



Furnaces & Ovens for the Aerospace Industry



Carbolite furnaces & ovens for the Aerospace Industry

There are some heat treatment tasks where there is no room for error. This is where Carbolite's 70 years of practical experience and reputation for quality and reliability are invaluable.

Heat treatment of aircraft components, both for initial manufacture and for MRO (maintenance, repair and overhaul), is most certainly one of those tasks and Carbolite furnaces and ovens are the first choice for many of the aerospace industry's most respected companies.

Designed and built at our factory in the UK, all of our products are constructed in a manufacturing facility that operates under a quality assurance scheme that is certified to ISO 9001:2000. They are built to comply fully with the UK and European Union 'Health & Safety at Work' legislation. All of our industrial products are also designed to comply with the EU Low Voltage, Machinery, and EMC directives and carry the CE mark.

Carbolite products are recognised and chosen by customers manufacturing to the highest levels. Carbolite's in-depth understanding of aerospace industry standards means that for customers providing heat treatment to NADCAP / SAE Aerospace Standard AMS 2750D, we are able to specify exactly the right furnace or oven to operate within a specific compliance class.

Because the use of Carbolite products is already widespread amongst aerospace manufacturers, we are able to offer excellent references and when processing work is being relocated we can frequently supply equipment to match original specifications.

In addition to the enormous range of standard models, Carbolite has the skill and experience to modify our furnace and oven designs so that they more precisely meet customers' requirements. Where required we can produce totally custom built furnaces, ovens and load management systems. The following are a few examples:



A bespoke multiple hearth top hat furnace system with multiple hearths atmospheric control and detachable lifting frame.



A bespoke top hat system for pack aluminising turbojet turbine blades at temperatures up to 1150°C under a controlled atmosphere



Two similar installations of bespoke toploding furnaces for surface treatment of turbine blades. Once lifted from the furnaces the controlled atmosphere retorts are placed into a cooling station.



A bespoke LGP large general purpose 300°C oven used for drying aerospace components



A bespoke 1100°C top hat furnace system for a proprietary turbine blade coating technique. Comprising of 2 working hearths, 2 retorts an atmosphere control system & a furnace chamber.



A bespoke LGP 600°C 2600 litre oven with load management system & quench, conforming to the requirements of AMS 2750D for Class 2 Thermal Processing Equipment with Type D instrumentation.



One of 2 identical 1000°C air recirculation furnaces complete with load management systems for heat treatment of turbine blades at 750°C

LGP Large General Purpose Ovens

Standard features

- ✓ 250°C, 425°C, 625°C or 700°C maximum operating temperatures.
- ✓ 500 to 14000* litre chamber volumes (*custom build).
- ✓ PID digital set and display using the 2216 controller
- ✓ Large capacity, rugged well proven designs.
- ✓ Robust construction, for heavy duty cycles.
- ✓ Efficient air circulation and excellent temperature uniformity from heavy duty impellers.
- ✓ Corrosion resistant ferritic grade 430 stainless steel interior.
- ✓ Steel section & zinc coated, painted mild steel exterior.
- ✓ Single & double door models.
- ✓ Vertical rising door on larger high temperature models.
- ✓ Shelf runners on models up to 1000 litres.
- ✓ Low thermal mass insulation for economical running.
- ✓ Fully adjustable chamber ventilation.



LGP 2/1000 (with accessory options including stoving & curing kit & chart recorder)

Options

specify these at time of order

- ✦ Over-temperature protection to DIN 12-880 class 2 (recommended to protect valuable contents & for unattended operation).
- ✦ Digital process control timers & multi segment programmers are available.
- ✦ Bespoke specifications are available for AMS2750 (NADCAP) & ISO/TS16949:2002 compliant applications.
- ✦ Access ports for cables & pipes.
- ✦ Exhaust proving switch.
- ✦ Manual or motorised vertically opening doors.
- ✦ Vertical airflow impellers.
- ✦ Explosion relief panels.

- ✦ Interior light (subject to temperature limitations).
- ✦ Standard or heavy duty shelves as required.
- ✦ A wide range of sample loading & handling accessories can also be supplied.
- ✦ Paperless DAQ (Data Acquisition) graphical recorders available.

