How to Work Safely with – Static Electricity – Fact Sheet

WHAT TOPICS ARE COVERED IN THIS QUESTION AND ANSWER DOCUMENT?

This document summarizes safety issues related to static electricity, bonding and grounding containers, etc. When working with flammable liquids.

What is static electricity and how is it generated?

Static electricity is the electric charge generated when there is friction between two things made of different materials or substances, like clothes tumbling in your dryer. Static electricity is what causes the sparks when you comb your hair or touch a metal object, like a doorknob, after walking across a carpet on a cold, dry day (especially during Canadian winters). It can also be generated by repeated contact and separation between unlike materials, like a flat belt on a rotating pulley.

Electric charges can build up on an object or liquid when certain liquids (e.g., petroleum solvents, fuels) move in contact with other materials. This charge can occur when liquids are poured, pumped, filtered, agitated, stirred or flow through pipes. This buildup of electrical charge is called static electricity. Even when liquids are transported or handled in non-conductive containers, something rubbing the outside surface of the container may cause a static charge to build up in the liquid. The amount of charge that develops depends, in part, on how much liquid is involved and how fast is it flowing or is being agitated or stirred.

Is static electricity hazardous?

Depending on circumstances, static electricity can be a nuisance or a hazard. Static cling in your clothes can be a nuisance but a spark that has enough energy to cause a fire or explosion is a definite hazard. To decide if static electricity is likely to be a hazard, you must consider several factors:

- Is there an ignitable mixture (e.g., solvent vapour or dust in the air) in the area where a static electricity discharge can occur?
- Can a static electric charge be generated under the operating conditions?
- Can the charge accumulate?

- If it discharges, will it cause a spark?
- Will the discharge generate an incendive spark, i.e., a spark that has enough energy to ignite the mixture in air?

If the answer to the above five questions is yes where a solvent or fuel is used, then static electricity can be a fire / explosion hazard. It means that the spark can ignite a vapour/air mixture that is in its flammable range, the concentration range between the upper and the lower flammable limits.

Be aware that when a person walks around, there is a redistribution of the static electric charge on their body as they get close to or leave an area where there is a charge. This change is also related to any items the person may have on their body, such as clothing, tools, flashlights, pens, etc.

What kind of solvents are likely to be a static electricity hazard?

Flammable and combustible liquids can present a static electricity hazard depending on their ability to generate static electricity, how well they conduct electricity (conductivity), and their flash point.

Solvents and fuels produced from petroleum (e.g., benzene, toluene, mineral spirits, gasoline, jet fuel) can build up a charge when they are poured or flow through hoses. They tend to hold a charge because they cannot conduct electricity well enough to discharge when in contact with a conducting material, like a metal pipe or container, that is grounded. When enough of a charge is built up, a spark may result. If the vapour concentration of the liquid in air is in the “flammable range” and the spark has enough energy, a fire or explosion can result.

According to the National Fire Protection Association (NFPA) (Code 77 – Recommend Practice on Static Electricity), solvents that are soluble in water (or can dissolve some water themselves) do not build up static electricity. Examples of such liquids include alcohols and ketones like acetone. However, when liquids are transferred into non-conductive containers (e.g., plastic, glass), even conductive solvents may build up a charge because the plastic or glass containers decrease the rate at which the charge in the solvent dissipates.

The flash point and vapour pressure of the liquid and the temperature are other factors to consider. The vapour levels will be higher in the air around the container if you are working outside on a hot summer day than in the winter when the temperature is below 0°C (32°F) or colder.

At higher elevations in the mountains, the air pressure is significantly lower and solvents boil at lower temperatures. Under these conditions, the flash point and the temperature for the optimal vapour/air ratio are lower.

A liquid like hexane has a low flash point and it is flammable when its temperature is in the range -33°C to -3°C (-28°F to +26°F) at sea level. At normal room temperatures, the vapour/air ratio at the surface of the solvent will be well above its upper flammability limit and would be “too rich” to burn. However, at some distance away from the solvent surface, there is a concentration of hexane vapour in the air that is in the flammable range.

A fuel like kerosene is a liquid with a flash point above 38°C (100°F). Under hot weather conditions or if high flash point liquids are heated to temperatures around or above their flash points, a flammable vapour/air mixture will form.

