

**PROCESS SAFETY
EQUIPMENT –**
Expertise in Explosion & Process Safety



Full Instrument Index

Carius Tube.....	6
Gas Burette.....	7
Minimum Ignition Energy (MIE) Cloud.....	8
Minimum Ignition Temperature (MIT) Cloud.....	9
20 Litre Sphere.....	10
Portable Explosion Kit.....	11
Group A/B Dust Flammability Lab Rig.....	12
Layer Ignition Temperature	13
Burning Rate Apparatus	14
Oxidising Solids Test Apparatus	15
Autoignition Temperature (AIT).....	16
BAM Fallhammer	17
BAM Friction.....	18
Koenen Tube	19
Combined Time Pressure/Oxidising Liquids.....	20
Floor Glove & Footwear Kit.....	21
Liquid Conductivity.....	22
Powder Resistivity.....	23
Protective Clothing Resistivity Test Apparatus.....	24
10kV Power Supply	25
Burning Behaviour	26
Custom Equipment	27
Adiabatic Dewar Calorimeter	28
Hartmann Pressure Tube	29
Aerated Cell / Diffusion Cell.....	30
Basket Test.....	31
Flammable Range	32
Gas Probe Incendivity & Calibration.....	33
Powder Chargeability	34
Self Accelerating Decomposition (SADT)	35
Electric Spark Tester.....	36
Flammability of Gases.....	37
Commissioning & Training	38
Calibration	39

DEKRA Process Safety

The breadth and depth of expertise in process safety makes us globally recognised specialists and trusted advisors. We help our clients to understand and evaluate their risks, and work together to develop pragmatic solutions. Our value-adding and practical approach integrates specialist process safety management, engineering and testing. We seek to educate and grow client competence to provide sustainable performance improvement. Partnering with our clients we combine technical expertise with a passion for life preservation, harm reduction and asset protection. As a part of the world's leading expert organisation DEKRA, we are the global partner for a safe world.

Process Safety Management (PSM) Programmes

- > Design and creation of relevant PSM Programmes
- > Support the implementation, monitoring, and sustainability of PSM Programmes
- > Audit existing PSM Programmes, comparing with best practices around the world
- > Correct and improve deficient Programmes

Process Safety Information/Data (Laboratory Testing)

- > Flammability/combustibility properties of dusts, gases, vapours, mists, and hybrid atmospheres
- > Chemical reaction hazards and chemical process optimisation (reaction and adiabatic calorimetry RC1, ARC, VSP, Dewar)
- > Thermal instability (DSC, DTA, and powder specific tests)
- > Energetic materials, explosives, propellants, pyrotechnics to DOT, UN, etc. protocols
- > Regulatory testing: REACH, UN, CLP, ADR, OSHA, DOT
- > Electrostatic testing for powders, liquids, process equipment, liners, shoes, FIBCs

Specialist Consulting (Technical/Engineering)

- > Dust, gas, and vapour flash fire and explosion hazards
- > Electrostatic hazards, problems, and applications
- > Reactive chemical, self-heating, and thermal instability hazards
- > Hazardous area classification
- > Mechanical equipment ignition risk assessment
- > Transport & classification of dangerous goods

We have offices throughout North America, Europe, and Asia.

For more information, visit www.dekra-process-safety.co.uk

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- > Circuit Board Manufacture
- > Universities
- > Research Institutes
- > Quality Assurance
- > Defence
- > Petrochemical & Refining

Compliance with Technical Standards*

CTL Code	Instruments No. Description	Pg No.	US	International	EU	UK	Other
04	MIE Cloud	8	ASTM E2019	ISO/IEC 80079-20-2			
05	MIT Cloud	9	ASTM E1491	ISO/IEC 80079-20-2	EN 50281-2-1		
06	20 Litre Sphere	10	ASTM E1226		EN 14034 -Part 1 & 4 & Part 2 & 3		
15	Layer Ignition Temperature	13	ASTM E2021	ISO/IEC 80079-20-2	EN 5028-2-1		
16	Flammability of Solids	14		UN Test N1	A10		
17	Oxidising Solids	15		UN Test O1	A17		
19	AIT Apparatus	16	ASTM E659		A15		DIN 51794
22	BAM Fallhammer	17		UN Test 3(a)(ii)	A14		
23	BAM Friction Test	18		UN Test 3(b)(i)	A14		
24	Koenen Test	19		UN Test 1(b);2(b)	A14		
25	Time Pressure Oxidising Liquids Test	20		UN Test 1(c) (i);2(c)(i) UN Test O.2	A21		
26	Floor Glove & Footwear Kit	21		IEC 61340-4-5		BS EN 60079- 32-2	PD CLC/TR 60079-32-1
27	Liquid Conductivity	22		IEC 60079-32-2		BS5958	
29	Surface Resistivity	24			EN 1149		

CTL01 - 10 g Screening Tool (Carius Tube)

An instrument for thermal instability and pressure rate screening to search for exothermic activity and gas generation of powders and liquids

Functional Specification and Deliverables

- > Carius oven - 110 - 240 V a.c / 1 kW oven
- > Temperature controller and oven range 0 - 400 °C (ramp typical 0.5 °C)
- > Temperature accuracy within + / - 1 °C
- > Pressure range 0 - 100 barg. ¼" transducer connected via 1/16" oil filled pressure link
- > Pressure accuracy within + / - 0.1 barg from 0 - 50 barg and within + / - 0.2 barg above 50 barg
- > Data logging – slow log rate – every 30 sec, fast log rate – every 0.1 sec standard
- > Carius system program and driver discs
- > Miscellaneous cables
- > Set of Carius glass tubes and miscellaneous fittings supplied as standard
- > Traceable calibration for master equipment to national/UKAS standards
- > Tested with known calibration sample prior to delivery

Optional Extras

- > Higher speed data acquisition measurement options available in order to explore the pressure effects of more energetic materials
- > Spare pressure transducers, temperature sensors, 10 g glass Carius tubes and other accessories available
- > PC with software pre-installed
- > Training

Benefits:

- > Larger 10 g or 15 ml test sample size makes it easier to test a representative multiphase sample compared to other thermal instability measurement techniques
- > The **Carius Tube** can be re-configured to enable sample addition during the duration of the test
- > Enables permanent measurement of pressure and temperature to determine whether tube pressure is due to vapour pressure or permanent gas generation
- > Useful preliminary screening technique prior to conducting large scale Adiabatic Dewar Calorimeter testing



10 g Screening Tool

CTL03 - Gas Burette System

An instrument for laboratory quantification of gas evolution rates from chemical processes and decompositions

The principle of the apparatus is very simple. Gas generated by a process displaces the fluid in the U-Tube and causes a pressure increase (directly equivalent to the volume of gas evolved). The pressure increase (measured as the head of a column of liquid in the U-Tube) is recorded by a sensitive transducer mounted on the side of the U-Tube. Once the pressure reaches a pre-determined limit selected and calibrated by the operator, a solenoid valve opens and relieves the pressure by venting the gases. The pressure measured by the transducer, and the number of times the solenoid valve has activated, are recorded by link-up to a data acquisition system thus enabling the total gas evolved from the process to be calculated.

Functional Specification and Deliverables

- > Mains supply: 110 - 120 - or 220-240 V a.c / 2 Amp
- > Accurate data up to approximately $5 \text{ cm}^3 \cdot \text{s}^{-1}$
- > Analogue count output and analogue pressure output (1 V or 10 V full scale selectable)
- > Supplied with electronic control unit, mounting back-board, Gas Burette U-Tube, solenoid outlet valve plus a spare outlet valve, pressure transducer, silicon oil, glass accessories, miscellaneous tubing and cables, 100 ml glass calibration syringe
- > 1 x instruction manual

Benefits:

- > Permits laboratory quantification of gas evolution rates from chemical processes
- > Simple to use
- > May be connected to a Mettler RC1 set-up or to any other data acquisition system
- > Volumetric measurement does not require composition of gas to be known
- > Suitable for a wide range of hazardous gases with inert construction materials

Optional Extras

- > Additional glassware to enable Test A12 Flammability of Solids – contact with water testing to be performed
- > Miscellaneous sundries
- > Data acquisition card and software for logging gas data
- > Training



Gas Burette apparatus

CTL04 - MIE Cloud Apparatus (MIE III)

Determines the smallest quantity of energy, as a capacitive or inductive spark discharge, required to ignite a powder dust cloud. Resulting data can be used to assess risks in processing and handling industrial powders.

Functional Specification and Deliverables

- > Mains Supply - 110 - 240 V a.c / 3 A
- > Energy Range: 4 mJ – 2000 mJ (trickle charge method)
- > 29 device capacitance bank (energy selection increments of 1 mJ)
- > 0 - 15 kV adjustable high voltage power supply
- > Arc gap breakdown voltage monitoring unit utilising JCI 140 internal proximity voltmeter
- > New high voltage digital meter (to 3 decimal places) for accurately setting up the breakdown voltage during testing
- > Dust / air dispersion unit with set of acrylic Hartmann tubes with adjustable air regulator facility and rear external air inlet connection
- > 1 x instruction manual
- > 1 x set of accessories

Benefits:

- > Voltage and capacitance can be controlled in fine increments
- > Arc gaps can be manually adjusted for researching alternative gaps being more conducive to ignition
- > Delivers results to ASTM E2019 and ISO/IEC 80079-20-2 and EN standards
- > Wide range of available accessories

The Following Options Available at an Additional Cost

- > JCI 140 / JCI 148 Voltmeter – for self-checking calibration of high voltage output with the knowledge and confidence that the voltmeter has no detrimental loading effects on the output voltage (accuracy + / - 2%)
- > Chart Recorder
- > Laptop with voltage transient analysis data card and software pre-installed (research tool)

Optional Extras

- > Glass or acrylic Hartmann tubes and electrode spares, other dispersion base spares etc
- > Hot coil tube with hot coil and independent power source for screening powders, that are intended for processing above 110 degC on plant, for thermal sensitivity when dispersed in the form of a dust cloud through a hot ignition source (hot coil temp ca 1000 deg C). Samples with positive results can then be tested within CTL05 MIT Cloud apparatus (page 7)
- > Training



MIE Cloud Apparatus (MIE III)

CTL05 - MIT Cloud Apparatus

Measures the lowest temperature at which ignition takes place when a powder product is dispersed in heated air.

