Fire Protection Association

Report Number
FPA-00101813.002

CUSTOMER REPORT

Ad-hoc fire test on a mobile cooking stations local fire suppression system

SYSTEM BRIEF DETAIL

Report detailing the findings of two fire tests conducted to assess the extinguishing performance of a local fire suppression system designed for use with a mobile cooking station

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Review

Approval	Name	Date
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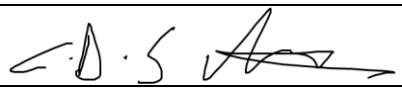
Reviewed by	David Sibert	04/11/2019
Reviewers signature		

Distribution

Name	Company
Steven Evans	Stirling Fire Solutions Limited

Document version history

Version	Date	Superseded documents/description/details
1.0	04/11/2019	Draft release for review
2.0	06/11/2019	Incorporating client comments
3.0	19/11/2019	Summary updated

Contents

1 Introduction

FPA were approached to undertake an ad-hoc fire test of a local fire extinguishing system for use with a mobile cooking and extraction station.

The system tested was Rieber's ACS Air Cleaning System, ACS 1600 mobile cooking station used with a twin electric fryer unit as shown in Figure 1. For the test programme, the system was supplied, setup and operated by Stirling Fire Solutions Limited.

Installed in the cooking station was a prototype fire suppression system. The system used a pressurised canister containing 2.75 US gallon of wet chemical extinguishing agent. When activated the agent was discharged through and array of 4 spray nozzles. Two of the nozzles were directed over cooking area and two of the nozzles discharged into the filter housing. Under normal operating conditions the system is activated based on the response of an electronic linear heat detection system. However, for the test programme it was operated manually after a two minute delay (to exceed the LPS1223 protocol of 30 seconds and meet the UL300 protocol of 2 minutes) to ensure that the fire represented a challenging test to the system.

Photographs of a nozzle are shown in Figure 2 and Figure 3.

Figure 1 – Mobile cooking station with twin electric fryer

Figure 2 – Nozzle installed over the RHS of the cooking area

Figure 3 – Nozzle installed above the LHS filter unit

2 Experimental assessment

Two tests were conducted on the on the cooking station. Test 1 with the fans of the extraction system running and Test 2 with the fans of the extraction system switched off.

Prior to the test the system manufacturer disabled the thermostatic protection on the twin fryer unit, to ensure the oil in the fryers would reach auto ignition temperature.

For each test, the twin fryer was filled with new cool vegetable oil. The fryer was switched on and the oil was heated up until the oil in the fryers ignited. Following ignition, the time at which the detection systems activated was noted. The suppression system was operated manually two minutes after auto ignition of the oil.

2.1 Instrumentation and video

Six type-k mineral insulated thermocouples were used to monitor temperatures in the cooking station. Details of thermocouple positions are shown below.

Two video cameras were used to film the tests. Key timings of events were determined from the footage recorded.

Thermocouple ID	Location
TC1	Temperature of oil in LHS fryer
TC2	Temperature of oil in RHS fryer
TC3	Temperature in the proximity of the detection system above LHS fryer
TC4	Temperature in the proximity of the detection system above RHS fryer
TC5	Temperature in LHS filter unit housing
TC6	Temperature in RHS filter unit housing

Figure 4 – Thermocouple locations

3 Test results and observations

3.1 Test 1, fans operating

Over a period of 46 minutes the oil in the fryer gradually heated to a temperature of 364˚C, at which point the oil in the LHS fryer auto ignited. Following ignition, the power supply to the fryer was isolated. The oil continued to burn for 2 minutes before the suppression system was activated. During this period the flames did not spread to the oil well of the RHS fryer. Following suppression activation, the flames were fully extinguished in under 2 seconds.

