



AQUEOUS VERMICULITE DISPERSION

A NEW & REVOLUTIONARY
FIRE EXTINGUISHING AGENT
FOR LITHIUM-ION BATTERY FIRES

www.AVDFIRE.com

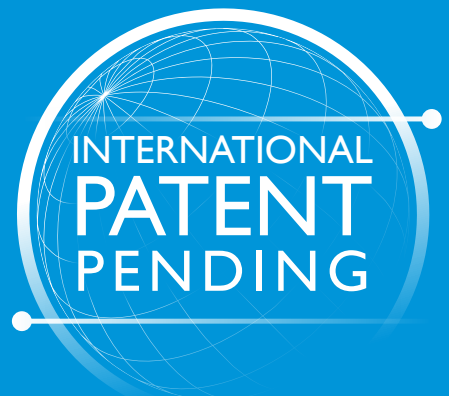
ADVANCED FORMULATION





AVD is a revolutionary new fire extinguishing agent specifically designed for lithium-ion battery fires. It offers significantly superior performance to both control and extinguish flammable lithium-ion battery fires. AVD's enhanced fire extinguishing properties when compared to the existing products make it the only fire extinguishing agent you should consider for lithium-ion battery fires..

- ✓ Suitable for portable & fixed installations
- ✓ Proven results on lithium-ion batteries.
- ✓ Ideal for warehouse environments
- ✓ High and low pressure systems
- ✓ High quality mist produced
- ✓ Environmentally friendly



Dupré Minerals[®] have proven that AVD is more effective at extinguishing lithium-ion battery fires, than conventional extinguishing agents.

- ✓ Water content cools the fire source
- ✓ Vermiculite platelets create a fire proof high insulation oxygen barrier
- ✓ Smaller volume of the agent required to extinguish the fire compared to conventional agents
- ✓ Shorter time to handle extinguished fuel source
- ✓ Larger lancing distance
- ✓ Effectively extinguishes Class A fires
- ✓ Can be used as a fire break
- ✓ Ability to be used in portable and fixed installations due to fluid nature
- ✓ Possible to use standard fire fighting equipment for its deployment
- ✓ Environmentally friendly

We have tested AVD in the following deployment systems:

- ✓ Portable Extinguisher Bottles
- ✓ Back Pack Extinguishers
- ✓ Trolley Based Extinguishers
- ✓ Fixed Installations



WHAT IS AVD?

AVD is an aqueous dispersion of chemically exfoliated Vermiculite.

Vermiculite is the name given to a group of hydrated laminar Aluminium-iron-magnesium silicates. Raw vermiculite consists of thin, flat flakes containing microscopic layers of water.

When Vermiculite is exfoliated, either thermally or chemically, the microscopic layers of water are removed and this either causes expansion (thermally exfoliated) or creates microscopic, individual platelets that are freely suspended in water (chemically exfoliated).

- ✓ AVD is a stable suspension of vermiculite platelets with a D90 of 180 microns (0.18mm)
- ✓ AVD is non flammable and has excellent insulation properties
- ✓ It is approximately 20% Vermiculite / 80% water.
- ✓ It has a viscosity of 3000 cPs

ENVIRONMENTAL INFORMATION

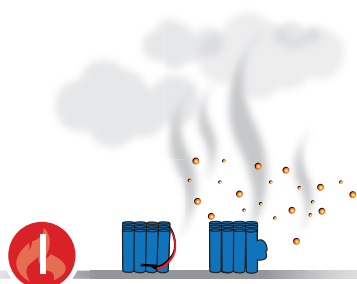
- Vermiculite is a naturally occurring mineral that is exempt from REACH regulations.
- It is chemically and physically inert, releasing only steam when exposed to raised temperatures rendering it sterile.
- Non toxic to:
 - ✓ Aquatic living organisms plants and animals
 - ✓ Soil organisms
 - ✓ Aerobic plants, organisms and animals
 - ✓ Anaerobic plants, organisms and animals



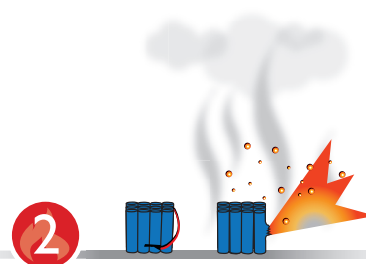
HOW DOES AVD WORK?

