



# Thermoforming with KRELUS IR Heaters from Leister

**FOCUS** | Save Energy in Thermoforming

# Infrared Technology from Leister for the Mechanical Engineering Industry

## **Infrared Solutions in Mechanical Engineering for Plastic Manufacturing**

The powerful KRELUS infrared heaters from Leister are ideally suited for customer-specific infrared solutions in various industrial applications. Whenever high radiation intensity, easy controllability, short reaction times, and tailor-made solutions with optimum economic efficiency are required, KRELUS infrared solutions from Leister are in demand and have proven themselves worldwide.

**Leister. We know how.**

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# Precise Heating with IR Heaters

A wide range of sectors in the plastics manufacturing industry use thermoforming to produce plastic components for a variety of applications. The medium-wave KRELUS IR heaters from Leister are perfect for heating plastic semi-finished products to the required temperature uniformly, precisely and quickly.



Application example agricultural machinery: Thermoformed tractor cladding such as hood, fenders, cab interior and trailer

# Save Energy when Thermoforming

Leister offers the fast-reacting medium-wave KRELUS IR heaters. So you always have the right tool to save energy when thermoforming. Because IR heating appliances can only be operated to suit custom requirements with the use of fast-reacting IR heaters. In the thermoforming cycle, this means switching off in seconds when not needed.

## Demand-oriented Operation of IR Heaters when Thermoforming Saves Energy

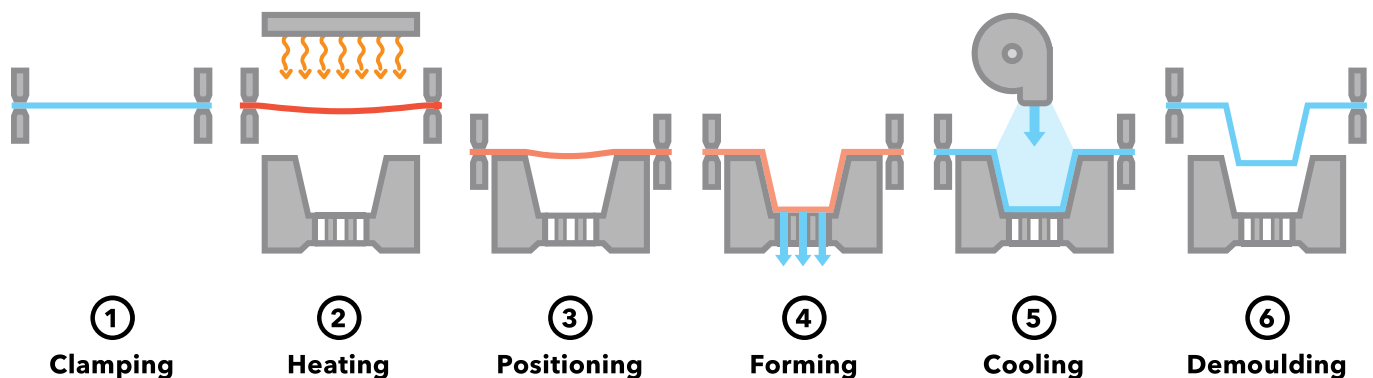
There are two process categories when thermoforming: Heavy-gauge thermoforming for thick-walled and thin-gauge thermoforming for thin-walled plastic components. While thin-walled components are usually manufactured continuously on roller machines, sheet fed machines are used for thick-walled components. In that way great energy saving potential arises through the cyclic process control. This is because IR heaters are switched on exclusively during the heating phase. Otherwise, they remain switched off and use no energy.