Table 1 – Test 1 sequence of events

Time from start of test	Time from ignition of the oil	Event
00m 00s	--	Fryer units tuned on and oil begins to heat
46m 00s	0s	Oil in LHS fryer ignited (oil temperature = 364˚C)
--	0s – 10s	Power supply to fryer isolated
--	121s	Suppression system activated manually
--	123s	< 2 second from activation of the suppression system, flames extinguished
--	124s	Electronic detection system activated
--	125s – 135s	Power supply to cooking station isolated and extraction stopped
--	176s	Extinguisher exhausted

Fire moments after ignition

Fire shortly before activation of the suppression system

Fire immediately after activating suppression system

Cooking station post-test

Figure 5 – Test 1, video screen shots showing development of the fire

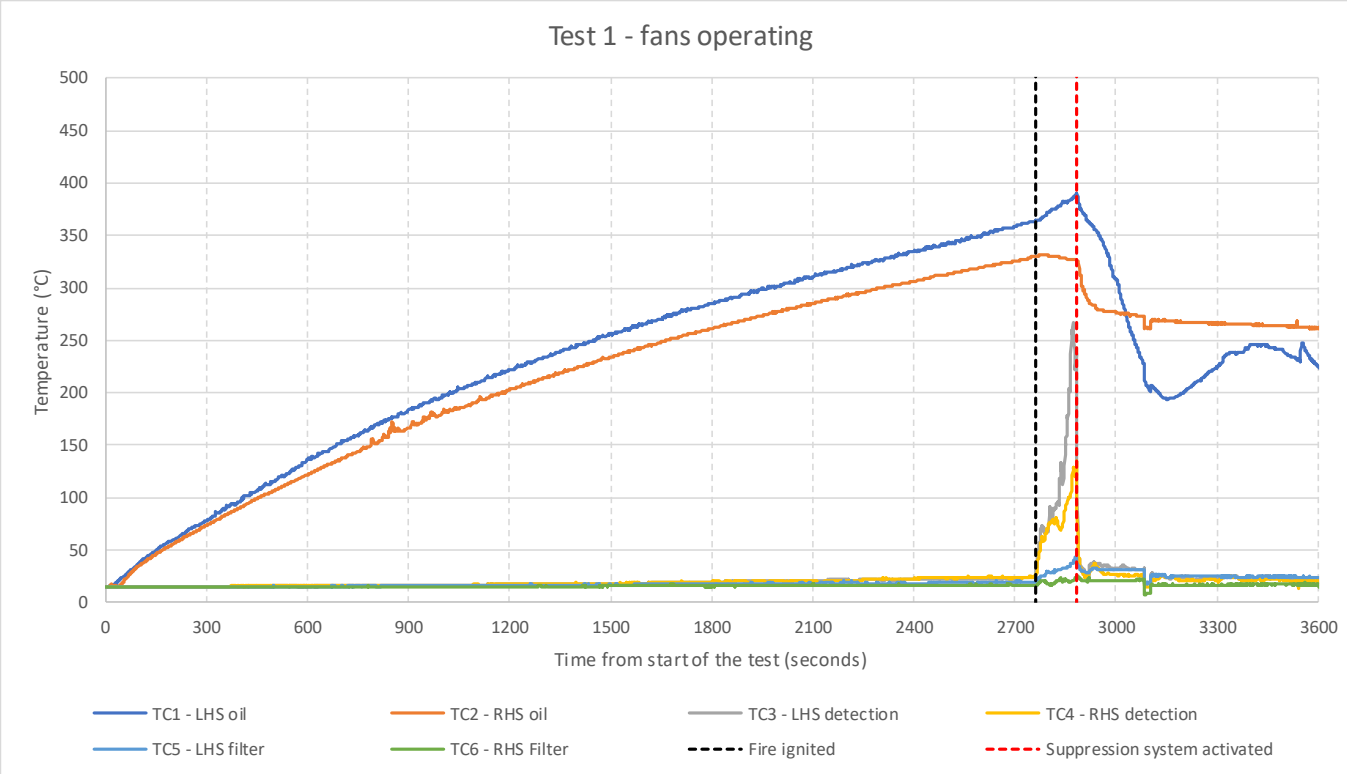


