



Client EnviroTech (Europe) Ltd
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Report issue date 26th August 2011
Report number S106734R1V1/11

Supercorr A

Aerosol Classification Testing

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For and on behalf of Chilworth Technology Limited	

Quote / Job Numbers: 106734 / 304669
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THE EXPERTS IN PROCESS SAFETY

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1. INTRODUCTION

This report contains test data for EnviroTech (Europe) Ltd regarding the aerosol flammability characteristics of Supercorr A. Specifically, the following tests have been undertaken.

- Ignition Distance Test for Spray Aerosols
- Enclosed Space Ignition Test

The test sections within this report detail any sample preparation (where appropriate), prior to testing.

Detailed characterisation of the material tested in this study is provided in Section 2 of this report (with results summarised in the conclusions section). A description of the test procedures together with full test results and information on their interpretation is given in the test sections of this report. Chilworth Technology's Laboratories are GLP (Good Laboratory Practice) compliant and this study was carried out to the principles of GLP. All original test records are kept in a locked archive for a minimum of 10 years after the date of this report.

The following are the key dates for the work reported here:

Sample receipt date	:	05/08/2011
Start date of the experimental work	:	24/08/2011
Completion date of the experimental work	:	25/08/2011

Note: Any remaining material will be stored for 1 month after the issue date of this report and will then be disposed of.

This report together with any relevant graphs has been issued in digital format. In order to ensure that the integrity of the data is maintained, the signed hard copy (retained in the CTL archive) will be considered to be the source document, and any digital versions will be considered to be copies.

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2. SAMPLE CHARACTERISATION

Product Name	:	Supercorr A
Batch Number	:	5707
CTL Sample Reference	:	113411
Use	:	Anti-corrosion thin film lubricant. For use on electronic circuitry, switchgear, wiring and metal surfaces.
Special Hazards	:	Classified as Xn (Harmful); with Risk Phrases R20 (Harmful by inhalation), R30 May become highly flammable in use) & R52/53 (Harmful to aquatic organisms, may cause long term adverse effects in the aquatic environment).
Appearance	:	As received, the sample is observed to be a brown liquid.
Heat of combustion	:	< 20 kJ/g (Supplied by client)

3. IGNITION DISTANCE TEST FOR SPRAY AEROSOLS

Test Objective and Information

The test is conducted according to UN Recommendations on the Transportation of Dangerous Goods, fifth revised edition.

Apparatus

Graduated scale, support and clamp	-	graduations in centimetres
Gas burner with support and clamp	-	Blue, non-luminous, + flame > 1000°C
Chronometer	-	accurate to ± 0.2 s
Water bath at 20 °C	-	accurate to ± 1 °C
Calibrated laboratory scales (balance)	-	accurate to ± 0.1 g
Thermometer	-	accurate to ± 1 °C
Hygrometer	-	accurate to ± 5 %
Pressure gauge	-	accurate to ± 0.1 bar

Test Objective and Information

The test describes the method to determine the ignition distance of an aerosol spray in order to assess the associated flame risk. The aerosol is sprayed in the direction of an ignition source over a range of 15 – 90 cm to observe if ignition and sustained combustion of the spray takes place.

The test shall be conducted in an adequately ventilated and draught-free area with the temperature controlled at 20 °C ± 5 °C and the relative humidity in the range 30 – 80 %.

The filled aerosol can is immersed in the water bath at a temperature of 20 °C ± 1 °C for at least 30 minutes prior to any testing.

Each aerosol dispenser is to be tested:

- When full
- When 10 – 12 % full nominal (% by mass)

Interpretation of Results

Spray aerosols shall be classified as flammable, extremely flammable or non flammable according to the following criteria:

An aerosol with a chemical heat of combustion less than 20 kJ/g is classified as flammable if ignition occurs at a distance equal or greater than 15 cm but less than 75 cm.

An aerosol with a chemical heat of combustion less than 20 kJ/g is classified as extremely flammable if ignition occurs at a distance of 75 cm or more.