Extensive experience in industrial oven and furnace design are combined with the very latest in technology, materials and manufacturing practice to build the standard range of ovens. These also form the basis of numerous bespoke designs that solve specific customers application requirements.

Model	Max temp (°C)	Temp stability (°C)	Temp uniformity (°C) @250°C	Volume (litres)	Heat-up time to max (mins)	Dimensions		Shelves fitted/accepted	Shelf loading each/total (kg)	Max power (W)	Power supply
						Internal H x W x D (mm)	External H x W x D (mm)				
LGP 2/500	250	±0.5	±5.0	500	60	800 x 800 x 800	1240 x 1725 x 1375 Single door	0 4	50 200	9000	3 phase
LGP 2/730	250	±0.5	±5.0	730	60	900 x 900 x 900	1265 x 1775 x 1450 Single door	0 4	50 200	9000	3 phase
LGP 2/1000	250	±0.5	±5.0	1000	60	1000 x 1000 x 1000	1375 x 1900 x 1450 Single door	0 4	50 200	12000	3 phase
LGP 2/1500	250	±0.5	±5.0	1500	60	1500 x 1000 x 1000	1900 x 1900 x 1450 Single door	0 7	50 350	15000	3 phase
LGP 2/1750	250	±0.5	±5.0	1750	60	1200 x 1200 x 1200	1600 x 2100 x 1700 Single door	0 5	50 250	18000	3 phase
LGP 2/2160	250	±0.5	±5.0	2160	60	1500 x 1200 x 1200	1900 x 2100 x 1700 Single door	0 7	50 350	18000	3 phase
LGP 2/3370	250	±0.5	±5.0	3370	60	1500 x 1500 x 1500	1900 x 2400 x 2000 Single door	0 7	50 350	24000	3 phase
LGP 2/5830	250	±0.5	±5.0	5830	60	1800 x 1800 x 1800	2200 x 2700 x 2300 Two door	0 9	50 450	35000	3 phase
LGP 2/8000	250	±0.5	±5.0	8000	60	2000 x 2000 x 2000	2400 x 2800 x 2900 Two door	0 —	— —	42000	3 phase
LGP 2/13820	250	±0.5	±5.0	13820	60	2400 x 2400 x 2400	2800 x 3200 x 3300 Two door	0 —	— —	60000	3 phase

LGP Large General Purpose Ovens



LGP 2/3200 (with optional process timer)

Model	Max temp (°C)	Temp stability (°C)	Temp uniformity (°C) at 250°C	Volume (litres)	Heat-up time to max (mins)	Dimensions		Shelves fitted/accepted	Shelf loading Each/total (kg)	Max power (W)	Power supply
						Internal H x W x D (mm)	External H x W x D (mm)				
LGP 4/500	425	±0.5	±5.0	500	60	800 x 800 x 800	1240 x 1725 x 1375 Single door	0	50 200	9000	3 phase
LGP 4/730	425	±0.5	±5.0	730	60	900 x 900 x 900	1265 x 1775 x 1375 Single door	0	50 200	12000	3 phase
LGP 4/1000	425	±0.5	±5.0	1000	60	1000 x 1000 x 1000	1375 x 1900 x 1450 Single door	0	50 200	18000	3 phase
LGP 4/1500	425	±0.5	±5.0	1500	60	1500 x 1000 x 1000	1900 x 1900 x 1450 Single door	0	50 350	21000	3 phase
LGP 4/1750	425	±0.5	±5.0	1750	60	1200 x 1200 x 1200	1600 x 2100 x 1700 Single door	0	50 250	24000	3 phase
LGP 4/3370	425	±0.5	±5.0	3370	60	1500 x 1500 x 1500	1900 x 2100 x 1700 Single door	0	50 350	33000	3 phase
LGP 4/5830	425	±0.5	±5.0	5830	60	1800 x 1800 x 1800	1900 x 2400 x 2000 Two door	0	50 350	48000	3 phase
LGP 4/8000	425	±0.5	±5.0	8000	60	2000 x 2000 x 2000	2200 x 2700 x 2300 Two door	0	50 450	54000	3 phase



