contain a different filament, which determines colour temperature, heating length and segmentation, among other things, and can be tailored precisely to customer needs and process requirements in combination with a reflective coating.

Ushio also offers twin tube lamps of up to 5 metres in length, which appeal to the glass processing industry, for example. These lamps offer a higher power density and flexible connection and control options with less installation effort. The positioning of the temperature-sensitive pinching area outside the heating zone makes them particularly suitable for applications where wide webs need to be heated. Waterproof versions are likewise available.

Double Tube

For customers who require a similarly high power density of twin-tube lamps but are looking for a cost-effective alternative, Ushio offers double-tube lamps. These lamps consist of two parallel single-tube lamps connected at both ends by bases. They are available with electrical connection on one or two sides. Different lengths are available based on customer requests.

Applications

- ◆ Adhesive Activation
- ◆ Composite Material Pre-Treatment
- ◆ Drying of Varnishes and Paper
- ◆ Food Preparation, e.g. Pre-Flash Freezing
- ◆ Heating and Fusing of Synthetic Materials
- ◆ Heating of Composite Materials
- ◆ Lamination and Shrinking of Foils
- ◆ Semiconductor and Photovoltaics Production
- ◆ Welding of Synthetic Fluid Reservoir

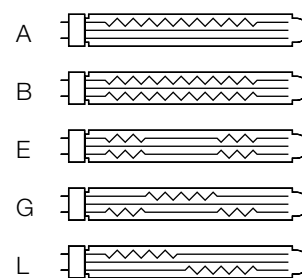


Available up to 5 metres long

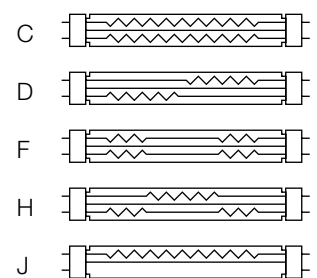


Twin Tube Lamp Filament Design

Single Ended



Double Ended



Benefits

- ◆ High-level radiation density
- ◆ Various filament designs
- ◆ Single or double ended electrical connections available
- ◆ Can be fitted with an optional reflective coating
- ◆ Compact bridge design for maximised heating length

Shaped Glass Single & Twin Tube

Our specialist bent quartz lamps are built with a curved tube to ensure your emitter is able to maximise your space potential and focus the infrared radiation where it is needed the most.

Substrates with a non-uniform surface can be difficult to treat evenly with a regular IR lamp, so a new solution was required.

Ushio has developed an advanced production process which has also seen the arrival of highly sophisticated bent or curved twin-tube lamps. The advantage of these lamps is the possibility to combine them in a variety of ways to provide stable and homogeneous heating fields.

If our popular U-shaped glass tube, that minimises e.g. the unheated lengths in linear applications, is not quite to your needs, it is possible to request different shaped designs. As always, Ushio is ready to listen to your exact requirements and deliver unique solutions to your infrared industrial lighting applications.



Applications

- ◆ Annealing
- ◆ Coating
- ◆ Contour Heating
- ◆ 3D Printing
- ◆ Drawing of Plastic Fibres
- ◆ Moulded Plastic Deburring
- ◆ IR Welding
- ◆ PET Blow Moulding
- ◆ Printing
- ◆ Textiles



Benefits

- ◆ Lamp shape, power, and wavelength are customisable
- ◆ Perfect for installations with restricted spatial requirements

Our Lamp Technology Explained

All Ushio infrared lamps are manufactured using the highest quality materials, and many of them are meticulously handmade by our own production facilities. Ushio's IR solutions range from short-wave (IR-A) to medium-wave (IR-B) emitters.

Adaptable, Application Specific Design

Ushio's IR lamps are designed in such a way to obtain a particular power at a certain voltage. The operational lifetime of your lamp depends directly on that. A frequent load change can result in a shorter lifetime for your lamp. Operation at overvoltage will decrease the lifetime significantly. Ushio can adapt the production of any IR lamp in such a way that its lifetime will be optimised for the specific operation conditions. If you let us know early on, our experts can design an IR lamp with your specific needs and application in mind. The lamps can be dimmed, but excessive dimming shortens the service life. Prior consulting is therefore essential to get the most out of your lamps.