If for an aerosol with a chemical heat of combustion less than 20 kJ/g, no ignition occurs in the ignition distance test, the enclosed space ignition test shall be performed.

Table 3.2: Full test results

Date 24/08/2011		Temperature 20°C		
Name of product Supercorr A		Humidity 54 %		
Net volume	30 g	Can 1	Can 2	Can 3
Initial level of filling		10 - 12%	10 - 12 %	10 - 12 %
Dispenser distance	Test	1	1	1
15 cm	Ignition? Yes (y) / No (n)	n* n**	n* n**	n* n**
Observations - including can position		* - Can upright ** - Can inverted		

Comment

No ignition observed in any test.

4. ENCLOSED SPACE IGNITION TEST

Test Objective and Information

The test is conducted according to UN Recommendations on the Transportation of Dangerous Goods, fifth revised edition.

The test covers the flammability of products emerging from aerosol dispensers due to their propensity to ignite in an enclosed or confined space.

The contents of an aerosol dispenser are sprayed at a 90° angle relevant to the vertical axis of the can into a cylindrical test vessel containing a burning candle. If an observable ignition occurs, the elapsed time and amount discharged is noted.

Before testing, each aerosol dispenser should be conditioned to 20°C ± 1°C in a water bath for 30 minutes and then primed by discharging for approximately 1 second. The purpose of this action is to remove non-homogeneous material from the diptube.

The tests should be carried out in a draught-free environment capable of ventilation, with the temperature controlled at 20°C ± 5°C and relative humidity in the range of 30 - 80 %.

The filled aerosol can shall be used in accordance with the conditions of use recommended by the manufacturer.

Apparatus

Chronometer (Stopwatch)

Water bath maintained at 20 °C

Calibrated laboratory scales (balance)

Thermometer

Hygrometer

Pressure gauge

Cylindrical test vessel approximately 200 dm³ (55 gallons) volume

Preparation of test apparatus

A cylindrical vessel approximately 200 dm³ (55 gallons) volume, approximately 600 mm in diameter and approximately 720 mm long and open at one end should be modified as follows:

A closure system consisting of a hinged cover should be matched to the open end of the receptacle, or:

A plastic film 0.01 to 0.02 mm thick may be used as a closure system. If the test is carried out with a plastic film this must be used as described below:

A film is stretched over the open end of the drum and held in place with an elastic band. The strength of the band should be such that when placed around the drum resting on its side, it stretches by only 25 mm when a weight of 0.45 kg is attached to its lowest point.

At the other end of the drum a drilled 50 mm diameter hole is made 100 mm from the edge in such a way that the orifice is uppermost when the receptacle is laid down and ready for the test.

On a 200 x 20 mm metal support a paraffin wax candle 20 to 50 mm in diameter and 100 mm high is placed. The candle is replaced when having a height of less than 80 mm. The candle's flame is protected from the action of the spray by 150 mm wide, 200 mm high deflector. This includes the plane inclined at 45° produced 150 mm from the base of the deflector.

The candle placed on the metal support is positioned midway between the two ends of the drum.

The drum is laid on the ground or on a support at a spot where the temperature is between 15°C and 25°C. The product to be tested is sprayed within the drum of roughly 200 cubic dm in which there will be a source of ignition.

Usually, the product leaves the aerosol can at an angle of 90° relevant to the vertical axis of the can. The layout and procedure described refers to this kind of aerosol product. In the case of unusually operating aerosols (e.g. vertical-spray aerosol dispensers) it will be necessary to record changes to equipment and procedures in accordance with GLP, such as ISO/IEC 17025:1999 (General Requirements for the Competence of Testing and Calibration Laboratories).

Test Procedure

A minimum of 3 full aerosol dispensers per product are conditioned to 20°C ± 1°C in a water bath with a least 95 % of the dispenser immersed in the water for at least 30 minutes (If the aerosol is fully immersed, 30 minutes conditioning is sufficient).

