# Work Instruction

| Title: | Control of Static Electricity Work Instruction | | |
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| **Author:** | Melissa Lowry | **Doc No:** | Document Number Redacted |
| **Reviewed by:** | Alex Wishart | **Rev No:** | 1 |
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## 1 Scope

This document describes the hazards and controls related to static electricity which can be generated while operating blast and paint equipment, during product transfers, draining vessels and lines and other day to day maintenance or operations activities.

It does not cover the static electricity reduction design aspects of permanent plant installations.

## 2 Purpose

This resource document is intended to form part of the permit to work system and describes:

1. The reasons for putting static electricity precautions in place.
2. What precautions are necessary?
3. How to test that the precautions are adequate.

## 3 Causes of Static

Static Electricity is caused naturally by the movement of fluids (including some gases, hydrocarbon liquids, dust and grits) through pipes and hoses, by vehicles moving on rubber tyres, and through the friction from one surface rubbing against another.

Static may be generated when fluids flow in pipes, or when fluids are pumped, agitated, filtered, mixed, shaken, poured or sprayed. The amount of static generated depends on the type of fluid and the flow rate.

Water is not usually considered a static hazard when it remains in a liquid state as its high conductivity causes any charge to dissipate as quickly as it is formed, however this can change when it is mixed with firefighting foam, detergents or other substances, or when used with high energy processes (i.e., water blasting).

As a general guide all pure flammable liquids can be expected to present dangers from the generation of static unless proved otherwise. Entrained water in hydrocarbon liquids will significantly increase the tendency of a product to produce static.

## 4 Static Electricity Hazards

The primary hazard is the potential for a static discharge causing a spark with enough energy to ignite a flammable atmosphere, particularly hydrocarbons in the vapour phase which have lower ignition energies.

A static discharge can occur when enough static charge is allowed to accumulate (either in the fluid itself or on the surface of hoses, tanks, vessels or equipment) and some intentional or accidental contact to earth or another part of the plant or equipment occurs.

## 5 Static Electricity Control

Earthing and Bonding are the primary means of reducing static generation and charge accumulation.

Static will naturally dissipate when there is a connection to earth which is why bonding cables and external earth cables are used with the potentially static generating equipment and operations described in this document.

Under certain favourable condition static can dissipate naturally but as these conditions can vary, earthing is the primary method for dissipating static charge.

## 6 References

AS/NZS 1020:1995 The control of undesirable static electricity.

## 7 Responsibilities

It is the responsibility of the personnel operating the equipment to ensure that the static electricity precautions described in this document are put in place before starting work.

It is the responsibility of the permit issuer and area technician to ensure that the visual inspections and continuity tests have been performed correctly and the test results recorded on the PTW checklist.

If there is any doubt about whether the static electricity precautions or testing have been performed adequately then the responsibility for checking falls to the permit issuer.

## 8 Glossary

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| Static | Static is caused by charge separation at a molecular level through disunion or relative movement of two contacting surfaces having a different physical and/or chemical structure |
| Charge | Charge (or electrostatic charge) is the name given to the build-up of static electricity, there are many variable that determine the energy that can be accumulated in a charge which are described in detail in the standards |
| Dissipation | When static electricity safely flows to earth thus preventing a static build up. Usually in a continuous and gradual fashion through an earth cable. |
| Discharge | In static electricity terms this refers to a sudden release of a stored static charge from one ‘body’ to earth or to another ‘body’. This may occur during the intentional earthing or bonding of equipment or vessels but may be unexpected. Can be potentially hazardous depending on the energy contained in the charge |
| Earthing | Connecting some equipment or device to the main plant earth, usually by a cable known as an earthing cable. Allows the safe dissipation of static electricity to earth. |
| Bonding | Connecting conducting parts (usually metallic) together so they are at the same electrical potential – to remove the possibility of spark occurring between them and to aid in the dissipation of static charge, usually done with a bonding cable. Often referred to as equipotential bonding |

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| Plant Earth | The interconnected system of above ground earthing conductors buried plant earth grid and earthing electrodes. Used to provide a safe path to earth for lightning, static electricity or for any electrical system faults. All electrical systems, structures, vessels, pipes, racks and ladder systems are connected to it. |

## 9 Static Earthing and Bonding General Requirements

The following describes the minimum requirements for earthing/bonding systems used to dissipate static electricity from machinery, tanks/vessels and vehicles used on Todd Energy sites.

### 1.1 Plant Earth Connections

Static earth cable connections to plant Earth should ideally be made at an earth connection boss; these are located on all cable racks, structures, vessels, pipe sections and stands.

Failing this, other bright or galvanised steel structural parts may be used provided they are connected to the main plant earth.

Stainless steel instrument tubing should not be used as it may not be adequately connected to plant earth.

A painted surface will not provide an adequate connection to earth.

#### 9.1.1 Pipe Sections

If connecting an earthing cable to a pipe section, ensure that there are no insulating gaskets in the line preventing a connection to plant earth.

When breaking flanges or cutting lines, use a bond cable across the break to equalise any charge difference that may be generated across the pipe sections.

### 9.2 Earthing/Bonding Clamps

For connecting to the plant earth or bonding, spring clamps (large alligator clips) are suitable for product and fuel transfers, use of half drums or where blast and paint equipment will be used for less than one day at a location.

Alligator clips or battery clamps should have teeth and a strong spring to ensure that a good connection is made.

Where blast and paint equipment will be in an area for more than one day it should be connected to the plant earth by a more secure bolted/screwed connection (lug, welding type G clamp or similar).

