CARBOLITE®
Leading Heat Technology

Custom Designed
Ovens & Furnaces up to 3000 °C

part of VERDER scientific

VERDER scientific

Science for Solids

As part of the VERDER Group, the business division VERDER SCIENTIFIC sets standards in the development, manufacture and sales of laboratory and analytical equipment. The instruments are used in the areas of quality control, research and development for sample preparation and analysis of solids.

Retsch®

Solutions in Milling & Sieving

Laboratory mills and sieve shakers for sample preparation and characterization of solids

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CARBOLITE®

Leading Heat Technology

Furnaces and ovens for laboratory and industrial use up to 1800 °C

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Solutions in Particle Sizing

Particle characterization with Dynamic Image Analysis from 1 µm to 30 mm

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CARBOLITE GERO 30-3000 °C

High temperature furnaces up to 3000 °C and for vacuum and other modified atmospheres

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ELTRA®

ELEMENTAL ANALYZERS

Combustion analyzers for the determination of C, S, N, O, H and thermogravimetric analyzers

www.eltra.com

Leading Heat Technology

Innovative from the start in Sheffield in 1938 Carbolite took its name from the silicon carbide elements that were at the heart of its new high temperature combustion furnaces. Continuing to grow, in 1956 the privately owned business became incorporated as a limited company and in the intervening years Carbolite has become the UK's largest manufacturer of standard laboratory and bespoke industrial furnaces and ovens exporting to over 100 countries worldwide.

In 2013 Carbolite acquired Gero Hochtemperaturöfen GmbH & Co. KG, a manufacturer of industrial furnaces based in Neuhausen near Stuttgart in southern Germany. Gero has more than 30 years of professional heat treatment experience with standard products and customer-specific solutions and is now known as Carbolite Gero. Carbolite, together with Carbolite Gero, is part of the Verder Scientific Division which includes Eltra, Retsch and Retsch Technology.

Operating from a modern manufacturing plant and sales office in the heart of the Peak District National Park, Carbolite has established a reputation for engineering expertise that is founded upon many years' experience in applied heating technology.

Continuous product development and longstanding, interactive relationships with suppliers enable us to incorporate the latest technologies into our products, keeping us at the forefront in furnace and oven design.

Standard chamber designs are available from 3 to 14,000 litres and can be supplied with many load handling options. The products encompass a temperature range from 30 – 1800 °C. This portfolio is enhanced by Carbolite Gero products with furnaces up to 3000 °C and a large variety of solutions for vacuum and other modified atmospheres.

Temperature control options range from simple setpoint controllers, to sophisticated multiple zone, cascade and programmable temperature control systems.

Carbolite's flexibility and ability to solve customers' individual application requirements have given its products an important place in aerospace, engineering, materials science, heat treatment, medical, bioscience and contract testing laboratories around the world to name just a few.

Carbolite not only regularly supplies products with standards compliant furnace and oven designs, such as for Nadcap (AMS2750E) heat treatment processes, but can also supply fully traceable certification for control, measurement, recording and data acquisition devices, issued by an independent UKAS accredited laboratory.

All the products featured in this catalogue, and more, are available through an extensive worldwide network of dealers and local offices. Factory trained field engineers provide a complete range of after sales support and technical advice. Guidance on product selection is available from a team of qualified engineers based at Hope or via our international distributor network.

www.carbolite.com

04 Content

This catalogue shows the details of some of the custom built design solutions that Carbolite has supplied to many customers to solve their particular heating requirements. Carbolite has a well proven history of adapting its comprehensive range of standard products and also of designing and building complete custom solutions.

Carbolite ovens typically have metallic chambers with temperatures up to 750°C

More products

For Carbolite standard products please see catalogue „Ovens and Furnaces‘ up to 3000°C“ or www.carbolite.com

For Carbolite Gero high temperature furnaces for vacuum and other modified atmospheres please see catalogue „Heat Treatment from 30 - 3000°C“ or www.carbolite-gero.com

Disclaimer

As Carbolite has a policy of continuous product development, improvements and changes will be made during the lifetime of this catalogue. Carbolite reserves the right to amend the specifications at any time and in any particular way without prior notice provided that the ultimate performance of the equipment is not reduced by such action.

If the dimensions or technical specification of a product in this catalogue are critical, it is important that Carbolite is contacted to confirm the details prior to order placement.

Chamber furnaces heat above 750°C and usually have ceramic materials creating the chamber, but may be fitted with metallic retorts where process gases are required.

Due to the nature of custom design solutions you will find some products don't fit neatly into these groups.

These furnaces are tubular in format. They may contain a work tube which could contain a process gas, and could be a split construction to close around a work piece.

Carbolite can provide custom solutions in one of two ways:

1. **Product is a modification of a standard product.**
2. **Product is custom designed to provide a customer specific process solution.**

Listed to the right are some common modifications to the standard range of products that are frequently requested.

Icons used in this catalogue

Icons are displayed against products that feature these details

- Product is a modification of a standard product.
- Product is custom designed to provide a customer specific process solution.
- AMS 2750 E — Product conforms to aerospace Nadcap AMS2750E.
- 3 ZONE — Product incorporates zoned temperature control. The number represents the number of heated zones.
- Product incorporates safety systems. Example: gas safety systems.
- Product incorporates atmosphere control systems.
- Product incorporates forced cooling systems. Examples: Blowers with automatic damper settings, lifting roof panels.
- Product incorporates rotary motion. Example: rotating tube furnace or rotary hearth.
- Product incorporates vertical motion. Examples: elevator hearth and top hat furnaces.
- Product incorporates horizontal motion. Examples: tube furnaces on rails, automatic thermocouple loading for calibration.

Common modifications

for all products

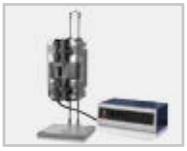
- **Fans**
  To reduce cooling time and to move ambient air through the hot zone or around the hot zone if an atmosphere is to be maintained
  (See examples on pages 15 - 18, 23, 32, 35, 37, 42)



- **Mechanical changes**
  To fit with customers' equipment
  (See examples on pages 13 - 20, 27 - 31, 45 - 53)








- **Instrumentation and performance validation for aerospace standard AMS2750E**
  (See examples on pages 13, 14, 20, 21, 27, 28, 32, 34)



- **Atmosphere control packages** which could include: Multiple gas inlets; multiple flow meters with manual flow adjustment; mass flow controller with manual adjustment; mass flow controller with automatic adjustment; pressure sensing of gas or mass flow control to sense gas flow; gas solenoid valves manually or automatically switched; solenoid valves to change rate of flow; gas flow solenoids interlocked to process parameters, e.g. H_2 flow interlocked to minimum temperature
  (See examples on pages 16, 18, 20, 28, 32 - 36, 39 - 41, 46, 47, 49, 50, 58 - 63)



- **Gas pre-heating**
- **Inputs and outputs**
  To link temperature controllers to customers' automated equipment
- **Higher power heating elements**
  To increase heating rate and to reduce heat up time

More common modifications

for ovens

- **Access ports**
  For thermocouple access; for cable entry to parts under test; to give custom shaped access ports for customers' equipment; ports to quickly load and unload small parts into ovens
- **Customer specified shelf locations**
- **Heavy duty shelves and runners**
- **Viewing windows**
  Using borosilicate glass; for viewing and optical temperature measurement
- **Sliding drawers in doors**
- **Vertical lifting doors**
- **Motorised doors**
- **Door interlocks**
  Automated door locking with the temperature, or with the temperature program
- **Chambers extended in one dimension**
  Can often be a simpler modification than changes to all three dimensions
- **Custom dimensions for chambers**
- **Interior chamber construction**
  From alternative grades of stainless steel
- **Reinforced base**
- **Bases modified for trolley access**
- **Loading trolleys**
- **Flange mounts**
  For fitting to walls in clean rooms
- **Multiple temperature zone control**
- **Programmable vacuum / partial vacuum & extraction**
- **Spark-proof chamber**
- **Oxygen measurement of oven atmosphere**

for chamber furnaces

- **Access ports**
  For thermocouple access; ports to quickly load and unload small parts
- **Viewing windows**
  For higher temperature capability using quartz or sapphire: for viewing and optical temperature measurement. Can be applied to: HTR rotary reactor, chamber furnace doors
- **Door interlocks**
  Automated door locking with the temperature, or with the temperature program
- **Chambers extended in one dimension**
  Can often be a simpler modification than changes to all three dimensions
- **Custom dimensions for chambers**
- **Reinforced chamber hearth**
- **Loading trays and racks in stainless steel or nickel chromium alloy (Inconel)**
- **Furnace heating element protection**
  Silicon carbide protection tiles for chamber furnaces
- **Heating elements located under the hearth**
  For improved temperature uniformity
- **Multiple temperature zone control**
- **Programmable vacuum / partial vacuum & extraction**
- **Loading trolleys**
- **Flange mounts**
  For fitting to walls in clean rooms
- **Motorised doors**

for tube furnaces

- **Access ports**
  Small diameter tube perpendicular to work tube
- **Viewing windows**
  For higher temperature capability using quartz or sapphire: for viewing and optical temperature measurement. Can be applied to: tube furnace end seals, tube furnaces perpendicular to a quartz work tube, exit end of rotating tube furnaces
- **Tube furnace custom heated lengths and diameters**
  longer heated lengths; shorter heated lengths; larger diameter versions >200 mm
- **Multiple temperature zone control**
  Zone barriers in tube furnaces with modular vacuum formed elements including non-split tube furnaces EHC, EVC, GHC, GVC & split tube furnace EZS, EVZ, HZS, TVS
- **Tube furnace equalisation block**
  to improve temperature stability and uniformity

Carbolite's expertise in pyrometery and the application of AMS2750E

Created by the Performance Review Institute, the Nadcap programme is designed to provide an accreditation and quality assurance framework for a defined range of 'special processes and products' that are used within the Aerospace and Defence sectors. It was originally sponsored by Boeing and is now adopted by all Western aerospace manufacturers.
Nadcap is becoming increasingly important in the aerospace sector with accreditation frequently being requested by companies such as: GE Aviation, Rolls Royce plc, MTU, Snecma, Turbomeca, Boeing, Vought Aircraft Industries, Bombardier, Honeywell, Hamilton Sundstrand and Sikorsky Aircraft.
Manufacturers and end users must follow the requirements of the SAE Aerospace Standard Number AMS2750E. In this Standard ovens and furnaces are classified by their temperature uniformity and the type of control instrumentation that they use.

Carbolite has significant expertise in supplying aerospace customers with ovens and furnaces designed for full Nadcap compliance.

AMS 2750 E

Some examples are shown on the following pages identified by this AMS icon.

What is Nadcap?

National Aerospace and Defence Contractors Accreditation Programme

A quality system for aerospace manufacturers and subcontractors controlled through audited standards.

Other standards aligned within Nadcap
- Aerospace Standard AS7102 Ref A
- Audit Control AC 7102 Rev B
- Rolls Royce standard RPS 953 issue 12

For product to conform with AMS2750E the following have to be defined:

1. **Temperature range of compliance**
2. **Class of temperature uniformity required – either Class 1, 2, 3, 4, 5 or 6**
3. **Temperature Instrumentation type - either Type A, B, C, D or E – see diagram on the next page**
4. **Uniform zone required – define H x W x D**
5. **Temperature Uniformity Survey (TUS) required either with charge or empty chamber**
6. **System Accuracy Test (SAT) requirements**

Class	Uniformity
1	±3°C
2	±6°C
3	±8°C
4	±10°C
5	±14°C
6	±28°C

For class 1 uniformity, ±3°C, the size of an oven chamber needs to be significantly larger than the working volume. If a working volume of 600 mm x 600 mm x 600 mm is required we recommend a chamber volume of at least 800 mm x 800 mm x 800 mm.

Examples

See page 14

See page 20

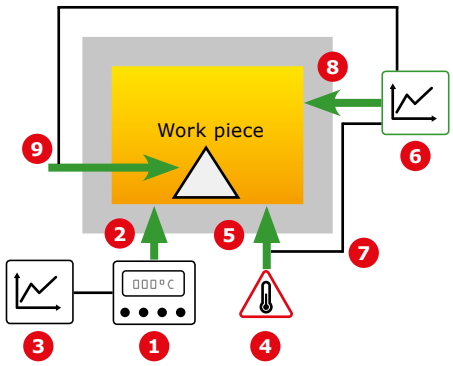
See page 19

See page 21

Product instrumentation 'Type'

Control instrumentation type is defined as Type A, B, C, D or E. The differences between these types are shown in the diagram below and relate to the number of recording thermocouples permanently installed in the work-space and the instrumentation used to monitor these.

Diagram of instrumentation components



	Instrumentation components	Type A	Type B	Type C	Type D	Type E
1	Control instrument with temperature display	X	X	X	X	X
2	Control sensor	X	X	X	X	X
3	Control instrument recorder	X	X	X	X	
4	Over-temperature protection instrument	X	X	X	X	
5	Over-temperature protection sensor	X	X	X	X	
6	Multipoint chart recorder (or separate channel in control instrument recorder)	X	X	X		
7	High temperature protection sensor connected to multipoint recorder	X		X		
8	Low temperature sensor connected to multipoint recorder	X		X		
9	Load sensor connected to multipoint recorder	X	X			

Examples of products built to comply with AMS2750E

Model	Max temp. (°C)	Temperature uniformity ± (°C)	AMS2750E Uniformity class	AMS2750E Instrumentation type
PF800	250	5	2	D
PF200	300	5	2	D
PF60	300	5	2	B
PF200	250	5	2	D
GP450A	300	10	4	D
GP450A	300	5	2	D
GP220B	250	6	2	B
LGP2/935	250	6	2	C
LGP2/1212	250	6	2	A
LGP2/1750	250	5	2	C
LGP4/1419	425	6	2	A
LGP6/1180 S&C	625	10	4	B
LGP6/1750	625	5	2	C
LGP6/2700	625	6	2	D
3 Oven System: Chamber 1	300	5	2	D
Chamber 2	300	5	2	D
Chamber 3	300	5	2	D
HT4/220	400	6	2	D
HT5/95	500	14	5	B
HT5/350	500	6	2	C
HT6/220	600	6	2	A
HRF 7/45B	750	6	2	D
HRF 7/45	750	5	2	D
GPC 12/36	1200	10	4	D
GPC 13/65	1300	6	2	D
GPC 12/131	750	5	2	D
LCF 14/350	1400	10	3	D
LCF 12/560	1200	6	2	B

Ovens from 30°C - 750°C

Examples of custom designed oven solutions

Ovens from 30 °C – 750 °C

Carbolite defines an oven as a chamber with a metallic lining operating up to 750 °C, where the heat transfer is predominantly by convection. Carbolite's extensive range of ovens has chamber volumes ranging from 30 to 14000 litres. The following temperature ranges of ovens are available:

- **Ambient + 30 °C to 250 °C**
- **Ambient + 30 °C to 300 °C**
- **Ambient + 60 °C to 400 °C**
- **Ambient + 60 °C to 500 °C**
- **Ambient + 60 °C to 600 °C**
- **Ambient + 60 °C to 750 °C**

The majority of Carbolite ovens have chamber circulation fans to mix the air and improve temperature uniformity. Air vents are provided with adjustable dampers to assist with removal of moisture or fumes. All ovens have excellent temperature control provided by a range of sophisticated digital controllers. Comprehensive data logging and connection to computers and networks are available along with remote webpage access.

Carbolite has a comprehensive range of standard ovens which are detailed in the catalogue 'Ovens and Furnaces up to 3000 °C' and are available with a number of standard options including: exhaust fans; moisture extraction; stoving and curing featuring an explosion relief panel; variable speed fan; cable entry ports. The standard range of GP and LGP ovens often form the basis of custom oven solutions.

Common oven features

- Highly efficient thermal insulation using a combination of ceramic fibre & mineral wool
- Metallic sheathed mineral insulated rod elements
- Stainless steel interior 430 grade
- Horizontal airflow via internal circulation fan
- Door closing mechanism using a shoot bolt arrangement
- Fresh air inlet via fan shaft tubes (LGP range)
- Exhaust port with adjustable damper
- Sophisticated digital temperature control
- Over-temperature protection
- Solid state power control

Common oven modifications

- **Fans:** To reduce cooling time and to move ambient air through the hot zone or around the hot zone if an atmosphere is to be maintained
- **Mechanical changes:** To fit with customers' equipment
- **Instrumentation and performance validation for aerospace standard AMS2750E**
- **Atmosphere control packages** which could include: Multiple gas inlets; multiple flow meters with manual flow adjustment; mass flow controller with manual adjustment; mass flow controller with automatic adjustment; pressure sensing of gas or mass flow control to sense gas flow; gas solenoid valves manually or automatically switched; solenoid valves to change rate of flow; gas flow solenoids interlocked to process parameters, e.g. H_2 flow interlocked to minimum temperature
- **Gas pre-heating**
- **Inputs and outputs:** To link temperature controllers to customers' automated equipment
- **Higher power heating elements:** To increase heating rate and to reduce heat up time
- **Access ports:** For thermocouple access; for cable entry to parts under test; to give custom shaped access ports for customers' equipment; ports to quickly load and unload small parts into ovens
- **Customer specified shelf locations**
- **Heavy duty shelves and runners**
- **Viewing windows:** Using borosilicate glass; for viewing and optical temperature measurement
- **Sliding drawers in doors**
- **Vertical lifting doors**
- **Motorised doors**
- **Door interlocks:** Automated door locking with the temperature, or with the temperature program
- **Chambers extended in one dimension:** Can often be a simpler modification than changes to all three dimensions
- **Custom dimensions for chambers**
- **Interior chamber construction:** From alternative grades of stainless steel
- **Reinforced base**
- **Bases modified for trolley access**
- **Loading trolleys**
- **Flange mounts:** For fitting to walls in clean rooms
- **Multiple temperature zone control**
- **Programmable vacuum / partial vacuum & extraction**
- **Spark-proof chamber**
- **Oxygen measurement of oven atmosphere**

PF 120 fan oven for Nadcap compliance

AMS 2750 E

Twelve chamber ovens were specified for the customer's process rather than one large batch oven. This provided more flexibility for their production and faster throughput of parts. The ovens were stacked 2 high and mounted on frames to minimise the space required.

