GUIDANCE NOTE No. 51

SELECTION OF IBCS FOR HANDLING HYDROCARBON AND OXYGENATED SOLVENTS.

Introduction

An 'Intermediate Bulk Container' (IBC) is a container used for transport and storage of fluids and bulk materials. IBCs have become widely used in the solvents industry as they can transport and store a larger volume of material than cylindrically shaped containers in the same surface area. As the number of containers can be reduced with the use of IBCs, this in turn reduces manual handling, and they are also more resistant to weathering.

The purpose of this Guidance Notice is to define the criteria for the use of IBCs for filling, storing and transporting Oxygenated and Hydrocarbon solvents. Not all solvents can be used safely with every type of IBC and so it is important to take care when selecting the right IBC to use with a particular solvent. IBCs have also been involved in some recent incidents, such as stacks collapsing, the ignition of contents due to static electricity and leakage leading to serious fires or risks to the environment.

The Solvents Industry Association (SIA) has compiled this overview of the use of IBCs to increase awareness among solvent users and to promote best practice in the solvent supply chain. This guidance should not be used in isolation and reference should be made to other Standards and Codes of Practice. In devising its methodology for the safe selection of IBCs the SIA has sourced the classification of solvents into conductive/semi-conductive/non-conductive from existing Codes of Practice, but as their recommendations with respect to the selection of IBCs for low-flash solvents are not universally agreed, the SIA has based its recommendations on the experience of the Solvents Industry in the UK environment.

What is an IBC?

IBCs are a form of "packaging" designed for mechanical handling. They are subject to the internationally agreed UN certification procedure, the details of which may be found in the European Agreement concerning the International Carriage of Dangerous Goods – ADR, which regulates the carriage of dangerous goods by road. The IMDG Shipping Regulations are also based on UN certification but have different criteria due to the increased risk when transporting by sea.

Various UN certified IBCs are available. For flammable solvents these can be sub-divided into two main types:

- all Metal IBC, either Stainless Steel or Mild Steel
- Plastic "Composite" IBC.

Steel IBCs are compatible with most solvents but are expensive to purchase. Composite IBC's are less expensive but they are less versatile as they are not compatible with all solvents.

A Composite IBC has a rigid outer structure encasing a plastic inner receptacle/bottle, usually made of high density polyethylene. The outer and inner assemblies are used as an integrated single unit. A Composite IBC has the following components: a built-in pallet of metal, wood or plastic; a plastic outlet valve (usually a butterfly or a ball valve) with a secondary closure cap and possibly a flap to protect the valve, and a top filling opening with in some cases a venting screw cap.

Electrostatic protected composite IBCs can have a combination of a dissipative or a conductive outer layer, a conductive grid with a mesh size not bigger than 100 centimetre squared and a metal contact surface inside the IBC in the form of a pin, a plate or a ring which penetrates outwards through the plastic body and connects with the metal construction of the IBC via an earthing cable. These measures prevent the build up of static electricity from brush discharges and from the filling and discharge processes so that a dangerous static electricity discharge is eliminated.

For sensitive products, an additional chemical barrier, ethylene vinyl alcohol (EVOH) or fluorination, can be used to prevent the permeation of solvents or gases, like oxygen, carbon dioxide, nitrogen and odours. Additional UV and light protection can be used for products sensitive to light.

Hazards associated with use of IBCs for solvents

The operator must ensure that containment is not breached. Composite IBCs have historically been shown to be vulnerable to fire. When exposed to the heat of a fire, plastic or composite IBCs can soften and fail catastrophically, releasing their contents rapidly. The presence of a metal cladding can delay the process but ultimately all contents may be released. In a fire, the total loss of the contents could overflow the storage area containment. All IBCs, even those of metal construction, can have exposed plastic components that are vulnerable to fire. Such ignitions develop rapidly to cause complete failure of the IBC. In a fire, metal packaging may fail hydraulically or by ullage space explosion.

