RECOMMENDATION OF SUITABILITY No. RP-0016/2024

Centrum Naukowo-Badawcze Ochrony Przeciwpożarowej
im. Józefa Tuliszkowskiego
Państwowy Instytut Badawczy
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CNBOP-PIB
TESTOWANIE
REKOMENDACJA

Series:
Recommendations of suitability

**Recommendation of suitability for use
in fire protection
No. RP-0016/2024**

Centrum Naukowo-Badawcze Ochrony Przeciwpożarowej – Państwowy Instytut Badawczy at the request of:

PM3D S.A.

ul. Fordońska 2

85-085 Bydgoszcz

on the basis of the evaluation of the tested product gives a recommendation of suitability

for use in fire protection of the product under the name:

Vehicle fire control sheet type PG-001

Manufactured by: PM3D S.A.
ul. Fordońska 2
85-085 Bydgoszcz

Expiration date:
Indefinitely

CENTRUM NAUKOWO-BADAWCZE OCHRONY PRZECIWPOŻAROWEJ im. Józefa Tuliszkowskiego PAŃSTWOWY INSTYTUT BADAWCZY

Deputy Director
for Certification and Admittance

st. bryg. Jacek Zboina, Dsc, PhD Eng.

Józefów, 7 June 2024

This document was originally translated from Polish to English between 06-07.11.2024.
In case of conflict between the original document and this translation, the Polish document shall be binding.

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1. SUBJECT OF THE RECOMMENDATION OF SUITABILITY

1.1. General technical characteristics of the product

The subject of this recommendation is fire control sheet type **PG-001.**

As declared by the manufacturer, the vehicle fire control sheet type PG-001 is designed to suppress and mitigate car fires. Among other things, it can be used as equipment for firefighting appliances, surface and underground parking lots, tunnels or electric vehicle charging stations.

The fire control sheet type PG-001 is made of fiberglass coated on one side with silicone. The working side of the sheet is silver in colour, and the outer side is grey in two shades. The sheet should be applied with the silver side toward the burning vehicle.

Photo 1. Fire control sheet type PG-001
Source: CNBOP-PIB.

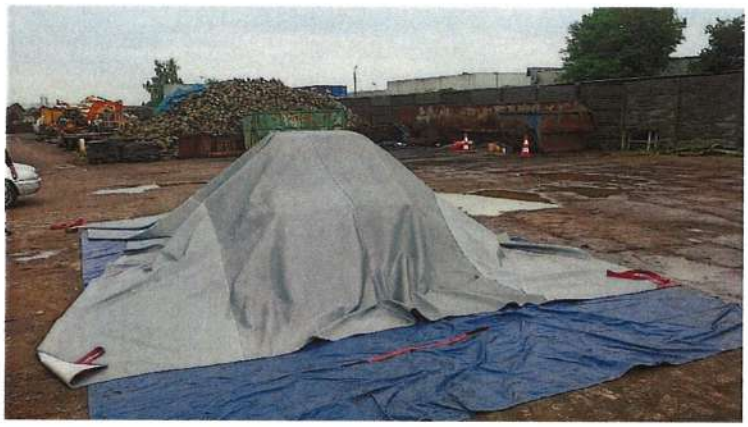

Photo 2. Fire control sheet type PG-001 applied on the vehicle
Source: CNBOP-PIB.

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Product properties declared by the manufacturer:

- Dimensions: 6 x 8 m (48 m^2)
- Thickness: 0,75 mm +/- 5%
- Weight: 750 g/m^2 +/- 50g/m^2
- Mass: 36 kg
- Construction material: fiberglass coated on one side with silicone
- Short-term operating temperature: > 1100°C
- Long-term operating temperature: > 1100°C
- Usage: reusable

2. INTENDED USE, SCOPE, CONDITIONS OF USE AND LIMITATIONS

2.1. Intended use

The fire control sheet type **PG-001** is designed for suppression and mitigation of car fires.

