Thermal Analysers

Thermogravimetric Analysers & Ash Fusion Determinators

Elite Thermal offers thermal analysers for the analysis of Coal, Fuels and Minerals. Elite Thermal has been manufacturing ash fusion determinators for over ten years now and has recently launched their thermogravimetric analysers

Setting the Standard for Thermal Process Solutions Worldwide

Thermogravimetric Analysers TGA et250

Elite Thermal's Thermogravimetric Analysers (TGAs) are high-performance proximate analysers that measure the weight change of a sample as a function of temperature. They are used to study the thermal stability and composition of materials. Elite Thermal's TGAs are utilised for the determination of moisture, ash, volatile matter, fixed carbon, and loss on ignition (LOI) in a wide range of organic, inorganic, and synthetic materials.

Elite Thermal offers a range of TGAs to meet the needs of different applications. TGA et250 is a versatile instrument that features a programmable furnace and an integrated balance, enabling fast and accurate measurements. TGA et250 can analyse up to 19 samples simultaneously and employs a single carousel design for holding crucibles. TGA et250 is a cost-effective instrument that is ideal for basic TGA applications with manual handling of crucible lids.

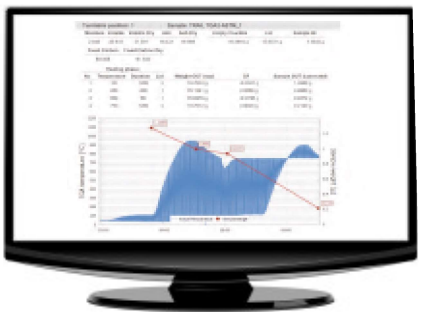
Elite Thermal's Thermogravimetric analysers replace traditional analytical techniques that are labour-intensive, slow, and susceptible to operational errors. TGA et250 comes with an integrated balance that combines drying, ashing, and weighing processes, thereby improving efficiency, precision, and providing high sample throughput.

Elite Thermal's TGA systems comply with several international standards, including ASTM, ISO, DIN, EN, and more. Elite Thermal's TGAs find applications in various industries, including coal, coke, mineral ores, cement, limestone, foodstuffs, feeds, and many more.

A typical coal analysis method consists of determining moisture, volatile matter, and ash content. Customisation options within the software encompass temperature ramping, start and end temperatures, gas flow programming, and mass constancy criteria, guaranteeing a fully adaptable instrument that meets the unique demands of every user.

TGA et250 key features

- Single Carousel design
- Analysis of up to 19 samples
- Manual handling of Crucible lids
- Samples: Organic, Inorganic & Synthetic
- Parameters: Moisture, Volatiles, Ash, LOI & Fixed Carbon

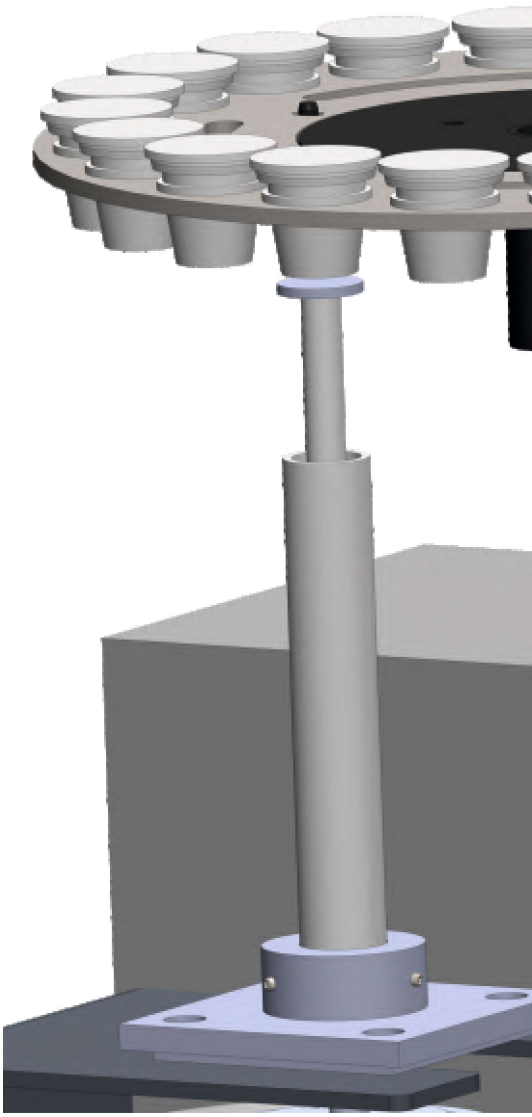


Robust Heating Elements

- High power thermal elements facilitate quick temperature ramp-up and provide exceptional temperature stability
- Embedded heating elements ensure uniform temperature inside the furnace chamber throughout the analysis cycle
- Higher maximum temperature range up to 1100°C