- 12 x PF 120 ovens mounted onto stacking frames
- All 12 ovens connected via communication to iTools software for monitoring
- Integrated into the customer Nadcap regime

Technical data

Ref No.	Max temp. (°C)	Dimensions internal H x W x D (mm)	Dimensions external H x W x D (mm)	Doors	Volume (litres)	Max power (W)
712273	300	500 x 490 x 520	670 x 865 x 670	Single side hinged	127	2000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

LHT 5/60 with sliding tray

This oven is fitted with a customised sample loading tray which enables the insertion of samples into the chamber without opening the door. This feature minimises heat loss and means that recovery of oven temperature after insertion of the sample is much more rapid. For customers testing painted sheets of metal the stoving and curing options would be added.

- For loading and unloading with minimal temperature drop
- Usable tray dimensions: 10 mm high x 265 mm wide x 425 mm deep

Technical data

Ref No.	Max temp. (°C)	Dimensions internal H x W x D (mm)	Dimensions external H x W x D (mm)	Doors	Volume (litres)	Max power (W)
718040	500	400 x 400 x 405	670 x 930 x 870	Single side hinged	60	2250

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Oven Modification Examples

GP 450A general purpose oven for Nadcap compliance

AMS 2750 E

This is an example of a standard product that has been modified to allow use in the aerospace industry. The working volume and uniformity class must be specified along with the instrumentation type. Modifications include thermocouple access ports to make temperature uniformity survey possible along with a panel mounted thermocouple connection loop to simplify instrument calibration. See page 8 for more information regarding Nadcap and AMS2750E.

- Oven used for drying components used in the aerospace industry
- System accuracy test (SAT) port through the door
- Thermocouple connections with plug and socket arrangement accessible on the control panel for ease of re-calibration
- Forced airflow via internal circulation fan with speed control

Technical data

Ref No.	Max temp. (°C)	Temp uniformity (°C)	Dimensions internal H x W x D (mm)	Dimensions external H x W x D (mm)	Doors	Volume (litres)	Max power (W)
705934	300	See page 9	1270 x 600 x 600	1910 x 900 x 840	Single side hinged	450	6000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

GP 450A general purpose oven with rotating mechanism

This is a good example of a mechanical modification of a standard product. In this case the customer required continuous agitation of their samples. The samples are simply clipped onto the fixtures which rotate once the oven door is closed. The fixtures can be rotated slowly with a manual push button to the correct positions to load the samples.

- Testing corrosion inhibitors used in the petroleum industry between 60 and 120 °C

- Rotating mechanism to accept 20 of the customer's reactors on two shafts, directly driven via motor and gearbox
- Independent adjustable rotation speed in the range 1 to 10 revolutions per minute.
- Door closing mechanism using shoot bolt with interlock to stop rotation of mechanism when the door is open
- Manual override to allow shaft to rotate slowly for loading and unloading
- Forced airflow via internal circulation fan with speed control

Technical data

Ref No.	Max temp. (°C)	Temp. uniformity (°C)	Dimensions internal H x W x D (mm)	Dimensions external H x W x D (mm)	Doors	Volume (litres)	Max power (W)
727251	300	Better than ±8°C	1220 x 610 x 610	1850 x 1100 x 850	Single side hinged	450	6000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

LGP 4/1750 general purpose oven with rotary hearth

Designed to ensure that all customer's parts placed in the oven should see the same temperature profile, with a tight tolerance. A rotating hearth and frame move the parts continuously within the chamber whilst they are processed.

- Sintering of moulded PTFE components used in the aerospace and subsea applications

- Rotating hearth assembly with variable speed drive – nominal rotating speed 0.5 revolution per minute
- Rotary hearth ensures components are heated as uniformly as possible
- Heating elements interlocked to circulation fan so heating only takes place if the fan is running
- Ø 200 mm exhaust port with adjustable damper
- Fresh air inlet via fan shaft tubes
- Exhaust fan
- Forced cooling via inlet blower automatically started at the end of a temperature program cycle. Dampers automatically opened

Technical data

Ref No.	Max temp. (°C)	Temp. uniformity (°C)	Dimensions internal H x W x D (mm)	Dimensions external H x W x D (mm)	Doors	Shelf loading	Volume (litres)	Max power (W)
106147	400	Better than ±5 °C	1250 x 1290 x 1380	2135 x 2830 x 1755	Single side hinged	4 shelves	2225	24000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

LGP 6/3920 general purpose oven adapted for rapid quenching

Modified to allow a basket of components to be removed and quickly quenched. It is used in the aluminium heat treatment industry for solution heat treatment. The modifications include an electrically actuated door and basket runners mounted on the hearth.

- Solution heat treatment of aluminium
- Basket runners allow components to be quickly removed and dropped into the quench tank

- Also used for precipitation hardening
- One piece fully counterbalanced electrically operated door
- Exhaust port with adjustable butterfly damper
- All controls are located in a separate free standing control panel.

Technical data

Ref No.	Max temp. (°C)	Temp. uniformity (°C)	Uniformity dimensions H x W x D (mm)	Dimensions internal H x W x D (mm)	Dimensions external H x W x D (mm)	Volume (litres)	Max power (W)
80997	600	±5 °C between 120 - 550 °C	1200 x 1200 x 1800	1400 x 1400 x 2000	2828 x 3071 x 2593	3920	54000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Oven Modification Examples

LGP 2/4872 general purpose oven for drying powders with low auto ignition temperature

Designed for drying powdered materials with low auto ignition temperature. The control system includes a comprehensive over-temperature system that monitors both chamber and element surface temperatures to ensure they remain below the auto ignition temperature. Materials are loaded onto trays which are supported on loading racks. The loading racks are placed on wheeled bogies for ease of movement. Loading racks and bogies were supplied with the oven. There is access under the oven for the stacker truck used to loading and unloading.

- Ovens for drying lightweight materials including pellets and powders
- 3504P25 controls temperature, time, cooling and fan speeds. The fan speeds are pre-set for each program
- Door closing mechanism with electrical interlocking
- Ø 150 mm exhaust port with adjustable damper
- 3000 litre per minutes exhaust fan
- Forced cooling via inlet blower automatically started by the temperature program cycle. Dampers automatically opened.
- Horizontal airflow via internal circulation fans with speed control

Technical data

Ref No.	Max temp. (°C)	Temp. uniformity (°C)	Dimensions internal H x W x D (mm)	Dimensions external H x W x D (mm)	Doors	Shelf loading	Max power (W)
724765	150	Better than ±5°C @ 105°C	2100 x 1600 x 1660 Uniform volume 1700 x 1400 x 1250	1360 x 2180 x 2300	Two side hinged	17 shelves on removable racks	36000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

LGP 3/1500 general purpose oven for curing vacuum bagged composites

This oven is an increased width version of the LGP range. The shape profile was required to suit the composite components manufactured in the F1 racing industry. The composite components can be placed in vacuum bags, which are then placed in the oven for curing under vacuum.

- Heat treatment of components used in the Formula 1 racing industry
- Vacuum bagged composite materials processed in the oven
- Extraction fans used as part of a controlled cooling profile
- Tight uniformity specification
- Horizontal forced air circulation via internal rear mounted fans
- Powerful exhaust fan

Technical data

Ref No.	Max temp. (°C)	Temp. uniformity (°C)	Dimensions internal H x W x D (mm)	Dimensions external H x W x D (mm)	Doors	Shelf loading	Volume (litres)	Max power (W)
704438	300	Better than ±5°C @ 105°C	1050 x 1540 x 1040	1940 x 2110 x 1990	Double door	2 shelves 4 positions	1680	18000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

LGP 6/1000 general purpose oven for sterilising & depyrogenation of bottles

The Environment Agency in the UK is responsible for testing water from rivers and canals. The 1 litre glass bottles used for the samples must go through a sterilisation and depyrogenation cycle. This oven was modified to provide trolley and runners to suit the bottle carriers. An additional programmed exhaust/cooling fan allows the bottles to be cycled as quickly as possible without breakages being caused due to thermal shock.

- 200 bottles are loaded into baskets and placed on a trolley rack system
- Baskets pushed onto basket runners in the oven chamber
- Internal basket support frame
- Custom designed bottle carriers
- Heating elements interlocked to circulation fan so heating only takes place if the fan is running.
- Program controlled exhaust/cooling fan

Technical data

Ref No.	Max temp. (°C)	Temp. uniformity (°C)	Dimensions internal H x W x D (mm)	Dimensions external H x W x D (mm)	Doors	Shelf loading	Volume (litres)	Max power (W)
704219	600	Better than ±5°C	1000 x 1000 x 1000	1600 x 2060 x 1660	Single door	Custom basket and support frame	1000	22000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

HTMA high temperature modified atmosphere oven with custom built dimensions

The HTMA range of products is often modified to provide capacities greater than the standard range. A number of the more popular sizes are listed in the table below. All are fully seam welded to contain modified atmospheres and can have manual or automatic gas control.

- All the standard and options features of the HTMA range are available

Technical data

Ref No.	Model	Max temp. (°C)	Dimensions internal H x W x D (mm)	Dimensions external H x W x D (mm)	Shelves fitted/ accepted	Shelf loading each/total (kg)	Volume (litres)	Max power (W)
717744	HTMA 5/2000	500	1150 × 1400 × 1350	2105 × 2210 × 2310	3 / 4	50 / 200	2000	48000
725426	HTMA 5/4872	500	2100 × 1600 × 1450	3055 × 2410 × 2410	3 / 8	50 / 400	4872	81000
718176	HTMA 6/350	600	700 × 700 × 700	1650 × 1700 × 1200	3 / 4	10 / 40	350	9000
707464	HTMA 6/1000	600	1000 × 1000 × 1000	2200 × 2200 × 1500	3 / 4	50 / 200	1000	22000
712620	HTMA 6/1200	600	1000 × 1000 × 1200	2200 × 2200 × 1850	2 / 4	50 / 200	1200	24000

HTMA 5/4872 high temperature modified atmosphere oven for processing powders with low auto ignition temperature

This high temperature oven is used to dry and process powdered materials with low auto ignition temperature. The control system includes a comprehensive over-temperature system that monitors both chamber and element surface temperatures to ensure they remain below the maximum allowed, and includes a safety nitrogen quench. Fan speed is adjustable to avoid movement of the powdered material and atmosphere control allows use of air, inert nitrogen, or reducing nitrogen +5% hydrogen.

- A Eurotherm 3504P25 controls temperature, time, cooling, moisture extraction and fan speeds
- A load monitoring thermocouple is used to control the sample temperature via a cascade control system
- The circulation fan speeds are automatically controlled during the process
- Gas-tight construction, seam welded stainless steel interior
- Process gases each have digital mass flow control and automatic switching
- Cooling channels with speed-controlled fans run outside the chamber and do not compromise the process atmosphere
- Nitrogen injection can be used to reduce the cooling time if required
- Over-pressure relief valves
- Horizontal airflow via three internal circulation fans
- Automatic door locking mechanism using a shoot bolt with electrical interlocking

Technical data

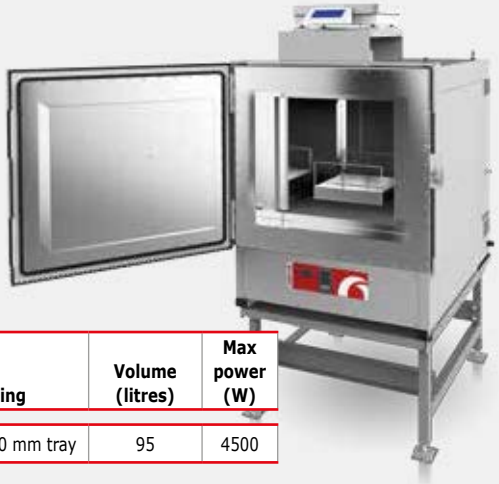
Ref No.	Max temp. (°C)	Temp. uniformity (°C)	Dimensions internal H x W x D (mm)	Dimensions external H x W x D (mm)	Doors	Shelf loading	Volume (litres)	Max power (W)
725426	500	±10 °C @ 105 to 500	2100 x 1600 x 1450 Uniform volume 1700 x 1400 x 1250	2655 (+ 400 for exhaust) x 2410 x 2410	Single side hinged	17 shelves on removable racks	4872	81000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period with extraction fan off and optimised fan speeds

HTMA 6/95 high temperature modified atmosphere oven with continuous sample weighing

Modified to allow the weight of the sample placed inside to be constantly monitored. A tray is suspended from a top mounted weighing balance through a liquid seal so that the atmosphere is contained inside the oven. Organic materials are removed from the sample until a constant weight is achieved. Both temperature and weight are logged using iTools software.

- Balance communication with temperature controller for data logging of temperature and weight
- Samples may be weighed during the heating process
- Gas tight for use with inert atmosphere
- Inert gas inlet
- Air circulation via natural convection
- Exhaust port with connection flange



Technical data

Ref No.	Max temp. (°C)	Dimensions internal H x W x D (mm)	Dimensions external H x W x D (mm)	Doors	Shelf loading	Volume (litres)	Max power (W)
704766	600	455 x 455 x 455	1180 x 880 x 1120	Single door	Internal 300 x 300 mm tray	95	4500

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

CR/450 clean room oven to fit into a clean room wall

A modified clean room oven suitable for operation within a clean room environment. When installed the oven is built into the wall of the clean room. Air is drawn from the clean room interior, circulated within the oven and then exhausted to the environment outside the room. The oven is used for the drying of materials used in the manufacture of synthetic bone allografts.

- Fully sealed low thermal mass insulation to avoid shedding fibres
- Fully enclosed brushless fan motor
- Perforated stainless steel shelves
- Particle free silicone rubber door seal
- Membrane control panel with clear bright LED display
- Air exhaust fan
- Gas inlet

Technical data

Ref No.	Max temp. (°C)	Dimensions internal H x W x D (mm)	Dimensions external H x W x D (mm)	Features	Volume (litres)	Max power (W)
715921	250	2095 x 1125 x 1005	2095 x 1125 x 1005	Air inlet port, air exhaust fan, gas inlet	450	6000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

HRF 7/324 high temperature air recirculation oven with vertically opening door

AMS 2750 E

This oven features a mechanical modification to a standard HRF furnace. The door has been changed from the standard side opening door to a vertical lift door. This was required by the customer to work with their material handling systems and to save working space.

- Fully compliant with the SAE Aerospace standard AMS2750E See page 8 for more details
- Audible and visual alarm, complete with status indicator

Technical data

Ref No.	Max temp. (°C)	Dimensions internal H x W x D (mm)	Dimensions external (Door closed) H x W x D (mm)	Dimensions external (Door open) H x W x D (mm)	Shelf loading (kg)	Volume (litres)	Max power (W)
715841	750	600 x 600 x 900	2240 x 1555x 1715	2750 x 1555 x 1632	50	324	24000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Oven Modification Examples

HRF 7/324 high temperature air recirculation oven with side mounted control panel

Another example of a mechanical modification to a standard HRF oven. The control panel has been moved to the side. This was required by the customer to give access to the control system when they have their material loading trolley in place at the front of the oven.

- Fully compliant with the SAE Aerospace standard AMS2750E See page 8 for more details
- Audible and visual alarm, complete with status indicator
- Thermocouple connections with plug and socket arrangement accessible on the control panel for ease of re-calibration

Technical data

Ref No.	Max temp. (°C)	Dimensions internal H x W x D (mm)	Dimensions external (Door Closed) H x W x D (mm)	Shelf loading (kg)	Volume (litres)	Max power (W)
704103	750	600 × 600 × 900	1800 × 1200 × 2280	50	324	24000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Custom Built Oven Examples

Oven with paternoster mechanism

This custom built oven fits into the customer's automated sampling cell in the pharmaceutical industry. The stepper motor movement of the paternoster and pneumatic opening of the access slot are linked to the customer's control system. A robotic system loads (and unloads) samples onto the paternoster trays.