## Energy Savings - User Benefits

You, the user, save a lot of energy during the cyclical operation of your thermoforming sheet fed machines, provided they are equipped with fast-reacting KRELUS IR heaters from Leister. Your benefits:

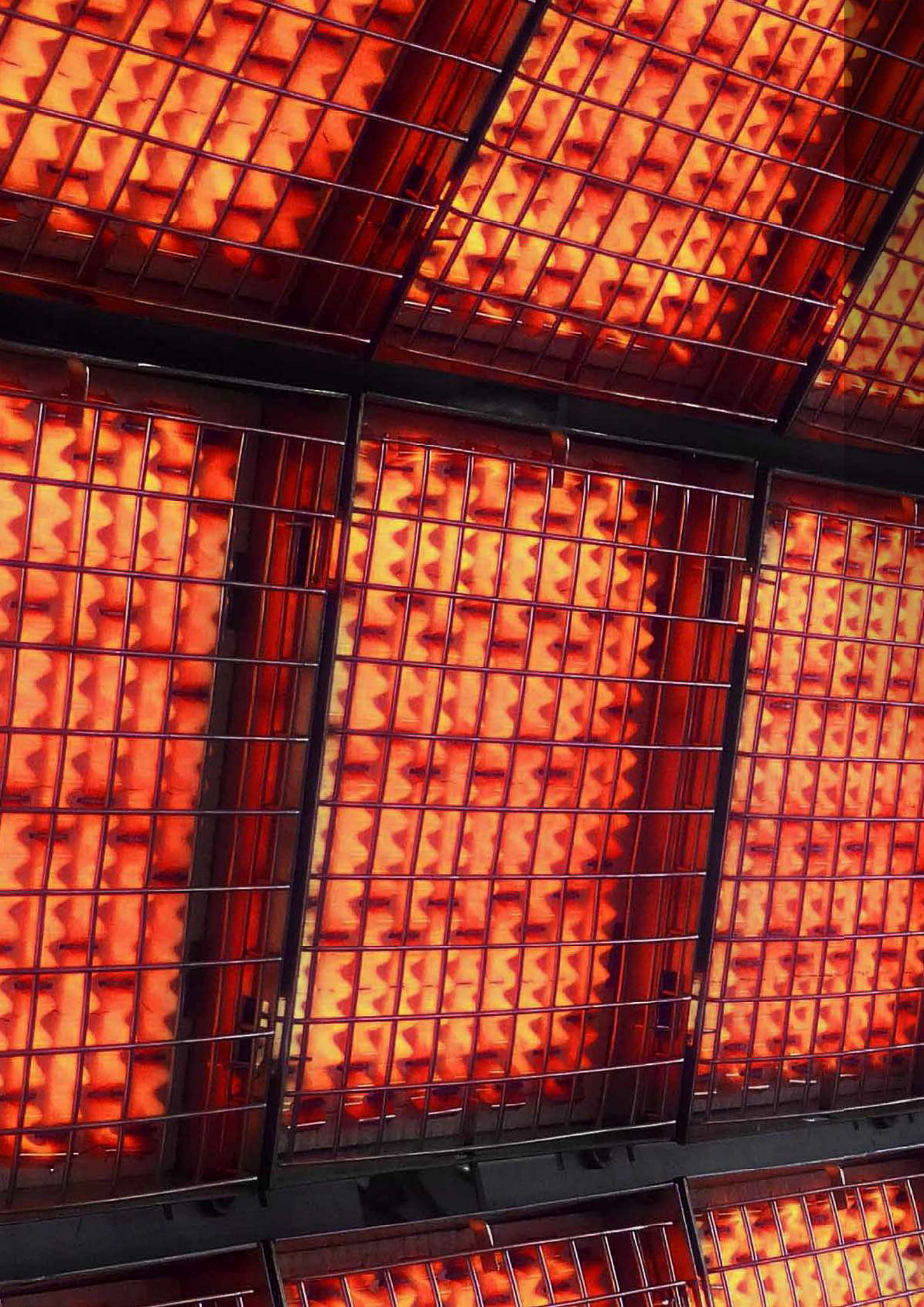
- Energy savings through demand-oriented operation of the IR heaters
- Cut operating costs with efficient energy use
- Less waste heat from the IR heater field
- High process stability due to precise control of the component temperature
- Faster material changeover thanks to temperature control

