

Innovative Heating Solutions



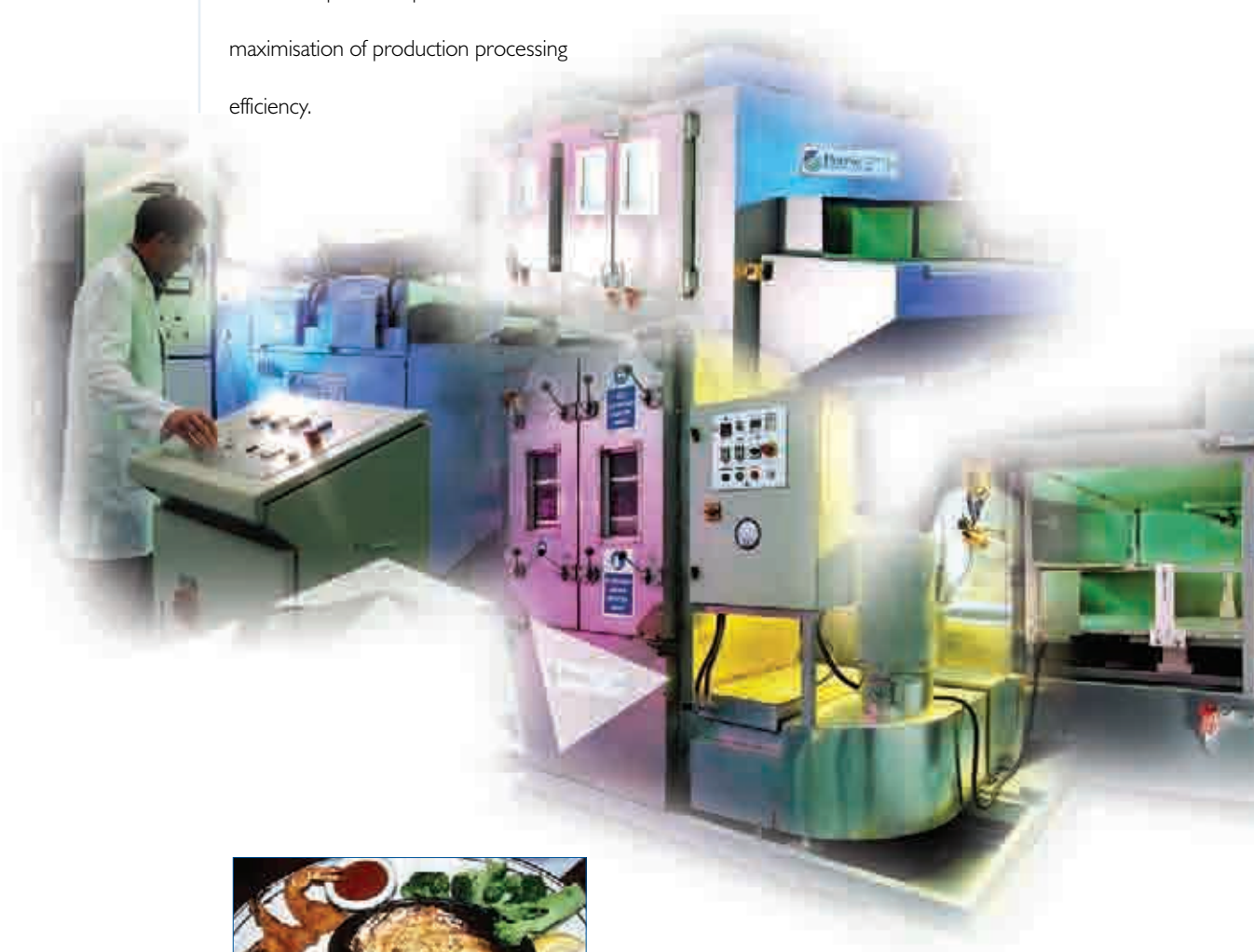
  
**Petrie**  
TECHNOLOGIES LIMITED

# Innovative Heating Solutions

## Innovative Heating Solutions

Petrie Technologies specialises in the development, manufacture and supply of optimum heating solutions. Our primary expertise is in the innovative application of energy - including radio frequency, microwave, induction, infrared, steam and hot air heating technologies - to meet customer specific requirements in the maximisation of production processing efficiency.

