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TÜV®



The AXS Group, Inc.
Attn. Mr. Michael Makki
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Suite 508
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USA

Your ref.:

-

Dated:

February 12th, 2015

Our ref.:

axsw0012-GMZ-BIE.docx

Date:

16.03.2015

TÜV-Austria Division Electrical Engineering performed for company "EFKON GmbH", Andritz Reichsstraße 66, A-8045 Graz, Austria the following explosion tests on the aluminum mesh product "eXess®" (expanded aluminum foil with a honeycomb structure):

- 1.) On 24.02.1997 a test acc. to test report ETW0904/ZR - ignition (with source heater plug Bosch 508 N9YC) in an acetylene-air mixture (app. 14 vol% acetylene) in a metal vessel 65x24x12cm
- 2.) On 07.05.1999 a test acc. to test report ETW0831/ZR - ignition (with source spark plug Champion 508 N9YC) in a propane-air mixture (app. 4.6 vol% propane)) in a metal vessel with volume 0.4m³.

Hereby we acknowledge that the results of above mentioned tests still are acceptable under the condition of no changes of material or structure of the aluminum mesh product. Under these circumstances the reports mentioned above are still valid. All test methods used for these tests were agreed with the client (EFKON GmbH). The used gas mixtures are mentioned in the latest version of IEC 60079-1:2007 standard and considered as "most explosive" mixture.

Accredited as:
Testing Laboratory,
Inspection Body,
Certification Body,
Calibration Laboratory,
Erst- and
Kesselprüfstelle,
Verifizierungsstelle

Notified Body 0408

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AT131200052949001066
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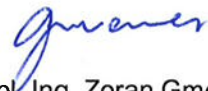
VAT ATU63240488
DVR 3002476

Best regards,

TÜV AUSTRIA SERVICES GMBH

Electrical Engineering – Explosion protection – Fire protection


Dipl.-Ing. Kurt Mayerhofer
Deputy Head of Business Unit Electrical Engineering


Dipl. Ing. Zoran Gmeiner
Expert Electrical Engineering

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Firma
EFKON GmbH

Andritzer Reichsstraße 66
A-8045 Graz

Vienna, 23.03.2000
ETW0831/ZR

TEST REPORT

On 7. Mai 1999 TÜV Austria (division electrical engineering) carried out in the following described explosion tests to examine whether the ignition of an explosive propane-air mixture under atmospheric conditions could be prevented by coating the ignition source with eXess® (expanded aluminum foil with a honeycomb structure).

1. Experimental set up

location: TÜV Austria PZW / Exd-testing punk
combustion chamber: volume 0.4 m³, cylindrical (picture 3)
trial gas: propane (4.6 Vol-%, flow meter)

safety specification:

	ignition temperature [°C]	explosion limit [Vol-%]		max. explosion pressure [kp/cm²]
		lower	upper	
propane	470	2,1	9,5	8,6

origin: Nabert/Schön, 2. extended edition

ignition source: spark plug Champion 508 N9YC
power supply: power pack 12 V with ignition coil
pressure measurement: Piezo – receiver: AVL; 12QP300cv (425)
charge amplifier: Kistler; Type 5011
Digiscope: Trace; 8612

**Akkreditierte
Prüfstelle,
Überwachungsstelle,
Zertifizierungsstelle;
Kalibrierstelle**

Notified Body 0408

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Bankverbindungen:
CA 0066-28978/00
BA 220-101-949/00
PSK 7072.756

DVR 0047 333
UID ATU 37086005

2. eXess® specification given by manufacturer

dimensions:	diameter	290 mm
	height	2 coils à 19 cm
	weight	total 2.37 kg

Material and production description:

eXess® explosion protection network or cylindrical bodies are made of a 0,07 mm thin aluminum alloy. After perforating the foil in special distances it is expanded and cut in the desired length. The density of the material is declared in Liter/Volume.

3. Transaction

The spark plug was centrally brought into the first eXess®-coil in such a way that the spark gap was on the face even laminar (picture 1). With a second, identically constructed (diameters, height, density) eXess®-coil the spark plug was covered (picture 2) and both roles were tied together with a plastic-isolated cooper wire.

This structure was positioned at the bottom of the 400 liters large explosion container (picture 4); and rinsed 5 times with propane air mixture (4,6 Vol-% propane) according to standard EN 50018 ("Electrical apparatus for potentially explosive atmospheres – flameproof enclosure").