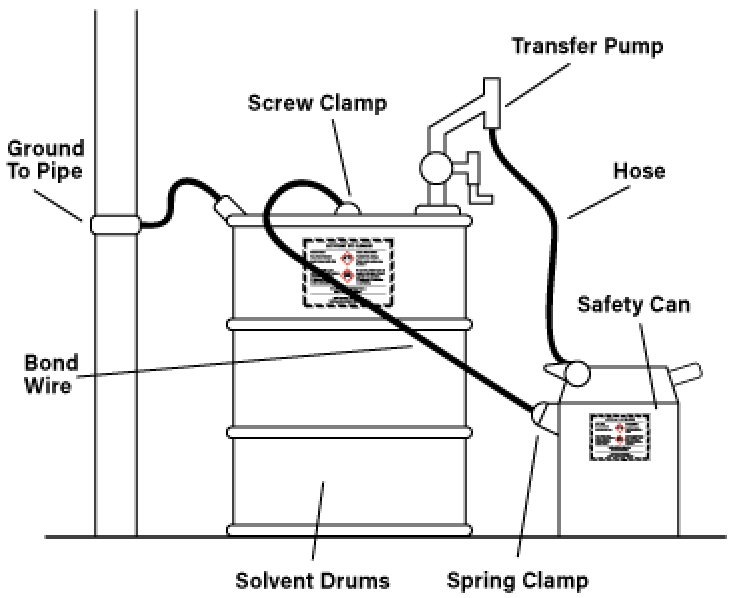
Generally, the conditions for igniting a liquid are optimal when the liquid is used at a temperature that produces a vapour in air concentration (at the surface of the liquid) that is halfway between the upper and lower flammability limits. Recognizing that these conditions represent an “optimal” fire hazard, one has to take appropriate precautions.

Why is it important to bond and ground containers?

Transferring a liquid from one metal container to another may result in static electrical sparks. To prevent the build up of static electricity and prevent sparks from causing a fire, it is important to bond metal dispensing and receiving containers together before pouring. Bonding is done by making an electrical connection from one metal container to the other. This ensures that there will be no difference in electrical potential between the two containers and, therefore, no sparks will be formed.

Bond containers by securely attaching a special metal bonding strap or wire to both containers. Some liquid transfer pumps have self-bonding hoses. Bonding can also be done by keeping a solid metal-to-metal contact between the containers themselves or between a metal container and a conducting nozzle. These last two methods are usually not reliable because a good electrical contact is often hard to make and maintain during the entire transfer. In addition, while grounding conductors can be covered or insulated (e.g., with a plastic coated cable), uninsulated conductors are preferred as defects are easier to see.

In the flammable liquid storage and dispensing area, ground dispensing drums. Grounding is done by connecting the container to an already grounded object that will conduct electricity. This could be a buried metal plate, a metallic underground gas piping system, metal water pipes or a grounded, metal building framework. Bonding both containers and grounding one of them “drains off” static charges and prevents the discharge of sparks. All grounding and bonding connections must be bare metal to bare metal. Remove all dirt, paint, rust or corrosion from points of contact. Specially designed and approved bonding and grounding wire assemblies are available from safety equipment retailers.



Do all kinds of containers have to be bonded or grounded?

You only need to bond those containers that conduct electricity, such as those made from metal or conductive plastics.

If a container is made from a material that does not conduct electricity, such as polyethylene plastic or glass, bonding or grounding is not necessary.

Are there special precautions to take when filling non-conductive containers?

Even if a liquid is conductive, filling or handling plastic or other non-conducting containers can be hazardous. The splashing and turbulence of the liquid in the container can cause a static electric charge to build up in the liquid or on conductive parts on the container that are not grounded. A spark with enough energy to ignite a vapour/air mixture in its flammable range (an incendive discharge) can originate from the liquid or from the container.

For portable tanks, intermediate bulk containers and non-bulk containers, NFPA advises to ground any metal parts on the container (and nearby conductive surfaces that the container may come in contact) and fill the container from the bottom through a long, grounded metal pipe. This procedure will reduce the amount of static charge produced and will enable the generated charge to relax (dissipate) through the metal pipe. Use the smallest container for the job. The risk of fire from static electricity increases with the volume of the container and the volatility of the liquid being used.

When filling non-conducting portable containers, the NFPA recommends that a grounded dip pipe or grounded wire be in the liquid in the container while it is being filled. The filling rate should be minimized, especially if there is filter in the line. Any metal parts of the container and metal funnel, if one is used, should also be grounded. When filling containers with low-conductivity liquids (i.e., ones with a conductivity less than 50 picoSiemens, pS), one should keep the grounded dip rod in the liquid for around 30 seconds after the filling is completed.

Similarly, filling an ungrounded portable fuel tank on a plastic-lined truck bed can cause spark-induced gasoline fires. For that reason, portable fuel tanks should be removed a safe distance from the vehicle (which, of course, is turned off) and be filled on the ground. The nozzle should be held in contact with the container while it is being filled.

When do I need to bond and ground containers?

Bonding and grounding are needed when dispensing flammable liquids from storage drums to smaller electrically conductive containers. Similarly, whenever you transfer these liquids between conductive containers in any work areas, for example, when filling or draining dip tanks, mixers, rinse tanks or other equipment, bond both containers together and ground one of them. Check bonding and grounding connections regularly to ensure they are in good condition.