Minimum operating temperature approximately ambient plus 35°C
 Uniformity values are measured with vents closed in a steady state oven after a stabilisation period.
 Shelf loadings are based on evenly distributed weight

LGP Large General Purpose Ovens



LGP 6/3370 (with optional chart recorder)

Model	Max temp (°C)	Temp stability (°C)	Temp uniformity (°C) at 250°C	Volume (litres)	Heat-up time to max (mins)	Dimensions		Shelves fitted/ accepted	Shelf loading Each/ total (kg)	Max power (W)	Power supply
						Internal H x W x D (mm)	External H x W x D (mm)				
LGP 6/500	625	±0.5	±5.0	500	75	800 x 800 x 800	1240 x 1725 x 1375 Single door	0	50 200	15000	3 phase
LGP 6/730	625	±0.5	±5.0	730	75	900 x 900 x 900	1265 x 1775 x 1375 Single door	0	50 200	18000	3 phase
LGP 6/1000	625	±0.5	±5.0	1000	75	1000 x 1000 x 1000	1375 x 1900 x 1450 Single door	0	50 200	24000	3 phase
LGP 6/1500	625	±0.5	±5.0	1500	75	1500 x 1000 x 1000	1900 x 1900 x 1450 Single vertical rising	0	50 350	30000	3 phase
LGP 6/1750	625	±0.5	±5.0	1750	75	1200 x 1200 x 1200	1600 x 2100 x 1700 Single vertical rising	0	50 250	36000	3 phase
LGP 6/3370	625	±0.5	±5.0	3370	75	1500 x 1500 x 1500	1900 x 2100 x 1700 Single vertical rising	0	50 350	48000	3 phase
LGP 6/5830	625	±0.5	±5.0	5830	75	1800 x 1800 x 1800	1900 x 2400 x 2000 Single vertical rising	0	50 450	72000	3 phase
LGP 7/500	700	±0.5	±5.0	500	—	800 x 800 x 800	1240 x 1725 x 1375 Single door	0	50 200	18000	3 phase
LGP 7/730	700	±0.5	±5.0	730	—	900 x 900 x 900	1265 x 1775 x 1375 Single door	0	50 200	24000	3 phase
LGP 7/1000	700	±0.5	±5.0	1000	—	1000 x 1000 x 1000	1375 x 1900 x 1450 Single door	0	50 200	30000	3 phase
LGP 7/1500	700	±0.5	±5.0	1500	—	1500 x 1000 x 1000	1900 x 1900 x 1450 Single vertical rising	0	50 350	36000	3 phase
LGP 7/1750	700	±0.5	±5.0	1750	—	1200 x 1200 x 1200	1600 x 2100 x 1700 Single vertical rising	0	50 250	48000	3 phase



Minimum operating temperature 50°C

uniformity values are measured in an empty chamber with vent closed after a stabilisation period & within a volume 100mm from the walls & roof, & 150mm from the floor & doors

Shelf loadings are based on evenly distributed weight

HT Industrial High Temperature Ovens

Standard features

- ✓ 400°C, 500°C or 600°C maximum operating temperature.
- ✓ 28, 95 or 220 litre capacity.
- ✓ Carbolite 301 controller providing single ramp to set point or countdown process timing.
- ✓ Rugged well proven design.
- ✓ Excellent performance & reliability.
- ✓ Door locks easily operated whilst wearing gloves.
- ✓ Stainless steel liner.
- ✓ Steel section construction.
- ✓ Stainless steel mesh shelves.



HT6/350 (with optional chart recorder & door interlock)

Ideal for applications such as tempering, glass annealing, preheating and stress relieving these small scale industrial ovens are able to operate efficiently up to 600°C

Options

specify these at time of order

- ✦ Over-temperature protection to DIN 12-880 class 2 (recommended to protect valuable contents & for unattended operation).
- ✦ Digital process timer.
- ✦ Programmable controller.
- ✦ Additional shelves.
- ✦ Stoving & curing kit to extract volatile fumes.
- ✦ Chart recorders & paper free digital acquisition (DAQ) devices.
- ✦ Viewing window.
- ✦ Fixed or castor mounted floor stands.
- ✦ Standard spares kit.
- ✦ Bespoke specifications are available for AMS 2750 (NADCAP) & ISO/TS16949:2002 compliant applications.

