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**Institut za ispitivanje materijala a.d. Beograd**  
**Centralna laboratorija za ispitivanje materijala**  
**Laboratorija za toplotnu tehniku i zaštitu od požara**

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# IZVEŠTAJ O ISPITIVANJU

Br. GFT-5094/15-OPŽ

<b>Predmet ispitivanja:</b>	Sposobnost gašenja požara pomoću mikroinkapsuliranih termoreaktivnih supstanci za gašenje požara - sistemi PYROSTICKER AST i PYROCORD (M)
<b>Proizvođač:</b>	PIROHIMIKA – CENTRE LLC Moskva Rusija
<b>Naručilac:</b>	TMG Group d.o.o. 11000 Beograd Tadeuša Koščuška 68 Srbija
<b>Zahtev/Ponuda/Ugovor:</b>	Ponuda IMS br. 41-956 od 2015-02-04
<b>Sadržaj:</b>	Ukupno 24 strane, od čega 12 u prilogu

**Izveštaj odobrio:**

Laboratorija za toplotnu tehniku i  
zaštitu od požara  
Rukovodilac,

  
Slaviša Bogunović, dipl.ing.arh.

Beograd, 25. maj 2015. godine.

## 1. OPŠTI PODACI

### 1.1 Opšti uslovi

Ispitivanje koje je predmet ovog izveštaja je realizovano u skladu sa Ugovorom o zajedničkom ispitivanju zaključenom između Instituta za ispitivanje materijala a.d., Beograd i Zavoda za gradbeništvo Slovenije, Ljubljana.

Naručilac ispitivanja je dao saglasnost da se ispitivanje izvrši u gore navedenoj Laboratoriji, kao podugovoreno ispitivanje.

### 1.2 Predmet ispitivanja

Predmet ispitivanja je sposobnost gašenja požara pomoću mikroinkapsuliranih termoreaktivnih supstanci za gašenje požara - sistemi PYROSTICKER AST i PYROCORD (M).

### 1.3 Opis uzorka

Opis uzoraka je definisan na osnovu informacija dobijenih od Naručioca.

Sistem za gašenje požara sa mikroinkapsuliranim termoreaktivnim supstancama je sačinjen od poliakrilnog polimera sa mineralnim česticama. Razvijen je sa specijalnom namenom za zaštitu od nastanka požara u objektima male zapremine, kao što su električne razvodne table, razvodne kutije, sefovi i sl.

Promena temperature utiče na aktivne komponente, usled čega dolazi do trenutne reakcije i emisije snažnih inhibitora gorenja koji dovode do potpunog suzbijanja žarišta požara.

#### 1.3.1 PyroSticker AST-25

PyroSticker AST-25 je u obliku tanke savitljive, zeleno obojene, ploče, koja se nalazi u zaštitnom omotaču, sa dvostrano lepljivom trakom koja je deo sistema.

Ukupne dimenzije: 64,4 mm x 110,0 mm x 1,8 mm (izmereno)

Ukupna težina: 21,66 g (izmereno)

Površinska masa: 0,306 g/cm<sup>2</sup> (izmereno)

#### 1.3.2 Pyrocord (M)

Pyrocord (M) je u obliku savitljivog užeta koje se nalazi u tkanom crevu bele boje.

Ukupne dimenzije: Ø 5,5 mm

Masa: 20,1 g/m<sup>1</sup> (izmereno)

### 1.6 Metod ispitivanja

S obzirom da ne postoji standardom definisan metod ispitivanja za ispitivanje ove vrste proizvoda, Naručilac i Laboratorija su se sporazumeli da sledeći postupak ispitivanja može adekvatno da demonstrira sposobnost gašenja požara predmetnim sistemima u okviru razvodnog ormara dimenzija:

300 mm x 300 mm x 180 mm - mala kutija i

400 mm x 500 mm x 180 mm - velika kutija,

sa prozorom u prednjim vratima i 14 rupa Ø16 mm na dnu kutije:

- Izvori požara:
  1. Svitak dvožilnog telefonskog kabla dužine  $l=5,0 \text{ m}^1$ , obešen u centru malog razvodnog ormara;
  2. Šolja  $\varnothing 74 \text{ mm}$  ispunjena vodom, sa slojem heptana debljine  $d=10 \text{ mm}$ , postavljena u centru malog razvodnog ormara;
  3. Šolja  $\varnothing 100 \text{ mm}$  ispunjena vodom, sa slojem heptana debljine  $d=10 \text{ mm}$ , postavljena na cca  $1/3$  visine velikog razvodnog ormara;
- Pre ispitivanja sposobnosti gašenja, sprovedeno je ispitivanje gorivosti izvora požara u zatvorenim razvodnim ormanima sa ciljem da se utvrdi da li postoji dovoljna količina kiseonika za njihovo sagorevanje;
- Ispitivanje sposobnosti gašenja je sprovedeno sa ciljem da se utvrdi da li je izvor požara ugašen i da li ima pojava naknadnog paljenja;
- Mikrokapsulirani sistemi za gašenje moraju biti ugrađeni u skladu sa uputstvima Proizvođača, na čistu gornju površinu/tavanicu razvodnog ormara, sa aktivnim slojem okrenutim nadole;
- Tokom ispitivanja su sačinjeni fotografski i video zapisi;
- U razvodnim kutijama su merene temperature i koncentracija kiseonika na mernom mestu cca  $10 \text{ cm}$  ispod gornje površine/tavanice.

**2. REZULTATI ISPITIVANJA****2.1 Datum ispitivanja**

Ispitivanje je izvršeno 6. februara 2015.god.

**2.2 Mikroklimatski uslovi**

Na početku ispitivanja su utvrđene sledeće vrednosti:

Temperatura ambijenta: 14,3 °C  
 Atmosferski pritisak: 970 MPa  
 Relativna vlažnost: 31%  
 Brzina strujanja vazduha <0,1 m/s (prostorija 2,4 m x 2,4 m x 2,4 m)

**2.3 Zapažanja tokom ispitivanja****2.3.1 PyroSticker AST-25 - prvo ispitivanje**

Izvor požara je svitak dvožilnog telefonskog kabla dužine  $l=5,0\text{ m}^1$ , obešen u centru malog razvodnog ormara dimenzija 300 mm x 300 mm x 180 mm.

Bez sredstva za gašenje unutar ormara:

Vreme [min:s]	Zapažanje
0:00	Početak ispitivanja, izvor požara upaljen, vrata ormara zatvorena;
1:00	Gorenje završeno. Pad koncentracije kiseonika u ormanu tokom ispitivanja na 14,4%;
5:00	Kraj ispitivanja;

PyroSticker AST-25 postavljen/zalepljen na tavanicu ormara:

Vreme [min:s]	Zapažanje
0:00	Izvor požara upaljen i obešen u orman;
0:20	Vrata ormara zatvorena. Početak ispitivanja. ispitivanja na 14,4%;
0:36	Sva gorenja ugašena. Pad koncentracije kiseonika u ormanu tokom ispitivanja na 11,3%;
4:00	Bez pojave naknadnog paljenja. Kraj ispitivanja;

**2.3.2 PyroSticker AST-25 - drugo ispitivanje**

Izvor požara je 10 mm deo sloj heptana u šolji Ø74 mm, postavljenoj u centru malog ormara dimenzija 300 mm x 300 mm x 180 mm.

Bez sredstva za gašenje unutar ormara:

Vreme [min:s]	Zapažanje
0:00	Početak ispitivanja, izvor požara upaljen, vrata ormara zatvorena;
15:00	Heptan izgoreo, gorenje završeno. Pad koncentracije kiseonika u ormanu tokom ispitivanja na 8,4%;
18:00	Kraj ispitivanja;

PyroSticker AST-25 postavljen/zalepljen na tavanicu ormara:

Vreme [min:s]	Zapažanje
0:00	Izvor požara upaljen. Vrata zatvorana. Početak ispitivanja;
0:23	Sva gorenja ugašena. Pad koncentracije kiseonika u ormanu tokom ispitivanja na 13,2%;
4:00	Bez pojave naknadnog paljenja. Izgorelo 0,6 g heptana. Kraj ispitivanja;

### 2.3.3 Pyrocord (M)

Izvor požara je 10 mm debeo sloj heptana u šolji Ø100 mm, postavljenoj u centru velikog ormara dimenzija 400 mm x 500 mm x 180 mm.

