IMPORTANT note from the Editor

The following is an unsolicited article received at the **Insite** office from Dr Walmsley on the safety of plastic pipeing used in the construction of fuelling stations. The views given here are entirely the conclusions of Dr. Walmsley. The PEIMF and **Insite** magazine have in no way contributed to the content and do not agree or disagree with the contents. The terms on which **Insite** publishes articles are clearly laid out on page 1, but in such cases of safety, we especially rely on the contributors to ensure what they are submitting is accurate. Dr. Walmsley has offered his full CV which we will published on our web site for readers reference.

Insite actively encourages all views and as such, would ask any readers that wish to take issue with Dr. Walmsley's conclusions as stated in this article, then please send them to us for publication. The criteria for such articles will be subjected to same principles stated here and in our terms shown on page 1.

Dr. Walmsley has agreed to receive directly to him any comments via e mail.

Frank Hare *Insite Editor*

The safety of plastic pipes at petrol stations: conductive vs. non-conductive

Dr H L Walmsley, Harold Walmsley Electrostatics Ltd, 21/12/12

Background

Over the past decade there has been an ongoing debate about the relative safety of conductive and non-conductive plastic pipe systems for underground use at petrol stations. In the course of this debate a number of myths have been generated and used to create a degree of scare-mongering about conductive pipes. This misinformation has tended to skew the debate away from a rational course. This article aims to set the record straight and provide a realistic assessment of the relative levels of electrostatic hazard with conductive and non-conductive systems.

Debunking the Myths

Myth 1: ***Electrical discharges from plastic surfaces (called "brush" discharges) are weak and cannot cause ignition***

This is manifestly untrue. There is a large body of scientific literature stretching back several decades that is directly concerned with the ignition of hydrocarbon vapours by brush discharges. It includes the establishment of ignition thresholds in terms of the voltage on the charged surface, the charge transferred in discharges and the area of the plastic.

Myth 2: ***Ignitions cannot be caused by discharges from the insulating surfaces of non-conductive pipes (non-conducting pipe surfaces are inherently safe)***

This is demonstrably untrue for the following reasons:

- Established electrostatics codes of practice give values for the maximum area or diameter of chargeable insulating plastic surface that can be permitted without encountering an ignition risk from brush discharges. Typical exposed areas of plastic pipe in fill boxes etc. exceed these limits.
- Tests with plastic pipes have produced surface voltages within a factor of two of the ignition threshold voltage even though no particular care was taken to perform the tests with a high charging fuel. These results strongly suggest that the voltages produced by the highest charging fuels would exceed the ignition threshold.
- Several reported ignition incidents have been associated with non-conductive pipe systems on which all conductive objects were earthed. These ignitions could only have arisen from discharges from an insulating surface.

Myth 3: ***Conductive pipes have a greater need for earthing***

Whilst it is undoubtedly true that the linings of conductive pipes must be earthed it is equally clear that all metal components connected to non-conductive pipes must also be earthed. This is demonstrated by two observations:

- Most of the incidents recorded with non-conductive pipes involved sparks from unbonded metal components (see Incidents section below) and
- Laboratory tests with non-conductive plastic pipes produced voltages that were high enough to cause ignition by sparks from unbonded metal components.

Myth 4: ***It is harder to provide the required earthing with conductive pipes***

This myth has been posted in commercial white papers and websites. In reality, with a properly designed conductive system:

- Continuity along the pipe is easily provided by suitable internal earth links.
- Continuity is readily verified with a simple end-to-end continuity test as a final stage of installation.
- Once a complete run of pipe has been installed and verified as electrically continuous, the internal earth links maintain the continuity with a high degree of integrity that compares with the integrity of the system for liquid containment (both depend on the stability of the welded joints).
- After an electrically continuous conductive pipe run has been laid, both ends can be earthed to provide a useful redundancy of earth contact[1].