AVD is applied in the form of a 'mist'. The Vermiculite particles within the mist are deposited on the surface of the burning fuel to create a film over the top of the fire. This film instantly dries and because the high aspect ratio platelet particles overlap and bind together, they produce a non flammable oxygen barrier between the fire and the atmosphere.

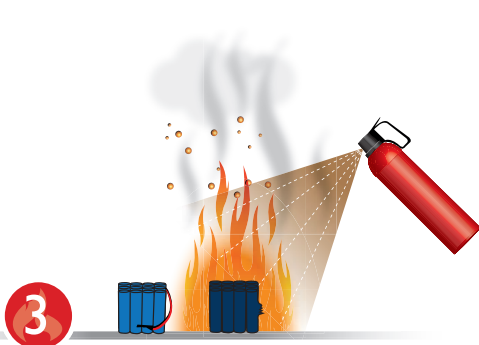
This process offers cooling to the surface of the fire and as the AVD platelets begin to build up layer upon layer of vermiculite particles on the top of the fuel source, the fire is gradually cooled and brought under control. Unlike other Extinguishing Agents where the fire has to be left for long periods of time before the fire is truly under control and completely burnt out, AVD offers rapid control of the fire.



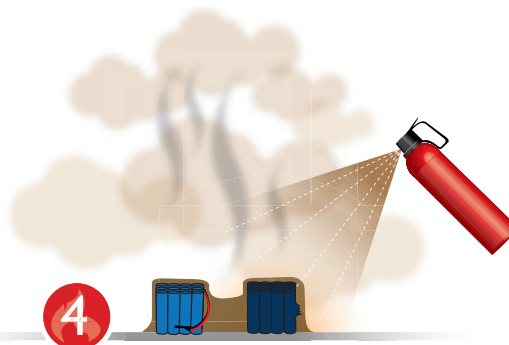
1 When Lithium-ion batteries are exposed to heat, physical/impact damage or over charging they go into thermal runaway.



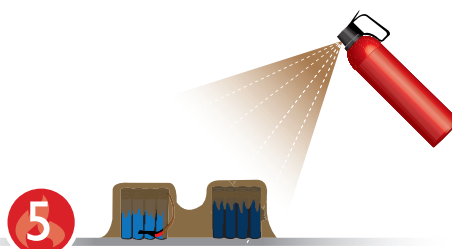
2 The cells are sufficiently swollen releasing hot flammable gases (hydrocarbons) which can ignite.



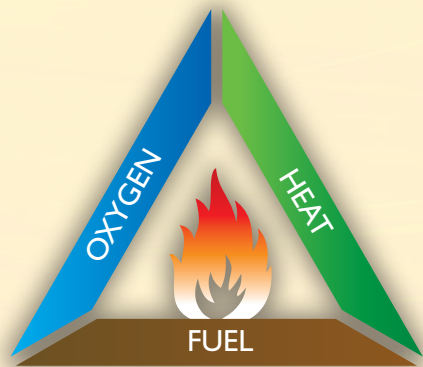
3 The Hydrocarbons burn vigorously at high temperature and rapidly heat surrounding cells and materials resulting in a significant fire.