Bez sredstva za gašenje unutar ormara:

Vreme [min:s]	Zapažanje
0:00	Početak ispitivanja, izvor požara upaljen, vrata ormara zatvorena;
09:00	Heptan izgoreo, gorenje završeno. Pad koncentracije kiseonika u ormanu tokom ispitivanja na 16%. Temperatura u ormaru $T_{max}=400\text{ °C}$ ;
13:00	Kraj ispitivanja;

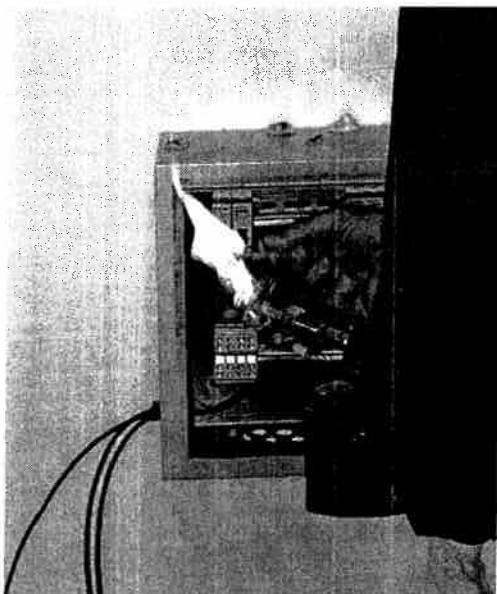
Pyrocord (M) unutar ormara:

Vreme [min:s]	Zapažanje
0:00	Izvor požara upaljen. Vrata zatvorana. Početak ispitivanja;
0:09	Sva gorenja ugašena. Pad koncentracije kiseonika u ormanu tokom ispitivanja na 14,5%. Temperatura u ormaru $T_{max}=160\text{ °C}$ ;
4:00	Bez pojave naknadnog paljenja. Izgorelo 0,6 g heptana. Kraj ispitivanja;

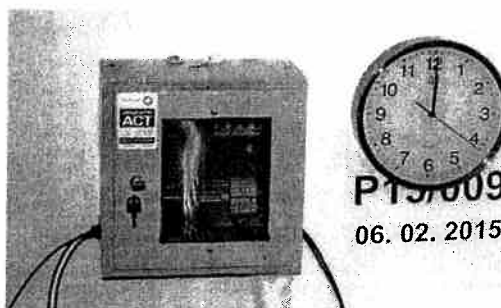
**PiroSticker AST 25: Ispitivanje sa telefonskim kablom koji sagoreva u el. razvodnom ormanu dimenzija 300 mm x 300 mm x 180 mm**



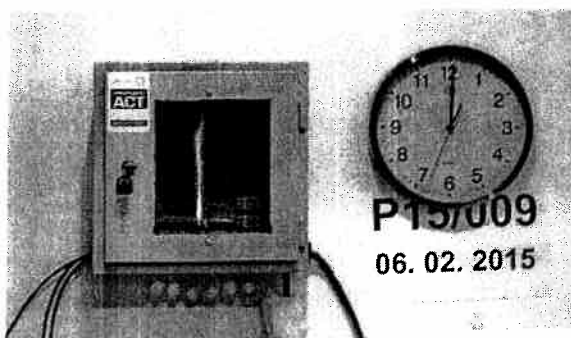
Slika 1:  
Sagorevanje telefonskog kabla obešenog u ormanu.  
Gorenje kabla u ormanu bez PiroSticker-a u trajanju od cca1 min.



Slika 2:  
Paljenje telefonskog kabla.  
Pokretanje sekundomera.

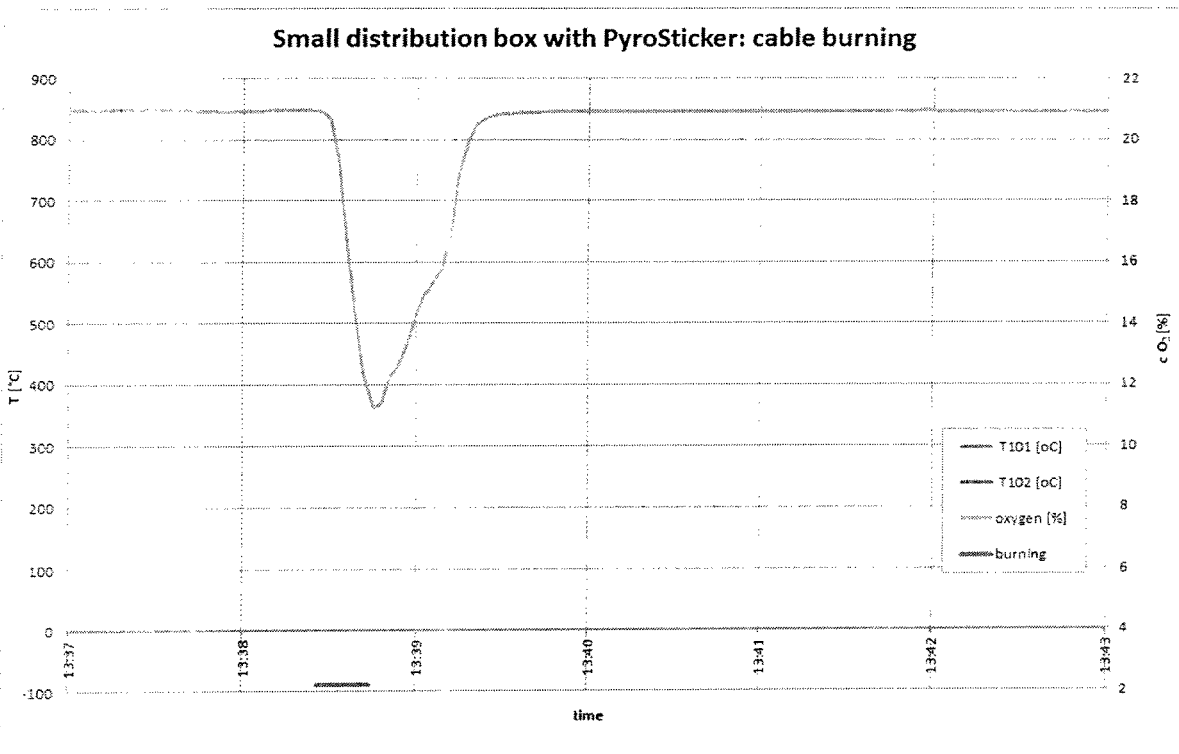
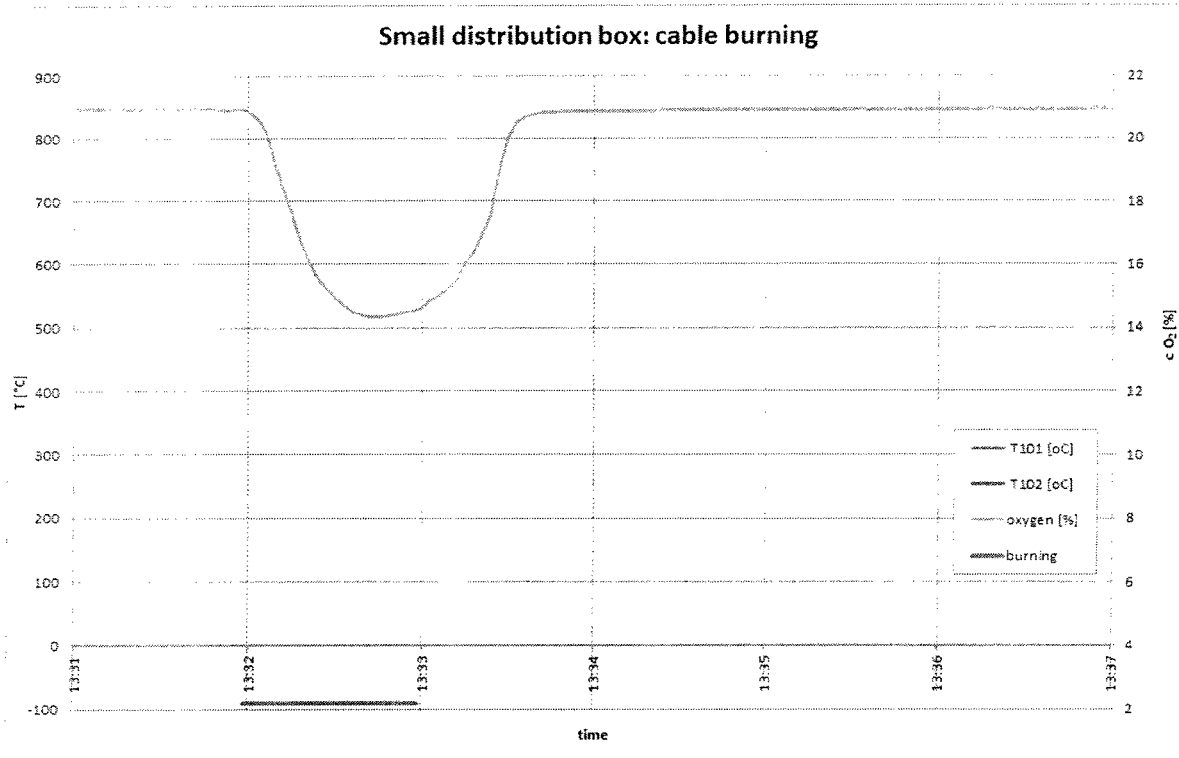


Slika 3:  
Gorenje telefonskog kabla u ormanu.  
PyroSticker AST-25 je postavljen/zalepljen na tavanicu ormana.