When dealing with potentially explosive atmospheres, it is crucial to avoid the accumulation and discharge of static electricity. Electrostatic charging is greatest when liquids are flowing through pipes and hoses. Therefore it is important to have safe methods of filling and withdrawal of the liquid. Within an IBC, electrostatic discharges are most likely to occur just above the liquid surface, as the flammable vapours build up rapidly. Adequate ventilation and flow rate of product should be managed to prevent vapour from reaching the outside of the IBC.

Some solvents and pure hydrocarbons have a low conductivity and hence present a significantly greater static risk than others as there can be a build-up of static charge which can spark a fire or an explosion.
To eliminate this hazard, the operator can either use a metal IBC or an electrostatic protected composite IBC, in combination with a suitable earthing system when filling or emptying, subject to the product’s flashpoint.

Selection of IBCs

The selection of an IBC is based on its specification, its condition, its compatibility, its durability and its suitability for a specific solvent. Conditions attached to the IBC's UN certificate MUST be followed and local industry guidance assessed.

Compatibility

There is a legal requirement in the transport regulations that permeation shall not create a danger under normal conditions of transport. Composite IBCs may not be compatible with all solvents or acceptable to customers or by insurers. The manufacturer will give advice on the compatibility of the bottle and its accessories – valves, valve seals with the intended use. If there is no approval, do not use.

Suitability

Many of the solvents in use by industry are identified under UN as Class 3, being extremely flammable, highly flammable or flammable.

This Guidance Note has reviewed the physical properties that could be used for deciding which IBC types are suitable for a given solvent and concluded that flash point, conductivity and dielectric constant are the three most useful properties. It must be noted that measurement of conductivity can be difficult, and conductivity will be affected by impurities such as water. Read SIA GN 47 for further information.

The SIA considers that the following tables, identify the **best practice** from within the Solvents Industry in the UK environment with regards to the selection of IBCs and recommends them to its members. Periodic review of these tables will be carried out by the SIA going forward as new IBC technology is developed by the manufacturers.

Table 1 defines how solvents can be categorised as conductive, semi-conductive or non-conductive.

TABLE 1: Conductivities According to NFPA 77-07 Annex F with Their Typical Relaxation Times

NFPA77-07			SIA Code	Typical Relaxation Time
Annex F	**Conductivity, pS/m**	**Fluid Description**		
F2	Up to 50	**Nonconductive**	**N**	180 milliseconds to greater than 1 second
F3	50 to 10,000	**Semi-conductive**	**S**	2-500 milliseconds
F4	Above 10,000	**Conductive**	**C**	Less than 1 millisecond

Table 2 below takes the conductivity categories and combines them with the property of flash point to provide a guide to best practice in selecting an IBC. This table includes all recent improvements in IBC technology.

TABLE 2: Recommended IBC Type Selection According Solvent Flash Point and Conductivity Group

IBC Type (if compatible)	Flash Point of Solvent			
	<0°C	0° to 40°C	40° to 60°C	>60 °C
Unprotected composite	No for N, S, C	No for N, S, C	No for N, S, C	Yes for N, S, C
Electrostatic protected composite	No for N, S, C	No for N, S Yes for C	No for N, S Yes for C	Yes for N, S, C
Electrostatic protected composite with conductive plastic bottle and permeation barrier	No for N, S, C	No for N, S Yes for C	No for N Yes for S, C	Yes for N, S, C
Steel	Yes for N, S, C	Yes for N, S, C	Yes for N, S, C	Yes for N, S, C

N = Non-conductive, S = Semi-conductive, C = Conductive solvents

Worked examples using these tables for particular products can be found in Appendix 1.

Filling and handling of IBCs

Prior to filling, there must be a formal inspection to ensure the IBC is fit for purpose and prepared for safe filling. Damaged pallet corners on composite IBCs can snag and tear the bottles of adjacent IBCs. IBCs MUST be labelled in compliance with supply and transport regulations.

The IBC and the filling equipment, such as fill nozzle and hoses, must be bonded and earthed prior to filling to prevent static charge build up and must be designed for flammable service.

