

# Furnaces and Chambers for Universal Materials Testing



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# High Temperature Furnaces and Climatic Chambers for Testing under Simulated Environmental Conditions

The challenging applications such as testing materials used in aircraft turbines, rocket propulsion, hot outer skin structures, automotive industry as materials for exhaust systems etc. requires high temperature testing installations with related high temperature furnaces, pull rods, couplings and adapters.

w+b supplies a wide range of thermal products for typical applications include tension, compression and bending tests on specimens such as metals, elastomers, plastics, textiles, composites, paper, asphalt and testing of finished goods and components as body and engine mounts, tire cords, shock absorbers, isolators or laminates.

- **High Temperature Furnaces**

The family of high-temperature furnaces is designed to cover a wide range of temperatures for testing of a variety of materials in tension, compression and bend. Typically used in applications such as those simulating the thermal cycles endured by power generation plant and aircraft engines. All furnaces are available as split or closed type with one up to 5 heating zones.

- **High Speed Induction Heating Systems**

Induction heating is a method of providing fast, consistent heat and allows a very precise heating of test specimens. The heating process relies on induced electrical currents within the material to produce heat. Induction heating works directly only with conductive materials, normally metals. Plastics and other non-conductive materials can often be heated indirectly by first heating a conductive metal susceptor which transfers the heat to the non-conductive material.

- **Vacuum Furnace System**

In vacuum furnaces the testing process takes place inside an airtight vessel, where the specimen inside the furnace is surrounded by a vacuum. The absence of air or other gas prevents heat transfer with the specimen through convection and removes a source of contamination. The system provides uniform temperatures and very low contamination of the specimen by carbon, oxygen and other gases. Available for vacuum levels up to  $10^{-6}$  mbar upon request!

- **Heated Compression Platens** up to 400 °C or higher

- **Environmental Chambers**

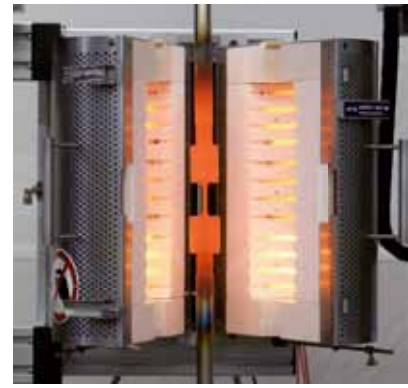
The standard chambers has been designed for materials testing applications. The wide range of sizes and options allow the chambers to be mounted onto most materials testing machines, with either fixed brackets or roller carriage assemblies.

- **Temperature / Humidity Environmental Chambers**

Various ranges of temperatures and humidity. This chamber systems consists of an insulated environmental enclosure, an indirectly coupled heating and cooling plant (Air Handler) and a humidity plant, connected by insulated hoses. The air handler combines all heating and cooling systems, together with the control system and connected services. This system performance has been optimised for both dry temperature tests and humidity performance.

- **Grips, Fixtures and Extensometers**

Available are high temperature compression platen, flexural devices, tension-only adapters for threaded, shoulder or flat samples, pull rods, couplings, adapters and low-cycle fatigue through zero grips for use in environmental or high temperature furnaces. Extensometers are used to measure strain at high temperature during tension, compression and through-zero fatigue testing applications. The range covers axial, diametral, reduction-in-width, deflection and non-contacting extensometers.



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# High Temperature Split Furnaces

## Series STE

## 900°C up to 1600°C

**Designed primarily for use on materials testing machines, where samples are being tested in tension and / or compression.**

**Typically used in applications such as those simulating the thermal cycles endured by power generation plant and aircraft engines.**

Furnace temperatures of up to 900°C, 1000°C or 1100°C resp. 1200°C / 1600°C are achievable. The high quality 3-zone split design provides easy installation of the specimen and extensometer. Both halves of the furnace are hinged on a common axis, which also serves as a swivel mounting for the furnace. Power supplies, the temperature control thermo-elements, and apertures for customer's own thermo-elements are mounted on the furnace's rear side. Furnace case made from stainless steel. The furnaces feature extensometer cut-out. Hinged

furnace mounting bracket for the furnace installation are available. The furnace can be conveniently swung out of the testing area when not used. Swivelling furnace bracket installation of the split furnace on the testing machine with centring facility for easy extensometer installation. The horizontal position can be adjusted. The Series STE 08 and 19 come in various dimensions to suit existing loadstring. Version 19 is a short construction for specially designed for LCF - testing. The limit switch of Series STE 15 and 19 interrupts the power supply as soon as

the furnace is opened. The Series STE 20 come with water cooling. They can be used for high temperature testing in gas with the optional inert gas supply. Optional is a quartz window for the use of the video-extensometer.

### Options and Accessories

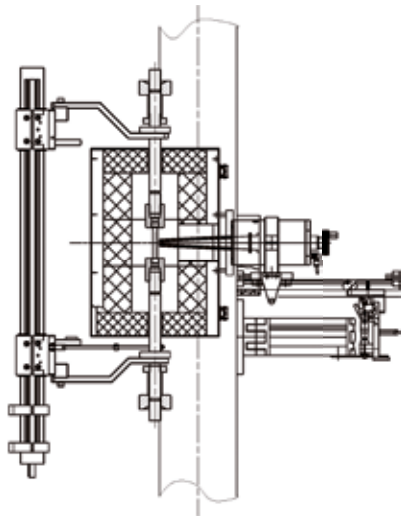
- Viewing ports and windows
- Inert atmosphere retorts
- Vacuum capsules
- Support brackets for most testing machines
- Large range of high-temperature pull rods, couplings, adapters and grips are also available.