4. Results

Caused by the ignition of the eXess® coated spark plug an explosion with a max. positive pressure of approx. 1.2 bar took place.

On the basis the analysis of the eXess® material it is easily evident that the flame front of the ignited gas burned slowly outward trough the aluminum mesh and then the free gas volume must have been ignited. This is confirmed also by the deformed lattice structure of the extreme windings due to the resulting temperature and pressure. Also the fact that contrary to the container walls the eXess® was perfectly soot-free inside, does not permit an other conclusion.

The analysis of the eXess® material shows that in the eXess® - area no explosion took place.

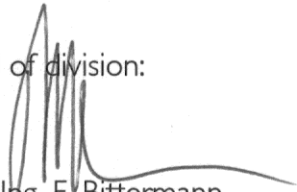
Finally it can be stated that in a container filled with explosive propane/air mixture under atmospheric conditions due to a complete filling with eXess® in the case of an ignition no explosion, but only a controlled burn, accompanied by a dumped increase of pressure, takes place.

Within the framework of executed examinations no investigations concerning continuous fire security were done. With the application of the product as explosion-suppressing system, specifications corresponding the minimum of filling amount in combination with containers and the period of recurring inspection of sufficient presence of the material, have to be given by the manufacturer or operator of the product.

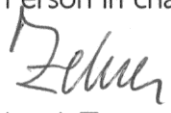
Manuals or user handbooks were not submitted to the TÜEV Austria and were therefore not the subject of the investigation.

TÜV Austria
Division Electrical Engineering

Head of division:


Dipl.-Ing. F. Bittermann

Person in charge:


Ing. J. Zetner

Pictures/Appendix:

- Picture 1: centrally, on the face even laminar positioned spark gap
- Picture 2: the used identically constructed eXess® coils after the ignition in the eXess® free space
- Picture 3: 0,4m³ explosion chamber
- Picture 4: eXess® coil in explosion chamber

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Firma
EFKON GmbH

Andritzer Reichsstraße 66
A-8045 Graz

Vienna, 24.03.1997
ETW0904/ZR

TEST REPORT

On the 24 02 1997, explosion tests at specific vessels described in the following have been performed by the TÜV Austria, Department for Electro-Technics.

Akkreditierte
Prüfstelle,
Überwachungsstell
Zertifizierungsstelle
Kalibrierstelle

Notified Body 0408

1. Test Item

Metal vessels with internal dimensions 650 x 240 x 120 mm (according to EFKON drawing No. TUV01971).
Diagonal gas entrance and outlet supplies; pressure sensors and heater plug directly arranged at the gas entrance.
Explosion protection material according to point 2.

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2. Specifications of the filling according to manufacturer

Out of a special aluminium foil, a network with rhomboidal openings is produced which can be further processed into three-dimensional cylindrical form bodies. The manufacturing process is continous.

DVR 0047 333
UID ATU 3708600

Specification of material and manufacturing:

The eXess[®] material consists of an aluminium alloy.

eXess[®] explosion protection network or cylindrical form bodies are fabricated out of a two-dimensional foil of 0.05 to 0.08 mm width.

The foil strip receives perforated cutting spots, staggered transverse to the conveying direction, the cutting spots are stretched to the breadth and twofold folded, lopped into pieces, cylindrically bent round, twisted at the ends and continuously rolled into cylindrical form bodies.

By this way of manufacturing, the cylindrical form body receives its stability and homogenous distribution of surface.

The density of the material is indicated in volume litres.

3. Task Setting

It had to be examined if after the charging of explosive vapours (pressureless) into above described vessels, a triggering of an explosion in the interior of the vessel by means of an high-energy ignition source (heater plug, surface temperature > 800°C; see appendix) is possible.

As test gas, an acetylene-air mixture (app. 14 Vol% acetylene) had been chosen.

The ignition temperature of acetylene is 305°C; the ratio of mixture was chosen analog to the standards for examination of explosions of electrical equipment (EN 50018).

4. Test description

The vessel was filled first of all empty, then equipped with cylindrical eXess[®] form bodies with app. 14 Vol% acetylene-air mixture without supercharging. Immediately after that, a heater plug, reaching into the container (4 cm), was brought to glow for > 1 minute, at which temperatures of atleast 800°C (red hot) were reached.

The burnings each time took place 30 seconds after turning on the heater plug supply.