Figure 6 – Test 1, temperature measurements in cooking station

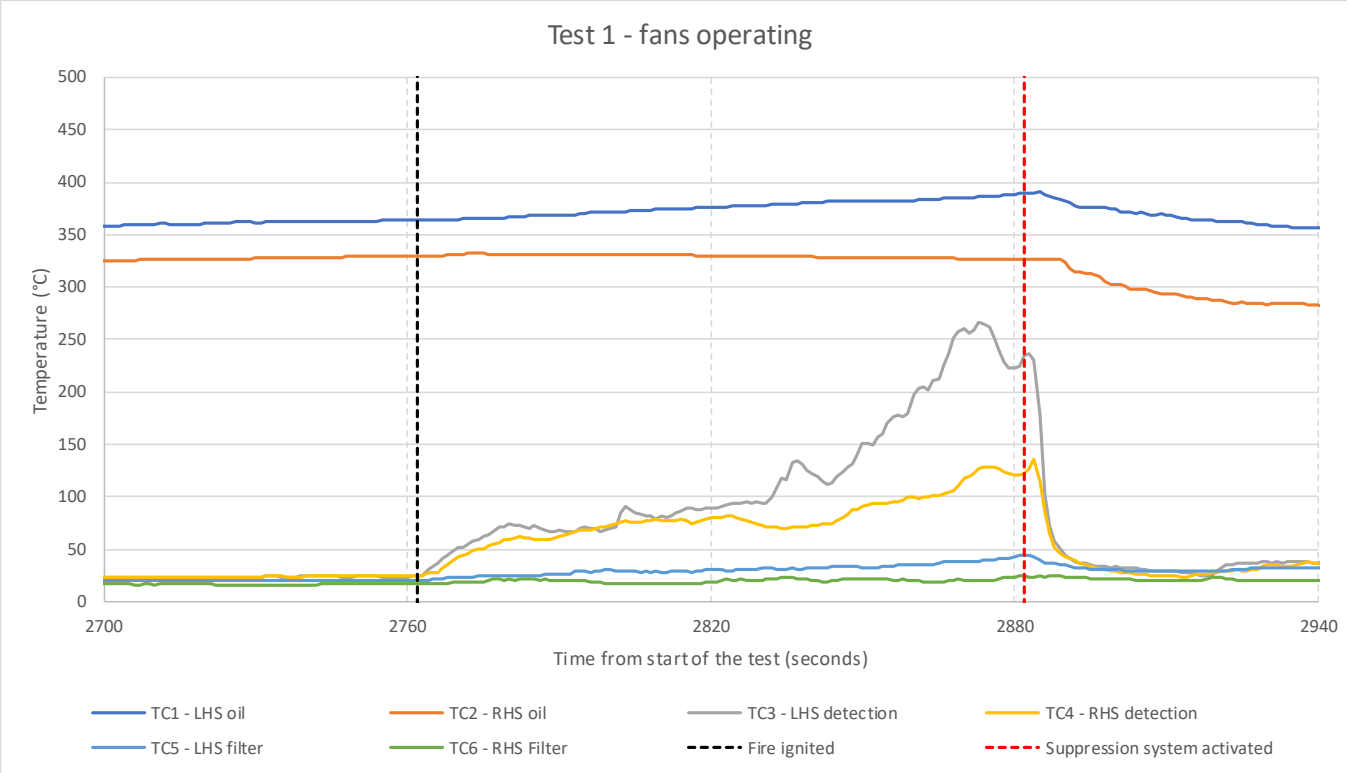


Figure 7 – Test 1, temperature measurements in cooking station (near time of ignition)

Figure 8 – Test 1, Cooking station post-test

3.2 Test 2, fans switched off

Over a period of 38 minutes the oil in the fryer gradually heated to a temperature of 368 ˚C, at which point the oil in the LHS fryer auto ignited. The oil in the RHS fry was lit 30 seconds later by applying a lit taper to the surface of the oil. The oil continued to burn for 2 minutes before the suppression system was activated. Following activation suppression, the flames were fully extinguished in under 2 seconds. The power supply to the fryer was isolated shortly after operation of the suppression system.