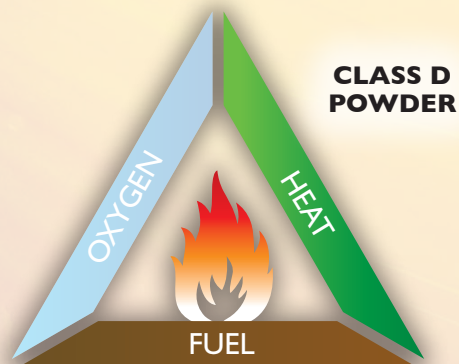
4 AVD is applied as a fine mist, which instantly cools the batteries and extinguishes the flames.



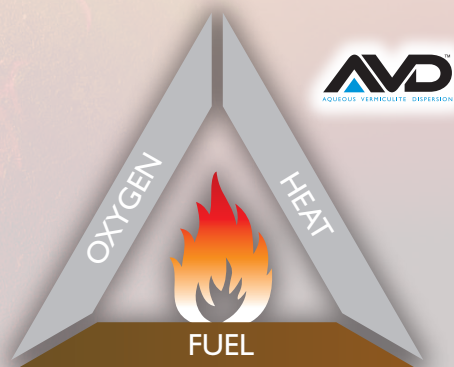
5 The AVD encapsulates the fuel source and insulates the cells preventing further thermal runaway; bringing the fire under control.



3 elements vital to start a fire.



A Class D Powder will slightly smother but will not totally cut off the oxygen supply.



AVD's aqueous content will remove heat from the fire. AVD will also form a 'crust' that will starve the fire of oxygen.



LITHIUM-ION BATTERY FIRES

We have seen enormous growth in demand for Lithium-ion batteries, most portable devices use these batteries and we are all carrying them. The fire hazard exists when batteries are:

- > Accidentally damaged – physical shock.
- > Over charged
- > Short circuited

All are situations which can arise with ease.

There have been some significant fires - most notably the UPS flight 747-44AF which crashed in 2010 near Dubai and the Ethiopian Airlines Dreamliner which was grounded in London following a battery fire. All were caused by ignition of the batteries following the initiation of thermal runaway.

Growth in demand for Lithium-ion batteries present problem areas as follows;

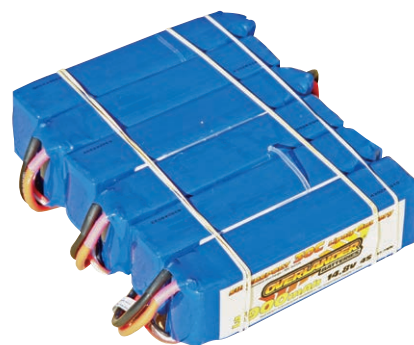
- Electric vehicles
- Charging stations
- Re-cycling plants
- Battery power plants
- Portable devices

AVD TESTING CARRIED OUT TO DATE

- ✓ We have done many trials with several different batteries types.
- ✓ AVD has successfully extinguished all the fires which we have conducted.
- ✓ AVD can be applied through both portable and fixed systems.
- ✓ It coats adjacent batteries and prevents spread of fire.
- ✓ The system can be designed to suit the specific requirements of the location.
- ✓ Dielectric Test approved in line with BS EN 3-7:2004 + A1:2007 (tested at Apragaz).

MOVING FORWARD

We are actively looking to work closer with Lithium battery recycling companies and manufacturers in order to develop our test methods further and fully evaluate the performance of AVD fighting Lithium battery fires.



- ✓ Easy to operate & refill
- ✓ Targeted fire fighting
- ✓ AVD mist
- ✓ High efficiency

EXTINGUISHER

The AVD fire extinguisher is an ideal fire fighting solution for warehouses, workshops and construction sites where high risk flammable materials are stored or processed.



BACKPACK 10L & 19L

The 10ltr and 19ltr AVD Backpack system is an ideal fire fighting solution for warehouses, workshops and construction sites where high risk flammable materials are stored or processed.



TROLLEY 50L

The 50ltr AVD Trolley system is an ideal fire fighting solution for warehouses, workshops and construction sites where high risk flammable materials are stored or processed.



