Intrinsic Safety Is Not Such A Black Art!

By Ajay Maira, Manager Electrical Low Current Branch, TestSafe Australia

It's 2 am in the morning, and you wake up with the smell of unburnt gas coming into your bedroom. You shake yourself rapidly out of your slumber, and stumble into the children's bedroom. They are safely asleep. You go towards the kitchen, and the smell becomes stronger. You are now sure that the recent plumbing for the new cooking range may have sprung a leak. As you put out your hand to turn on the light, you stop and think – the spark in the switch might cause the whole thing to explode. You are now sweating, but being very careful. You wake up the family, and tell all of them not to use any electrical gadgets or switches. You take them out of the front door, and when the air is cleaner, you heave a sigh of relief and bang on the neighbour's door and ask him to dial '000'.

Does the above sound far-fetched, or do you feel that it may be something that might happen? Have you seen tankers carrying fuel with the familiar warning signs on them that it contains 'flammable liquids'? Ever wondered what electrical equipment is being used when the tankers are being refuelled?

As a matter of fact, visit any oil refinery, petrochemical plant, coal mine or grain terminal and you will be asked to remove your watch, handover your mobile phone, torch and camera before you are permitted to enter. The reason being that these battery-powered objects are unsafe in these hazardous areas as they are a potential ignition source.

Garry Jeffery, Electrical Engineer, TestSafe Australia performing a spark test.

But, what do they use to measure the amount of fuel delivered to a tank, or the pressure inside the pipeline, or temperature inside the silo? The answer is: 'intrinsically safe' explosion protected electrical equipment.

This is not a black art, as many would like to dismiss it. It is a science where the design of the equipment limits the amount of energy that can be released at any place where a spark might exist. It also examines the maximum possible temperature at any part of the circuit where the heat may cause ignition of the flammable atmosphere.

TestSafe Australia is an internationally acclaimed testing organisation that has the expertise to examine intrinsically safe designs. It conducts such tests as may be necessary, and follow it up with a comprehensive report that details the results of its examination. It also provides certificates under National and International schemes for such explosion protected electrical equipment. Other than intrinsic safety, it offers a similar service in a host of other protection techniques, the notable ones being flameproof, increased safety and encapsulation.

So, how does intrinsic safety work?

Let's get to basics: How do we get an explosion? You need 3 things:

- Flammable material (that could be the petrol vapour at a fuel dispensing station, or grain dust in a silo)
- Oxygen (plenty of that available in normal air!)
- A source of energy

We normally try to control the first one by removing the flammable material where electrical apparatus may be around. That's sheer common sense, and is called 'risk reduction strategy' for the professionals.

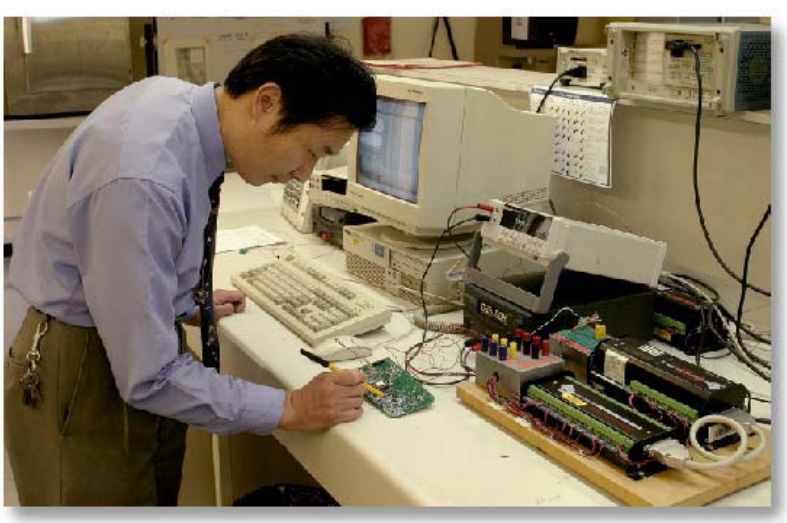
For the second item, it may not be readily obvious how to effect removal of the oxygen available in normal air, but that is precisely the method used where huge transformers have to be used in underground coal mines – we fill the enclosure containing the transformer with inert nitrogen.

The last item – removing the source of electrical energy, is again a very common sense method. Don't use electrical equipment, and use compressed air to drive the motor, etc.