Table 2 – Test 2 sequence of events

Time from start of test	Time from ignition of the oil	Event
00m 00s	--	Fryer units tuned on and oil begins to heat (oil temperature 60 ºC)
38m 00s	0s	Oil in LHS fryer ignited (oil temperature = 368˚C)
--	30s	Oil in RHS fryer ignited with lit taper
--	53s	Electronic detection system activated
--	113s	Fluorescent tube in canopy, bursts
--	123s	Suppression system activated manually
--	123s – 125s	< 2 second from activation of the suppression system, flames extinguished
--	125s - 135	Power supply to fryer isolated
--	175	Extinguisher exhausted

Fire moments after ignition

Ignition of RHS fryer

Fire when electronic detection system activated

Fire as light bulb ruptures

Fire shortly before activation of the suppression system

Immediately after activating suppression system

Figure 9 – Test 2, video screen shots showing development of the fire

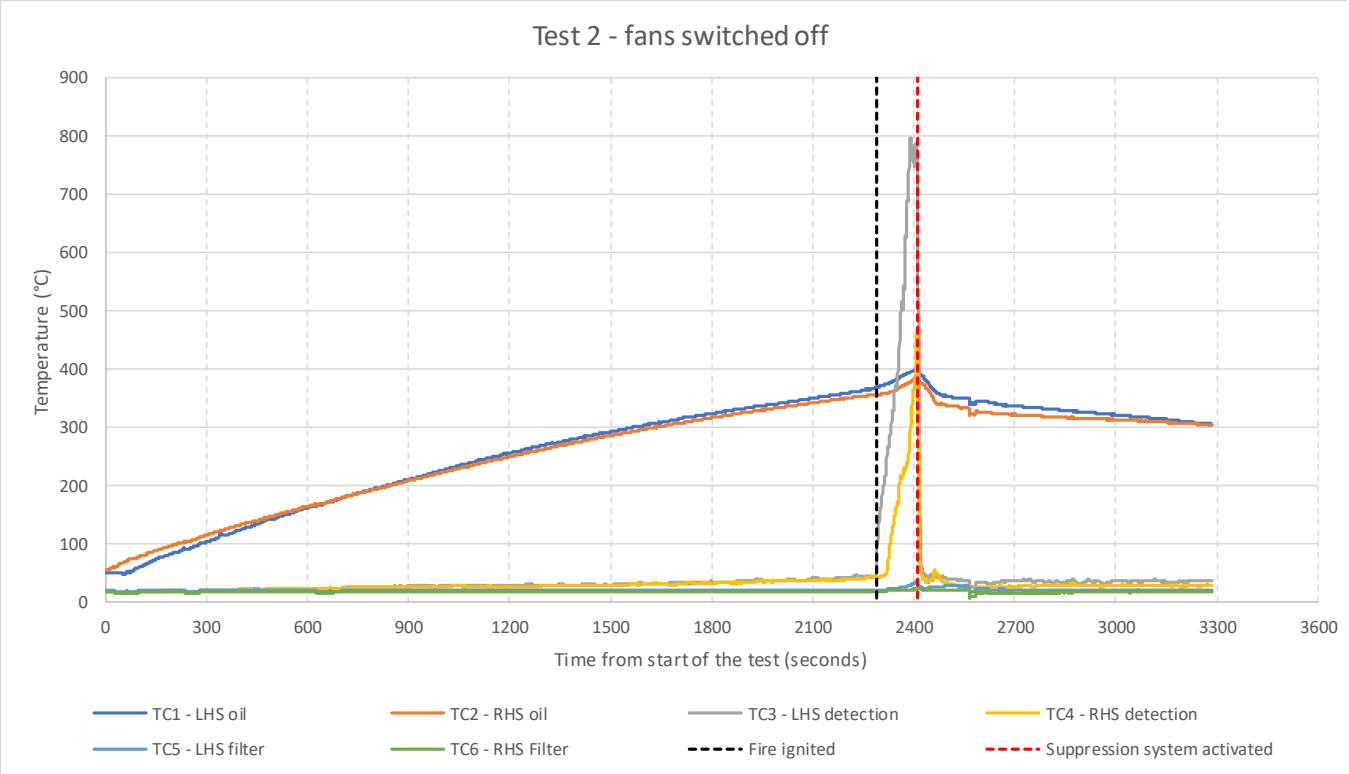


Figure 10 – Test 2, temperature measurements in cooking station

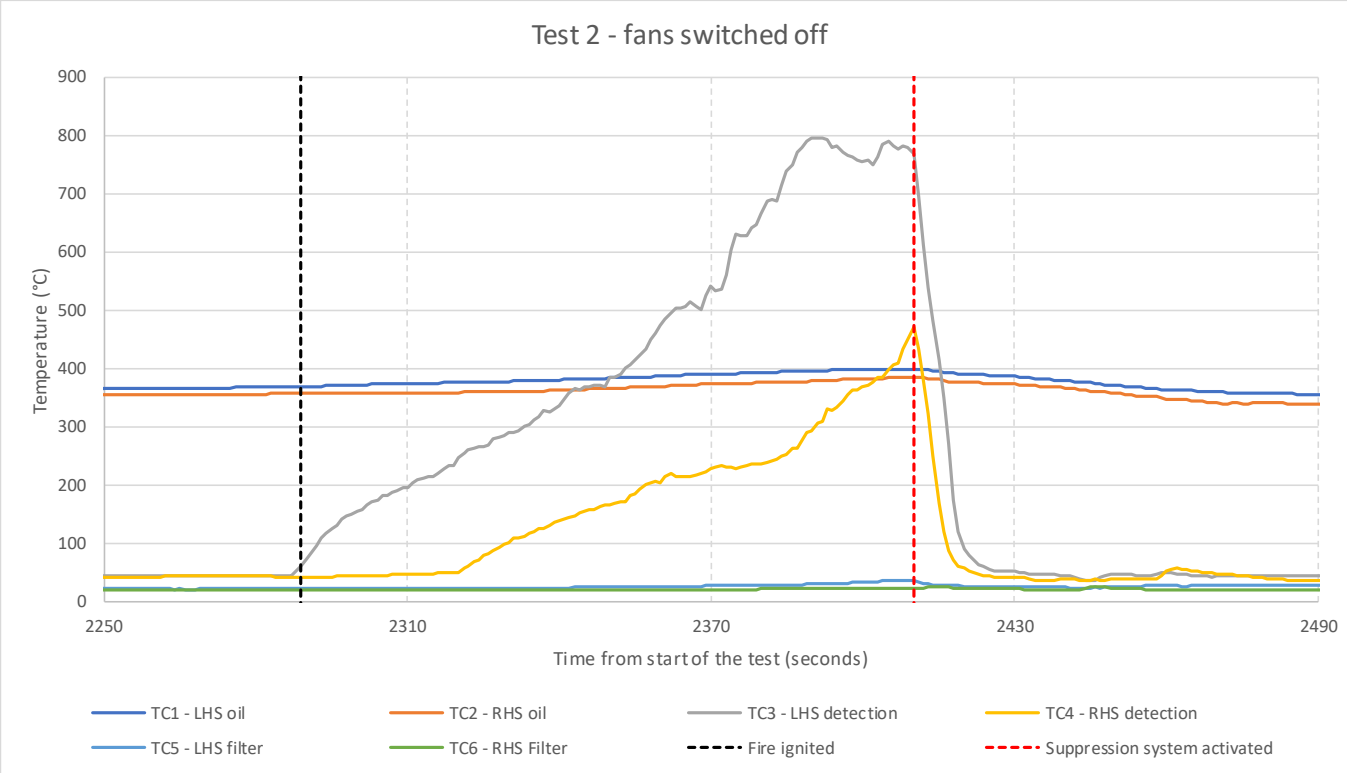


Figure 11 – Test 2, temperature measurements in cooking station (near time of ignition)

Figure 12 – Test 2, Cooking station post-test

4 Summary

Two tests were conducted to evaluate the extinguishing performance of a prototype detection and suppression system for use with a mobile cooking and extraction system. The tests were conducted with Rieber's ACS 1600 mobile cooking station used with a twin electric fryer unit. The suppression system has also been designed to be compatible with the ACS 1100 and ACS 1500 units which are small width versions of the cooking station.

For each test, oil in the fryer was heated until it auto ignited. The suppression system was manually activated 2 minutes after ignition.

Test 1 was conducted with the cooking station fans operating. The system extinguished the fire in the cooking area within 2 seconds of its operation.

Test 2 was conducted with the fans switched off. The system extinguished the fire in the cooking area within 2 seconds of its operation.

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