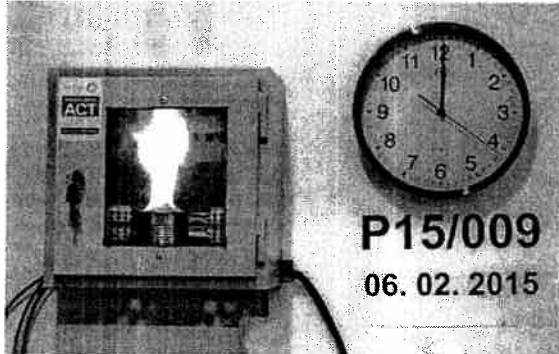


Slika 4:  
Prestanak gorenja u 16 s posle zatvaranja vrata

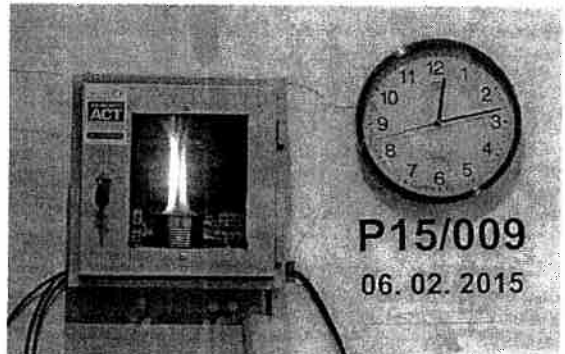
PiroSticker AST 25: Ispitivanje sa telefonskim kablom koji sagoreva u el. razvodnom ormanu dimenzija 300 mm x 300 mm x 180 mm



**PiroSticker AST 25: Ispitivanje sa heptanom koji sagoreva u šolji Ø75 mm u el. razvodnom ormanu dimenzija 300 mm x 300 mm x 180 mm**



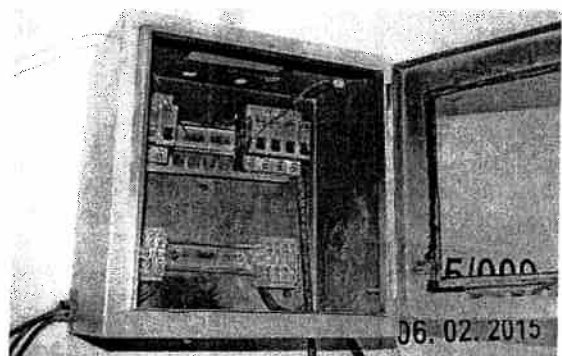
Slika 1:  
Heptan u šolji Ø75 mm. Sagorevanje heptana u ormanu bez PiroSticker-a



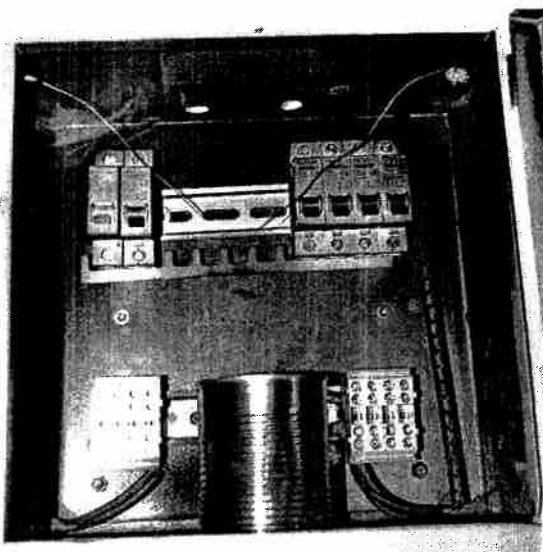
Slika 2:  
Sagorevanje heptana u ormanu bez PiroSticker-a u trajanju od 15 min



Slika 3 i 4:  
Postavljenje PiroSticker AST-25



Slika 5:  
PiroSticker AST-25 postavljen/zalepljen na tavanicu ormana

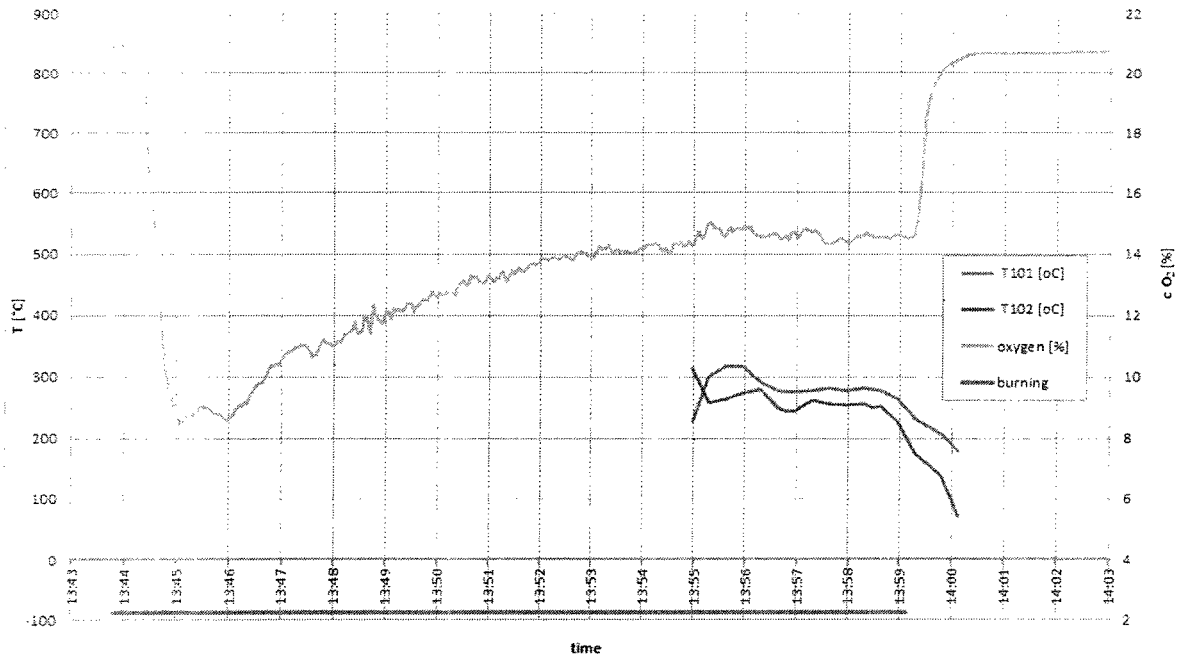


Slika 6: Otvoren orman posle ispitivanja.  
Gašenje plamena posle 23 sekundi

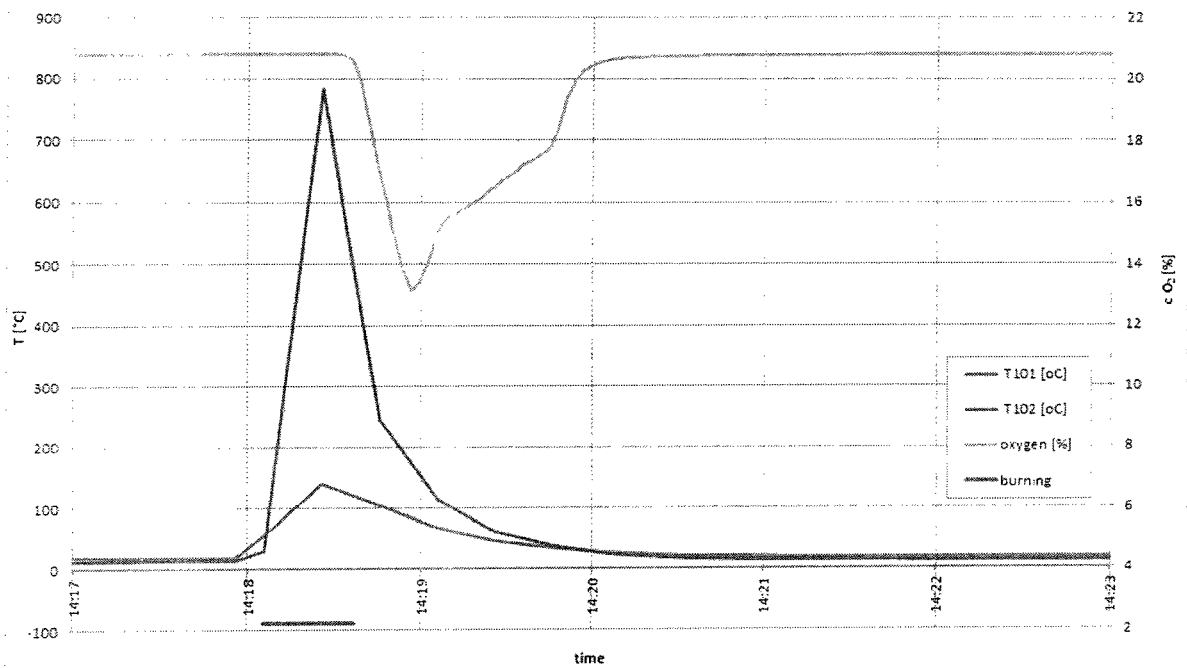


**PiroSticker AST 25: Ispitivanje sa heptanom koji sagoreva u šolji Ø75 mm u el. razvodnom ormanu dimenzija 300 mm x 300 mm x 180 mm**