Splash filling of flammable liquids is dangerous as it creates static and must be avoided. This can be prevented either by bottom filling at not more than 2 metres per second, or by using a metal conductive fill nozzle or dip pipe which must reach to the base of the IBC. The maximum filling velocity must initially be limited to 1 metre per second. Once the end of the filling pipe is covered, the maximum filling velocity must be limited to 2 metres per second, giving an industry-typical filling time of 6 to 10 minutes per 1000 litres. After filling, the earth connection should be left in place for the relaxation time as advised by the product supplier and IBC manufacturer, to allow static charge to dissipate**. It must be emphasised that splash filling and uncontrolled gravity filling of solvents into IBCs are not safe practices.** Solvents such as toluene, produce their most readily ignitable mixture strengths at common handling temperatures.

Measures should be taken to prevent overfilling such as metering, weigh scales or high level detection and cut-out.

The presence of vapours will depend on the rate of filling, the solvent volatility and the effectiveness of ventilation or vapour capture. A local exhaust ventilation system to remove vapours generated during filling operations should be available to reduce risks of ignition and exposure to operators.

Uncontrolled filling of IBCs at a customer's premises must not occur. The risk of over-fill, rupture or static discharge is high. IBCs should be returned to the supplier for filling. The only exception is where there is a fixed filling installation and the supplier's safety audit confirming appropriate safeguards are in place.

At the customer's premises, IBCs must be correctly earthed before discharge and kept away from any sources of ignition. It is important to consider controls for both the internal and external incendive sparks. With respect to potential electrostatic discharge at openings of IBCs, at no time must an IBC be moved after filling until the opening cap is replaced.

Inspection and testing of IBCs

All IBCs must be inspected before use and re-tested on a regular basis, but as a minimum in accordance with ADR. A competent person must examine each IBC at prescribed intervals, in order that UN certification can be maintained and should monitor discussions on IBC Testing and Inspection within UN Committees of Experts.

Routine Inspection, Maintenance and Repairs must be carried out in accordance with ADR and Manufacturer's recommendations by competent organisations. IBCs must be clean and vapour free, as verified by a portable gas detector, to reduce the risk of fire. IBCs have the potential to fail catastrophically during pressure testing for leaks, therefore safety precautions must be taken. Modifications to IBCs must be carried out by the IBC manufacturer.

The operator has to decide whether to buy new, re-use or buy previously used IBCs (laundered IBCs). The test report and UN approval will enable a check on the design of frame and bottle, closure, valves, make and type. If the decision is to buy previously used for dangerous goods there should be evidence that it has been suitably configured, has a known history and has the required UN certification. Additional inspection and certification relating to the earthing capability of previously used IBCs will also need to be carried out and checked. If there are any doubts or there is an incomplete history, then previously used IBC's should not be used for flammable materials.

Storage and transport of IBCs

Ideally, flammable liquids including solvents should be stored in a cool dry place in the open air, away from sources of ignition and heat. Outdoor storage has disadvantages such as Ultra-Violet light degradation of plastic packages, damage by wind and rain and solar gain causing the packages to heat up. Lightweight weather protection and good stock rotation minimise these disadvantages. Steel drums containing flammable liquids should be kept away from composite IBCs where practicable.

For indoor storage, ventilation is important and the hazardous areas assessment must consider the wider range of ignition sources. The risk assessment for the site should reflect the fact that a fire in an IBC store can result in the release of all the liquid within a period of 10 minutes.

Specialist advice may be required in the selection and deployment of fire detection systems and fire fighting equipment. Flammable solvents should be segregated from products such as oxidisers and other reactive products and from combustible liquids that will increase the fire loading. Pool fires that run under pallets of metal drums or metal IBCs will escalate the incident, increasing the risk of boiling liquid expanding vapour explosion, leading to projectiles. The risk may be reduced by separating plastic and composite IBCs from metal drums and metal IBCs. Segregation could include kerbs or level grading to control the flow of burning liquid. If limited bunding is provided, the effects of liquid flowing out of the bund should be considered. To reduce risks, the quantity of liquids stored in IBCs should be minimised and suitable selection of lift trucks, store location, bunding and storage racks be considered. Any lift truck used to handle IBCs containing highly flammable liquids should be suitable for use in zoned areas.