- Internally mounted rotating paternoster system with hangers
- 18 hangers to hold a total of 216 sample trays
- Indexing mechanism driven by stepper motor to present each hanger at a loading slot
- Index mechanism can run in both directions with index time between adjacent trays 5 seconds, indexing time to any tray 45 seconds
- Automatic robot access via 50 x 1300 mm slot with pneumatically operating parallel action door to minimise heat loss
- Service access doors with window mounted on the rear of the unit
- Vertical forced air circulation via internal top mounted fan and air guide system, with anti-vibration mounts

Technical data

Ref No.	Max temp. (°C)	Temp. uniformity (°C)	Dimensions internal H x W x D (mm)	Dimensions external H x W x D (mm)	Doors	Shelf loading	Volume (litres)	Max power (W)
70302	50	Better than ±1°C @ 37°C	1550 x 1565 x 500	2310 x 1975 x 600	Loading slot and two maintenance access doors	Internal paternoster system with 18 hangers	1200	1000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Custom built GP 2/900 chamber oven

The oven is used to maintain the required temperature of a test rig which includes storage vessels that contain highly flammable gasses. The customer requirements for this oven include a comprehensive safety system. A comprehensive alarm system with speech and SMS text messaging of alarms is included which given indication of: over and under temperature; power failure; gas detection; and element surface temperature limit. The oven has 45 access ports though the back wall and 300 x 300 mm viewing windows with external illumination though the front and back.

- Fan speed control
- Reinforced base to carry loads up to 150 kg
- Heating elements and circulation fans located at each side of the chamber
- 150 mm exhaust damper is located centrally on top of the oven with 150 mm inlet located at the base of the left hand side

Technical data

Ref No.	Max temp. (°C)	Temp. stability (°C)	Temp. uniformity (°C)	Dimensions internal H x W x D (mm)	Dimensions external H x W x D (mm)	Volume (litres)	Max power (W)
720985	150	±1	±2	1350 x 1350 x 610 Uniform volume 1050 x 1050 x 300	1890 x 2550 x 890	900	7.5

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Triple oven system

An integrated 3 oven system designed for heat treatment to AMS 2750E Class 2 (±5 °C) instrumentation Type D. The system was made for a manufacturer of electronic engine and fuel system controls for aircraft engines. They wished to save space hence the 3 ovens are housed within a single frame. The chambers have independent temperature control and share a six channel digital chart recorder equipped with Ethernet communications.

- Ovens used for drying components used in the aerospace industry
- System accuracy test (SAT) port through the side
- Thermocouple connections with plug and socket arrangement accessible on the control panel for ease of re-calibration
- Each oven is fitted with air inlet and adjustable exhaust ports

Technical data

Ref No.	Max temp. (°C)	Temp. uniformity (°C)	Instru-mentation type	External dimensions (whole system) H x W x D (mm)	Uniform dimensions (2 x Smaller chamber) H x W x D (mm)	Internal dimensions (2 x Smaller chamber) H x W x D (mm)	Uniform dimensions (Taller chamber) H x W x D (mm)	Dimensions internal (Taller chamber) H x W x D (mm)	Volume (litres)	Max power (W)
720581	300	Class 2 (±5°C)	D	1800 x 1600 x 1460	450 x 350 x 450	550 x 450 x 550	950 x 350 x 450	1200 x 450 x 550	2 x smaller ovens: 136 each Taller oven: 297	8.5

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Top & front loading oven

This custom built top and front loading fan convection oven is one of several that have been manufactured for a number of different applications. These include the thermal testing of borehole test probes for the petrochemicals industry and heat treatment of medical components.

- Single, hinged, counterbalanced lid that opens to expose the top and front of the oven chamber.
- Multiple ovens can be joined at the ends to create a longer oven
- Forced airflow via rear mounted internal circulation fans
- Interlock to prevent heating without the fans running
- Adjustable Ø 63mm air vent
- Plugged end slots to allow cable entry into the chamber
- Internal base formed into a tray to contain molten grease escaping from equipment placed in the oven
- Oven mounted on stand with castors

Technical data

Ref No.	Max temp. (°C)	Temp. uniformity (°C)	Dimensions internal H x W x D (mm)	Dimensions external H x W x D (mm)	Doors	Volume (litres)	Max power (W)
717590	200	Better than ±5°C	305 x 3350 x 380	1100 x 3580 x 925	Top and front opening access	388	12000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Top loading oven with rotating headstocks

This top loading air circulation oven has been custom built to cure composite components whilst continuously rotating them. In the oven chamber are three electrically driven head-stocks and three tail-stocks which are adjustable so variable lengths of component can be mounted. An adjustable drip tray system collects any residue falling from the components.

3 ZONE

- 80 mm 3-jaw chucks with matching adjustable tailstocks
- The tailstocks adjustable for work pieces from 200 mm up to 2500 mm in length
- Head stocks rotate at a fixed speed between 10 & 20 rpm
- The oven can hold one work piece of up to Ø 500 mm and up to 2500 mm long, or three pieces of a smaller diameter
- 3 zone control
- Large opening lid with 300 mm × 300 mm viewing window for checking work piece rotation

Technical data

Ref No.	Max temp. (°C)	Temp. uniformity (°C)	Internal heated dimensions H x W x D (mm)	External dimensions (unit closed) H x W x D (mm)	External dimensions (unit open) H x W x D (mm)	Volume (litres)	Max power (W)
727311	250	±3°C at 120-180°C ±6°C at 200-250°C	800 × 3100 × 800	1505 × 3900 × 1250	2200 × 3900 × 1250	1267	24000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Mesh belt oven

This is an example of a lower temperature mesh belt working in air. It is used for the heat treatment of steel piston rings and can process up to 101 kg per hour. Mesh belt ovens are used to provide a continuous process line that can combine different temperature heating and cooling sections. In this way the material passing through is subject to a heating and cooling profile without having to wait for the oven itself to heat and cool. Atmosphere control is also possible by passing the mesh belt through a retort that has gas curtains at each end to ensure the correct atmosphere is maintained within the retort.

2 ZONE

- 380 mm wide mesh belt
- Variable speed drive with up to 80 mm per minute
- Nominal belt speed of 34 mm per minute
- 2 x 2000 mm long heated zones
- 1000 mm long air cooled zone

Technical data

Ref No.	Max temp. (°C)	Mesh belt width (mm)	Heated length (mm)	Dimensions: External H x W x D (mm)	Max power (W)
66067	640	380	4000	1700 x 7960 x 1450	36000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

HTCR 4/232 high temperature clean room with front and back entry

A custom built pass-through oven that fits through the wall of a clean room operated by a medical device manufacturer. Able to heat to 400 °C with a stability of better than ±1 °C under steady state conditions and with a uniformity of better than ±5 °C inside the chamber. This is achieved by using a three zone control system. The oven is used to heat treat vascular stents that are carried on mandrels that are held in a specially designed loading system.

3 ZONE

- Used in a clean room for heat curing of stents which are placed inside arteries
- Side hinged doors at each end
- Forced airflow via top mounted internal circulation fans
- Front and back zones each have one fan, but the centre zone has two fans
- 304 stainless steel chamber with externally welded seams.
- Chamber loading frame with rollers to suit customer's application
- Loading frame trolley use when removing the frame from the chamber
- Oven support frame

Technical data

Ref No.	Max temp. (°C)	Temp. uniformity (°C)	Dimensions internal H x W x D (mm)	Dimensions external H x W x D (mm)	Doors	Volume (litres)	Max power (W)
121057	400	Better than ±5°C	400 x 400 x 1450	2045 x 1030 x 1915	One door each end side hinged	232	12000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Chamber Furnaces up to 1800 °C

Examples of custom designed chamber furnace solutions

Chamber Furnaces up to 1800 °C

Carbolite defines a chamber furnace as a chamber with a ceramic lining operating up to 1800 °C, where heat transfer is predominantly by radiation. For temperatures in the range 1800 °C to 3000 °C please refer to the catalogue from our sister company Carbolite Gero. Carbolite's extensive range of chamber furnaces has chamber volumes ranging from 3 to 725 litres. The following temperature ranges of chamber furnaces are available:
1000 °C; 1100 °C; 1200 °C; 1300 °C; 1400 °C; 1500 °C; 1600 °C; 1700 °C; 1800 °C.

To ensure operator safety, the majority of Carbolite chamber furnaces have up and away doors which keep the hot surface of the door insulation away from the operator. A chimney is provided to assist with removal of fumes. All chamber furnaces have excellent temperature control provided by a range of sophisticated digital controllers. Comprehensive data logging and connection to computers and networks is available along with remote webpage access.

Carbolite has a comprehensive range of standard chamber furnaces which are detailed in the catalogue 'Ovens and Furnaces up to 3000 °C' and are available with a number of standard options including: gas inlets, over-temperature protection, hearth protection tiles and loading trays.

All Carbolite products can be modified to use non-REACH classified thermal insulation materials if required.

Common chamber furnace features

- Highly efficient thermal insulation using a combination of ceramic fibre & refractory brick
- Heating elements made from resistance wire, silicon carbide or molybdenum disilicide depending on the power and maximum temperature required
- Up and away door keeps heated surface away from user
- Hard wearing refectory hearth plate resists damage and supports heavier loads
- A chimney to enable fumes to be removed from the chamber
- Sophisticated digital temperature control
- Over-temperature protection
- Solid state power control

Common chamber furnace modifications

- **Fans:** To reduce cooling time and to move ambient air through the hot zone or around the hot zone if an atmosphere is to be maintained
- **Mechanical changes:** To fit with customers' equipment
- **Instrumentation and performance validation for aerospace standard AMS2750E**
- **Atmosphere control packages** which could include: Multiple gas inlets; multiple flow meters with manual flow adjustment; mass flow controller with manual adjustment; mass flow controller with automatic adjustment; pressure sensing of gas or mass flow control to sense gas flow; gas solenoid valves manually or automatically switched; solenoid valves to change rate of flow; gas flow solenoids interlocked to process parameters, e.g. H_2 flow interlocked to minimum temperature
- **Gas pre-heating**
- **Inputs and outputs:** To link temperature controllers to customers' automated equipment
- **Higher power heating elements:** To increase heating rate and to reduce heat up time
- **Furnace heating element protection:** Silicon carbide protection tiles for chamber furnaces
- **Access ports:** For thermocouple access; ports to quickly load and unload small parts
- **Viewing windows:** For higher temperature capability using quartz or sapphire: for viewing and optical temperature measurement. Can be applied to: HTR rotary reactor, chamber furnace doors
- **Door interlocks:** Automated door locking with the temperature, or with the temperature program
- **Chambers extended in one dimension:** Can often be a simpler modification than changes to all three dimensions
- **Custom dimensions for chambers**
- **Reinforced chamber hearth**
- **Loading trays and racks in stainless steel or nickel chromium alloy (Inconel)**
- **Furnace heating element protection:** Silicon carbide protection tiles for chamber furnaces
- **Heating elements located under the hearth:** For improved temperature uniformity
- **Multiple temperature zone control**
- **Programmable vacuum / partial vacuum & extraction**
- **Loading trolleys**
- **Flange mounts:** For fitting to walls in clean rooms
- **Motorised doors**

GPC 12/36 General purpose chamber furnace with element protection and afterburner

An example of a GPC chamber furnace adapted for ashing many different types of foodstuffs and human waste. The resulting ash is used for determination of radioactive isotopes usually Strontium. The heating elements are protected from the potentially corrosive vapours by enclosing them behind silicon carbide tiles. This system incorporated an afterburner to further burn any unburnt hydrocarbons.

- Wire helical coil heating elements located in the walls behind silicon carbide protection tiles
- Tubular afterburner based on the standard GHA 12/300 furnace

Technical data

Ref No.	Max temp. (°C)	Dimensions internal (furnace) H x W x D (mm)	Dimensions external (overall) H x W x D (mm)	Features	Volume (furnace) (litres)	Max power (W)
711673	600 (Chamber) 650 (Afterburner)	250 × 280 × 450	2510 × 770 × 960	Afterburner made from GHA 12/300	36	11340

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

LCF 12/540 Large chamber furnace with roller hearth & 3 zone control

This 540 litre chamber furnace is used for batch annealing of bronze bearings used in the aerospace industry and is AMS2750E compliant. It has rollers fitted into the hearth to assist in the loading and unloading of the customer's support trays and baskets. The customer uses a trolley to position their work in front of the the chamber and simply pushes it in.

AMS 2750 E

3 ZONE

- Chamber furnace with three zone temperature control
- Silicon carbide hearth fitted with rollers to assist with loading customer's support trays and baskets from a trolley
- Maximum charge weight 150 kg
- Complies with the requirements of AMS2750E to class 4, instrumentation type D
- Pneumatically operated vertically opening door keeps the hot face away from the operator
- Heavy gauge wire heating elements in a roof below the hearth

Technical data

Ref No.	Max temp. (°C)	Temp. uniformity (°C)	Chamber dimensions H x W x D (mm)	External dimensions H x W x D (mm)	Volume (furnace) (litres)	Max power (W)
89263	950	±10 °C at 900 °C	600 × 750 × 1200	Furnace: 2975 × 1310 × 1760 Control cabinet: 1800 x 600 x 600	540	48000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Chamber Furnace Modification Examples

LCF 12/405 Large chamber furnace with atmosphere retort

Another example of a chamber furnace used for heat treatment of parts used in the aerospace industry. In this case the furnace is adapted for, and supplied with, a metallic retort to contain an atmosphere. The retort has a sand sealed lid and is fully inserted into the chamber with gas connection pipes exiting through a slot in the vertically opening door.

- Maximum charge weight 125 kg
- Hearth made from silicon carbide tiles providing a hard wearing surface
- Kanthal AF heavy gauge wire spiral heating elements located in the roof and protected below the hearth

Technical data

Ref No.	Max temp. (°C)	Continuous operating temperature (°C)	Retort Dimensions H x W x D (mm)	External Dimensions H x W x D (mm)	Volume (furnace) (litres)	Max power (W)
86583	1175	900	325 × 490 × 890	2589 × 1820 × 2140	141.5	36000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

LCF 12/560 Large chamber furnace for Nadcap compliance

In this example an LCF chamber furnace has been increased in depth and provided with three zone temperature control. It is compliant with AMS2750E to class 2 and has instrumentation type B (see page 8 for more details). It is used to heat treat fabricated and cast metal parts for the aerospace industry.

- 3 zone cascade control
- Fully calibrated graphic data recorder in control panel
- Hearth made from silicon carbide tiles providing a hard wearing surface
- Kanthal AF heavy gauge wire spiral heating elements located in the roof and protected below the hearth

Technical data

Ref No.	Max temp. (°C)	Temperature stability (under steady state conditions) (°C)	Temperature uniformity (°C)	Uniform volume dimensions H x W x D (mm)	Chamber dimensions H x W x D (mm)	External dimensions H x W x D (mm)	Volume (furnace) (litres)	Max power (W)
715390	1200	±1	±6	350 × 550 × 1200	500 × 750 × 1500	2310 × 1340 × 2050	560	45000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

LCF 14/725 Large chamber furnace

The modifications in this example are an extended chamber depth and an electrically operated door. The customer required a particular uniform volume which was achieved by this modification, and the electrically operated door was better suited to their method of loading and unloading.

- Large chamber furnace model LCF 14/725 suitable for batch production in an industrial environment
- Electrically operated vertical lift door
- Gas inlet
- Hearth made from silicon carbide tiles providing a hard wearing surface
- Silicon carbide heating elements located in the roof and protected below the hearth

Technical data

Ref No.	Max temp. (°C)	Temperature uniformity (°C)	Uniform volume dimensions H x W x D (mm)	Chamber dimensions H x W x D (mm)	External dimensions H x W x D (mm)	Volume (furnace) (litres)	Max power (W)
706965	1400	Better than ±10 °C	350 × 500 × 1200	500 × 700 × 1475	2730 × 1500 × 2200	725	60000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

RHF 14/35 Rapid heating chamber furnace with element protection and electric door actuation

An RHF 14/35 was modified using silicon carbide tiles for the roof, walls and hearth. The heating elements are positioned on both sides behind the silicon carbide tiles and so are protected from the load sample. The customer required a reduced oxygen content atmosphere in the chamber and specified a gas inlet for inert gas. One of their applications for the furnace is heating steel 'charpy' samples for heat treatment experiments.

- High purity double spiral silicon carbide elements
- Silicon carbide tiles assist with maintaining a low oxygen atmosphere
- Electrically operated door
- Emergency stop button fitted due to electrically moving parts
- Over-temperature protection

Technical data

Ref No.	Max temp. (°C)	Continuous operating temperature (°C)	Chamber dimensions H x W x D (mm)	External dimensions H x W x D (mm)	Volume (litres)	Max power (W)
727591	1400	1350	238 × 200 × 465	885 × 780 × 945	22	16000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Chamber Furnace Modification Examples

Bottom loading furnace for thermal cycling

This modified BLF is used to repeatedly thermal cycle materials for the cement industry. The hearth automatically lowers after a specified period of heating, and remains lowered for a set period of time to cool, before rising again into the heated zone. Time periods are adjustable and the number of cycles can be programmed for fully automated operation.

