TESTING INSTRUMENTS FOR ENERGETIC MATERIALS LABORATORIES

ver. 2016
OZM Research® is a knowledge-based company formed by experienced explosives scientists and engineers. The company’s core business model is to produce the best specialized testing instruments for the energetic materials using the latest technologies and to provide our clients the most comprehensive expert services for their applications.

EXPERTS

The company's core business model is to produce the best specialized testing instruments for energetic materials using the latest technologies and to provide our clients the most comprehensive expertise throughout the entire process — from selecting an instrumentation for a specific application, to its installation and training, to preparation of testing methodologies and their implementation at the client’s laboratory.

TAILORED PRODUCTS

We offer not only standard testing equipment complying with the military or industrial standards as shown in this catalog. We often design tailored products meeting the client’s specific requirements. Please do not hesitate to challenge our engineers with a request for a new instrumentation if not finding the appropriate type in our catalogue.

CONTACT

Industrial Designer

Jan Ermis collaborates with OZM Research® since 2008 on the development and innovation of industrial design of the company’s portfolio.

Jan Ermis graduated at the Academy of Architecture Art and Design in Praguerial Arts branch Industrial Design.

From the perspective of product designer is important to cultivate the visual aspect of devices, but also bring novel solutions to technological development.

I believe that our cooperation with OZM Research® will bring in the future an extraordinary solution for OZM customers and clearly separate ourselves from other commercial products.

SELECTED REFERENCES

EXPLOSIVES HANDLING TABLE

Safe Storage of Larger Stocks of Explosive Samples

PORTABLE GAS-TIGHT EXPLOSION-RESISTANT CONTAINERS

Safe Storage of Larger Stocks of Explosive Samples

EXPLOSIVE PROCESSING OF METALS

SELECTED REFERENCES

EXPLOSION-RESISTANT STORAGE CONTAINERS

Safe Laboratory Storage of Small Explosive Samples

EXPLOSIVES HANDLING TABLE

Safe Laboratory Burning of Samples DISPOSABLE LIGHT STAINLESS STEEL PROTECTING TESTING CONTAINER

EXPLOSIVE PROCESSING OF METALS

SELECTED REFERENCES

DEVELOPMENT OF HANDLING EQUIPMENT

For handling explosives, we produce the best specialized testing instruments for energetic materials.

Our product managers are PhDs in explosives science and technology with decades of experience in development and applications of new testing methods and instruments in academic, industrial and military domastic and international projects. We offer our clients our expertise throughout the entire process — from selecting an instrumentation for a specific application, to its installation and training, to preparation of testing methodologies and their implementation at the client’s laboratory.

Be sure to check out the selection of instruments in academic, industrial and military domestic and international projects. We offer our clients our expertise throughout the entire process — from selecting an instrumentation for a specific application, to its installation and training, to preparation of testing methodologies and their implementation at the client’s laboratory.

ABOUT OZM RESEARCH

OZM RESEARCH IS READY TO HELP YOU WITH YOUR TASKS IN ENERGETIC MATERIALS!
## Energetic Materials Applications

Testing instruments for thermal stability, sensitivity and performance tests

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The X SPARK 10™ is the newest generation of the universal testing instrumentation (originating from the ESD 2008™) designed for precise measurement of the initiation energy of energetic materials by electrostatic spark in the range of discharge energies from 25 μJ to 25 J and voltages between 500 V and 10 kV. The X SPARK 10™ operates in the two discharge regimes — Oscillating and Damping — suitable for different classes of energetic materials (with shock wave or thermal mechanism of initiation).

**APPLICATION**
Electrostatic discharge is one of the most frequent and the least characterized causes of accidental explosions of energetic materials. Reliable data on the electrostatic spark sensitivity of energetic materials is thus critical in their manufacture, quality control, explosives processing, loading, transportation, storage, demilitarization and research and development of the new explosive materials.

**COMPLIANCE**
- EN 13938-2 Explosives for civil uses — Propellants and rocket propellants – Part 2: Determination of resistance to electrostatic energy
- STANAG 4490
- MIL-STD-1751A Safety and Performance Tests for the Qualification of Explosives - Methods 1031, 1032 & 1033

Other available versions of spark testers:
- ESDX25™ (Electrostatic discharge generator for testing of electro-explosive devices)
- ESD LS30™ (Large-scale electrostatic discharge sensitivity tester)

**ADVANTAGES & FEATURES**
- Compact design
- Allows for the measurement of both the total spark energy and the net initiation energy (energy transferred to the sample)
- Applicable for all types of energetic materials including crystalline/ granular high explosives, propellants, pyrotechnics and primary explosives with different testing modes
- Replaceable spark gaps
- Gas-tight protection cap allows simple collection of gaseous decomposition products for eventual chemical analysis
- Several models of automatically operated testing stands according to different international standards including stands with fixed electrodes and with an approaching anode
- Modified designs of the spark gap assemblies according to the requirements of other standards or testing methods are available upon request.
- External testing assemblies are designed for up to 500 mg explosive samples
- Wide selection of capacitors in the capacitor bank for testing with wide ranges of spark energies

**ACCESSORIES**
- Fixed electrode testing stand
- Approaching anode testing stand
- Spark gap assembly acc. to MIL-STD-1751A methods 1031 & 1033
- Spark gap assembly acc. to MIL-PRF-46676B (AR)
- Spark gap assembly acc. to MIL-STD-1751A methods 1031 & 1033
- Spark gap assembly acc. to OZM/TNO/DTTX

**COMPLIANCE**
- EN 13631-3:2004 – Explosives for civil uses - High explosives - Part 3: Determination of sensitiveness to friction of explosives
- STANAG 4487
- MIL-STD-173-1A: Safety and Performance Test for the Qualification of Explosives (High Explosives, Propellants, and Pyrotechnics), Method 1024: BAM Friction Test
- TB 7002, DoD Ammunition and Explosives Hazard Classification Procedures (2012), Section 5-34
- GB/T 21566-2008: Test method for friction sensitivity of explosives substance

**ACCESSORIES**
- Spark gap assembly acc. to MIL-STD-1751A methods 1031 & 1033
- Spark gap assembly acc. to MIL-PRF-46676B (AR)
- Spark gap assembly acc. to OZM/TNO/DTTX
- Spark gap assembly acc. to GB/T 21566-2008
- Spark gap assembly acc. to UN R 6.1

**APPLICATION**
The friction sensitivity of a tested substance is determined in accordance with the BAM procedure. OZM Research® has designed the FSMK 10™ with a unique interchangeable loading arm mechanism: a light loading arm designed for testing highly sensitive primary explosives and pyrotechnics and a standard loading arm designed for testing highly explosive, less sensitive energetic materials and other substances.

**ADVANTAGES & FEATURES**
- Complete stainless-steel stand
- Unique interchangeable loading arm design
- Standard 6-position loading arm accompanied by two sets of weights generating loads from 0.5 N to 360 N
- Light 3-position loading arm, specially designed for testing highly sensitive substances, accompanied by two sets of weights generating loads from 0.1 N to 60 N
- Protective shield to protect personnel against potential fragments of porcelain plate or peg
- Digitally controlled step motor for the high precision movement of the porcelain plate
- Working table covered by an electrostatic conductive surface
- Wide range of accessories available
- Premium quality consumables at cost effective prices

**ACCESSORIES**
- Porcelain Plate and Peg
- Set of Weights PEx-14
- Set of Weights PEx-5

**COMPLIANCE**
- STANAG 4490
- MIL-STD-1751A Safety and Performance Tests for the Qualification of Explosives - Methods 1031, 1032 & 1033
- Aluminium plate with wide ranges of spark energies
- Replaceable spark gaps
- Compact design
- Robust stainless steel design
- Two interchangeable loading arms are available — for sensitivity testing of highly sensitive explosives as well as less sensitive explosives at one apparatus

**APPLICATION**
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- Working table covered by an electrostatic conductive surface
- Wide range of accessories available
- Premium quality consumables at cost effective prices

**ACCESSORIES**
- Spark gap assembly acc. to MIL-STD-1751A methods 1031 & 1033
- Spark gap assembly acc. to MIL-PRF-46676B (AR)
- Spark gap assembly acc. to MIL-STD-1751A methods 1031 & 1033
- Spark gap assembly acc. to OZM/TNO/DTTX

**COMPLIANCE**
- EN 13631-3:2004 – Explosives for civil uses - High explosives - Part 3: Determination of sensitiveness to friction of explosives
- STANAG 4487
- MIL-STD-173-1A: Safety and Performance Test for the Qualification of Explosives (High Explosives, Propellants, and Pyrotechnics), Method 1024: BAM Friction Test
- TB 7002, DoD Ammunition and Explosives Hazard Classification Procedures (2012), Section 5-34
- GB/T 21566-2008: Test method for friction sensitivity of explosives substance

**ACCESSORIES**
- Spark gap assembly acc. to MIL-STD-1751A methods 1031 & 1033
- Spark gap assembly acc. to MIL-PRF-46676B (AR)
- Spark gap assembly acc. to MIL-STD-1751A methods 1031 & 1033
- Spark gap assembly acc. to OZM/TNO/DTTX
SENSITIVITY TESTS

**FSA12™** is a portable version of the OZM’s BAM Friction Apparatus FKSM10, which can be placed and operated on a standard laboratory working table. **FSA12™** is used to determine the friction sensitivity of all types of energetic materials in accordance with BAM procedure. Due to the unique design of two interchangeable loading arms, the applicable load can vary from 0.1 N to 360 N (from 0.01 kg to 36 kg).