But, what do you do if you DO need to measure the temperature and humidity of the grain in the silo? Use intrinsic safety!

This technique does allow the source of energy, but limits it to an amount that will not cause an ignition.

All flammable materials have been classified with the amount of spark energy that can cause an explosion. They have also been classified by the necessary temperature that causes them to self-ignite. And, intrinsic safety is a technique that requires that the design of the equipment is such that the energy is less than that required for ignition, and the temperature of the components is less than that required for the self-ignition.



James Zhao, Electrical Engineer, TestSafe Australia performing a temperature rise test.

Simple, isn't it?

And, just to give additional protection, we also have a system of adding further integrity to the equipment by allowing for such faults that we know might occur (for example, somebody inadvertently dropping a pager and the battery popping out, or somebody bringing a cable to grief by inadvertently stretching it) and the energy STILL being too low to set off an explosion.

So, our group of engineers at TestSafe are experts with an electronics design background and who have acquired an intimate knowledge of intrinsic safety standards. We examine the design of the equipment by reviewing the circuit schematics, interconnection diagrams, circuit board layouts, and most of this work is done on the desk.

As and when required, the circuit, or an equivalent one made up in our laboratory, is then tested on the Spark Test Apparatus. Explosive gases are mixed and piped into this apparatus,

and wires from the circuit under test are connected to an arrangement of tungsten wires being brought intermittently into contact with a cadmium disk. The purpose is to 'make and break' the circuit 1600 times inside an explosive atmosphere to check if the energy in the circuit may cause an ignition

We measure the maximum temperature rise on the surface of the components, and confirm that the temperature is less than that at which the explosive gas could ignite. Power is applied to the components under test, and the temperature is measured.

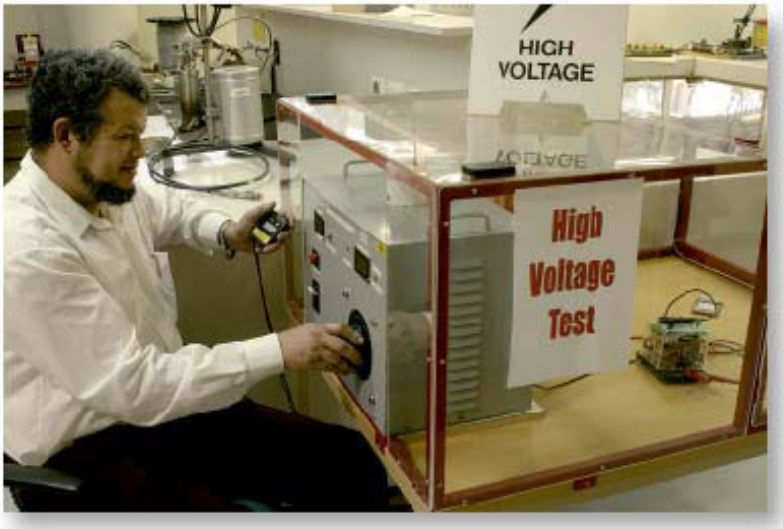
We measure the critical spacing distances on the electronic printed wiring board, a sample, or layout drawings, for the places where spacing is critical. The distances are measured on an Optical Profile Projector and compliance is thus determined.

David Fraser, Electrical Engineer, TestSafe Australia performing a segregation distance measurement

We test that the internal circuits are adequately insulated from any metallic parts that may not be grounded. A high voltage test is applied between the metallic enclosure and the internal circuit and the leakage is measured.
There are several other tests that may be applicable – Drop test, IP test, impact test on piezo-electric devices, battery short circuit test, small component ignition test etc., and these are conducted using documented procedures using calibrated equipment.

In the end, a compliance test report is prepared, with a complete listing of all the safety components, and how compliance was determined.

Certification of the product is based on the test report and an audit of the manufacturing facility where the product is produced.



Mohamed Abdelkrimi, Electrical Engineer, TestSafe Australia performing a high voltage test

Next time you fill up at the petrol station, look carefully for the all-important nameplate on the pump. You will find a label plate that will say 'Ex d IIB T3' followed by a certificate number. This is your guarantee that the equipment has been designed and examined by a group of experts with your safety at heart. And, the workers at the petrochemical refinery plant and oil drilling rig would similarly be examining their equipment before they use it to measure the temperature or pressure. It would have the code 'Ex ia IIB T4' or similar.

I told you that intrinsic safety wasn't a black art, after all!