The **MIT Cloud Apparatus** provides an objective way to measure the susceptibility of a dust cloud to auto ignition in a heated environment (e.g. with plant processing temperatures above 110 °C). When most powders are dispersed in heated air, spontaneous combustion will take place provided the air temperature is high enough.

The Minimum Ignition Temperature (MIT) test measures the lowest temperature at which such ignition will take place.

Functional Specification and Deliverables

- > Mains supply: 100 - 120 V or 220 - 240 V inlet / 100-120 V/ 10A output to furnace operation
- > 1 kW furnace heating from ambient to 1000 °C via temperature control unit
- > Supplied with spare glass sealing gaskets and observation glasses, set of thermo couples, new integral control unit complete with furnace temperature controller and inlet pressure meter
- > 1 x instruction manual

Optional Extras

- > Spare observation glasses, gaskets, thermocouples
- > Training

Benefits:

- > Simple to use
- > New robust design
- > New control unit displaying on-board temperature of both centre tube thermocouples as well as inlet pressure
- > New 1/4" bsp inlet pressure transducer connection
- > Complies with technical standards: (ISO/IEC 80079-20-2 , EN 50281-2-1 & ASTM E1491-06)
- > MIT data finds application in the specification of electrical equipment for use in the presence of combustible dusts and also has some application in the specification of safe drying temperature (above 110 °C) on process plant



MIT Cloud Apparatus

CTL06 - 20 Litre Sphere Test Apparatus

Determines the explosion severity (maximum pressure and speed of explosion) of a dust cloud under specified test conditions.

The **20 litre sphere test apparatus** is used to determine the explosion severity (maximum pressure and speed of the explosion) of a dust cloud under specified test conditions.

The dust is dispersed in the 20 litre explosion chamber by injecting it from a dust container pressurised with air at 20 bar. By pre-evacuating the explosion chamber, the ignition is initiated by very powerful chemical ignitors (2 x 5 kJ chemical ignitors), at atmospheric pressure. The delay time is the period between start of

dispersion and ignition and is chosen to obtain results consistent with the standard 1 m³ vessel.

The pressure-time history is measured and, for each test, the maximum explosion pressure (P_m) and maximum rate of pressure rise ((dP / dt)_m) are established and recorded to a PC.

The resulting data is normalised to a 1 m³ vessel. The test is conducted according to BS EN14034 parts 1, 2 & 3 & ASTM E1226.

Functional Specification and Deliverables

- > Mains supply: 110 - 240 V a.c selectable operation
- > 20 litre sphere for dust explosion testing
- > Data control unit – interfaces with measurement piezoelectric sensors via charge amplifiers and sends pressure and control data to / from PC (PC not supplied)
- > Ignitor initiation unit – sends ignite signal to chemical ignitors and also filters the air and contains air inlet lines.
- > 20L Sphere
- > Set of spare parts
- > 1 x instruction manual

Note: customers outside the UK will, for transport logistics reasons, have to source their own chemical ignitors. Details available on request.

The Following Is Available at an Additional Cost

- > PC with 20 litre software pre-loaded

Optional Extras

- > Vacuum pump
- > Ignitor storage safe
- > Full commissioning and training package in safety operational aspects and use of 20 litre apparatus (bottom valve overhaul procedure covered)
- > LOC control unit and 20 litre mods to accommodate this unit

Benefits:

- > Data applicable for explosion vent sizing, suppression & containment design
- > Compact size compared to testing with 1 m³ sphere and uses less sample
- > Allows accurate vent sizing calculations for full scale plant
- > Easy to use
- > Automated ignition and data acquisition system
- > Optional accessories eg. seals, simple partial pressure method of controlling via Limiting Oxygen Concentration control unit and optional full commissioning and training package also available from DEKRA Process Safety



20 Litre Sphere Test Apparatus with optional lifting gear shown

CTL07 - Portable Explosion Kit

A portable kit demonstrating the hazards that even a small quantity of powder product can pose when dispersed in the form of a dust cloud through an electrostatic spark discharge ignition source

There is no better way than a live demonstration to raise awareness of dust explosion hazards. The DEKRA Process Safety portable **dust explosion demonstration kit** gives the audience an insight into the hazards that even the smallest quantity of powder product can pose when dispersed in the form of a dust cloud through an electrostatic spark discharge ignition source. The kit is supplied with all accessories in a compact, ready to use, robust case.

Typically icing sugar or custard powder may be used for demonstration purposes. However, other products, for example metal powders and photo copier toner, may also be tested (optional glass tube recommended for ease of cleaning in those cases).

Functional Specification and Deliverables

- > Powder dispersion unit with acrylic Hartmann tube
- > Mains supply: 110 - 120 V a.c / 220 - 240 V a.c – 200 W
- > 8.5 kV / 0.25 mA constant arc internal ignition source
- > Hand-held control handset for arc activation and air dispersion
- > Double action hand pump for pre-charging the internal air reservoir
- > Rupture paper disc set
- > Air line
- > Electrodes
- > Built in air regulator – typical default setting 4 barg
- > Lightweight at just 15 kg and packed into robust case
- > 1 x instruction manual

Optional Extras

- > Glass tube
- > Polycarbonate protective screen
- > Spare electrodes
- > Spare rupture discs
- > Training

Benefits:

- > Impressive visual and audio demonstration of the hazards presented by dust clouds when subjected to an ignition source
- > Allows employers / teachers to simply demonstrate to employees, students and co-workers the dangers that even the smallest quantities of some powders can pose when exposed to, or in the vicinity of, an electrostatic ignition source
- > Compact - all standard accessories pack neatly away in the same case
- > Portable, robust case design facilitates easy transportation



CTL08 - Group A/B Flammability Screening Apparatus

Determines whether a dust is capable of explosion when dispersed as a cloud and exposed to an ignition source

For the **Group A/B Classification** of a dust cloud of powder product, this method requires a constant arc to be produced through the test sample. An ignition is an observation of flame propagation away from the ignition source. If at any time during the procedure an ignition is observed then the test is complete and the dust is classed as Group A Flammable.

Note that a Group B classification does not imply that the dust cannot be involved in a fire or show exothermic behaviour (self-heating). Other tests must be performed to establish this.

Functional Specification and Deliverables

- > Mains supply: 110 - 240 V a.c / 3 A
- > Dust / air dispersion base complete with steel mushroom for dust cloud optimisation - typically 7 barg service air required
- > 1 litre acrylic Hartmann tube (can be cleaned with warm soapy water and dried)
- > Tube rupture papers (for top tube closure)
- > Brass electrodes for creating arc
- > Constant arc power source
- > Remote handset (arc and air activation)
- > 1 x instruction manual

Optional Extras

- > 1 litre glass hot coil tube and power source for screening of products that are to be processed on full scale plant above 110 °C (comes complete with power source, hot coil holder and wire)

Note: if a result is positive then full testing can be carried out in the MIT Cloud Apparatus CTL04 (see page 9).

- > Spare electrodes
- > Spare rupture discs
- > Other accessories available

Benefits:

- > Screens for ignition sensitivity to electrostatic spark discharge and / or ignition sensitivity to exposure to a 1000 °C heat source (see options) to represent those ignition sources most commonly encountered in industry
- > Hot coil is relevant for any product processing above 110 °C
- > Small and compact
- > Extremely easy to use
- > Air supply can either be from a standard service air pressure within a laboratory environment or an air cylinder



Group AB Flammability Screening Laboratory Rig

CTL15 - Layer Ignition Temperature Apparatus

Determines the minimum ignition temperature for a given thickness of powder deposited on a hot surface.

The **Layer ignition temperature test apparatus** permits the determination of the minimum ignition temperature of a given thickness of powder deposited on a hot surface. The method is used for the specification of the 'T' temperature rating of electrical equipment for use in hazardous areas (dusty atmospheres). It is also relevant to other industrial equipment where dust is present on hot surfaces in thin layers exposed to the atmosphere and is manufactured in accordance with IEC 61241-2, EN 50281-2-1 & ISO/IEC 80079-20-2..

Functional Specification and Deliverables

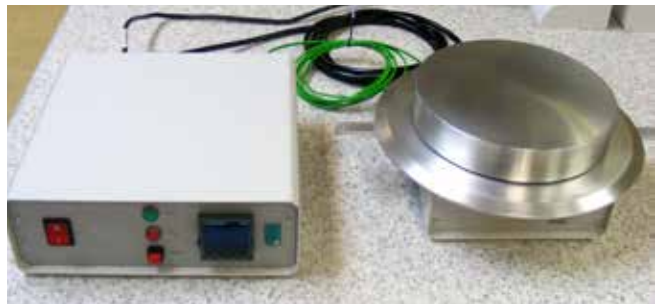
- > Layer Ignition Hotplate (1250 W / 6 A, 220 - 240 V (100 - 120 V via transformer option)) single-phase. Temperature range = 0 - 400 °C (500°C max ASTM standard)
- > Remote controller unit (incorporates PID temperature control). Sample may be ramped in temperature or held isothermally.
- > K-type thermocouple and extension cable for both hotplate and sample
- > 5 mm, 12.5 mm, 15 mm sample retaining rings supplied (100 mm diameter)
- > Data acquisition hardware and software
- > 1 x instruction manual

Optional Extras

- > 200 µm sieve and catchment tray with lid
- > Spare sample retaining rings (rings of any height may be fabricated for you)
- > Spare thermocouples
- > PC and LCD monitor with LIT test software pre-installed
- > Calibration services
- > Training services in Layer Ignition Temperature testing
- > Custom data acquisition for multiple hotplates

Benefits:

- > Designed for testing to ISO/IEC 80079-20-2, EN 50281-2-1 & ASTM E2021 for specifying the maximum surface temperature of electrical and non-electrical equipment
- > Tests can be performed on a range of samples including 5, 12.5 or 15 mm depths (other depths available optionally)
- > Data recording
- > Compact in size
- > Novel sloping edge shield design located under the hotplate surface to permit expanding samples to run down into a drip tray located under the hot-plate unit (drip tray not supplied as standard)



Layer Ignition test apparatus

CTL16 - Flammability of Solids - Burning Rate Apparatus (UN) & European Journal (Physical Properties - A Test Series)

Permits testing to the following standards: Flammability of Solids (Test A10), Oxidising Solids (Test A17) and UN Transport of Dangerous Goods Test N1 (for discovering whether the product under test is to be classified into Division 4.1 and determine which packing group the product falls into under UN regulations) – using the Fire Train / mould equipment and accessories

The **Flammability of Solids (Burning Rate)** apparatus is manufactured in accordance with the “Classification, Packaging and Labelling in the EU – testing methods” publication, test A10 (Flammability of Solids) and also with EU test A17 (oxidising solids) and UN Transport of Dangerous Goods Division 4.1 (burning rate) tests. The test serves to characterise the hazards (if any) arising from materials subjected to given stimuli. The Fire Train Test, for readily combustible solids, checks the ability of a substance to propagate combustion by igniting it and determining the burning time across a given length of that material.