With a team of experienced engineers and scientists, backed by the extensive design and manufacturing resources of the NIS Group, we have the capability to deliver total solutions for a wide range of food, chemical, pharmaceutical and industrial processing needs.



# Petrie Technologies Profile

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Petrie Technologies has been involved in the design, development and manufacture of special purpose machinery for more than 100 years. Our primary expertise is in the innovative application of energy, embracing radio frequency, microwave, induction, infrared, steam and hot air heating technologies - harnessed individually or jointly to achieve temperature elevation to precisely optimised levels.

Backed by the extensive design and manufacturing resources of the NIS Group, Petrie's team of engineers and scientists has the capability to deliver total solutions for a wide range of food, chemical, pharmaceutical and industrial needs - our mission, 'to maximise competitiveness by enhancing production process quality and efficiency'.



Drying

Tempering

Forming

Defrosting

Curing

Searing

Baking

Welding

# Petrie Technologies Profile



## Energy

### Radio Frequency (RF)

### Microwave

### Induction

### Infrared

### Microwave + Induction

### Radio Frequency + Hot Air (ARFA)

### Hot Air

With a dedicated test and development laboratory, we custom design and develop both machinery and processes to meet individual customer requirements. This unique field of expertise can be applied across numerous applications, here are some typical examples:

## Applications

Defrosting - mass thawing of frozen food products to precise temperature levels, typically -20°C to 0°C

In-line cooking

Plastics forming and moulding

Rapid drying of wood and fibre products evenly from surface to core

Moisture profiling of cigar and tobacco products

Rapid partial or rapid complete cooking of foodstuffs

Expansion fitting of precision metal components

Curing, surface drying and annealing

Cooking and searing of foodstuffs for ready meals

Cooking, baking and moisture profiling

Controlled temperature, humidity and curing



# Manufacturing Resources

Petrie Technologies is a member of the NIS Group of Companies, an integrated engineering organisation specialising in the design and manufacture of complex mechanical handling and heat transfer solutions.

This extensive resource is used to manufacture Petrie's range of high technology process equipment - from the fabrication of its stainless steel cases, to the design and production of the controls and the mechanical handling systems.



3D CAD

System integration

Robotics

Automation

# Manufacturing Resources Manufacturing Resources



The facility is located in impressive, purpose built premises totalling more than 7,100 square metres and incorporates five overhead cranes and a comprehensive precision machining facility. Welding and fabrication of a wide range of metals, including high grade stainless steel, are undertaken, together with assembly and testing of mechanical, hydraulic, pneumatic, electronic and software control systems - all to ISO 9001 accreditation.



- Aerospace
- CRT
- Food
- Nuclear
- Pharmaceutical
- Medical

With an exceptional wealth of experience in the production of equipment of all kinds, the NIS Group currently supplies engineering solutions across a diverse range of industries, worldwide.

# Mobile RF Tempering & Defrosting

Petrie Technologies offers a range of equipment for continuous thawing applications. Based on radio frequency dielectric heating (RF), the technique provides a means of rapid, 'just in time' processing to achieve product quality which may be close to that of fresh chilled product, with less drip loss and much reduced biological growth, as compared to conventional methods. Significantly, unlike microwave techniques, which are only used for tempering, RF can be used for both tempering and defrosting.



Industrial applications exist in both the fish and meat industries. Products which have been successfully tempered or defrosted include; meat, fish, fruit and vegetables.

The equipment uses a modular concept to match the throughput needs of a process. Typically, a minimum of two and a maximum of five modules may be used depending on the process to give throughputs of around a tonne per hour for defrosting and several tonnes per hour for tempering.

To assist product and process evaluation, a two zone mobile continuous pilot unit is available, capable of throughputs of around 100 kg per hour for tempering (dependent on the product).