Effective Temperature Control

- Best-in-class temperature set point control is achieved through the use of two high precision thermocouples
- The first thermocouple to monitor the furnace temperature. Second thermocouple to monitor the sample temperature precisely
- Additional thermocouples are available as an optional feature. In addition to the two thermocouples mentioned above, a third thermocouple is provided for monitoring the lower furnace, and a fourth thermocouple provides temperature cross-verification and temperature calibration functionality
- These third and fourth thermocouples are factory-installed options. They must be ordered along with the main TGA et250 instrument



Precise Weighing System

- TGA et250 is integrated with a top-loading balance featuring an inbuilt auto-calibration facility and the ability to weigh the sample crucibles repeatedly throughout the analysis
- Thermally isolated balance for accurate weighing
- High-resolution balance ensuring accuracy to 0.0001 g for precise results

Exceptional Analytical Performance

- State-of-the-art thermogravimetric analyser featuring robust hardware and user-friendly software encased in a durable design, delivering exceptional analytical capabilities
- TGA et250 is constructed using high-quality materials, ensuring superior functionality and performance even in challenging conditions, and offering consistent operation and reliability
- The carousel is constructed from specialised materials that withstand high temperature stress without warping
- TGA et250 is available in a dual furnace package which allows for two TGAs to be operated from a single PC for laboratories that require the highest sample throughput

Superior Carousel Mechanism

- Single carousel for holding crucibles with manual handling of crucible lids
- The carousel accepts 19 samples and 1 reference
- Carousel MOC: Either Metal or Ceramic
- Bi-directional movement and ability to skip empty positions for faster analysis times
- Up-and-down movement of the carousel using pneumatic control and motorised rotation enables precise and accurate analysis without any oscillation

Exhaust & Cooling System

- In-built exhaust system with two internal blowers minimises harmful vapours and odours in the laboratory
- Cooldown process is automatically initiated at the end of each analysis cycle
- User programmable furnace lid opening to improve cool down time
- Optional external exhaust system is available for even faster cooling

Gas Flows

- With TGA et250, users can seamlessly transition between oxidizing and inert atmospheres through automated controls
- An optional feature includes a software-controlled mass flow controller, which enables programmable adjustment of gas flow rates

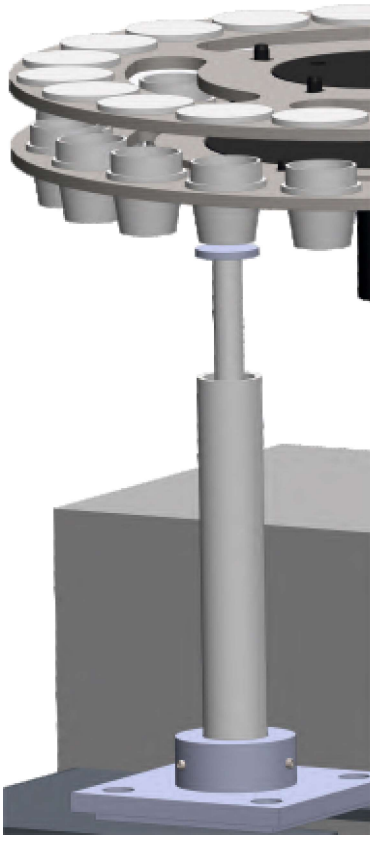
Thermogravimetric Analysers TGA et500

The TGA et250 and TGA et500 are essentially the same in terms of features, except that the TGA et500 comes with a dual carousel configuration, differing in their operating mechanisms. The TGA et500 features two carousels for placing crucibles and their lids.

Elite Thermal's TGA et500 is a dual carousel thermogravimetric analyser, distinguished by its unique capability of controlling crucible lids. During typical analysis, the lower carousel is used for placing crucibles, while the upper carousel is used for placing crucible lids. The TGA et500 Instrument utilises a pneumatic carousel mechanism for accurate crucible placement. The movement of the carousel from one crucible position to another is motorised, and the up and down mechanism of the carousel is controlled pneumatically. The carousel is made of special materials that are not susceptible to warping under high-temperature stress.

TGA et500 key features

- Dual Carousel design
- Analysis of up to 19 samples
- Fully Automatic analysis
- Samples: Organic, Inorganic & Synthetic
- Parameters: Moisture, Volatiles, Ash, LOI & Fixed Carbon
- Automatic placement & removal of crucible lids

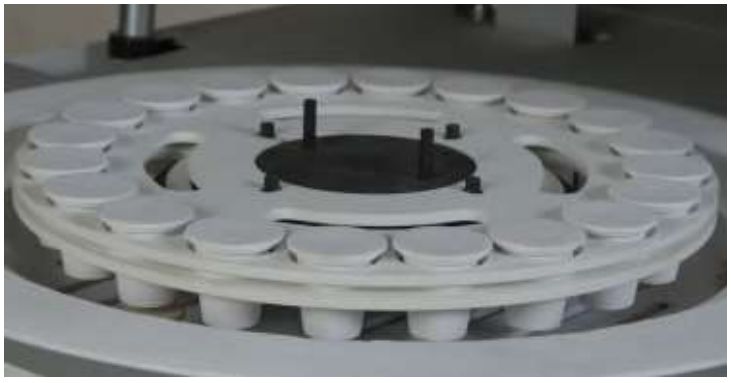


Precise Temperature Regulation

- Best-in-class temperature setpoint control is achieved through the use of four thermocouples
- The first thermocouple is used to detect the upper furnace temperature, while the second is used for lower furnace temperature detection. The third thermocouple is employed for real-time temperature measurement of the sample and, finally, the fourth thermocouple provides temperature cross-verification and temperature calibration functionality