2.2. Scope, conditions of use and limitations

According to the manufacturer's declaration, the fire control sheet type PG-001 is reusable. The working side of the sheet is in silver colour, and the outer side is grey, in two shades, which makes it easier to position the sheet on the vehicle. The sheet should be applied with the silver side toward the burning vehicle.

After use, the sheet should be washed according to the manufacturer's recommendations, dried and prepared for another use.

3. PRODUCT TESTING

3.1. Assessing product suitability for testing

The vehicle fire control sheet type **PG-001**, as of the date of the recommendation, is not subjected to the obligation of obtaining an admittance for use in accordance with Article 7 of the Act of 24 August 1991 on fire protection (i.e. Polish Journal of Laws: Dz. U. z 2024 r., poz. 275).

On the basis of §2 of the testing procedure, after analysing the technical documentation of the product in question attached to the application for the testing of the innovative product, Centrum Naukowo-Badawcze Ochrony Przeciwpożarowej – Państwowy Instytut Badawczy (CNBOP-PIB) positively assessed the possibility of testing the fire control sheet type **PG-001** in the organizational units of the National Fire Service.

3.2. Testing program and process

Testing of the fire control sheet type **PG-001** of 6 x 8 m dimensions was carried out in accordance with the testing program approved by the Chief Commander of the National Fire Service in a Testing Unit selected by the Chief Commander of the National Fire Service.

The testing took place on **20.05.2024**.

The purpose of the test was to evaluate the suitability of the **fire control sheet type PG-001** for suppressing fires of passenger vehicles.

Practical testing of the product took place during training drills of duty shifts from Fire and Rescue Units No. 1 and No. 2 in Grudziądz. The place of the training drills was the yard on the premises of the TKJ Matuszewski plant in Grudziądz.

The following activities were conducted as part of the testing:

- applying sheets to vehicles parked in different layouts to simulate possible situations in reality, e.g. in parking lots or garages,
- unfolding and folding the fire control sheet several times,
- conducting two test fires of passenger vehicles (one vehicle with conventional propulsion and the other with EV batteries), the use of a sheet for fire suppression and evaluation of its practical suitability during firefighting operations,
- washing the sheet after using it to suppress a fire of a vehicle,
- visual inspection of the sheet after application and assessment of the possibility of using it again.

During the "dry" exercise, a sheet was applied to the vehicles set up at yard of the TKJ Matuszewski plant.

Photo. 3 – 6. Placing a sheet type PG-001 on a vehicle
Source: CNBOP-PIB.

Two fires of passenger vehicles were carried out during the fire drill.

1. Fire in a passenger vehicle with conventional propulsion.

A wrecked SKODA FELICJA vehicle was used – the vehicle had the front and rear windows on the driver's side open. The arson site was soaked in unleaded gasoline in an amount of about 3 dm^3. A VOLKSWAGEN GOLF vehicle was set up near the SKODA FELICJA vehicle to simulate obstructions in conducting operations.

The fire was initiated by setting fire to the rear bench seat. Approximately 3 minutes into the test, the vehicle's fire was developed and its fire temperature exceeded 650 °C[1]. Firefighters placed a fire control sheet over the vehicle, and spread the sides of the sheet on the ground to increase the tightness of the cover and limit oxygen access.

The sheet was kept on the vehicle for a period of 30 minutes. During this time, the vehicle was monitored and at intervals of 5 minutes temperature measurements were taken using a FLIR K55 thermal imaging camera. Table 1 contains the results of the temperature measurements at the point where the temperature was highest (around the centre of the vehicle's rear window).

[1] The maximum measurement range of the FLIR K55 thermal imaging camera

Table 1. Results of temperature measurements – fire of passenger vehicle with conventional propulsion

No.	Time	Temperature [°C]
1	Before applying the sheet	Above 650 °C
2	After applying the sheet	250 °C
3	About 5 minutes after applying the sheet	180 °C
4	About 10 minutes after applying the sheet	150 °C
5	About 15 minutes after applying the sheet	128 °C
6	About 20 minutes after applying the sheet	125 °C
7	About 25 minutes after applying the sheet	108 °C
8.	About 30 minutes after applying the sheet (before removing the sheet)	96 °C

After a period of 30 minutes, the sheet was removed and the vehicle was observed for visible flames and burning recurrence.