Model	Max temp (°C)	Temp stability (°C)	Temp uniformity (°C)	Heat-up time to max (mins)	Recovery time to max (mins)	Dimensions		Shelves fitted/accepted	Shelf loading Each/total (kg)	Volume (litres)	Max power (W)	Power supply
						Internal H x W x D (mm)	External H x W x D (mm)					
HT4/28	400	±0.5	±5.0	60	10	305 x 305 x 305	880 x 675 x 885	2 / 2	10 20	28	1000	Single phase
HT4/95	400	±0.5	±5.0	60	10	455 x 455 x 455	1010 x 880 x 1120	3 / 4	15 30	94	1500	Single phase
HT4/220	400	±0.5	±5.0	60	10	610 x 610 x 610	1160 x 1030 x 1280	3 / 4	25 50	227	2000	Single phase
HT5/28	500	±0.5	±5.0	60	16	305 x 305 x 305	880 x 675 x 885	2 / 2	10 20	28	2500	Single phase
HT5/95	500	±0.5	±5.0	60	16	455 x 455 x 455	1010 x 810 x 1120	3 / 4	15 30	94	3000	Single phase
HT5/220	500	±0.5	±5.0	60	16	610 x 610 x 610	1160 x 1030 x 1280	3 / 4	25 50	227	4500	Single phase or 2 phase
HT6/28	600	±0.5	±5.0	75	20	305 x 305 x 305	880 x 675 x 885	2 / 2	10 20	28	6000	Single phase
HT6/95	600	±0.5	±5.0	70	20	455 x 455 x 455	1010 x 880 x 1120	3 / 4	15 30	94	12000	Single phase or 2 phase
HT6/220	600	±0.5	±5.0	90	20	610 x 610 x 610	1160 x 1030 x 1280	3 / 4	25 50	1810	18000	Single phase or 3 phase



Minimum operating temperature approximately ambient plus 50°C
 Uniformity values are measured in an empty chamber with vents closed after a period of stabilisation
 Shelf loadings are based on evenly distributed weight

HRF Air Recirculating Chamber Furnaces

Standard features

- ✓ 750°C maximum operating temperature
- ✓ 22, 112 or 324 litre chamber volumes
- ✓ Resistance wire elements in both sides of chamber
- ✓ Stainless steel liner
- ✓ Combination of low thermal mass and refractory board insulation.
- ✓ Carbolite 301 controller, with single ramp to set-point & process timer
- ✓ Safe outer case temperature

Options

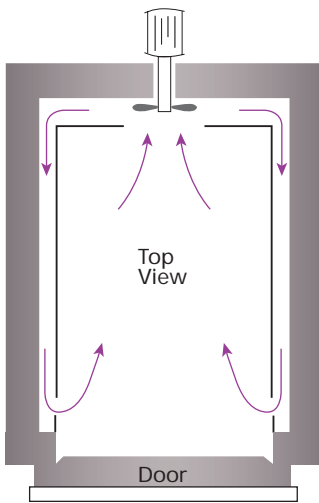
specify these at time of order

- ★ Over-temperature protection (recommended to protect valuable contents & for unattended operation)
- ★ 8 or 20 segment programmer
- ★ RS232 communications
- ★ Shelves & runners



HRF 7/22/301

A powerful fan and airguide system provide good uniformity and rapid heat transfer for applications such as; stress relieving, tempering, normalising and annealing. The stainless steel liner has 3 shelf runners with shelves available as an additional option.



HRF air Flow



HRF 7/324 (with additional over-temperature control & 7 day-24 hour process timer)

Model	Max temp (°C)	Heat-up time (mins)	Dimensions		Volume (litres)	Max power (W)	Thermo-couple type	Weight (kg)	Power supply
			Internal H x W x D (mm)	External H x W x D (mm)					
HRF 7/22	750	63	220 x 200 x 495	590 x 450 x 870	22	3000	K	61	Single phase
HRF 7/112	750	-	400 x 400 x 700	1550 x 1000 x 1600	112	18000	K	480	3 phase
HRF 7/324	750	-	600 x 600 x 900	1800 x 1200 x 2280	324	24000	K	1000	3 phase



External dimensions with door closed and include chimney.