- ✓ High extinguishing performance
- ✓ Option to integrate foam
- ✓ Ideal for use on small trucks
- ✓ AVD mist triggered system

MODULAR UNIT

The AVD Compact Modular Unit is designed to be used on small trucks, trailers or pick ups. The compact design makes this unit ideal for integration onto rapid response units.





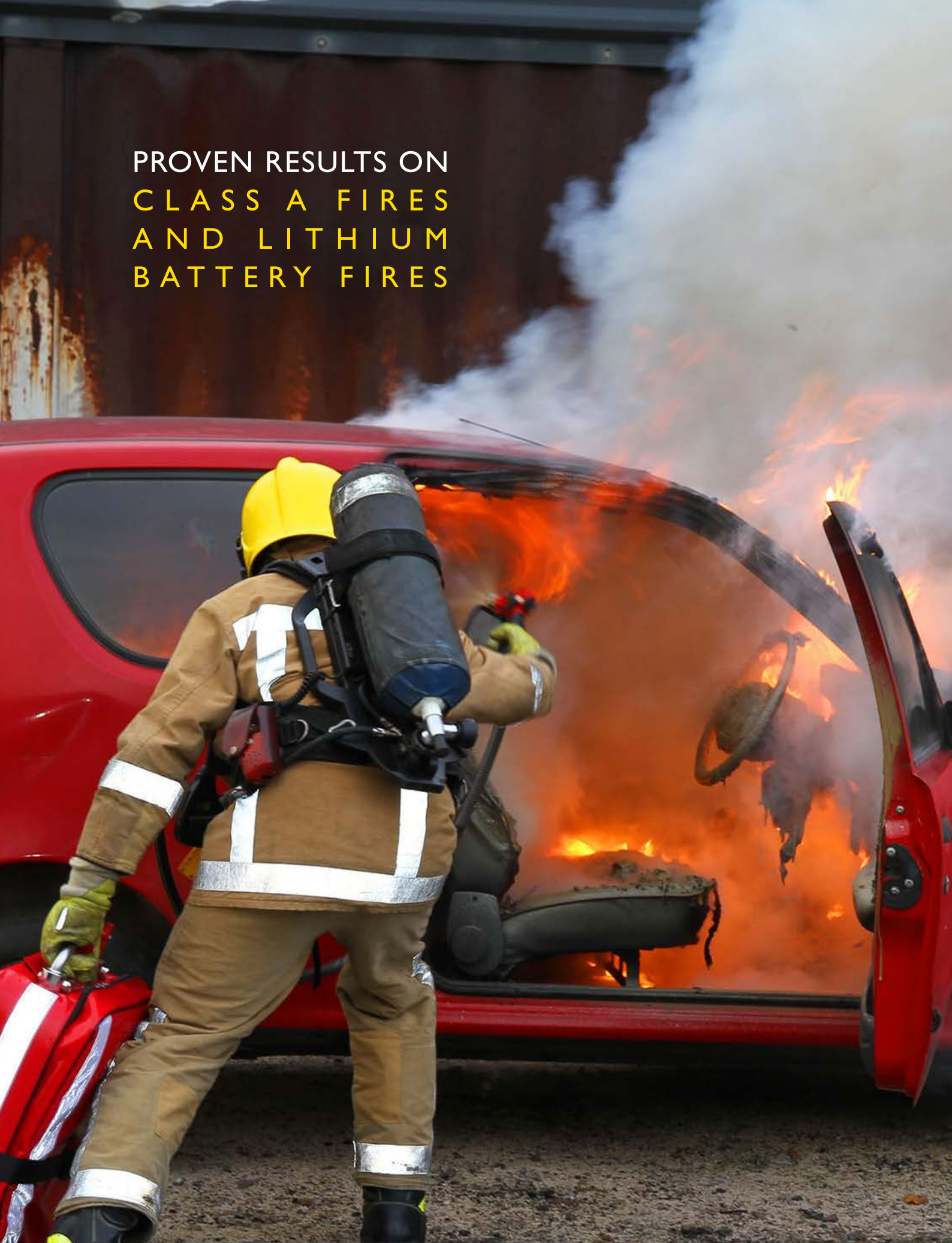
FIXED DELIVERY SYSTEMS

Dupré Minerals have been working in conjunction with Nobel Fire Systems to develop a fixed system utilizing AVD for installation in high risk environments. Nobel Fire Systems focus on the design, supply and installation of fire suppression and extinguishing systems for high risk environments.