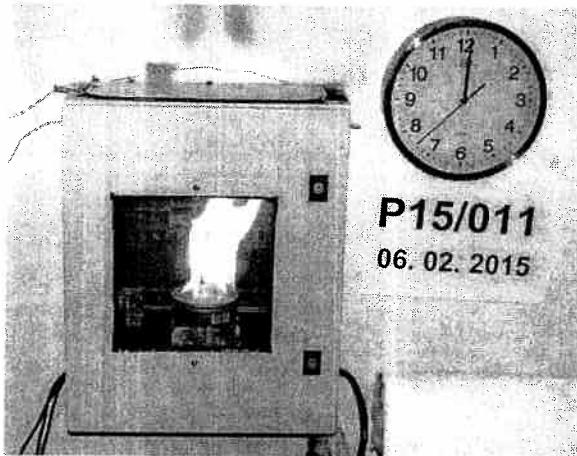
**Small distribution box: heptan burning**



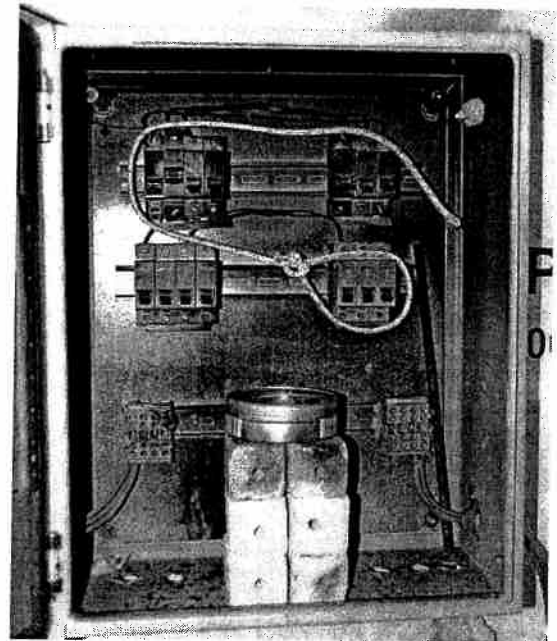
**Small distribution box with PyroSticker: heptan burning**



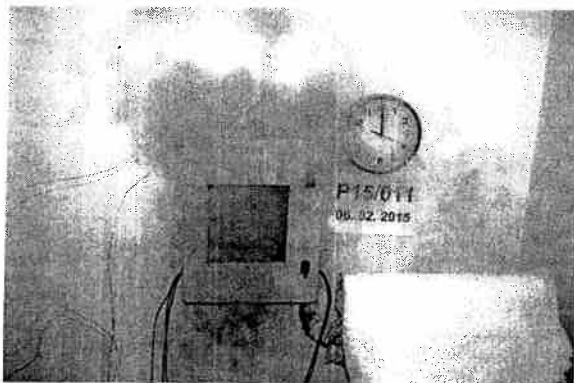
**Pirocord (M):** Ispitivanje sa heptanom koji sagoreva u šolji Ø100 mm u el. razvodnom ormanu dimenzija 400 mm x 500 mm x 180 mm



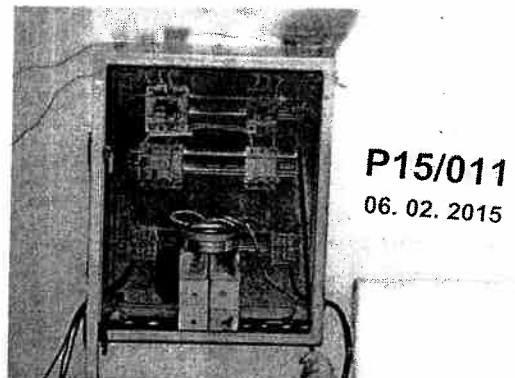
Slika 1: Heptan u šolji Ø100 mm. Sagorevanje heptanau ormanu bez Pyrocord (M) u trajanju od 9 min



Slika 2: Postavljanje Pyrocord (M) dužine 1 m



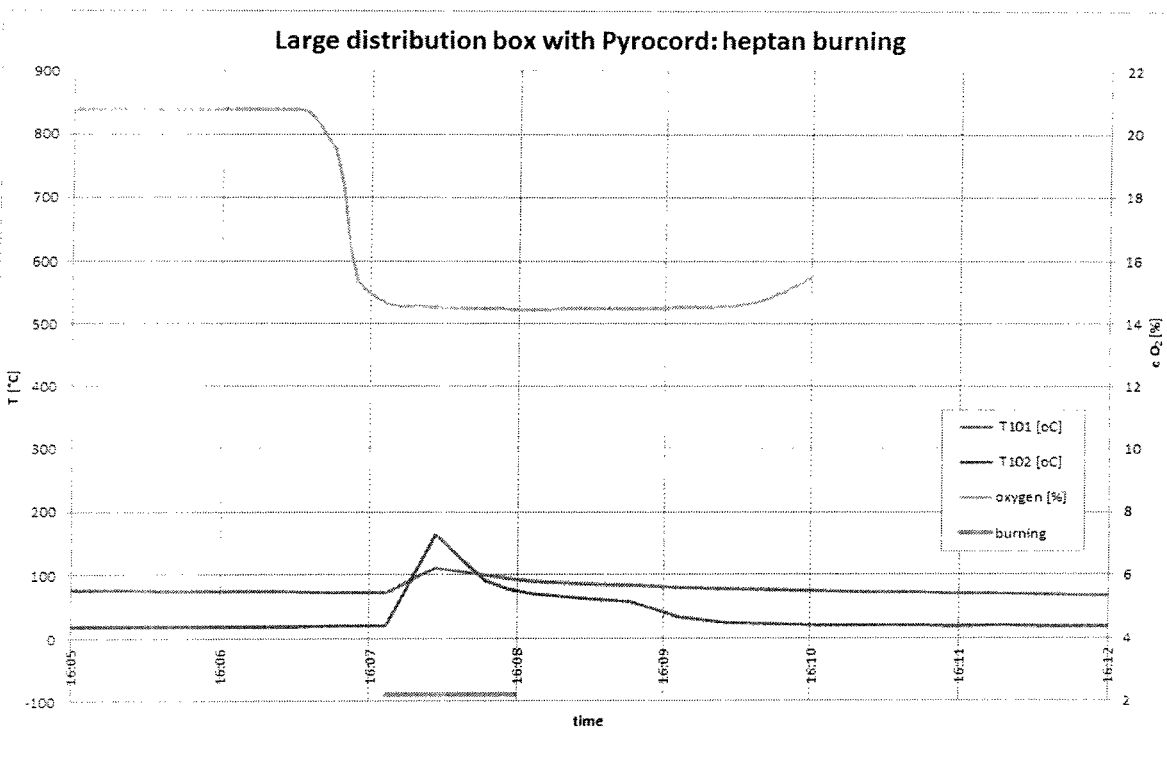
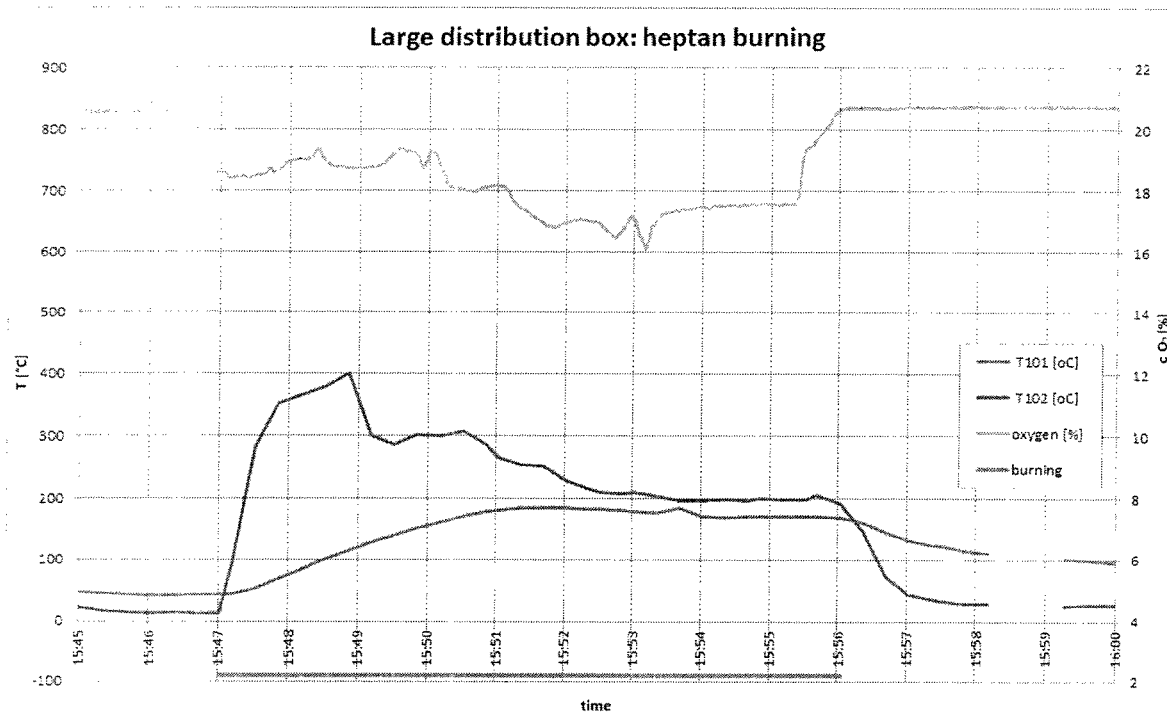
Slika 3: Gašenje posle 9 sekundi