IBCs may be stacked, but there are limitations in load bearing capacity, as labelled under ADR, and differences in design. A competent person should draw up site rules and procedures to ensure that IBCs are stacked safely. Filled IBCs that are designed to stack together should be stacked no more than two high and only on level ground. Partly filled IBCs should be treated as full IBCs for stacking height. Drums should never be stacked on IBCs.

Racking systems allow high space utilisation and must be competently designed, installed and subject to adequate inspection and maintenance. Racking systems are prone to mechanical damage by lift trucks and corrosion.

Containment systems such as yards, bunds, drains, interceptors and their control valves should be designed, inspected and maintained to minimise the potential impact of product leaks. Good housekeeping regimes must be implemented to prevent build-up of combustible materials, spillages and vegetation.

Leaking packages must be identified and rectified promptly in a safe area before a significant pool is able to accumulate.

The operator will need to consider site security and where appropriate the specific provisions in ADR.

Risk Assessment and training

Safety should be actively managed through a process that starts with risk assessment. The findings of risk assessments must be communicated to employees, and should underpin operating procedures. Regular training should include: solvents' properties and hazards, procedures for safe handling, use of lift trucks, racking and stacking, recognition of abnormal situations, reporting of faults and incidents, use of protective clothing, housekeeping, dealing with minor leaks and spills and emergency procedures.

Technical literature

(1) CDG: The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations.

(2) ADR: European Agreement concerning the International Carriage of Dangerous Goods by Road.

(3) IMDG: International Maritime Dangerous Goods Code.

(4) API Recommended Practice 2003: Protection Against Ignitions Arising Out Of Static, Lightning, And Stray Currents.

(5) HSE Guidance Note HS(G) 51: The storage of flammable liquids in containers.

(6) RID: Regulations Concerning the International Carriage of Dangerous Goods by Rail from Annex I of the 'Convention Concerning International Carriage by Rail.

(7) British Standard BS 5958-2:1991: Code of practice for control of undesirable static electricity. Recommendations for particular industrial situations.

(8) All conductivity figures are empirical and will vary according to conditions.

(9) SIA Guidance Notice Number 47: Flammable Solvents and the Hazard of Static Electricity.

(10) NFPA 77-07: Recommended Practice on Static Electricity.

(11) Standard in development: PD IEC/TS 60079-32-1 Ed 1.0 Explosive atmospheres Part 32-1: Electrostatic hazards; Guidance.

(12) AIChE CCPS: Avoiding Static Ignition Hazards in Chemical Operations by Laurence G. Britton.

(13) PD CLC/TR 50404:2003: Electrostatics. Code of practice for the avoidance of hazards due to static electricity.

(14) SIA Guidance Notice Number 54: Guidance for the Storage of Intermediate Bulk Containers.

Technical references are subject to external updates.

All SIA Guidance Notes are available on the SIA website www.sia-uk.org.uk

Appendix 1: Worked examples

Based on the criteria in this Guidance Note, example solvents have been tabulated against their recommended IBC types according to flash point and conductivity group.