As well as acting as a regulatory test, the Fire Train Test result has uses in process safety in the assessment of fire risk with powders and in helping to predict the consequences of dust fires and explosions. If testing to test A17 then please purchase optional powder cone (see options).

Functional Specification and Deliverables

- > Fire Train forming mould with anodised aluminium 90° Vee groove former, support cradle, base plate and brass holding clamps
- > Test Plate: impervious, non-combustible and low thermal conductivity quartz test plate
- > An ignition source is required but is not supplied due to the documentation and certification required to ship a gas cylinder overseas. A small portable hand held butane or propane cylinder with a nozzle diameter of greater than 5mm is all that is required
- > Metric rule for measuring Fire Train distances High grade non-rusting steel rule marked in millimetres complete with UKAS calibration certificate
- > Laboratory stopwatch for timing combustion and linear burning intervals
- > 1 x instruction manual

Benefits:

- > Designed for testing to EU and UN standards
- > Anodised finish means that corrosive samples do not harm the fire train mould
- > Compact size
- > Easy to use

Optional Extras

- > Additional fire train moulds, quartz test plates, sundries
- > A small conical sample chamber for forming a powder pile (3.5 cm dia x 2.5 cm height) is available at additional cost to enable preliminary oxidiser screening of samples (Test A17 only)

Note: Preliminary screening of samples is a requirement of test A17 and is performed in the interest of safety to establish whether the solid sample has oxidising properties. If it does then no further testing is required. However, if it does not have oxidising properties then the full fire train test is then carried out.



Test Apparatus: Powder 250 mm long train flame transiting length of the sample. The Fire Train mould prepares sample pile in a V-line for the burning rate test

CTL17 Oxidising Solids Test Apparatus

Tests the potential for burning rates and intensity to increase when two solids are mixed together

The **Oxidising Solids Test Apparatus** is designed to test for the potential of a solid substance to increase the burning rate, or burning intensity, of a combustible substance when the two are thoroughly mixed. The test is to the UN Transport of Dangerous Goods Manual of Tests and Criteria (Test 0.1) and is used to establish whether a product is an oxidizer of division 5.1 or not and, if so, whether it falls into packing group I, II or III.

Benefits:

- > Tests to the United Nations Transport of Dangerous Goods Manual of Tests & Criteria (Test 0.1)
- > Compact size
- > Nickel Chromium wire easily changed
- > Simple to use

Functional Specification and Deliverables

- > Mains supply: 220 - 240 V or 120V mains inlet / 12 V d.c output 150 W hot coil power source
- > 1 x glass conical sample loading chamber (glass blown with 60° angle for optimal powder cone forming as per test standard requirements)
- > 1 x insulated quartz plate
- > 1 x roll 100 m NiCr wire (0.5 mm diameter)
- > 1 x stop watch
- > 1 x instruction manual

Optional Extras

- > Spare nickel chromium wire
- > Quartz plates
- > Glass sample loading chambers



Oxidising Solids Test Apparatus

CTL19 Auto Ignition Test Apparatus (AIT)

Determines hot and cool flame ignition temperatures in chemical liquids and solids

The **Auto Ignition Temperature Test** is performed to enable determination of hot and cool flame auto ignition temperatures of a liquid chemical (and solid chemicals*) in air at atmospheric pressure in a uniformly heated vessel.

Auto Ignition is defined as the ignition of a material commonly in air as the result of heat liberation due to an exothermic oxidation reaction in the absence of an external ignition source such as a spark or flame.

The following standards (each with slight differences) are applicable to the test:

- > ASTM E659
- > EC test A15
- > DIN 51794
- > Other configurations

* Within certain limitations, the test can also be used to determine the auto ignition of solid chemicals which readily melt and vaporise at temperatures below the test temperature.

Benefits:

- > Simple to set up and operate
- > Compact size

Optional Extras

- > PC and LCD monitor (recommended). Client to specify required operating system requirements if any (default Windows 10)
- > Spare vessels for ASTM (round bottom) or DIN (conical)
- > Spare syringes
- > Spare thermocouples
- > Spare oven insulation
- > Training services
- > Also available. A fan assisted model of the AIT apparatus capable of 650 °C with fast flask changing capability via a new novel flask holder design.

Functional Specification and Deliverables

The ASTM Method spec is covered here. For DIN standard apparatus deliverables please contact us.

- > Mains supply: 220 - 240 V 50 Hz single phase furnace
- > 150 - 650 °C PID temperature control (standard operating range)
- > Capable of controlling the flask temperature within + / - 1 °C up to 350 °C and + / - 2 °C from 350 °C to 650 °C
- > Temperature uniformity is better than + / - 4 °C measured on the outside of an aluminium clad flask at three positions
- > 10 x round bottom borosilicate flasks
- > Data acquisition hardware and AIT software supplied
- > Supplied with vapour temperature thermocouple, spare thermocouple and sample injection syringe set
- > Pre-calibrated
- > 1 x instruction manual



Auto Ignition Test Apparatus

CTL22 BAM Fallhammer Test Apparatus

For determining the sensitivity of powders to impact stimuli for assessing transport, packaging and regulatory classification (UN, EC and EMTAP)

Some powders are deliberately manufactured with highly energetic behaviour, but occasionally it is an unexpected property of a new material. For regulatory compliance there are a number of screening tests which have to be performed on new materials in order that they can be safely transported. One such screening is a **BAM Fallhammer test**, which measures sensitivity to mechanical force and enables testing to UN & EU Regulations.

Functional Specification and Deliverables

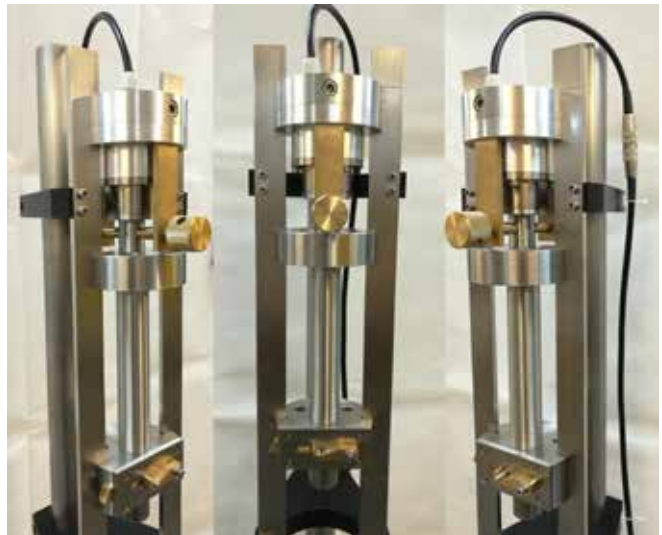
- > A solid cast steel base block
- > Main 100 mm diameter anvil
- > A centring ring for locating the intermediate anvil on the main anvil
- > 2 x Intermediate 26 mm diameter anvils
- > 2 x locating rings with orifices for gas release
- > 200 steel cylinders (roller bearings)
- > 50 rubber 'o'rings for steel cylinders (liquid testing only)
- > 100 steel collars for steel cylinders locating
- > An upper to lower cylinder distance gauge for 1 - 2 mm sample gap setting required for liquids
- > A central column with guides (graduated scale) ready set for correct height
- > A 1 kg drop weight carrier assembly
- > A 1 kg weight already fitted to 1 kg drop weight assembly for a 2 kg overall weight
- > A 5 kg drop weight carrier assembly
- > A 5 kg weight already fitted to 5 kg drop weight assembly for 10 kg overall weight
- > A drop weight electromagnetic release device
- > An electromagnetic power supply distribution box together with electromagnet 24V supply cable, 100 - 120 V / 220 - 240 V mains inlet supply cable and remote handset for weight release (power ON = drop, power OFF = hold)
- > Electromagnet safety pin
- > A 40 mm³ sample loading spatula
- > A polycarbonate protective shield
- > 1 x instruction manual

Benefits:

- > Excellent for screening products for sensitivity to impact stimuli in order to determine whether a substance is an impact sensitive explosive
- > Excellent screening tool for classifying a product for transport and EU packaging and labelling classification
- > Simple to use electromagnetic drop weight release mechanism
- > Robust design

Optional Extras

- > Zone 22 certified power supply control equipment for electromagnet drop mechanism
- > Additional sets of BAM Fallhammer collars and rollers
- > Bespoke custom weights or other requirements may be possible (please enquire)
- > Training



BAM Fallhammer Apparatus

CTL23 BAM Friction Test Apparatus

Measures a substance's susceptibility to friction from sliding or rubbing contact for transport, packaging and regulatory classification (UN, EC and EMTAP)

Some powders are deliberately manufactured with highly energetic behaviour, but occasionally it is an unexpected property of a new material. For regulatory compliance there are a number of screening tests which have to be performed on new materials so they can safely be transported. One such screening is the **BAM Friction test**, which measures sensitivity to sliding (rubbing) contact and permits determination of whether the substance is too dangerous to transport in the form tested, or to classify in terms of its explosivity and labelling etc.