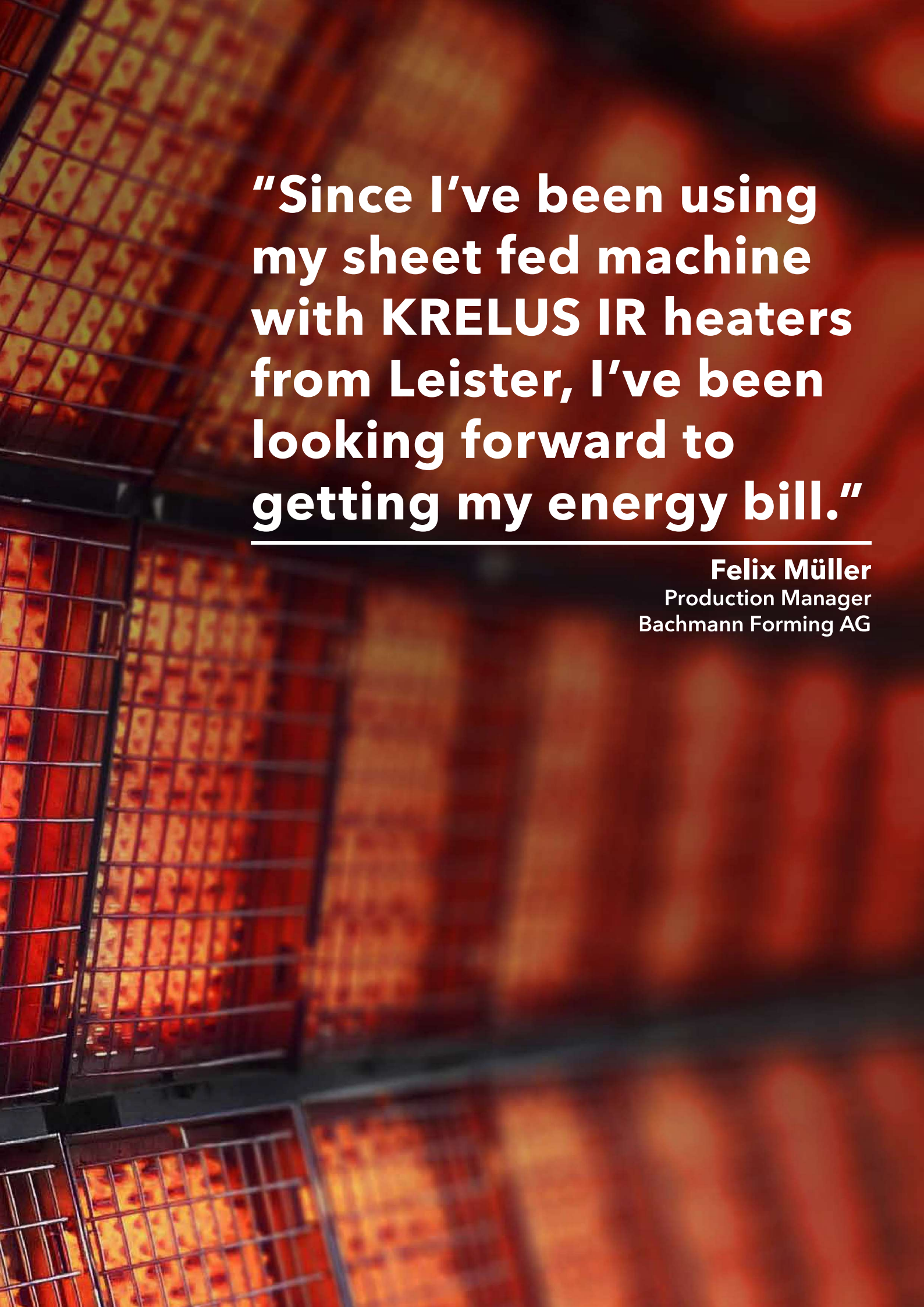
## Thermoforming Process Phases



Request a free expertise now







**“Since I’ve been using  
my sheet fed machine  
with KRELUS IR heaters  
from Leister, I’ve been  
looking forward to  
getting my energy bill.”**

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**Felix Müller**  
Production Manager  
Bachmann Forming AG

# 50 % Lower Energy Costs

The biggest energy consumer when thermoforming is the heating process step. Many of today's thermoforming machines use ceramic heaters for this. They are cheaper, but they react very slowly compared to more expensive metal foil heaters. Read on to find out why this is a problem and why it pays to invest in fast-reacting metal foil heaters.