Tuna

Sardines

Salmon

Chicken

Prawns

Turkey

Mackerel

Beef

Fruit

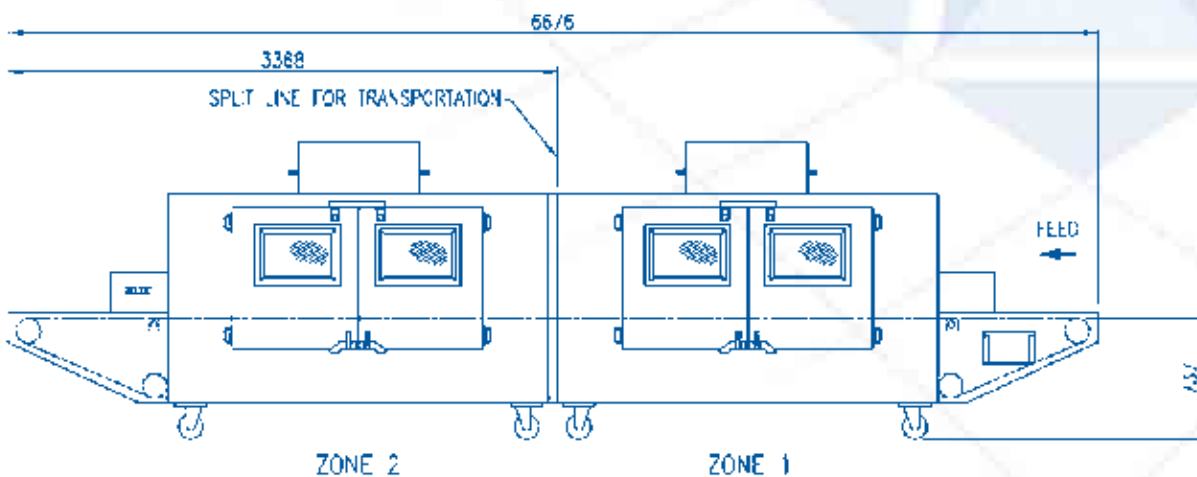
Vegetables



# Pilot Unit Specification

The following specification may be used as a guideline when considering space requirements and services when operating the equipment:

Number of Modules	2
L x W x H	3.38 x 1.25 x 2 m
Weight	600 kg
RF Generators	2
Operational Frequency	13.56 MHz
Max Power Output	Typically up to 15 kW and 5 kW for appropriate module
L x W x H	Up to 0.9 x 0.9 x 1.8 m depending on generators used
Weight	Up to 1000 kg (approx.) depending on generators used
Electrical Supply	208 V or 400 V, three phase + neutral + earth, 35 kW (exact configuration depends on generators used, an intermediate transformer may be required as part of ancillaries)
Ancillaries	Skid + control and cooling system
Dimensions and Weight	Comparable to single module above