This apparatus is defined in the United Nations Handbook "Recommendations on the Transport of Dangerous Goods – Manual of Tests and Criteria" and also in the European Commission Handbook "Classification, Packaging and Labelling of Dangerous Substances in the European Union Part 2 – Testing Methods". This apparatus also appears in the Defence Ordnance Safety Group, Energetic Materials Testing and Safety Policy Committee Manual of Tests Vol.1 Test 43 A (EMTAP).

Benefits:

- > Excellent for screening products for sensitivity to sliding/rubbing stimuli in order to determine whether a substance is a friction sensitive explosive
- > Excellent screening tool for classifying a product for transport and EU packaging and labelling classification
- > Simple to use hook on weight location method
- > Robust design

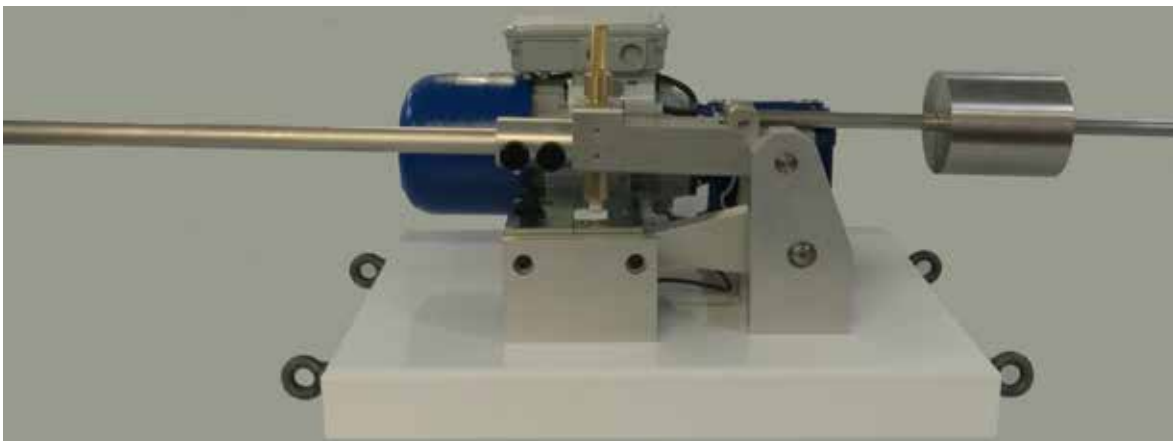
Functional Specification and Deliverables

The apparatus and accessories supplied are as follows:

- > 1 x Friction Tester assembly complete with base plate, cam assembly with sliding carriage, motor drive (220 / 240 V / 50 Hz or 100 / 120 V / 60 Hz), peg locating device, counterbalance arm and operating switch box
- > 1 x loading arm with weight location positions (hook supplied)
- > 1 set (400 pce) porcelain pegs
- > 1 set (100 pce) porcelain plates
- > 9 x load weights with eyes (to cover 5 - 360 N load range)
- > 1 x counterbalance weight
- > 1 x instruction manual
- > 1 set calibration graphs for load weight locations
- > All apparatus supplied by DEKRA Process Safety is provided with a warranty (excluding consumables)

Optional Extras

- > Other load weights available at extra cost
- > Additional sets of porcelain pegs and plates



BAM Friction Apparatus

CTL24 Koenen Tube Test Apparatus

Determines the effects of heating under confinement of potentially explosive materials.

The identification of potentially explosive or high rate decomposing properties in a material is a pre-requisite for safe handling. Any material which contains groups of known explosive properties (eg. nitro-, peroxide, azide etc.) should be tested and examined to identify the reaction of the material to various forms of explosion initiation, namely: impact, friction and thermal initiation, the latter is provided by testing with the **Koenen tube apparatus**.

This apparatus is used to determine the effect of heating under confinement on potentially explosive materials. The material under test (liquid, solid or paste) is placed within a steel tube fitted with a standard diameter orifice at one end. The tube is exposed to direct flame heating. The condition of the tube after the test provides an indication of the sensitivity of the material to heating under confinement. The apparatus is manufactured in accordance with the United Nations Transport of Dangerous Goods, Manual of Tests & Criteria and for EC regulatory classification (A.14).



Koenen Test Apparatus

Functional Specification and Deliverables

- > The apparatus and accessories supplied are as follows:
- > Support frame with 4 burners and solenoid valve (Propane Gas inlet)
- > Complete set of Orifice plates comprising of the following sizes: 1, 1.5, 2, 2.5, 3, 3.5, 4, 5, 6, 8, 10, 12, 14, 16, 18 & 20 mm
- > Collar assembly including 2 sizes
- > 100 disposable Koenen tube shells
- > Length of gas inlet hose
- > Remote handset for gas inlet valve and ignitor activation
- > 4 x electrical ignitors fitted and 8 x spares
- > Koenen tube support rod spares x 2
- > Spare Teclu burner set (4 total)
- > 1 x 1 mm diameter k-type thermocouple + thermocouple extension cable
- > Stopwatch

Optional Extras

- > Spare thermocouple, burners, ignitors, orifice plates and collars, Koenen tubes
- > A tamping device, to assist with packing down the material inside the Koenen tube with a known 80 Newton force (ref: UN Manual) is also available

Benefits:

- > Excellent for screening products for sensitivity to heating under confinement to determine whether a substance may have explosive properties
- > Excellent screening tool for classifying a product for transport and EU Packaging & Labelling Classification
- > Remote burner ignition system
- > Robust design

CTL25 Combined Time - Pressure/ Oxidising Liquids Test Apparatus

Examines the ability of a substance to propagate a deflagration, as well as the oxidising potential of a liquid to increase the burning rate of a combustible substance when the two are mixed. For **UN and EMTAP classification** of explosives.

The Time / Pressure apparatus is designed to examine the effect of an ignition on substances under confinement and in particular, the possibility that ignition might lead to a deflagration with explosive violence at pressures which can be attained with substances in normal commercial packages. The testing is conducted according to the UN Transport of Dangerous Goods Recommendations Manual of Tests and Criteria Test 1 (c) (i), Test 2 (c) (i) or Test C.1 and also to the EMTAP Manual of Tests Volume 1. Testing of Oxidising properties is also possible using the newly supplied integral control unit and software package to UN/EC test standards.

Benefits:

- > Simple to use
- > Automated ignition / monitoring set-up
- > Test software / hardware: graphical display showing time vs pressure trace
- > High speed logging of raw data



Time / Pressure Test Apparatus



Functional Specification and Deliverables

- > Time Pressure / Oxidising Liquids Control Unit with remote handset push button initiation of ignition following commencement of logging of data. Complete with changeover switch to enable either time pressure testing or oxidising liquids testing to be undertaken
- > Time Pressure Vessel and Stand
- > Pressure Transducer (0-25 barg / 0-362.5 psig)
- > Ignitor output cable
- > USB Data communication cables
- > Torque Spanner for vessel end cap maintenance
- > Vessel and end cap maintenance stands
- > 1 x set aluminium burst discs (100 pcs)
- > 1 x set lead washers (200 pcs)
- > Time Pressure / Oxidising Liquids documentation
- > Time Pressure / Oxidising Liquids test program

Optional Extras

- > Spare burst discs
- > Spare lead washers
- > Spare pressure transducer
- > PC with LCD monitor (recommended)
- > Oxidising liquids Nickel Chromium wire for hot coil ignition source*

*Note: Due to transport restrictions, primed cambric or fuse heads are not supplied as standard. These are used in conjunction with each other to form the ignition source for time pressure testing. These components must therefore be sourced locally by the customer.

CTL26 Floor Glove & Footwear Kit

For testing flooring resistance and personnel glove and footwear resistance.

Suitable for testing flooring resistance and personnel glove and footwear resistance, the DEKRA Process Safety **Floor, Glove & Footwear Test Kit** enables portable testing to follow BS5958 guidelines, IEC 60079-32-1:2015 and IEC 61340-4-5.

Flooring material and associated coatings can contribute to a build-up of electrostatic charge as a result of the motion of people, trolleys, pallet and packaging lifting devices and general furniture; for example workbenches, chairs etc. Abrupt discharge of the static charges can cause discomfort to personnel and, in extreme cases, ignition of process products if the ignition energy of the electrostatic spark discharge is above the minimum ignition energy of the product. It is possible, in such cases for products, when present in the atmosphere in the form of a dust layer or dust cloud, to ignite.

Other areas where electrostatic build-up is of concern is electronic equipment where it is possible for malfunctions to arise due to electrostatic spark discharge. It is clear that not only is flooring resistance important, but also the resistance of personnel - particularly with respect to gloves and footwear as well as garments being worn.

Benefits:

- > Compact kit within a portable hard carry case
- > Simple to use
- > Optional additional accessories available for a variety of on-site safety assessments including JCI 140 static monitor

Functional Specification and Deliverables

- > Resistance meter – Maximum range > 200 GΩ (Calibration Certificate supplied)
- > Brass hand electrode with pre-fitted 10 KΩ safety resistor installed, 25 mm diameter x 160 mm
- > 2 x stainless floor electrodes with conductive rubber pads each 63.5 mm dia x 105 mm = 2.5 Kg
- > Integral Aluminium floor plate with fixed PTFE backing sheet
- > 1 GΩ calibration check resistor
- > 5 metre earth lead
- > Miscellaneous other leads (for resistance meter)
- > Instruction manual

Optional Extras

- > JCI 140 portable static proximity voltmeter (0 - 20 kV Accuracy + / - 2 % no drift). Measures surface voltage without contact with the target.
- > Humidity meter (with temperature read-out) – typically within RH + / - 5 % and temp + / - 0.5 °C (important because resistivity properties are known to change with varying humidity)
- > JCI 148 which, when combined with a JCI 140 meter, can measure accurately the voltage on a body or conductor to 20kV directly without experiencing detrimental loading effects due to the JCI 148's very high input impedance properties (ask for a datasheet on the JCI 140/JCI 148 if these products are of interest)
- > Ohm square surface resistivity test cell (can be used in conjunction with the supplied resistance meter if desired)
- > Additional sets of leads
- > Other resistor values for instrument checking available
- > Calibration services
- > Custom floor electrodes to other standards not listed here
- > Additional cut outs may be incorporated into case supplied (where possible) to cater for individual needs).