- ✓ Automatic and / or manual deployment through a fixed system
- ✓ Very effective in 3 dimensions, adhering to vertical surfaces
- ✓ The AVD delivery system can be adapted to suit each individual location
- ✓ Targeted application contains the amount of damage to machinery, plant and property
- ✓ Actively protects surrounding material and structures from exposure to fire and heat



PROVEN RESULTS ON
CLASS A FIRES
AND LITHIUM
BATTERY FIRES



Classifying an agent such as AVD's performance is therefore ongoing, however, we currently have the following certification in place.

35KV DIELECTRIC APPROVAL

APRAGAZ
a.s.b.l.
Your Inspection Authority

Chaussée de Vilvorde, 156 B-1120 Brussels
Phone 32/2284 03 60 - Fax: 32/2288 89 58
e-mail: info@apragaz.com - V.A.T. BE 407.199.070

DUPRE MINERALS Limited
Spencroft Road
Newcastle-under-Lyme
Staffordshire ST5 5UE
UNITED KINGDOM

YRef. : CHL/MNO
CRef. : Dielectric tests, extinguisher type WA9
Subject : Dielectric tests, extinguisher type WA9

September 11, 2014


PORTABLE FIRE EXTINGUISHERS
CONFORMITY WITH EN 3-7-A1:2007, clause 9.2- DIELECTRIC TESTS

We hereby certify that the fire extinguisher

- type : WA9
- manufacturer : CHUBB FIRE & SECURITY Ltd
Lilleshall Road, Ashford
Middlesex TW15 1TZ, United Kingdom
- type and commercial name of extinguishing medium : AVD - Aqueous Vermiculite Dispersion
- nominal charge of extinguisher : 9 l
- pressurisation : stored pressure (15 bar N₂ or air)

successfully passed, in our laboratory, the dielectric tests performed according to the applicable clause 9.2 of the EN 3-7-A1:2007 standard and that it is conform with the aforementioned standard.

The results are reported in chapter 16 of our report No. EN 11524 that was issued on September 4, 2014.

The General Manager,

Christian LEPLAT, R.

MAGNESIUM APPROVAL - DIN EN 3-7:2007-09

MPA Dresden

MPA Dresden GmbH - Fachbereich 07 - D-01059 Freiberg

Date: 2014-09-30
Official: M. Dietrich
Phone: +49 (0)3731-2 03 89 100
Fax: +49 (0)3731-2 03 89 110
E-Mail: info@mpa-dresden.de
Post number: 130545
Press number: 2014/093
(Please state when replying.)

Report of test results
Test fire performance of the aqueous extinguishing liquid AVD applied in conjunction with a portable EN 3 portable fire extinguisher

Product name: AVD 170/3000 (Aqueous Vermiculite Dispersion), batch no.: 140488 / sample 1684
The liquid AVD was filled into a 9 liter portable, stored pressure fire extinguisher with the following characteristics:
- cylinder capacity 13.2 liter
- working pressure 15 bar at 20 °C (nitrogen)
- fog nozzle model ZCSFH3-00.00/W3

Receipt of the test sample: 15th September 2014

Test specification: Clause a) - 3 kg magnesium alloy swarf - of the national appendix NA - test fire rating class D - of DIN EN 3-7:2017-09 Portable fire extinguishers

Test date and site: September 18, 2014, MPA Dresden GmbH Freiberg, Germany

Test course: 3 kg swarf of light metal alloy with 85% magnesium in a 50 cm by 50 cm steel sheet metal tray were ignited. Then 50% of the metal burned the whole contents of the above mentioned fire extinguisher was applied to the test fire. 10 min after the extinction the test object was opened. Unburned remains of swarf were detected.