The standard cycle time for thermoforming processes on sheet fed machines is 30 seconds to several minutes. IR radiation, however, is only required during the heating process step. To save energy and cut costs, the medium-wave IR heaters need to be switched off during the other process phases. This works with fast-reacting metal foil heaters. This is because they cool down immediately after switching off and heat up again in a few seconds. Ceramic heaters, on the other hand, need several minutes to heat up and cool down.

With this slow reaction time, turning off the ceramic heater for a short period is not an option, which is why it is used continuously. Therefore, you also use energy in process phases in which heating is not required.

The following calculation illustrates the annual energy consumption of ceramic heaters compared with metal foil heaters. The calculation is based on IR heaters fields with an output of 50 kW and a cycle time of one minute.

## Conditions

Cycle time	1 min
Heating time	25 s
Stand-by-time (forming, cooling)	35 s
Number of shifts per day	3
Machine hours per shift	7 h
Working days per year	220 d
Machine hours per year	4620 h
Usage of IR-heater power	50 kW
Energy price for 1 kWh (industry)	0.15 EUR/kWh*

## Example Calculation

	Metal Foil IR Heater	Ceramic IR Heater
Heating time	5 s	several minutes
Heater "ON" time per cycle	30 s (incl. 5 s pre-heating)	1 min
Total consumption per day	525 kWh	1050 kWh
Total consumption per year	115 500 kWh	231 000 kWh
Electricity cost per year	17 325 EUR	34 650 EUR
<b>Savings per year</b>	<b>17 325 EUR</b>	

\* The energy price for 1 kWh in industrial applications is subject to wide fluctuations.

In this example, the metal foil heaters are switched on for 30 seconds during a cycle time of one minute. Compared with continuous IR heater operation, the energy saving amounts to 50%.

The efficiency of medium-wave metal foil heaters is also higher compared to ceramic heaters. This means that the same radiant energy absorbed by the product is achieved with around 10% less electricity. This increases the savings still further.

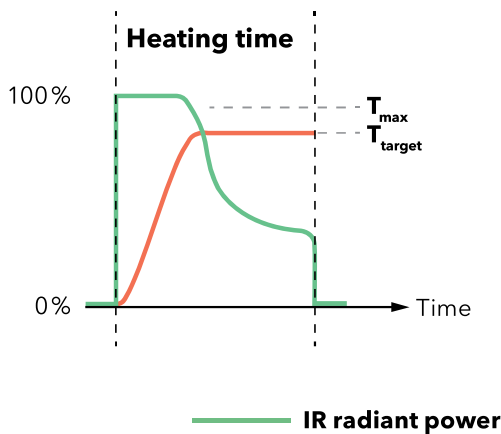
# Everything Under Control

With KRELUS IR heaters from Leister you are one step ahead in the process. Because with them temperature regulated process management is possible. The plastic semi-finished product reaches its deformation temperature regardless of changing environmental conditions - without overheating.

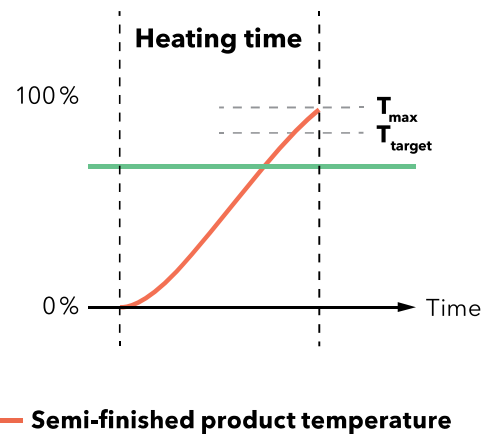
Temperature regulated process management has benefits over time-controlled process management because temperature control enables you to precisely adjust the power output of the metal foil heaters in real time. This occurs by measuring the surface temperature of the semi-finished product and via PID control. So the plastic semi-finished product receives exactly the amount of heat radiation it requires, regardless of the material, target temperature and environmental conditions.