Floor, Glove and Footwear Test Kit (static measuring options available)



CTL27 Liquid Conductivity Test Apparatus

For accurate measurement of the conductivity / resistivity of liquids and other applications.

The **liquid conductivity test apparatus** is used to assess a liquid's conductive properties by measuring the current flowing through the material when a known 10 V is applied across it with reference to ground. A heptane reference sample is used to check the equipment prior to conducting a test on liquid sample with no known conductivity data. The equipment permits testing in general accordance with BS5958. The test cell also complies to IEC 60079-32-2.

Benefits:

- > Simple to use
- > Simple assembly / disassembly of test cell. This is especially important since cleaning of the test cell regularly between test samples is essential when performing liquid conductivity tests
- > Close interference fit machined surfaces for excellent sealing when testing liquids



Liquid Conductivity Test Apparatus

Functional Specification and Deliverables

- > 10 V d.c power supply (resolution 0.1 V, accuracy + / - 2 %)
- > Picoammeter (2 nA to 20 mA ranges) – 2 nA range has 10 fA resolution + / - 400 fA. Noise 20 fA. Instrument calibration certificate supplied
- > Custom manufactured liquid conductivity test cell
- > Miscellaneous cables
- > Instruction manual

The Following Is Available at an Additional Cost

- > The JCI 155v6 Charge Decay Analyser together with a JCI 173 liquid sample support insert for testing charge decay time of liquids may also prove to be beneficial when performing R&D into various liquid properties or for assessing electrostatic risks with processing and handling the product.
- > Alternative measuring meters may also be specified to meet customers individual requirements

CTL28 Powder Resistivity Test Apparatus

For measurement of conductivity / resistivity of powder samples to enable identification of highly insulating powders which may create electrostatic ignition risks.

Powders will nearly always acquire electrostatic charge during processing, the level of charge being largely determined by the violence of the process. BS5958 gives ranges of charge levels which might be expected from different processes.

Whether or not these charge levels prove to be a problem, or indeed whether they can be observed at all, depends largely upon the rate at which the charge is dissipated, particularly from the bulked powder. If the bulked powder is ohmic (that is, electric current through the powder is directly proportional to applied voltage for all voltages), an indication of the severity of electrostatic problems to be expected can be obtained by measuring the resistivity of the powder. Please also refer to details of our JCI 155v6 charge decay time analyser (see: DEKRA Process Safety's range of other Electrostatic Measuring Instruments) which is the best measuring equipment for monitoring charge decays of products that have non-exponential, as well as those that have exponential, charge decay times. The powder charge decay times (time to $1/e$) of many powder products are non-exponential in nature and therefore it is important to appreciate both powder resistivity and charge decay data in conjunction when considering electrostatic risks or when applying the data to develop new products and processes associated with those products

Functional Specification and Deliverables

- > Custom manufactured power supply with 500 V, 1 kV, 2 kV, 3 kV (fixed settings) and 0 - 10 kV (adjustable settings for other uses requiring higher voltages)
- > Accuracy +/- 1 V on 500 V range, +/- 10 V (all other fixed settings), within +/- 100 V with 10k V applied on the 0 - 10 kV adjustable range. Maximum current draw from power supply 500 μ A
- > Minimum resistance measurement possible is approximately 1 - 2 M Ω – dependent on sample properties and power supply voltage output tolerances
- > Custom manufactured test cell with guard ring electrode incorporated
- > Picoammeter for measurement of current through or across the test sample (2 nA to 20 mA ranges) – 2 nA range has 10 fA resolution +/- 400 fA, Noise 20 fA.
- > Miscellaneous cables

Benefits:

- > Simple to use
- > Small and compact equipment
- > Custom manufactured powder resistivity test cell with built-in guard electrode to minimise errors from surface conduction when volume resistivity measurements are made and from volume conduction when surface resistivity measurements are being made
- > Test cell sits on support base in a precise position so that uniform and reliable pressure is applied to the top of the test substance for every test



Powder Resistivity Test Apparatus

- > In line Transorb over voltage protection unit (for protecting the sensitive pico-ammeter from over voltage)
- > Powder resistivity instruction manual and calibration certificates.

Optional Extras

- > Calibration services

The Following Items are Available at an Additional Cost

- > JCI 155v6 Charge Decay Analyser with JCI 173 Powder Sample support insert for testing charge decay time of powders. (JCI 176 sample support base is included in this optional package)

CTL29 Protective Clothing Resistivity Test Apparatus

(Other applications catered for)

For measurement of surface and volume resistivity on protective clothing and other surfaces.

Powders will nearly always acquire electrostatic charge during processing, the level of charge being largely determined by the violence of the process. BS5958 gives ranges of charge levels which might be expected from different processes.

Designers of protective clothing, or any other man made material for that matter, need to know the resistivity properties of their product. For instance, depending on the nature of the target industry, the garment's intended use may well be in a static sensitive area (such as a clean room or electronics workbench) where any charge build-up could damage electronic components. Alternatively, ignition of sensitive gases, vapours or even powders as a result of static electricity could be hazardous to personnel and result in damage to plant and equipment. Even in the retail industry, designers may need to know resistive properties of materials, since static can lead to self-clinging of fabrics, which not only causes discomfort for the wearer but also attracts dust and dirt to the garment reducing its lifetime and potentially causing an unsightly appearance.

Functional Specification and Deliverables

- > Terra Ohmmeter with built in 100V power supply (powered from 220-240V power supply although other supplies possible).
- > BS EN1149 Protective Clothing Surface (volume resistivity test cell)

Optional Extras

Other test cells can also be manufactured for testing other material types and to meet various applications:

- > Ohm square test cell for basic resistivity measurements of solid materials. Can be adjusted for slightly non-uniform / irregular surfaces. (Cell constant is 1)
- > Concentric ring electrode – testing in accordance with BS6524 (for measurement of surface resistivity of textile fabrics)
- > Testing to BS6233 (now superseded by BS62631 for measurement of volume and surface resistivity of solid insulating materials)
- > Testing to DIN 54345 pt 5 – Determination of electrical resistance of textile fabrics

Benefits:

- > Simple to use
- > Small and compact test equipment
- > Permits measurements to determine protective clothing surface and volume resistivity to BS EN1149
- > Tera-Ohmmeter with built in 100 V power supply
- > Auto ranging measurement function
- > Custom test cell to BS EN1149
- > Data here can also be used in conjunction with JCI 155v6 charge decay time data (see optional extras) to obtain a full resistance properties overview of your products

The Following are Available at an Additional Cost

- > Charge decay time analysis equipment – JCI 155v6 with JCI 176 sample support base (other inserts also available if your company also has a need to test powders and liquids)*

*Note: Where a textile fabric, garment or other material contains conductive yarns it is very important to properly understand their possible effects on resistivity measurements, which often depends on the type of resistivity cell used, or even its orientation. In these cases it is helpful, or even essential, to support the resistivity measurement with a charge decay time and capacitance loading measurement. DEKRA Process Safety manufactures a charge decay time analyser (JCI 155v6) which includes measurement of capacitance loading.



Surface & Volume Resistivity Test Apparatus

CTL39 10 kV Power Supply

For use in conjunction with test cells and current measurement devices.

DEKRA Process Safety manufacture a **10 kV power supply** which can be used to carry out a variety of process safety tests in conjunction with other equipment, e.g. test cells and current measuring devices.

The fixed voltage settings i.e. 500 V, 1 kV, 2 kV and 3 kV, are extremely useful when conducting electrostatic tests to determine resistivity of textiles and powders etc.

Functional Specification and Deliverables

- > Voltage settings : 500 V, 1 kV, 2 kV, 3 kV fixed 0 - 10 kV adjustable
- > Current output capability : 500 μ A
- > Mains input : 100 - 240 V a.c 1 A
- > LCD display – Resolution :
10 V on 500, 1 kV, 2 kV, 3 kV ranges
100 V on 0 - 10 kV adjustable range (above 3 kV)

Optional Extras

- > Calibration services

Benefits:

- > Versatile use – can be used as a power source for any of the electrostatics resistivity tests
- > Variable settings – fixed 500 V, 1 kV, 2 kV, 3 kV and 0 - 10 kV adjustable settings
- > Compact and lightweight
- > Ease of use



DEKRA Process Safety 10 kV Power Supply

CTL56 Burning Behaviour Test Apparatus – VDI Method

Determines whether a fire will propagate in a dust layer once started by an external ignition source.

The DEKRA Process Safety Burning Behaviour unit is based on VDI 2263. It determines if, and to what degree, a fire will propagate in a dust-layer once started by an external ignition source. The result is either given by a “combustion number” or the rate of propagation of the fire.

The test equipment comprises an electrically heated glowing platinum wire at approx. 1000 °C (diameter: 1 mm, length 86 mm, current 30 A). A drying oven is also required for this test but not supplied as standard (see options).

Functional Specification and Deliverables

- > 1 x platinum hot coil current control unit
- > 1 x heater power handset (pre-wired into the control unit)
- > 1 x insulating block
- > 1 x glass tube
- > 1 x 100 mm length of platinum wire
- > 100 - 200 V / 220 - 240 V - 6 A input
- > Fine coil output current control (optimum 29 to 31 A. Control derived from low voltage d.c output)
- > 1 x instruction manual

Optional Extras

- > Spare platinum wire
- > Spare glass tubes
- > Spare insulating blocks

The Following Is also Available at an Additional Cost

- > A drying oven

Benefits:

- > Digital LED display of current flowing through the platinum wire
- > Front panel fine adjustment of current flowing through the wire
- > Timer cut-out incorporated - safety feature to power down the control unit if left on for ca 7 minutes
- > Easy platinum wire change facility (repeatable method assuring the wire length is maintained when the wire is changed)



Burning Behaviour Test Apparatus

Custom Equipment Examples

Laboratory professionals are often asked to source equipment for specific research conceived within their organisations where there is no 'off-the-shelf' solution. Our instruments experts provide a comprehensive design, fabrication and support package to meet your specifications.