Crucible lids open

Weighing with crucible lids open



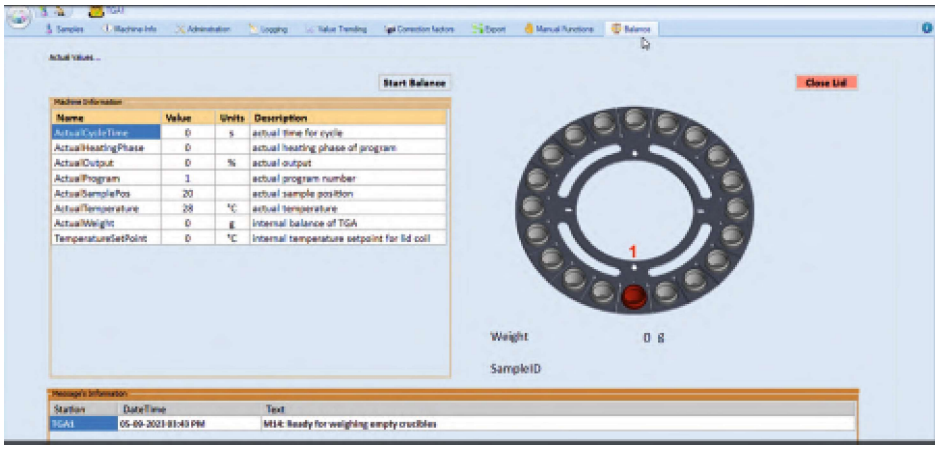
Crucible lids closed

Weighing with crucible lids closed

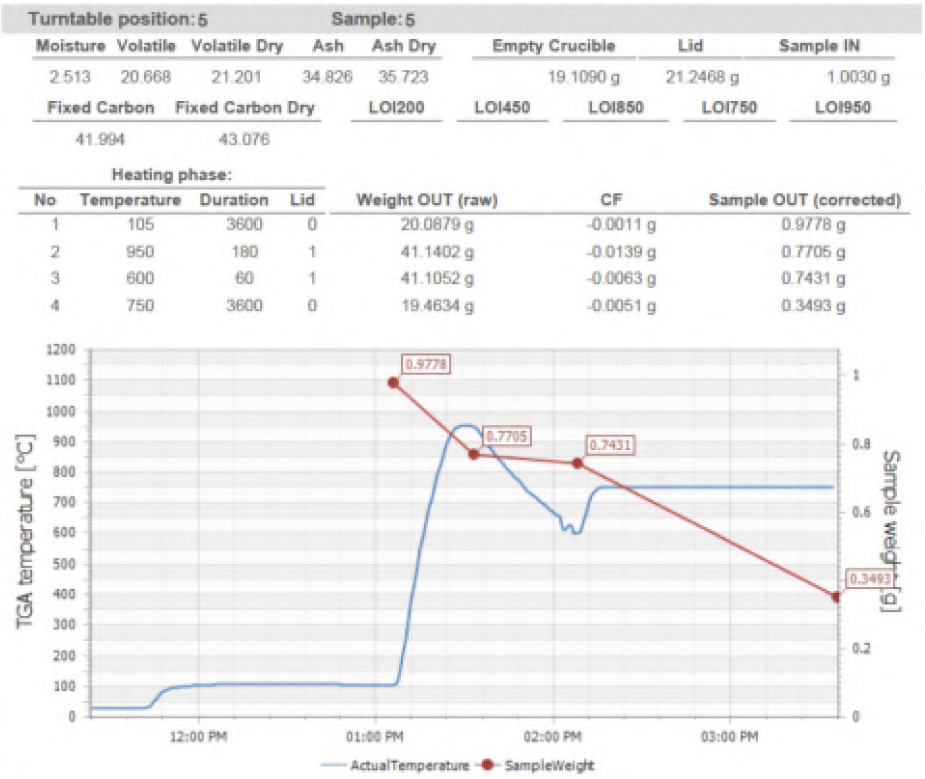
- TGA et500 employs two carousels, each built with high strength and corrosion-resistant materials. One carousel is designated for crucibles, while the other is designated for crucible lids
- The carousels are constructed using a unique material that exhibits exceptional resistance to warping when exposed to elevated levels of thermal stress
- The second carousel enables the automated placement and removal of crucible lids within the furnace, eliminating the need to open the furnace lid
- The dual carousel design offers enhanced precision in the measurement of volatile matter along with automated functionality, thereby preventing any potential sample oxidation
- Automatic crucible management removes the risk of potential burns to the operator when exposed to elevated temperatures, and removes the possibility of the operator inadvertently dropping the crucible lids into the furnace