Test result: Test fire extinguished. Test passed.


Gerd Eng. Dietrich
Laboratory Manager

MPA Dresden GmbH
Fachbereich 07
01059 Freiberg
www.mpa-dresden.de

Geschäftsführer: Thomas Hübner
Tel.: +49 (0)3731-203824
Fax: +49 (0)3731-20383110
E-Mail: info@mpa-dresden.de

Antwortschrift: Chemnitz HRB 2050
Stammnummer: 2017160204
USt-ID-Nr.: DE391271236

Sparkasse Mittelsachsen
Postfach 14
09509 Freiberg
BLAN 2509 61030000110004072
BIC: WELADED33XXX



25L Container

For 23ltr extinguisher backpack refills.

Weight - 27.5kgs net approx
Dimensions - 28 x 48cm per unit
Packed in fibre board box
31 x 31 x 48cm



120L Drum

Suitable for multiple refills of all portable units.

Weight - 132kgs net approx
Dimensions - 81 x 50cm per mauser
4 mausers per pallet



1000L IBC

Suitable for fixed installation refills and all portable unit refills.

Weight - 1100kgs net approx
Dimensions - 1.0 x 1.2 x 1.2m per IBC



Dupré Minerals was founded in the early 1950's. Based at Newcastle-under-Lyme, Staffordshire, we manufacture an extensive range of high quality products, servicing the Vermiculite, Precision Casting, Friction and Refractory Industries.

The processing and manufacture of Vermiculite continues to be one of our core business markets. The established Dupré brand inspired the development of some of the world's most advanced Vermiculite product formulations.

Applications for crude and exfoliated Vermiculites include dispersions, insulation, friction, horticulture, construction, packaging and wherever lightweight or heat resistant properties are required.

Dupré Minerals is a 100% owned subsidiary of Goodwin PLC based in Stoke on Trent. Goodwin PLC have a patented pending status covering the use of AVD as a fire extinguishing agent and Micashield as a fire protective paint.

Dupré Minerals Limited, Spencroft Road, Newcastle-under-Lyme, Staffordshire, ST5 9JE