Project Examples

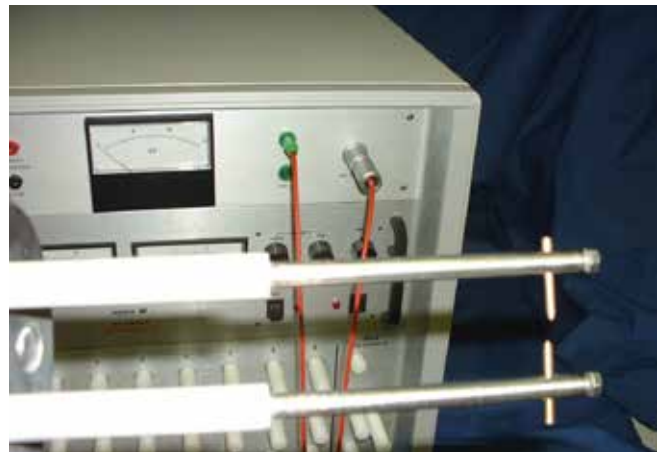
Requested: A high pressure vapour ignition research test apparatus

Delivered: A complete system capable of 3500 barg at 400 °C for recording temperature and pressure data resulting from vapour ignitions at elevated starting pressure conditions.



Requested: A capacitive spark discharge capability for a 20 litre sphere

Delivered: Development of a capacitive spark discharge system within a 20 Litre sphere by utilising the pre-existing KSEP 310 ignition firing signal.



Requested: Exothermic waste-stream screening calorimeter

Delivered: A custom, automated calorimeter linked to mixing, dosing, heating, agitating and relief equipment for short duration on-site screening of mixed waste stream samples by non-technical operators.



Requested: A high pressure 1m³ spherical explosion powder ignition test vessel

Delivered: A system capable of operating at 225 barg at 100 °C with custom dispersion and firing electronics to BS EN & ISO test standards.



CTL02 - Adiabatic Dewar Calorimeter ADC II

For determination of temperature and pressure data resulting from runaway chemical reactions and specifying plant protection measures, process failure scenarios, data for **vent sizing** using DIERS methods or advanced thermal stability analysis under low Phi factor and adiabatic conditions. PLEASE NOTE: This apparatus must be used within a blast containment enclosure.

Functional Specification and Deliverables

- > 6 kW 3-phase 380 V - 415 V Dewar oven. 0 - 400 °C capability
- > Pressure range 0 - 100 barg. Vent relief set to 23 barg
- > Dewar flask set with two fully ported and populated stainless steel head assemblies (ports include potential for entry of sample thermocouple, sample pressure sensor, sample heater, stirrer motor, additional spare thermocouple)
- > Electronic control unit (configured to suit various test scenarios in conjunction with the supplied software) – with built in oven temperature controller (oven temperature tracks the sample temperature reliably within 1 °C or better under steady rate of rise conditions and can follow exothermic activity of sample at rates of up to 40 - 60 °C/min). Also features sample pressure and heater power local monitors, emergency manual vent for the vessel and interfacing to all ancillary Dewar services e.g. system sensors and optional extras highlighted below
- > Personal computer and LCD monitor with ADC software pre-installed
- > Data acquisition card capable of monitoring and/or controlling: sample temperature, oven temperature, sample pressure, stirrer speed, stirrer torque, heater power (and also optional extras such as tempering cell pressure, tempering cell inlet and

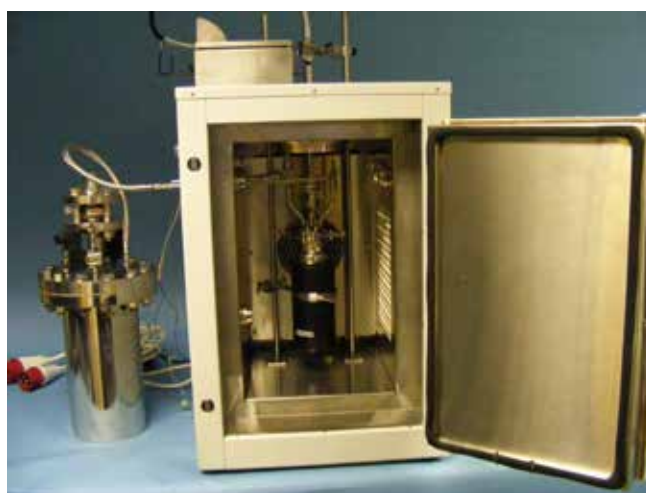
- outlet solenoid operation, additional thermocouples, chemical injection pump, laboratory balance, Gas Burette. Typical log rates are: every 20 seconds for standard logging and every 0.1 second logging per channel based on the trigger point being exceeded on rate of pressure or temperature rise data
- > Accuracy of pressure +/- 0.1 barg to 50 barg and +/- 0.2 barg above 50 barg
- > Accuracy of temperature +/- 1 °C

Optional Extras

- > Tempering cell
- > K-type spare thermocouples and spare pressure transducers
- > Additional Dewar vessels
- > Additional custom configured Dewar head assemblies to meet your requirements
- > Chemical injection pump for pumped addition capability
- > Containment enclosure
- > Gas Burette
- > Spare seals and miscellaneous sundries are also available
- > Training in the use of the ADC apparatus

Benefits:

- > Completely adiabatic test environment with low Phi factor, high pressure reactor
- > Highly accurate test results applicable directly to large scale reactors
- > Permits characterisation of exothermic runaway reactions, thermal decomposition stability and evaluation of gas generation rates
- > Data can specify plant protection measures e.g. emergency relief system design
- > Direct venting simulation using optional tempering cell equipment
- > Full range of process deviations & reactor component failure scenarios (e.g. heater / stirrer failure, effect of pumped additions with optional chemical injection pump)



Above: an Adiabatic Dewar Calorimeter (shown with electronic control unit and optional tempering cell for venting trials)

CTL09 Hartmann Pressure Tube Apparatus

Classical method for determining indications of the explosion severity of a dust cloud where available powder quantities are low and the price to produce small quantities of powder are large. (Data not for use in vent sizing calculations).

The **Hartmann Pressure Tube apparatus** is an explosion screening system for testing small quantities of powder product (e.g. pharmaceutical powder) and enables comparison of maximum peak pressure and maximum rate of pressure rise of powder products, under development, to be researched. Its purpose is NOT to provide highly accurate Pmax and Kst data for plant scale application, such data only being obtainable through use of a 20 litre sphere apparatus (see CTL06).

However, for comparison of samples developed in house that would initially be too expensive to produce in the quantities needed for testing within a 20 litre apparatus, this equipment is ideal. The data recorded with the Hartmann Pressure Tube apparatus must NOT be used for explosion protection measures on plant. If accurate data is needed, use a 20 litre apparatus as explained above.

Functional Specification and Deliverables

- > Mains supply: Volts 110 - 240 V a.c / 3 A
- > Dust / air dispersion base with mushroom design to optimise internal dust cloud
- > 1.2 litre stainless steel Hartmann tube
- > Top removable screw cap with built-in dynamic pressure transducer and vent valve
- > Viewing window (for visual observation of arc gap and flame propagation)
- > Brass electrodes
- > Constant arc power source
- > Remote handset (arc & air activation)
- > Electronic control unit containing high speed data acquisition card and pressure transducer charge amplifiers
- > Data acquisition program/driver set
- > O'ring set
- > High speed pressure transducer
- > 1 x instruction manual

Benefits:

- > Ideal for screening small quantities of powder product (e.g. 0.5 g etc)
- > Perfectly honed smooth inner vessel bore lends itself to ease of cleaning following testing
- > Easy removable lid for fast access
- > High resolution multi-turn inlet regulator for accurate reservoir pressure setting
- > Handset activation of arc and air dispersal. Arc initiation starts high speed data acquisition to PC to ensure no pressure curve data is missed during explosion.

Optional Extras

- > Spare electrodes, spare viewing window, spare seals, ancillaries
- > PC / LCD monitor with control and acquisition software included ready installed (recommended)



Hartmann Pressure Tube Apparatus

CTL12 - Aerated & Diffusion Cell Thermal Instability Screening Test Apparatus

Test method to evaluate and quantify self-heating of bulked powders in stagnant or aerated environments.

The purpose of the **aerated cell test** is to simulate the conditions in dryers in which a hot air stream passes through the material, whilst the diffusion cell test simulates conditions in silos or bags and at the bottom of dryers where material can collect in bulk. The only difference between the two tests is with the diffusion cell test, the lid is removed from the glass test cell and there is no hot air stream passing through the material. Instead, heating occurs uniformly inside the oven so that the powder sample can be ramped-up to its target temperature gradually (typically 0.5 °C.min⁻¹) thus enabling examination of the test sample for self- heating effects within the bulk of the product held within the test cell.

If the heat developed by a reaction of a substance with oxygen or by exothermic decomposition is not lost rapidly enough to the surroundings, self-heating leading to self-ignition can occur. Self-ignition therefore occurs when the rate of heat production exceeds the rate of heat loss. The test procedure is useful as a preliminary screening test for powders being processed on plant.

Functional Specification and Deliverables

- > Mains supply: Volts 220 V - 240 V a.c / 7 A or 120 V a.c / 13 A
- > 30 litre fan assisted oven (400 °C capability)
- > Air flow meter fitted (adjusts flow through the pre-heating coil). Typical air flow is set to 0.6 l.min⁻¹
- > Temperature controller (ramps oven at 0.5 °C.min⁻¹)
- > Glass test vessel set each comprising cylinder closed at the base and top with sintered glass and a close fitting lid for aeration cell tests
- > Thermocouples for monitoring oven temperature at several places within the powder layer within the vessel
- > Data acquisition software (pre-installation on optional PC recommended) for conducting either the aerated cell test (with lid) or the diffusion cell test (no lid)
- > Thermocouple extension cables
- > Glass vessel support stand with pre-drilled thermocouple securing holes for repeatable alignment of thermocouples
- > 1 x instruction manual

Benefits:

- > Designed to meet the specification published in the 1990 Institute of Chemical Engineers book "Prevention of Fire & Explosions in Dryers", pages 16-18. (Author: John Abbott, ISBN-10: 0852952570)
- > Excellent screening-tool for examining self-heating effects within dryers, silos and bags
- > Simple to use glass test vessel enabling easy test configuration modification between either an aerated test or a diffusion test scenario
- > Internal pre-heating pipework configuration
- > Repeatable thermocouple location method
- > Multi-channel data acquisition system

The Following is Available at an Additional Cost

- > PC & LCD monitor (recommended)
- > Spare glassware
- > Thermocouples
- > Training



Aerated cell with pre-heated air (top entry)

CTL14 - Basket Test Apparatus

Tests samples of dust and powders, when stored in bulk, in order to determine their self-heating properties and enable accurate scale-up of ignition temperatures

The DEKRA Process Safety **Basket Test Apparatus system** comprises all the necessary components to permit testing in accordance with the method described by the UN Transport of Dangerous Goods - Manual of Tests and Criteria and also by P.C Bowes in the paper "Self Heating: Evaluating & Controlling the Hazards", Buildings Research Establishment, UK, ISBN 011671364X.