The temperature and relative humidity of the environment is recorded along with the weight of one of the aerosol dispensers.

The candle is lit and the closure system applied.

Place the aerosol dispenser actuator orifice 35 mm or closer for a wide spray product, from the centre of the entrance hole in the drum. Start the chronometer (stopwatch) and following the instructions for use of the product; the spray is directed towards the centre of the opposite extremity (cover or plastic film). Note: the aerosol shall be tested in the position it is designed to be used in, e.g. upright or inverted.

The aerosol is sprayed until ignition occurs. The chronometer is stopped and the time elapsed noted. The aerosol dispenser is re-weighed and its weight recorded.

The drum is ventilated and cleaned removing any residue likely to affect subsequent tests and allowed to cool if necessary.

The test procedure is repeated for another two aerosol dispensaries of the same product (3 in total, note: each dispenser is only tested once).

Remarks

The time equivalent (t_{eq} , in seconds) needed to achieve ignition in one cubic metre can be calculated where:

$$t_{eq} = \frac{1000 \times \text{discharge time (s)}}{\text{Actual volume of drum (dm}^3\text{)}}$$

The deflagration density (D_{def} , in $\text{g}\cdot\text{m}^{-3}$) needed to achieve ignition during the test may also be calculated where:

$$D_{def} = \frac{1000 \times \text{Amount of product dispensed (g)}}{\text{Actual volume of drum (dm}^3\text{)}}$$

An aerosol shall be considered flammable if the time equivalent to achieve ignition is found to be ≤ 300 s/m³ or the deflagration density is ≤ 300 g/m³; otherwise the aerosol is classified as non-flammable.

4.1 Test Results for Supercorr A

Date : 25/08/2011
 Operator : E. Russell / P. Bremble
 Preparation : Sample tested as received.
 Barometric Pressure : 101.3 kPa
 Humidity : 57 %
 Ambient Temperature : 19°C
 SOP Reference : CTL SOP No. 239
 Standard used : UN Recommendations on the Transportation of Dangerous Goods, fifth revised edition.

In the enclosed space ignition test Supercorr A does not meet the criteria as being a flammable aerosol.

Table 4.1: Full test results

	1 st Aerosol Can	2 nd Aerosol Can	3 rd Aerosol Can
Can Weight (g) (Initial)	424.8	423.5	422.7
Time to ignition (s)	127	67	85
Observation	Orange flame	Orange flame	Orange flame
Sample dispensed (g)	157.6	101.3	112.4
Can weight (g) (On completion)	267.2	322.2	310.3
t_{eq} (s)	635	332	425
D_{def} (g.m⁻³)	788.0	506.5	562.0

Comment

Mean result of t_{eq} = 463 s/m³
 Mean results of D_{def} = 618.8 g/m³

5. SUMMARY OF RESULTS AND CONCLUSIONS

5.1 Summary of Test Data Obtained

The results of testing completed on Supercorr A are summarised in Table 5.1.

Table 5.1 : Summary of results

Parameter	Test Results
Aerosol Flammability	
Ignition Distance Test for Spray Aerosols	No ignition
Enclosed Space Ignition Test	
Mean result of t_{eq} (s/m ³)	463
Mean results of D_{def} (g/m ³)	618.8

The results of testing are highly dependent on the composition and physical nature of the sample. In dust explosion testing, for example, the particle size distribution, moisture content, particle shape and preparation method can all markedly affect results. For this reason, any change in manufacturing / handling procedures or composition should be accompanied by a review of the relevant data. This also includes any modification to the spray head of the aerosol; as a finer spray could alter the results.

Chilworth Technology Ltd would be pleased to provide specific advice, including interpretation and application of experimental data. Site visits to discuss operational safety or to perform plant inspections and measurements can be arranged on request.

5.2 Interpretation of Results and Recommendations

In accordance with the UN Recommendations on the Transportation of Dangerous Goods, Manual of tests and criteria, 5th Revised Edition 2009 it can be concluded that Supercorr A should be classified as non-flammable.