

Plastics
Technologies
in Motion.



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INFRARED Plastics Joining

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Thermoplastics can be welded together using infrared radiation. With this method the infrared radiation is absorbed by the material and transformed into heat, whereby the surface layer is melted and the plastic components are joined by pressing them together. Infrared heat is transferred without contact. The heat input is fast, specific and energy-efficient. Power-controlled and time-controlled infrared emitters allow for precise and controlled welding processes. Typical applications include instrument panels, door trims and center consoles with complex 2D or 3D welding contours. Particle-free welding is particularly important when joining air-ducting pipes, fluid containers, tank systems and filters or filter housings.

FRIMO JoinLine – The complete range of infrared welding machinery

The FRIMO infrared product portfolio includes 6 standard machines for all production needs. We offer small and economical machines for welding applications such as filters, tubes and special parts. In the mid-size machinery segment we offer machines capable of welding components such as glovebox doors, kneebolsters, etc. The infrared machines in the larger segment are designed to handle complex and large components. Utilizing our high-speed magnetic drive welding machine, we are able to significantly shorten cycle times. Furthermore, FRIMO offers numerous automated solutions which can be designed to meet customer and project demands, e.g. combination and special solutions. All JoinLine infrared welding machines can also be equipped with additional ultrasonic welding steps.

IR-V-ECO-1600



IR-H-Highspeed



IR-V-RPS-1800



IR-V-ECO-800



Standard Tooling and Machinery

INFRARED Plastics Joining



IR-V-RPS-Maxi



IR-H-500

Innovative machinery concepts

IR-V-RPS-Maxi "The Maxi"

Do you need large components to be welded? FRIMO's Maxi-design infrared welding unit offers the only standard machine on the market that can handle infrared processes for components such as truck instrument panels.

Applications:

- Large components, e.g. instrument panels for commercial vehicles
- Tooling with multiple welding stations

| | |
|---------------------------------|---------------------------------|
| Movement: | Vertical |
| Drives and Axles: | 3 axles using servo-gear motors |
| Machine dimensions (W x D x H): | 4100 x 3500 x 3100 mm |
| Tool-clamping surface (W x D): | 2600 x 1200 mm |



IR-V-RPS-1800 "The Workhorse"

This FRIMO standard design stands the test of time in numerous production projects and is our bestseller. This robust and effective machine design is suitable for a high number of process applications.

Applications:

- Instrument panels (airbag and air duct) with off axis component movements
- Center consoles (multiple welding stations)
- Large containers

| | |
|---------------------------------|---------------------------------|
| Movement: | Vertical |
| Drives and Axles: | 3 axles using servo-gear motors |
| Machine dimensions (W x D x H): | 3450 x 3100 x 3050 mm |
| Tool-clamping surface (W x D): | 1840 x 1000 mm |



IR-V-ECO-1600 “The Economical”

The Eco-series is the optimal choice for a high number of applications, depending on the specific project parameters. The advantages are compact machinery design and significantly reduced weight while maintaining high performance for numerous joining demands.

Applications:

- Instrument panels (airbag and air duct)
- Center consoles (multiple welding stations)
- Large containers

| | |
|---------------------------------|---|
| Movement: | Vertical |
| Drives and Axles: | 2 or 3 axles using servo-gearred motors |
| Machine dimensions (W x D x H): | 2600 x 2600 x 3100 mm |
| Tool-clamping surface (W x D): | 1600 x 900 mm |



IR-H-Highspeed “The Fast and Precise”

With the JoinLine Highspeed, FRIMO offers the fastest welding unit on the market. With this solution the process is handled without gas, high temperature and dirt. By using the high-speed magnetic drive, cycle times are significantly reduced. This makes infrared technology a competitive alternative to classical joining techniques used in high quantity manufacturing processes.

Applications:

- All high performance plastics
- Air ducts
- Containers/filters
- Air duct systems/cylinders

Advantages of the linear driven motors:

- Fast (max 3.5 m/sec)
- Drive without mechanism
- Noise reduction
- Absolute repeating accuracy

| | |
|---------------------------------|-----------------------|
| Movement: | Horizontal |
| Drives and Axles: | Linear motors |
| Machine dimensions (W x D x H): | 2700 x 2300 x 2400 mm |
| Tool-clamping surface (W x D): | 600 x 400 mm |

Economical for low volume applications



IR-V-ECO-800 “The Economical Allrounder”

This new development offers all the advantages of the infrared welding technique with a comparatively low investment. This machine can be used as a starting unit for welding small quantities or for laboratory use. The IR-V-ECO-800 offers customers an attractive possibility to integrate infrared technology into their production environment.