The flames were not visible, and there was no recurrence of burning for a period of 5 minutes and 30 seconds.

The following pages present photographic documentation of the conducted fire test.

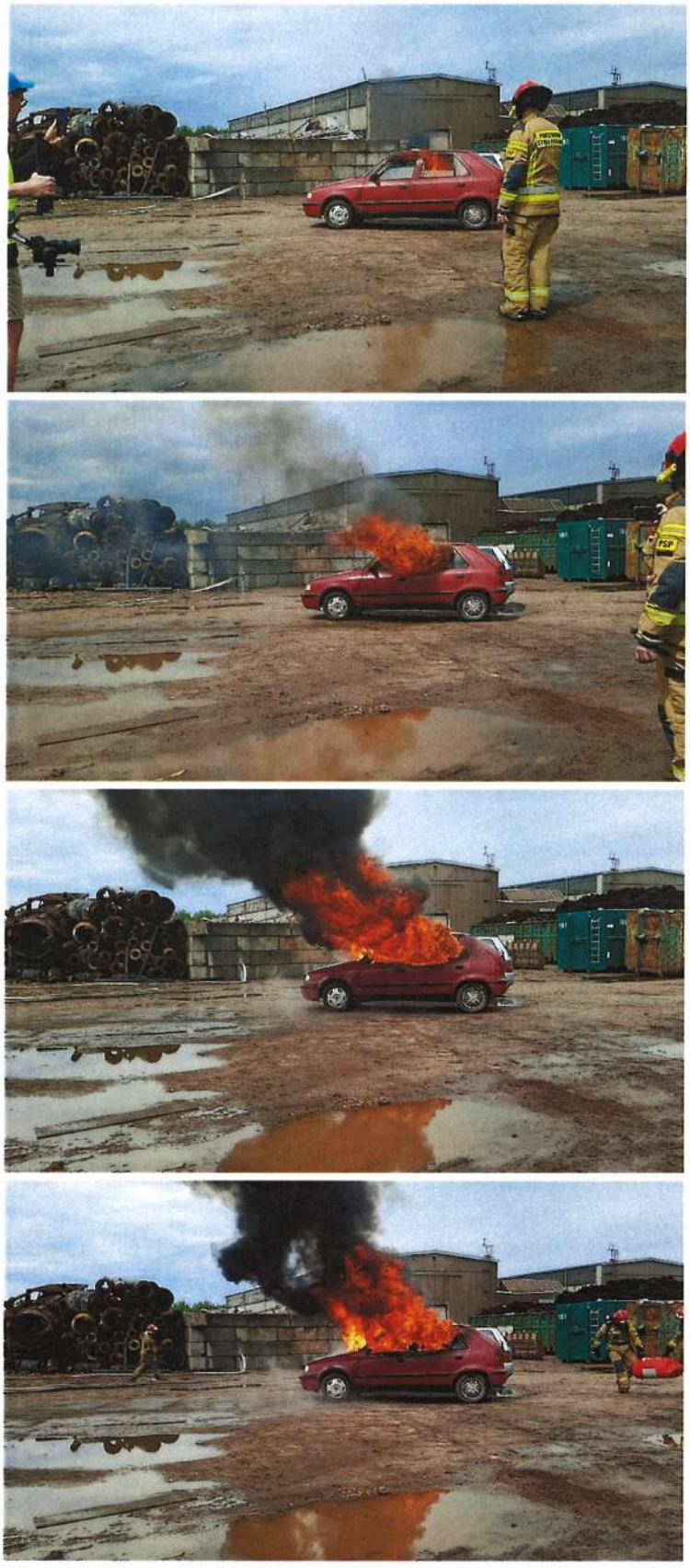
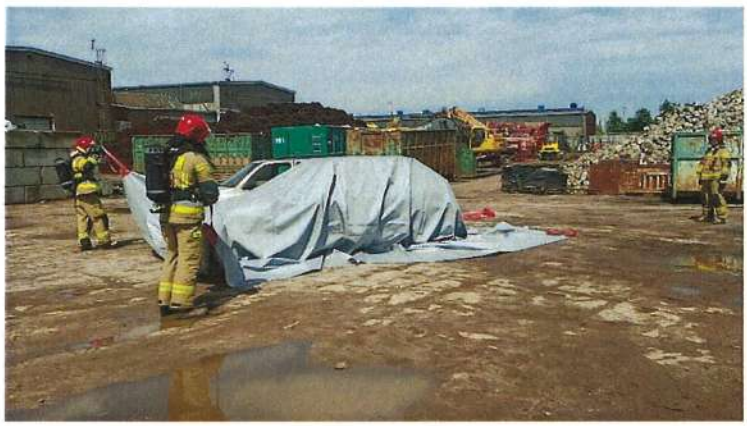