### Electronic 3-Zone Control Unit

- 3-PID controllers (Eurotherm 2216).
- Pluggable electric connections.
- 3 (for each zone) RS 485 interface for temperature data acquisition through DION Software
- Hours meter, 3 thermocouples NiCr-Ni



## Specifications



- Accuracy**                      Temperature regulation  $\pm 2$  °C
- Control**                        Eurotherm Series 2216 3-PID Controllers
- Power Requirements**        3 x 400 V, 50 Hz.

Type STE		08	08-1	08-2	19	19-1	19-2	15	20
Max. Temperature	°C	900	1000	1100	900	1000	1100	1200	1600
Max. Heating Rate	°C/min	20	20	20	20	20	20	20	5-20
Heating Zones	No.	3	3	3	3	3	3	3	3
Heating Zone Height	mm	300	300	300	200	200	200	300	300
Heating Zone Diameter	mm	100	100	100	100	100	100	100	100
Outside Diameter	mm	275	275	275	275	275	275	275	455
Overall Length	mm	405	405	405	305	305	305	405	560
Weight	kg	30	30	30	25	25	25	30	45
Power Consumption per Zone	W	3600	3600	3600	3600	3600	3600	3600	3600

Series STE 08/19



Series STE 15



Series STE 20



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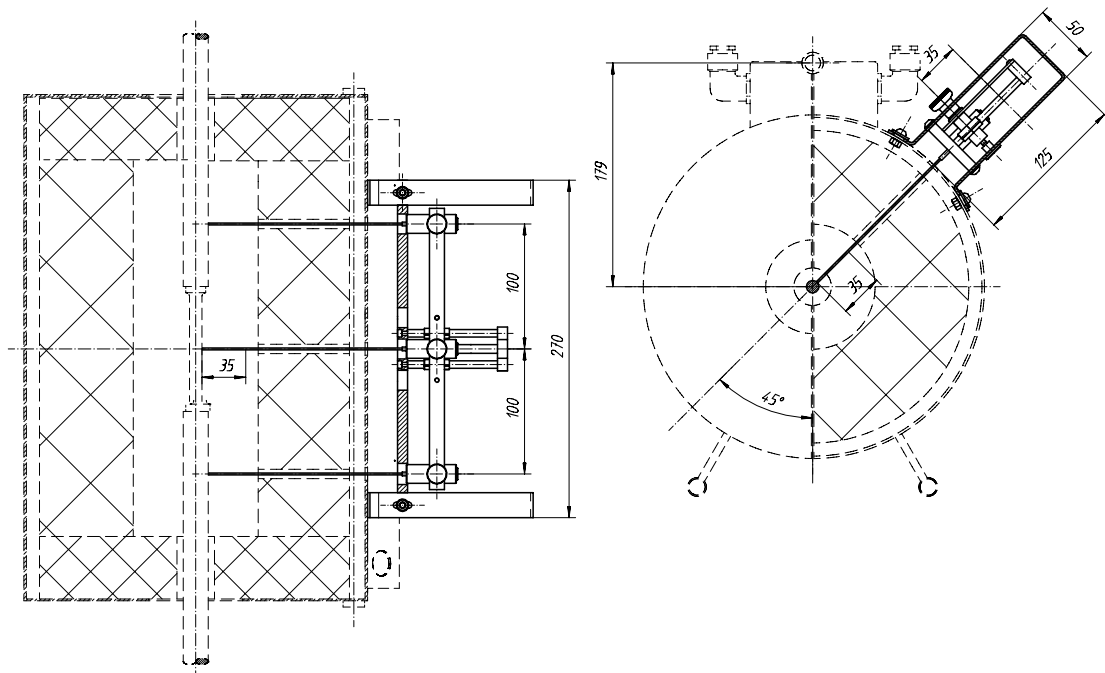
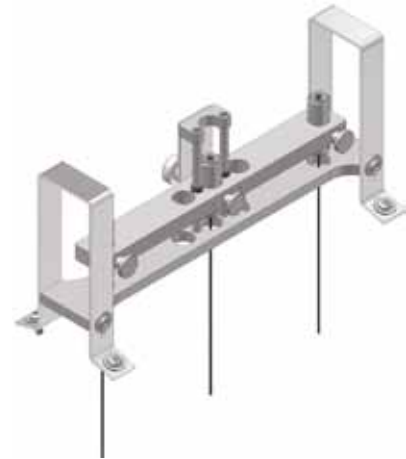
# OPTION

## Slideable Thermocouple Device for High Temperature Furnaces Series STE

Optional available for the high temperature furnaces is an slideable device with three or five spring loaded thermocouples for the control of the sample temperature and control measurements at the pullrods.

Standard with three (3) thermocouples for furnace control. The TCs are located in the middle of each heating zone. The middle one can be located at the sample to control the sample temperature, the two outer are located at the pull-rods.

Additional two (2) TCs with a distance of 25 mm to each side from the middle one. This additional two TC measure the sample temperature so that in total 3 temperatures can be acquired direct from the sample, one from the upper and one from the lower zone (pull-rod).