Possible options:

- Programmable automated hearth movement
- Guard

Technical data

Model	Max temp (°C)	Heat-up time (mins)	Dimensions: Internal H x Diameter (mm)	Dimensions: External H x W x D (mm)	Volume (litres)	Max power (W)	Thermocouple type	Weight (kg)
BLF 17/3	1700	80	190 x 150	975 x 750 x 530 (Bench-top)	3	4125	B	155
BLF 17/8	1700	80	250 x 200	1950 x 1360 x 800 (Floor-standing)	8	8130	B	424
BLF 17/21	1700	180	300 x 300	1850 x 1250 x 900 (Floor-standing)	21	12000	B	600
BLF 18/3	1800	110	190 x 150	975 x 750 x 530 (Bench-top)	3	4775	Pt20%Rh/Pt40%Rh	155
BLF 18/8	1800	110	250 x 200	1950 x 1360 x 800 (Floor-standing)	8	7010	Pt20%Rh/Pt40%Rh	424

BLF 17/3 Bottom loading furnace with horizontal movement hearth

This standard furnace was modified to meet the customer's requirements regarding loading and unloading and to protect the heating elements. A crucible used for the glass melting process can be removed by lowering the hearth then moving it horizontally away from the furnace to give maximum access. The heating elements are protected from the glass melting process by the use of a thin walled plasma sprayed alumina tube.

- 600 mm manual horizontal hearth movement in the open position for easy batch charging and removal
- Electrically operated vertical hearth movement into the furnace chamber
- Molybdenum disilicide heating elements positioned around all walls of the chamber
- Excellent temperature uniformity as a result of the hexagonal chamber

Technical data

Ref No.	Max temp. (°C)	Heat up time (mins)	Dimensions internal H x W x D (mm)	Dimensions external H x W x D (mm)	Temp. uniformity (°C)	Volume (litres)	Max power (W)	Thermocouple
701800	1700	80 to 1600 °C	190 x 150	1000 x 990 x 755	± 2 °C vertically on the centreline of the chamber	3	4125	Type B

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period
Max continuous operating temperature is 100 °C below maximum temperature

BLF 17/3 Bottom loading furnace with rotary hearth

This bottom loading furnace has been modified to include a rotating hearth. A rotating hearth in this type of furnace is often used for mixing the contents of a crucible placed on the hearth. A ceramic tube is positioned off-centre through the roof of the furnace chamber. It is lowered into the contents of the crucible which causes them to be mixed as the crucible rotates.

- Rotary hearth with speed control of 3 to 50 revolutions per minute
- Alumina element protection tube
- Inert gas inlet through the hearth
- Hearth cage
- Excellent temperature uniformity as a result of the hexagonal chamber

Technical data

Ref No.	Max temp. (°C)	Heat up time (mins)	Dimensions internal H x W x D (mm)	Dimensions external H x W x D (mm)	Temp. uniformity (°C)	Volume (litres)	Max power (W)	Thermocouple
124181	1700	80 to 1600 °C	190 x 150	1215 x 750 x 580	±2 °C vertically on the centreline of the chamber	3	5000	Type B

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period
Max continuous operating temperature is 100 °C below maximum temperature

Custom Built Chamber Furnace Examples

GPC General purpose chamber furnace to fit into a clean room wall

2 ZONE

An example of a GPC chamber furnace adapted for use in clean room conditions. The furnace is adapted to fit into the wall of the clean room. Over-centre clamps secure the closed door to a steel surround creating both thermal and gas sealing, preventing the pressurised clean room air leaking into the furnace chamber.

- Two zone control
- Wall mounted
- Furnace chamber accommodates 4 rows of trays; each row comprises 7 trays
- Insulated door opens outwards then sideways via central pivot support, keeping the hot face away from the operator
- A chimney is fitted in the roof of the furnace, complete with auto / manual damper valve

Technical data

Ref No.	Max temp. (°C)	Dimensions internal H x W x D (mm)	Dimensions external H x W x D (mm)	Volume (litres)	Max power (W)
300904	1200	460 x 460 x 1060	1700 x 1110 x 1300	224	16000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Custom Built Chamber Furnace Examples

Large chamber furnace with circulation fan and loading system

One of an identical pair of air recirculation furnaces supplied for a 'centre of excellence' manufacturing process development site. The units are designed for use in Nadcap AMS2750E heat treatment applications and operate in the range 500 °C to 1000 °C. Each has a pneumatically vertically opening door and load handling accessories. Air recirculation fans provide rapid and uniform heating through the convection phase of the heating cycle.

- Age heat treatment of Inconel compressor aero foil blades 1000 off per batch run, blade sets loaded into a rack system
- Customised stacker truck for loading & unloading the furnace chamber ensures the racks are correctly positioned within the chamber
- Audible and visual alarm, complete with comprehensive status indicator control panel
- Standby key switch, allowing the operator to place the furnace in a standby mode via one single switch
- Roof mounted internal circulation fan
- Wire coiled heating elements positioned on four sides: side walls, back and door

Technical data

Ref No.	Max temp. (°C)	Temp. uniformity (°C)	Dimensions internal H x W x D (mm)	Dimensions external H x W x D (mm)	Doors	Shelf loading	Volume (litres)	Max power (W)
123829	1000	NADCAP class D 500 - 750 class 2 750 - 1000 class 4	975 x 1330 x 1615 Uniform volume 850 x 850 x 1150	4620 x 2050 x 2750 + separate control cabinet 1800 x 1200 x 600	Vertical lift door	Inconel loading frame	Uniform volume 830	72500

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Debinding furnace with retort & forced cooling

This custom built furnace incorporates a metallic retort and is used for sintering ceramic abrasive discs under an inert atmosphere. Other versions of this furnace design have been built to remove binders under controlled atmosphere conditions and have incorporated an exhaust system with an afterburner. The automatically operated roof is opened by variable amounts to achieve controlled cooling rates.

- Atmosphere seal made within the heated zone to avoid condensation
- Roof opening assists with rapid cooling from 800 °C to 400 °C
- The furnace has three zone control
- Three gas inlets to the retort will be via pipes around the outside of the retort through a three gas manifold located to the side of the retort
- Easy access for removal of retort

Technical data

Ref No.	Max temp. (°C)	Retort heated zone dimensions Ø x L (mm)	External dimensions (roof closed) H x W x D (mm)	External dimensions (roof open) H x W x D (mm)	Volume (furnace) (litres)	Max power (W)
301224 or 702253	1000	600 × 1500	2206 × 1845 × 2445	3340 × 1875 × 2445	424	40000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Graphite thermal oxidation test furnace

This custom built unit was designed specifically to test graphite control rods used in the nuclear power industry. The customer wanted to carry out accelerated testing of the graphite rods under controlled atmosphere and temperature conditions.

- Retort made from Inconel 601
- Retort door incorporates high temperature silicone seals and water cooled bearing mounts
- Doors clamped to the retort using eight heavy duty clamps
- Gas system with two different flow paths
- Mixed $CO+CO_2$ pass through the centre of the product
- Argon gas passes around the outside of the product

Technical data

Ref No.	Max temp. (°C)	Temp. uniformity (°C)	Retort dimensions Ø x H (mm)	Furnace dimensions H x W x D (mm)	Volume (litres)	Max power (W)
719430	1050	±10	600 x 950	1800 x 1200 x 1000	268.6	14800

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Chamber furnace with retort to fit in a glovebox

This pair of furnaces are built into a glove box and are used in the nuclear industry as part of the process of containing nuclear waste. The furnaces are designed to meet the rigorous requirements typical in this industry.

- Used for processing materials under an inert atmosphere in a clean room environment
- Maximum component weight 12 kg
- Removable gas tight air cooled stainless steel access panels for maintenance of elements and thermocouples
- Gas tight 10 mm thick Inconel 601 retort with a flat base
- 304 stainless steel water cooled profiled flange to make a bolt on seal to the glove box outer wall
- 400 mm long removable Inconel radiation plug, complete with handle, fits inside the front of the retort to reduce the temperature of the door
- Manual door opening system with top hinge pivot point
- The furnace external casing and containment panels are cooled by constant flow rated fan
- Three zone cascade temperature control system

Technical data

Ref No.	Max temp. (°C)	Temp. uniformity (°C)	Heat up time (mins)	Uniform dimensions H x W x D (mm)	Furnace dimensions H x W x D (mm)	Max power (W)
721091	1000	±10 °C at 1000 °C	10 °C per min	100 × 300 × 440	1400 × 1460 × 1800	12000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Custom Built Chamber Furnace Examples

Hydrogen chamber furnace with manual pusher

This custom built brazing furnace allows the operator to manually push product into the furnace which can be purged with either 100 % nitrogen or 100 % hydrogen. The entrance and exit to the furnace have a gas curtain burner that activates when the door is opened and a sophisticated gas control system with a series of safety interlocks. Construction is based upon a tube furnace design in which the product is heated in the 'hot' zone and after a pre-determined time it is pushed into a water cooled cooling zone.

- For use with 100% hydrogen following a nitrogen purge
- Door interlock to prevent opening below 750 °C when hydrogen is present
- Hydrogen flow interlocked to safety system with gas burn off and flame failure detection
- 600 mm long water cooled zone
- Removal of sample via exit door
- Inconel metal work tube

Technical data

Ref No.	Max temp. (°C)	Work tube inner Ø (mm)	Heated length (mm)	Dimensions external H x W x D (mm)	Max power (W)	Thermocouple
705679	1150	150	600	1460 x 2080 x 890	15000	Type K

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Top loading chamber furnace with metallic retort

These units have been constructed for a number of customers for the heat treatment of components for the aerospace industry. The metallic retort can be lifted out of the furnace into a cooling frame to speed up the cooling process. This also allows the use of multiple retorts with a single furnace to reduce overall cycle times. 1150 °C can be achieved in the nickel chromium (Inconel) alloy retort, and with a water-cooled flange the gas atmosphere is maintained. The design is suitable for inert or reducing atmospheres. 3-zone cascade temperature control is used to maximise the uniform temperature volume within the retort.

- Retort lid with centre support and component support arrangement, bottom flange, gas inlet/outlet pipes and 5 gas tight thermocouple glands
- Free radiating resistance wire elements supported on ceramic tubes on 4 sides of the heating chamber
- Hard wearing load bearing refractory brick support hearth for the retort
- Rated to heat 50 kg load in the retort to 1150°C in 3 hours

Technical data

Ref No.	Max temp. (°C)	Temp. uniformity (°C)	Retort dimensions Ø x H (mm)	External dimensions H x W x D (mm)	Volume (retort) (litres)	Max power (W)
72099	1150	±10 °C at 1150 °C	600 x 1550 Uniform volume: 600 × 1000	Furnace: 1400 × 1400 × 1700 Control cabinet: 1000 x 600 x 1750	440	36000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Twin bogie elevator hearth furnace

This twin bogie elevator hearth furnace is designed for sintering boron nitride SAPI & ESAPI (enhanced small arms protective insert) plates. The twin hearth system allows one bogie hearth to be moved under the furnace and raised for processing whilst a second bogie hearth is unloaded and re-loaded. This results in a faster turn around with consequential overall process time savings.

- Elevator hearth raised and lowered by electro-mechanical drive system, with simple bush button operation
- Audible and visual alarm, complete with comprehensive status indicator control panel in a separate control cabinet
- Horizontal movement of hearth by motor and drive pinion system with control system located on the furnace frame for full observation
- Assisted cooling via two roof vents which are automatically operated during cooling below 800 °C
- Molybdenum disilicide heating elements positioned around all four walls of the chamber
- Product monitoring thermocouple positioned in the centre of the hearth

Technical data

Ref No.	Max temp. (°C)	Temp. uniformity (°C)	Dimensions internal H x W x D (mm)	Dimensions external H x W x D (mm)	Doors	Hearth loading (kg)	Volume (litres)	Max power (W)
700659	1700	±7 at 1600 °C	1000 x 1000 x 1000	Furnace: 3600 x 2400 x 2400 Control cabinet: 1800 x 2000 x 600	Vertical lift door	900	1000	140000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Debinding & sintering furnace with retort & press

This custom built elevator hearth furnace has a retort manufactured from Inconel 601 material and a sophisticated design that incorporates ducts used to introduce laminar airflow plus access at the top for a hydraulically loaded press. The airflow is pre-heated before entering the retort at a rate of two volume changes per minute. The hydraulic press is used to heat materials whilst they are subjected to pressure.

- An elevator hearth furnace specially designed for debinding and sintering up to 1100 °C
- Bell type retort made from Inconel 601
- Maximum hearth load 100kg.
- Hearth forms a gas tight seal with the retort
- Elevator hearth raised and lowered by electro-mechanical drive system with simple push button operation
- Two zone cascade control system with thermocouples located beside the elements and the test samples to accurately control the temperature of the sample
- Cooling fan mounted for cooling operation linked in to the heating or cooling cycle of the furnace

Technical data

Ref No.	Max temp. (°C)	Temp. uniformity (°C)	Retort dimensions Ø x H (mm)	Dimensions external H x W x D (mm)	Volume (litres)	Max power (W)
85054 + 90121	1100	±5°C	475 x 500	5100 x 2120 x 1630	88	44 kW

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Custom Built Chamber Furnace Examples

Debinding & sintering furnace with retort

This custom built elevator hearth furnace is specially designed for debinding and sintering up to 1150 °C. It has a retort manufactured from Inconel 601 material, which forms a gas tight seal with the hearth. Integrity of the seal is maintained by water cooling.

- Furnace fitted with two valves for N_2 purge and N_2 + H_2 process gas
- Gas supply pressure to be regulated to 2 bar
- The flow meters are scaled to as follows:
  - H_2 2 – 15 litres per minute
  - N_2 6 – 50 litres per minute
- At the furnace exhaust a pilot flame ensures combustion of the exhaust gas
- Full hydrogen gas safety system is provided
- Elevator hearth raised and lowered by electro-mechanical drive system with simple push button operation
- Fully automated programmed temperature control and gas flow system
- Over-temperature protection with audible and visual alarm indication

Technical data

Ref No.	Max temp. (°C)	Temp. uniformity (°C)	Retort dimensions Ø x H (mm)	Dimensions external H x W x D (mm)	Volume (litres)	Max power (W)
81271	1150	±5°C	500 x 350	2822 x 2000 x 1296	68	44

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

1800 °C elevator hearth furnace

This design of elevator hearth furnace provides the highest temperature operation possible in air with conventional heating and thermal insulation technology. It can be used for many heating applications required for ceramic research or manufacture.

- Kanthal S 1900 molybdenum disillicide elements suspended vertically from the roof of the chamber
- Elevator hearth raised and lowered by electro-mechanical drive system with simple bush button operation
- Roof insulation and heating elements independently supported by an external metal frame
- The hearth is supported by a robust steel frame incorporating guide wheels for smooth and accurate movement

Technical data

Ref No.	Max temp. (°C)	Internal dimensions H x W x D '(mm)	External furnace dimensions H x W x D (mm)	External control cabinet dimensions H x W x D (mm)	Volume (litres)	Max power (W)
49722	1800	400 x 450 x 600	2000 x 1100 x 1200	1800 x 1200 x 600	108	28

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Thermal cycling calibration furnace

This custom built unit is used to calibrate colour change paint used in the aerospace industry. The coated material samples are automatically placed into the thermal cycling furnace where they are moved into the heated zone for a pre-defined period of time. Once the dwell period is complete the sample is moved to a cooling position and when cool is returned to its original position. This cycle repeats for all the samples loaded into the system.

- Eycon 20 control system for visualisation, temperature control and data recording, with colour touch screen
- Liner drive pick and place 600 mm x axis, 500 mm y axis and 100 mm z axis movement
- Sample probe thermocouple incorporated in the furnace lift actuator
- Cascade temperature control system controls the temperature of the sample
- Two over-temperature protection systems in heating element and sample locations

Technical data

Ref No.	Max temp. (°C)	Work tube inner Ø (mm)	Heated length (mm)	Dimensions external H x W x D (mm)	Temp. uniformity (°C)	Max power (W)	Thermocouple
120737	Maximum 1600 Operating temperature range 150 to 1500	60	250	2410 x 1800 x 1190	±4 over central 50 mm	3500	Type R

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Thermal cycling furnace

This thermal cycling unit is used for testing the thermal barrier coating of turbine blades used in the power generation industry. The automated cycling mechanism moves the sample material into the hot zone and once at the desired temperature it is held in position for a pre-defined amount of time. After this dwell period the sample material is removed to an air quench zone where the temperature is reduced to a pre-defined temperature. This cycle is repeated as many times as required.

- Cascade temperature control system controls the temperature of the sample
- Probe thermocouple located within the lifting mechanism
- 6 channel paperless data-logger

Technical data

Ref No.	Max temp. (°C)	Work tube inner Ø (mm)	heated length (mm)	Dimensions external H x W x D (mm)	Temp. uniformity (°C)	Max power (W)	Thermocouple
102095	1500	125	300	1890 x 1375 x 800		9000	Type R

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Custom Built Chamber Furnace Example

Top hat furnaces

The principle of a top hat furnace is a fixed hearth and a movable heating chamber. The furnace chamber, which has heating elements on all sides, is raised to expose the hearth and make the working volume of the furnace accessible. Product can be loaded onto the hearth manually or by charging machine; the chamber is then lowered to form a thermal insulation seal with the refractory hearth. Benefits of this design include: excellent temperature uniformity with four sided heating; additional hearths can be used to reduce overall processing time; incorporation of 'bell' style metallic retorts to work with atmosphere gases; can be zoned vertically to improve temperature uniformity.