Fully Customisable Specifications

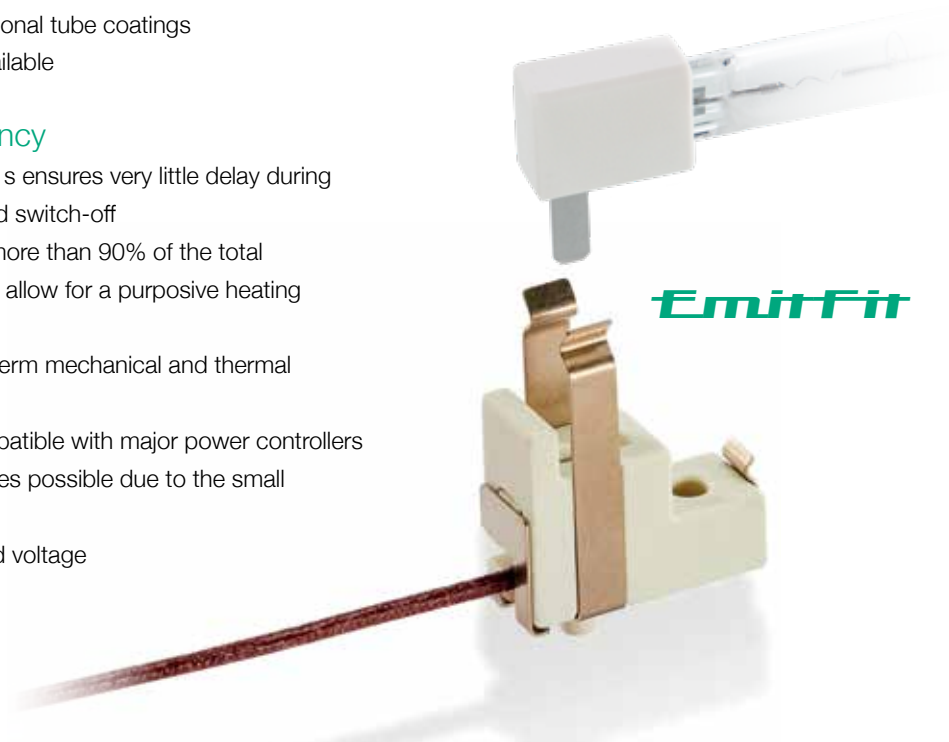
- ◆ Available from 80 W - 20,000 W
- ◆ Colour temperature from 800 K - 3,300 K
- ◆ Specific power densities available from 4 W/cm to 300 W/cm
- ◆ Available with or without an integrated reflector, allowing the operator to maximise the use of IR radiation
- ◆ Client-specific modifications or entirely new IR lamp developments are available on request including segmented filaments for optimised beam profiles
- ◆ Radiation wavelength adaptation for application optimisation through the use of alternated tubes or optional tube coatings
- ◆ Vacuum and water resistant lamps are available