LCF12 Large Chamber Furnaces

Standard features

- ✓ 1200°C & 1400°C maximum temperatures.
- ✓ Digital setting & display using 301 controller.
- ✓ Ramp to set-point or process timer.
- ✓ Excellent uniformity & close temperature control.
- ✓ Robust construction using hollow steel section & zinc coated steel sheet.
- ✓ Double wall case for safe exterior temperature.
- ✓ Manually operated vertically opening door keeps the hot face away from the operator.
- ✓ Low thermal mass insulation for high energy efficiency.
- ✓ Hard wearing silicon carbide tiled hearth.
- ✓ 1200°C range heated by heavy gauge spiral wound elements in roof and below the hearth.
- ✓ 1400°C range heated by high quality silicon carbide elements.
- ✓ Safety door interlock isolates power from the elements whenever the door is opened.



LCF 12/405, modified to accept bespoke retort

Options

specify these at time of order

- ★ Pneumatically or electrically operated doors
- ★ Multiple segment controllers able to store multiple programs
- ★ Remote mounted control module
- ★ Chart recorders & paperless (DAQ) data acquisition devices
- ★ RS232 & RS484 communications
- ★ Designs for compliance with NADCAP and other industry standards.

Model	Max temp (°C)	Dimensions		Volume (litres)	Max power (kW)	Thermocouple type	Power supply
		Internal H x W x D (mm)	External H x W x D (mm)				
LCF 12/202	1200	300 x 600 x 1120	2310 x 1180 x 1590	202	24	Pt /Pt 13% Rh	3 Phase
LCF 12/405	1200	450 x 750 x 1200	2620 x 1350 x 1710	405	36	Pt /Pt 13% Rh	3 Phase
LCF 12/560	1200	500 x 750 x 1500	2700 x 1500 x 2300	560	45	Pt /Pt 13% Rh	3 Phase
LCF 12/670	1200	500 x 750 x 1800	2700 x 1500 x 2600	675	60	Pt /Pt 13% Rh	3 Phase

Model	Max temp (°C)	Dimensions		Volume (litres)	Max power (W)	Thermocouple type	Power supply
		Internal H x W x D (mm)	External H x W x D (mm)				
LCF 14/125	1400	250 x 500 x 1000	2310 x 1340 x 1650	125	30	Pt /Pt 13% Rh	3 Phase
LCF 14/350	1400	400 x 760 x 11360	2545 x 1549 x 1800	350	48	Pt /Pt 13% Rh	3 Phase
LCF 14/480	1400	500 x 800 x 1200	2560 x 1650 x 1900	480	60	Pt /Pt 13% Rh	3 Phase



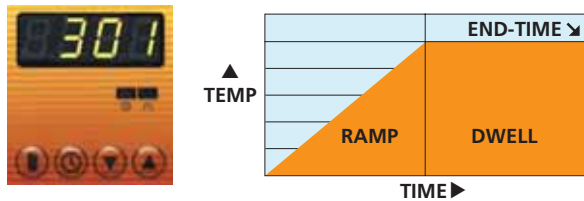
(Contact Carbolite for the exact current ratings for the LCF 1400°C furnaces operating on specific 3 phase configurations)

Temperature Control Options

(★ Specify at the time of order)

301 Controller

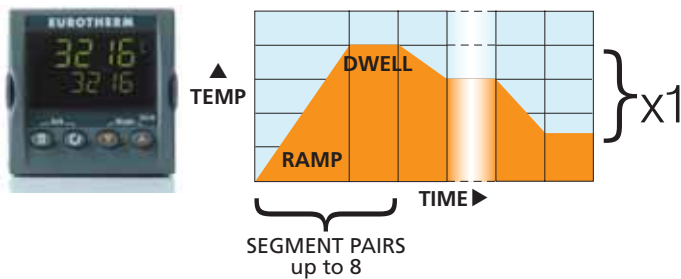
The 301 provides precise PID (Proportional Integral Derivative) control meaning that ramp rates and set points are very closely adhered to and the risk of overshoot at the end of the ramp is largely avoided.