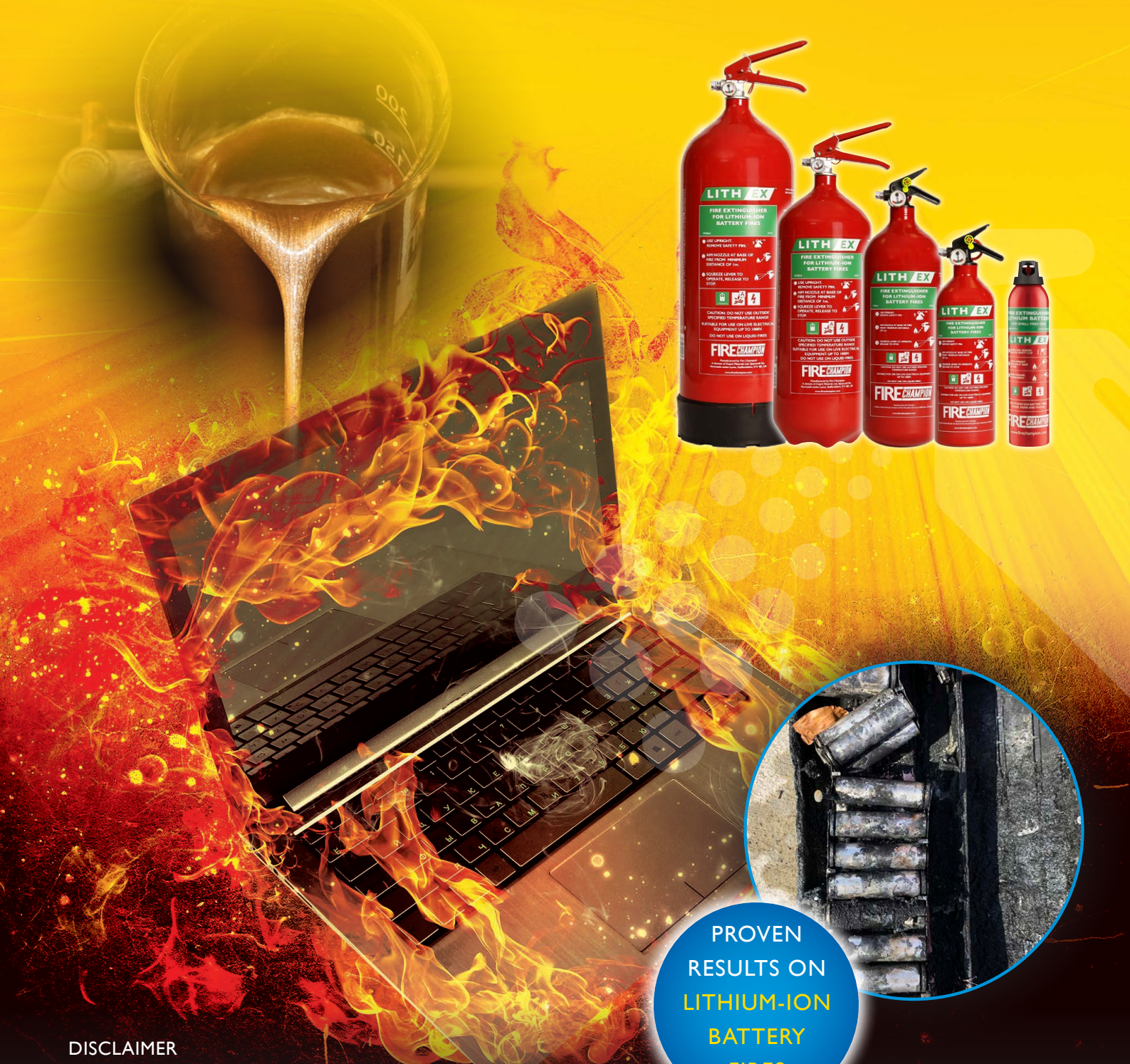
Tel +44 1782 383000 Fax +44 1782 383101 Email info@dupreminerals.com

www.dupreminerals.com





AQUEOUS VERMICULITE DISPERSION



DISCLAIMER

While every reasonable effort is made to ensure that the information provided in this document is accurate*, no guarantees for the accuracy of information are made. Dupré's website and material data relating to information, products or services (or third part information, products and services) is provided 'as is'. It is provided without representation or endorsement and made without warranty of any kind, whether express or implied, including but not limited to the implied recommendations or warranties of satisfactory quality, performance or fitness for a particular purpose, non infringement, compatibility, security or accuracy.

*The technical data provided herein reflects typical indicative results of testing of products under controlled conditions, to provide the best information to allow end users, specifiers, installers, contractors, retailers and alike to determine the suitability of Dupré products for intended application.

PROVEN
RESULTS ON
LITHIUM-ION
BATTERY
FIRES

www.AVDFIRE.com

ADVANCED FORMULATION

TO CONTROL
& EXTINGUISH



LITHIUM-ION BATTERY FIRES

Aqueous Vermiculite Dispersion (AVD) fire extinguishing agent is a new, revolutionary technology that has key benefits over existing solutions utilising fixed and portable delivery techniques.

www.AVDFIRE.com



Dupré Minerals® Limited, Spencroft Road, Newcastle-under-Lyme, Staffordshire, ST5 9JE
Tel +44 1782 383000 Fax +44 1782 383101 Email avd@goodwingroup.com
www.dupreminerals.com