Version with 3 Thermocouples



Version with 5 Thermocouples

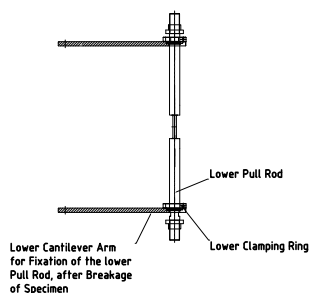
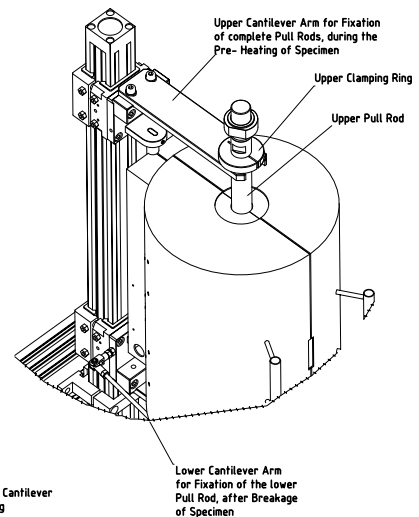
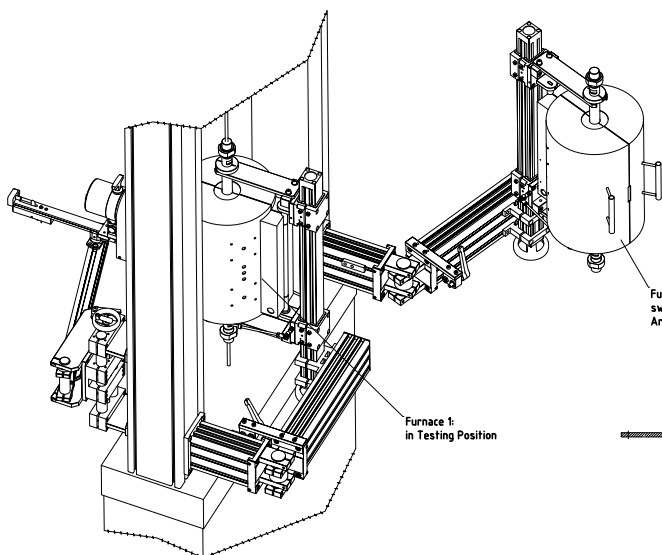
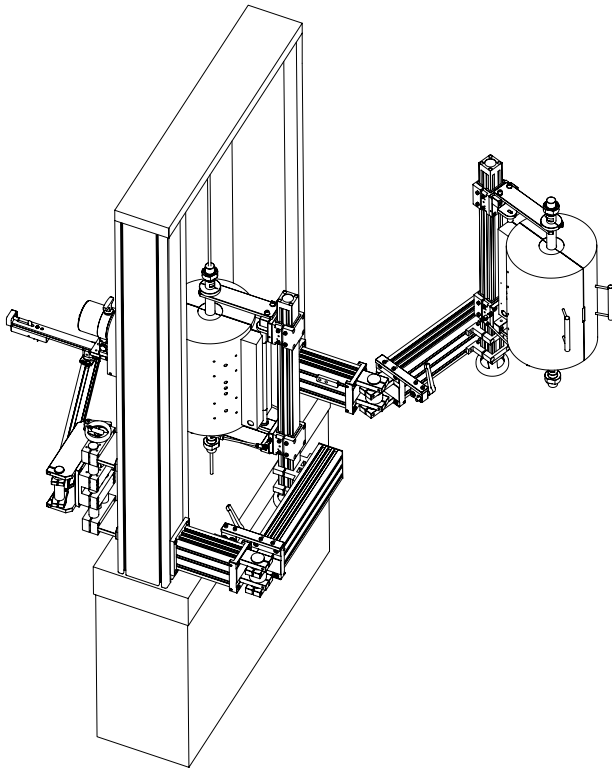


Slideable Device



# APPLICATION

## High Productive Testing with Multiple Furnaces



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# High Temperature Split Furnaces

## Series STE 1000°C up to 1350°C

**Designed primarily for use on materials testing machines for testing under high temperatures up to 1350°C. For high temperature tension or compression tests, creep or relaxation, low-cycle-fatigue, fatigue crack growth and fracture toughness testing.**

This three zone furnaces are provided with the additional heating tiles and control capability to allow much improved thermal uniformity over the specimen gauge length. The hexagonal case design is constructed from polished stainless steel. Heated via wire wound heating element and insulated with high-grad, low-mass insulation. The thermocouples to each zone entering the furnace chamber through the side wall. Additional lead-through can be made and a protective U-plate for the thermocouples

is included. The furnace is designed to accommodate different high temperature axial, COD etc. extensometers. This furnace can also be used for general laboratory applications in either horizontal or vertical orientation. On request the Series STE can also be supplied as five zone high temperature furnaces.

The furnace comes along with the electronic control unit Type LFA-V25-Z3 with integrated transformer and power supply, and 3 digital PID temperature controller for the most

accurate and stable temperature control. The controllers feature easy adjustment of the PID control parameters through preliminary adjustment (pre-tune) and self-adjustment (self-tuned facilities). Further the controllers feature very easy set point adjustment directly through front panels keys, two-line high-luminosity LED display, permanent set point and actual value display, two software alarms, IP 65 system of protection, adjustable digital input filter and adjustable actual value offset for the correction of the measured value.

All electric connections including heat current are pluggable. The controller is equipped with RS-232 interface and includes 3 thermocouples (PtRh-Pt Type S or K) and compensating cables. The LFA-V25-Z3 interfacing the DION Material Testing Software family for fully communication and data acquisition of furnace. Each zone is acquired independently and additionally mean temperature calculated.