In contrast it is actually much harder to ensure the adequate earthing of all potentially isolateable metal items on a run of non-conductive pipe:

- The number of components requiring earthing depends not only on the pipe itself but also on the details of the fill boxes and sump boxes and on the nature of the lead throughs into these boxes. It requires considerable knowledge and skill on the part of the installer to identify and earth all relevant items. It is much harder to do this properly than to provide and verify continuity along the liner of a conductive pipe.
- In current experience it is commonplace to find unearthed metal items (notably Jubilee clips and uncapped welding sockets) on non-conductive pipe systems. This leaves them vulnerable to ignition.

Myth 5: ***It is more costly to verify earthing with conductive pipes***

This is false for the following reasons:

- It is considerably more difficult and expensive to check that all the individual metal items on a non-conductive pipe are earthed (many measurements) than to check the end-do-end continuity and earthing of a conductive pipe (one measurement).
- In conductive systems the continuity is provided by links welded permanently into the pipe system that are protected by the pipe wall from corrosion and stress.
- In non-conductive systems the bonding depends on wires that are vulnerable to corrosion or mechanical damage (e.g. by snagging on hose lugs). Therefore in non-conductive systems earth checks should be more frequent than in conductive systems.

Myth 6: ***Conductive pipe systems need to be periodically drained to enable earth checking, which is expensive***

This is again completely wrong and misleading. The reasons are:

- The end-to-end resistance of the pipe via the internal links and linings is much lower than that through the liquid column (even with a relatively conductive fuel such as ethanol). Therefore the presence or absence of the fuel makes no significant difference to the result of the measurement.
- Even if the fuel did make a difference, charge only has to be dissipated when fuel is flowing so it is the resistance with fuel present that is important. Hence the system does not need to be drained for testing.

Myth 7: ***Highly energetic discharges can be obtained from the unbonded liners of a conductive pipe:***

This is more a scare story than a myth. It is a true statement but is misleading because the liners of a conductive pipe are not used in an unbonded state; they are bonded together to provide electrical continuity along the pipe (easily verified) and both ends of the pipe are then earthed. The incident record (see below) demonstrates that in practice the required connections do get properly made.

The incident record

The incident record provides revealing information that reinforces the points made above about the misleading nature of the myths. In order of increasing incident frequency, the incident records with each type of pipe are:

Conductive plastic pipes: Neither the author nor the suppliers of conductive pipes are aware of any incidents (reported or anecdotal) with conductive pipes even though there is a high likelihood that if an incident did occur it would be well-publicised by non-conductive pipe suppliers and reported by the user to the supplier.

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JOHN WIGFULL & Co. Ltd.
First Hangings
Blaby Road
Enderby
Leicester LE19 4AQ
Tel: 0116 286 2287
Fax: 0116 275 1232
Email: HYPERLINK mailto:
wigfullr@btopenworld.com
LPG Engineering Services
Design
Installation
Testing
Commissioning
Training
Consultancy
Investigations
LPG dispenser and tanker meter proving
Member of
UKLPG, APEA, GAS SAFE, SAFECONTRACTOR

The absence of incidents amply demonstrates the fallacy of the unbonded liner scare.

Steel pipes: Surprisingly, a few ignition incidents have been reported with steel pipes. It is hard to understand the mechanism but we may conjecture that the combination of an insulating external anti-corrosion coating and heavy taping of pipe joints could lead to un-earthed pipe sections or end fittings.

Non-conductive plastic pipes: We have seen written reports of more than 20 incidents with non-conductive pipes at petrol stations since the year 2000. We are also aware of many more incidents (possibly hundreds[2]) for which we only have limited verbal reports. In addition, there is a general lack of awareness of the electrostatic hazards with non-conductive pipework that has probably led to this ignition mechanism being ignored or underestimated in many incident investigations. This certainly happened in the recent (2011) investigation into a serious petrol station fire at Maddington, Australia. The investigation was, in all other respects, extremely thorough but completely failed to consider the possibility of electrostatic discharges from the non-conductive plastic pipes that were in use at the site. Many other relevant incidents may have gone unrecognised in this manner and consequently, the incidents we are aware of (written and verbal) may be only the tip of the iceberg.