It enables setting of a single ramp rate to set point and incorporates a process timer. Setting is via a smooth wipe clean membrane panel with large bright display.

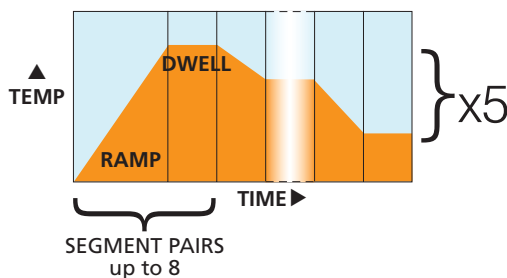
3216P1 ★

This controller offers programmable control using up to 8 segments, each segment comprising a ramp followed by dwell. The dwell may be set to zero time.



3216P5 ★

This controller has all the functionality of the 3216P, with the additional capability of being able to store and retrieve up to 5 separate programs.



Options

RS232 & RS484 Communications ★

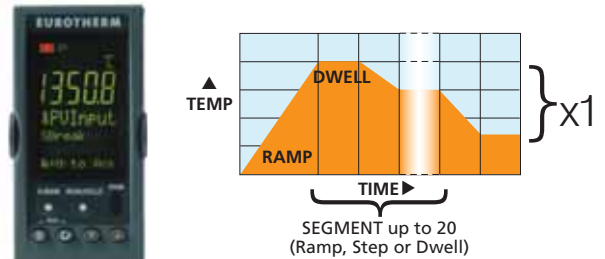
The 3216P1 and 3216P5 controllers both have the option to add RS232 or RS485 communications. This requires but does not include suitable PC based software (for example iTools) and connection cables.

RS232 permits a single controller to communicate with a computer. RS485 permits multiple controllers to communicate with a single computer.



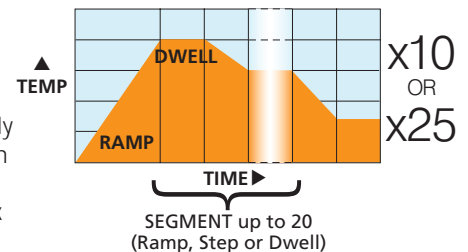
3508P1 ★

This controller offers programmable control in which 20 segments may be set as ramp, step or dwell. (where 'step' is an immediate rise or fall in setpoint temperature). The 3508 series provide a more comprehensive display of information.



3508P10 & 3508P25 ★

The 3508P10 and 3508P25 have all of the functionality of the 3508P1 with the additional capability to store and retrieve 10 and 25 programs respectively. Additionally individual programs can be linked together into longer or more complex sequences.



Options

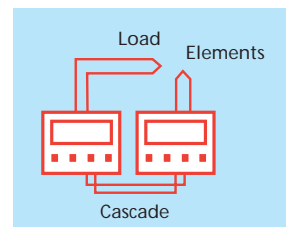
Over-temperature Control ★

This has a variable setpoint to protect either the chamber or the load. Where the main controller is from the 3216 or 3508 series this is provided by an addition of an independent 2132 controller. Whilst all Carbolite chambers 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.



Cascade Control ★

This should be considered for even more precision and ability to counteract many of the performance effects that result from placing different loads into the chamber. In particular faster heating of loads which have high thermal capacity is possible. A standard controller operates by sensing the temperature close to the elements. In cascade control the primary controller's operation is modified by a second nonprogrammable 3216 controller, which is used to sense the temperature of the load. It is essential that the primary controller is one of the 3508 series



Programmable Logic Controllers (PLC) ★

Where temperature control must be integrated with mechanical devices or atmosphere control equipment or where the chamber must be integrated within a wider process control system then Carbolite are able to supply bespoke PLC control systems.



Chart Recorders & DAQs

(🔥 Specify at the time of order)

Chart Recorders & DAQs (Data Acquisition Devices) 🔥

This is just a small selection of the options that are available for recording data from Carbolite furnaces. If you require advice please contact Carbolite for further information.

NOTE: Please confirm with Carbolite whether the chart recorder can be fitted within the standard oven case, in some instances it may require mounting in a separate case.

4102 Series 100mm Wide Compact Strip Chart Recorder 🔥

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



4103 Series 100mm Wide Strip Chart Recorder 🔥

The 4103 is a high specification, 100mm 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 VFD display.