**APPLICATION**

The sensitivity to impact stimuli is one of the most important characteristics of energetic materials. Small BAM Fall Hammer BFHPEx™ is especially suitable for testing of the most sensitive materials with special emphasis to maximum operator safety.

**ADVANTAGES & FEATURES**

- Entire corrosion-proof design
- Wide range of impact energies from 0.025 J to 10 J
- Six Drop Weights spanning from 25 grams to 1,000 grams
- Electromagnetic or Pneumatic Releasing Device for the remote controlled release of the Drop Weight
- File plates as alternative consumables
- Protective Housing
- Wide range of accessories for specialized testing
- Premium quality consumables at cost efficient prices

**COMPLIANCE**

- EN 13631-4:2002 Explosives for civil uses. High explosives Part 4: Determination of sensitiveness to impact of explosives
- STANAG4849
- MIL-STD-1751 A: Safety and Performance Test for the Qualification of Explosives (High Explosives, Propellants, and Pyrotechnics), Method 1015: BAM Impact Test Apparatus
- Energetic Materials Testing & Assessment Policy Committee Manual of Tests, Volume 1, Issue 4, Nov 2007 (EMAT TESTING); Test No 43
- GB/T 21567-2008: Dangerous goods – Test method for impact sensitivity of explosive substance

Other available versions of Impact Testers:

- BFH10™
- BFH12™
- BFHPEx™
- BFH12R™ (comply with GOST 4545-88)

**BFH12A**

The BAM Fall Hammer (also known as BAM Impact Tester or Drop Hammer) is designed to determine the sensitivity to the impact stimuli of a fallen drop weight in accordance with the BAM procedure.

The BFH12A™ is equipped with an automated lifting mechanism for remote controlled positioning, dropping and collection of the drop weight. The BFH12A™ introduces a unique Drop Weight Exchange Window for safer, quicker and more convenient exchanges of the drop weights.

**APPLICATION**

The sensitivity to impact stimuli is one of the most important characteristics of energetic materials defining their safety in handling, processing or transportation. Its determination is a necessary part of characterization of new explosives, modified formulations or manufacturing conditions, as well as for defining influences of impurities or ageing. It is also used in quality control of manufactured explosives, surveillance of in-service explosives and transport/storage classification of explosive materials.

**ADVANTAGES & FEATURES**

- Unique Drop Weight Exchange Window for safer, quicker and more convenient exchange of Drop Weights
- Automated Lifting Mechanism remotely operates positioning, fall and collection of Drop Weight
- Protective Housing
- Wide range of impact energies from 0.25 J to 100 J
- Six Drop Weights from 0.25 kg to 10 kg
- Drop weights equipped with brass grooves for reduced sliding friction
- Pneumatic or electromagnetic releasing devices for remotely controlled drop weight fall
- File Plates as alternative consumables
- Wide range of accessories
- Premium quality consumables at cost effective prices

**COMPLIANCE**

- EN 13631-4:2002 Explosives for civil uses. High explosives Part 4: Determination of sensitiveness to impact of explosives
- STANAG4849
- MIL-STD-1751 A: Safety and Performance Test for the Qualification of Explosives (High Explosives, Propellants, and Pyrotechnics), Method 1015: BAM Impact Test Apparatus
- Energetic Materials Testing & Assessment Policy Committee Manual of Tests, Volume 1, Issue 4, Nov 2007 (EMAT TESTING); Test No 43
- GB/T 21567-2008: Dangerous goods – Test method for impact sensitivity of explosive substance

**BFHPEx**

Designed for determination of impact sensitivity of highly sensitive materials as primary explosives or pyrotechnics in accordance with the BAM procedure.

**APPLICATION**

This sensitivity to impact stimuli is one of the most important characteristics of energetic materials. Small BAM Fall Hammer BFHPEx™ is especially suitable for testing of the most sensitive materials with special emphasis to maximum operator safety.

**ADVANTAGES & FEATURES**

- Entire corrosion-proof design
- Wide range of impact energies from 0.025 J to 10 J
- Six Drop Weights spanning from 25 grams to 1,000 grams
- Electromagnetic or Pneumatic Releasing Device for the remote controlled release of the Drop Weight
- File plates as alternative consumables
- Protective Housing
- Wide range of accessories for specialized testing
- Premium quality consumables at cost efficient prices

**COMPLIANCE**

- The same as for BAM Friction Apparatus FSKM10™ described on the previous page
- Integrated handles for easy moving
- Remote control

Other available versions of Impact Testers:

- BFH10™
- BFH12™
- BFHPEx™
- BFH12R™ (comply with GOST 4545-88)
The STABIL® (Modernized Vacuum Stability Tester) is used for the determination of the chemical stability and compatibility (reactivity) of energetic materials. Electronic pressure transducers allow for the determination of the volume of evolved gases.

The unique design of the STABIL® VI completely replaces old mercury-containing apparatuses with non-toxic, safe and easy-to-operate precise instrumentation. OZM Research® continues with long and proud tradition of the electronic vacuum stability testers - the first generation of STABIL® instrument was developed over 40 years ago in the Czech Republic. Today’s STABIL® VI is the latest generation of this long innovation process and creates the standard of excellence in the VST testing equipment worldwide.

**ADVANTAGES & FEATURES**
- Continuous Pressure-Time Record and automatic calculation for Volume-Time Dependence
- Automatic temperature calibration
- 1 to 20 independent sample measurements may be conducted simultaneously
- Independent alarm circuit for monitoring of temperature (to avoid overheating)
- Rate of pressure rise and overpressure inside test tubes are monitored by software as a part of the alarm functions
- High precision and long term accuracy of pressure measurement

**APPLICATION**
Vacuum stability test is frequently used for determination of chemical stability and compatibility of energetic materials and for quality tests of energetic ingredients. The test is able to discover chemical instability of energetic materials due to the presence of destabilizing impurities, incompatibility with surrounding materials, or ageing, with high sensitivity, precision and reproducibility. Vacuum stability test finds its wide application in qualification, surveillance, manufacture, quality control and research & development of a wide range of energetic materials.

**COMPLIANCE**
- STANAG 4556, 4147, 4022/4, 4023, 4230, 4284 and 4566
- **WINSTAB software: Examples**
- **Pressure transducer and test tube**

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**DTA552-Ex**
**differential thermal analyzer**

The DTA552-EX™ (Differential Thermal Analyzer) was developed specifically for the evaluation of thermal stability, purity (melting point), compatibility and decomposition parameters of all types of energetic materials including primary explosives or other hazardous exothermic substances.

Robust design of DTA552.EX™ makes the instrument the ideal choice for the characterization of explosive materials which explosions during the test would likely damage or destroy conventional thermal analyzers.

**ADVANTAGES & FEATURES**
- Robust design capable to withstand an explosion of up to several hundred milligrams of explosives
- Variability of applicable substance forms (paste, liquid, foam and corrosive)
- High sensitivity - direct contact of the thermocouple with the sample
- User-friendly software for data acquisition, analysis and archiving
- **COMPLIANCE**
- STANAG 4513 Ed. 2

**APPLICATION**
The DTA552-EX™ detects and analyzes thermal changes (melting, polymorph transformation, evaporation and thermal decomposition) occurring in the sample and allows for the evaluation of the thermal stability, purity, compatibility and the thermal decomposition parameters of all types of energetic materials.

The DTA552-EX™ is an essential instrument for quality control of energetic materials or raw materials, characterization and qualification of new compounds, in-service surveillance, research and development and many other testing programs.

**ADVANTAGES & FEATURES**
- Low costs of investment and operation
- **COMPLIANCE**
- STANAG 4491

**AET402**
**explosion temperature apparatus**

The AET402™ (Automatic Explosion Temperature Apparatus) is used for the determination of the explosion (ignition) temperature of energetic materials submitted to the thermal load (heat).

**ADVANTAGES & FEATURES**
- Measures up to 5 samples simultaneously
- Robust heating block design
- Time-saving automatic determination of the explosion temperature

**APPLICATION**
The AET402™ is the most frequently used as a quality-control instrument in the manufacture of explosives, pyrotechnics mixtures and propellants. The AET402™ can also be used for the determination of time-to-explosion data (time needed for the ignition of a sample at a given constant temperature). The AET402™ provides a fast and simple evaluation of the thermal sensitivity of energetic materials with up to 5 samples simultaneously heated. Compared to “classic” explosion temperature instrumentation, the AET402™ incorporates an automatic detection of the explosion temperature by means of thermocouples, avoiding necessity of the operators to visually observe the test for the whole time of its execution.

**COMPLIANCE**
- STANAG 4513 Ed. 2

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**SW + ACCESSORIES**
- **STANAG 4556, 4147, 4022/4, 4023, 4230, 4284 and 4566**
- **WINSTAB software: Examples**
- **Pressure transducer and test tube**
**Performance Tests**

**THERMAL STABILITY TESTS**

The MBP™ (Minimum Burning Pressure Apparatus) is used for the determination of the minimum burning pressure of emulsion explosives ignited by a hot wire in a closed vessel under high pressure conditions. The pressure and temperature of the sample are recorded. The MBP™ is a completely new approach to advanced stability and sensitivity testing of emulsion explosives, developed in cooperation between OZM Research® and Canadian Explosives Research Laboratory (CERL).