Software Features

- The user-friendly software enables complete control of the analyser through a graphical interface. It provides visual representations of temperature versus weight loss measurements, as well as real-time displays of parameters such as furnace temperature, sample status, and remaining time

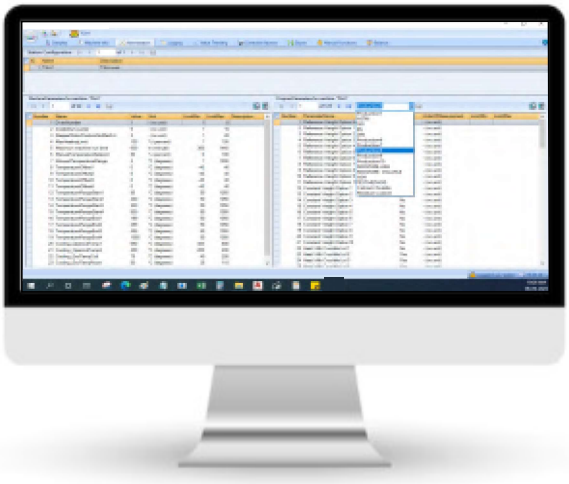


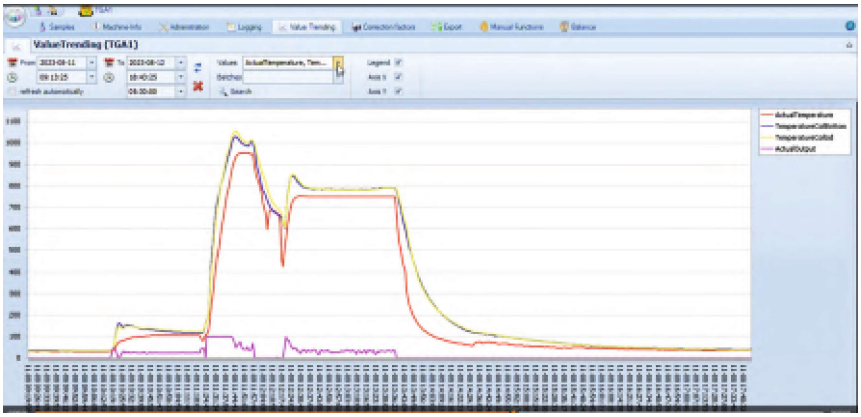
- The software provides flexible method settings, including temperature ramps, set points, programmable gas flows, and options for placing or removing crucible lids, as well as criteria for maintaining mass constancy. These settings cater to various customer applications such as moisture determination, volatile matter determination, Loss on Ignition (LOI) determination, and ash determination



- TGA et250 & TGA et500 come pre-programmed with 10 in-built standard methods for analysing coal samples in accordance with ASTM and ISO standards. Additionally, the software enables users to configure up to 16 custom methods based on their specific requirements

- The software offers a versatile sample login and loading procedure, accompanied by real-time graphical representations of analysis data





Test Methods

Elite Thermal's TGA et250 & TGA et500 complies with the following test methods.

Coal & Coke

Mineral Ores

Gypsum & Hydrated lime

Soil & Fertiliser

Cement & Building Materials

Food & Feed

Standard	Title of the standard
ASTM D7582-15	Standard Test Methods for Proximate Analysis of Coal and Coke by Macro Thermo Gravimetric Analysis.
ASTM D5142	Standard Test Methods for Proximate Analysis of the Analysis Sample of Coal and Coke by Instrumental Procedures.
ISO 562	Hard Coal and Coke - Determination of volatile matter.
ASTM D7348	Standard Test Methods for Loss on Ignition (LOI) of Solid Combustion Residues.
DIN 51718	Testing of solid fuels - Determination of the water content and the moisture of analysis sample.
ASTM E1755	Standard Test Method for Ash in Biomass.
DIN 51719	Determination of ash in solid mineral fuels.
ISO11722	Solid mineral fuels - Hard coal - Determination of moisture in the general analysis test sample by drying in nitrogen.
ISO1171	Solid mineral fuels - Determination of Ash.
EN 15148	Solid biofuels - Determination of the content of volatile matter.
ISO/TR 18230	Determination of Loss on Ignition - Non oxidized ores.
ASTM C114	Determination of Loss on Ignition of Hydraulic Cement.
ISO 806	Aluminum Oxide Primarily used for the product of aluminium - Determination of loss of mass at 300°C and 1000°C.
EN 14775	Solid biofuels - Determination of Ash content.
AS1038	Proximate analysis & Testing.
BS1016	Proximate analysis.