# Radio Frequency Defrosters

## Radio Frequency Defrosters



Maximum retention of product quality and taste

Negligible drip loss

Standardisation of processes, yields and qualities

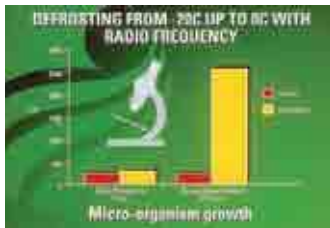
Significant cost and time savings



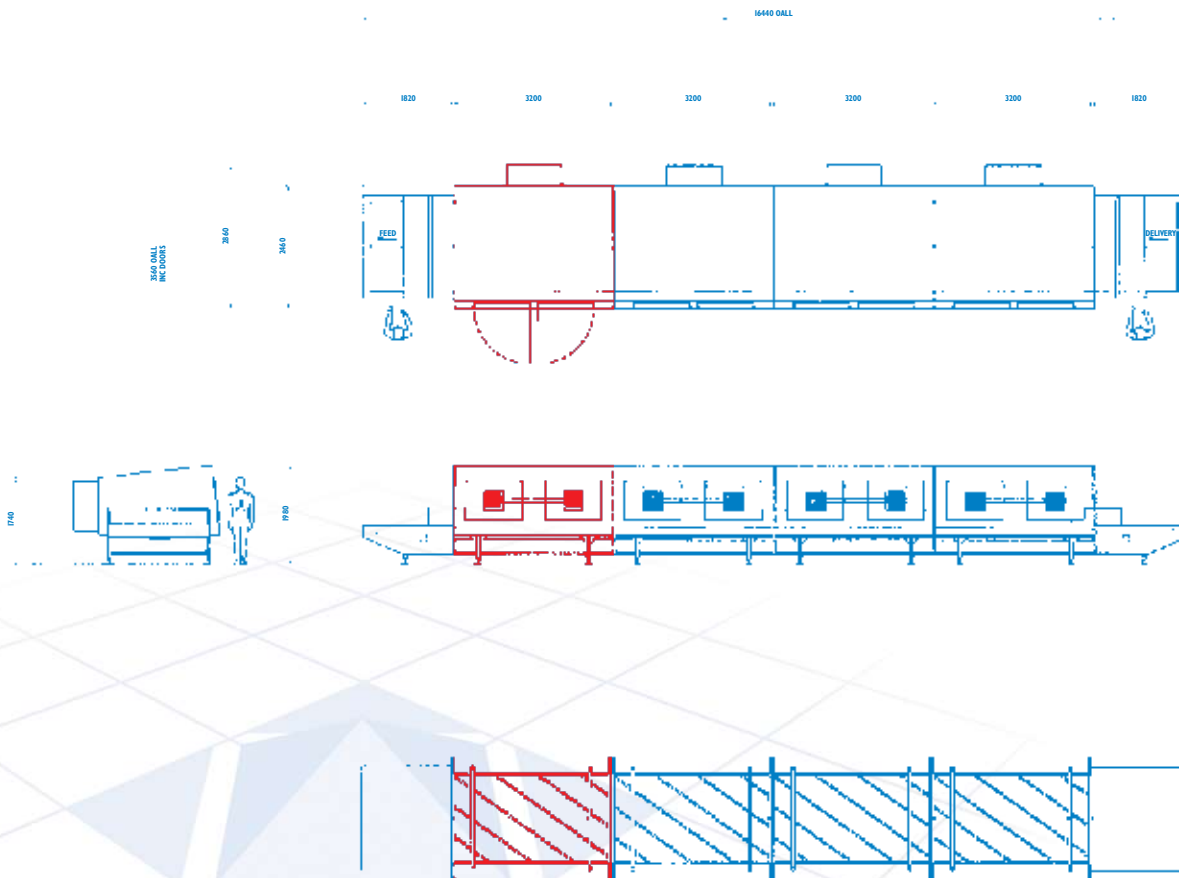
Petrie's Radio Frequency (RF) technology brings tremendous advantages to food processing, particularly where rapid, controllable and penetrative temperature elevation is required.

RF energy heats uniformly and rapidly throughout the product, without the overheating or biological degradation associated with other technologies.

# Radio Frequency Defrosters



The Petrie 3X40 continuous defrosting and tempering machine has a proven track record of use throughout the food processing industry. Its modular design (shown below in red) means it can be supplied in any number of units from two to five, to meet specific product requirements.



All stainless steel construction

Three 40 kW RF generators

50 Ω technology

Non-metallic conveyor

Product presence detectors

Clean-in-place system

Product height detectors

Adjustable mounting legs

Optional remote siting of generator and control panel

Full PLC control with data logging facility available

Machine mounted control station

# Pilot Induction Heated Hotplate



- **Hot plate operating temperatures up to 340 °C**  
- Suitable for all cooking requirements
- **Rapid heating**
- **Much improved thermal efficiency**  
- 84 % efficient in recent US Dept of Energy research  
(compare to ~ 40 % for gas cookers)
- **Operator friendly**
- **Safe and hygienic**

Petrie's Pilot induction heated hotplate is ideal for the development of products that are traditionally cooked using gas based systems.