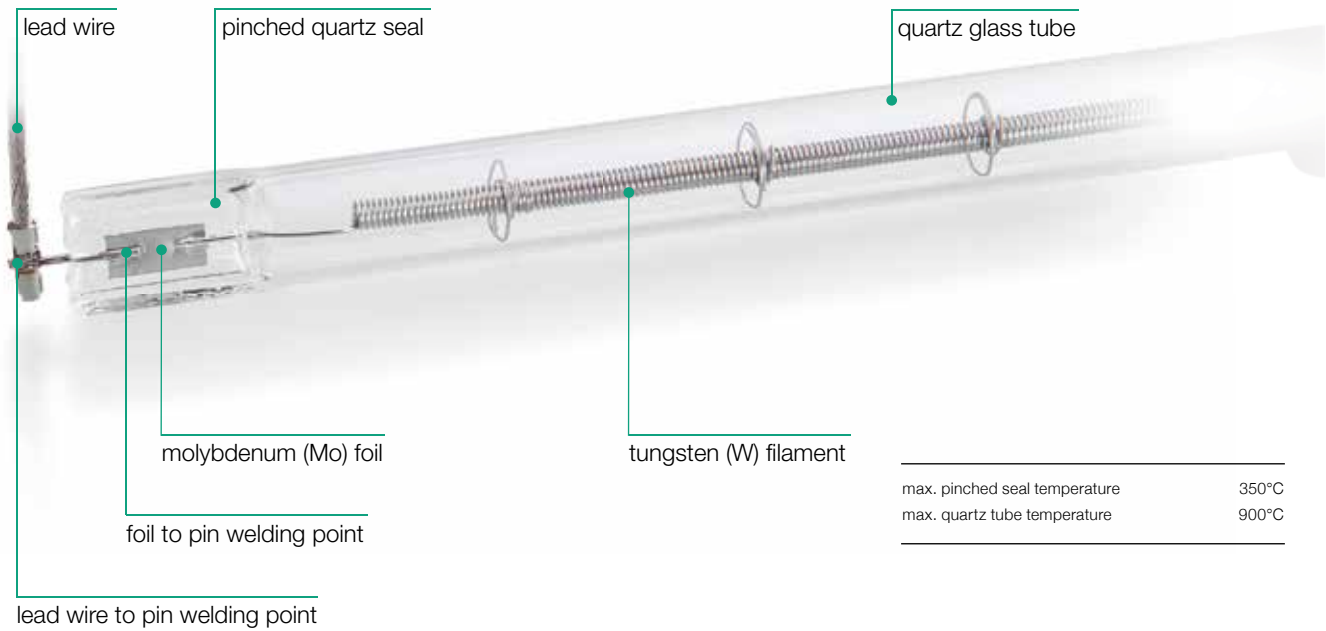
Plug-And-Play: The EmitFit Way

- ◆ A unique, optional feature of Ushio IR lamps is the proprietary EmitFit 'plug-and-play' technology. With this technology, even the exchange of customised lamps becomes an extremely fast and easy task
- ◆ EmitFit is individually adjustable and combines convenience and functionality. The lamp is both electrically connected and mechanically mounted at the same time
- ◆ Simple, time-saving and tool-free replacement
- ◆ Space-saving installation for confined areas

Unmatched Performance & Efficiency

- ◆ Short reaction time: Reaction time below 1s ensures very little delay during switch-on, power control adjustments, and switch-off
- ◆ Efficient short wavelength lamps convert more than 90% of the total electrical power input into IR radiation and allow for a purposive heating of the target material
- ◆ High-quality quartz tubes guarantee long term mechanical and thermal robustness and enhanced lamp lifetimes
- ◆ All Ushio IR lamps are dimmable and compatible with major power controllers
- ◆ Full integration into compact OEM machines possible due to the small dimensions of the IR lamps
- ◆ Average lifetime up to 5,000 hours at rated voltage





Only The Highest Quality Quartz Glass

All Ushio IR lamps are made using high quality quartz glass not only for improved thermal shock resistance and high softening temperature, but also for its high purity and IR transmission. We make no compromises when it comes to the quality of our components.

Halogen Cycle

Halogen lamps contain small additions of halogen admixtures to the filling gas. Their addition makes it possible to virtually eliminate bulb blackening (caused by evaporating tungsten stemming from the filament) and the associated reduction in transmission & lifetime. In the halogen cycle process, the evaporated tungsten atoms are captured by halogen atoms and redeposited on the filament.

The Molybdenum Foil Bridge

Electricity is able to pass through the vacuum seal thanks to the implementation of a molybdenum (Mo) foil bridge welded to the tungsten filament and contact pin. The Mo foil is necessary because tungsten (W) has a coefficient of thermal expansion ten times higher than quartz glass. This would lead to quartz leakage and bursting when the lamps are in operation. The introduction of the foil allows a thermally stable, vacuum sealed connection within the quartz glass which will remain intact for the duration of the lamp's operational lifetime.

Heat Management Is Key

To maintain the operational lifetime of the emitter, it is recommended that the foil does not exceed a temperature of 350°C. This prevents oxidation of the molybdenum layer and premature failure of the lamp.

In addition, overheating of the lamp bulb must be prevented, which depends on the lamp wall load and various environmental parameters. Rely on our development expertise and let our engineers advise you.

