WHITEPAPER

Top Ten Myths About Ignition Sources

What are the fundamental conditions leading to an explosion? What are the most potent potential ignition sources? It is impossible to cover everything there is to know about ignition sources in this short article; however we have focussed on the key things that operations personnel really need to know. DEKRA's Process Safety specialists continue to come across situations where there is poor control over ignition sources. In this article we identify some commonly held myths associated with these ignition sources.

Background Information

The Fire Triangle:

There are three things needed for combustion;

1 - Fuel

2 - Oxidant, typically the oxygen in air

3 - Sufficiently energetic Ignition Source.

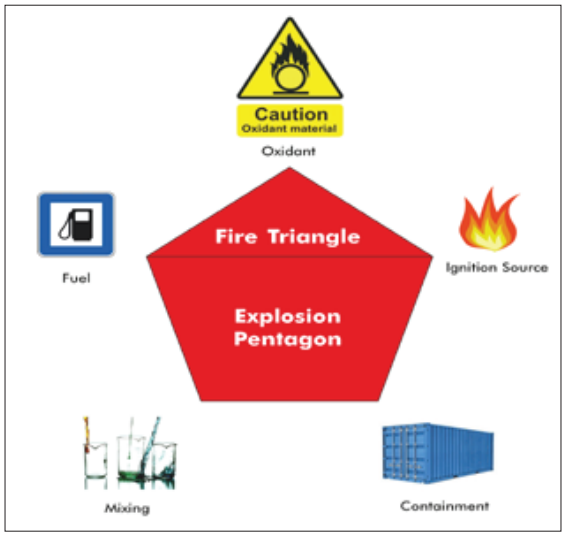
These three elements form the fire triangle.

The Explosion Pentagon:

Adding two more elements to the Fire Triangle gives rise to an explosion:

4 - Containment

5 - Mixing or Dispersion (Suspension for dust explosions)



Together, these five elements form the Explosion Pentagon.

Ignition Sources

"Ignition sources are the only thing we get for free in the chemical industry" – T. Kletz

Whenever flammable liquids, gases, powders or their mixtures are handled, ignition sources are never far away. The consequences of ignition can be devastating - resulting in loss of life, damage to the environment, adverse publicity and potential business failure to name but a few. There are 13 types of ignition sources we take into account in our specialist assessments; the list here is derived from EN 1127-1:

1. Mechanically generated sparks
2. Self-heating (including self-ignition of dusts) and other exothermic reactions
3. Hot surfaces – including frictional heating
4. Electrostatic discharges
5. Flames and hot gases
6. Electrical apparatus
7. Stray electrical currents, cathodic corrosion protection
8. Lightning
9. Radio frequency electromagnetic radiation, 104 Hz to 3 x 1012 Hz
10. Visible electromagnetic radiation, 3 x 1011 Hz to 3 x 1015 Hz
11. Ionising electromagnetic radiation
12. Adiabatic compression and shock waves
13. Ultrasonics

In addition to the above, one ignition source not listed in its own right (because it is a part of several of them, such as electrical equipment, hot gases, flames, hot surfaces, but is worthy of mention at this point) is 'hot work'. There are many examples of ignition sources associated with fires and explosions; a rich source of such examples is Lee's Loss Prevention in the Process Industries Hazard Identification Assessment and Control. This table is derived from the Third Edition.

Ignition Sources	Examples
Flames	Flare: elevated or ground level flare; full flare or pilot condition; incinerator. Furnace: natural or forced draught. Fired heater. Boiler. Laboratory heater: bunsen burner; furnace. Personnel heater: solid fuel or electrical fire. Burning operations: burning rubbish; burning during demolition. Firing: explosion for demolition; other explosives. Warning flare: hazard warning flare; fog warning detonator. Accidental fire. Hot material: brand; hot particles.
Hot Work	Welding: arc welding; oxyacetylene welding. Cutting: oxyacetylene cutting. Grinding. Hot tapping.
Hot Surfaces	General: vessel and pipework. Machinery: engines; turbines; exhausts. Laboratory equipment: hot plate; oven. Hot particles: soot.

Despite the introduction of European regulations for explosive atmospheres, such as the ATEX Directives, and country legislation such as UK's DSEAR which incorporates ATEX and the Chemical Agents Directives, DEKRA's experts still identify situations in which ignition sources are inadequately controlled. Examples are many but include:

1. Poor bonding and earthing of equipment and personnel
2. Lack of maintenance of earthing systems
3. Lack of awareness of how to safely handle non-conductive highly flammable liquids (such as toluene)
4. Use of plastic bags to add powders to solvents
5. Incorrect selection of Flexible Intermediate Bulk Containers (FIBC) for control of electrostatic charges
6. A run to failure maintenance philosophy applied to non-electrical equipment in hazardous (Ex) areas
7. Poor control of hot work including a lack of understanding of what constitutes hot work
8. 'Ex' electrical equipment which is poorly maintained, wrongly specified or wrongly installed
9. Lack of data on safe powder drying and storage temperatures
10. Insufficient understanding of the ignition characteristics of combustible dusts
11. Lack of awareness of the implications of hybrid mixtures on flammable properties
12. Poor management of change arising from loss of corporate technical knowledge.