Photo. 7 – 10. Development of the fire
Source: CNBOP-PIB.

Photo. 11- 14. Placing a sheet type PG-001 over a burning vehicle

Source: CNBOP-PIB.

Photo. 15. Vehicle covered with the vehicle fire control sheet type PG-001
Source: CNBOP-PIB.



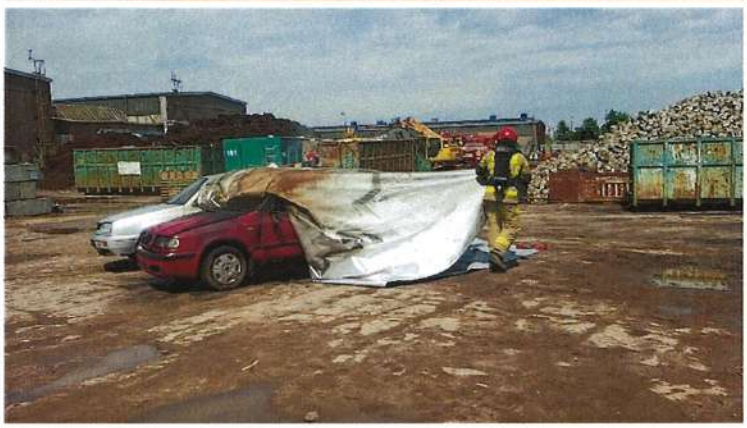


Photo. 16 – 17. Removal of the sheet type PG-001
Source: CNBOP-PIB.

Photo. 18 – 19. Removal of the sheet type PG-001
Source: CNBOP-PIB.

Photo. 20. Vehicle after removal of the sheet type PG-001
Source: CNBOP-PIB.

The sheet was visually inspected to detect any damage and burn-through. The sheet was then washed with water and prepared for reuse on the second fire.

Photo. 21. Fire control sheet type PG-001 after one use and washing with water
Source: CNBOP-PIB.

Conclusions:

The vehicle fire control sheet type PG-001 effectively isolates oxygen access to the combustion zone and suppresses the vehicle fire, as well as isolates the impact of the fire on the surrounding area.

The sheet type PG-001 was not damaged or burned through and was suitable for reuse after washing. There were traces of sooting and exposure to high temperatures on the fire extinguishing sheet.

2. **EV battery passenger vehicle fire.**

A wrecked VOLKSWAGEN GOLF vehicle was used, the vehicle had open front and rear windows.

In order to simulate an EV fire, 2 packs created from 444 18650-type lithium-ion cells were used (according to the applicant's declaration, the total capacity of the packs was about 10.6 kWh/460 Ah) – the electric vehicles have batteries with a larger capacity than those used in the tests.

The batteries were placed in a metal tub on the rear seat of the vehicle. The tub was filled with a flammable liquid of about 2 dm^3. The front seats of the vehicle were soaked in the flammable liquid. The fire was initiated by setting fire with a gas burner to the flammable liquid in the tub in which the batteries were placed.

After about 5 minutes from the start of the test, thermal runaway was observed in one battery, followed by the process in subsequent cells..

Approximately 5 minutes into the test, the vehicle's fire was developed and its temperature exceeded 650 °C[1]. Firefighters applied a fire control sheet to the vehicle, and spread the sides of the sheet on the ground to increase the tightness of the cover and limit oxygen access. Firefighters applied the same sheet a second time, with the same side to the burning vehicle.