Ceramic Isolation

At the ends of the lamp, an outer pin, which is usually shielded by a ceramic base, facilitates the electrical connection. The ceramics used by Ushio have a high temperature stability combined with high thermal conductivity. The corrosion-resistant base not only serves to mechanically stabilise and integrate the lamp into the device and the power supply, but also acts as an electrical insulator.

In addition to a comprehensive range of standard ceramic insulations, Ushio also offers customised options for specific customer requirements.

Alongside the proprietary lamps, Ushio can support you with industrial systems and a range of optional features such as lamp housings, additional IR modules, power supplies, and electricals for different processes or applications.

IR Solutions Beyond Standard

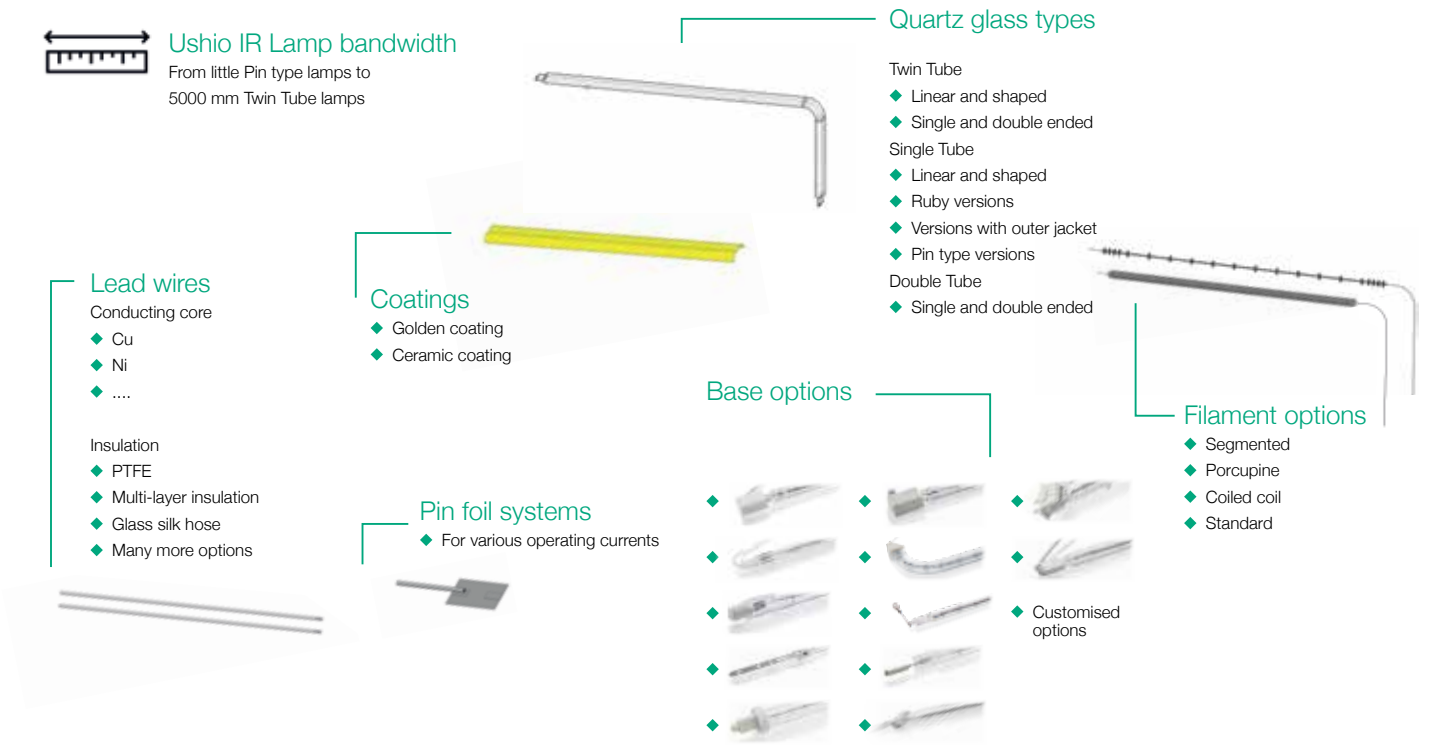
From single components to individual solutions

Despite our global presence, we maintain the agility to adapt and cater to the unique requirements of its clients. In the realm of IR applications, off-the-shelf solutions sometimes prove inadequate.