TABLE 3: Recommended IBC Type Selection According To Solvent, Flash Point, Conductivity Group

Solvent	Indicative Boiling Point Range (Hydro - carbon)	Flash Point Group	Conductivity Group	Unprotected Composite	Electrostatic Protected Composite	Electrostatic Protected Composite With Conductive Plastic Bottle And Permeation Barrier	Steel
				Compatible Approved IBCs Only			
1,4-Dioxane		0°C to 60°C	Non-conductive	No	No	No	Yes
2-Ethyl hexanol		Greater than 60°C	Conductive	Yes#	Yes	Yes	Yes
Acetone		Less than 0°C	Conductive	No	No	No	Yes
Amyl acetate		0°C to 60°C	Semi - conductive	No	No#	Yes	Yes
Benzene		Less than 0°C	Non-conductive	No	No	No	Yes
Benzyl alcohol		Greater than 60°C	Conductive	Yes#	Yes	Yes	Yes
Butyl acetate (iso- and n-)		0°C to 60°C	Semi - conductive	No	No#	Yes	Yes
Butyl glycol		Greater than 60°C	Conductive	Yes#	Yes	Yes	Yes
Butyl glycol acetate (BGA)		Greater than 60°C	Conductive	Yes#	Yes	Yes	Yes
Cyclo-hexane		Less than 0°C	Non-conductive	No	No	No	Yes
Cyclo-hexanol		Greater than 60°C	Conductive	Yes#	Yes	Yes	Yes
Cyclo-hexanone		0°C to 60°C	Conductive	No	Yes	Yes	Yes
D30		0°C to 60°C	Non-conductive	No	No	No	Yes

D40		0°C to 60°C	Non-conductive	No	No#	No#	Yes
D60, D70, D75, D80, D90		Greater than 60°C	Non-conductive	Yes#	Yes	Yes	Yes
DEB 100 (ethanol)		0°C to 60°C	Conductive	No	Yes	Yes	Yes
Diacetone alcohol		0°C to 60°C	Conductive	No	Yes	Yes	Yes
Diamyl ether		0°C to 60°C	Non-conductive	No	No	No	Yes
Diethyl ether		less than 0°C	Non-conductive	No	No	No	No
Diisobutyl ketone		0°C to 60°C	Conductive	No	Yes	Yes	Yes
Diisopropyl ether		Less than 0°C	Non-conductive	No	No	No	Yes
Dimethyl formamide		0°C to 60°C	Conductive	No	Yes	Yes	Yes
Dipropylene glycol methyl ether (DPM)		Greater than 60°C	Conductive	Yes#	Yes	Yes	Yes
Dipropylene Glycol n-Propyl Ether (DPNP)		Greater than 60°C	Conductive	Yes#	Yes	Yes	Yes
Ethanol, IDA, TSDA, CDA		0°C to 60°C	Conductive	No	Yes	Yes	Yes
Ethoxy propanol		0°C to 60°C	Conductive	No	Yes	Yes	Yes
Ethyl acetate ++		Less than 0°C	Conductive	No	No	No	Yes
Ethyl lactate		0°C to 60°C	Conductive	No	Yes	Yes	Yes
Ethyl propionate		0°C to 60°C	Conductive	No	Yes	Yes	Yes
Ethyl-benzene (isomer of xylene)		0°C to 60°C	Non-conductive	No	No	No	Yes
Ethylene glycol diethyl ether		0°C to 60°C	Conductive	No	Yes	Yes	Yes

Heptane		**Less than 0°C**	**Non-conductive**	**No**	**No**	**No**	**Yes**
Hexane		**Less than 0°C**	**Non-conductive**	**No**	**No**	**No**	**Yes**
Hexylene glycol		**Greater than 60°C**	**Conductive**	**Yes#**	**Yes**	**Yes**	**Yes**
Hydro-carbons, C10, aromatics, >1% naphthalene	**179/209**	**Greater than 60°C**	**Non-conductive**	**No#**	**No#**	**Yes**	**Yes**
Hydro-carbons, C10-C12, isoalkanes, <2% aromatics (f.p. 0°C to 60oC)	**160/173**	**0°C to 60°C**	**Non-conductive**	**No**	**No#**	**No#**	**Yes**
Hydro-carbons, C11-C12, isoalkanes, <2% aromatics (f.p. 0°C to 60oC)	**178/192**	**0°C to 60°C**	**Non-conductive**	**No**	**No#**	**No#**	**Yes**
Hydro-carbons, C11-C13, isoalkanes, <2% aromatics (f.p.>60°C)	**186/208**	**Greater than 60°C**	**Non-conductive**	**Yes#**	**Yes**	**Yes**	**Yes**
Hydro-carbons, C11-C14, n-alkanes, isoalkanes, cyclics, <2% aromatics	**>229**	**Greater than 60°C**	**Non-conductive**	**Yes#**	**Yes**	**Yes**	**Yes**
Hydro-carbons, C6-C7, isoalkanes, cyclics, <5% n-hexane	**79/83**	**Less than 0°C**	**Non-conductive**	**No**	**No**	**No**	**Yes**