Dusts and powders stored at elevated temperatures can undergo a chemical reaction leading to self-heating and possibly ignition within the bulk material. Several factors are to be considered when determining safe storage temperatures. The volume and surface area of the storage vessel, the proposed storage temperature and the storage duration should all be taken into account.

The basket test technique provides a useful modelling tool for understanding these parameters of product behaviour. The levels at which (a) ignition occurs and (b) no signs of ignition are evident are determined for baskets of typically three different volumes. From graphical analysis of this data it is possible to determine the self-heating onset temperature for any volume of material.

Functional Specification and Deliverables

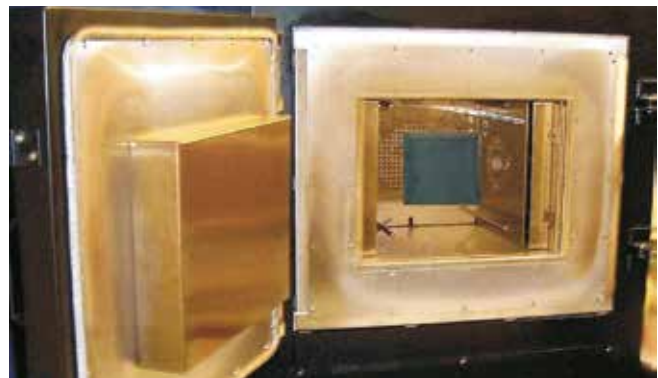
- > Oven: 0 - 400 °C fan assisted with PID temperature controller
- > Mains supply: 220 - 240 V single phase / 13 A
- > Thermocouples: K type, 1 metre long. Oven and sample
- > Reaction vessels: 1 set stainless steel mesh basket cubes 25mm / 50 mm / 75 mm / 100 mm (more can be supplied as spares)
- > Sample support: Outer basket which permits air flow circulation to / around inner basket cubes
- > Miscellaneous items: 1 x instruction manual and catchment tray
- > Data acquisition card and software: Basket test apparatus data acquisition software which can be pre-installed on the recommended optional PC / monitor

Benefits:

- > Designed for testing to the UN Transport of Dangerous Goods manual of tests & criteria and in general accordance with the paper "Self Heating: Evaluating & Controlling the Hazards", Buildings Research Establishment, UK, 1984, ISBN 011671364X
- > Easy method to explore self-heating effects of powder materials stored in bulk
- > Easy functionality and simple to change / suspend each test sample within the system oven

Optional Extras

- > K-type thermocouples
- > Baskets
- > Special configuration systems such as basket test apparatus with Nitrogen blanketing
- > PC with software pre-installed
- > Training



Basket Test Apparatus

CTL20 Flammable Range Test Apparatus

Determines lower and upper concentration limits of flammability of chemicals having sufficient vapour pressure to form flammable mixtures in air

The **Flammable Range Apparatus** test method determines the lower and upper concentration limits of flammability of chemicals having sufficient vapour pressure to form flammable mixtures in air at one atmosphere pressure at test temperature. This method may be used to determine these limits in the presence of inert dilution gas. The apparatus is manufactured in accordance with ASTM E681- standard test method for Concentration Limits of Flammability of Chemicals.

Functional Specification and Deliverables

The ASTM Method spec is covered here.

- > Flammable range fan assisted oven 220 - 240 V a.c typically 1.5 kW / 7 A
- > Temperature rating 0 - 300 °C (test operating temperature limited to 150 °C due to the PTFE head assembly)
- > Safety glass window in door
- > Magnetic stirrer drive
- > New integral oven control unit including pressure reader, temperature reader and temperature controller. Also includes stirrer controller and arc controller ignition source and activation handset
- > 500 µl syringe with needle (Other syringes upon request)
- > 5 litre glass test vessel
- > 1 x vacuum pump + 6 mm inlet line and exhaust hose
- > Vacuum pump inlet filters, plastic-coated magnetic stirring bars
- > 1 x remote handset for constant arc activation
- > 2 x 5 litre covers / head assemblies with ports for sample injection, electrodes, thermocouple, vacuum/ exhaust line(s) with needle valve isolation and trans ducer connection (complete with cover clamps)
- > 1 x pressure transducer -1 to 1 barg
- > 1 set x 5 litre head rubber seal gaskets
- > 1 set x septums for injection line connection
- > 1 x length of tungsten constant arc electrode wire

Note: if the sample quantity available is unlimited, then a 12 litre system can be ordered rather than the standard 5 litre system. A 12 litre system also permits the user to test lower and upper flammable limits of refrigerant samples. Where the sample quantity availability is limited, then a standard 5 litre system is normally preferable to the customer.

Benefits:

- > Testing to ASTM 681 standard (5 litre test vessel supplied) or to ASHRAE 34 (12 litre vessel optionally available for testing the flammability of refrigerant gases)
- > Enables the upper and lower limits of flammability to be determined
- > Bottom built in stirrer fitted for uniform mixing
- > PTFE head assembly can be adapted to other test configurations if desired



Flammable Range (LFL/UFL) Apparatus

The Following Options are Available at an Additional Cost

- > Spare transducers – pressure and thermocouples
- > Spare tungsten wire, valves / tubing and vessels
- > Spare 5 litre or 12 litre covers / head assemblies with ports for sample injection electrodes, thermocouple, vacuum / exhaust line(s) with needle valve isolation and pressure transducer connection (complete with cover clamps)
- > 1 x 12 litre vessel support stand
- > 1 set x 12 litre head rubber seal gaskets
- > 1 x 12 litre vessel stirrer extension rod
- > Spare test vessels
- > Training

CTL30 Gas Probe Incendivity & Calibration Apparatus

To determine if incendive discharges can be developed from plant equipment or items which are capable of igniting highly flammable gases, e.g. propane.

Processes or operations to be performed within a flammable atmosphere could create incendive discharges resulting in personnel injury and plant damage. In the worst case scenario personnel deaths or total plant destruction could result.

The gas probe incendivity test gives an indication of discharge hazards from products or materials used in a particular environment. For instance, the incendivity gas probe can be used as an assessment tool within a controlled laboratory environment for evaluating the risk of ignition from a product or material within a plant flammable atmosphere, by simulating the type and volume of gas concentration associated with that which may be present on plant.

DEKRA Process Safety can supply the Gas Probe Incendivity Calibration Station to enable a customer to obtain the optimum mixture through the gas probe and by utilising the supplied high voltage power supply to create a simulated electrostatic spark discharge. By moving the earthed gas probe ball electrode towards and in the direct vicinity of the high voltage electrode, an electrostatic discharge will occur. These calibration trials precede applying the same gas / air mixture (gas concentration) to the application; for instance, the application may involve determination of whether it is possible to ignite a gas / air mixture when the gas probe earthed ball electrode is presented to the charged product under test, e.g. a Fibre Insulated Bulk Container (FIBC) or similar charged body-

Functional Specification and Deliverables

- > Gas probe with manual quick release gas shut-off valve and gas mixing shroud
- > Gas mixing unit with 2 x digital mass flow meters: one for air and one for gas (Propane by default). Total gas flow to the gas probe must be 0.21 litres / sec +/- 0.04 litres / sec (ref: IEC 61340-4-4)
- > A 10 kV custom manufactured calibrated power supply unit with fixed output: 500 V, 1 kV, 2 kV, 3 kV and adjustable 0 - 10 kV front panel controls. 220 - 240 V / 100 - 120 V a.c input 10 kV output (500 μ A) LED display read-out of high voltage output
- > A calibration document for the 10 kV power supply included
- > A capacitance charging station and stand with electrode
- > Instruction manual

Benefits:

- > Gas flow meter with internal memory store containing density data for multiple pre-programmed selectable gases (propane standard)
- > Custom fabricated calibration station for gas probe with accurate spark gap clock gauge distance setting facility
- > Custom fabricated lightweight gas probe - permits testing in general accordance with IEC 61340-4-4
- > Custom fabricated high voltage power supply



Gas Probe Incendivity & Calibration Apparatus

Optional Extras

- > Nitrogen feed-line and separate flow-meter
- > Calibration services
- > Bespoke requests may also be possible
- > Other electrostatics properties measuring equipment available e.g JCI 178/JCI 179 probe charge measuring instrument combination (used to measure the energy of a spark drawn from a charged surface).

Note: for safety reasons, the user must fit flashback arrestors on gas cylinders (not supplied)

CTL32 Powder Chargeability Test Apparatus

For measurement of a material's propensity to generate charge.

Whenever one material moves against another, electrostatic charging may result. The net rate of charge acquisition will depend on both the rate of charge generation and the rate of charge dissipation. While measurements of resistivity and charge relaxation time (refer to JCI 155v6) reveal a material's ability to dissipate charge, chargeability indicates its propensity to generate it. DEKRA Process Safety manufactures equipment for determining a material's propensity to generate charge. Various factors will have an effect on the end results of a particular **chargeability test series**.

These are:

1. Particle size
2. Moisture content
3. Humidity
4. Media being transited (e.g glass, stainless steel, polypropylene or PVC etc)
5. Velocity of travel through the media

The latter two items are considered in the test procedure and are adjusted accordingly to simulate various conditions that could occur on plant.