Explore our unparalleled expertise in infrared solutions, where customisation meets precision engineering. With a robust R&D foundation, we are able to offer tailored IR solutions to meet your exact specifications.

Our diverse range of quartz glass types, lamp geometries and dimensions, filament options, and base configurations allows for precise customisation. From single pin lamps to 5 metre long twin-tube emitters, we offer unmatched flexibility.

Our engineers work closely with you to identify the optimal combination of components for your specific needs. Together, we transform challenges into opportunities, delivering IR solutions that surpass expectations.

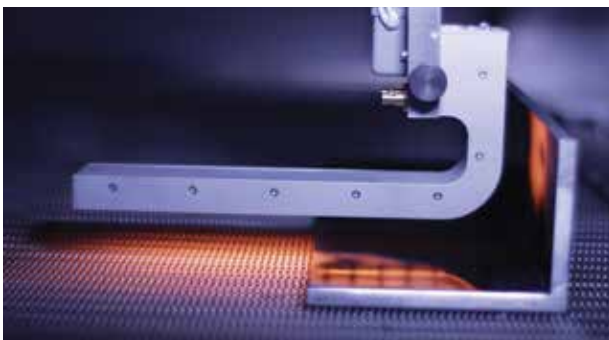


Ushio Technical Engineering: research as a joint enterprise

With a steadfast commitment to offering every client a unique solution to their needs, Ushio Europe has pledged to involve each customer in the R&D process. Catering for the plethora of requests received at Ushio, our experts have constructed several facilities for the development and testing of vacuum-ultraviolet (VUV), UV, visible light (VIS), and IR lamps.



The completion of the Ushio Application Laboratories in Germany allows every client the opportunity to test our solutions on their own materials under strictly controlled conditions. Located in Steinhöring, Germany, prospective clients are welcome to experiment with industrial IR processes like never before.



The IR lamp engineers at Ushio undertake intensive in-house research, conceptualisation, and design while keeping you in the loop during each phase. Whether your interest lies in stretch blow moulding, or you are searching for the perfectly homogenous heat source for printed circuit board solder reflow, Ushio will lend you its knowledge and experience during the investigatory stages.

Once this crucial exploratory phase has found the best solution to compliment your application, the testing is relocated and repeated at your own production facility. Here the final adjustments can be made in a 'real world' scenario by taking your actual efficiency, environmental conditions, and production intensity into account.

Let Ushio know which industrial or laboratory solution you wish to perfect and the best product development team in the business will experiment with all manner of lamps, doses, and speeds to present you with the perfect IR solution to take your process to the next level.

The Ushio Solution Development Procedure follows a simple set of important steps to implement and maintain your Ushio infrared equipment to the highest possible standard.

Before

- ◆ Application research and experienced comparison
- ◆ Co-operative conceptualisation
- ◆ In-house design and recommendations
- ◆ Extensive comparative testing simulations

During

- ◆ 60 years of speciality lighting expertise
- ◆ One-stop-shop for adjustments and advisements
- ◆ Uncompromisingly focused on impeccable quality