Applications for top hat furnaces include: annealing; tempering; stress relieving; specialised component coting; brazing; metal power sintering; firing of ceramics; lost wax process.

General purpose top hat furnaces

This design of elevator hearth allows clear access to the hearth for loading and is used for fuel cell testing. The fuel cell test stand is placed onto the hearth and pipework passes through the hearth. It is an ideal alternative to a chamber furnace when complex or delicate assemblies have to be heated. This design of elevator hearth give clear access to the hearth for loading and is used for fuel cell testing. The fuel cell test stand is placed onto the hearth and pipework passes through the hearth. It is an ideal alternative to a chamber furnace when complex or delicate assemblies have to be heated.

- Hard wearing hearth plate can be easily replaced
- Loading height with furnace in raised position: 500 mm
- Electric raise/lower mechanism for furnace chamber
- Durable furnace stand supplied (350 mm height)

Ref No. 104331
(LHT 11/49)

Ref No. 115613
(LTH 11/31)

Technical data

Ref No.	Max temp. (°C)	Retort dimensions H x W x D (mm)	Furnace dimensions H x W x D (mm)	Control unit dimensions H x W x D (mm)	Volume (litres)	Max power (W)
115613	1100	500 x 250 x 250	1300 x 500 x 600	225 x 370 x 375	31	8000
104331	1100	400 x 350 x 350	220 x 640 x 1057	included in furnace case	49	9000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Top hat furnace system with twin retorts

This complete top hat system has two vertical tubular Inconel 601 retorts with a furnace that can heat one retort whilst the other is being prepared or is cooling. The furnace has a parking position when not in use. The system is supplied with a gas safety system to allow the use of hydrogen and can also be used under vacuum.

- Machined retort base plate for vacuum sealing against a water cooled hearth base with twin elastomer seals
- Heating interlocked with both a pressure check between the seals and cooling water flow
- Gas inlets for gas purge through the retort hearths
- Hydrogen flow interlocked to gas safety system requirements: furnace temperature; minimum flow rates; gas supply pressures; and pre-timed nitrogen purge; gas burn off with flame failure system
- Three heated zones of 200 mm with 25 mm thick insulated zone barriers
- Audible and visual alarm, complete with comprehensive status indicator control panel in an integrated control cabinet

Technical data

Ref No.	Max temp. (°C)	Temp. uniformity (°C)	Retort dimensions Ø x H (mm)	Heated length (mm)	Dimensions external H x W x D (mm)	Thermocouple	Volume (litres)
721148	1100 Maximum process temperature 1050	±10 °C between 800 and 1050 °C	190 x 765	600	Overall: 3920 x 3000 x 1200 Furnace: 1090 x 780 x 780	Type N	21

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Top hat furnace system with twin retorts

A top hat furnace system supplied with two bell retorts, two working hearths and two parking hearths. The frame has two lifting hoists which have two speeds of operation that allow accurate positioning of the retorts and furnace. The nitrogen inert gas atmosphere can flow through the hearths at up to 100 litres per minute with automated switching of the gas flow.

- Retorts made from 3 mm thick Inconel 601
- Audible and visual alarm, complete with comprehensive status indicator control panel in a separate control cabinet
- 6 channel paperless data-logger
- Hearth construction using graded durable load bearing insulation brick
- Wire coiled heating elements supported on ceramic tubes positioned on four side walls

Technical data

Ref No.	Max temp. (°C)	Temp. uniformity (°C)	Retort dimensions Ø x H (mm)	Dimensions external H x W x D (mm)	Thermocouple	Hearth loading (kg)	Volume (litres)	Max power (W)
701743	1000	500 mm high x Ø 650 mm at ±10 °C	750 x 750 Hearth 400 mm above floor level	Furnace: 1557 x 1822 x 1990 Control cabinet: 1800 x 2000 x 600 Frame :4700 x 7880 x 1797	Type R	100	300 per retort	35000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Wire & strip heat treatment furnaces

Carbolite manufactures a range of products for the wire and strip industry. These include: furnaces for hardening and tempering of blade strip; continuous annealing of stainless steel wire; hardening and tempering of carbon steel wire with in-line quenching; the continuous bright annealing of stainless steel tubes.
Continuous furnaces for the heat treatment of wire and strip can be supplied as a single lane up to 22 lanes, with temperatures ranging from 200 °C to 1200 °C depending on the customers' requirements. Furnace length is determined by the diameter of the wire, or thickness of strip and the throughput requirements. The wire or strip pass through metallic or ceramic tubes and, where required, through the appropriate atmosphere and water cooling.
In this catalogue we show some examples of custom solutions for wire and strip continuous heat treatment. The scope of Carbolite supply is the furnace for heat treatment, the lane tubes and atmosphere control equipment.
Carbolite does not supply the wire or strip feed equipment.

Four lane strand furnaces for hardening and tempering

In this example two furnaces work together to provide both hardening and tempering of stainless steel razor-blade strip, which passes though both furnaces on the same production line.

- 4 × oval cross section work tubes
- Cracked ammonia atmosphere used in the hardening furnace
- Fine control valves allowing flows of 2 – 22 litres per minute
- 8 equal zones and multiple over-temperature protection
- Wire spiral elements cemented onto ceramic support tubes and mounted horizontally above and below the work tubes
- The furnace is split horizontally at the work tube height allowing the furnace lid section to be lifted easily on its hinged structure
- A limit switch ensures that the furnace power is disconnected when the lid is lifted
- 16 off type R thermocouples for control and independent over-temperature protection
- Each instrument is fitted with a deviation band alarm giving an audible and visual alarm in the event of furnace over or under temperature

Technical data

Ref No.	Max temp. (°C)	Heated dimensions of inner work tube (oval tube) H × W x L (mm)	Furnace dimensions H x W x D (mm)	Furnace dimensions (open) H x W x D (mm)	Features	Max power (W)
101680-01	1200	50 x 30 × 5800	1350 x 6450 x 1650	1850 x 6450 × 2150	8 equal zones on each of the 4 lines	68000
101680-02	550	50 x 38 × 1416	1350 x 1856 x 1650	1850 x 1856 x 2150	1 separately controlled zone on each of the 4 lines	18000

Eight lane strand furnace

This heat treatment furnace was combined with the customer's own wire handling equipment. Up to 8 wires can be heat treated simultaneously as they pass through the ceramic tubes supplied with the furnace. The gas system is also part of the furnace and includes 8 nitrogen flow-meters which control the flow rate between 1 and 12 litres per minute.

- Gas flow isolation by electrically actuated solenoid valve
- Normal operating temperature range 500 to 1250 °C
- Three zone temperature control
- Audible and visual alarm, complete with comprehensive status indicator control panel
- Holding power 11000 W at 1300 °C
- APM wire heating elements wound onto ceramic tubes, supported above the eight lane work tubes
- Split construction for maintenance access to work tubes and heating elements
- Interlocks prevent heating if the lid is open

Technical data

Ref No.	Max temp. (°C)	Temp. uniformity (°C)	Lane tubes inside Ø x length (mm)	Heated length (mm)	Dimensions external H x W x D (mm)	Thermocouples	Max power (W)
704944	1300	±10 over 600 mm at 1200 °C	8 tubes Ø 21 x 1286	600	1830 x 1670 x 1360	Type R	18000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Mesh belt furnace with retort

Mesh belt furnaces are used to provide a continuous process line that can combine different temperature heating and cooling sections. In this way the material passing through is subjected to a heating and cooling profile without having to wait for the furnace itself to heat and cool. Atmosphere control is also possible by passing the mesh belt through a retort that has gas curtains at each end to ensure the correct atmosphere is maintained within the retort.

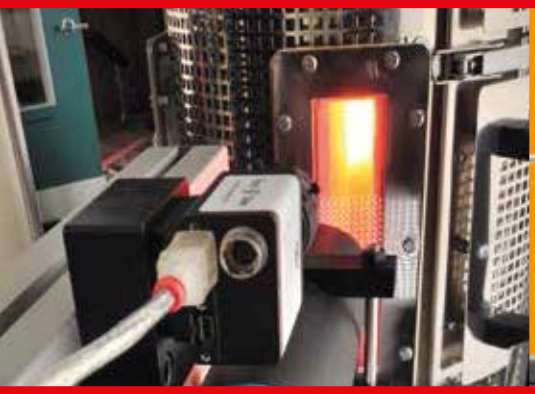
- Mesh belt furnace with dewax, firing and cooling
- 455 mm wide mesh belt
- Four selectable process gases
- 3 m long gas fired dewax zone
- 4 x 1400 mm long heated furnace zones
- 1500 mm long water cooled zone
- 3000 mm long super cooled zone

Technical data

Ref No.	Max temp. (°C)	Mesh belt width (mm)	Furnace heated length (mm)	Dimensions: External H x W x D (mm)	Max power (W)
69170	1150	455	5600	2280 x 20815 x 1500	126000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Tube Furnaces up to 1800°C



Examples of custom designed tube furnace solutions

Tube Furnaces up to 1800 °C

Carbolite defines a tube furnace as a furnace that uses a work tube to contain the sample being heated. They are typically constructed using ceramic linings and operating up to 1800 °C, where the heat transfer is predominantly by radiation. For temperatures in the range 1800 °C to 3000 °C please refer to the catalogue from our sister company Carbolite Gero. Carbolite's extensive range of tube furnaces has tube diameters ranging from 15 mm to 150 mm.

The following temperature ranges of tube furnaces are available: 900 °C; 1000 °C; 1100 °C; 1200 °C; 1400 °C; 1500 °C; 1600 °C; 1700 °C; 1800 °C.

Carbolite tube furnaces are available with single zone temperature control. Many are also available with three zone control, used to increase the temperature uniformity along the work tube. Split tube furnaces are also available where the body of the furnace opens along its length allowing the furnace to be closed around a work tube or work piece.
All tube furnaces have excellent temperature control provided by a range of sophisticated digital controllers. Comprehensive data logging and connection to computers and networks is available along with remote webpage access.

Carbolite has a comprehensive range of standard tube furnaces which are detailed in the catalogue 'Ovens and Furnaces up to 3000 °C' and are available with a number of standard options including: a range of metallic and ceramic work tubes; work tube end seals incorporating gas inlets, thermocouple glands and vacuum flange connections vertical stands; thermal insulation plugs and radiation shields to reduce thermal losses from the ends of work tubes; wall mounting bracket; separate control cabinet; over-temperature protection;.

All Carbolite products can be modified to use non-REACH classified thermal insulation materials if required.

Common tube furnace features

- Highly efficient thermal insulation using a combination of ceramic fibre & refractory brick
- Heating elements made from resistance wire, silicon carbide or molybdenum disilicide depending on the power and maximum temperature required
- Sophisticated digital temperature control including multi-zone temperature control
- Over-temperature protection including over-temperature per zone for multi-zone control
- Solid state power control

Common tube furnace modifications

- **Fans:** To reduce cooling time and to move ambient air through the hot zone or around the hot zone if an atmosphere is to be maintained
- **Mechanical changes:** To fit with customers' equipment
- **Instrumentation and performance validation for aerospace standard AMS2750E**
- **Atmosphere control packages** which could include: Multiple gas inlets; multiple flow meters with manual flow adjustment; mass flow controller with manual adjustment; mass flow controller with automatic adjustment; pressure sensing of gas or mass flow control to sense gas flow; gas solenoid valves manually or automatically switched; solenoid valves to change rate of flow; gas flow solenoids interlocked to process parameters, e.g. H_2 flow interlocked to minimum temperature
- **Gas pre-heating**
- **Inputs and outputs:** To link temperature controllers to customers' automated equipment
- **Higher power heating elements:** To increase heating rate and to reduce heat up time
- **Furnace heating element protection:** Silicon carbide protection tiles for chamber furnaces
- **Access ports:** Small diameter tube perpendicular to work tube
- **Viewing windows:** For higher temperature capability using quartz or sapphire: for viewing and optical temperature measurement. Can be applied to: tube furnace end seals, tube furnaces perpendicular to a quartz work tube, exit end of rotating tube furnaces
- **Tube furnace custom heated lengths and diameters** longer heated lengths; shorter heated lengths; larger diameter versions > 200 mm
- **Multiple temperature zone control:** Zone barriers in tube furnaces with modular vacuum formed elements including non-split tube furnaces EHC, EVC, GHC, GVC & split tube furnace EZS, EVZ, HZS, TVS
- **Tube furnace equalisation block** to improve temperature stability and uniformity

MTF 12/38/250 Mini tube furnace with angle adjustment stand

This modification can be applied to most tube furnaces where the main tube body is mounted on a stand that allows the angle of the furnace to be adjusted. Once the angle is chosen, the furnace can be clamped into that position.

- The angle of the furnace body can be adjusted by 180°
- Clamping system for work tube to ensure stability in furnace

Technical data

Ref No.	Max temp. (°C)	Temp. uniformity (°C)	Heat up time (mins)	Dimensions internal Ø x D (mm)	Dimensions external H x W x D (mm)	Volume (litres)	Max power (W)
702895	1200	±5°C over 90 mm	25	38 × 250	1014 × 848 × 570	0.3	1000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

TZF 12/100/1200E 3-zone tube furnace with equal length zones

Tube furnaces can be easily made with different heated lengths, as shown in this example with a 1200 mm heated length.

- Increased heated length tube furnace
- Three equal heated zones each of 395 mm long

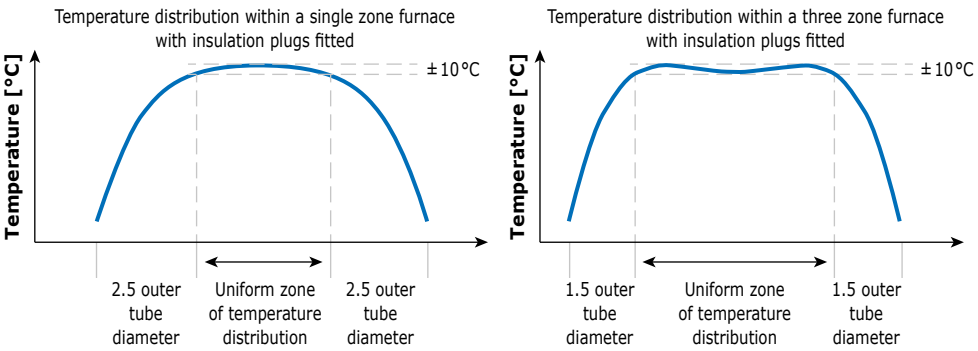
Technical data

Ref No.	Max temp. (°C)	Max continuous operating temperature (°C)	Dimensions: fixed tube inner Ø (mm)	Dimensions: heated length (mm)	Dimensions external H x W x D (mm)	Thermocouple	Max power (W)
700097	1200	1100	75	1500	527 x 1250 x 358	Type N	5700

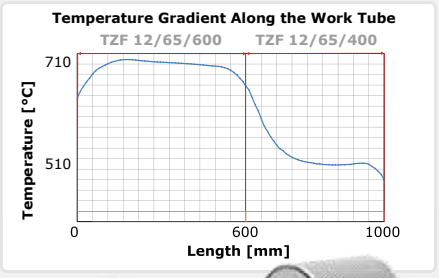
Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Multi zone tube furnaces

Multi zone tube furnaces are capable of compensating for the temperature drop towards the ends of a tube furnace. Three zone, or even eight zone, tube furnaces are available.

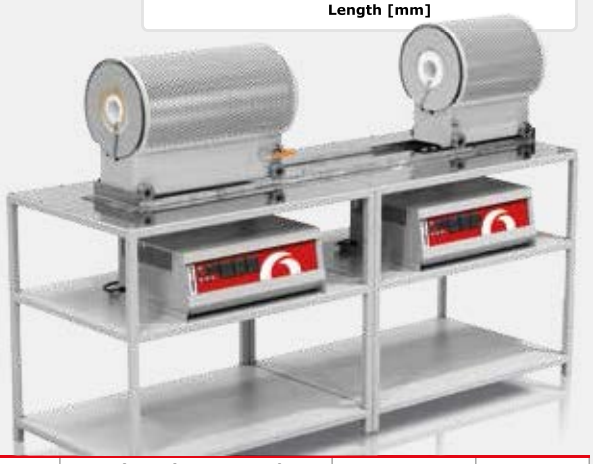


TZF 12/65/400 & TZF 12/65/600 Twin 3-zone tube furnace system with rails



Two tube furnaces are used to provide a flexible system that can provide a temperature gradient or a long uniform length. The furnaces can be moved along rails mounted on the support table. This customer uses the temperature gradient for thermoelectric research applications.

- Used for three processes:
  - As a diffusion furnace
  - For coating surfaces by chemical transport
  - For purification by chemical transport
- Two independently controlled three zone tube furnaces on wheels mounted on rails
- When pushed together the furnaces provide a profile of 700 °C in one furnace and 515 °C in the other with a gradient between
- The two furnaces can be fixed together using over-centre clamps



Technical data

Ref No.	Max temp. (°C)	Max continuous operating temperature (°C)	Dimensions: fixed tube inner Ø (mm)	Dimensions: heated length (mm)	Dimensions external H x W x D (mm)	Thermocouple	Max power (W)
700118	1200	1100	65	400	455 x 455 x 340	Type N	2000
700118	1200	1100	65	600	455 x 655 x 340	Type N	3000

4 x GHA 12/450 Modular horizontal tube furnaces in a rack system

Four standard tube furnaces have been mounted into a support frame with the control equipment positioned in an integrated control panel. Each furnace can be used independently and is used for long term oxidization of material in atmospheres for periods of up to 6 months.