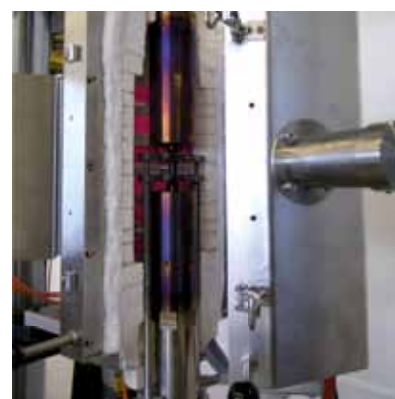
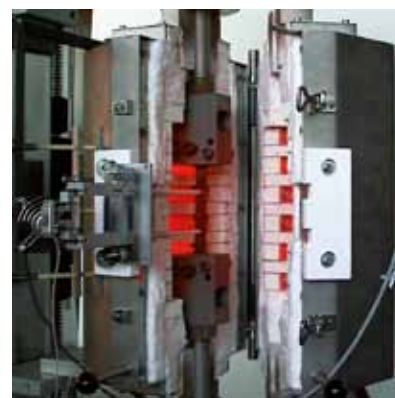
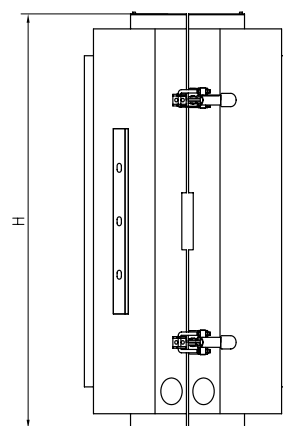
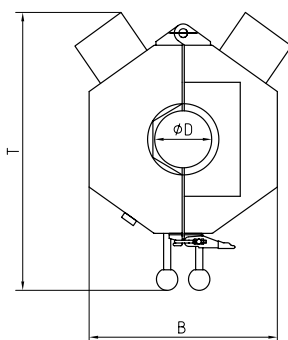




# Specifications

**Accuracy** Temperature regulation  $\pm 2$  °C  
**Control** Eurotherm 3-PID Controllers  
**Power Requirements** 3 x 400 V, 50 Hz.

Type STE 12 - H		1000	1100	1250	1350
Max. Temperature	°C	1000	1100	1250	1350
Max. Heating Rate	°C/min	20	20	20	20
Heating Zones	No.	3	3	3	3
Heating Zone Height	mm	210 - 350	210 - 350	210 - 350	280
Heating Zone Diameter	mm	100	100	100	100
Overall Height (H)	mm	370 - 590	370 - 590	370 - 590	500
Overall Width (B)	mm	290	290	290	340
Overall Depth (T)	mm	390	390	390	455
Port Diameter (D)	mm	65	65	65	40
Weight	kg	40	40	40	50
Power Consumption	W	2250	2250	2250	2250



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# High Temperature Furnaces for Rotary Bending and Torsion Machines

## Series STE 100°C - 1000°C

Specially designed for the installation into the rotating bending and torsion testing machines. The short construction is very suitable for mounting it into these machines. This high temperature furnace contains a high duty heat and insulation bracket where rugged heat resistors are situated free of reflection.

The line voltage is reduced to a low tension of 25 V, which leads to a minor surface charge of the heat resistors and it guarantees a safe operation and a high time laid also at a high temperature level. Available are 1- or 3-area furnaces with different temperature ranges for different specimens lengths and diameters. Series STE furnaces are available with digital control system integrated in the 19 control console type LRA. Series STE 19 furnaces have a separate control system type

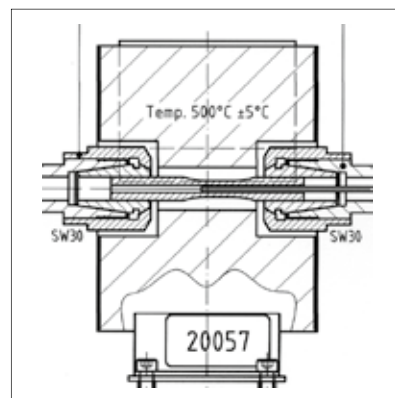
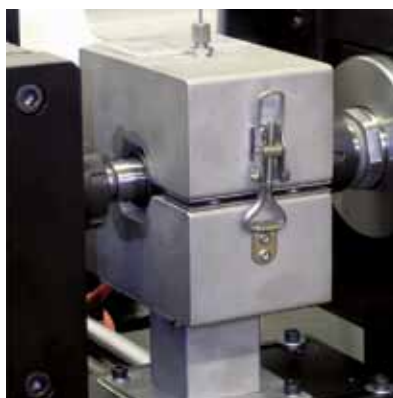
MSRA 61 in a stand-alone 19" rack.

### Features

- For very short specimens with total length of min. 80 mm
- Sample diameter depending on model up to Ø 12 mm or up to Ø 30 mm.
- Max. testing temperatures up to 1000°C or higher upon request.
- 1- or 3 area design of furnaces.

### Optional Temperature Measurement

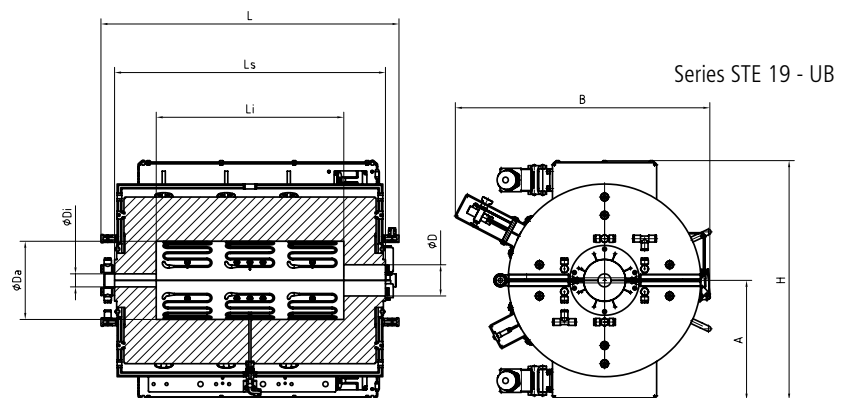
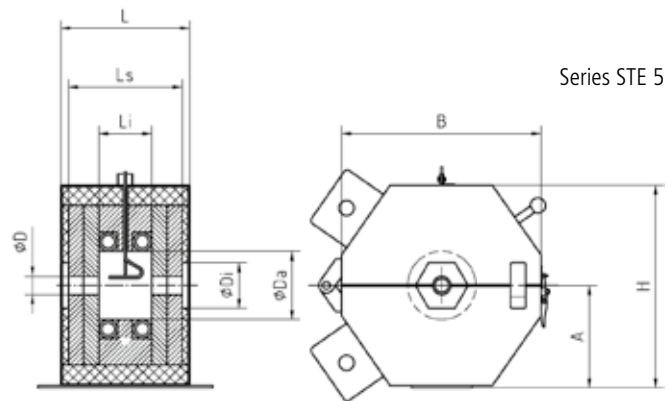
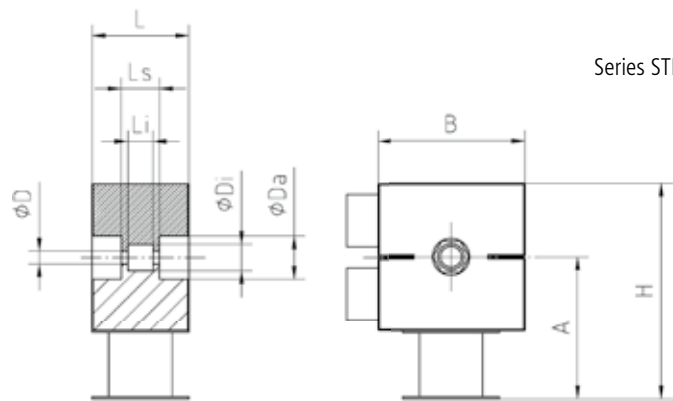
Temperature Measurement in the Inside of the Specimens from internal diameters of Ø 3 mm or larger.