Model	Channels (pens)	User programmable	Accuracy To paper (%)	Speed mm/hr 🔥	Annotation 🔥
4102C	1	✗	0.25	10, 30, 60, 120 or 5, 20, 60, 120	Extra option
4102C	2	✗		20, 30, 60, 120 or 30, 60, 120, 300	Extra option
4102M	6	✗		300 or	Standard
4103C	1	✓		Software selectable	Standard
4103C	2	✓			Standard
4103M	6	✓			Standard

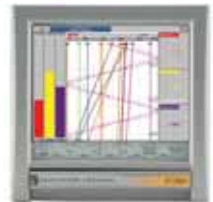
6100 Series Digital Data Acquisition Recorder & Display 🔥

Model	Channels	Display Screen	Memory For History Mb	Inputs	USB Ports	Serial Ports	Timers	Event Triggers
6100E	6	5.5" VGA	6	6	1	✗	6	3
6100A	6	12.1" XGA	32 or 96	up to 18	up to 3	up to 2	12	up to 96
6100A	12	12.1" XGA	32 or 96	up to 18	up to 3	up to 2	12	up to 96

A series of digital data acquisition recorders that able to function as stand alone devices or be integrated into wider network systems. They have a total sample rate of 125ms for up to 48 input channels. Input channels are freely configurable to suit your process requirements. Each instrument has an intuitive touch screen display to enable operators to clearly view process data in varying formats.



All have onboard Flash data storage capability, Ethernet communication and choice of Compact Flash or SD Card. Data is stored in a tamper resistant binary format that can be used for secure, long term records of your process. Recording can be to internal flash memory, removable media and remote FTP (simultaneously if required) Data protection includes Audit Trail for 21CFR Part 11 and NADCAP applications, with recorded login, use of unique usernames and passwords. Event triggers such as batch start, alarm and percentage full level for media can be programmed.



For Advice and Specifications to Comply with NADCAP (AMS 2750D) for Heat Treatment Applications

Please contact Carbolite for advice on this or any other standards compliance issues.

Calibration Certificates

A number of calibration options can be supplied each of which is available with either a factory certificate of calibration or a certificate from a UKAS accredited laboratory and hence traceable to a UK National Standard.



Factory issued certificate for the thermocouple only calibrated at 3 temperature points 🔥

UKAS traceable certificate for the thermocouple only calibrated at 3 temperature points 🔥

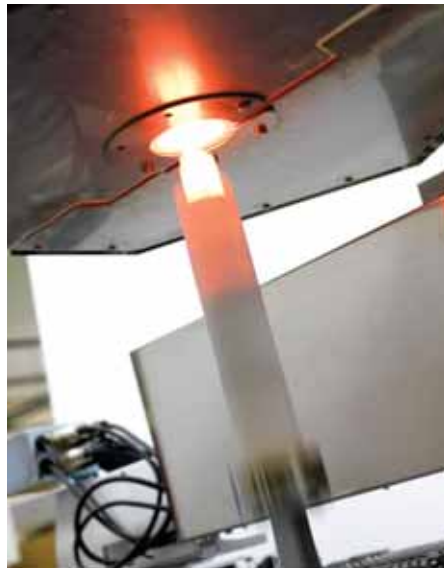
Factory issued certificate for the temperature controller (or temperature display) 3 point calibration 🔥
At 3 points of our choosing.

UKAS traceable certificate for the temperature controller (or temperature display) 3 point calibration 🔥
At 3 points of our choosing.

Factory issued certificate for the specific individual combination of thermocouple & temperature controller (or temperature display) 3 point calibration 🔥

UKAS traceable certificate for the specific individual combination of thermocouple & temperature controller (or temperature display) 3 point calibration 🔥

Custom Made Thermal Cycling Furnaces For the Aerospace Industry



Bespoke thermal test rigs. One for evaluation & calibration of thermal indicator paints that are used in aerospace turbine blade manufacture. The other for extended cycling from ambient temperature to 1200°C to test turbine blade barrier coatings

A bespoke thermal cycling system for extended testing of temperature sensors between ambient and 1200°C over thousands of repetitions