Slika 4: Otvoren orman posle ispitivanja

Pirocord (M):

Ispitivanje sa heptanom koji sagoreva u šolji Ø100 mm u el. razvodnom ormanu dimenzija 400 mm x 500 mm x 180 mm



### 3. PRIMENLJIVOST IZVEŠTAJA

Ovaj izveštaj o ispitivanju nije sertifikat o bezbednosti od požara niti sertifikat o usglašenosti.

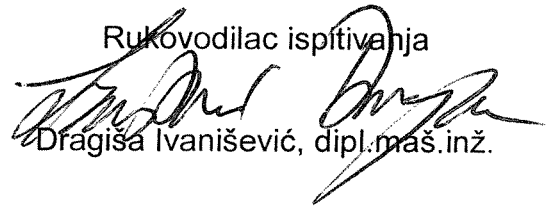
Rezultati ispitivanja se odnose samo na ispitani uzorak proizvoda u definisanim ispitnim uslovima, i nije im svrha da budu jedini kriterijum za procenu performansi proizvoda u krajnjoj primeni.

Dobijeni rezultati i zaključci sadržani u Izveštaju, odnose se samo na ispitane uzorke i ne odražavaju kvalitet proizvodnje iz koje je uzorak uzet iz kao ni kvalitet svih proizvoda ovog tipa.

Sastavni deo ovoga izveštaja (u Prilogu) je: Izveštaj o ispitivanju broj P 0388/15-530-1 od 2015-04-10, izdat od strane ZAG – Ljubljana - Slovenija.

Beograd, 25. maj 2015. godine

Rukovodilac ispitivanja



Dragiša Ivanišević, dipl.maš.inž.

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**PRILOG –**

Izveštaj o ispitivanju broj P 0388/15-530-1 od 2015-04-10, izdat od strane ZAG –  
Ljubljana - Slovenija.

strana: 11 (jedanaest)

Ljubljana, 10. 04. 2015

## TEST REPORT

**No. P 0388/15-530-1**

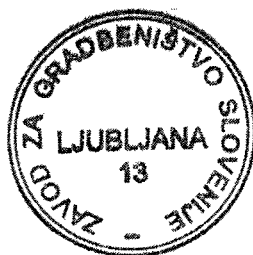
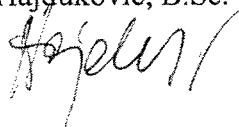
Capability of the fire extinguishing device  
**PyroSticker AST and  
Pyrocord (M)**

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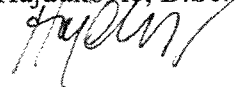
**Sponsor:** TMG Group d.o.o., Tadeuša Koščuška 68, RS-11002 Beograd  
**Order No:** 15-013-000019/30.03.2015

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**Responsible investigator:**  
Milan Hajduković, B.Sc.



**Head of laboratory:**  
Milan Hajduković, B.Sc.



**Director:**  
Assoc. Prof. Dr Andraž Legat



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Other accreditations: BUREAU VERITAS (Certificate of Recognition No. SMS.LAB 462/2900/C.0)

Member of egolf - European Group of Organisations for Fire Testing, Inspection and Certifications

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The test results relate only to the tested sample. Test report may be reproduced only as a whole. Complaints regarding the content of this report will only be considered if received within 15 days of the date of issue of the report. Number of pages: 11

1. **PRODUCT:** Fire Suppression System with microencapsulated thermal activated fire extinguisher substance  
**PyroSticker AST-25 and Pyrocord (M)**
2. **SUPPLIER:** TMG Group d.o.o., Tadeuša Koščuška 68, RS-11002 Beograd
3. **MANUFACTURER:** "Pirohimika-Centre" LLC, Moscow, Russia
4. **SAMPLING:** The specimens were supplied by the sponsor on the date of test, i.e. Feb 6<sup>th</sup>, 2015. ZAG was not involved in any selection or sampling. ZAG sample No. P15/009 (PyroSticker) and P15/011 (Pyrocord).

## 5. DESCRIPTION OF THE TEST SPECIMEN

The descriptions of the specimens given below have been prepared from information provided by the sponsor of the test.

Fire Suppression System with microencapsulated thermal activated fire extinguisher substance is a micro-extinguisher made from polyacrylyc polymer with mineral particles. It was developed especially for protection against inflammations in small sized objects such as electric switchboards, safes, etc. Micro-extinguisher works as intellectual fire extinguishing system. Changes in temperature influence its active components that lead to instant reaction and emission of strong burning inhibitors, up to full suppression of seat of fire.

### 5.1 PyroSticker AST-25

PyroSticker AST-25 is in a form of a thin flexible green colored plate, which is placed in the protected volume using double-sided adhesive tape, which is the part of the system. Overall dimensions: 64,4 mm x 110,0 mm x 1,8 mm (determined by ZAG)  
Overall weight: 21,66 g / 0,306 g/cm<sup>2</sup> (determined by ZAG)

### 5.2 Pyrocord (M)

Pyrocord (M) is in a form of a flexible rope within white colored woven hose. The appropriate length of the rope is hanged over electric cables and couplings within the protected volume.  
Overall dimensions: ca.  $\Phi$  5,5 mm  
Overall weight: 20,1 g/m (determined by ZAG)

## 6. CONDITIONING OF THE SPECIMENS: -

7. **DATE OF TEST:** 6<sup>th</sup> of February 2015

## 8. ENVIRONMENTAL CONDITIONS at the start of testing:

Ambient temperature	14,3 °C
Barometric pressure	970 MPa
Relative humidity	31 %
Speed of the wind	< 0,1 m/s (enclosure 2,4 m x 2,4 m x 2.4 m)

## 9. TESTING PROCEDURE

As there is no standard test procedure for testing this type of product, the sponsor and ZAG agreed that the following test procedure was considered to best demonstrate the ability of a fire extinguishing device to extinguish a fire within a distribution box of dimensions 300mm x 300mm x 180mm – small box and 400mm x 500mm x 180mm – large box, with window in front door and 14 holes  $\Phi$ 16 mm in the bottom of the box:

- A fire sources:
  - 1) A bundle of two- wire telephone cable 5 m long hanged in the centre of the small distribution box.
  - 2) A cup  $\Phi$ 74 mm full of water with a 10 mm thick layer of heptane placed in the centre of the small distribution box.  
10 mm deep layer of heptane burns outdoors approximately 13 minutes.
  - 3) A cup  $\Phi$ 100 mm full of water with a 10 mm thick layer of heptane placed at approx. 1/3 of height of the large distribution box.
- Before the extinguishing ability test, only combustion of fire sources within the closed distribution box was observed to check if there is enough oxygen.
- The fire source was ignited and observations were made to determine if the fire source was extinguished and there is no re-ignition.
- The micro-extinguisher should be installed according to producer's instruction to the clean ceiling of the box with an active layer downwards.
- Still photographs and a video recording were taken of the test.
- Temperature and oxygen was measured within the distribution box approx. 10 cm bellow the top of the distribution box.

## 10. OBSERVATIONS DURING THE TEST

### 10.1 Observation during the first test - PyroSticker AST-25:

A fire source is a bundle of two- wire telephone cable 5 m long hanged in the centre of the small distribution box of dimensions 300 mm x 300 mm x 180 mm.

No extinguishing media inside the cabinet:

TIME [min:s]	OBSERVATION
0	The test commenced, fire source ignited, door is closed
1:00	All flaming ceased. The oxygen content in the cabinet dropped to 14.4% during the test
5	The test terminated.

Pirosticker AST 25 attached to the ceiling of the cabinet:

TIME [min:s]	OBSERVATION
0	A fire source is ignited and hanged in-to the cabinet.
0:20	The cabinet's door is closed. The test commenced.
0:16	All flaming ceased. The oxygen content in the cabinet dropped to 11.3% during the test.
4	The test terminated, no re-ignition.