# Specifications

**Furnace Support** in x / y axis adjustable for the exact centring.  
**Power Requirements** 3 x 400 V, 50 Hz. 2 kW

Type		STE 5 - UB1	STE 5 - UB2	STE 5 - UB3	STE 19 - UB	
Regulated Temp. Range	°C	100 - 400	200 - 850	200 - 1000	RT - 1100	
Heating Areas	No.	1	1	1	3	
Control Accuracy	°C	2	2	2	2	
Power	W	300	750	750	3 x 1200	
Design		Rectangular	Hexagonal	Hexagonal	Round	
Opening Angle ca.	°	100	100	100	100	
Dimensions	D	mm	12	16	24	31
	Di	mm	25	60	60	Ø 100
	Da	mm	41	90	90	Ø 100
	L	mm	92	130	170	305
	Ls	mm	36	110	150	520
	Li	mm	24	65	70	200
	A	mm	135	135	135	230
	H	mm	205	267	267	460
B	mm	140	264	264	488	



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# Induction Heating System

## Series IHS up to 1600°C

**Inductive heating system providing a reliable, compact solution for heating specimens with a quick, clean source of heat, ideal for repeatable, non-contact specimen heating.**

The movable work head can be located up to 6 m from the power supply (3 m is standard). Equipped to operate over a broad frequency range (150-400 kHz), it's ideal for heating a wide range of specimens with excellent heating control within 50 W resolution. Agile tuning supports single-cycle and continuous heating operations without time-consuming changeovers. Power level is selected and monitored from the convenient front panel LCD and sealed touch pad. Remote power control is available also in combination with additional PCS8000 controller for synchronized testing with test load, displacement or strain control. The length of the heating cycle is easily controlled with a built-in programmable digital timer. The unit is water-cooled, requiring connection to a heat exchanger (chiller). The system is supplied as bench-top (alternative rack-mounted) unit, a truly portable heat source.



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# Environmental Temperature Chambers Series ETC

**Maximum Operating Temperature: + 600°C**

**Minimum Operating Temperature: - 150°C**

**(with the Cryogenics Option)**

**Wide range of sizes and options allow the chambers to be mounted onto most testing machines with either fixed brackets or roller carriage assemblies.**

This series of chambers are also supplied with a variable speed fan, which ensures an even distribution of air and superior temperature uniformity. The fan speed can be adjusted when testing delicate specimens to reduce turbulence and load effects. All chambers incorporate outer skin heating and cooling to prevent icing or excessive skin temperatures. The control system is based upon a EURO THERM 2408 self-tuning digital temperature controller.

## Cryogenic Option

The entire range of chambers can be operated at below ambient temperatures. This is achieved using cryogenic liquids (either nitrogen or carbon dioxide) or mechanical refrigeration. The chambers can be easily configured for use with the optional cooling pack. This contains everything required to adapt the chamber for low temperature use. The only additional item required is a dewar flask.

## Features

- **Heating:** Fast response heating element located next to a fan at the rear of the chamber. The convected air is channelled using a baffle plate to the top and bottom of the chamber and returned through the centre of the baffle plate.
- **Temperature Measurements:** Thermocouple Type K which is located close to the baffle plate within the air stream.
- **Cooling Option:** LN<sub>2</sub> injection via a rear mounted cooling pack, comprising solenoid valve, internal connection hoses, pressure relief valve and external exhaust hose.
- **Door:** Hinged to the left or right. A safety interlock switch cuts power to the heating elements and the fan if the door is opened during operation.
- **Window:** Fitted centrally within the door. The window is heated during low temperature testing to help prevent frosting of the panes.
- **Ports:** With top and bottom ports. An instrumentation port is also included on the top of the chamber complete with a plug. Including removable wedge option enable the chamber to be withdrawn from the test area without removing the loadsting.
- **Construction:** The inner chamber is constructed from stainless steel and insulated by high efficiency insulation. A forced air skin heating/cooling system is incorporated to minimise skin temperatures when testing at high temperature. The outer case is constructed from mild steel. All Instrumentation is positioned in the rear section of the chambers including access to heat, cool and system enable. The controls are integrated in a housing, which can be placed on the table.