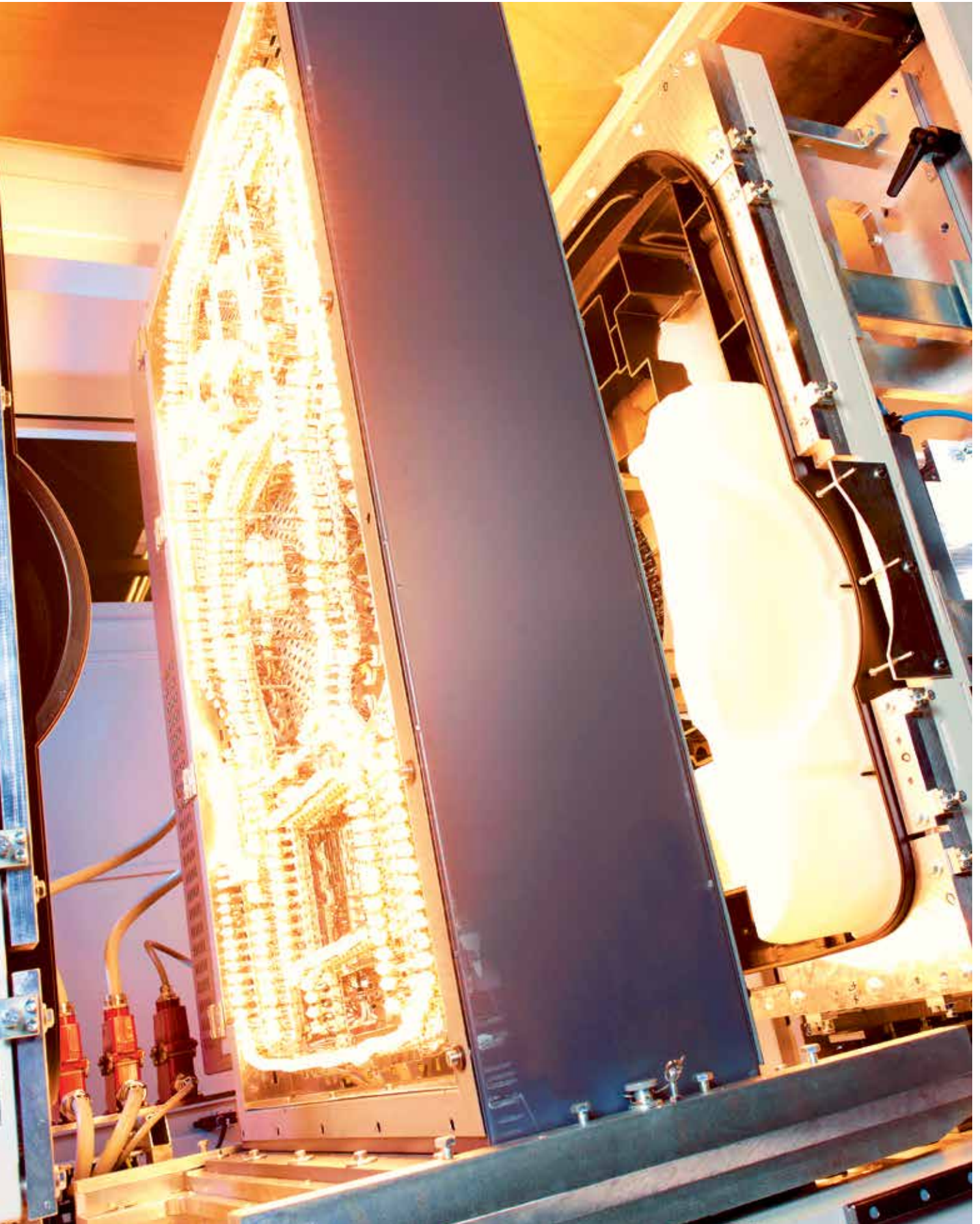
After

- ◆ Controlled reassessment of solution output results
- ◆ Continued focus on improvement
- ◆ Post-sale performance analysis and alterations