**Applications**

While emulsion explosives are normally quite safe for handling, accidents connected with them are however still occurring and conventional methods of stability or sensitivity testing are not representative enough to discover their risky behavior. It has been found that most of the accidents happened during pumping, manufacturing and transporting of emulsion explosives when the materials were subjected to elevated pressures and temperatures. The determination of the minimum burning pressure has therefore become one of the most important safety characteristics of emulsion explosives.

The MBP™ is primarily designed for testing of emulsion explosives during both their development and industrial manufacture. Small testing trials with MBP™ can provide very important information about the emulsion explosive's safe pumping pressure. The MBP™ can also be used for other explosives, which are likely to be subjected to pressure and temperature loads.

**Advantages & Features**

- Certified closed vessel from noncorrosive material
- Working pressure up to 500 bar (with remotely controlled pressure manifold)
- Precise constant current power supply for thermal ignition of the sample
- Measurement of time-to-decomposition, terminal pressure of decomposition and decomposition rate
- Easy to handle, one-box design with simple connectivity and user-friendly software for data processing

Additional equipment and consultation for the development and testing of emulsion explosives is available on request.

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**Heating Blocks**

for testing thermal stability

Thermal and chemical stability is vital for the safe manufacture, storage, transportation and use of energetic materials. OZM Research® offers a wide range of instruments for the determination of the thermal and chemical stability for all types of energetic materials. Whether concerning quality control, hazardous materials or in-service surveillance OZM Research® has the most reliable and highest quality thermal stability testing equipment.

**Applications**

Traditional tests for the determination of the chemical stability of energetic materials (mainly propellants) are based on heating samples at elevated temperatures and detecting their reactive decomposition products (NDOs). This detection can be based on visual identification of colored gases above the sample (Heat Storage Test at 100 °C), a color change of indicator papers (Abel Test, Methyl Violet Test), the titration of acidity in a water extract of the gases (Bergmann-Junk Test) or with the determination of weight loss (Holland Test). Heating at elevated temperatures is also used in the artificial aging of propellants (STANAG 4117, AOP-48).

All devices for testing thermal stability consist of temperature controllers and heating blocks, each containing multiple (4 – 45) holder holes of appropriate size. Customized glass test tubes are supplied with each instruments.

**Compliance**

The instruments comply with all relevant standards for its particular heat test and can be further modified upon client’s request.

**Advantages & Features**

- Customized heating blocks available on request
- High precision and accuracy of the heating block temperature
- Fast operation time and proven testing procedures
- Independent alarm circuit (limit controller) for additional temperature control

**List of Available Heating Blocks**

- Abel Heat Apparatus - AET™
- Bergmann-Junk Apparatus - BeJu™
- Methyl Violet Apparatus - MVT™
- Heating Block for Accelerated Aging - HBA™
- Dutch Weight Loss Test (Holland Test) - CH100™

Others upon request

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**MBP**

Minimum Burning Pressure Apparatus

**Applications**

The MBP™ (Minimum Burning Pressure Apparatus) is used for the determination of the minimum burning pressure of emulsion explosives ignited by a hot wire in a closed vessel under high pressure conditions. The pressure and temperature of the sample are recorded. The MBP™ is a completely new approach to advanced stability and sensitivity testing of emulsion explosives, developed in cooperation between OZM Research® and Canadian Explosives Research Laboratory (CERL).
Optical signals can be used as a rich source of information on explosion processes and their effects on other materials. OZM Research® now offers complete solution for characterization of performance properties of energetic materials based on the optical methods. The optical probes are resistant to humidity and electromagnetic disturbances and allow our products to be used in almost any harsh and electrically noisy environment. High measurement precision is achieved by application of high frequency digitizers.

VOD815™ Velocity of Detonation Tester is a simple-to-use instrument designed for precise measurement of the velocity of detonation wave passing through the explosive charge or the burning rate of propellants using fiber optics. The detonation velocity is calculated from measured time intervals of light signals travelling between 8 optical probes positioned at known distances in the explosive charge.

APPLICATION
Detonation velocity of explosives or burning rate of propellants or pyrotechnics are some of the most important parameters characterizing these energetic materials. The VOD815™ can be used for quality control in the explosives manufacture, mining, research and development.

ADVANTAGES & FEATURES
- 8 plastic optical fiber probes
- Impact resistant and waterproof transport case
- Battery charged instrument equipped with internal memory
- USB communication cable and software WinVOD for data acquisition

OPTIMEX 8
optical analyzer of explosion processes

ADVANTAGES & FEATURES
- 8 optical probes selected according to customer’s application (plastic or glass fiber)
- Complete light intensity-time profiles available
- Automatic data evaluation
- LCD display
- Battery charged instrument equipped with internal memory
- USB communication cable and data evaluation software

COMPLIANCE
- EN 13631-14 Explosives for Civil Uses – High explosives, Part 14: Determination of Velocity of Detonation

NEW!

OPTIMEX 64
advanced optical analyzer of explosion processes

APPLICATION
OPTIMEX® 64 is a valuable scientific instrument for optical measurements in research and development of energetic materials. It can be used for detonation velocity and detonation wave curvature measurements with unprecedented confidence level. With high number of fiber probes, the instrument’s capabilities resemble those of high speed streak camera. OPTIMEX® 64 may also find its use in measurements of strong shockwave velocities in inert materials, detonation temperature or timing of shock to detonation transitions. Using continuous optic probes, detonation velocity can be measured on millimeter scale, in multiple charges at once, or shock wave shapes can be traced in explosive charges with complex shapes.

ADVANTAGES & FEATURES
- Up to 64 optical probes selected according to customer’s application (plastic or glass fiber)
- Full light intensity-time profiles available
- User adjustable light signal gain
- Continuous optic probes applicable
- Automatic or manual data evaluation
- PC with instrument control and data evaluation software

COMPLIANCE
- EN 13631-14 Explosives for Civil Uses – High explosives, Part 14: Determination of Velocity of Detonation

OPTIMEX® 64 advanced optical analyzer of explosion processes uses up to 8 to 64 fiber optic probes to visualize light intensity of the explosion or detonation wave in time. This allows detonation velocity and detonation wave curvature to be measured more precisely and with better confidence than ever before thanks to full light signal processing availability. The probe number and type can be selected according to the customer’s needs.

APPLICATION
OPTIMEX® 64 is a valuable scientific instrument for optical measurements in research and development of energetic materials. It can be used for detonation velocity and detonation wave curvature measurements with unprecedented confidence level. With high number of fiber probes, the instrument’s capabilities resemble those of high speed streak camera. OPTIMEX® 64 may also find its use in measurements of strong shockwave velocities in inert materials, detonation temperature or timing of shock to detonation transitions. Using continuous optic probes, detonation velocity can be measured on millimeter scale, in multiple charges at once, or shock wave shapes can be traced in explosive charges with complex shapes.

ADVANTAGES & FEATURES
- Up to 64 optical probes selected according to customer’s application (plastic or glass fiber)
- Full light intensity-time profiles available
- User adjustable light signal gain
- Continuous optic probes applicable
- Automatic or manual data evaluation
- PC with instrument control and data evaluation software

COMPLIANCE
- EN 13631-14 Explosives for Civil Uses – High explosives, Part 14: Determination of Velocity of Detonation

NEW!

PHOTONIC DOPPLER VELOCIMETER
PDV is a laser interferometer system for determination of continuous velocity-time profiles of flying objects such as explosively accelerated expanding cylinders, metal plates, concrete walls, etc. The maximum velocity which can be measured lies typically in the range from hundreds to several thousand meters per second. Time resolution of velocity histories reaches 10s of nanoseconds. The system can be mounted in a durable 19” rack box or used as a tabletop apparatus with up to four measurement channels available.

APPLICATION
The measurement of velocity profiles of explosively accelerated materials can be used for inferring key properties of high explosives such as particle velocity, detonation pressure, Gunney energy and parameters of James-Williams-Lee equations of state. Unlike Hess or Kast tests which are used for relative determination of brittleness, PDV allows direct measurement without the need of comparison with standard samples. Typical testing procedures where the instrument can be used are cylinder expansion test and flyer plate test. The use of the PDV system is not limited to explosives but includes high energy physics, plasma physics, construction and engineering.

ADVANTAGES & FEATURES
- Up to 4 active laser channels
- Velocity measurement in the range from 0 to 10 km/s with extreme time resolution
- Software for data evaluation included
- Eye safety thanks to all fiber optics design

NEW!

PERFORMANCE TESTS
PERFORMANCE TESTS
PERFORMANCE TESTS
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PERFORMANCE TESTS

BCA500™ (High pressure bomb calorimeter) is an advanced combustion calorimeter designed for the rapid determination of the calorific values of solid and liquid samples. Compared to other commercial calorimeters, the BCA500™ incorporates a high pressure bomb allowing to safely determine combustion heats of energetic materials under a wide range of conditions.