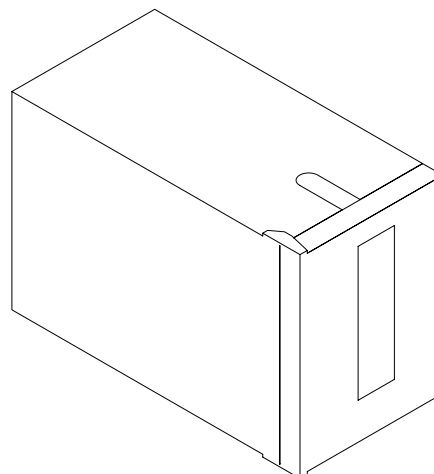
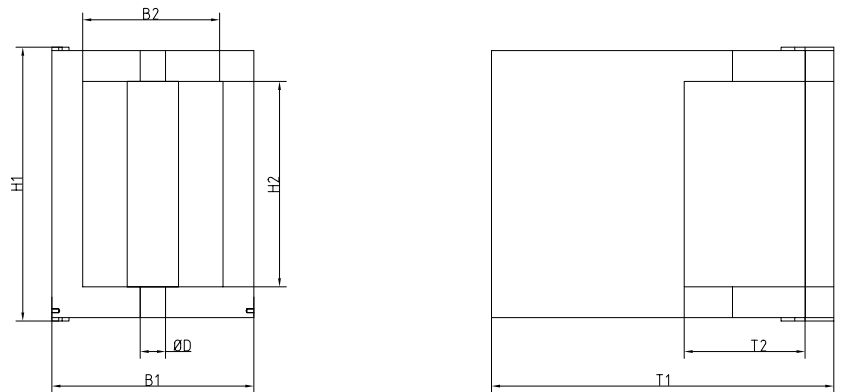


# Specifications

**Accuracy** Overall System <5 °C  
**Control** Eurotherm 4-PID Auto-Tuning Digital Controller  
**Power Requirements** 3 x 400 V, 50 Hz.

Type ETC		350-1	350-2	460-1	460-2	550-1	550-2
Max. Temperature	°C	600	350	600	350	600	350
Min. Temperature Liquid N2	°C	-150	-100	-150	-100	-150	-100
Min. Temperature Liquid CO2	°C	-70	-70	-70	-70	-70	-70
Heating Time to max. Temp.	min	<90	<70	<90	<70	<90	<70
Cooling Time to min. Temp.*	min	<45	<90	<90	<90	<90	<90
Temperature Gradient**	°C	±2	±2	±2	±2	±2	±2
External Width (B <sub>1</sub> )	mm	350	350	460	460	550	550
External Depth (T <sub>1</sub> )	mm	850	850	1000	1000	930	930
External Height (H <sub>1</sub> )	mm	710	710	700	700	710	710
Internal Width (B <sub>2</sub> )	mm	240	240	320	320	400	400
Internal Depth (T <sub>2</sub> )	mm	230	230	400	400	400	400
Internal Height (H <sub>2</sub> )	mm	550	550	550	550	550	550
Pullrod Port Diameter (ØD)	mm	67	67	67	67	125	125
Weight	kg	98	95	151	148	151	148

\* with 10 kg mass, approx. equivalent to grips and pull rods  
 \*\* set point after 10 minutes stability time. Measured at the specimen (metal) over 50 mm gauge length. Maximum temperature overshoot: 2°C  
 Please note the above performance data is dependent on the load string configuration.



# Environmental Temperature Chambers Series ET

**Temperature Regulation Range:**

**- 70°C to +300°C**

**by a incorporated air heating / cooling system  
(cooling without LN2 or CO2)**

**Optional with Humidity Control:**

**40 % to 90 % RH from +10 to +80 °C**

The inner chamber is constructed of stainless steel and surrounded by high efficiency ceramic fiber isolation. A forced air heating / cooling system is incorporated. The outer case is constructed from mild steel. The fan speed is variable to minimise turbulence for sensitive test procedures. The central ports for the pull rods e.g. are sealed via silicon rubber bellows. The door has a central and is heated during the low temperature testing. The door is also equipped with a safety interlock switch to shut down the heating-cooling and humid-

ity systems if the door is open. The chamber has also a hole on the rear right hand side for passing through measuring cable leads etc.

## Features

- **Heating:** Through isolated elements located next to the fan at the rear of the chamber
- **Cooling:** Through hermetic refrigeration compressor, CFC-fluorocarbon free (Copeland)
- **Measurement and Control:** Temperature and humidity sensor (temperature compensated) with flexible leads and fixtures to place the sensors nearest to the specimen. Digital controllers enabling to store 4 programmes with 12 segments including RS-232 Interface and 0 - 10 V analogue output.
- **Option:** Humidity Control through superheated steam (evaporation).