- Designed to save space and be used within a work cell
- To suit work tubes inner Ø 150 mm x 750 mm long
- Each furnace has independent 3216P1 digital temperature control with RS232 communications

Technical data

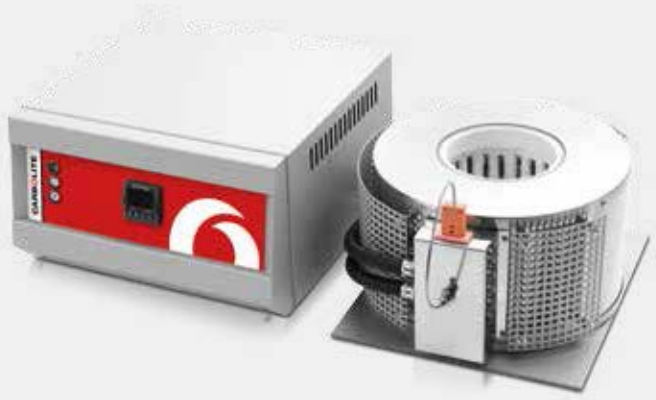
Ref No.	Max temp. (°C)	Max continuous operating temperature (°C)	Dimensions: heated length (mm)	Dimensions: maximum outer Ø accessory tube (mm)	Dimensions: external H x W x D (mm)	Thermocouple	Max power (W)
707008	1200	1100	450 each	170	1525 x 1850 x 900	Type R	12880

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

GVA 12/125/150 Modular vertical chamber furnace

A simple adaptation of a tube furnace heating element is used to create a small top loading chamber furnace.

- Adaptation of a short heated length large diameter tube furnace to create a top loading chamber
- Vertical single zone tube furnace
- To suit work tubes or work pieces up to outside Ø 125 mm



Technical data

Ref No.	Max temp. (°C)	Max continuous operating temperature (°C)	Dimensions: heated length (mm)	Dimensions: maximum outer Ø accessory tube (mm)	Dimensions: external H x W x D (mm)	Thermocouple	Max power (W)
709325	1200	1100	150	125	Furnace:200 x 380 x 320 Control Box:225 x 370 x 380	Type N	3000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Custom Built Tube Furnace Examples

Twin 2 x MHC 12/230/450 Modular horizontal tube furnaces in a rack with gas system

In this case four custom built tube furnaces have been mounted into support frames. Each pair of furnaces has an integrated control panel with both 3 zone temperature and mass view gas control. The customer's quartz vessels fit into the furnaces and connect to the gas system. They are used for a diffusion process.

- The two sets of frame work join together at the centre, forming one unit, with control units on opposite sides
- Each furnace has water cooled outer case
- Two mass flow control units for N_2 & O_2 per furnace

Technical data

Ref No.	Max temp. (°C)	Max continuous operating temperature (°C)	Dimensions: heated length (mm)	Dimensions: maximum outer Ø accessory tube (mm)	Dimensions: external H x W x D (mm)	Thermocouple	Max power (W)
726887	1200	1100	450 each	230	1635 x 1000 x 1025 each	Type N	20000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

MTF 15/5/100 Mini tube furnace with platinum alloy heating element

An example of a very small, 5 mm diameter, tube furnace used in conjunction with equipment for elemental analysis. Pyrolysis of a sample takes place inside a very small diameter tube that passes through the furnace.

- Heats to 1500 °C in 7 minutes
- The gases flow along a Ø 1 mm tube which runs through the furnace
- Single zone tube furnace
- Platinum alloy heating element
- Supplied with a mounting bracket that fixes within the customer's equipment

Technical data

Ref No.	Max temp. (°C)	Max continuous operating temperature (°C)	Dimensions: fixed tube inner Ø (mm)	Dimensions: heated length (mm)	Dimensions: external H x W x D (mm)	Thermocouple	Max power (W)
703625	1500	1450	5	100	Furnace: Ø 200 x 260 long Control Cabinet: 430 x 400 x 400	Type R	300

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

TZF 12/38/400 3-zone calibration tube furnace with automated loading

One of five identical thermal cycling furnaces for accelerated aging tests on sensors that are used in aircraft engines. These 1200 °C 3 zone furnaces have actuators which can insert up to 15 sensors, approximately 2 mm in diameter, into the furnace for 30 minutes, and then remove them to cool to ambient temperature before commencing the cycle again. Can be used for up to 4000 cycles.

3 ZONE

- Linear actuated motion system moves the thermocouples into the heated zone of the furnace
- Two timers are used to control the period of time in the hot zone position and the period of time in the cooling position
- Safety interlocked lid stops the movement of the actuator if opened

Technical data

Ref No.	Max temp. (°C)	Max continuous operating temperature (°C)	Dimensions: fixed tube inner Ø (mm)	Temperature uniformity (°C)	Dimensions: heated length (mm)	Dimensions: external H x W x D (mm)	Thermocouple	Max power (W)
117899	1200	1100	38	±5 °C over 130 mm in the centre	400	550 x 1000 x 410	Type N	1500

ACT 13/360 Air cooled calibration tube furnace

This custom built tube furnace is used during the manufacture of thermocouples. It is used for calibration over a wide temperature range and has 'bifilar' elements to minimise induced electro-magnetic effects. This system allows a fast throughput of products due to a quick heat up rate and an accelerated cool down feature.

- Horizontal tube furnace with twin metallic work tubes and air cooling
- Cooling air is introduced between the two work tubes to achieve rapid cooling rates
- Inner Kanthal APM work tube inner Ø 64 mm x 900 mm long
- Phase angle current limit power controller
- Silicon carbide heating elements positioned parallel to the work tube

Technical data

Ref No.	Max temp. (°C)	Max continuous operating temperature (°C)	Dimensions: heated length (mm)	Dimensions: tube Ø (mm)	Dimensions: external H x W x D (mm)	Thermocouple	Max power (W)
706402	1300	1200	360	Inner tube: Ø 64 mm inside Outer tube:Ø 99 mm inside	Furnace: 730 x 860 x 510 Control cabinet: 620 x 600 x 500	Type R	7000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Cycling corrosion test furnace with gas system

This is an excellent example of a system which combines a tube furnace, gas control equipment and mechanical modifications. The tube furnace and its integral extraction hood are mounted on wheels and can be moved along the quartz work tube. The rails for the wheels are mounted on the support frame. Mass flow controlled gas supplies are fed into the work tube through end seals together with probe thermocouples. It is used for long term corrosion testing of turbine blades.

- Siemens TP 177B HMI colour touch screen control system with temperature display, gas control and alarm display
- Three gas inlets designated for:
  – Mixed gases H_2 - CO – CO_2 – H_2O
  – Sulphur dioxide SO_2
  – Nitrogen purge and emergency nitrogen purge
- Gas control through mass flow controllers connected to the Siemens control system with flow range 0 to 10 litres per minute
- Mixed gases pass through a humidifier with a maximum flow rate of 4 litres per minute. Deionised water supply required
- Hydrogen and carbon monoxide flow interlocked to furnace temperatures above 750 °C. Override key switch is provided
- Four gas leak detectors
- Heavy gauge APM wire heating element cassette suitable for 1300 °C operation

Technical data

Ref No.	Max temp. (°C)	Continuous temp. (°C)	Work tube inner Ø (mm)	Heated length (mm)	Dimensions external H x W x D (mm)	Thermocouple	Max power (W)
700368	1300	1200	150	500	1980 x 2200 x 1000	Type R	12600

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

STF 15/200/450 High temperature large diameter tube furnace

A custom built tube furnace designed to accept a larger diameter work tube than is possible with Carbolite's standard 1500 °C furnaces.

- An increased diameter STF tube furnace
- Horizontal single zone tube furnace
- To suit work tubes up to outside Ø 220 mm

Technical data

Ref No.	Max temp. (°C)	Max continuous operating temperature (°C)	Dimensions: maximum outer Ø (mm)	Dimensions: heated length (mm)	Dimensions: external H x W x D (mm)	Thermocouple	Max power (W)
122468	1500	1400	220	450	815 x 1335 x 625	Type R	14000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

CO_2 reactivity test furnace to meet ISO 12981-1 & BS 6043-2.20.1

A custom built unit to determine the reactivity of carbon anodes, used in the production of aluminium, to CO_2. It is used for testing in compliance with the requirements of ISO 12981-1 & BS 6043-2.20.1

- Integrated CO_2 pressure regulation, flow control and temperature control
- Audible signal to indicate furnace ready for test
- Push button start once the sample is placed in the furnace
- Mass-view flowmeter to adjust and monitor the CO_2 gas flow
- Automatic switching of CO_2 with audible alarm to indicate end of test
- Probe thermocouple inserts into the sample
- To suit work tubes or work pieces up to outside Ø 40 mm

Technical data

Ref No.	Max temp. (°C)	Max continuous operating temperature (°C)	Dimensions: heated length (mm)	Dimensions: maximum outer Ø accessory tube (mm)	Dimensions: external H x W x D (mm)	Thermocouple	Max power (W)
721871	1000	1000	200	40	660 × 660 × 475	Type N	950

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

VST 12/50/150 Vertical split tube furnace with element protection

A standard furnace has been modified to change the hinge arrangement and to provide protection of the heating elements by metallic shields. The furnace is used in a long term materials test rig, with materials being tested for months or years.

- Vertical split tube furnace with single zone temperature control
- Inner Inconel liner shield prevents accidental contact with the heating elements
- Furnace body is hinged and split into two along its length and is held closed with over-centre clamps
- Easy access to reactors or work tubes
- To suit work tubes or work pieces up to outside Ø 50 mm

Technical data

Ref No.	Max temp. (°C)	Max continuous operating temperature (°C)	Dimensions: heated length (mm)	Dimensions: maximum outer Ø accessory tube (mm)	Dimensions: external H x W x D (mm)	Thermocouple	Max power (W)
702380	1000	900	150	50	Furnace: 210 x 250 x 270 Control Box:225 x 370 x 380 each	Type N	900

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

2 x TVS 12/90/900 Vertical split 3-zone tube furnaces in tandem on a mounting frame

6 ZONE

Two standard 3-zone vertical split tube furnaces have been joined together to provide an extended heated length. They are used in the processing of ceramic filters. The modifications include the addition of metallic element protection shields and the mounting of the furnaces onto a single frame.

- Six zones of control with a short unheated section
- Inner Inconel liner shield prevents accidental contact with the heating elements
- Furnace body is hinged and split into two along its length and is held closed with over-centre clamps
- To suit work tubes or work pieces up to outside Ø 75 mm

Technical data

Ref No.	Max temp. (°C)	Max continuous operating temperature (°C)	Dimensions: heated length (mm)	Dimensions: maximum outer Ø accessory tube (mm)	Dimensions: external H x W x D (mm)	Thermo-couple	Max power (W)
709972	1000	900	Top zone = 150 Centre zone = 600 Bottom zone = 150 per furnace	900	Furnace: 2080 x 500 x 560 Control Box: 225 x 570 x 380 each	Type N	9000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

HZS 12/400 Horizontal split 2-zone tube furnace with zone barrier

2 ZONE

A two zone tube furnace with a zone barrier between the heated zones. The zone barrier allows different temperatures to be controlled in the two zones. It can be used for CVD (chemical vapour deposition) where a solid material is evaporated in one zone and the vapour produced is deposited in the other zone e.g. onto a wafer for micro-electronics.

- Horizontal split tube furnace with 2-zone cascade temperature control
- Two equal zone lengths of 150 mm
- Furnace body is hinged and split into two along its length and is held closed with over-centre clamps
- Easy access to reactors or work tubes

Technical data

Ref No.	Max temp. (°C)	Max continuous operating temperature (°C)	Dimensions: heated length (mm)	Dimensions: maximum outer Ø accessory tube (mm)	Dimensions: external H x W x D (mm)	Thermocouple	Max power (W)
707531	1200	1100	Zone 1: 150 mm Zone 2: 150 mm	110	Furnace: 330 × 530 × 360 Control Box: 225 x 370 x 380 each	Type N	1500

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Split tube furnaces for materials testing (page 53)

Material testing often requires the material under test to be held at elevated temperatures. Carbolite has designed and manufactured many furnaces and ovens for these applications.

The furnace or oven body is a split construction allowing the furnace to be clamped around the material under test. The split body may be a hinged construction or the two halves could separate completely either supported on rails or by fixing to a stacker truck. Space constraints often limit the heated length of the furnace leading to the requirements for 3-zone temperature control to achieve the desired temperature uniformity.

For very long term testing the requirements may include the built in redundancy of the control thermocouple, and very conservative rating of heating elements to reduce the risk of failure during the test.

Split tensile test furnace with extensometer access

Split tube furnaces can be readily modified to give extensometer access for material testing. The furnace is clamped around the material under test with the extensometer passing through the cut away slot in the side of the furnace. A bracket is fixed to the cut away area of the furnace for mounting the extensometer.

3 ZONE

- Vertical split tube furnace with 3-zone temperature control
- Furnace body is split into two along its length and is held closed with over-centre clamps
- Furnace mounted on vertical rods to suit the customer's equipment and give easy access to sample
- Extensometer access slot measuring 120 mm high x 10 mm wide cut-out at the centre of the furnace split line
- To suit work tubes or work pieces up to outside Ø 90 mm

Technical data

Ref No.	Max temp. (°C)	Max continuous operating temperature (°C)	Dimensions: heated length (mm)	Dimensions: maximum outer Ø of sample (mm)	Dimensions: external H x W x D (mm)	Thermocouple	Max power (W)
302253	1200	1100	Top zone = 100 Centre zone = 100 Bottom zone = 100	90 (Chamber inner Ø = 120)	500 x 340 x 340 Control Box:225 x 570 x 380	Type N	2500

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Split tensile test furnace with viewing windows

A split tube furnace used for materials testing. In this case quartz viewing windows are fitted in both sides. The windows can be used for viewing by a camera or for optical temperature measurement of the sample.

3 ZONE

- Vertical split tube furnace with 3-zone temperature control
- Furnace body is split into two along its length and is held closed with over-centre clamps
- Furnace is mounted by M6 threaded holes in the ends of the furnace body
- Two quartz viewing windows 170 x 40 mm each with two glass panels
- To suit work tubes or work pieces up to outside Ø 90 mm

Technical data

Ref No.	Max temp. (°C)	Max continuous operating temperature (°C)	Dimensions: heated length (mm)	Dimensions: maximum outer Ø of sample (mm)	Dimensions: external H x W x D (mm)	Thermocouple	Max power (W)
720840	1000	1000	Top zone = 100 Centre zone = 100 Bottom zone = 100	90 (Chamber inner Ø = 120)	410 x 300 x 440 Control Box: 225 x 570 x 380	Type N	2500

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Split chamber furnace with viewing windows

3 ZONE

A custom built split chamber furnace with quartz viewing windows. The quartz viewing windows can be used for viewing with a camera, illumination, and for optical measurement of the sample surface temperature. The split design allows the furnace to be clamped around the test piece in a materials test rig.

- Furnace body is split into two along its length and is held closed with over-centre clamps
- Furnace mounted on linear slide bearings on a frame to suit the customer's equipment and give easy access to sample
- Quartz viewing window 125 x 50 mm with 2 glass panels with reflective coating
- Adjustable lateral camera mounting bracket
- Ø 30 mm sight glass ports used by the customer to illuminate the chamber
- Heating rate up to 20 °C per minute
- To suit work tubes or work pieces up to outside Ø 100 mm

Technical data

Ref No.	Max temp. (°C)	Max continuous operating temperature (°C)	Dimensions: heated length (mm)	Dimensions: maximum outer Ø of sample (mm)	Dimensions: external H x W x D (mm)	Thermocouple	Max power (W)
712992	800	800	Top zone = 100 Centre zone = 100 Bottom zone = 100	100	450 x 400 x 400 Control Box: 225 x 570 x 380	Type N	3000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Split chamber furnace to fit into a hydraulic press

A split chamber furnace designed to fit within the customer's hydraulic press. The customer processes the materials under both pressure and high temperature. Half of the furnace is removed on a stacker truck to give clear access to the material in the press.