Hydro-carbons, C7-C9, isoalkanes (f.p.<0°C)	**98/104**	**Less than 0°C**	**Non-conductive**	**No**	**No**	**No**	**Yes**
Hydrocarbons, C7-C9, isoalkanes (f.p. 0°C to 60°C)	**114/139**	**0°C to 60°C**	**Non-conductive**	**No**	**No**	**No**	**Yes**
Hydro-carbons, C7-C9, n-alkanes, isoalkanes, cyclics	**100/140**	**0°C to 60°C**	**Non-conductive**	**No**	**No**	**No**	**Yes**
Hydro-carbons, C7-C9, n-alkanes, isoalkanes, cyclics	**100/120**	**0°C to 60°C**	**Non-conductive**	**No**	**No**	**No**	**Yes**
Hydro-carbons, C9, aromatics	**164/180**	**0°C to 60°C**	**Non-conductive**	**No**	**No#**	**Yes**	**Yes**
Hydro-carbons, C9-C10, n-alkanes, isoalkanes, cyclics, <2% aromatics	**145/160**	**0°C to 60°C**	**Non-conductive**	**No**	**No**	**No**	**Yes**
Isoalkane mixture (f.p.>60°C)	**182/202**	**Greater than 60°C**	**Non-conductive**	**Yes#**	**Yes**	**Yes**	**Yes**
Isoalkane mixture (f.p.>60°C)	**206/255**	**Greater than 60°C**	**Non-conductive**	**Yes#**	**Yes**	**Yes**	**Yes**
Isoalkane mixture (f.p. 0°C to 60°C)	**181/198**	**0°C to 60°C**	**Non-conductive**	**No**	**No#**	**No#**	**Yes**
Isobutanol		**0°C to 60°C**	**Conductive**	**No**	**Yes**	**Yes**	**Yes**
Isohexane		**Less than 0°C**	**Non-conductive**	**No**	**No**	**No**	**Yes**
Isopropanol		**0°C to 60°C**	**Conductive**	**No**	**Yes**	**Yes**	**Yes**

Isopropyl acetate		0°C to 60°C	Conductive	No	Yes	Yes	Yes
Kerosene		0°C to 60°C	Non-conductive	No	No	No	Yes
MEK (Methyl Ethyl Ketone)		Less than 0°C	Conductive	No	No	No	Yes
Methanol		0°C to 60°C	Conductive	No	Yes	Yes	Yes
Methoxy-propyl acetate (PMA)		0°C to 60°C	Conductive	No	Yes	Yes	Yes
Methoxy-propanol (PM)		0°C to 60°C	Conductive	No	Yes	Yes	Yes
Methyl acetate ++		Less than 0°C	Conductive	No	No	No	Yes
Methyl ethyl ketone (2-butanone)		Less than 0°C	Conductive	No	No	No	Yes
Methyl isobutyl ketone		0°C to 60°C	Conductive	No	Yes	Yes	Yes
Methyl lactate		0°C to 60°C	Conductive	No	Yes	Yes	Yes
MIBK		0°C to 60°C	Conductive	No	Yes	Yes	Yes
n-Butanol		0°C to 60°C	Conductive	No	Yes	Yes	Yes
n-Hexanol		Greater than 60°C	Conductive	Yes#	Yes	Yes	Yes
n-Hexyl acetate		0°C to 60°C	Conductive	No	Yes	Yes	Yes
n-Pentanol		0°C to 60°C	Conductive	No	Yes	Yes	Yes
n-Propanol		0°C to 60°C	Conductive	No	Yes	Yes	Yes
n-Propyl acetate		0°C to 60°C	Conductive	No	Yes	Yes	Yes
Pentane (n- and i-)		Less than 0°C	Non-conductive	No	No	No	No +
Propylene glycol n-butyl ether (PNB)		Greater than 60°C	Conductive	Yes#	Yes	Yes	Yes