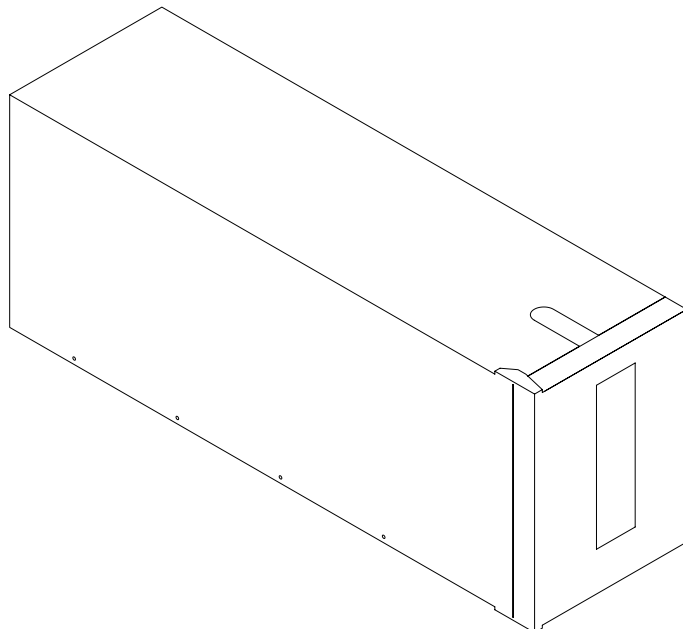
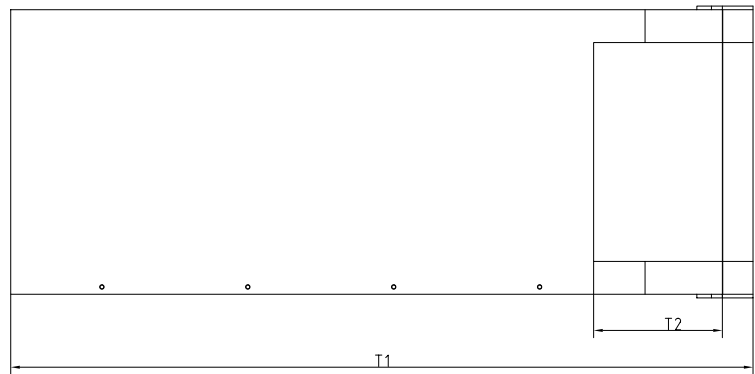
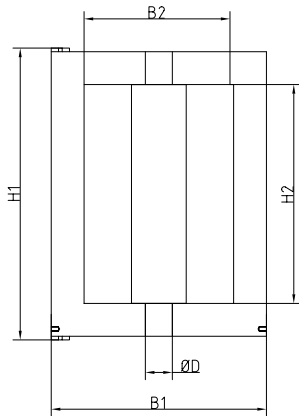


## Specifications

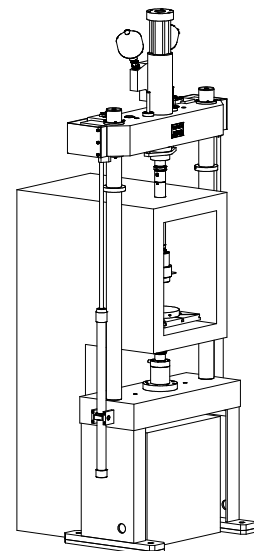
- Accuracy** Overall System <2 °C
- Control** Eurotherm 4-PID Auto-Tuning Digital Controller
- Power Requirements** 3 x 400 V, 50 Hz.
- Option** Dimensions can be custom designed according to your needs.

Type ET		40-40	40-70	200-70	300-70
Max. Temperature	°C	+40	+40	+200	+300
Min. Temperature	°C	-40	-70	-70	-70
Temperature Gradient*	°C	±1-2	±1-2	±1-2	±1-2
External Width (B <sub>1</sub> )	mm	590	590	590	960
External Depth (T <sub>1</sub> )	mm	1290	2035	2035	2930
External Height (H <sub>1</sub> )	mm	820	780	840	1000
Internal Width (B <sub>2</sub> )	mm	410	400	400	400
Internal Depth (T <sub>2</sub> )	mm	400	350	350	300
Internal Height (H <sub>2</sub> )	mm	600	600	600	700
Pullrod Port Diameter (ØD)	mm	70	70	70	70

\* set point after 10 minutes stability time. Measured at the specimen (metal) over 50 mm gauge length. Maximum temperature overshoot: 2°C  
Please note the above performance data is dependent on the load string configuration.



### Option upon request: Space Saving Design



# Mini Environmental Temperature Chambers

## Series ETC Mini

**Maximum Operating Temperature:** + 250 °C  
**Minimum Operating Temperatures:** - 70°C with cryogenics option  
**Designed for single column testing machines for vertical or horizontal use.**



This chamber system consists of an insulated environmental enclosure with an integrated heating system, temperature controller and optional liquid nitrogen or carbon dioxide cooling modules.

It is specially developed for use with single column testing machines Series LFM-L.

With full side opening door, this provides a compact enclosure and yet optimized access into the test space to either change the specimen or adjust/remove the grips.

Optional is a rail mount to roll the chamber in and out of the testing machine.

A large window 200 x 100 mm or 500 x 100 mm is provided for visual observation of the test.

Cooling option LN2 for temperatures as low as -70°C. The LN2 gets injected via a mounted cooling pack.

Standard height for compression and short travel tensile applications. Extra height for elastomeric and other extended travel tensile applications. Optional versions for horizontal use.

### Features

- Eurotherm 2216 autotuning PID control system
- Large observation window with internal light
- Optimized test space with full side opening door and high performance insulation

## Specifications

**Accuracy** Temperature regulation  $\pm 2$  °C

**Control** Eurotherm 3-PID Controllers

**Power Requirements** 3 x 400 V, 50 Hz.

Technical Data	ETC Mini 650	ETC Mini 350
Max. Operating Temperature	+250°C	+250°C
Min. Operating Temperature	-70°C*	-70°C*
Time ambient to min. / max. Temp.	< 30 min	< 30 min
Temperature Stability	$\pm 2$ °C	$\pm 2$ °C
Overall Dimensions W x D x H	400 x 235 / 400* x 650 mm	400 x 235 / 375* x 350 mm
Internal Dimensions W x D x H	140 x 140 x 550 mm	140 x 140 x 250 mm
Weight	22 kg	31 kg
Power Supply	230 V, 50 / 60 Hz	230 V, 50 / 60 Hz

# Vacuum Chambers for TMF - Testing Series VK

The vacuum chamber is intended for stationary, fixed installation in the Series LFV or Series LFMZ testing systems.

