Wildland-Urban Interface Virtual Essays Workbench

WUIVIEW

GA number 826522

PBD Virtual Lab WUIVIEW

Funded by European Union Civil Protection

Technical Note TN 7.4
Domestic LPG canisters

WP - Task		Version (1)	1.0
Filename	WUIVIEW_TN7.4_Domestic_LPG canisters	Dissemination level (2)	Internal
Programmed delivery date		Actual delivery date	

Document coordinator	Thiago Barbosa (ADAI)
Contact	thiago.fernandes.barbosa@gmail.com
Authors	Thiago Barbosa (ADAI)
Reviewed by	Luís Mário Ribeiro (ADAI)

Abstract	This document presents the preliminary experiments and analysis performed on domestic LPG canisters, as a WUIVIEW complementary scenario of WUI fire hazard. This demonstration was performed to gather evidences on the response of canisters´ materials under fire. For these preliminary experiments, the canisters were filled with water or were used empty. Future tests will be performed with canisters filled with LPG. For the canisters made with composites, the first and second layers melted and the pressure inside rose twice when compared with canisters made with steel. For canisters protection, this structure could block until 70% of heat flux radiated.

(1) Draft / Final
(2) Public / Restricted / Internal

Disclaimer

The content of this publication represents the views of the authors only and is their sole responsibility. The European Commission does not accept any responsibility for use that may be made of the information it contains.

Table of Contents

1. Introduction

LPG canisters are widely used in Portugal for different purposes, like heating houses, water and cooking. Also, the majority of rural WUI areas do not have piped gas. When a wildfire occurs, the canisters become dangerous for people and structures because of the enormous amount of energy stored. Consequently, during heating, the vessel structure can burst and the energy will be released suddenly.

There have been some canister related accidents in Portugal in recent years., for instance: Funchal in 2016, Freamunde and Miranda do Corvo in 2020 and Sesimbra in 2021. Therefore, this experimental campaign is being undertaken to understand the canisters' behaviour when exposed to a wildfire and to find ways to avoid these catastrophic events.

Figure 1: Canisters collected by firefighters from Miranda do Corvo, after an incident

2. Description of the tests

The preliminary experiments were done at the Forest Fire Research Centre of ADAI (CEIF-ADAI). These experiments were divided into two groups: the first one related to the behaviour of the canister's material under fire while the second one is related to its protection.

2.1. Behaviour of canisters materials

The most common materials for the manufacture of canisters in Portugal is steel and composite. So, these two types were filled with water and exposed to fire. The forest fuel used for the tests was wood and the canisters were set at 50 centimetres from the fire. In each test two type K thermocouples, a manometer and a heat flux sensor were used.

Each canister was 15 minutes under heating at heat flux with an average of 0,6 W/cm^2 and a peak of 1,2 W/cm^2.

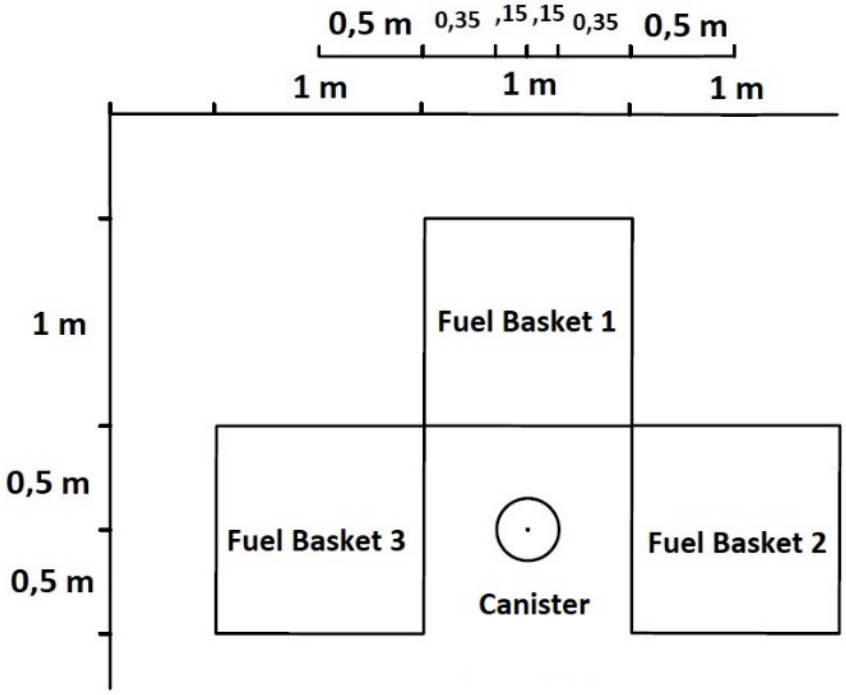

Figure 2: Design A

Figure 3: Design B

2.2. Protection tests

The canisters were put close to the fire at three different distances (1 m, 0,75 m and 0,5 m). The tests were performed using a protection structure that is still in development. For this test we used one heat flux sensor and five thermocouples. The forest fuel used was shrubs.

Figure 4: Canister inside protection

3. Preliminary results

3.1. Behaviour of canisters materials

For steel canisters, its surface remained undamaged and the internal pressure rose to 0.5 bar. For the composite canisters, the first and second layers melted and the internal pressure rose to 1 bar.

Figure 5: Composite canister test

3.2. Protection tests

The structure for canister protection in these preliminary tests could block until 70% of the heat flux radiated. The temperature on the canister surface rose only 3 Celsius degrees. The time of exposure was 8 minutes, the radiated heat flux average was 4,8 W/cm^2 and the heat flux peak was 8,9 W/cm^2. For these tests, the canisters were empty.

Figure 6: Protection test

4. Future work

For future work we intend to perform tests with canisters filled with LPG under fire to measure internal pressure and temperature increments. Some of the tests will be carried until the canisters burst. In those tests we will measure the time to burst, fragments projected distance and overpressure.

5. Conclusion

Preliminary tests have shown that steel canisters are safer than composite canisters when both are exposed directly to fire. It was observed a higher increment of internal pressure in composite canisters than in steel canisters and also that the layers of composite structure melt under fire.

To avoid the increment of pressure and temperature it is possible to use very light and cheap protection systems with a high percentage of heat flux blocking.