5. Result

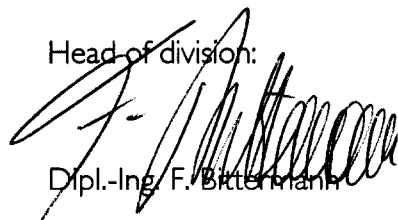
Based on the experiments described under paragraph 4, the following result is shown:

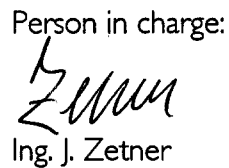
At the experiments with a filling of the eXess® form bodies, a certainly audible explosion, but combined with a smaller increase of pressure and a significant smaller pressure-time surface occurred, whereat it has to be mentioned that a small unprotected volume (gas pipes between closing device and the protected sample) remained due to the experimental arrangement.

At the examination without eXess® form bodies in the vessel, a clearly audible explosion with the according march of pressure could be triggered (by heater plug) after app. 30 seconds.

The march of pressure during the above ignition experiments can be learned from the appendix.

TÜV Austria
Division Electrical Engineering

Head of division:

Dipl.-Ing. F. Bittermann

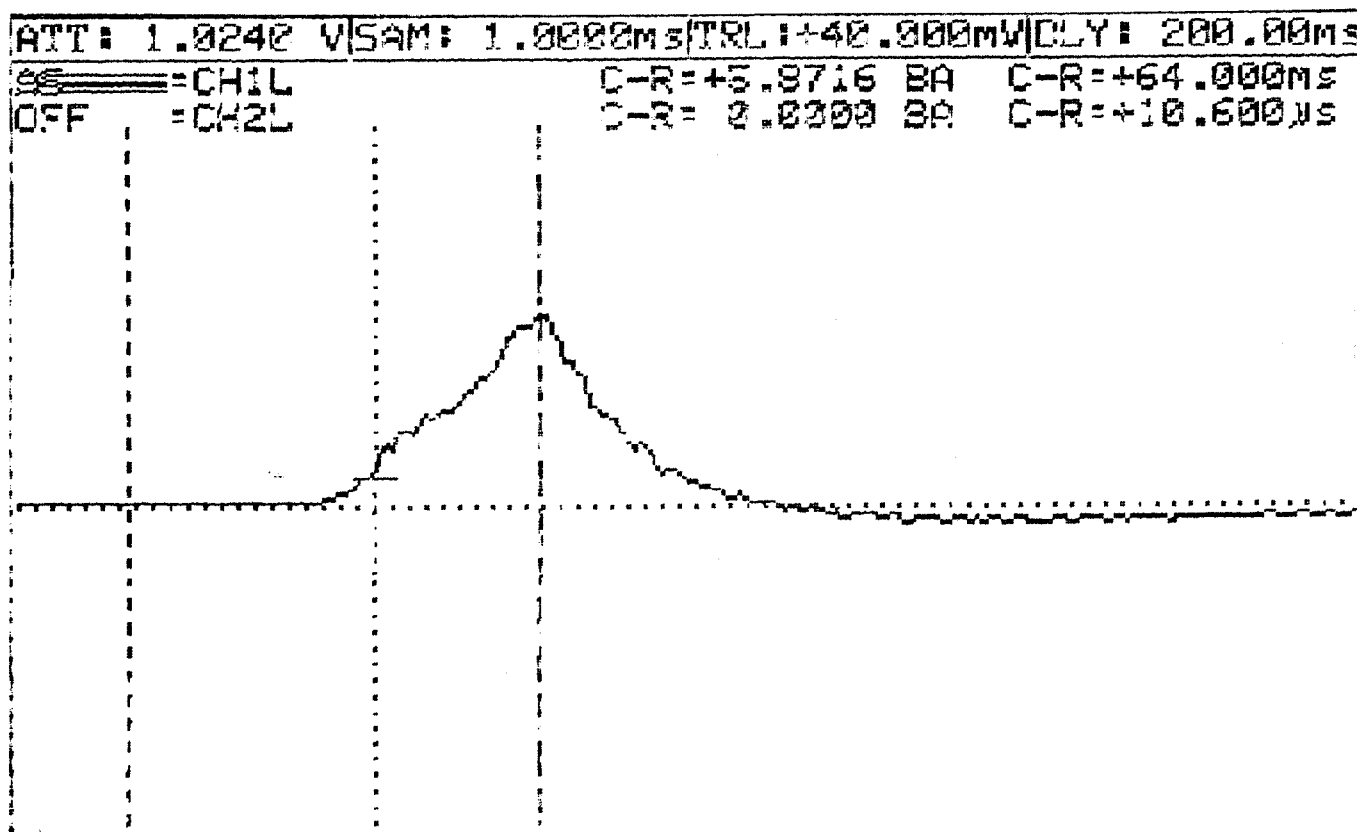
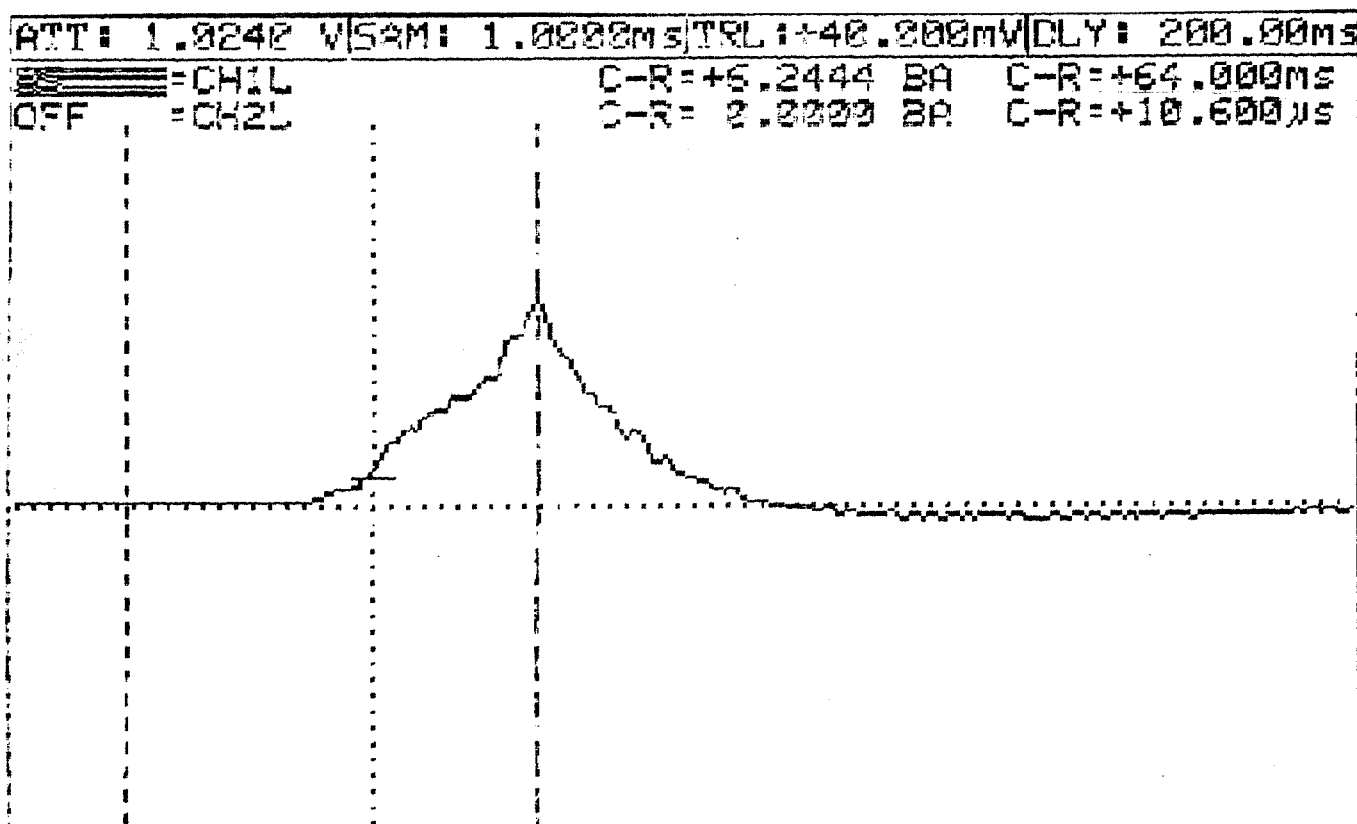
Person in charge:

Ing. J. Zetner

Appendix: March of pressure of empty (unprotected) test sample
 March of pressure of protected test sample
 List of testing equipment

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