Some of these examples are due to lack of awareness, but some reflect the complexity of the problem. Guidance is there but can be hard to interpret and apply practically.

Ignition Sources	Examples
Friction & Impact	Impact: hand tool, power tool, boot stud, loosening of caked material, moving vehicle. Rubbing: belt, conveyor, roller, brake, clutch on machinery, skidding of road or rail tanker.
Hot Material/Gas	Discharged material: hot ash from boiler; used catalyst; hot process material. Hot gas.
Reactive and unstable materials	Pyrophoric material. Incompatible material: material which reacts with material of construction
Engine	Ingestion of flammable: petrol, diesel or gas engine mixture. Friction and impact: thermite reaction. Instrument: catalytic element
Mechanical Rupture	Spark associated with rupture giving rise to release
Atmospherics	Lightning strikes.
Compression	Ingestion of flammable mixture: compressor, high speed blower.
Smoking	Means of lighting: matches, lighter. Item smoked: cigarette, cigar, pipe.
Vehicles	General vehicles: petrol, diesel or electrically driven. Crane. Forklift truck. Aircraft.
Electrical	Machinery: motors, alternators, dynamos, convertors. Fixed equipment: contact devices such as switches, relays, contactors. Insulators: arcing across spark gaps at high voltage insulators. Cable: broken cable, damaged cable, water ingress. Batteries: connecting up damaged battery. Heating tape. Lighting. Fault current conductor: poor joint. Portable equipment: meter, radio, TV, camera, hearing aid. Earth movement: sparking due to earth movement such as earthquake or subsidence.

Myths About Ignition Sources

It is impossible to cover everything there is to know about ignition sources in this article; however the key focus is to discuss the things the plant personnel really need to know. Over decades of working in the field of process safety, the team of experts at DEKRA has determined that there are several myths regarding process safety in general, and ignition sources in particular.

Avoidance of ignition sources is not usually advised as the 'sole' basis of safety. However, where protection systems such as inerting or explosion venting are also present, minimising demand on these systems is paramount.

	Myth
One	I've been loading powder to that reactor via an open manway for 30 years and have never had an explosion so I can't have an ignition problem.
Two	I operate the process below the liquid flashpoint so I'm safe.
Three	We can use literature data for our dust ignition properties, materials don't vary.
Four	We don't have an ignition problem because we use a hot work permit.
Five	My operators can't become electrostatically charged; they don't rub against anything.
Six	Everything is earthed so I have no problem with static.
Seven	I've installed ATEX certified electrical equipment so I'm safe
Eight	We use an earth clip for drums, so we are safe.
Nine	I don't have any isolated conductors on my plant and it's metal to metal contact so it should be earthed - right?
Ten	We issue static dissipative footwear so we dont have a problem with sparks from people or hand-held tools and I didn't think people could ignite flammable vapours anyway.

Summary

Although there are explosion protection systems in place, it is still important to reduce the demand on these systems. Protection systems such as explosion vents are not intended for frequent use – hence it is critical to control ignition sources where flammable atmospheres are unavoidable. Over the years and after discussion with several clients, the team of experts at DEKRA has determined that there are several myths regarding process safety in general and ignition sources in particular.

DEKRA has extensive experience in the management of flammable gases and vapours and combustible dust fire and explosion hazards. Operating at an acceptable level of risk requires understanding of the specific hazards involved with these materials.

DEKRA Organisational & Process Safety

DEKRA Organisational and Process Safety are a behavioural change and process safety consultancy company. Working in collaboration with our clients, our approach is to assess the process safety and influence the safety culture with the aim of 'making a difference´.

In terms of behavioural change, we deliver the skills, methods, and motivation to change leadership attitudes, behaviours and decision-making among employees; supporting our clients in creating a culture of care and measurable sustainable improvement of safety outcomes is our goal.

The breadth and depth of expertise in process safety makes us globally recognised specialists and trusted advisors. We help our clients to understand and evaluate their risks, and work together to develop pragmatic solutions. Our value-adding and practical approach integrates specialist process safety management, engineering and testing. We seek to educate and grow client competence to vide sustainable performance improvement; partnering with our clients we combine technical expertise with a passion for life preservation, harm reduction and asset protection.

We are a service unit of DEKRA SE, a global leader in safety since 1925 with over 45,000 employees in 60 countries and 5 continent. As a part of the world's leading expert organisation DEKRA, we are the global partner for a safe world.

We have offices throughout North America, Europe, and Asia.
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