Handling & Operation tips for infrared lamps

General Hints

- ◆ IR lamps are for heating purposes only and are not intended for illumination purposes or use in other applications.
 - ◆ Before use, take note of the machine manufacturer's operating instructions, as well as the IR lamp operating instructions, which are enclosed with the lamp on delivery and must be observed at all times.
 - ◆ Remove any packaging material before operating the lamp.
 - ◆ IR lamps pose a high risk of burns or other serious injury. Switched off, damaged, or inoperable lamps may still be hot!
 - ◆ The lamp manufacturer does not assume liability in the event of improper lamp handling. Ushio IR lamps are subject to strict quality control measures and are designed not to cause any damage when used according to the instructions.
 - ◆ Secure lampholders and housings to prevent loosening or turning of the lamp during operation.
 - ◆ Slacken power connection wires during installation to prevent mechanical tension and potential separation from the lamp.
 - ◆ During installation and operation, care must be taken to maintain adequate distance between the IR lamp and the heated surface, as well as the reflector / fixture, to avoid damage to the lamp or substrate.
 - ◆ During operation, the IR lamp burning position must be in accordance with the enclosed specification.
The burning position is specified for every IR lamp, and may vary depending on the model acquired. If the IR lamp is operated beyond the intended burning position, its lifetime will decrease significantly. Ushio offers IR lamps which are especially designed for vertical use.
 - ◆ To avoid melting of the quartz tube, interruption of the halogen cycle, and oxidation of the molybdenum (Mo) foil during operation of the lamp, care has to be taken to keep the operating temperatures.
 - ◆ Always protect the lamp against mechanical stress.
 - ◆ Always operate the lamp with a fused and protected fitting.
 - ◆ IR lamps may only be handled and exchanged when disconnected from the power supply.
 - ◆ Clean gloves must be worn when handling IR lamps to avoid contamination of the quartz glass tube.
 - ◆ Check the fitting and lamp for signs of wear, dirt, charring, and any other damage. Clean or replace, if necessary.
 - ◆ If cleaning is necessary, this should be done using rubbing alcohol or another suitable alcohol.
 - ◆ Protect the machine against heat congestion and, if necessary, implement a suitable cooling system.
-

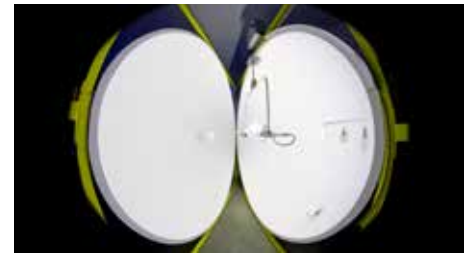


Spot welding unit with IR Pin-type lamps; image by bielomatik Leuze GmbH & Co. KG

R&D and Sales Division - Ushio Germany

Ushio Germany GmbH, launched 1968, is home to our European Research & Development center and sales hub for Infrared (IR) lamps, along with a wide range of other lamp types. Conveniently located near Munich, our facility boasts state-of-the-art technology for precise measurement.

In addition, we house an IR application laboratory, where internal testing and collaborative trials with clients take place, ensuring the development of cutting-edge solutions tailored to meet diverse needs.



Production Division - Ushio Poland

Ushio Poland, daughter company of Ushio Germany, and located near Warsaw, hosts our European production facility with a floor space of approx. 6000 m², established in 2017. This state-of-the-art plant serves as Ushio's key production hub in Europe, manufacturing not only Infrared (IR) lamps but also Ultraviolet (UV), High-Pressure Sodium (HPS) and Tanning lamps.

And of course, Ushio Germany and its production plant have maintained DIN EN ISO 9001:2015 certification, ensuring the highest standards of quality and excellence across our operations.



Ushio Worldwide

Japan

- ◆ Ushio Inc. Tokyo (Headquarters)
 - ◆ Harima Division
 - ◆ Yokohama Division
 - ◆ Gotemba Division
 - ◆ Kyoto Division
 - ◆ Osaka Branch