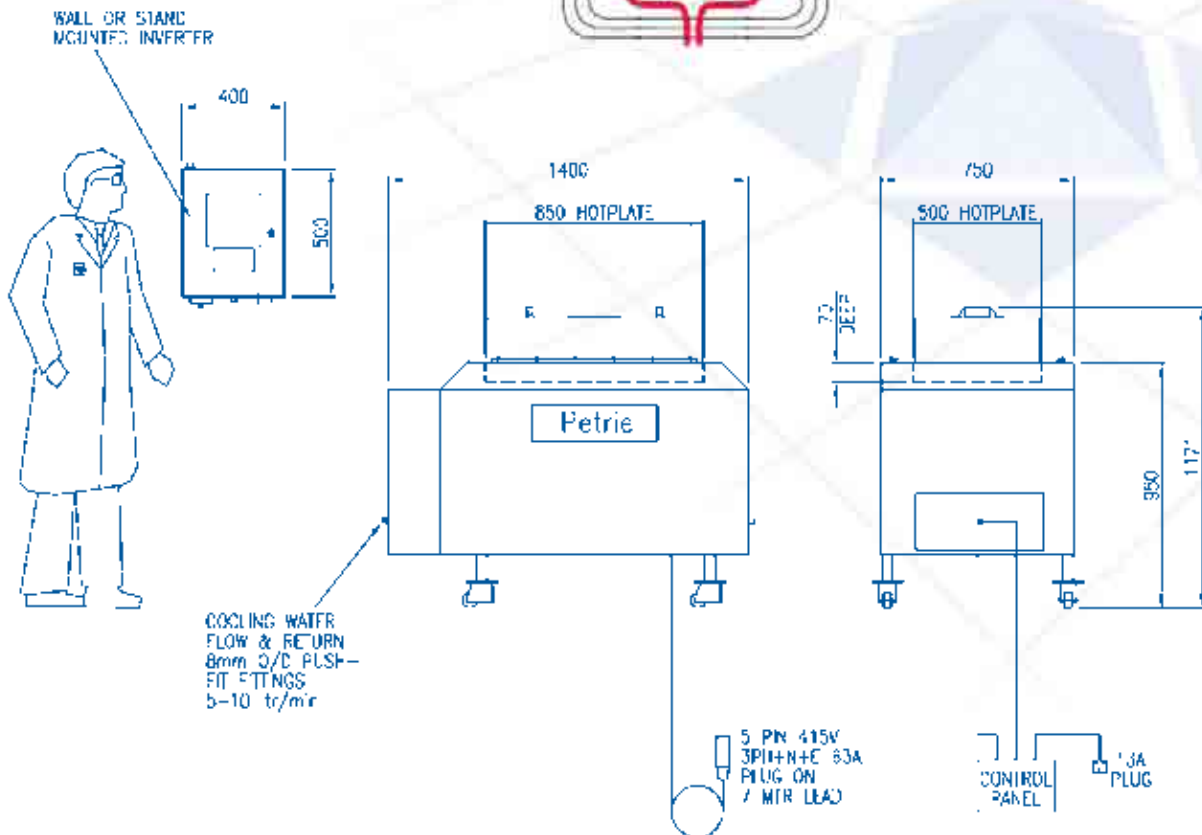
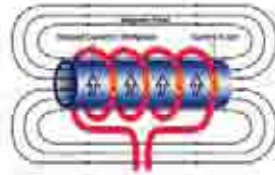
The principle of induction heating is that an alternating electrical current is passed through a metal coil thereby generating a changing magnetic field. The magnetic field then passes through the metal object to be heated and produces an electric current in the body. Since the metal body has little resistance it heats up due to resistance heating. Efficient and uniform heating is the result of the design of the metal coils and consistent power supply.

When coupled with a microwave / steam process, the process can form part of a continuous stir-frying process. Delivering accurate and precise amounts of heat to food ingredients at very rapid rates. The process can be described as a series of 'WOK' zones arranged sequentially on a continuous flat bed, each of which is heated appropriately to the required end product. The combined effect can overcome problems such as irregular heating that is encountered with gas based methods.