Most of the reported incidents with non-conductive pipes were associated with the non-earthing of metal components. These incidents, along with many site photographs, confirm that the earthing of conductors on existing non-conductive systems often falls below the necessary standard. This is probably not surprising given the statements by some manufacturers that earthing requirements are less with non-conductive systems.

A few of the documented non-conductive pipe incidents occurred when all metal components were earthed. These must have been caused by discharges from one of the insulating surfaces of the pipe. Their occurrence demonstrates the fallacy of the "non-conductive pipe surfaces are inherently safe" myth.

The overall picture

Non-conductive plastic pipes

- Despite some confident statements to the contrary, ignition incidents have occurred and continue to occur with non-conductive plastic pipes although the frequency is relatively low given the number of systems in service.
- Non-conductive systems can be made safer than at present by a more careful approach to earthing. That is by ensuring that all metal objects on the pipes in fill boxes and sumps are earthed and by checking the integrity of this earthing at regular intervals.
- Even with perfect earthing, there is a small residual risk arising from discharges from the non-conductive surfaces of the pipe. Although the risk is, at present, small, the safety margin is also relatively small and any future increase in fuel charging tendency could lead to more frequent incidents of this type.

Conductive plastic pipes

There have been no known incidents with conductive pipes. These systems therefore appear to be safer than non-conductive systems. The good safety record suggests that although there could, theoretically, be a hazard if the lining were not earthed, in practice the design and installation procedures achieve satisfactory earthing of linings and voltages are kept to safe levels. With satisfactory earthing, the voltage safety margin provided by conductive plastic pipe systems is very large and is expected to be sufficient to deal with all realistically foreseeable future changes in fuel charging.

1 Unlike the case with steel pipes, the moderately high lining resistance of a conductive pipe, which is "dissipative" rather than truly "conductive", is perfectly matched to dissipating static charge whilst resisting the flow of circulating earth currents or electrical fault currents from power systems. Thus earthing at both ends does not introduce a concern about creating an earth loop.

2 It is difficult to give accurate numbers because verbal reports are less reliable, they range from clear but undocumented accounts to vague rumours and it is possible, for example, that different accounts may refer to the same incident.

How clean is your fuel?

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- Test fuel, preferably monthly, and inspect fuel samples for solids or floating gel. This will tell you what is going on inside the tank.
- Certify fuel every 6 months with independent testing which follows an industry standard and will remain unchallenged.
- Ensure all samples are from tank dead bottom, following ASTM or similar standard fuel sampling procedure. Samples form nozzles should only be seen as indicators. A low level at a nozzle means a high level in the tank.
- If you see rust in the sample, the tank is likely being eaten away from the inside. Take immediate action.
- If the fuel is cleaned, ensure it is certified post cleaning.

Ian Roos founded FUELQC in 2006, and since has pioneered a range of fuel quality management solutions, including testing, filters, fuel and tank cleaning systems and advisory services.

For more information please feel free to contact FUELQC at info@fuelqc.com

Ian Roos

NEWS ITEMS

Kevin Powell nominated to BSI Committee

PEIMF National Committee member and Managing Director of Ledbury Welding & Engineering Ltd Kevin Powell has been nominated to join the important BSI Group committee RHE/13 associated with tank manufacturing.

The PEIMF are very proud to have nominated Kevin to this important position and especially on the 20th anniversary of the Federation. This underlines the prominent position that the PEIMF holds in this industry.

NEWS ITEMS

First Northern Ireland Motorway Service Station

The Northern Ireland Government has given permission for the construction of the first ever motorway service areas in the Province. The planning permission has been granted for two sites on the M2 motorway. Proposals are also on going for two more on the M1. Petrogas are the driving force behind these major developments amounting to some £20m. They operate all motorway service areas in the Republic of Ireland currently. These planning applications were turned around in a 12 week period.

Greenergy make progress

Supplies from the Greenergy North Tees terminal commenced last November supplying petrol, diesel and kerosene to the area. The terminal was closed following the collapse of Petroplus Refining Teeside earlier in 2012.