Propylene glycol		**Greater than 60°C**	**Conductive**	**Yes#**	**Yes**	**Yes**	**Yes**
Sec-butanol		**0°C to 60°C**	**Conductive**	**No**	**Yes**	**Yes**	**Yes**
Sec-butyl Acetate		**0°C to 60°C**	**Conductive**	**No**	**Yes**	**Yes**	**Yes**
Special Boiling Point (de-aromatised)	**60/95**	**Less than 0°C**	**Non-conductive**	**No**	**No**	**No**	**Yes**
Styrene		**0°C to 60°C**	**Non-conductive**	**No**	**No**	**No**	**Yes**
Tetra-hydrofuran		**Less than 0°C**	**Semi - conductive**	**No**	**No**	**No**	**Yes**
Toluene		**0°C to 60°C**	**Non-conductive**	**No**	**No**	**No**	**Yes**
VM & P Naphtha +		**Less than 0°C**	**Non-conductive**	**No**	**No**	**No**	**No**
White spirit 30		**0°C to 60°C**	**Non-conductive**	**No**	**No**	**No**	**Yes**
White spirit 40		**0°C to 60°C**	**Non-conductive**	**No**	**No#**	**No#**	**Yes**
White spirit 60		**Greater than 60°C**	**Non-conductive**	**Yes#**	**Yes**	**Yes**	**Yes**
Xylene (mixed isomers)		**0°C to 60°C**	**Non-conductive**	**No**	**No**	**No**	**Yes**

Yes#: Where approved by the IBC manufacturer and subject to suitable risk assessment - unsuitable for filling in zoned hazardous areas due to the ignition hazard.

No#: This is a revised recommendation within GN51.

+ Packing Group 1 solvents cannot be stored in a steel IBC. A pressure vessel is required.

++ Methyl and Ethyl Acetates are not considered suitable to go into plastic composite IBCs no matter what electrostatic protection is provided in the IBC due to the peculiar property of acetates to charge rapidly during filling operations.

Appendix 2: Technical discussions supporting guidance on selection of IBCs

The time needed for static electricity generated from IBC filling and discharging operations to dissipate can be predicted from a given solvent's physical properties. The relationship for this can be found in the SIA Guidance Note 47, Flammable Solvents and The Hazard of Static Electricity:

$$\tau = \frac{\varepsilon\varepsilon_0}{\gamma} \times 10^{12}$$

Where τ is the relaxation time constant in seconds, ε is the relative permittivity or dielectric constant of the liquid, ε_0 is the permittivity of free space 8.85×10^{-12} F/m, and γ is the conductivity of the liquid in pS/m.

Dielectric constant values for common solvents are usually in the range of 2 to 40 and can be found in reference tables. In general, those for hydrocarbons are around 2 and those for oxygenated solvents are slightly greater but generally from 2 to around 40. The values for some common amides (nitrogen based liquids) can be as high as 200. In practice, conductivity is much larger and so has a greater impact on relaxation time than dielectric constant except for nonconductive or semi-conductive solvents.

Table 1 is derived from the US National Fire Protection Association Recommended Practice on Static Electricity, this Practice provides information on the Classification of Liquids Based on Conductivity and provides a definition of what is deemed to be conductive, semi-conductive or non-conductive. Charge relaxation is governed mainly by conductivity, and to a lesser degree by dielectric constant. Typical Relaxation Times are taken from the publication, Avoiding Static Ignition Hazards in Chemical Operations by Laurence G. Britton.