# Pilot Induction Heated Hotplate Spec.

Hotplate Size (Working Area)	0.85 m x 0.5 m (0.425 m <sup>2</sup> )
Approximate Weight	300 kg
Installed Power	24 kW - 60 kVA
Nominal Maximum Mains Current	35 amps
Electrical Connections	415 V, 3 phase via 5 pin 63 amp plug (supplied with 7 m of cable) 240 V, single phase (3 amp) for control unit
Cooling Water Requirements	Minimum 5 litres / min of clean water in the range of 20 to 40 °C
Operating Frequency	20 kHz
Maximum Operating Temperature	350 °C (dependent upon the flashpoint of oil)



# Advanced Food Processing System



High temperature searing

Internal cooking with microwaves

Excellent product quality

Reduced manpower



Petrie Technologies' Advanced Food Processing System (AFPS) is a revolutionary cooking method which incorporates the world's first induction heated Wok coupled in-line with a microwave/steam cooker. This innovative technology makes it possible to reproduce, on an industrial scale, the quintessential characteristics and qualities associated with traditional Wok cooking.

The induction heating technique overcomes the problem of conventional methods by delivering a precise amount of heat to the ingredients at a very rapid rate. Furthermore, the induction process can be configured as a series of Wok zones arranged sequentially on a continuous flat bed - each independently heated appropriate to the end product.

When integrated with a Petrie in-line microwave/steam cooker, used for pre-heating the centre of ingredients to 85-90°C, the result is a system capable of achieving pre-prepared meals which are indistinguishable from restaurant cooking, on a continuous basis.

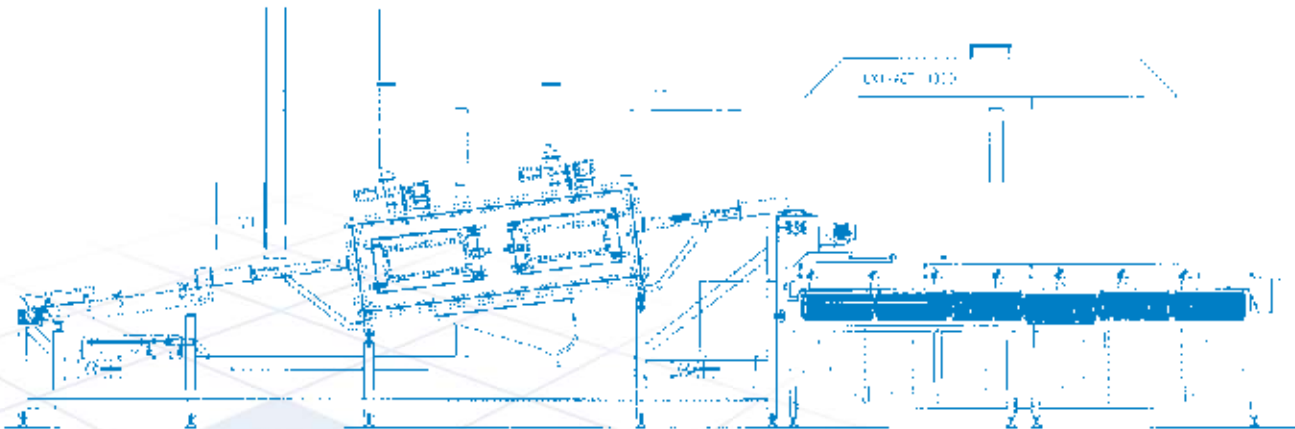
# Electrical and Mechanical Aspects



Driven by a newly developed Boucherot switched mode compact power supply, capable of delivering up to 30 kW per hot plate - the Petrie induction heated Wok utilises food compatible surfaces with the right ferromagnetic properties, mounted onto specially designed induction coils.

It also incorporates a unique mechanical indexing system, which automatically turns and progresses the ingredients through the Wok zones.

Computer controlled, the Petrie Technologies AFPS can be rapidly programmed by an operator to meet specific product profiles, maximising production flexibility.