- For the manufacture of material used in thermal imaging and detecting equipment
- Furnace body is split into two along its length and is held closed with over-centre clamps
- Furnace body mounting points to fix to customer's equipment
- 3508P1 temperature control with digital input to monitor customer's air pressure and hydraulic valves
- To suit work tubes or work pieces up to outside Ø 150 mm

Technical data

Ref No.	Max temp. (°C)	Max continuous operating temperature (°C)	Dimensions: heated length (mm)	Dimensions: maximum outer Ø of sample (mm)	Dimensions: external H x W x D (mm)	Thermocouple	Max power (W)
711520	1300	1300	160	150	550 x 560 x 560 Control Box: 770 x 600 x 500	Type R	21000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

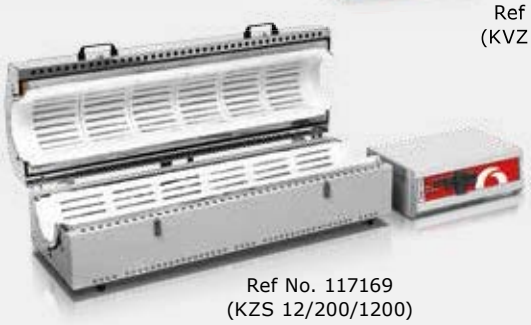
K-Range split 3-zone tube furnaces

3 ZONE

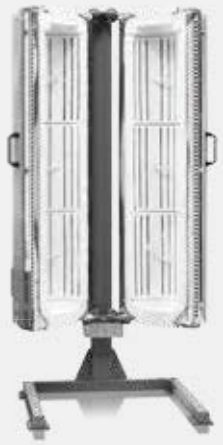
A number of custom built split tube furnaces have been designed for use with work tubes or reactor vessels up to 200 mm outer diameter. These products have been given the model designation letter K to create the K-range of split tube furnaces. These furnaces can be used for many applications such as heating reactors in pilot plant or the manufacture of plastic parts in the automotive industry.

- Horizontal and vertical split tube furnaces with 3-zone temperature control
- Furnace body is hinged and split into two along its length, and is held closed with over-centre clamps
- Easy access to reactors or work tubes
- To suit work tubes or work pieces up to outside Ø 200 mm

Ref No. 113095
(KVZ 12/200/600)



Ref No. 117169
(KZS 12/200/1200)



Ref No. 112819
(KVZ 12/200/1200)

Ref No. 717254
(KVZ 12/200/1500)

Technical data

Ref No.	Model	Max temp. (°C)	Max continuous operating temperature (°C)	Dimensions: heated length (mm)	Dimensions: maximum outer Ø accessory tube (mm)	Dimensions: external furnace H x W x D (mm)	Dimensions: control box H x W x D (mm)	Max power (W)
117169	**KZS 12/200/1200**	1200	1100	Top zone = 400 Centre zone = 400 Bottom zone = 400	200	440 × 1350 x 560	225 x 570 x 380	18000
113095	**KVZ 12/200/600**	1200	1100	Top zone = 200 Centre zone = 200 Bottom zone = 200	200	1300 × 790 × 680	225 x 570 x 380	9000
112819	**KVZ 12/200/1200**	1200	1100	Top zone = 400 Centre zone = 400 Bottom zone = 400	200	1900 × 790 × 680	225 x 570 x 380	18000
717254	**KVZ 12/200/1500**	1200	1100	Top zone = 350 Centre zone = 800 Bottom zone = 350	200	2565 × 500 × 1000	225 x 570 x 380	19200

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Custom Built Split Tube Furnace Examples

M-Range vertical split tube furnaces

3 ZONE

A number of custom built split tube furnace have been designed for use with work tubes or reactor vessels up to 250 mm outer diameter. These products have been given the model designation letter M to create the M-range of split tube furnaces. These furnaces can be used for many applications such as heating reactors in pilot plant or to fit around a hydraulic press.

- Vertical split tube furnaces with single or 3-zone temperature control
- Furnace body is hinged and split into two along its length and is held closed with over-centre clamps
- To suit work tubes or work pieces up to outside Ø 250 mm

Ref No. 122193
(MVT 12/250/600)

Technical data

Ref No.	Model	Max temp. (°C)	Max continuous operating temperature (°C)	Dimensions: heated length (mm)	Dimensions: maximum outer Ø accessory tube (mm)	Dimensions: external furnace H x W x D (mm)	Dimensions: control box H x W x D (mm)	Thermo-couple	Max power (W)
122193	MVT 12/250/600	1200	1100	600	250	1210 x 790 x 830	225 x 370 x 380	Type N	6000
711373	MVZ 12/250/1350E	1200	1100	Top zone = 320 Centre zone = 750 Bottom zone = 180	250	1500 x 610 x 640	620 x 600 x 500	Type N	20100

High temperature split 3-zone tube furnaces

3 ZONE

These high temperature horizontal split tube furnaces have many applications in material research where easy access to the work tube or reactor is required. Applications include:

– Used for the development of new wafer materials
– Clean-room conditions inside the work tube
– Working with vacuum to 10^{-5} mbar
– Working where purified gases are required

- Maximum temperatures of 1300 °C, 1500 °C & 1600 °C
- Heating elements positioned perpendicular to the chamber to allow multi-zone temperature control
- Horizontal split tube furnace with three zone temperature control
- Insulation zone barriers between heated zones
- Furnace body is hinged and split into two along its length, and is held closed with over-centre clamps
- Lid opening assisted by gas springs
- To suit work tubes outside diameters in the range 60 mm to 130 mm (see data table for details)
- Can be mounted on an 'L' stand to allow horizontal and vertical use

Ref No. 124296
(HZS 13/110/600)

Ref No. 726853
(HZS 15/60/600)

Ref No. 120101
(HZS 16/110/900)

Technical data

Ref No.	Model	Max temp. (°C)	Max continuous operating temperature (°C)	Dimensions: heated length (mm)	Dimensions: maximum outer Ø accessory tube (mm)	Dimensions: external furnace H x W x D (mm)	Dimensions: control box H x W x D (mm)	Thermo-couple	Max power (W)
124296	HZS 13/110/600	1300	1250	End zones = 180 Centre zone = 180	130	910 × 1000 × 860	225 x 570 x 380	Type R	9000
726853	HZS 15/60/600	1500	1400	End zones = 200 Centre zone = 200	60	1000 × 1680 × 940	620 x 600 x 500	Type R	10000
120101	HZS 16/110/900	1600	1500	End zones = 300 Centre zone = 300	110	1500 × 1200 x 760	Integrated into furnace	Type R	12000

Batch rotating tube furnaces

The batch rotating tube furnaces, or rotary reactor furnaces, contain the material being processed in a vessel which is rotated or oscillated whilst atmosphere gases flow through. In addition to constant agitation, the movement exposes powdered or granular material to the atmosphere that is present in the vessel. This reduces the reaction times compared with those achieved in a chamber or tube furnace, with a static material.

The quartz glass or metallic vessels can be easily removed for loading and unloading of the material being processed. Agitation and mixing of the material is aided by the incorporation of flutes (quartz vessels) or 'flights' (metallic vessels) on the inner surface of the vessel.

Continuous rotating tube furnaces

The continuous rotating tube furnaces contain the material being processed within a rotating tube whilst atmosphere gases flow through. Material is fed in at one end of the work tube via a screw or vibration feeder, or a combination of the two. In addition to rotating the work tube it is set at a slight incline which causes the material to move or flow along the work tube. 'Flights' can be attached to the inner surface of the work tube to agitate the material, the movement exposing powdered or granular material to the atmosphere that is present in the work tube. The rate of material flow through the tube is adjusted by both rotation speed and inclination angle. The processed material is collected at the exit of the work tube into a stainless steel or quartz collection vessel. Rotating tube furnaces not only reduce the reaction times that would be achieved with a static material in a batch furnace but also offer the advantages of a continuous process.

Rotary Reactor Furnaces Modification Examples

HTR 6/100/350 Rotary reactor tube furnace with stainless steel reaction vessel

A modified rotary reactor furnace used for research into reactions and catalysts for lithium chemistry. It differs from the standard HTR furnaces in that it has a metallic reaction vessel with continuous rotation.

- 304 grade stainless steel reaction vessels with four inner flutes
- Positive pressure digital display
- Pressure relief valve
- Gas inlets for argon and hydrocarbon
- Reaction vessel easily removed for loading and unloading
- 1 to 8 revolutions per minute with speed controller
- Vessel rotation stops when the chamber lid is opened
- Gas sealed system to maintain atmosphere inside the vessel
- Process gas enters and exits the vessel though rotary gas seals

Technical data

Ref No.	Max temp. (°C)	Max continuous operating temperature (°C)	Dimensions: heated length (mm)	Dimensions: Reaction chamber capacity (ml)	Dimensions: Reaction chamber inner Ø x length (mm)	Dimensions: external H x W x D (mm)	Thermo-couple	Max power (W)
709809	600	600	600	200	100 x 350	545 x 1710 x 685	Type K	4900

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

2 x twin HTR 11/75 Rotary reactor tube furnace – total of 4 vessels

In this custom built rotary reactor furnace two reaction vessels have been mounted next to each other in two furnaces. A pair for these furnaces are mounted one above the other to give a total of four reaction vessels. It is used in a quality control application.

- Each furnace operated independently
- Each furnace runs with two vessels in place
- Four quartz reaction vessels with fluted inner surface
- Each reaction vessel oscillates thought 315°
- Reaction vessel easily removed for loading and unloading
- 1 to 8 revolutions per minute with speed controller
- Vessel oscillation stops when the chamber lid is opened
- Gas sealed system to maintain atmosphere inside the vessel
- Each vessel has an independent gas inlet
- Process gas enters and exits the quartz vessel through flexible silicone rubber tube

Technical data

Ref No.	Max temp. (°C)	Max continuous operating temperature (°C)	Dimensions: heated length (mm)	Dimensions: reaction chamber capacity (ml)	Dimensions: reaction chamber inner Ø x length (mm)	Dimensions: external H x W x D (mm)	Thermo-couple	Max power (W)
726678	1100	1000	160	50 per vessel	75 x 100	1515 x 1220 x 650	Type K	6000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Tube Furnace Modification Examples

STF 16/610 Hign temperature single zone tube furnace with rotating and tilting mechanism

This rotating tube furnace is used by the customer for catalyst research and simulates a manufacturing process. It uses a standard STF tube furnace.

- For processing powder or small granular materials
- Continuous material processing
- Standard STF 16/610 furnace modified to house a rotating tube
- Mounted on adjustable tilting frame up to 10°
- 1 to 8 revolutions per minute with speed controller

Technical data

Ref No.	Max temp. (°C)	Max continuous operating temperature (°C)	Dimensions: heated length (mm)	Dimensions: inner Ø (mm)	Dimensions: external H x W x D (mm)	Thermocouple	Max power (W)
723640	1600	1500	610	65	1290 × 3070 × 535	Type R	7000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Split Tube Furnace Modification Examples

HZS 12/75/900 with rotating and tilting mechanism

This rotating tube furnace utilises a standard split 3-zone tube furnace. It can be used for continuous processing of powder or granular materials fed from a vibratory feeder.

- IAP work tube inner Ø 75 mm 1500 mm long
- 1 to 8 revolutions per minute with speed controller
- Tube rotating interlock to temperature to ensure rotation above 150 °C to avoid tube distortion
- Gas sealed system to maintain atmosphere inside the furnace
- Gas inlet flowmeter
- Manually operated tilting mechanism; maximum tilt of 6° from horizontal
- Stainless steel inlet hopper with 5 litres capacity and a sealed lid
- Processed materials exit into a sealed stainless steel collection vessel

Technical data

Ref No.	Max temp. (°C)	Max continuous operating temperature (°C)	Dimensions: heated length (mm)	Dimensions: inner Ø (mm)	Dimensions: external H x W x D (mm)	Thermocouple	Max power (W)
700130	1200	1100	900	75	1245 × 2610 x 500	Type N	4500

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

HZS 12/75/900 Horizontal split 3-zone tube furnace with rotating and tilting mechanism

This custom built rotating tube furnace uses a larger diameter split tube furnace and is used for the manufacture of hydroxyapatite based synthetic bone graft materials. The screw feeder mechanism pushes material into a vibratory feeder which in turn pushes the material into a metallic work tube. The processed material is collected under an inert atmosphere.

- For processing powder or small granular materials
- Stainless steel 304 grade work tube inner Ø 120 mm 1900 mm long
- 1 to 8 revolutions per minute with speed controller
- Tube rotating interlock to temperature to ensure rotation above 150 °C to avoid tube distortion
- Gas sealed system to maintain atmosphere inside the furnace
- Gas inlet flowmeter
- Manually operated tilting mechanism; maximum tilt of 6° from horizontal
- Stainless steel inlet hopper with 5 litres capacity and a sealed lid
- Processed materials exit into a sealed stainless steel collection vessel

Technical data

Ref No.	Max temp. (°C)	Max continuous operating temperature (°C)	Dimensions: heated length (mm)	Dimensions: inner Ø (mm)	Dimensions: external H x W x D (mm)	Thermocouple	Max power (W)
718555	700	700	1200	120	2000 × 2840 x 700	Type N	12000

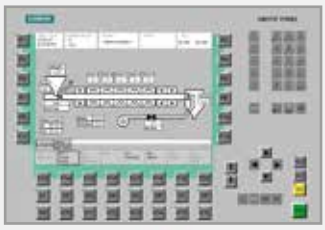
Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

Custom Built Split Tube Furnace Examples

HZS 12/120/1200 Horizontal split 5-zone tube furnace with rotating and tilting mechanism

This custom built rotating tube furnace has a colour touch screen HMI system controller for comprehensive monitoring and data logging of system parameters including: emergency stop indication; rotation; air flow; tube angle; heating element condition; alarm status; internal pressure; and water flow.

- For processing powder or small granular materials
- Haynes HR160 work tube inner Ø 160 mm 2600 mm long
- 1 to 30 revolutions per minute with speed controller
- Tube rotating interlock to temperature to ensure rotation above 150 °C to avoid tube distortion
- Gas sealed system to maintain atmosphere inside the furnace
- Electrically operated tilting mechanism with inclinometer; maximum tilt of 5° from horizontal
- Stainless steel inlet hopper with 25 litres capacity and a sealed lid
- Screw feeder with feed rate 5 to 30 kg per hour
- Processed materials exit into a sealed stainless steel collection vessel
- Tube water cooling with recirculation system incorporating water pump, heat exchanger, filters, and cross over valves
- Probe thermocouples to monitor inside the work tube for testing and survey work only
- Five independently heated zones each one measuring 240 mm
- Furnace start interlocked for the following conditions: nitrogen, air and water pressure; nitrogen generator; emergency stop OK; temperature alarm OK; output valve closed; hopper fill
- Standby switch allows the operator to place the furnace in a standby mode via one single switch



Technical data

Ref No.	Max temp. (°C)	Max continuous operating temperature (°C)	Dimensions: heated length (mm)	Dimensions: inner Ø (mm)	Dimensions: external H x W x D (mm)	Thermocouple	Max power (W)
300956	1000	900	1200	160	2825 × 5380 x 1140	Type N	15000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

3-zone split 13/120/1400 with rotating and tilting mechanism

This custom built rotating tube furnace has a colour touch screen HMI system controller for comprehensive monitoring and data logging of system parameters. The furnace start is interlocked for the following conditions: nitrogen, air and water pressure; nitrogen generator; emergency stop OK; temperature alarm OK; input vessel closed; output vessel closed; hopper fill and input lid closed.

- For processing powder or small granular materials
- 120 mm inside diameter x 2150 mm long IAP work tube
- 1 to 8 revolutions per minute with speed controller
- Gas sealed system to maintain atmosphere inside the furnace
- Manually operated tilting mechanism with maximum tilt of 6° from horizontal
- Stainless steel inlet hopper with 140 litres capacity and a sealed lid
- Screw feeder with loss in weight balance system
- Processed materials exit into a sealed stainless steel collection vessel
- Oxygen analyser 0.1ppm to 1% range
- Type R probe thermocouple with gland to monitor the exit end zone
- Three heated zones with lengths 1000 mm centre zone and 200 mm end zones

Technical data

Ref No.	Max temp. (°C)	Max continuous operating temperature (°C)	Dimensions: heated length (mm)	Dimensions: inner Ø (mm)	Dimensions: external H x W x D (mm)	Thermocouple	Max power (W)
701434	1300	1250	1400	120	3000 × 3800 x 1200	Type R	9000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

3-zone split 8/300/1500 with rotating and tilting mechanism

This custom built rotating tube furnace has a large 300 mm diameter metallic work tube. The material feed hopper with screw feeder is mounted on wheels and rails so it can be quickly withdrawn from the furnace.