**APPLICATION**
The BCA500™’s robust and precise design allows its use in the most demanding applications for determination of combustion heat of energetic materials during their research, development, manufacturing quality control, in-service surveillance. The BCA500™ is however not designed for the testing of materials in a detonation regime - see our detonation calorimeters DCA5 and DCA50 for this application.

**ADVANTAGES & FEATURES**
- Superb resolution of thermometers as low as 0.00001 K
- Built-in dynamic pressure sensor with a sampling rate of 2 MHz
- High strength stainless steel detonation chamber for testing in vacuum, air, nitrogen, argon, oxygen etc.
- Fully automatic operation, data acquisition and results evaluation
- Advanced water management system for conditioning, dosing and emptying
- All water tanks, valves, heaters, chillers, level and temperature sensors are included
- Built-in bomb manipulator and detachable cart for easy positioning
- Inbuilt manipulator for bomb positioning and detachable cart

Testing conditions in BCA500™ bombs

<table>
<thead>
<tr>
<th>Bomb</th>
<th>Conditions</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>OK-1/2</td>
<td>NO NO YES</td>
<td>Fuels and other combustible materials. Bayonet lock for fast and easy operation.</td>
</tr>
<tr>
<td>DC-1</td>
<td>YES YES NO</td>
<td>Pyrotechnic mixtures. High pressure design.</td>
</tr>
<tr>
<td>EX-1/2</td>
<td>YES YES NO</td>
<td>Fuels and other combustible materials. Ignitable explosives and propellants. Rigid design with thread lock.</td>
</tr>
</tbody>
</table>

**SAMPLE MATERIALS**
- Energetic materials – combustible high explosives, propellants, pyrotechnics and other ignitable explosives
- Fuels – oil, coal, wood etc.
- Waste material – plastics, water containing samples, PVC and others
- Polymers and other industrial materials
- Metal powders and high energy composite materials with AP

SW AND PRODUCT DETAILS

Detonation calorimeters DCA5™ and DCA50™ determine the heat produced by the detonation of energetic materials. Both utilize the classical constant volume arrangement combined with OZM Research’s durable bomb design.

**APPLICATION**
Detonation calorimeters DCA5™ (5.3-L volume, 25 g TNT capacity) and DCA50™ (14.5-L volume, 50 g TNT capacity) are well suited for characterization of performance properties of high explosives in their research, development, manufacture and in-service surveillance.

**ADVANTAGES & FEATURES**
- Superb resolution of thermometers as low as 0.00001 K
- Built-in dynamic pressure sensor with a sampling rate of 2 MHz
- High strength stainless steel detonation chamber for testing in vacuum, air, nitrogen, argon, oxygen etc.
- Fully automatic operation, data acquisition and results evaluation
- Advanced water management system for conditioning, dosing and emptying
- All water tanks, valves, heaters, chillers, level and temperature sensors are included
- Built-in bomb manipulator and detachable cart for easy positioning
- Inbuilt manipulator for bomb positioning and detachable cart

**PRODUCT DETAILS AND ACCESSORIES**
- Inbuilt water conditioning system
- Filling arrangement for vessels EX-1/2
- Bomb EX-1
- Bomb DC-1
- Dynamic Pressure Record of pressed TNT charge
- DCA5™ on-site
Industrial detonation chambers are automated machinery designed to withstand repeated detonations with equivalent of 2 - 16 kg TNT and applied in various programs, such as:
• Scientific detonation experiments
• Quality control tests in explosives or ammunition manufacture
• Explosive working of metals (hardening, cladding, welding, cutting, pressing)
• Environmentally friendly disposal of explosive wastes
• Forensic investigation and safe disposal of improvised explosive devices

During more than 40 years of service, these industrial detonation chambers have proven to have a long service life (> 100,000 detonations) and reliable, safe and simple operation with low investment and operating costs.

The industrial detonation chambers are manufactured in two design lines – vertical and horizontal – both equipped with hydraulic systems, control panels for fully automatic remote operations and, where required, with appropriate pollution abatement systems for off-gases. Electrical and optical measuring equipment for investigation of the explosion processes can be installed in the multiple ports at the chamber body.

VERTICAL DETONATION CHAMBERS
• For 2 kg TNT
• Open and close with back-folded cupola
• Suitable for compact charges
• Equipped with anti-fragment shields

HORIZONTAL DETONATION CHAMBERS
• For 8 – 16 kg TNT
• Open and close by a cover moving on rails
• Suitable for elongated charges.
• Best for explosive metalworking operations

Laboratory detonation chambers allow to safely carry out detonation experiments directly inside explosives laboratories. They can be used for scientific investigations, research, development and testing in the area of energetic materials, confined explosions and related applications such as explosive forming of metals or safe disposal of laboratory explosive wastes.

Laboratory detonation chambers are designed to withstand repeated detonations of up to 250 g TNT. The explosive charges are installed on a working table inside the chambers (KV series) or hanged through the top lid (LDC series) and safely fired by electric detonators connected to firing contacts. Gas-tight valves on the chamber body enable creating different gas atmospheres within the chamber, as well as sampling, evacuation and flushing of the post-explosion gases. The chambers are furthermore equipped with multiple ports, which can be used for installing various optical or electrical measuring instruments for investigations of the detonation processes.

Several full-scale performance and sensitivity tests can be safely executed inside the chambers such as measurement of detonation velocity, pressure-time and temperature-time records of confined explosions, brisance and explosive power tests (Hess, Kast, PDT, Trauzl), high-speed optical and X-ray photography, gas tests, cook-off tests, electrostatic discharge sensitivity tests, large-scale thermal stability tests etc.

**Laboratory Detonation Chambers**

<table>
<thead>
<tr>
<th>Type</th>
<th>TNT Equivalent (g)</th>
<th>Weight (kg)</th>
<th>Material</th>
<th>Atmosphere</th>
</tr>
</thead>
<tbody>
<tr>
<td>LDC 10</td>
<td>10</td>
<td>30</td>
<td>Stainless steel</td>
<td>Vacuum, air, inert gas or oxygen (up to 30 bar)</td>
</tr>
<tr>
<td>LDC 25</td>
<td>25</td>
<td>60</td>
<td>Stainless steel</td>
<td></td>
</tr>
<tr>
<td>LDC 50</td>
<td>50</td>
<td>190</td>
<td>Stainless steel</td>
<td></td>
</tr>
<tr>
<td>KV 150M2</td>
<td>150</td>
<td>1100</td>
<td>Steel</td>
<td>Air or inert gas (up to 1 bar)</td>
</tr>
<tr>
<td>KV 250M4</td>
<td>250</td>
<td>2200</td>
<td>Stainless steel</td>
<td></td>
</tr>
</tbody>
</table>

**POLLUTION ABATEMENT SYSTEM (PAS) FOR DETONATION AND BALLISTIC EXPERIMENTS**

Autonomous system for cleaning off-gases from experiments in detonation chambers and ballistic vessels before their releasing to the outside air, for the environmental protection and occupational hygienics.

Four-step gas filtration process involving:
• Separation of coarse particles (cyclone)
• Filtration of fine particles (particle filter with automatic dust-off)
• Absorption of submicron particles and acid gases (turbulent alkaline scrubber)
• Adsorption of semi-volatile organic compounds and/or mercury vapors (adsorbers with surface-coated active carbon)

PAS design was proven in industrial operations at multiple installations since 2003 for serial disposal of ammunition elements with heavy metal content. Filtration effectiveness (999.9% for heavy metals, 99.5% for acid gases) proven by repeated emission control tests by independent accredited laboratories. Fully automatic operation without direct presence of the operators. Containerized version available, built-in a 20’ HC shipping container.
PERFORMANCE TESTS

APPLICATION
The measuring system PREWAQ™ offers measurement of pressure wave parameters generated by any kind of explosion. This universal tool could be applied not only in the open field but could be also designed for measurement in closed spaces (e.g., explosion chamber). The DT version of the system is intended for measurement of explosions driven by deflagration mechanism so the change of parameters happen in order of microseconds. According to required measurements (type, speed and maximum measured values) the PREWAQ™ is equipped with the set of sensors together with appropriate cables and stands or holders.

DESCRIPTION
1) Water resistant pressure sensor and leading cables
2) Signal conditioning and data acquisition unit
3) Unit and software for data evaluation

FEATURES
• Standard measurement on either 4 or 8 input channels according to user needs.
• Simultaneous measurement of pressure, temperature (heat radiation), velocity of detonation and/or light.
• System is intended for measurement, storage and evaluation of explosion parameters.
• Standard measurement rate is since 3 Msps per channel up to 25 Msps per channel.
• Graphical output of measured data in formats suitable for spreadsheet and database editors is a standard.
• User-friendly software for apparatus operation, data recording and evaluation.

OPERATION
The PREWAQ™ underwater explosion test gives more reliable results compared to these classic mortar tests are not applicable. Compared to these classic larger critical diameters, for which the classic Trauzl and ballistic determination of working ability of industrial explosives with explosion chamber.

UWB
underwater pressure wave measurement system

APPLICATION
The UWB™ measurement system offers determination of pressure wave parameters generated by underwater explosions. The instrument is specifically designed for representative determination of working ability of industrial explosives with larger critical diameters, for which the classic Trauzl and ballistic tests are not applicable. Compared to those classic tests, the underwater explosion test gives more reliable results and allows the user to calculate values of the explosive energy released.