## Specification

Power per hot plate:	30 kW
Temperature range:	200-350 $\pm$ 10°C - excl. edge effects
Typical size of Wok zone:	(W) 670 mm x (L) 580 mm
Typical residence time:	2-5 minutes
Typical system throughput:	Up to 300 kg for pre-heated meat product, depending on size of system

# Mobile Pilot ARFA

Petrie's Pilot ARFA is ideal for the development of new product textures and properties. Essentially, heat transfer to the surface of the product by convective hot air is assisted by a quantity of radio frequency heating (RF) applied directly throughout the volume of the product, hence 'ARFA' - Air Radio Frequency Assisted heating.

The principle of the ARFA heating system is that the plenum chambers or nozzles used to deliver the hot air are used as the electrodes of the RF system to achieve simultaneous surface (hot air) and internal RF heating. The combined effect can overcome problems such as case hardening, cracking and irregular moisture profiles.

With the RF heating turned off, the machine performs as a conventional high velocity convection oven with good heat transfer. Equally, with minimal air flow (enough to prevent condensation of moisture inside the machine) the heating is provided predominantly by the RF energy alone. Typically, in the ARFA mode of operation, the RF energy may be less than 10% of the total energy supplied.

The challenge for product R&D is to identify the appropriate combination of surface and volumetric heating to give the desired product characteristics.

Moulding

Drying

Curing

Baking

Forming

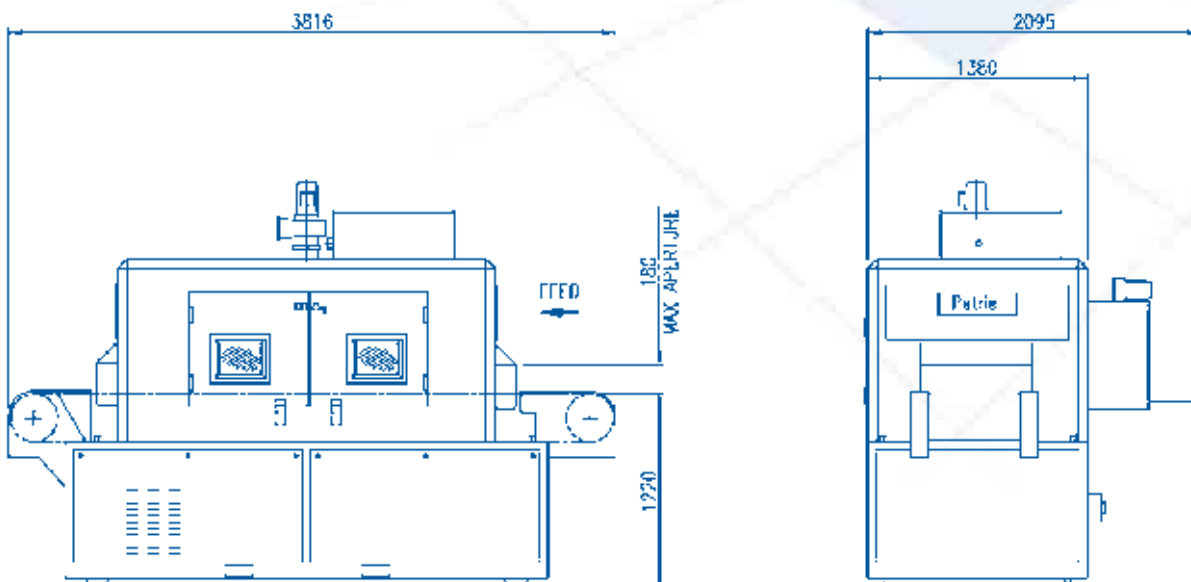


# Mobile Pilot ARFA Specification



The specification of an ARFA oven or dryer will depend on the characteristics of the product to be heated. In particular, the amount of installed RF energy compared to that available from the hot air, may vary considerably.