### 9.3 Flexible Hoses

Flexible hoses used for product transfers, vacuum trucks and blast and paint equipment are usually made from anti-static or conductive hose, if it is correctly terminated to earthed equipment it also provides a path for static charge to dissipate to earth. Typical acceptable resistance values for these types of hose are 1MΩ to 100MΩ end to end.

When hose lengths are joined together, a bonding wire should be used to ensure there is a good electrical connection between sections. An additional separate earth or bond wire is used to guarantee earth continuity to any metallic parts, flanges or couplings along the hose length.

## 10 Inspection and Testing

Static earthing and bonding systems and connections must be visually inspected and have resistance measured after installation and daily thereafter if they are to remain in place.

### 10.1 Inspection and Testing Requirements

#### 10.1.1 New or Relocated Installation

a) Visual inspection to confirm that Earth cable, bonding cables and all connections comply with the general and additional requirement of this document.

**b)** Confirm by measurement that resistance between any/all points of the entire static earthing and bonding system is less than **10 Ω.**

#### 10.1.2 Existing Installations

a) Daily visual inspection of Earth cable, bonding cables and all connections prior to beginning work.

### 10.2 Resistance Measurement

b) Earth cable continuity measurements shall be made with a digital multi meter with a current test certificate.

c) A gas test is required prior to performing a resistance measurement in a hazardous area.

d) Test the meter before measurement by shorting the probes together – the reading should be less than 0.1 Ω - otherwise repair or replace the meter.

e) Make the resistance measurements with one multimeter probe on a different plant earth point (NOT the one that you have just connected the earth clamp to) to each of the metallic bonded parts of the equipment (this is to prove the actual connection to plant earth, not just to the end of the earth cable).

f) Take separate readings from this earth point to all of the metallic part of the equipment to prove the bonding of the equipment.

g) The highest measured value must be recorded on the relevant PTW checklist or on the permit.

h) If necessary, the static earthing and bonding connections should be moved, repaired or improved until the earth resistance is below 10 Ω.

## 11 Additional Requirements

### 11.1 Sand Blasting / Water Blasting / Spray Painting / Steam Cleaner

These activities all produce static electricity due to the high fluid velocities flowing through the hoses and phase change occurring as the fluid leaves the nozzle.

a) All exposed metallic parts of the equipment including the nozzle and any flexible hose joints should be bonded together to ensure continuity through the entire length of the hose and connected to plant earth with an earth cable.

b) The work piece should be bonded to the equipment if it is not already connected to plant earth.

c) Inspections and tests of the earthing and bonding system are performed as described above.

### 11.2 Vacuum Truck

Vacuum truck operation has the potential to generate static charge, particularly if water is entrained with any hydrocarbon liquids being removed.

d) The Gully Sucker truck has a fitted earth cable with a spring clamp which should be connected to plant earth prior to operation.

e) Flexible hoses should be anti-static or conducting type to reduce static accumulation.

f) Resistance testing of the earthing connection from the truck chassis to plant earth is performed as described above, unless the vacuum truck is fitted with an earth monitoring device.

### 11.3 Half Drums

Draining process fluids into half drums can generate static charge through splashing or through mixing of different liquids.

g) Half drums with earth cables attached should be used for draining process fluids from vessels or pipes.

h) Plastic containers should never be used for this purpose as they will accumulate charge.

i) The earth cable clamp should be attached to a suitable earth connection point.

j) The earth cable and clamp should be checked to ensure that it provides a good connection before use.

### 11.4 Diesel Transfers

Fuel transfers from a towed trailer to fixed or mobile generators, blast and paint units or other engines.

k) A bonding cable shall be connected between the diesel tanker and the tank/chassis being filled, prior to starting the fuel fill.

l) If possible, the bonded vehicles should be connected to plant earth to reduce the ignition hazard from static generated by personnel.

m) Mobile air compressors used on Todd Energy sites are modified so that there is an obvious bonding point on the chassis for this purpose.

For fuel/diesel transfers using handheld 10L or 20L fuel containers there are no additional earthing requirements providing the activity is performed in a non-hazardous environment. Refer to Hazardous Area Classification drawings. Plastic fuel containers are allowed to be used for these activities.

### 11.5 Drums, IBCs and other transportable containers

Includes intermediate bulk containers used for wellsites chemical dosing and temporary dosing trailer use.

n) Steel drums should have an earth cable attached prior to filling or emptying.

- Filling/emptying drums or other transportables should only take place in a designated area where there is a flexible earth cable with a spring clamp permanently installed.

o) Bulk transportable chemical containers which are placed on site for chemical dosing or other services should have a bolted earth connection.

- Resistance testing from the container to plant earth should be performed as described above when a container is replaced.

p) IBCs made of non-conductive material shall have a conductive metal grid around the container. The grid shall mesh size shall be < 100mm x 100mm with a maximum distance between container and grid not exceeding 20mm.

The steel grid shall be earthed in the same way as for steel containers.

q) Plastic IBCs without the above mentioned metal grid shall not be used inside zone 1 & 2 areas.

## 11.6 Road Tanker Product Transfers

### 11.1.2 Without an Earth Monitoring System

a) Loading facilities are equipped with a purpose made earthing cable which is permanently connected to the plant earth.

b) The cable clamp shall be connected to the nominated earthing point on the chassis of the tanker unit prior to connecting hoses and beginning the transfer operation.

c) The cable should be connected as far as possible from where ignitable vapours can escape.

d) Resistance testing of the earthing connection from the truck chassis to plant earth shall be performed as described above.

### 11.1.3 With an Earth Monitoring System

a) Loading facilities are equipped with a purpose built earth monitoring system.

b) The earth cable is connected to the nominated earth connection point on the tanker chassis.

c) Loading/unloading only occurs when the earth connection is maintained.

d) Site specific instructions should be followed.

## Revision and Approval Details

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