**10.2 Observation during the second test - PyroSticker AST-25:**

A fire source is 10 mm thick layer of heptane in a cup  $\Phi 74$  mm placed in the cabinet of dimensions 300 mm x 300 mm x 180 mm.

No extinguishing media inside the cabinet:

TIME [min:s]	OBSERVATION
0	The test commenced, fire source ignited, door is closed
15:00	All flaming ceased. Heptane is burned. The oxygen content in the cabinet dropped to 8.4% during the test.
18	The test terminated.

Pirosticker AST-25 glued to the ceiling of the cabinet:

TIME [min:s]	OBSERVATION
0	The test commenced, fire source ignited, door is closed
0:23"	All flaming ceased. The oxygen content in the cabinet dropped to 13.2% during the test. max. temperature was almost 800 °C
4	The test terminated, no re-ignition. It burns 0,6 g of heptane.

**10.3 Observation during the third test - Pyrocord (M):**

A fire source is 10 mm thick layer of heptane in a cup  $\Phi 100$  mm placed in the cabinet of dimensions 400 mm x 500 mm x 180 mm.

No extinguishing media inside the cabinet:

TIME [min:s]	OBSERVATION
0	The test commenced, fire source ignited, door is closed
9:00	All flaming ceased. The oxygen content in the cabinet dropped to 16% during the test. max. temperature was 400 °C
13	The test terminated.

Pyrocord (M) inside the cabinet:

TIME [min:s]	OBSERVATION
0	The test commenced, fire source ignited, door is closed
0:09	All flaming ceased. The oxygen content in the cabinet dropped to 14.5% during the test. max. temperature was 160 °C
5	The test terminated, no re-ignition. It burns 0,6 g of heptane.

## 11. VALIDITY OF THE REPORT

This report is neither a fire safety certificate nor a conformance certificate.

The test results relate only to the behaviour of the test specimen of the product under the particular conditions of the test; they are not intended to be the sole criterion for assessing the performance of the product in its end use.

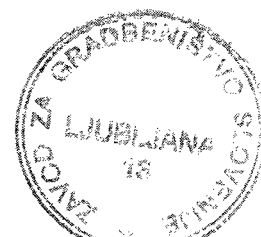
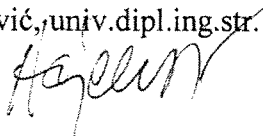
The obtained results and conclusions contained in the report apply only to the tested sample(s) and don't reflect the quality of the production-run where this sample was taken from as well as the quality of all the output of this type.

## 12. ATTACHMENTS

- Annex 1: page 1 of 2: Photos from the testing of PyroSticker AST-25 – telephone cable  
page 2 of 2: Temperature and oxygen inside the cabinet 300 x 300 x 180
- Annex 2: page 1 of 2: Photos from the testing of PyroSticker AST-25 – heptan  $\Phi$  74 mm  
page 2 of 2: Temperature and oxygen inside the cabinet 300 x 300 x 180
- Annex 3: page 1 of 2: Photos from the testing of Pyrocord (M) – heptan  $\Phi$  100 mm  
page 2 of 2: Temperature and oxygen inside the cabinet 400 x 500 x 180

The report was prepared by:

Milan Hajduković, univ. dipl. ing. str.



**PiroStiker AST 25: Test with telephone cable, which is burning within electric distribution box 300 mm x 300 mm x 180 mm**

**Photographs:**



Photo 29258d-8:  
Ignition of the telephone cable hanged in the cabinet.  
Burning of the cable within the cabinet without PiroStiker last approx.1 minute.

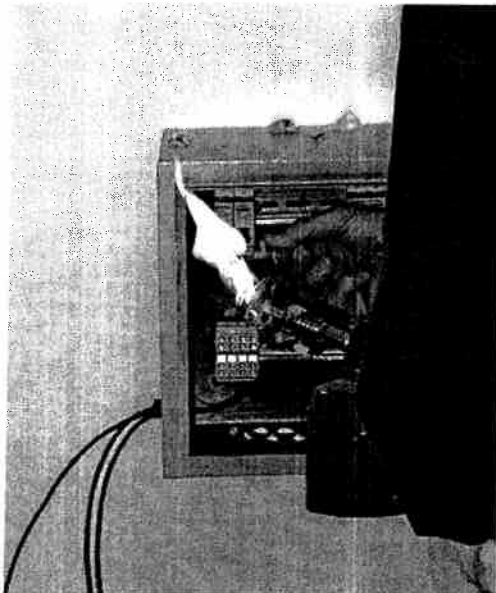


Photo 29258d-10:  
Ignition of the telephone cable.  
Start stop watch.

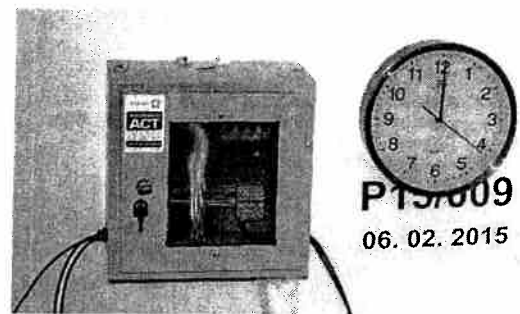
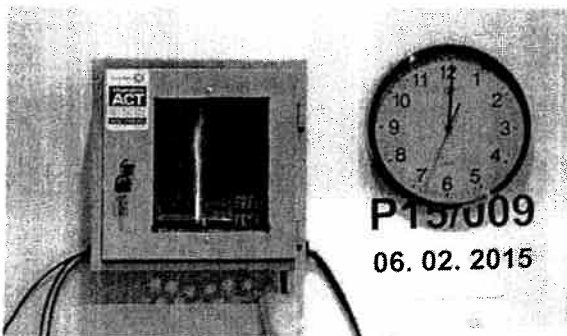
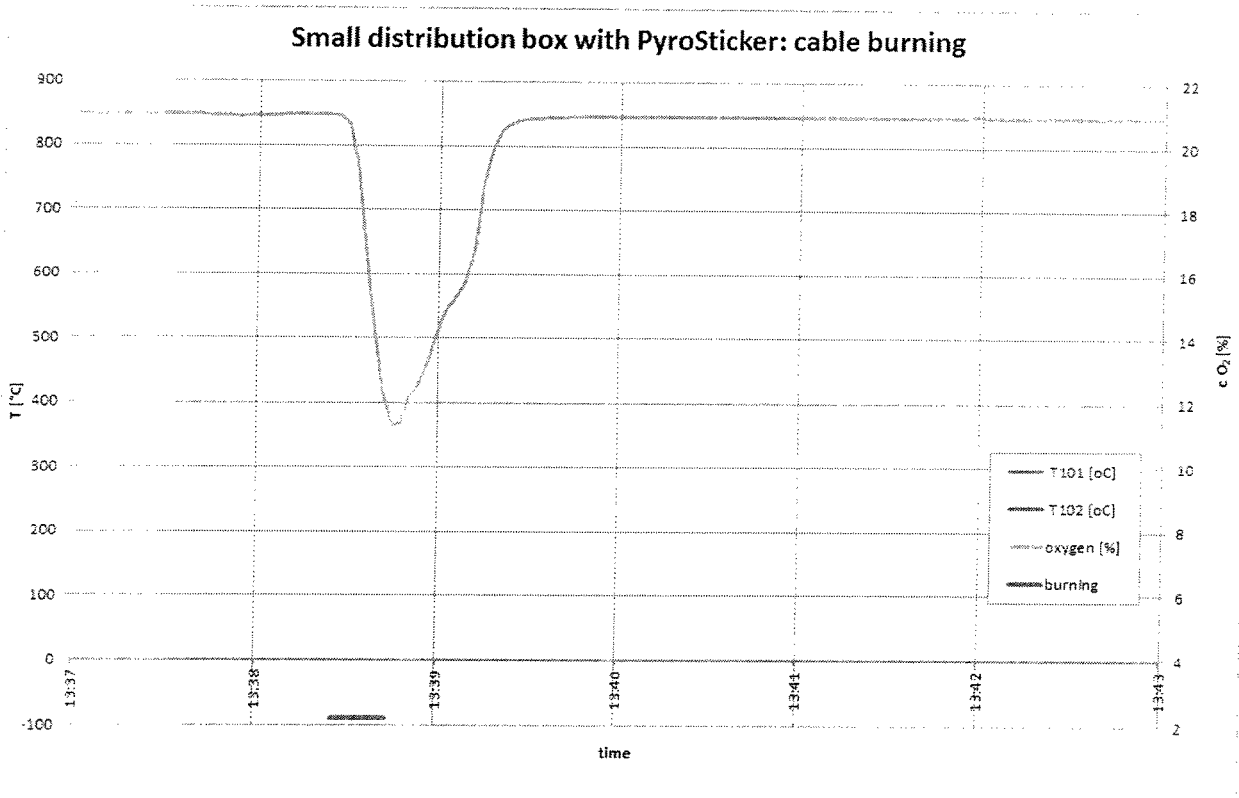
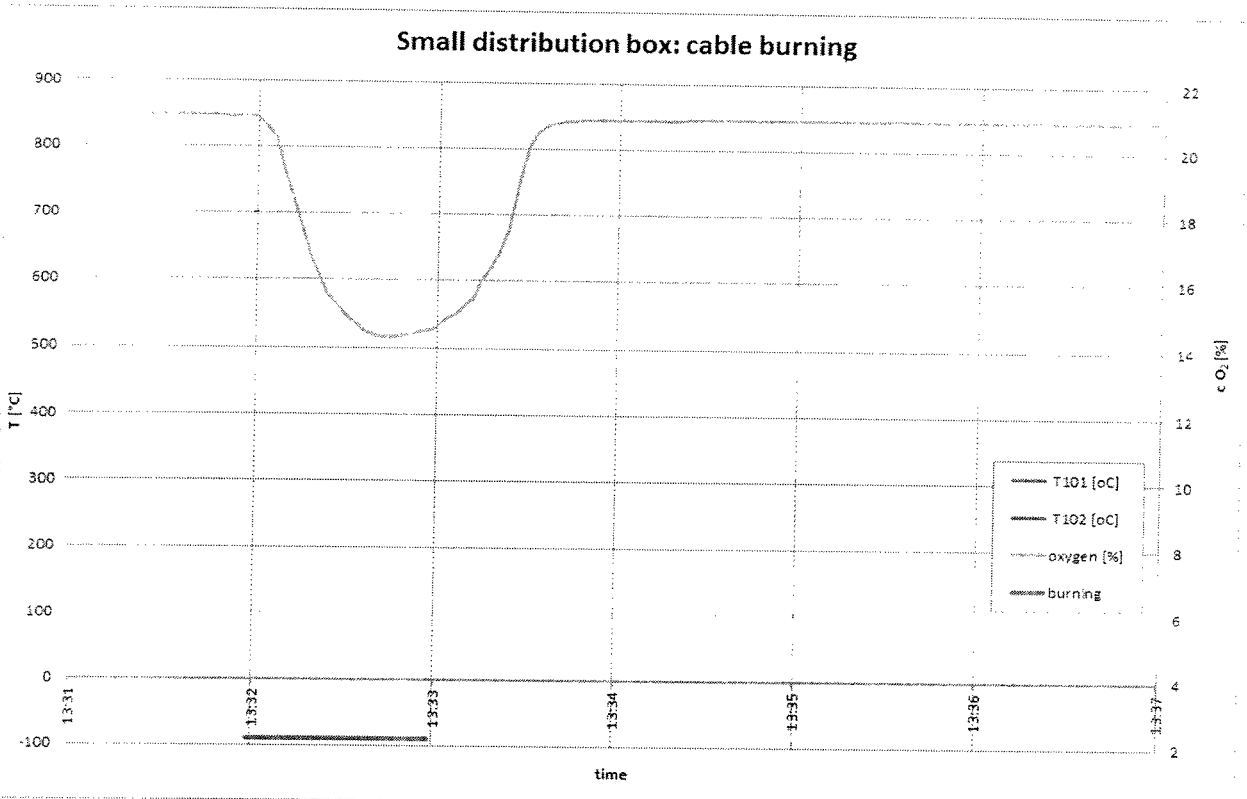