System consists of three parts:
1) Water resistant pressure sensor and leading cables
2) Signal conditioning and data acquisition unit
3) Unit and software for data evaluation

FEATURES
• Precise measurement and evaluation of the important explosion parameters
• Durable, simple and user friendly equipment for field measurement
• User-friendly software for system operation, data recording and evaluation
• Graphical output of measured data in formats suitable for spreadsheet and database editors
• Low operating expenses

SOFTWARE IS DEVELOPED
BY DR. MUHAMED SUCESKA

EXPLO5™ a thermochemical computer program that predicts the performance of ideal high explosives, propellants, and pyrotechnic mixtures on the basis of chemical formula, heat of formation, and density. As such, EXPLO5™ is a useful tool in synthesis, formulation, and numerical modelling of energetic materials.

The current version of EXPLO5™ program (Version V6.03) has significant improvements over the previous (V6.02). The most important improvement in the V6.03 version is incorporation of new equations state: Exp-6 EOS, based on the statistical mechanical theories and Exp-6 potential (instead of JCZ3 EOS), and so-called Modified BKW EOS. Thanks to these, the accuracy of prediction of detonation parameters has been considerably improved.

The important characteristic of the program is possibility to treat a larger number of chemical elements that constitute reactants. The Database includes 35 elements: C, H, N, O, Al, Cl, Si, F, B, Ba, Cu, Na, P, Li, K, S, Mg, Mn, Zr, Mo, Cr, Fe, Ni, Pb, Sb, Hg, Re, Te, I, Xe, Re, W, Sr, Cr, and Br. This makes EXPLO5™ capable of predicting detonation and combustion performance of wide variety of high explosives, propellants, and pyrotechnic formulations.

EXPLO5™’s Database is updated with new reactants and products — it contains now around 350 reactants, more than 600 products (including different phases of the same product). The Database access can be customized for multiple users on one computer, and can be easily manipulated (add/remove/modified reactants and products).

PRODUCT DATA
The progress of calculation can be followed from the Progress window. The summary results window. A user can save detail calculation results in MS Excel file format (detonation run) or in CSV format (combustion run).
The TPT Series™ (Testing Pressure Vessel Series) is used for the classification of hazardous and dangerous substances (flammable and energetic materials) as required by UN testing standards by the means of the measurement of the pressure rise time inside a defined vessel.

**Advantages & Features**
- Universal testing pressure vessel provided with a set of adapters for varying standardized testing procedures
- Vessel constructed for general testing of different materials (surface coated by DLC - diamond like carbon)
- Customized testing vessels for specialized purposes are available on request
- Precise and robust measurement of pressure/time rise
- Simple operation and evaluation of results – software for control, measurement, calibration and results evaluation
- Bursting membranes for the safe testing of unknown samples
- Two modes of ignition (electric igniter or by hot wire by controlled impulse of current)

**Application**
Identifying the pressure rise time is not the only function of the TPT series™; it can also be useful for the characterization and general testing of unknown energetic materials. The sample is properly situated and then it is heated or ignited in a closed pressure vessel via a hot wire or a fuse head while the pressure-time profile is being recorded. The burning rate, maximum pressure, pressure rise time, etc. are recorded by the TPT. Obtained results serve for hazard classification of energetic materials, pyrotechnic substances, oxidizing solids and liquids.

**Compliance**
- UN Recommendation on the Transport of Dangerous Goods, Manual of Tests and Criteria, 2010 - Test 1(c)(i), Test 2(c)(i), Test C.1: Time/pressure Test, or Test O.2: Test for Oxidizing Liquids
- UN Recommendation on the Transport of Dangerous Goods - HSL Flash Composition Test
- Power source for UN Recommendation on the Transport of Dangerous Goods - Test O.1: Test for Oxidizing Solids

**SW + Accessories**
- Measurement module serves for measurement and record of pressure rise and to control MCU unit
- Calibration module serves for calibration of a pressure transducer connected together with the MCU
- TPT vessel parts
- Using TPT module - to create the test protocol

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The EDA™ (Electro-Explosive Devices Analyzer) is a measuring and control unit used for the ignition and measurement of the pressure profile of a burning sample of energetic materials usually in a closed vessel. The EDA™ allows for the precise adjustment of ignition current level and time. Maximum pressure, burning time, ignition delay time, current and voltage level, pressure gradient, pressure rise time and/or the burning rate may be recorded and evaluated.

**Application**
The EDA™ is the perfect device for quality control, safety testing, research and development of energetic materials. The EDA™ is commonly found in the testing of electric initiators like squibs, fuses, etc. The determination of ballistic properties of small-caliber gun powders can also be conducted. The explosive and automotive industry, research and development and quality control laboratories around the world rely on the EDA™ for its precision and reliability.

**Advantages & Features**
- Precise adjustment and recording of current pulse parameters
- Recording and evaluation of pressure/time dependence
- Simple operation and evaluation of results
INTERIOR BALLISTIC TESTS

The Closed Vessels NV Series™ (Small Scale Manometric bombs) is used for measuring, with constant volume conditions, the pressure profile of a burning sample not only powders and compact energetic materials but also igniters and electrical squibs in a small closed vessel.

APPLIIIICATION
The typical internal volume range of the NV Series™ is 3, 5, 10 or 20 cm³ with maximum pressure of up to 5000 bars. Maximum pressure, burning time, ignition delay time, pressure gradient, pressure rise time, or burning rate may be acquired from the test records. The Closed Vessels NV series™ is designed for quality control, safety testing, research and development of energetic materials including primary explosives, propellants and pyrotechnic substances. The Closed Vessels NV Series™'s typical application is found in the testing of electric initiators like squibs, fuses, etc., as well as the determination of ballistic properties of small-caliber gun powders. The Closed Vessels NV series™ is so versatile it is found in all manner of explosive and automotive, research and development and quality control laboratories.

ADVANTAGES & FEATURES
• High pressure vessel up to 5000 bars
• Standard volumes 3, 5, 10 and 20 cm³
• Electrical ignition
• EDA™ – Electro-Explosive Device Analyzer – control unit with adjustable pulse current supply and speed measurement
• Simple operation and evaluation of results – control and evaluation software
• Customization is typical
• A simpler and less expensive alternative for the determination of the ballistic properties of small-caliber gun powders

The Closed Vessels RB Series™ (Manometric bombs) is used for the measurement of the ballistic parameters of gun propellant in a closed vessel up to 700 cm³ volume.

APPLICATION
The Closed Vessel RB series™ is used for the measurement of the pressure increase curve during the burning process of various gun propellant types in a constant volume. The behavior of the propellant is predicted (e.g. max pressure, vivacity, pressure gradient, cavolame, burning rate, etc). The Closed Vessels RB Series™ is designed for research and development, quality control, and safety testing of all kinds of gun propellants. Due to the maximised efficiency of the Closed Vessel RB series™ during testing the actual number of shots from a real weapon can be minimised—saving both lab time and money and limiting safety hazards.

ADVANTAGES & FEATURES
• High pressure vessel up to 5000 bars
• Standard volumes 40, 80, 200, 400 and 700 cm³
• Two outlet valves, cooling jacket, temperature conditioning unit, temperature sensor and positioning stand
• Two modes of ignition—electrical or mechanical
• Precise and high-speed measurement of pressure/time rise
• Simple operation and evaluation of results
• Electrical or mechanical ignition
• Precise and high-speed measurement of pressure/time rise
• Simple operation and evaluation of results

COMPLIANCE
• MIL-STD-266
• STANAG 4115

The Closed Vessels RB Series™ is so versatile it is found in all manner of explosive and automotive, research and development and quality control laboratories.

ADVANTAGES & FEATURES
• Possibility of modification according to customer requirements
• Long service life
• Universal range of application
• Possibility of modification according to customer requirements

PRESSING TOOLS

Pressing tools

We can also provide a complete pressing station equipped with remote central hydraulic press and installed within an explosion-proof bunker. Design of the pressing tools and complete station originates from long-term experience with these manufacturing tools in the explosives and ammunition industry.

PRESSING TOOLS

Several sensitivity or performance tests (gap tests, brisance tests, detonation velocity, etc) require the use of samples of high explosives or pyrotechnics in a form of pressed pellets. OZM Research offers a wide range of pressing tools for preparation of the charges, ranging from 5 mm to 100 mm charge diameter and creating pellets with flat surfaces, detonator entries, central holes or conical shapes.
**Stojan vessel SV-2**

propellants burning rate apparatus

The SV-2™ (Stojan Vessel) is used for the effective measuring of the pressure dependencies of the burning rate of solid rocket propellants. The SV-2™ test is a single shot experiment saving lab time and material expense. A single shot is sufficient for plotting burning rates in the whole pressure range. Samples are similar to that of a Subscale Rocket Motor. The SV-2™ is also adept at the testing of propellants at constant volume conditions up to 50 MPa. The SV-2™ is a simple-to-use instrument capable of fully replacing the old complicated Strand Burner equipment.

**APPLICATION**

The SV-2™ is used for research and development and the production control of solid rocket propellants. Typically, the influence of components (catalysts, energetic additives etc.), homogeneity, initial temperature, etc. can be observed in the burning rate profile. The determination of the burning rate of solid rocket propellants is usually carried out in a Strand Burner or in a sub-scale rocket motor at constant pressures. With a Strand Burner, about 10 individual shots are necessary to get the required burning rate plot in the whole pressure range while using very complicated and expensive instrumentation.