The sheet was kept on the vehicle for a period of 30 minutes. During this time, the vehicle was monitored and at intervals of 5 minutes temperature measurements were taken using a FLIR K55 thermal imaging camera. Due to the location of the batteries inside the vehicle, it was not possible to measure their temperature.

Table 2 contains the results of temperature measurements at the point where the temperature was highest (around the centre of the vehicle's rear window). During the test, the thermal runaway of successive battery cells was audible until about the 15th minute – however, most likely due to the method used to set the vehicle on fire and the lack of direct exposure of the gas burners to the batteries, it was not intense.

Table 2. Temperature results - passenger vehicle fire with EV batteries

No.	Time	Temperature [°C]
1	Before applying the sheet	Above 650 °C
2	After applying the sheet	290 °C
3	About 5 minutes after applying the sheet	270 °C
4	About 10 minutes after applying the sheet	210 °C
5	About 15 minutes after applying the sheet	162 °C
6	About 20 minutes after applying the sheet	130 °C
7	About 25 minutes after applying the sheet	114 °C
8.	About 30 minutes after applying the sheet (before removing the sheet)	108 °C

After a period of 30 minutes, the sheet was removed and the vehicle was observed for visible flames and recurrence of burning.

When the fire control sheet type PG-001 was removed, the flames were not visible, and after a time of about 3.5 minutes there was a recurrence of flame combustion of the interior of the vehicle, at the front in the passenger legroom. No recurrence of flame combustion was observed in the rest of the vehicle. The car was extinguished with a current of water. The battery cells located on the rear bench seat maintained a temperature of about 150°C. After several minutes of cooling with a diffused current of water, their temperature dropped to about 40 °C and did not increase in subsequent measurements. In order to exclude the possibility of resumption of thermal runaway, they were prophylactically placed for 24 h in a 200 dm^3 metal barrel filled with water.

The following pages present photographic documentation of the conducted fire test.



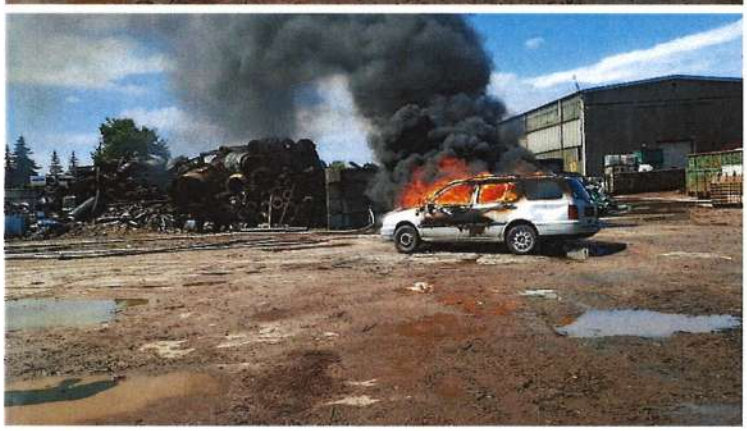



Photo. 22 – 25. Fire development
Source: CNBOP-PIB.