Photo 29258d-12:  
Burning of the telephone cable in the distribution box.  
PyroStiker AST-25 is attached to the ceiling of the distribution box.



29258d-14:  
Flaming ceased in 16 seconds after closing the door

**PiroStiker AST 25: Test with telephone cable, which is burning within electric distribution box 300 mm x 300 mm x 180 mm**



**PiroStiker AST 25: Test with heptane, which is burning in the container  $\Phi 75$  mm within electric distribution box 300 mm x 300 mm x 180 mm**

**Photographs:**

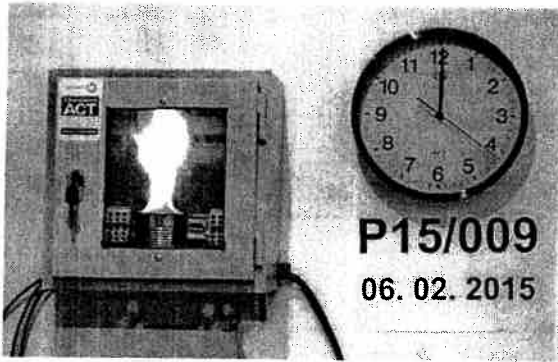


Photo 29258d-17: Heptane in container  $\Phi 75$  mm. Burning of heptane in the cabinet without PiroStiker

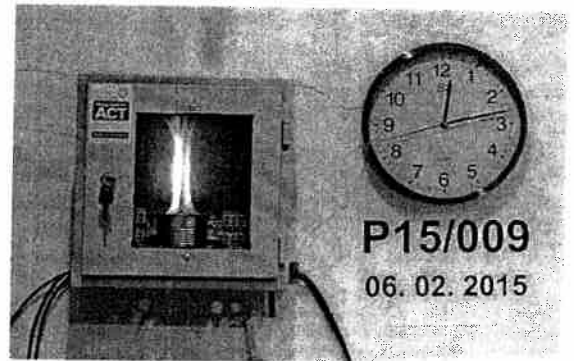


Photo 29258d-20: Burning of heptane in the cabinet without PiroStiker last 15 minutes