Applications:

- Containers or perimeter welding
- Glovebox lids
- Big speaker boxes
- Air ducting pipes

| | |
|---------------------------------|---|
| Movement: | Vertical |
| Drives and Axles: | 2 or 3 axles using servo-gearred motors |
| Machine dimensions (W x D x H): | 1600 x 1800 x 2500 mm |
| Tool-clamping surface (W x D): | 800 x 400 mm |

IR-H-500 “The Small One”

FRIMO also offers a special unit to cover welding of small components. Small and extra small parts can be handled with the same process reliability using this type of machinery.

Applications:

- 2D welding
- Exhaust filters
- Speakers
- Containers for brake fluid
- Small filters

| | |
|---------------------------------|------------------------------------|
| Movement: | Horizontal |
| Drives and Axles: | 2 axles using servo-gearred motors |
| Machine dimensions (W x D x H): | 1700 x 1200 x 2100 mm |
| Tool-clamping surface (W x D): | 600 x 400 mm |



FRIMO Infrared machine with rotary table

Rotary tables offer fast station times without loss of cycle times while allowing integration of further functions and process steps. For these demands FRIMO has developed tailor-made machinery concepts.

Features:

- 2-station machinery with rotary table to allow the operator to exchange welded parts with new parts within the weld cycle



IR-V-RPS Automated

Depending on the given manufacturing solutions, the use of automated tool change is possible

Features:

- Machine with automated tool change.
- "Sandwich tooling" can be changed within 3 minutes



Easy tool change by means of sandwich design

Special units

IR-V Double station unit

The double station unit is used for the combined manufacturing of different component variants which enables higher output rates by using multi-station units.

Features:

- Ideal for components in 2 different versions (e.g. LHD+RHD)
- Higher output rates by use of multi cavity molds



Robot based welding with the FRIMO JoinLine Highspeed

FRIMO also offers numerous automated solutions. These solutions offer more flexibility to the manufacturer. Several welding consoles and assembly grippers can be combined and existing functions can be adapted with the use of robots, thereby reducing the effort in handling different components within the production process.

Features:

- Equipped with an "in-house" robot
- Completely automated component handling possible (feeding, welding and removal)



For infrared joining, different types of IR emitters can be used. Depending on the project requirements, quartz glass bulb emitters or metal foil emitters can be used. FRIMO offers tailor-made solutions for both systems.



Quartz glass bulb emitter

- Radiation temperature approx. 1800-2400°C
- Achieves operating temperature within 1 sec
- Max power of 200 kW/m²
- Short cycle times (typical heating period about 12 sec)
- Greater distance to material possible; low risk of fire
- Flexible heating via individual control of single radiator units
- Standard straight, standard contour or special design, e.g. 3D contours
- Different wavelengths (0.78µm to 2µm)
- IR radiation has a greater heating distance that allows for broader part tolerances

Metal foil emitter

- Radiation temperature approx. 700°C
- Achieves operating temperature within 8-10 sec
- Max power of 32 kW/m²
- Longer cycle times necessary
- Lower power and temperature require shorter distance between emitters and material; risk of fire
- Only constant energy emission along length / width of the metal foils
- Flexible contour; easy to adjust
- Medium-wave system (2.1µm to 3.6µm)
- Shorter heating distance does not allow for broader part tolerances

FRIMO JoinLine – driving technique for infrared joining machinery

Roller Pinion System (RPS) Advantages:

- Absolute repeatability
- Free of play – no slipping in comparison to classic steering rack drives
- Speed of the drive
- Low-noise drive

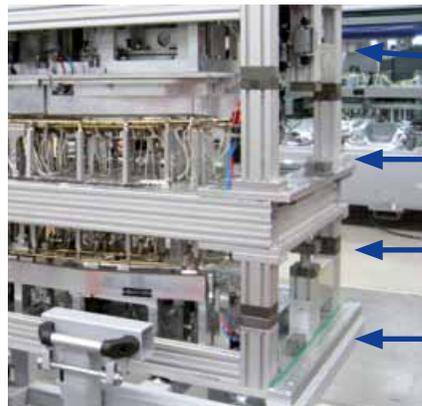


Lifting gear with the roller pinion system (RPS), drive via servo geared motors with absolute encoder.

Innovative tooling concepts

FRIMO offers innovative concepts for a quick tool change, allowing for optimal tool handling and increased productivity.

- Modular cartridge system
- Sandwich construction for optimal protection of emitter field
- Quick tool change within 3 minutes
- Several cartridges for one machine possible
- Tool change cart available
- Tool change can be operated from the front or back side of the machine, according to the production conditions



Basic design for changing tools

Upper part holder
(for the IR-H: left holder)

Infrared field

Lower part holder
(for the IR-H: right holder)

Tool change cart



Complex infrared (IP) tool with standard emitters, contour emitters and shadow plates.