In the SV-2™ the sample is burnt in a constant-volume vessel while the pressure profile is measured. An advanced mathematical procedure based on the most modern computational and ballistic procedures is then applied to calculate the pressure dependency on the burning rate from the single shot experimental data. Such mathematical procedures have proved to be in a correlation with experimental results of multiple-shot measurements using the Strand Burner (Crawford Bomb) or a sub-scale rocket motor (as TRM35™).

OZM Research® can readily supply all equipment and procedures for sample preparation and conditioning for both the SV-2™ and the TRM35™ instruments (hydraulic press, pressing tools, molds for casting, cutting machines, cutting tools, temperature and climatic chambers, etc).

**ADVANTAGES & FEATURES**

- Quick assessment of burning rate of new or modified rocket propellant formulations for testing, research and development
- Laboratory sub-scale rocket motor available for validation of measurement

**PRODUCT DATA**

- Pressure p - time t dependencies measured using STOJAN VESSEL
- Burning rate u (m/s) - pressure p (MPa) dependencies calculated from experimental data measured using STOJAN VESSEL
- Comparison of burning rate/pressure curve obtained by STOJAN VESSEL (line) and by Small Testing Rocket Motor (points)

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**RMM**

apparatus for rocket motor ballistic measurement

The RMM™ (Rocket Motor Ballistic Measurement) is designed for the measurement of thrust and pressure profiles of solid rocket motor rocket motors (mounted on stand) during static testing.

**APPLICATION**

The RMM™ is ideal for the research and development of new propellants, rocket motors and pyro-cartridges. The RMM™ is also an excellent tool for the verification of results obtained by both the Strand Burner test and/or the STOJAN VESSEL test. Ever adaptable the RMM™ is also employed for quality control and the assessment of rocket motors’ service lines. RMM™ can be also used for measurement of different types of closed vessels, pyro-cartridges for aircraft ejection systems, etc.

**ADVANTAGES & FEATURES**

- Robust pressure and thrust measurement with time
- Pressure up to 100 MPa, Thrust up to 1000 kN
- Electrical ignition unit – safety switch, ignition current pulse
- Simple operation and evaluation of results: measurement and evaluation software
- Tailored modifications upon client’s request (adapters, evaluation, data sheet, etc)

**APPLICATION**

The RMM™ and sub-scale rocket motors in general are a relatively new approved procedure in NATO STANAG standards. More individual shots are necessary to get the required parameters (e.g. burning rate, erosion influence, etc.) in the whole pressure range. The Subscale Rocket Motor is recommended as more universal supporting method. Measurement and evaluation by RMM™ is generally supplemented.

**ADVANTAGES & FEATURES**

- Wider assessment of ballistic behavior of new or modified rocket propellant formulations
- Pressure and thrust measurement with time
- Customizable according to client’s needs
- The results mimic that of a real rocket motortesting

---

**TRM35**

apparatus for subscale rocket motor measurement

The TRM35™ (TESTING SUB-SCALE ROCKET MOTOR) is designed for the measurement of the burning parameters of solid rocket propellants in a small scale rocket motor. During static testing the, TRM35™ measures and evaluates the pressure and thrust profiles of solid propellant in small testing rocket motors. The TRM35™'s design and results are close to a real rocket motor. The TRM35™'s operation is simple and is capable of meeting a wide range of testing conditions.

**APPLICATION**

The TRM35™, and sub-scale rocket motors in general, are a relatively new approved procedure in NATO STANAG standards. More individual shots are necessary to get the required parameters (e.g. burning rate, erosion influence, etc.) in the whole pressure range. The Subscale Rocket Motor is recommended as more universal supporting method. Measurement and evaluation by RMM™ is generally supplemented.

**ADVANTAGES & FEATURES**

- Wider assessment of ballistic behavior of new or modified rocket propellant formulations
- Pressure and thrust measurement with time
- Customizable according to client’s needs
- The results mimic that of a real rocket motortesting

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GAS & DUST TESTING INSTRUMENTS

APPLICATION
The MIE-D 1.2™ (Minimum Ignition Energy Tester) is used for the measurement of the minimum amount of energy required in a normal atmosphere - within a specified dust dispersion of a substance which will result in an ignition. The MIE-D 1.2™ is an essential part of a standard set of tests used for the assessment of potential industrial plant hazards and by certifying bodies, universities and other research organizations to characterize the hazards of dusts.

ADVANTAGES & FEATURES
• Spark energy range of from 1 mJ up to 3 J
• MIE-D 1.2™ is able to be equipped for the measurement of the real spark energy
• Three modes of spark triggering (high-voltage switch and a moving electrode, by dust cloud itself)
• Pneumatically operated and automatically controlled
• Durable stainless steel case

COMPLIANCE
• Minimum ignition energy of dust dispersions according to EN 13821

PRODUCT DETAILS

The Minimum Ignition Energy (MIE) of a combustible substance is the lowest value of the electrical energy stored in a capacitor which upon discharge is just sufficient to ignite a fuel/air mixture at atmospheric pressure and room temperature. The MIE of dust dispersions is one of the key parameters for an assessment of the hazard situation in plants with dust appearance establishing the extent and, hence, the cost of protective measures.

SAFETY ENGINEERING

testing explosibility of industrial explosive atmospheres

MIE-D1.2
min ignition energy of dust dispersion apparatus
**CA20L & CA1M3**

Explosion chambers for gas and dusts

Explosion chambers are used for the measurement of the basic explosion characteristic of flammable dusts, gases and vapors. The characteristics measured are the maximum explosion pressure, the maximum rate of pressure rise, the lower and upper explosibility limits and limiting oxygen concentrations.

**APPLICATION**

Two sizes of explosion chambers are mandated by international standards for dust explosion testing – 1 m³ (our CA1M3™) and 20 l (our CA20L™). For gas and vapor samples which require a volume larger than 5 l the CA20L™ is recommended.

Testing methods using the CA1M3™ and the CA20L™ are an essential part of a standard set of tests used by certified bodies, Universities and other research organizations to characterize dust, gas and vapors. Design of mitigating and protective measures such as explosion venting devices, automatic suppression or partial inerting, without knowledge of these explosion parameters is unimplementable.

**PRODUCT DETAILS**

**ADVANTAGES & FEATURES**

- Fully automated and remote-controlled machinery
- Robust design with 30 barg of operating and 40 barg of testing pressures
- Both the CA1M3™ and the CA20L™ may be equipped with heating for measurements under elevated temperatures up to 200 °C

**COMPLIANCE**

- EN 14034 (1-4) sets up 1 m³ explosion chamber (our CA1M3™) as a standard instrument for measurement of maximum pressure, rate of pressure rise, lower explosion limit (LEL) and limiting oxygen concentration (LOC) of dust dispersions. 20 l sphere (our CA20L™) is an alternative of 1 m³ explosion chamber given by EN 14034 (1-4)
- Both CA1M3™ and CA20L™ could be delivered with instrumentation for measurement of explosion parameters of gases and vapors according to EN 15967 (maximum pressure and rate of pressure rise), according to EN 14756 (LOC) and EN 1839 (explosion limits)

**CA1M3™ Explosion Chamber**

**CA20L™ Explosion Chamber**

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**AIT551**

Autoignition temperature of liquids apparatus

Autoignition temperature is the lowest temperature at atmospheric pressure at which a substance will burst into flame in the absence of an external source of ignition (spark or flame). The AIT (Auto-Ignition Temperature Tester) is used for the determination of the auto-ignition temperature of both liquid and solid chemicals through means of visual observation and sample temperature measurement.

**APPLICATION**

The measurement of the autoignition temperature of substances is essential for industry and technologies employing any high temperature operations. Liquid materials after exposure to temperatures may cause flammable vapors which in turn may lead to an explosion. The AIT is ideal for emerging technologies, operational safety control, research and development among many other applications. The results obtained are used for the classification of temperature class.

**ADVANTAGES & FEATURES**

- Dynamic mounting thermocouples allow for the use of several different types of banks
- Automatic detection of ignition of the sample in the flask
- Specially designed oven door for easy handling of the flask
- Software evaluation of temperature records
- Corrosion resistant stainless steel case

**COMPLIANCE**

- ASTM 6659 – 78: Standard Test Method for Autoignition Temperature of Liquid Chemicals
- EN 14522: Determination of the auto ignition temperature of gases and vapours
- EN 15188: Determination of the spontaneous ignition behaviour of dust accumulations

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**RsIT**

Relative self-ignition temperature of solids apparatus

When a solid spontaneously ignites at elevated temperatures this phenomenon is called self-ignition. The RSIT™ (Relative Self-Ignition Temperature for Solids) device is used to measure a solids self-ignition temperature. The RSIT™ is a preliminary used for screening tests for the lowest possible ambient temperature at which a substance will spontaneously combust.

**APPLICATION**

The self-ignition temperature of a substance is a very important parameter for safety in handling, storing and transporting solid materials. This parameter is used to set the proper security conditions not just for chemical materials but other substances as well. The results of the measurements are used as data for comparison with other methods of detecting the parameters of flammable materials.