Functional Specification and Deliverables

- > Custom made stainless steel roduct collection drum
- > Supply of powder collection bags
- > Electronic Manometer
- > Electrometer (220-240 V or 110-120V input / 1A)
- > Variable speed (220-240V single phase) conveyor belt system (transit time of belt typically set to 30 s)
- > 1 stainless steel, 1 glass, 1 polypropylene tube for powder transit
- > Sets of leads for measurement apparatus
- > Baseplate – chargeability components already pre- mounted for ease of installation
- > Stainless steel funnel and support stand
- > Stopwatch
- > Inline orifice plate for system outlet – already fitted
- > Test instruction manual detailing installation, commissioning, test procedure and routine maintenance
- > 220-240V Industrial vacuum suction device with Hepa filter installed

Benefits:

- > Ideal for simulating on plant charge accumulation within various pipe media under laboratory conditions
- > Easy quick release collection drum lid
- > Variable speed vacuum device for varying velocity of product flowing through test pipes
- > Antistatic powder delivery / conveyor belt so that any charge generated is due to the simulated process only



Powder Chargeability Test Apparatus

- > Industrial vacuum suction device variable speed controller – already fitted to base station
- > Miscellaneous instruction manual for Electrometer
- > Fittings for the drum inlet and outlet (already fitted)

The Following Is Available at an Additional Cost

- > Digital humidity / temperature meter
- > The JCI 155v6 Charge Decay Time Analyser
- > Powder resistivity test apparatus

CTL38 Self Accelerating Decomposition (SADT) UN Test H4 Apparatus

For determination of the minimum constant air temperature at which thermally unstable substances undergo exothermic decomposition

This method determines the minimum constant air environment temperature at which thermally unstable substances undergo exothermic decomposition at conditions representative of the substance when packaged for transport. The method can be used for the determination of the Self Accelerating Decomposition Temperature (SADT) of a substance in its packaging, including IBC's and small tanks (up to 2 m³).

Functional Specification and Deliverables

- > 0 - 150 °C temperature range (110 - 120 V a.c / 220 - 240 V a.c oven typically 1.5 kW)
- > Efficient flask holder / stand with minimal thermal influence on test
- > Custom made vessel plug / head – fast set-up
- > Data acquisition system provides fast and early indication of any exothermic onset
- > Debris collection fine wire mesh basket cage system – enables management and containment in the event of any flask breakages
- > USB connectivity (computer option available)

Optional Extras

- > Mesh baskets, support stands thermocouples, other accessories
- > Bespoke software changes to cater for additional functions

The Following Is Available at an Additional Cost

- > PC, LCD monitor and miscellaneous cables & accessories

Benefits:

- > Efficient flask holder / stand with minimal thermal influence on test
- > Custom made vessel plug / head – fast set-up
- > Data acquisition system provides fast and early indication of any exothermic onset
- > Debris collection fine wire mesh basket cage system – enables management and containment of debris in the event of any flask breakages during the test
- > USB connectivity (computer option available)



SADT & UN Test Apparatus

CTL44 Electric Spark Tester

Meets the Energetic Materials Testing and Assessment Policy Committee's (Defence Ordnance Group) Manual of Tests (EMTAP) *.

In general, explosives can be divided into two classes of electrostatic risk. It is possible for an operator to accumulate 0.02 J of energy on his person and for this reason, explosives which can be initiated with energies smaller than 0.02 J require the more stringent Second Degree Precautions. If the explosive requires an energy in excess of 0.02 J for ignition, First Degree Precautions are sufficient.

The electrostatic testing of explosives is, therefore, divided into two parts; a screening test to show whether the material is unlikely to be ignited at the 0.02 J level, and a more searching procedure for those materials which are ignited at that level. DEKRA Process Safety manufacture the spark testers (test no. 6) to enable screening from 0.045J to 4.5J.

Functional Specification and Deliverables

- > **Electric Spark Tester:** electrical control & ignition system mounted within 19" rack
- > Mains supply: 220 - 240 V a.c single phase power / 1 Amp
- > Power supply : 10kV output (Adjusted / optimised for desired fixed energy discharges from fixed value internal capacitors)
- > Set of polythene strips and high voltage electrodes supplied as standard
- > Instruction manual and energy verification data
- > Top vent which can be connected to room extraction
- > Safety features: door interlock and electrode earthing
- > Latched side access panel to aid cleaning
- > Selectable energies : 4.5 J, 0.45 J and 0.045 J (as per test no.6 requirements)

Benefits:

- > Compact unit (self-contained)
- > Electronic safety interlock on the door (isolates all power and grounds the high voltage electrode when the door is open)
- > polythene sample holders are quick to change between tests
- > Fast access side hatch for ease of cleaning down between sample tests

Optional Extras

- > Additional polythene strips
- > Additional high voltage electrodes

The Following Is Available at an Additional Cost

- > PC, LCD monitor and miscellaneous cables and accessories
- > Also available, the JCI 140 / JCI 148 Voltmeter combination and data card for spark monitoring (available for technical engineers and professionals)

* DEKRA Process Safety manufacture the apparatus required for the initial screening test (i.e. test no.6). Test samples are subjected to discharges of 4.5 J, 0.45 J or 0.045 J energy.



Electric Spark Tester

CTL52 Flammability of Gases Test A11 Screening Apparatus

For conducting the A11 EC physical properties tests.

The DEKRA Process Safety **Flammability of Gases test apparatus** is designed for conducting physical properties testing to the European Official Journal of Tests – Test A11. This method determines whether gases mixed with air at room temperature (approx. 20 °C) and atmospheric pressure, are flammable and if so, over what range of concentrations.

Mixtures of increasing concentrations (1 % steps) of the test gas with air are exposed to an electrical spark and it is observed whether ignition occurs.

Functional Specification and Deliverables

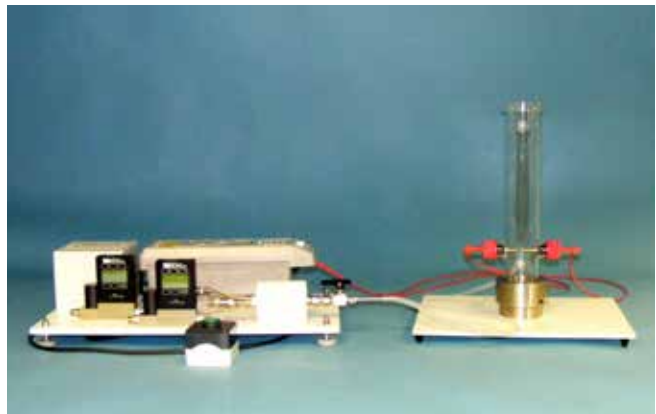
- > 1 x 15 kV constant arc power source
- > 1 x gas flow meter base plate with ignition and 0.2-0.4sec timer control
- > 1 x pair non return valve, pre-mixing chamber and isolation valve pre-fitted to gas flow meter base plate
- > 2 x gas mass flow meters (gas flow meter digital pre-programmed gases – propane/air = default)
- > 1 x power adapter unit for gas flow meters
- > 1 x set glass tube sealing membrane
- > 1 x flexible gas tube
- > 1 glass test tube (with quick tube bayonet release mechanism fitted)
- > 1 x instruction manual

Optional Extras

- > Spare glass tubes and accessories
- > Calibration services

Benefits:

- > Offers a selection of pre-programmed gases to choose from
- > Quick release glass tube facility
- > Automatically timed high voltage constant arc system (15 kV / 0.2 - 0.4 secs) on handset initiation
- > Pre-mix chamber facility for mixing air with gas prior to entering the supplied glass test tube



Flammability of Gases Test Apparatus

Commissioning & Training Services

Choosing the right process safety instrumentation, whether for an R&D laboratory or to carry out your own on-site testing, is a complex task. Our clients require a helpful, professional service, value-for-money and equipment widely proven in laboratory applications. They are entitled to complete, easy-to-follow instruction manuals, efficient after-sales support and comprehensive equipment warranties and accessories. DEKRA Process Safety has built our business on these key factors for more than 30 years.

Training

We at DEKRA Process Safety recognise that people developing their own process safety facilities benefit from our knowledge and assistance so staff can operate safely, competently and in accordance with set standards and protocols. We therefore provide **tailored training** to meet individual client requirements delivered either in our fully equipped process safety laboratories, at a client's site or through remote access video based support. This comprehensive support extends to interpretation and application of data from our team of expert consultants.

Test Standards

Our instrumentation complies with relevant national and international standards including BS, IEC, ISO, ASTM, VDI, DIN, UN and European Union regulations such as CLP (Classification, Labelling and Packaging) and REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals). Through their in-depth understanding of industry needs gained over more than a quarter of a century, DEKRA Process Safety's consultant engineers are frequently engaged with international standards committees and are well placed to help our customers to define the details of their testing requirements, whilst offering expertise in the interpretation and application of the data. For more details on our test standard compliance, please see p5.

Custom Manufacture

DEKRA Process Safety also provides a **custom manufacturing service** for bespoke apparatus to meet either our client's specific in-house test requirements or to meet other test standards not covered by our normal instrument range. At the end of this catalogue you will find some examples of our custom built instrumentation developed by us to address specific client needs. Please enquire to see if we are able to help with your requirements.

Warranty

Full 12 month warranties are supplied with all equipment. Commissioning & Maintenance : In addition to our comprehensive commissioning service, DEKRA Process Safety can also support you with contracts for repairs, maintenance, calibration and certification of our equipment consistent with a full range of quality programmes, including Good Laboratory Practice (GLP).

Calibration Services

Regular calibration of test apparatus is integral to ensuring that equipment returns reliable, high quality results critical to the characterisation of materials and safe operation of processes.

Using a range of master test equipment, DEKRA Process Safety provides **calibration services** traceable to nationally recognised standards for our range of process safety test apparatus. In circumstances where no formal calibration certificate with multipoint data is required, we offer a manufacturer's standard performance check certificate to ensure dependable data.

Service contracts are also available where equipment is tested against known data samples. With the option for on-site calibration or return to our UK based service centre, whether it be formal calibration, performance check or routine maintenance and servicing, DEKRA Process Safety offers peace of mind through our comprehensive, professional support package for all of our process safety test apparatus.

Benefits:

- > Master calibration equipment is traceable to either UKAS or National Standards
- > High level of accuracy and where possible and requested, verification against known test samples can be undertaken and documentation supplied accordingly



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