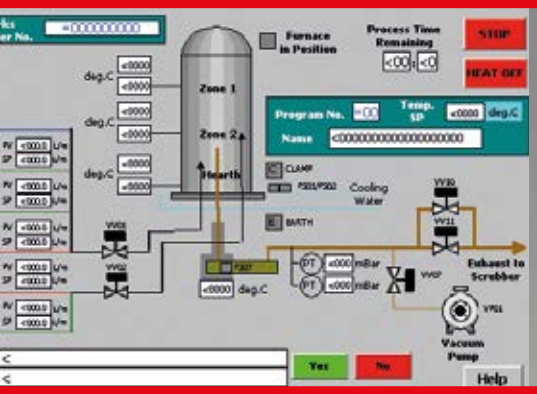
- For processing powder or small granular materials
- Continuous material processing
- Mounted on adjustable tilting frame; up to 3°
- Screw feeder is retractable for temperature protection
- A positive drive gives a variable tube speed of 5 – 14 rpm
- 3-zone temperature control

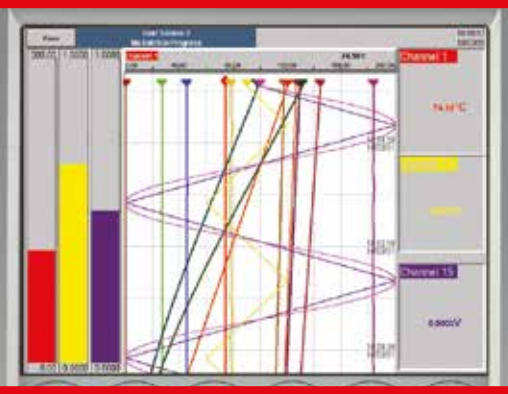
Technical data

Ref No.	Max temp. (°C)	Max continuous operating temperature (°C)	Dimensions: heated length (mm)	Dimensions: inner Ø (mm)	Dimensions: external H x W x D (mm)	Thermocouple	Max power (W)
724096	850	800	1500	300	2950 × 4000 × 1200	Type N	90000

Please note: Uniformity – empty chamber in steady state conditions after a stabilisation period

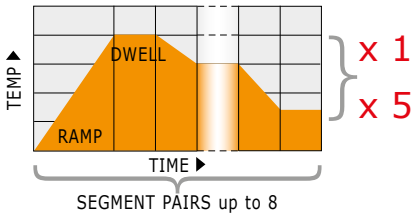
Temperature & System Control





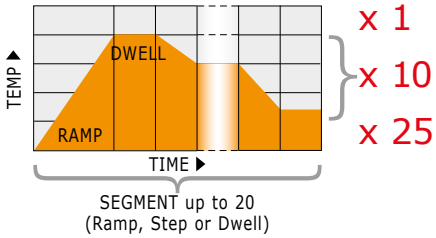
Temperature & System Control

Programmable controllers



3216P1 & 3216P5

These controllers offer programmable control using up to 8 segment pairs, each segment comprising a ramp followed by a dwell; the dwell may be set to zero time.
The 3216P5 can also store and retrieve up to 5 separate programs.



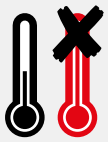
3508P1, 3508P10 & 3508P25

These controllers offer programmable control in which 20 segments may be set as ramp, step or dwell and may also be configured to control relays or logic outputs.
The 3508 series provide a comprehensive information display. If precise temperature control is required over a wide range of temperatures, the 3508 series allows the use of multiple PID terms (gain scheduling). This feature is not enabled as standard, but can be activated on request.
The 3508P10 and 3508P25 can also store and retrieve 10 and 25 programs respectively.

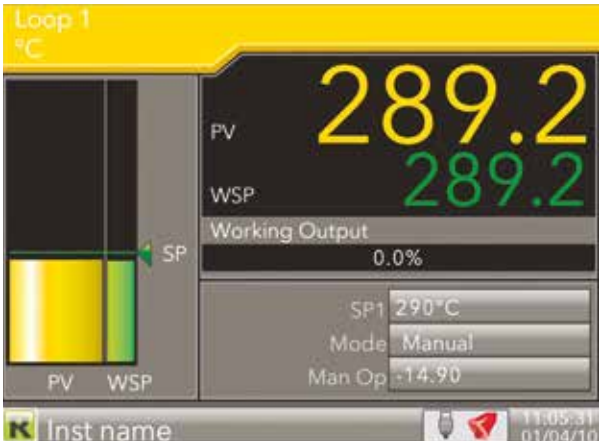
Options

Over-temperature control

This has a variable set point to protect either the furnace, oven or the load. If the main controller is from the 3216 or 3508 series this is provided by the addition of an independent 2132 controller. Whilst all Carbolite products are designed to fail safe in the event of a controller malfunction, over-temperature protection is strongly recommended for unattended operation or where valuable loads are to be processed.



Eurotherm nanodac™

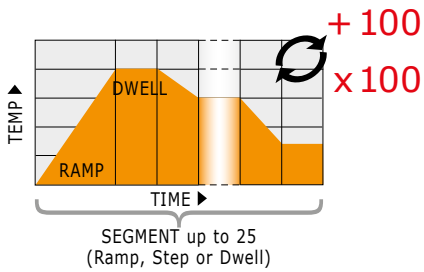


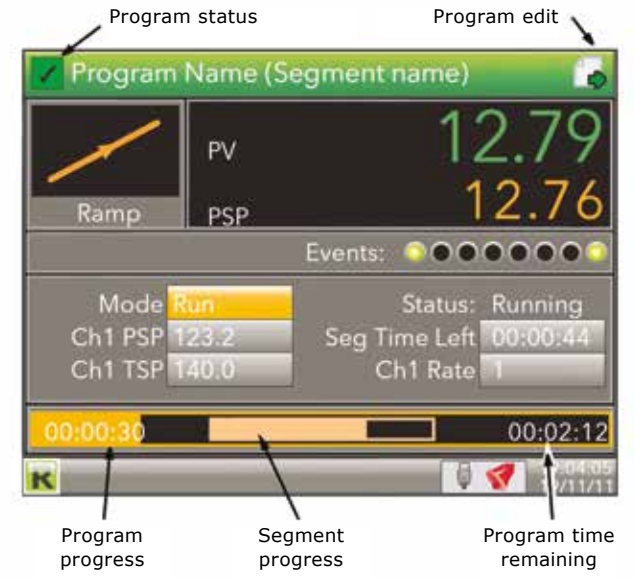
Recorder & PID controller

In this configuration the nanodac™ combines precision PID temperature control, with a fully functional data logger. The full colour display can be changed to display text in English, French, German, Italian or Spanish.
Data is continuously logged into either CSV (comma separated variable) or securely to UHH (Eurotherm Hydra History) files. Data can be archived onto a USB flash drive or via Ethernet to a networked server. Up to 4 channels can be recorded, with up to 14 virtual channels that can be set to record trends, alarms, communications or mathematical functions such as totals or averages.
Logged files can be opened and displayed on a PC, in chart form, using Eurotherm Review Lite software.

Recorder & PID programmable controller

This controller offers programmable control in which 25 segments may be set as a ramp, step or dwell and may also be configured to control relay or logic outputs. It stores and retrieves 100 programs.
Additional programs can be saved to, and retrieved from, a networker server via a USB flash drive or Ethernet. The action of up to 3 relays, or logic outputs, can be linked to a program segment; this can be used to switch on external devices such as gas solenoid valves and audible alarms
Note that some configurations may require additional components.





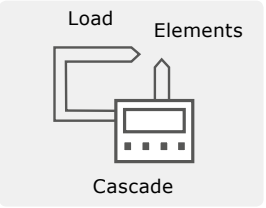
In this configuration the nanodac™ can hold up to 100 programs

RS232, RS485 and Ethernet communications

- RS232 allows a single controller to communicate with a single computer
- RS485 allows multiple controllers to communicate with a single computer
- Both require, but do not include, suitable PC based software (eg iTools) and connection cables
- 301 controller – RS232 is only available when ordered with over-temperature option (RS485 is not available with the 301 controller)
- 3216 and 3508 series controllers both have the option to add RS232 or RS485 communications
- Ethernet communication is supplied as standard with the nanodac™ controller and is optional in the 3508 series

Cascade control

This features offers the benefit of precise temperature control of the load. A standard controller operates by sensing the temperature close to the elements. With cascade control the controller's operation includes a second control thermocouple, which is used to sense the temperature of the load. It is essential that the controller is a dual loop 3508 or dual loop nanodac™.



Calibration certificates

The following calibration options can be supplied, each of which is available with a certificate from a UKAS accredited laboratory, which is traceable to a UK national standard

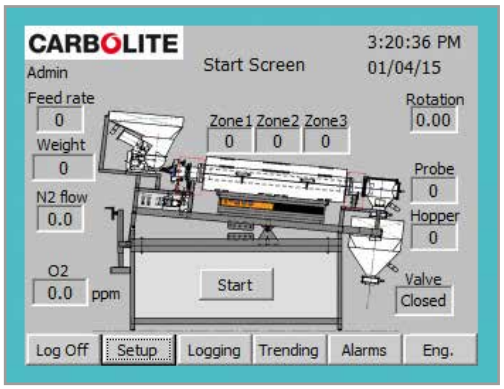
- UKAS traceable certificate for the thermocouple only, calibrated at 3 temperature points, specified by the customer
- UKAS traceable certificate for the temperature controller only, calibrated at 3 temperature points at temperatures specified by Carbolite
- UKAS traceable certificate at 3 temperature points for both thermocouple & temperature controller
- For advice and specifications to comply with AMS 2750E (Nadcap) for heat treatment applications, please contact Carbolite

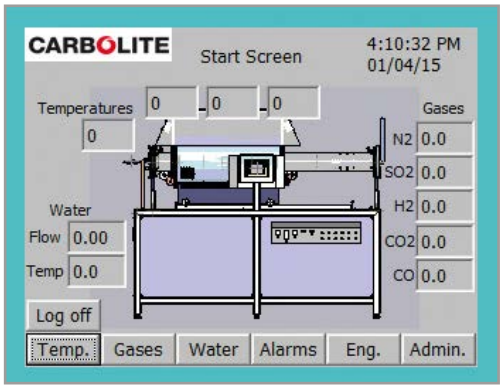
Panel mounted calibration loop

Panel mounted calibration loops can be fitted to the control panel to give easy access to the control to thermocouple connection. This can be used for on-site calibration.

Human Machine Interface (HMI) control systems

These control systems utilise a colour touch screen display with a mimic of the equipment and a number of pages for parameters setting, live graphical trending and alarm information. The HMI display is linked to the temperature controller(s) and a PLC (programmable logic control) to provide a fully integrated and sophisticated control system. All parameters required for operation are accessed via the HMI touch screen.



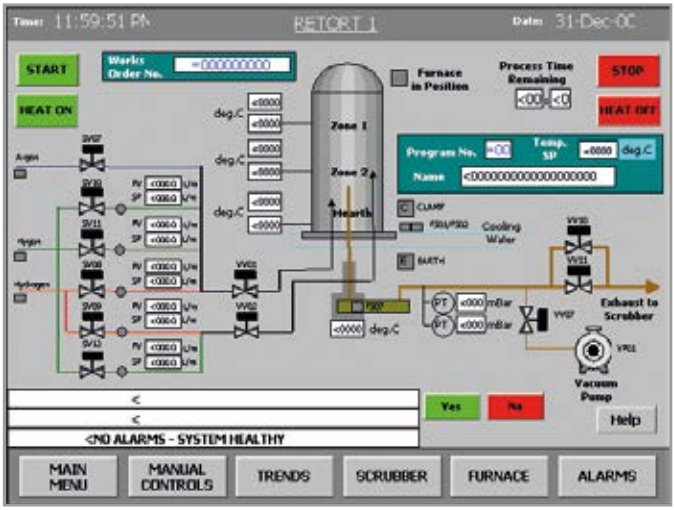


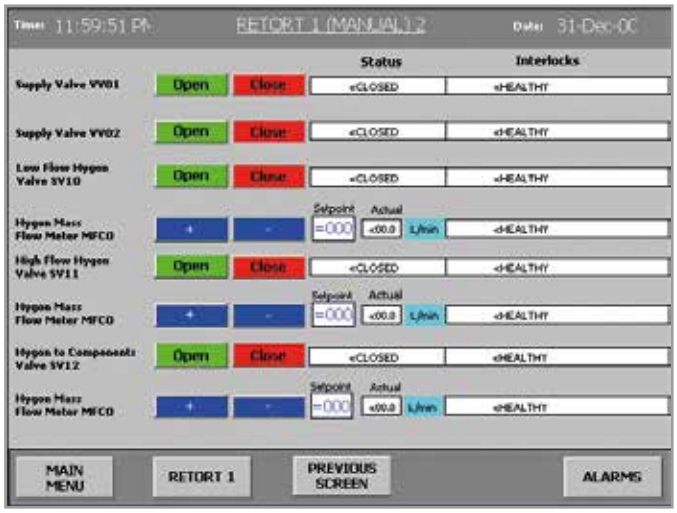
Examples of parameter settings available:

- Temperature
- Flow rate
- Pressure
- Circulation fan speed
- Cooling fan speed
- Damper valve positioning

These control systems can be connected to computer systems via communication links which can be:

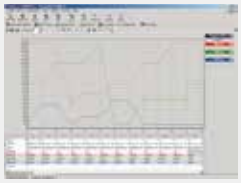
- RS232 or RS485 communication
- Ethernet communication
- Data logging access via Ethernet communication or USB memory stick
- Remote display of the control system to a PC or handheld device via an internet accessed webpage





iTools software

A versatile suite of software that allows Carbolite products that have been fitted with appropriate digital communications hardware to be set-up, recorded and monitored from a PC. The supplied licence is for a single PC to communicate with one furnace using RS232 or with many furnaces using RS485.



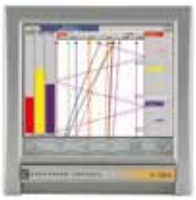
Data loggers & chart recorders

This is just a small selection of the options that are available for recording data from Carbolite products. If you require advice, please contact Carbolite for further information. NOTE: Please confirm with Carbolite whether the chart recorder required can be fitted within the standard product case; in some instances it may require mounting in a separate case.

Eurotherm nanodac™ DAQ recorder only

In this configuration the nanodac can be used in combination with a conventional controller as a paperless chart recorder. Data is continuously logged into either CSV (comma separated variable) or secure UHH (Eurotherm Hydra History) files. Data can be archived onto a USB flash drive or via Ethernet to a networked server. Up to 4 channels can be recorded, with up to 14 virtual channels that can be set to record trends, alarms, communications, or mathematical functions such as totals or averages. Logged files can be opened and displayed on a PC, in chart form, using Eurotherm Review Lite software.

6100 & 6180 series digital data acquisition, recording & display



A series of digital data acquisition recorders which can function as stand-alone paperless recorders or with more advanced models can be integrated into computer networks. All have the capability to archive data via USB flash memory devices or onto a networked server using Ethernet FTP or Modbus TCP (although the 6100E is Slave configuration only). 6100 series data recorders have a 5.25" TFT touch screen interface whilst the 6180 series data recorders have a 12.1" TFT touch screen interface.

The 6100 XIO and 6180 XIO data recorders record digital data and so must be used with controllers that are equipped with digital communications. This overcomes potential issues from the attenuation of analogue signals over distance. The 6180 AeroDAQ is a recorder configuration that has been optimised for AMS 2750E (Nadcap) applications and includes thermocouple monitoring.

Always confirm with Carbolite that your preferred data recorder can be fitted within the standard furnace case, alternatively a stand-alone cabinet may be required.

The following software options are available for use with the 6100 A, 6100 XIO and 6180 series data recorders for the 6100 series (these options are not compatible with the 6100 E model):
Batching / Grouping / Screen Builder / Bridge Software

Model	Function	Channels	Display screen	On-board memory for history (Mb)	USB ports	Serial ports
nanodac	PID control & record	4	89 mm TFT & software allocated keys	50	1	0
6100E	record analogue input	3 or 6	100 mm VGA touchscreen	8	1	0
6100A	record analogue input	6, 12 or 18	100 mm VGA touchscreen	32 or 96	up to 3	up to 2
6180A	record analogue input	6, 12, 18, 24, 30, 36, 42 or 48	180 mm XGA touchscreen	96	up to 3	up to 2
6100XIO	record digital comms input	128 virtual channels	100 mm VGA touchscreen	96	1	2
6180XIO	record digital comms input	128 virtual channels	180 mm XGA touchscreen	96	1	2
6180 Aerodaq	record analogue input	6, 12, 18, 24, 30, 36, 42 or 48	180 mm XGA touchscreen	96	3	2

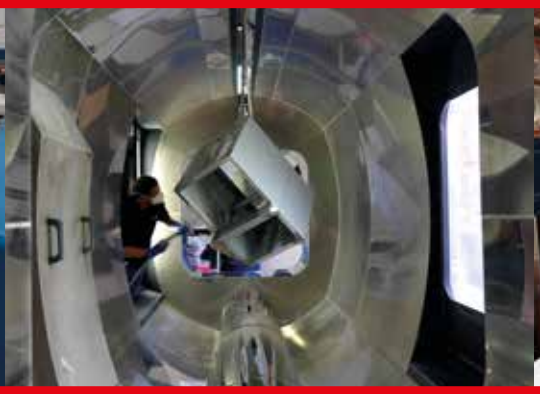
4102 series 100 mm wide compact strip chart recorder

The 4102 series are compact and economical 100 mm strip chart recorders, providing recording for up to 4 (continuous pen) or 6 (multi-point) process variables.

4103 series 100 mm wide strip chart recorder

The 4103 is a high specification, 100 mm strip chart recorder, providing continuous recording for up to 6 process variables. Information such as channel descriptor, alarm set point and scale information can be viewed on a high resolution display.

Model	Channels (pens)	User program-mable	Accuracy to paper (%)	Speed (mm/hr)	Annotation
4102 C	1	no	0.25	10, 30, 60, 120 or 5, 20, 60, 120 or 20, 30, 60, 120 or 30, 60, 120, 300	Extra option
4102 C	2	no			Extra option
4102 M	6	no			Standard
4103 C	1	yes		Software selectable	Standard
4103 C	2	yes			Standard
4103 M	6	yes			Standard

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