**COMPLIANCE**

- NF T 20-036 (September 85). Chemical products for industrial use. Determination of the relative temperature of the spontaneous flammability of solids

**ADVANTAGES & FEATURES**

- A simple sample application and preparation of measurement using an external stand
- The possibility of forced ventilation up to 8.5LPM
- Testing container constructed from resistant steels for reuse
- Safety features (pressure relief, locking system) ensure a high level of safety operation
- Software evaluation of temperature records
- Resistant stainless steel case

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**CA1M3™ software**

**CA20L™ software**
The SHT150™ is a vital instrument used for the determination of a substance’s self-heating due to self oxidative heating and then decompose. The SHT150™ operates on the determination of the exothermal decomposition of sample being directly exposed to hot air at elevated temperatures.

**APPLICATION**
Spontaneous combustions and the destructive fires resulting from them have plagued all manner of industries from hotels, to construction and painting, to manufacturing and transportation and so on.

The outcomes the SHT150™ provides are used for the flammability classification of solid substances and/or mixtures. This classification is necessary for carriage by rail or other such transport of energetic materials throughout the EU, the USA and the UN.

**ADVANTAGES & FEATURES**
- Testing container made of resistant steels for reuse
- Stand for mounting the thermocouple in a defined position in the container
- A sight glass in the oven allows for optical control
- Software evaluation of temperature records
- Resistant stainless steel case

**COMPLIANCE**
- European agreement concerning the international carriage of dangerous goods by inland waterways (ADN) (2013)
- Convention concerning International Carriage by Rail (COTIF) Regulations concerning the International Carriage of Dangerous Goods by Rail (RID) (2013)

**PRODUCT DETAILS**
A schematic arrangement of the tester in accordance with UN Recommendation

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**SHT150**
self heating substance apparatus

**ATEX CHAMBERS**

**APPLICATION**
Ensuring the usage of certified compliant electrical equipment is vital for health and safety officers; operation directors; and any other decision makers in quality and safety control who play a role in inspecting or maintaining electrical installations in an explosive atmosphere.

A schematic representation of the offered technology; the blue arrows indicate the direction of the gas flow; the purple arrows indicate the collection of data from the measuring device to the control PLC and PC; the orange arrows show the direction of control commands.

**ADVANTAGES & FEATURES**
- Robust design of chamber with testing pressure of up to 70 barg
- Fully automated system equipped with the Swagelok instrumentation
- Sizes of the chamber can be customized according to client’s requirements
- Automatic generation of explosive atmosphere without loss of material through the PLC control

**COMPLIANCE**
- EN 60079-1. Technology enables testing of electrical device, which are intended for use in explosive gas atmospheres according to EN 60079-1 Electrical Apparatus for Explosive Gas Atmospheres - Part 1: Flameproof enclosure “d”

**PRODUCT DETAILS**
A schematic arrangement of the system is shown in the picture above
GAS & DUST TESTING INSTRUMENTS

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GAS & DUST TESTING INSTRUMENTS

The GASmix™ apparatus is an universal tool for both laboratory and industrial purposes. The GASmix™ prepares gas mixtures of precise concentrations for the purpose of testing. It is an essential instrument for technologies or tests which require diluting or mixing different gas mixtures with a specific desired flow, pressure and temperature.

APPLICATION
The GASmix™ apparatus is an universal tool for both laboratory and industrial purposes. The GASmix™ prepares gas mixtures of precise concentrations for the purpose of testing. It is an essential instrument for technologies or tests which require diluting or mixing different gas mixtures with a specific desired flow, pressure and temperature.

ADVANTAGES & FEATURES
- Customized design for a wide range of industrial and laboratory applications including portable instruments
- Easy automatic and remote adjustment and control of parameters of the output gas mixture using the PLC software and touch panel for fast settings of desired parameters (within 2 s)
- High precision of parameters for the output gas mixture (concentration 0,5%; gas flow 1%, pressure 0,25%, temperature 0,2%, repeatability 0,5%) independent of the pressure of input gases
- Wide range of gas flow from 10L/min to 10KL/min
- Unlimited number of inputs gases and output positions
- Distribution of gas mixtures of different concentrations to different areas
- High quality materials of components made only from special stainless steel
- PTFE allows for the preparation of different gases mixtures including the combustible (H2, O2, C2H2) and the toxically and corrosive (Cl2, NH3)
- Automatic detection of gas leaks for improved safety
- Fluent adjustment of concentrations (changes of concentration)
- Possible synchronization of GASmix™ with client’s existing technology and instruments

PRODUCT DETAILS

The measurement of ignition temperature is essential for industrial plants or technologies dealing with fuels, oils, and other combustible liquids. The SCT—100™ (Sustained Combustibility Tester) determines the ability of a substance to sustain combustion after ignition by flame.

APPLICATION
In the SCT—100™ a metal block with a concave depression (sample well) is heated to a specified temperature. A specified volume of the substance is transferred to the well and an ignition attempt is conducted. The SCT—100™ can test paints (including water-borne paints), varnishes, paint binders, solvents, petroleum or related products and adhesives. However it is not applicable to assessing the potential fire hazards of dried painted surfaces.

ADVANTAGES & FEATURES
- Measuring the flammability of liquids ranges from 25-75 °C
- Remote control ignition flame and burner shift
- Safety ignition of the burner flame
- Resistant stainless steel surface

COMPLIANCE
MIT1000
minimum ignition temperature tester

The MIT 1000™ (Minimum Ignition Temperature Tester) is used for the determination of the minimum temperature of a hot surface which leads to the degradation or the ignition of suspended dust particles.

APPLICATION
Knowing the minimum temperature of a hot surface which will lead to a dust cloud ignition provides invaluable information for the safety and prevention of fires/explosions in industries where unwanted dust production is found. With the aid of the MIT 1000™ risk analysis can be performed to identify areas of increased surface temperature, assess the risk level of a dust ignition and then finally suggest preventive measures.

ADVANTAGES & FEATURES
• Dust sample container designed OZM Research™
• After measurement the reservoir remains are less than 5% of the sample
• Dosage air pressure via an automatic electronic system and control software
• Identification of the ignition of dispersed dust is realized using a flexible mirror
• Recording, archiving and measured data analysis on PC
• Resistant stainless steel case

COMPLIANCE
• EN 50281-2-1 Methods of determining minimum ignition temperature

APPLICATION
Spontaneous dusty layer ignition is a great fear in any industry where unwanted dust particles are accumulated. Knowing the minimum temperature a hot surface must be to ignite a dust layer provides important information for the prevention of fires in process industries. The MIT 1000™ detects the thermal resistance of occurring dust to thermal stress. Potentially dangerous areas of possible dust ignition in manufacturing plants (with surface temperature increases) are identified during risk analysis continuing with assessing the level of risk generated by ignition of dust. Preventive measures against the ignition are then able to be identified and taken.

ADVANTAGES & FEATURES
• Hotplates designed with a non-corrosive abrasion resistant surface
• Ceramic and stainless steel ring as sample holder for a dust layer
• Dosing and cleaning stainless steel set for easy application of the sample
• Recording, archiving and measured data analysis on PC
• Resistant stainless steel case

COMPLIANCE
• EN 50281-2-1 Methods of determining minimum ignition temperature

Lit400
dust layer ignition temperature tester

The LIT 400™ (Dust Layer Ignition Temperature Tester) is intended for the determination of the minimum temperature of a hot surface leading to the degradation or ignition of dust layers of a defined thickness.

FRTA-I
concentration limits of flammability apparatus

The FRTA-I™ (Instrument for Concentration Limits of Flammability Determination) is designed to determine both the Lower Flammability Limit (LFL) and the Upper Flammability Limit (UFL) of various flammable gases or volatile liquids.

The FRTA-I™ operates on high-voltage electrical ignition and visual observations of flame propagation. It disperses flammable liquids in air at atmospheric pressures via vapor pressure.

APPLICATION
The FRTA-I™ is used to measure and describe the response of properties of materials, products, or assemblies to heat and flame under controlled laboratory conditions. The LFL and UFL of gases and vapors define the range of flammable concentrations in air. The flammability limits rely on the test temperature and pressure. The limits of flammability may be used to determine the guidelines for the safe handling of volatile chemicals and fire risk/hazard assessment—particularly end use.