Source – Petroleum Review

In February Greenergy began supplying fuel to 90 Esso dealers in the UK and are also aiming to supply the Esso brand to non Esso dealers. They have also reached agreement to supply to Esso dealers in Nothern England , North Wales and Scotland . In a further development Greenergy is to market its fuel on Nisa Retail sites, thus extending the Nisa symbols from stores to forecourts.

Source – Fuel Oil News

Sainsbury's open new Station at the Crystal Palace

Sited at Selhurst Park, home of Crystal Palace FC, Sainsbury Supermarket have open a new filling station on Whitehorse Lane in South London. It will open from 6am till midnight.

Euro Garages buy 45 sites

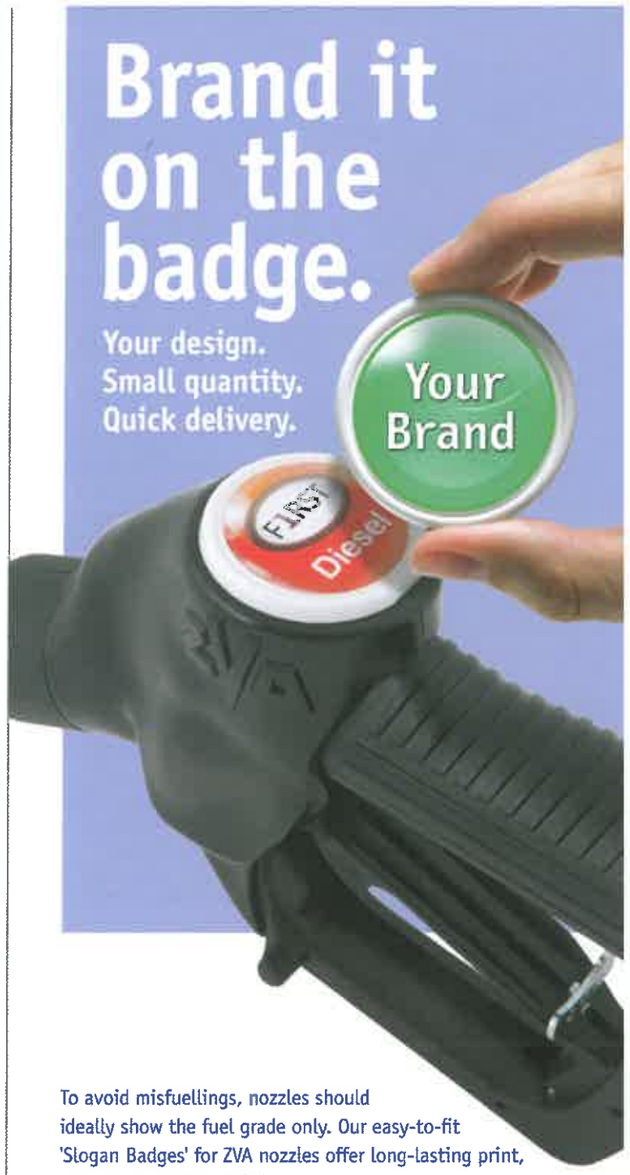
Euro Garages founded by the Issa brothers, have purchased 45 sites from Esso (Exxon). This brings the portfolio of the Blackburn based company to 120 sites. The group started with one site in Bury, Lancashire in 2001.

Planning Laws to be eased

The UK Government is seeking the views of interested parties with the view to easing the planning laws to make motorway service areas more able to get approvals for better access roads and junctions.

BP continues with Vicom4 Outdoor

BP International Ltd has extended its agreement with Vicom4 Outdoor, a leading company in the signage, façade and outdoor surface refurbishment. The agreement is a European wide deal now in its 5th year.



To avoid misfuellings, nozzles should ideally show the fuel grade only. Our easy-to-fit 'Slogan Badges' for ZVA nozzles offer long-lasting print, even in toughest conditions.

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ELAFLEX Ltd., Riverside House, Plumpton Road
Hoddesdon, Hertfordshire EN 11 0PA · UK
Tel. 01992 - 452-950 · Fax 01992 - 452-911
www.elaflex.co.uk · sales@elaflex.co.uk