Americas

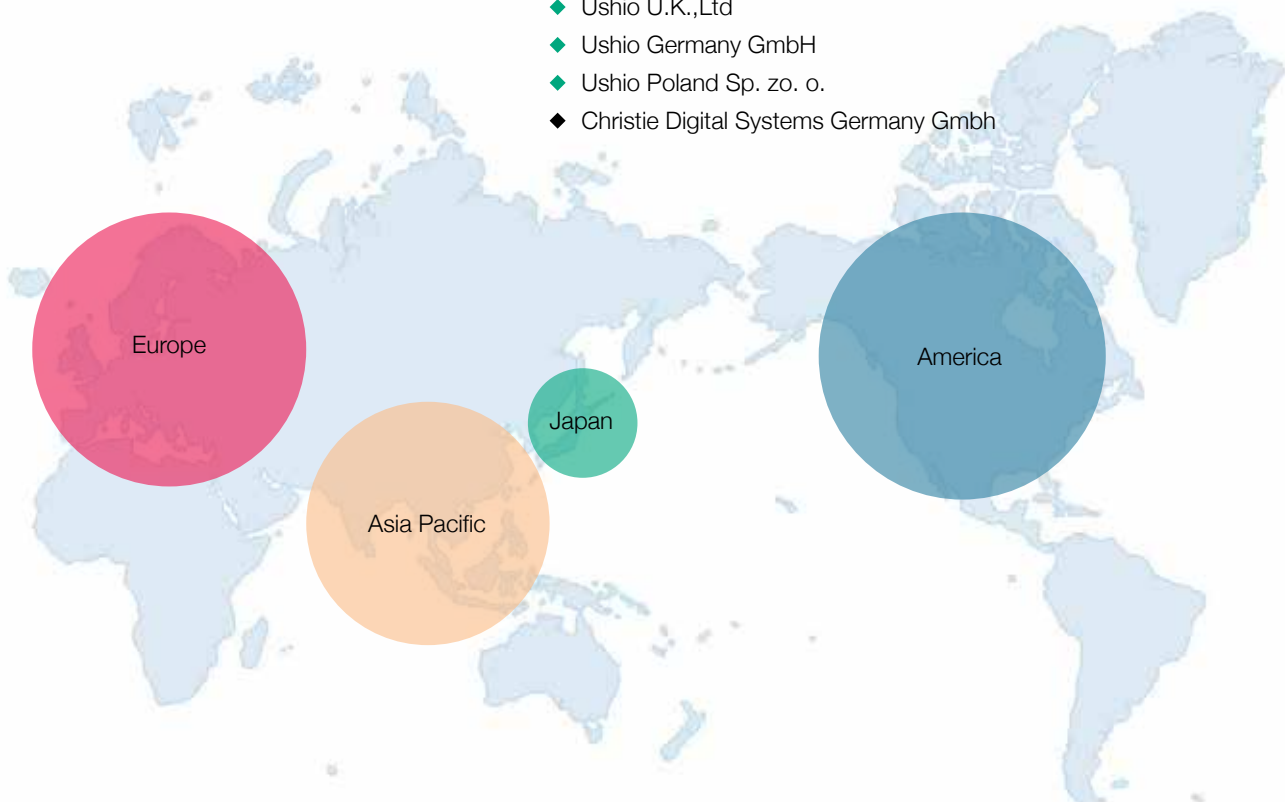
- ◆ Ushio America, Inc.
- ◆ Christie Digital Systems U.S.A., Inc.
- ◆ Christie Digital Systems Canada, Inc.
- ◆ Christie Digital Systems Mexico S.de R.L.de C.V.
- ◆ Christie Digital Systems South America LTDA
- ◆ Christie Digital Systems Columbia SAS
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- ◆ Necsel Intellectual Property, Inc.

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- ◆ Ushio Asia Pacific (Thailand) Ltd.
- ◆ Ushio Asia Pacific Vietnam Co., Ltd
- ◆ Ushio Taiwan, Inc.
- ◆ Ushio Korea, Inc.
- ◆ Ushio Hong Kong Ltd.
- ◆ Ushio Shanghai, Inc.
- ◆ Ushio Shenzhen, Inc.
- ◆ Ushio Asia Trading Ltd.
- ◆ Ushio (Suzhou) Co.,Ltd.
- ◆ Ushio (Shaoguan) Co.,Ltd.
- ◆ Ushio Philippines, Inc..
- ◆ Christie Digital Systems (Shenzhen) Co.,Ltd.
- ◆ Christie Digital Systems Australia Pty.Ltd.
- ◆ Christie Digital Systems India Pvt.Ltd.
- ◆ Christie Digital Systems (Hong Kong) Ltd.

Europe

- ◆ Ushio Europe B.V
- ◆ Ushio France S.A.R.L
- ◆ Ushio U.K.,Ltd
- ◆ Ushio Germany GmbH
- ◆ Ushio Poland Sp. zo. o.
- ◆ Christie Digital Systems Germany GmbH



Developing Solutions Together

Ushio is a partner that listens to your ideas and requirements. Let us optimise your processes according to your specifications and expectations. Use our expertise to develop a tailor-made solution that matches your needs.

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