<b>Machine Type</b>	Single section 50 ohm ARFA test machine
<b>Heat Sources</b>	RF - 5 kW 50 ohm RF generator Hot Air - 54 kW electric element heater
<b>Operational Frequency</b>	13.56 MHz
<b>Fans</b>	1.5 kW direct driven
<b>L x W x H</b>	3.82 x 2.1 x 2.02 m
<b>Weight</b>	2.5 tonnes (oven only)
<b>Conveyor</b>	Belt type stainless steel mesh, 0.47 m wide Height above floor - 0.915 m Maximum product height through machine - 125 mm Maximum linear speed - 4.25 m per minute
<b>Drive</b>	Rossi gearmotor 0.25 kW
<b>Electrical</b>	415 V, 3 phase
<b>Supply</b>	125 amps



# Mobile Pilot AMWA



Petrie's Pilot Air Microwave Assisted (AMWA) heating system is ideal for the development of new product textures and properties. The principle is that hot air and / or steam are used to achieve simultaneous surface (hot air) and internal (microwave) heating. The combined effect can overcome problems such as case hardening, cracking and irregular moisture profiles.

Essentially, heat transfer to the surface of the product, by convective hot air and / or steam, is assisted by a quantity of microwave heating (MW) applied directly throughout the volume of the product, hence 'AMWA' - air microwave assisted heating.

With the microwave heating turned off, the machine performs as a conventional hot air / steam oven with good heat transfer. Equally, with minimal air flow (enough to prevent condensation of moisture inside the machine) the heating is provided predominantly by the microwave energy alone. Typically, in the AMWA mode of operation, the microwave energy may be less than 20% of the total energy supplied.

Drying

Curing

Tempering

Baking

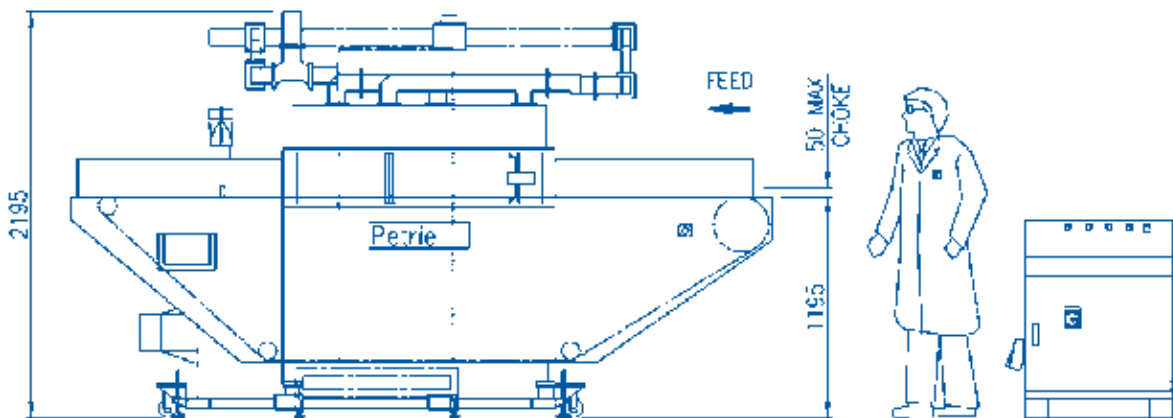
Defrosting



# Mobile Pilot AMWA Specification

The specification of an AMWA oven or dryer will depend on the characteristics of the product to be heated. In particular, the amount of installed microwave energy compared to that available from the hot air, may vary considerably.

<b>Machine Type</b>	Single section 6 kW AMWA test machine
<b>Heat Sources</b>	MW - 6 kW, 2.45 GHz, transformer type generator Hot Air - 30 kW electric element heater Steam - 16 amps, 1 - 2 litres / minute water
<b>Water</b>	5 litres per minute at ambient - 40 °C
<b>Fans</b>	3.0 kW direct driven, RHF 200 °C type
<b>L x W x H</b>	3.9 x 3.3 x 2.2 m
<b>Weight</b>	c. 1000 kg (oven only)
<b>Conveyor</b>	Belt type: PTFE coated Kevlar steel mesh, 0.3 m wide Height above floor - 0.915 m Maximum product height through machine - 30 mm Maximum linear speed - 4.25 m per minute
<b>Generator Weight</b>	6 cwt (c. 300 kg)
<b>Drive</b>	Rossi gearmotor 0.25 kW
<b>Electrical</b>	415 V, 3 phase
<b>Supply</b>	63 amps





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