Temperature regulated process management also enables the target temperature to be maintained while simultaneously adding energy. This ensures controlled heating, even with thick-walled components, through the entire thickness of the material. While the surface temperature remains constant, the core temperature increases until the desired even heating is achieved.

## Temperature Regulated Process



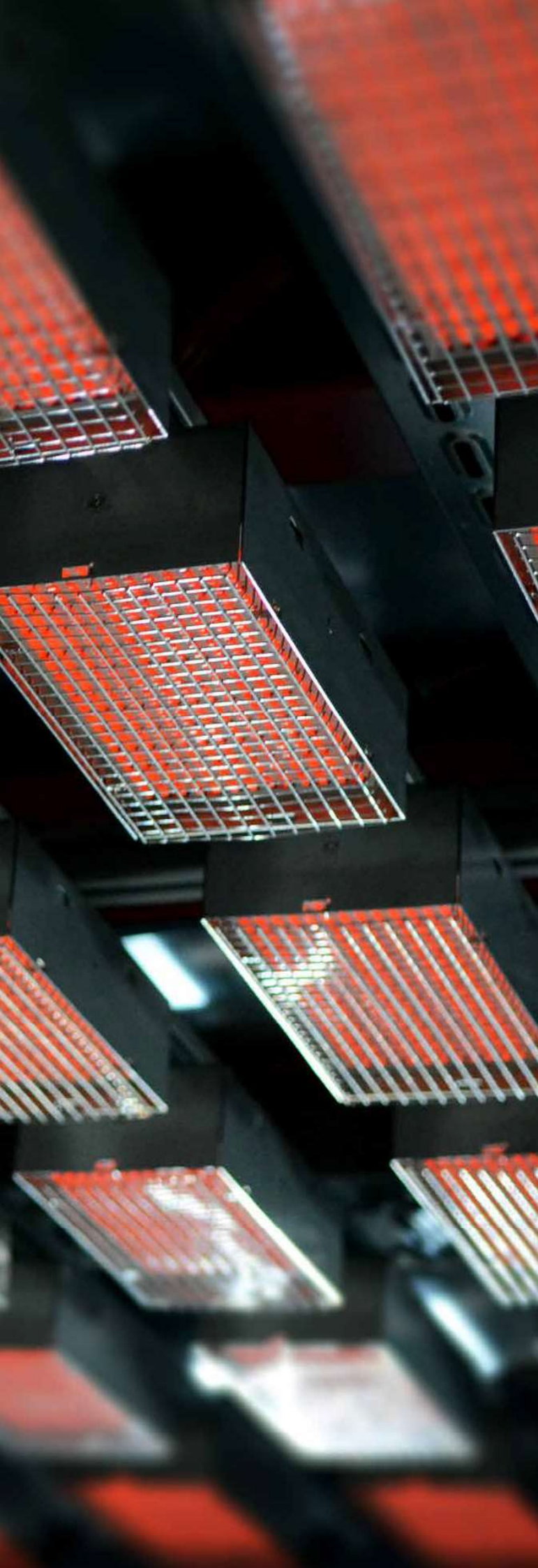
## Time-Controlled Process



Set up a consultation  
with experts







## **Infrared Heaters**

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# KRELUS G14-25 MINI



KRELUS G14-25 MINI square infrared modular heaters are ideal for larger or smaller fields with one or more separately controlled heating zones.

# KRELUS G7-50 MINI



KRELUS G7-50 MINI rectangular infrared heaters can be combined into heater fields. They can also be used with KRELUS G14-25 MINI heaters in one heater field.