Technical Specifications

Specifications	TGA et250	TGA et500
Temperature Range	Programmable from ambient to 1100°C	Programmable from ambient to 1100°C
Temperature Control Precision	±2 deg C (or) ±2% of set point temperature	±2 deg C (or) ±2% of set point temperature
Temperature Stability	±2 deg C (or) ±2% of set point temperature	±2 deg C (or) ±2% of set point temperature
Ramp Rate	Programmable from 10°C /minute to 50°C /minute	Programmable from 10°C /minute to 50°C /minute
Balance	Integrated Balance	Integrated Balance
Balance Resolution	0.0001g (0.1mg)	0.0001g (0.1mg)
Balance Readability	0.0001g (0.1mg)	0.0001g (0.1mg)
Weight Loss	0 to 100%	0 to 100%
Sample Size	up to 10 grams based on the sample type and its characteristics	up to 10 grams based on the sample type and its characteristics
Number of Samples	19 Samples +1 Reference	19 Samples +1 Reference
Number of Carousels	One for crucibles and crucible lids	Two (one for crucibles and the other for crucible lids)
Carousel Material	Metal or Ceramic	Metal or Ceramic
Weighing Precision	0.02% RSD (on inert samples)	0.02% RSD (on inert samples)
Electrical Power Requirements	230V (± 10%) / single phase / 50/60Hz / 32A	230V (± 10%) / single phase / 50/60Hz / 32A
Computer	230V (± 10%) / single phase / 50/60Hz / 2A	230V (± 10%) / single phase / 50/60Hz / 2A

Ash Fusion Determinator

- a step towards an improved Ash Fusibility Analysis

When any fuel is burned, an incombustible waste material is produced, commonly known as ash.

As the burning process progresses, the temperature of the combustion environment reaches a point where the ash particles start to melt.

This melting occurs because the heat energy breaks down the chemical bonds holding the ash particles together, causing them to transition from a solid state to a liquid state. Once the ash has melted, it begins to undergo a cooling process. As the melted ash cools down, it solidifies and forms clinkers.

Clinkers are hard, stony residues composed of the solidified ash particles, which frequently stick to the inner surfaces of the combustion chamber.

Clinker build-up poses challenges for large coal furnaces, often requiring furnace closure for maintenance. Understanding the fusibility properties of coal ash facilitates temperature management to mitigate clinker formation.

The Ash Fusion Temperature serves as an indicator of the point at which the ash undergoes a transition from a solid to a liquid state through melting. This temperature is a crucial parameter in the planning and execution of gasification systems.

Ash Fusion Determinator — EATC16 Series

Elite Thermal's EATC16 Series Ash Fusion Determinator for four critical temperatures:

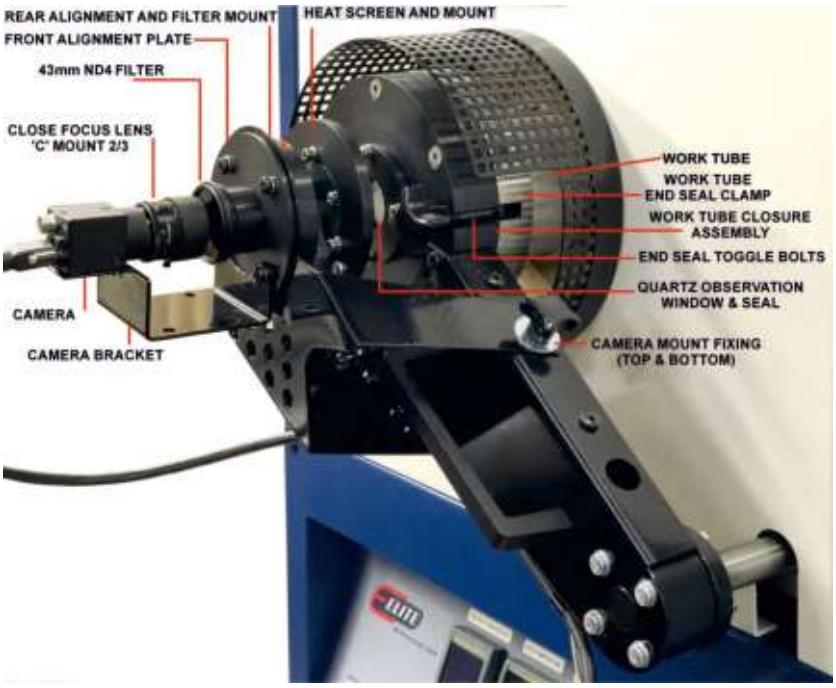
- Initial Deformation Temperature (IDT)
- Softening Temperature (ST)
- Hemisphere Temperature (HT)
- Fluid Temperature (FT)