ADVANTAGES & FEATURES
• Precise settings of experimental conditions (high voltage, pressure and temperature)
• Recording and display of pressure time curve after ignition for easy evaluation of results
• Safe operation of FRTA equipped by safety glass window and bursting membrane for the evacuation of fragments and pressure wave generated by explosion/implosion of glass testing vessel
• Remotely controlled firing (high voltage spark ignition)
• The maximum operating temperature of FRTA is 150°C
• Autonomous operation with no PC requirement

COMPLIANCE
• ASTM E 681 – 01

SW + PRODUCT DETAILS
SAFE LABORATORY
for safe storage of explosives from small samples to larger stocks

PORTABLE CONTAINERS
gas-tight explosion-resistant
safe laboratory storage of small explosive samples

**ADVANTAGES & FEATURES**
- Safe storage of sensitive or unstable samples
- All explosion effects contained inside, no release of shock wave, fragments, flame or toxic gases
- Overpressure safely released through manually opened valves
- Full protection of life and property in case of accidental explosion of stored explosive samples
- Zero safety distances: they can be stored directly inside laboratories
- Portable for transport of the explosive samples outside laboratories
- Interior made of antistatic rubber for eliminating risks of friction or spark discharge
- Quick opening and closing mechanisms
- J-025G and J-500G are certified for international transport of dangerous goods according to ADR/RID treaties

<table>
<thead>
<tr>
<th>Product Name</th>
<th>J-025G</th>
<th>J-120G2</th>
<th>J-200G</th>
<th>J-500G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity [g TNT]</td>
<td>20</td>
<td>120</td>
<td>200</td>
<td>500</td>
</tr>
<tr>
<td>Weight [kg]</td>
<td>7</td>
<td>25</td>
<td>90</td>
<td>400</td>
</tr>
<tr>
<td>Outside dimensions L x W x H [mm]</td>
<td>159 x 170 x 455</td>
<td>325 x 325 x 767</td>
<td>400 x 600 x 960</td>
<td>1250x792x852</td>
</tr>
<tr>
<td>Internal space L x W x H [mm]</td>
<td>175 x Ø 40</td>
<td>335 x Ø 72</td>
<td>450 x Ø 120</td>
<td>500 x 300 x 300</td>
</tr>
</tbody>
</table>

STORAGE MODULES
for expanding capacity of storage rooms (10 – 1000 kg TNT eq.)
containers for safe storage of larger stocks of explosive samples

**ADVANTAGES & FEATURES**
- Storage modules protecting against transfer of explosion (sympathetic detonation)
- Safety distances corresponding to the content of one module only (up to 2.5 kg TNT) despite total stored amount in the storage room (up to several tons)
- Minimization of safety distances / maximization of storage capacity of existing storage rooms
- Storage of otherwise incompatible classes of explosive materials in one room (e.g. detonators together with high explosives)
- Modules designed for mounting to sets with variable heights and widths
- Non-sparking and water-tight lids, antistatic rubber seals

<table>
<thead>
<tr>
<th>Product Name</th>
<th>ISS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity [kg TNT]</td>
<td>2 x 2.5 kg</td>
</tr>
<tr>
<td>Weight [kg]</td>
<td>245</td>
</tr>
<tr>
<td>Outside dimensions L x W x H [mm]</td>
<td>588 x 400 x 803</td>
</tr>
<tr>
<td>Internal dimensions of one tube Ø x L [mm]</td>
<td>300 x 500</td>
</tr>
</tbody>
</table>
EXPLOSIVES HANDLING TABLE

NEW!

APPLICATION
A working table designed for safer handling with highly sensitive explosive substances and devices such as primary explosives, pyrotechnic mixtures, detonators, primers or fuses. The reinforced steel working table structure and the front ballistic safety glass are protecting the head, body and legs of the operators against explosion and fragmentation effects of up to 10 g TNT charges. The table also provides the ESD protection necessary for safe handling the sensitive explosive materials.

ADVANTAGES & FEATURES
• Reinforced steel plates as a shock-wave and fragment-resistant worktop
• Removable fragment-resistant ballistic glass with protective film
• Leg protection by reinforced steel plate
• Adjustable working height
• ESD protected worktop
• Grounding points

PROTECTIVE TESTING CONTAINER

lightweight stainless steel protective container for safe execution of ballistic tests and disposal of explosive samples by burning

APPLICATION
Testing container for intra-laboratory experiments protecting against explosion effects (flame, high temperatures, flying fragments and residues, shock wave, overpressure) up to 10 g TNT eq.

ADVANTAGES & FEATURES
• Free volume of 50 L
• Designed and tested to resist explosions up to 10 g TNT eq.
• Static pressure resistance up to 16 bar
• Explosion-proof sandwich windows
• Equipped with bushings for firing cables, measuring cables, inert gases etc.
• Chimney to be connected to the lab ventilation system

Processing of metals

Processing of metallic and non-metallic materials using explosives
EXPLOSIVE PROCESSING OF METALS

- Labyrinth coolers
- Tube to tube-plate explosive welding and fixing
- Alignment of the socket pipes and the sheathing of rods or shafts
- Workpieces to be rolled down
- Semi-products for manufacturing tube plates for heat exchangers
- MAIN FOCUS OF ACTIVITIES:
  - Components are produced in cooperation with the respective client.
  - Degree, explosive forming—compaction of powder materials and explosive cladding of metallic and nonmetallic materials. In explosive welding such a tremendous amount of force is applied that metals (and in some cases nonmetals) which are typically difficult or even impossible to weld by conventional means are completely joined. With explosive hardening the power of the explosives’ shockwave is used to enhance metal structures such as railroad crossing frogs.

APPLICATION
Explosive processing requires mastery. OZM Research® is focused on developing and manufacturing explosion-clad bimetallic and multilayer metallic materials, explosive hardening and, to a lesser degree, explosive forming—compaction of powder materials and other applications. Intermediate products, structural elements and components are produced in cooperation with the respective client. OZM Research® offers its consultation services for the applicability of explosive processing of metallic and nonmetallic materials.

MAIN FOCUS OF ACTIVITIES:
- Bimetallic or multilayer sheets
- Semi-products for manufacturing tube plates for heat exchangers
- Workpieces to be rolled down
- Bearing materials and wear resistant materials
- Structural transition joints
- Semi-products for glass molds
- Alignment of the socket pipes and the sheathing of rods or shafts
- Tube to tube-plate explosive welding and fixing
- Labyrinth coolers
- Explosive hardening of manganese-steel construction elements

EXEMPLARY references

Albania
- Ministry of Defence

Algeria
- Ministry of Defence

Australia
- ORICA

Austria
- Austro Powder
- Josef Köhler Pyrotechnik
- Schaeffler

Azerbaijan
- Ministry of Defence

Belgium
- Royal Military Academy

Bulgaria
- Arduc Co.

Canada
- Canadian Explosives Research Laboratory
- General Dynamics
- OBICA
- Public Works and Government Services Canada

China
- Beijing Institute of Technology
- China Academy of Safety Science and Technology Beijing
- National Registration Center for Chemicals, SAWC (NRCC)
- Shenhua Group Zhongwei Energy Co.
- Xi’an Modern Chemistry Research Institute

Croatia
- Ministry of Defence
- University of Zagreb

Czech Republic
- Armament
- Explosia
- Inert Safety Systems
- Ministry of Defence
- Nuclear Research Institute
- Zavod Ammunition

Egypt
- Ministry of Defence

Finland
- PVITI

France
- CEA Le Ripault
- CNRS
- French-German Research Institute of Saint-Louis
- Herakles · Groups Sauron
- INERIS
- ONERA · French Aerospace Lab
- OUTREAU TECHNOLOGIES
- STAC

Georgia
- Express Diagnostic

Germany
- DASA
- DIEHL
- Dynamit
- Fisher-Scientific
- Fraunhofer-Institut für Chemische Technologie ICT
- Ludwig-Maximilians University of Munich
- Rheinmetall

Greece
- National Technical University of Athens

Hungary
- MA Arsenál
- TÜV Rheinland Interact Kft.

India
- DRDO
- TBBL
- YSSC

Italy
- AVIO Aerospace Propulsion

Japan
- National Institute of Advanced Industrial Science and Technology (AIST)

Jordan
- Ministry of Defence

Kazakhstan
- Ministry of Defence

Malaysia
- STROE Weapons Technology Division

NATO
- NAMSA

Netherlands
- TNO Prins Maurits Laboratory

Peru
- I.E.
- FAMESA

Poland
- Ramor Amorçage
- Instytut Przemysłu Organicznego
- Military Institute of Armament Technology
- Warsaw University of Technology
- Zakład Chemików „Nitro-Chem”

Portugal
- Ministério da Defesa Nacional

Romania
- Military Technical Academy

Russia
- Altai State Technical University
- Central Scientific Research Institute of Chemistry and Mechanics

Serbia
- Evros International
- Ministry of Defence

Singapore
- Advanced Material Engineering
- Advanced Technology Research Centre
- Nanyang Technological University
- National University of Singapore

Slovakia
- Komínka Defence
- Ministry of Defence

South Africa
- African Explosives Limited
- Denel Land Systems

South Korea
- Agency for Defence Development
- Hanwha
- Poscoam

Spain
- IATECH Tecnología
- Piramencia Ricardo Caballer

Sweden
- Dyno Nobel Sweden
- Fisher Scientific GTF
- FOI
- NAMMO LUB
- Swedish Defence Research Agency

Switzerland
- Armasuisse

Taiwan
- Precision International Corp.

Turkey
- Interhemispheres Industries
- Tubilisk Mamm
- Tubilek Seage
- Yavascalar

UK
- BAE Systems
- BREECO
- Chemistry Energetics UK
- Eley Limited
- University of Cambridge
- University of Warwick

UN
- International Atomic Energy Agency

USA
- Air Force Research Laboratory
- Alliant Techsystems Inc.
- ATK
- Fauzle & Associates
- Los Alamitos National Laboratories
- McAlester Army Ammunition Plant
- University of Southern California
- US Army ARDEC Picatinny Arsenal
- UTC Aerospace Systems

Vietnam
- Military Technical Academy
- Ministry of Defence
- Institute of Propellant and Explosive
- Chemical Manufacturer 21
- Industry Explosive Material Centre
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