**Operating Temperatures** up to 1600°C  
**Operating Vacuum Levels** up to 10<sup>-6</sup> mbar

The main vessel is cylindrical and is welded (in inert gas atmosphere) constructed from stainless with water-cooled double walls and two large doors at the front and rear side for easy access to the specimens. The inner surface is electro-polished and the outer one is pickled, rinsed and bead blasted. Ports on the vertical axis are fitted with low force bellows, which are clamped and sealed by O-ring joints. The intermediate flange is fixed to the main vessel and incorporates the vacuum-rotary-pump set. Located at the rear of the vessel is the vacuum-tight feed through for feeding the indicators into the interior of the chamber. Integrated in the front door are the two pyrometers and also the HT-extensometer.

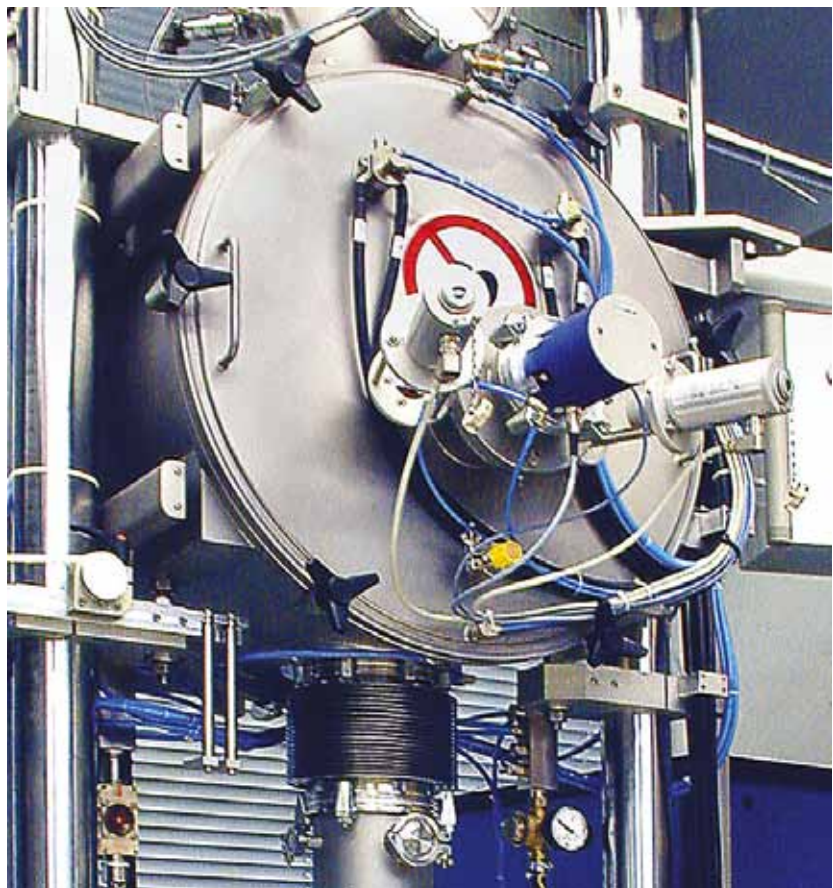


## All required flange connections for

- Turbo-molecular pump with ventilation
- Vacuum measurement-
- Feed-through for the induction coil (rear door)
- Gas inlet and outlet
- Mechanical pressure relief valve
- Load transfer, top and bottom
- Feed-through for the force signal and 3 TC signals
- Attachment for up to 2 pyrometers and the HT extensometer at the front door
- Feed-through for hydraulic fluid and coolant water for the hydraulic grips inside the vacuum chamber
- Suspension from the columns of the testing machine frame and coolant water distribution

## Technical Data

- Leak Proofness: < 1 x 10<sup>-6</sup> mbar
- Leak Rate: < 1 x 10<sup>-8</sup> mbar x litre x sec.<sup>-1</sup> (empty, chamber fully cured and cooled down)
- Weight 400 kg



A

B

C

D

E

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T

## Vacuum Pump Set

- Auxiliary pump, pumping capacity: 16 cubic metres per hour (initial vacuum generation)
- Turbo-molecular pump, pumping capacity: 260 litres per second (high vacuum generation)
- Oil mist separator
- Exhaust valve
- Drive electronics for turbo-molecular pump including cable set
- Set of measuring tubes for ascertaining vacuum, measuring range: 1000 to 10<sup>-6</sup> mbar
- Vacuum display including cable set
- Corrugated hose for connecting the auxiliary pump to the turbo-molecular pump
- Set of seals for vacuum-tight connection of all components
- Overpressure relief device (mechanical relief valve, max. 300 to 400 mbar overpressure)
- Cooling for turbo-molecular pump: with water

## Coolant Water Cooler

**For continuous operation of the HT vacuum testing system in order to cool the double-walled vacuum chamber and the specimen-clamping device.**

- Coolant: R407C, ecological (CFC-free)
- Cooling power: 8 kW
- Water tank 120 Litres
- Dimensions W x D x H: 720 x 720 x 1400 mm

## Gas Rinsing, Regulating and Measuring System

**For adjusting the inlet rate of 3 different gases in order to regulate pressure between two pre-selected values (continuous gas feed and exhaust), and for gas flow measurements.**

- 1 gas indicator panel in accordance with project sketches: SKZ\_03 + SKZ\_04
- 1 set of gas connector hoses
- 1 attachment stand for attachment to the load frame of the testing machine (column, profile or the like)

## Specimen Cooling Package for External Sample Cooling

**For targeted specimen cooling at external surfaces by means of rinsing with gas (external flow).**

**With cooling rate of approx. 25 K per second.**

- Air valve with interface to the temperature control
- Directional jets on the exterior of the sample
- Mounting bracket for the jets
- Full set of tubing and fittings to connect to customers compressed gas supply

Note: The cooling rates will be linear over the majority of the temperature range. The cooling rates will be linear over the majority of the temperature range.

Optional: Temperature Cooling Package for internal (gas flow through the centre of the specimen) sample cooling via gas flow