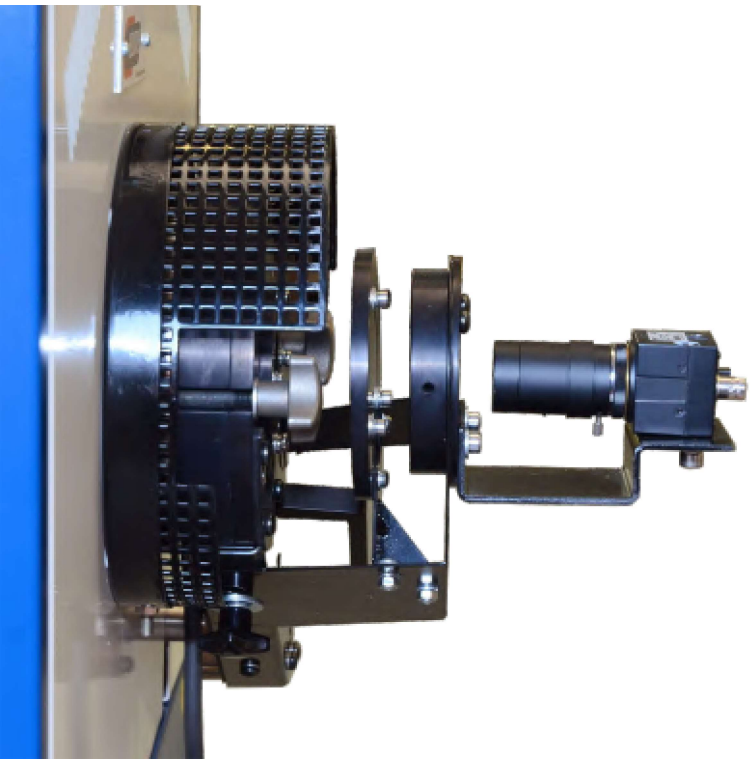
EATC16 Series key features

- Bench-mounted Ash Fusion Determinators
- Maximum Furnace Temperature: 1600°C
- Types of samples: Coal ash, coke ash, biomass ash, refuse-derived (RDF) ash, and solid biofuel ash
- Analysis parameters: Fusion points (IDT, ST, HT, and FT) of ash samples
- Type of analysis: Manual in EATC16 Manual Model
  Automatic in EATC16 & EATC16*plus*
- Precisely controlled high-temperature horizontal resistance furnace
- Furnace is capable of operating in both oxidising and reducing atmospheres
- Programmable temperature ramp rates
- Up to 6 samples can be analysed simultaneously for each batch
- Capture images of the samples at every 1°C increase temperature in EATC16 & EATC16*plus*
- Grid feature for accurate comparison of sample height and width in EATC16 & EATC16*plus*
- Quick cooling facilitated by low thermal mass insulation allows for the completion of multiple tests within a day
- Automatic gas switching between oxidizing and reducing gases based on selected test conditions (Available in EATC16*plus*)

EATC16 Manual

- A high-resolution camera with a manually adjustable lens mounted on a suitable arm is used to view the samples being tested
- This setup allows for easy movement away from the furnace to access the work tube
- The video image is sent to a high-end computer system where it is recorded and displayed in a specially created logging program
- Accepts specimen shapes in accordance with ASTM, ISO, and DIN standards, including cylinder, pyramid, upright pyramid, and truncated pyramid





EATC16 & EATC16*plus*

- A high-resolution camera is mounted on an arm on the EATC16 and EATC16*plus* for real-time monitoring of the entire test process
- The camera in EATC16 and EATC16*plus* allows viewing a complete video of the analysis
- Adjustable grid scale for each test specimen
- Grid overlay feature for accurate comparison of sample height and width
- Accepts specimen shapes as per standards
- Direct specimen capturing without using mirrors for accurate and precise fusion temperature measurements
- Continuous recording of sample images
- Real time monitoring of the samples and test process
- Auto identification of fusion temperatures (IDT, ST, HT & FT)

Biomass Ash | RDF Ash | Fly Ash | Petroleum Coke Ash | Coal Ash | Low ash metallurgical coke

EATC16 Manual

- EATC16 Manual Ash Fusion Determinator with Manual interpretation software, with 2 flow meters
- Gas inlets for reducing, oxidising & purge gases
- Alarms are fitted to indicate when supply gas pressures are running low
- The furnace has three gas connections on the rear of the furnace: Individual ports for CO_2, H_2, and one for Purge gas
- Pressure switches are fitted to all three gas lines, purge gas, CO_2 gas and H_2 gas

EATC16 Manual

EATC16

EATC16

- EATC16 Ash Fusion Determinator with automatic interpretation software
- Up to 6 samples can be analysed simultaneously for each batch
- Automatic and continuous recording of images
- Capture images of the samples at every 1°C increase in temperature
- The furnace has three gas connections on the rear side of the furnace: Induvidual ports for CO_2, H_2, and one for Purge gas
- EATC16 Ash Fusion Determinator used 2 flow meters for oxidising, reducing and purge gases
- A grid overlay feature is provided within the software for each sample
- The grids are positioned to identify the samples for automatic analysis or are used to assist manual analysis
- They ensure accurate comparison of the height and width of the sample melt points
- The position and scale of each grid is easily adjustable