## Technical Data

Voltage	200-240 V	
Frequency	50/60 Hz	
Power	1350-3600 W	
Power density	22.0-58.0 kW/m <sup>2</sup>	14.19-37.41 W/in <sup>2</sup>
Max. ambient temperature	500 °C	932 °F
Length	248.0 mm	9.76 in
Width	248.0 mm	9.76 in
Height	65.0 mm	2.55 in
Weight	2.7 kg	5.95 lb
Approvals	CE	
Protection class (IEC 60529)	IP20	
Protection class	I	

## Technical Data

Voltage	200-240 V	
Frequency	50/60 Hz	
Power	1350-3600 W	
Power density	22.0-58.0 kW/m <sup>2</sup>	14.19-37.41 W/in <sup>2</sup>
Max. ambient temperature	500 °C	932 °F
Length	496.0 mm	19.52 in
Width	123.0 mm	4.84 in
Height	65.0 mm	2.55 in
Weight	2.7 kg	5.95 lb
Approvals	CE	
Protection class (IEC 60529)	IP20	
Protection class	I	

## Product articles

KRELUS IR-Heater G14-25 MINI 4, 230 V/1360 W	116.688
KRELUS IR-Heater G14-25 MINI 5, 230 V/1700 W	116.690
KRELUS IR-Heater G14-25 MINI 6, 230 V/2000 W	116.691
KRELUS IR-Heater G14-25 MINI 7.5, 230 V/2500 W	116.692
KRELUS IR-Heater G14-25 MINI 9, 230 V/3100 W	116.769
KRELUS IR-Heater G14-25 MINI 10.5, 230 V/3565 W	122.539
KRELUS IR-Heater G14-25 MINI 6, 200 V/1740 W	126.933
KRELUS IR-Heater G14-25 MINI 6, 220 V/2000 W	126.934
KRELUS IR-Heater G14-25 MINI 6, 240 V/2000 W	126.935
KRELUS IR-Heater G14-25 MINI 6 PS, 230 V/2000 W (w pyrom.-hole std.)	116.949
KRELUS IR-Heater G14-25 MINI 6 PC, 230 V/2000 W (w pyrom.-hole center)	117.101

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## Product articles

KRELUS IR-Heater G7-50 MINI 4, 230 V/1360 W	117.770
KRELUS IR-Heater G7-50 MINI 5, 230 V/1700 W	119.412
KRELUS IR-Heater G7-50 MINI 6, 230 V/2000 W	119.424
KRELUS IR-Heater G7-50 MINI 7.5, 230 V/2500 W	119.452
KRELUS IR-Heater G7-50 MINI 9, 230 V/3100 W	119.453
KRELUS IR-Heater G7-50 MINI 10.5, 230 V/3565 W	130.387
KRELUS IR-Heater G7-50 MINI 6, 200 V/1740 W	128.195
KRELUS IR-Heater G7-50 MINI 6, 220 V/2000 W	128.216
KRELUS IR-Heater G7-50 MINI 6, 240 V/2000 W	128.451
KRELUS IR-Heater G7-50 MINI 6 PS, 230 V/2000 W (w pyrom.-hole std.)	117.131
KRELUS IR-Heater G7-50 MINI 6 PC, 230 V/2000 W (w pyrom.-hole center)	119.469

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# KRELUS G14-25 MINI-MINI



KRELUS G14-25 MINI-MINI rectangular heaters are half the size of the KRELUS-MINI heaters. That means it offers great flexibility when setting up heater fields.

# KRELUS G9-40 MINI-MINI



KRELUS G9-40 MINI-MINI infrared heaters are rectangular and have a particularly slim design. That makes it perfect for use in the narrow outer zones of heater fields.

## Technical Data

Voltage	200-240 V	
Frequency	50/60 Hz	
Power	760-1300 W	
Power density	24.0-42.0 kW/m <sup>2</sup>	15.48-27.09 W/in <sup>2</sup>
Max. ambient temperature	500 °C	932 °F
Length	248.0 mm	9.76 in
Width	123.0 mm	4.84 in
Height	65.0 mm	2.55 in
Weight	1.35 kg	2.97 lb
Approvals	CE	
Protection class (IEC 60529)	IP20	
Protection class	I	

## Technical Data

Voltage	200-240 V	
Frequency	50/60 Hz	
Power	760-1100 W	
Power density	24.0-34.0 kW/m <sup>2</sup>	15.48-21.93 W/in <sup>2</sup>
Max. ambient temperature	500 °C	932 °F
Length	398.0 mm	15.66 in
Width	79.0 mm	3.11 in
Height	65.0 mm	2.55 in
Weight	1.5 kg	3.3 lb
Approvals	CE	
Protection class (IEC 60529)	IP20	
Protection class	I	