Photo 29258d-22 and 25: Installation of PiroStiker AST-25

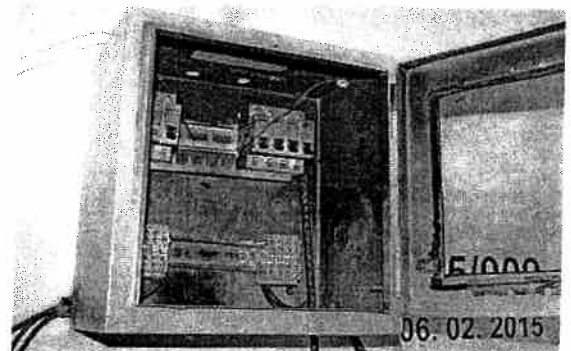
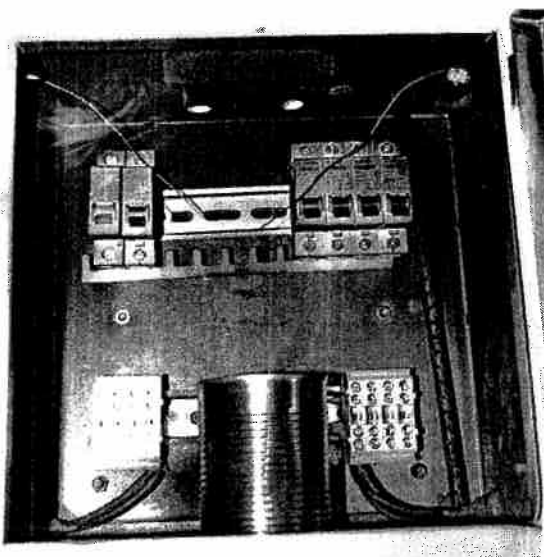
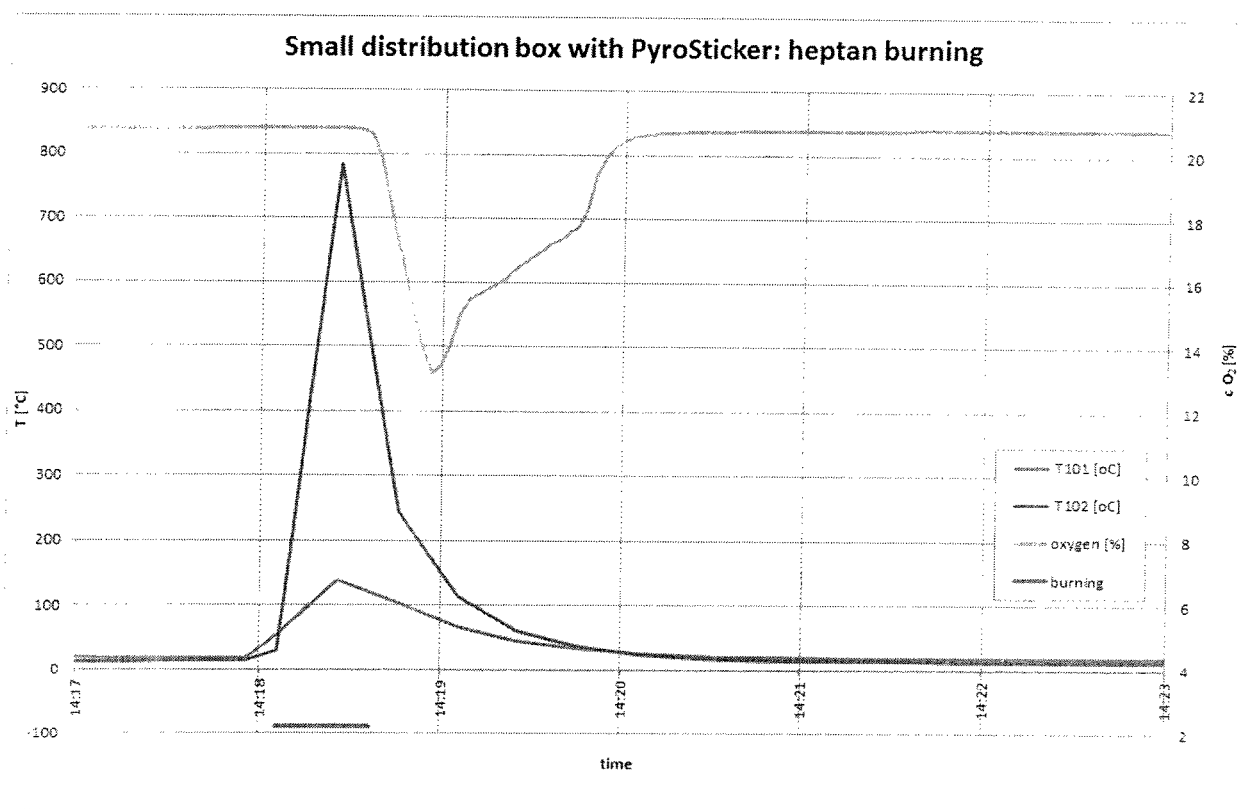
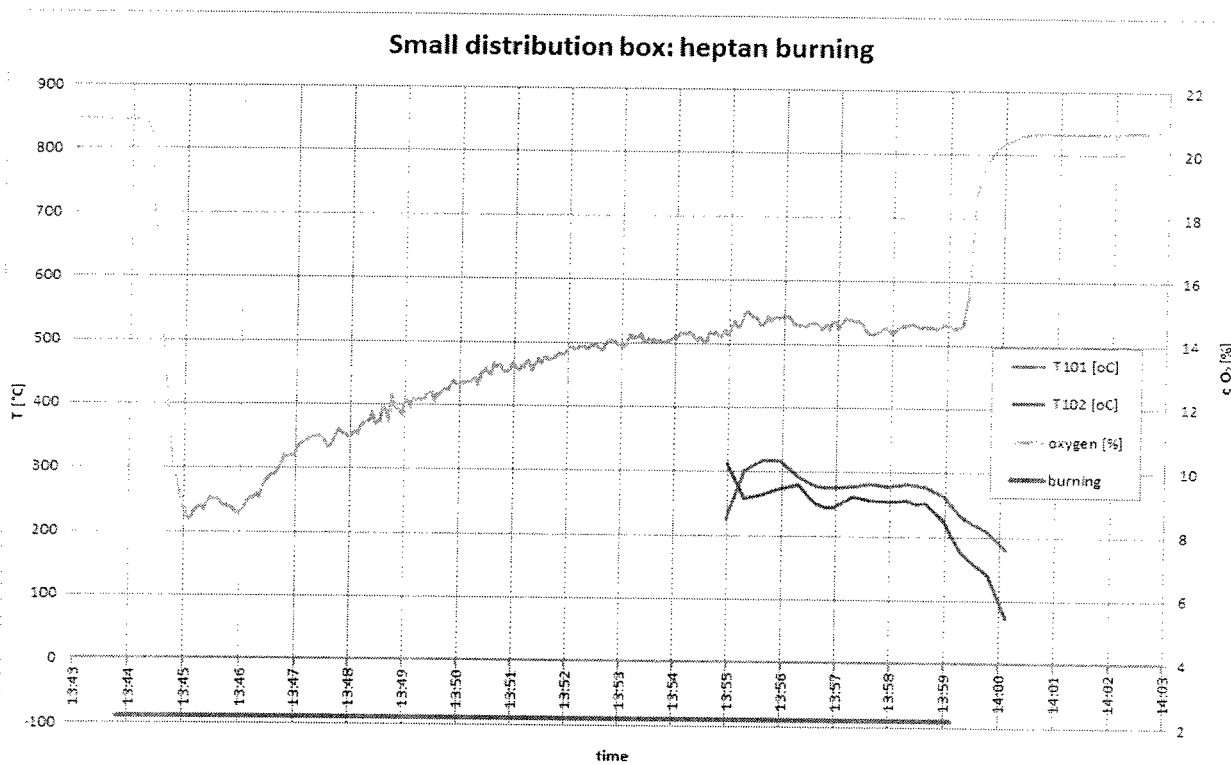


Photo 29258d-24: PiroStiker AST-25 to the ceiling of the distribution box



29258d-27: Opened box after the test. Extinguishing after 23 seconds

**PiroStiker AST-25: Test with heptane, which is burning in the container  $\Phi 75$  mm within electric distribution box 300 mm x 300 mm x 180 mm**



**Pyrocord (M): Test with heptane, which is burning in the container  $\Phi 100$  mm within electric distribution box 400 mm x 500 mm x 180 mm**

**Photographs:**

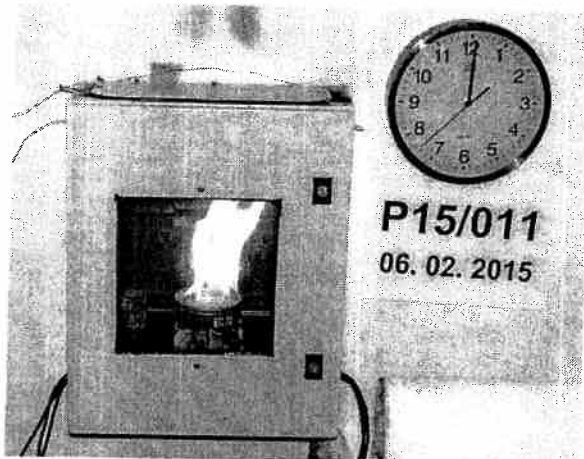


Photo 29258d-61: Heptan in container  $\Phi 100$  mm. Burning of heptane in the cabinet without Pyrocord (M) last 9 minutes

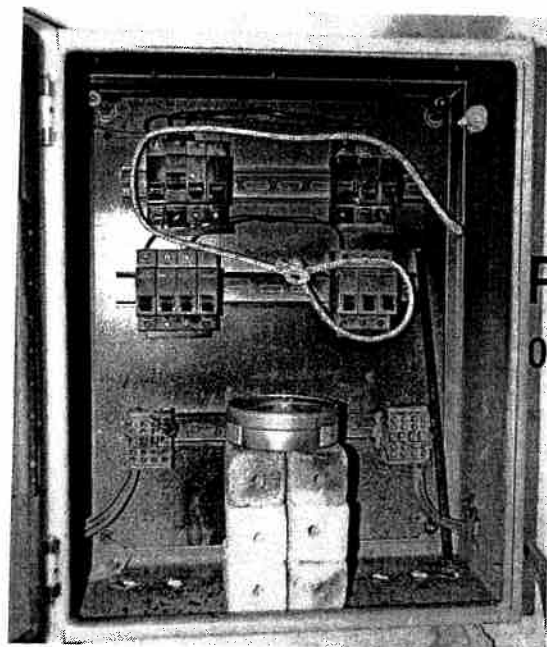


Photo 29258d-63: Installation Pyrocord (M) of length 1 m

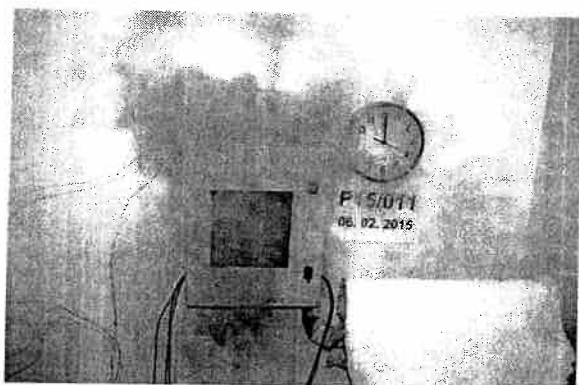


Photo 29258d-64: Extinguishing within 9 seconds

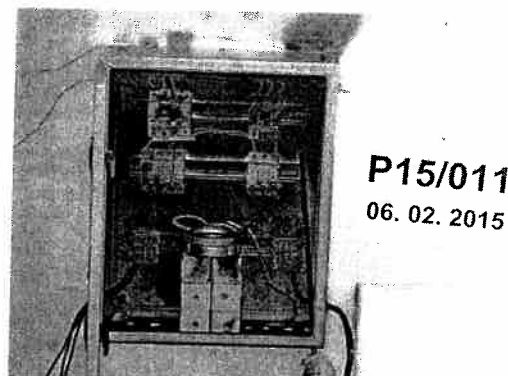


Photo 29258d-65: Opened cabinet after the test

**Pyrocord (M): Test with heptane, which is burning in the container  $\Phi 100$  mm  
within electric distribution box 400 mm x 500 mm x 180 mm**