EATC16*plus*

- Similar to EATC16, EATC16*plus* uses the same software
- The furnace has five gas connections on the rear side of the furnace: Individual ports for CO, CO_2, H_2, and Air and one for Purge gas
- A significant advantage of the EATC16*plus* is its four flow meters, which allow automatic switching between oxidising and reducing gases in response to selected test conditions
- EATC16*plus* includes separate gas inlets for CO, CO_2, H_2, N_2 and Air

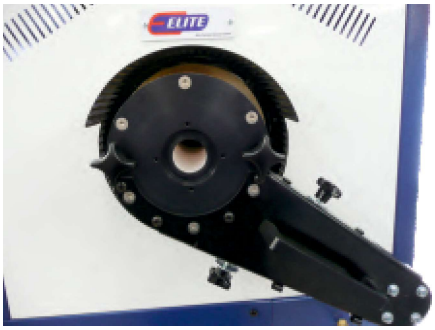
EATC16*plus*

General Specifications	EATC16*plus*	EATC16	EATC16 Manual
Ash Fusibility Determination	Automatic	Automatic	Manual
Fusion Points	IDT (Initial deformation Temperature), ST (Softening/Sphere Temperature), HT (Hemisphere Temperature) & FT (Fluid/Flow Temperature)		
Test Method	ASTM D 1857; ASTM E953; BS ISO 540; BS ISO 21404, CEN/TS 15370-1; CEN/TR 15404:2010. DIN 51730; ISO 540; ISO 21404		
Capable to Analyse	Cube/Cylinder, Pyramids/Cone, Upright cone/Upright Pyramid and Truncated cone/Truncated Pyramid.		
Sample shape identification	Automatic - Cube/Cylinder, Pyramids/Cone, Upright cone/Upright Pyramid and Truncated cone/Truncated Pyramid.		Manual - Cube/Cylinder, Pyramids/Cone, Upright cone/ Upright Pyramid and Truncated cone / Truncated Pyramid.
Analysis atmosphere	Oxidizing Atmosphere/Reducing atmosphere		
Furnace Specifications			
Temperature range	up to 1600°C		
Temperature Ramp Rate	programmable 1°C to 12°C per minute		
Temperature precision	±5°C as per standard test methods at 1064°C (99.98% pure gold wire sample melting point)		
Number of heating elements	6 nos - High temperature resistance type heating elements		
Working tube dimensions	90 x 76 x 675mm		
Material of construction of working tube	High grade RCA Alumina work tube		
Analysis Time	4 hours typical cycle time (depending ramp rate and temperature range)		
Stand by Temperature			
Stand by Temperature	Room Temperature	Room Temperature	815°C
Ventilation			
Ventilation	Forced air ventilation		
Exhaust	Pipe to be vented into a separate fume hood		
CO Monitor (Optional on request)	Integrated CO monitor with auditory alarm, Gas flow shut off on alarm. This is factory installed option. Need to order along with main EATC16 Instrument.		NOT AVAILABLE
Gas requirements			
Gas requirements	Integrated **four gas** flow meters to enable **automatic** switching of the gases based on the selected test conditions, such as oxidation or reduction.	Integrated **two gas** flow meters to enable **automatic** switching of the gases based on the selected test conditions, such as oxidation or reduction.	Integrated **two gas** flow meters for **manual** switching of the gases based on the selected test conditions, such as oxidation or reduction.
		Note: At the time of ordering, the user must specify the required gases for their analysis, choosing either CO_2/H_2 or CO/CO_2 for the reduction mode.	
Electrical requirements			
	380 – 415 V, 50/60 Hz two phase 25 A		
Environmental Conditions			
Operating Condition	15°C to 35°C		
Relative Humidity	20% to 80%, non-condensing.		
EATC16 External Dimensions			
Dimensions- H x W x D in mm	770mm x 660mm x 1010mm	700mm x 505mm x 970mm	700mm x 505mm x 970mm
Weight in kg	Approx. 160kgs	Approx. 95kgs	Approx. 90kgs
PC specifications			
Required PC Specifications	Processor: i3 or i5, RAM: Minimum 4GB, Memory: 512GB HDD or SSD PCI slots: Minimum 1, PCIe slots: Minimum 1, RS 232 Ports: 2 OS: Windows XP or higher		Processor: i3 or i5, RAM: Minimum 4GB, Memory: 512GB HDD or SSD PCIe slots: Minimum 1, RS 232 Ports: 1, OS: Windows XP or higher

Ash Fusion Determinator (High Temperature Model) EATC17

Elite Thermal's Ash Fusion Determinator, EATC17 is the high-temperature floor-mount model, which works similarly to the EATC16*plus*, but for samples which fuse at higher temperatures. A maximum temperature of 1700°C can be achieved using heating elements consisting of molybdenum disilicide. The results obtained are similar for both EATC17 and EATC16*plus* analysers.