Component fixture with independently powered 3D holding-down system



Vertical tool arrangement



Horizontal tool arrangement

Control – Monitoring – Documentation in IR applications

Various design conditions require the ability to closely control welding parameters. These include:

- Narrow and broad joining zones
- Different materials
- Visible edges
- Stacked emitters
- Different material thicknesses



Control technology

Machine operation and parameter entry is controlled by a comfortable touch panel located in either of the following positions:

- Integrated in control cabinet
- As an offset control panel



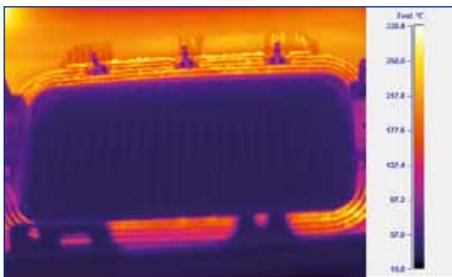
Touch screen in offset control panel

Comprehensive and new test methods – For more quality and safety

The following can be monitored in our systems:

- Current of the IR emitters
- Joining path
- Welding pressure
- Welding depth (by automated registration of material height)
- Heat input into welding seam can be recorded with infrared cameras and evaluated with image comparison
- Inspection of infrared heater field during OFF mode via cameras

Testing technique with INFRARED camera



Master image:

- Temperature profile of welding line as recorded with IR camera
- Determination of the temperature tolerances

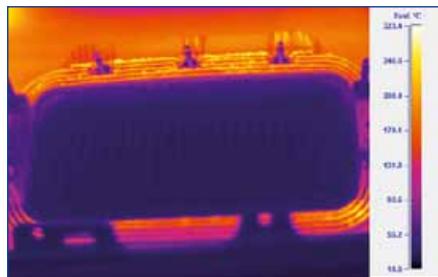
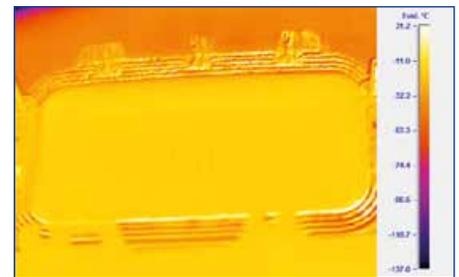


Figure for comparison:

- Recording per part at the time of production



Test image:

- Temperature difference image between master image and production record
- Automatic fault detection

Comparison of the joining processes

INFRARED welding allows for the following advantages in terms of quality and efficiency:

- Particle free; e.g. for air- or oil-ducting components (increasingly indicated in OEM specifications)
- Increased use of reinforced high-performance plastics, e.g. glass fiber
- Use of reinforced plastics for structural components and lightweight construction
- Higher yield strength in security-relevant areas
- 100% gas tight welds
- Welding of different materials
- Design freedom in regards to complex 3D geometries
- Productivity, economic viability and energy efficiency

Comparison of the joining processes for PP GF 30

| Features | Method | Infrared welding | Ultrasonic welding | Hot plate welding | Vibration welding | Hot-air welding |
|---------------------|--------|------------------|--------------------|-------------------|-------------------|-----------------|
| Strengths | | ●●● | ● | ●● | ●● | ●● |
| Gas-tightness | | ●●● | ● | ●●● | ●● | ●●● |
| Cycle time | | ●● | ●●●● | ● | ●● | ● |
| Particle-free | | ●●● | ● | ● | ● | ●●● |
| Different materials | | ●● | | ● | ● | ●● |
| 3-D contours | | ●●● | ● | ● | | ● |
| Service/changes | | ●● | ●●●● | ● | ● | ● |
| Distortions | | ●● | ●● | ●● | ●● | ●● |
| Investment | | ●● | ● | ● | ●● | ●● |

Recent and future applications:

- Large-scale components, e.g. instrument and door panels, center consoles
- Parts with complex 3D welding contours
- Air-ducting pipes
- Fluid containers
- Tank systems and filters
- Housing, e.g. air filter / filter housing
- Lamp housing
- Car battery chambers
- Technical components, e.g. for sanitary and medical parts and white goods

Advantages

- Non-contact method
- Welding of complex, three-dimensional contours
- Higher strengths
- Particle-free process
- Absolute air and gas tightness
- Joining of different materials, e.g. TPE with PP GF 30
- Simple machine technology, large parameter window
- Wide range of IR machines
- All types of tooling and emitters
- Numerous references
- Know-how for all known joining processes