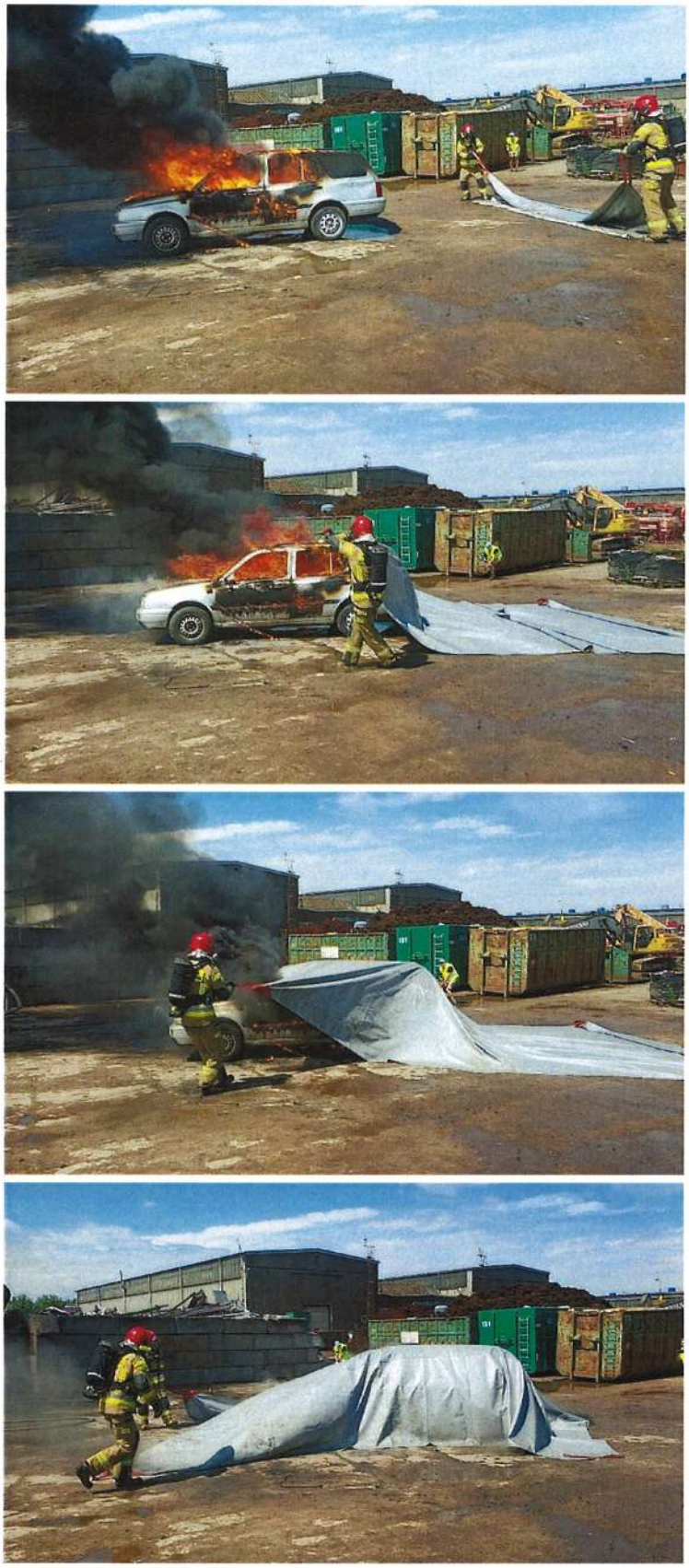


Photo. 26 – 29. Placing the sheet type PG-001 over a burning vehicle
Source: CNBOP-PIB.

Photo. 30 – 33. Removal of the sheet type PG-001
Source: CNBOP-PIB.

Photo. 34. Vehicle covered with vehicle fire control sheet type PG-001
Source: CNBOP-PIB.

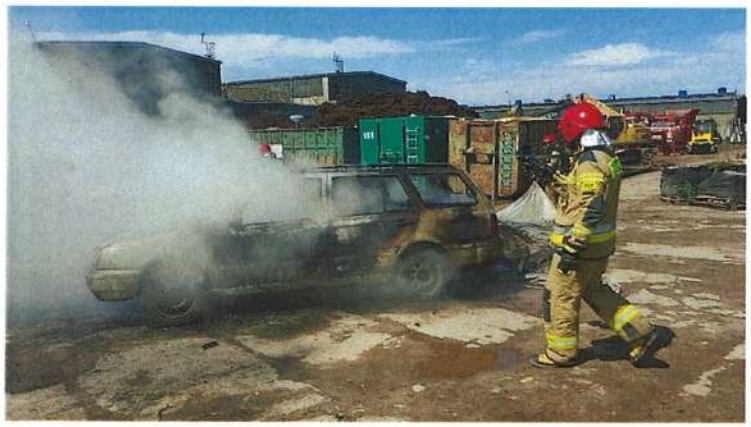


Photo. 35. Vehicle after removal of the sheet type PG-001
Source: CNBOP-PIB.