## Product articles

KRELUS IR-Heater G14-25-2.5 MM3, 200 V/757 W	123.848
KRELUS IR-Heater G14-25-2.5 MM3, 220 V/915 W	123.850
KRELUS IR-Heater G14-25-2.5 MM3, 230 V/1000 W	122.604
KRELUS IR-Heater G14-25-2.5 MM3, 240 V/1090 W	123.852
KRELUS IR-Heater G14-25-2.5 MM3.3, 200 V/904 W	124.623
KRELUS IR-Heater G14-25-2.5 MM3.3, 220 V/1090 W	124.624
KRELUS IR-Heater G14-25-2.5 MM3.3, 230 V/1200 W	122.609
KRELUS IR-Heater G14-25-2.5 MM3.3, 240 V/1300 W	124.629
KRELUS IR-Heater G14-25-2.5 MM3 PS, 230 V/1000 W (w pyrom.-hole std.)	122.657
KRELUS IR-Heater G14-25-2.5 MM3.3 PS, 230 V/1200 W (w pyrom.-hole std.)	122.785

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## Product articles

KRELUS IR-Heater G9-40-2.5 MM3, 200 V/757 W	123.803
KRELUS IR-Heater G9-40-2.5 MM3, 220 V/915 W	123.831
KRELUS IR-Heater G9-40-2.5 MM3, 230 V/1000 W	122.560
KRELUS IR-Heater G9-40-2.5 MM3, 240 V/1090 W	123.841



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# KRELUS G11-12 SUPER-MINI



KRELUS G11-12 SUPER-MINI square surface heaters can be used in smaller fields thanks to their reduced size. Like the other KRELUS modular heaters, they can also be used alone or in combination.

# KRELUS G5-25 SUPER-MINI



KRELUS G5-25 SUPER-MINI rectangular surface heaters can be integrated into small fields. In combination with the KRELUS G11-12 SUPER MINI, the size of the heater fields can be individually adjusted.

## Technical Data

Voltage	77 V	
Frequency	50/60 Hz	
Power	540-960 W	
Power density	35.0-60.0 kW/m <sup>2</sup>	22.58-38.7 W/in <sup>2</sup>
Max. ambient temperature	500 °C	932 °F
Length	123.0 mm	4.84 in
Width	123.0 mm	4.84 in
Height	50.0 mm	1.96 in
Weight	0.6 kg	1.32 lb
Approvals	CE	
Protection class (IEC 60529)	IP20	
Protection class	I	

## Technical Data

Voltage	77 V	
Frequency	50/60 Hz	
Power	540-960 W	
Power density	35.0-60.0 kW/m <sup>2</sup>	22.58-38.7 W/in <sup>2</sup>
Max. ambient temperature	500 °C	932 °F
Length	248.0 mm	9.76 in
Width	61.0 mm	2.4 in
Height	50.0 mm	1.96 in
Weight	0.6 kg	1.32 lb
Approvals	CE	
Protection class (IEC 60529)	IP20	
Protection class	I	

## Product articles

KRELUS IR-Heater G11-12 SM5 L, 77 V/540 W	122.795
KRELUS IR-Heater G11-12 SM5 LP, 77 V/540 W (w pyrom.-hole std.)	122.796
KRELUS IR-Heater G11-12 SM5, 77 V/960 W	122.786
KRELUS IR-Heater G11-12 SM5 P, 77 V/960 W (w pyrom.-hole std.)	122.787

## Product articles

KRELUS IR-Heater G5-25 SM5 L, 77 V/540 W	122.926
KRELUS IR-Heater G5-25 SM5 LP, 77 V/540 W (w pyrom.-hole std.)	122.927
KRELUS IR-Heater G5-25 SM5, 77 V/960 W	123.162
KRELUS IR-Heater G5-25 SM5 P, 77 V/960 W (w pyrom.-hole std.)	123.163



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Galileo-Strasse 10  
6056 Kaegiswil  
Switzerland

leister.com  
leister@leister.com  
+41 41 662 74 74



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