EATC17



Front view of camera arm without camera

Camera arrangement

Control panel

Test Standards

Ash Material	Test standard	Reducing Gas	Oxidizing Gas
Coal & Coke Ash	ASTM D 1857	CO-CO_2 Ratio: 60% CO - 40±5 % CO_2, N_2 for purging	Air
Coal & Coke Ash	BS ISO 540	CO-CO_2 Ratio: 55% to 65% CO - 35% to 45% CO_2, N_2 for purging H_2- CO_2 Ratio: 45% to 55% H_2- 45% to 55% CO_2, N_2 for purging	Air or CO_2
Fusibility Of Fuel Ash	DIN 51730	CO-CO_2 Ratio: 55% to 65% CO-35% to 45% CO_2, N_2 for purging H_2- CO_2 Ratio: 45% to 55% H_2- 45% to 55% CO_2, N_2 for purging	Air
RDF Ash	ASTM E953	CO-CO_2 Ratio: 60% CO - 40+/-5 % CO_2, N_2 for purging	Air or O_2 or CO_2
Solid Recovered Fuels	CEN/TR 15404:2010	CO-CO_2 Ratio: 55% to 65% CO - 35% to 45% CO_2, N_2 for purging	Air or CO_2
Solid Biofuels	ISO 21404	CO-CO_2 Ratio: 55% to 65% CO-35% to 45% CO_2, N_2 for purging H_2- CO_2 Ratio: 45% to 55% H_2- 45% to 55% CO_2, N_2 for purging	Air or CO_2

Technical Specifications

Specifications	EATC17
Temperature Range	Up to 1700°C
Temperature Ramp Rate	Programmable up to 12°C/minute
Work Tube dimensions	86 x 76 x 675mm
Heating Elements	High temperature resistance type heating elements - 4 nos
Maximum Sample Load	6 Samples per analysis
Conforms to Standards	ASTM D 1857; ASTM E953; BS ISO 540; BS ISO 21404, CEN/TS 15370-1; CEN/TR 15404:2010. DIN 51730; ISO 540; ISO 21404.
Ash Fusibility Determination	Automatic determination of IDT, ST, HT, FT fusion temperatures
Analysis Time	4 hours typical cycle time (depending ramp rate and temperature range)
Gas Requirements **Purge** **Oxidizing** **Reducing** **Ventilation**	 N_2 (or) CO_2 Air (or) CO_2 (or) O_2 CO + CO_2 or H_2 + CO_2 Forced air ventilation
Gas flow	Integrated two gas flow meters for manual switching of the gases based on the selected test conditions, such as oxidation or reduction. The furnace has three gas connections on the rear of the furnace: Individual ports for CO_2, H_2, and one for Purge gas. **Note:** At the time of ordering, the user must specify the required gases for their analysis, choosing either CO_2/H_2 or CO/CO_2 for the reduction mode.
Exhaust	Pipe to be vented into a separate fume hood
Power supply	380 – 415 V, 50/60 Hz two phase 32A
Environment Conditions **Operating Conditions** **Relative Humidity**	 5°C – 40°C 20% to 80% (Non-Condensating)
Required PC Specifications	Intel core i5 or above, 256GB SSD, 16GB RAM, Windows OS

Multi Tube/Pre Heat Furnace TMTH14

Multi Tube/Pre Heat Furnaces with multiple tubes are versatile, energy-efficient, and especially suitable for baking fluxes and crucibles. The baking process reduces contaminants and improves measurement accuracy and precision.

The baking process is simple and easy to implement and it can effectively remove impurities and moisture adsorbed by crucibles, samples and fluxes during storage, reducing the blank value and stabilizing the measured value, improving accuracy and precision of measurement.

For consistent and reliable results in various analytical applications, the design of TMTH14 series Multi Tube/Pre Heat Furnaces focuses on precise temperature control and uniform heating.

The TMTH14 series Multi Tube/Pre Heat Furnace offers greater efficiency because it allows the operator to burn off crucibles simultaneously in four combustion tubes, which increases productivity up to four times.

Standard Features

Maximum Furnace Temperature: 1400°C

Continuous Operating Temperature: 600°C to 1350°C

- This product is a stylish bench mounted furnace with integral controls mounted in its base, and is fitted with a shelf to store the crucibles
- Faster heating and cooling with high quality and high efficiency insulation
- Equipped with high-quality heating elements designed to achieve fast ramp rates
- Inner diameter of tube is 50mm for crucibles, samples and fluxes baking
- R type thermocouple for precise temperature measurement
- High end microprocessor PID temperature controller
- Easy to use temperature controller clearly displays set temperature or actual temperature
- This furnace design requires four separate work tubes, made from a grade suitable for the maximum temperature rating of 1400°C
- The combustion tubes are designed with both ends open, allowing for easy manual loading of crucibles from the front and unloading from the rear
- Work tubes are not included with the furnace and must be purchased separately, as they are essential accessories
- An independent over-temperature controller is fitted as standard
- Power Supply: 230V - 1 Phase -50Hz with N & E

TMTH14-4

Note: For all multi-tube/pre heat furnaces, Elite Thermal Systems manufactures custom-built solutions. Please contact us with your specific requirements.