The sheet was visually inspected to detect any damage or burn-through. The sheet was then washed with water.

Conclusions:

The vehicle fire control sheet, type PG-001 effectively isolates oxygen access to the combustion zone and suppresses the vehicle fire, as well as isolates the impact of the fire on the surrounding area.

The sheet type PG-001 was not damaged or burned through and was reusable after washing. There were traces of sooting and high temperature effects on the firefighting sheet.

3.3. Evaluation of the tested product

Evaluation of the tested product: **positive**

Vehicle fire control sheet type **PG-001** is useful for isolating and suppressing fires of passenger vehicles equipped with conventional, hybrid and electric propulsion. In case of a fire in hybrid or electric vehicles equipped with batteries after removing the sheet, a recurrence of flame combustion is possible – this depends on the individual conditions and course of the vehicle fire and the chemical reaction that occurs in the batteries as a result of exposure to high temperatures.

It has been confirmed that the sheet can be used repeatedly – an assessment formulated on the basis of two uses / tests described in this recommendation.

The number of possible applications depends on, among other things, the fire conditions in which it was used as well as the design of the vehicles, since it can be mechanically damaged by pulling through protruding / sharp elements of the vehicle. Therefore, it is recommended that a detailed inspection / assessment after each use of the sheet is made, with particular attention to damage, discoloration, abrasion, which may affect the functionality of the product during the next use, i.e. effective insulation of the burning vehicle from the environment.

After removing the sheet, the vehicle should be observed if necessary for recurrence of fire and extinguish and/or cool it with water.

In case of hybrid and electric vehicles, it is necessary to continue to monitor the temperature after the sheet is removed and to cool the batteries as needed.

Benefits of using sheets:

- effectively suppress a fire of a conventional vehicle, there is the possibility of suppression of hybrid / electric vehicle fire dependent on individual conditions,
- effectively isolate of a burning vehicle from its surroundings makes it possible to reduce losses and carry out other activities during rescue and firefighting operations, e.g. evacuation of people, reparking / towing of neighbouring vehicles, in order to enable the pulling of a burning vehicle from an underground garage, crowded parking lot, etc.,
- reduce the amount of volatile combustion products produced during combustion – a feature especially important when conducting operations in confined spaces such as parking lots/underground garages,
- easily apply the fire extinguishing sheet to quickly cover the burning vehicle/equipment, the hooks attached to the corners of the sheet work well for this purpose. After testing, in "dry" and in real conditions, it should be noted that the hot products of combustion lift the sheet and "help" in its application on the vehicle.

Impediments associated with the use of sheets:

- if the vehicle has additional equipment on the roof, e.g. aerial, roof bars and racks, and equipment carried on them (such as bicycles), there may be difficulties or exclusion in the application of the sheet,
- for tightly parked vehicles, there may be difficulties in applying the sheet,
- after conducting tests under real conditions and washing the sheet according to the manufacturer's recommendations, the characteristic odours of combustion products (smell) can be detected. It is recommended to store the sheet in a sealed transport package, which is sold together with the with the sheet.

Suggestions for product improvement:

- due to the fact that the product can be used to extinguish fires in various parking layouts, it is recommended to extend the handles used for stretching it. This will increase the ergonomics of the work and make it easier to put the sheet on a burning vehicle by stretching it over several vehicles and sealing only the one in which flames are developing,
- due to the heavy smoke that occurs during a vehicle fire, it is recommended to mark with a clear line the axis of symmetry of the product. The use of such marking will help firefighters correctly apply the firefighting sheet to the burning vehicle,
- in order to apply the product correctly (in accordance with the instructions for use), it is recommended to clearly (to prevent mistakes) mark the "inner" and "outer" layers near the handles.

4. MARKING THE PRODUCT WITH THE "TEST RECOMMENDATION" LABEL

4.1. General rules

The applicant may mark the product covered by this CNBOP-PIB Recommendation with the label "TESTING RECOMMENDATION", the design of which is presented in section 4.2.

"TESTING RECOMMENDATION" label can be placed:

- either directly on the product or on a label attached to it in a visible, legible and irremovable manner. The number of this Recommendation of suitability shall be placed below the label.
- if it is not technically possible to mark the product in the manner specified above, the mark shall be affixed to the unit packaging or bulk packaging of the product or to the commercial documents accompanying the product, and/or to the product data sheet, product instructions and other commercial documents accompanying the product.

4.2. Label model "TEST RECOMMENDATION"

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Photo. 36. Label model "TEST RECOMMENDATION"
Source: own project of CNBOP-PIB.

5. FORMAL PROVISIONS

5.1. Testing of the product was carried out in accordance with the Procedure for testing innovative products 2nd edition dated 12 March 2015.

5.2. The CNBOP-PIB Recommendation of suitability No. RP-0016/2024 was issued upon application for testing of an innovative product registered under the following number 035/DOT/TWI/2024 and is a voluntary document stating the applicability of the product for use in fire protection to the extent resulting from the provisions of this Recommendation.

5.3. The CNBOP-PIB Recommendation of suitability No. RP-0016/2024 confirms the usability of the product as manufactured by the Manufacturer and submitted by the Applicant for testing.

5.4. The Recommendation of suitability is not a document authorizing the labelling of a product with a label other than that shown in Section 4 of this Recommendation.

5.5. Recommendation of suitability does not relieve the manufacturer of responsibility for the quality of the product, each batch of that product, and individual units of that product.

5.6. The warranty for the product to which this Recommendation of suitability applies shall be provided by the Manufacturer on the basis of separate regulations.

5.7. In the content of issued brochures and notices, as well as other documents related to the product to which this Recommendation of suitability applies, the information about the Recommendation of suitability No. **RP-0016/2024** granted to this product by CNBOP-PIB shall be placed.

5.8. CNBOP-PIB Recommendation of suitability does not violate the rights arising from the provisions on protection of industrial property, in particular the Act of 30 June 2000 Industrial Property Law (i.e. Polish Journal of Laws: Dz. U. z 2023 r., poz. 1170). Ensuring these rights is the responsibility of the user of this Recommendation of Usability.

5.9. It is the manufacturer's responsibility to verify that the solution being the subject of CNBOP-PIB Recommendation of suitability does not infringe on the rights of third parties.

5.10. Responsibility for damage caused to anyone as a result of product defects shall be taken by the Manufacturer.

5.11. CNBOP-PIB, while issuing Recommendation of suitability, does not take responsibility for possible violation of exclusive and acquired rights.

5.12. CNBOP-PIB may make changes to this Recommendation of suitability on its own initiative or at the request of the owner of the Recommendation.

5.13. CNBOP-PIB Recommendation of suitability may be revoked by CNBOP-PIB, in case of changes in separate regulations, standards, scientific bases and the state of technical and practical knowledge, as well as failure to confirm, during use, the usability of the product for a given application. Recommendation of suitability may be revoked on CNBOP-PIB's own initiative.

6. EXPIRATION DATE

CNBOP-PIB Recommendation of suitability No. **RP-0016/2024** is valid indefinitely, provided that:

- no significant changes will be made in the product;
- there will be no changes in separate regulations, standards, scientific bases and the state of technical and practical knowledge;
- will not be revoked by CNBOP-PIB.

7. ADDITIONAL INFORMATIONS

7.1. Documentation

No.	Name of the document	Document No.	Date
1	Application for testing of innovative product with attachments	035/DOT/TWI/2024	25.01.2024

END OF RECOMMENDATION OF SUITABLIITY

Recommendation of suitability prepared by	**mł. bryg. Grzegorz Mroczko, M.Sc. Eng.** Title or equivalent term, first and last name	07.06.2024 Date, signature
Recommendation of suitability authorized by	Deputy Manager of the Technical Assessment Department **Robert Śliwiński, M.A. Eng.** Title or equivalent term, first and last name	07.06.2024 Date, signature

This document was originally translated from Polish to English between 06-07.11.2024.
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