

Handling of non-electrical ignition sources

Working Together for Safety Recommendation 042E/2019



SfS
Samarbeid for Sikkerhet

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Introduction

In January 2018, the Petroleum Safety Authority commissioned SINTEF to produce a research report on the control of non-electrical ignition sources. This report states that focus is generally placed on electrical ignition sources, but that ‘the topic of non-electrical ignition sources should be highlighted in the companies’ internal governing documents, procedures and training programmes.’

According to the report, reported incidents involving ignited HC leaks in Norwegian petroleum activities show that typical non-electrical ignition sources include:

- Overheating of motors / pumps / rotating equipment (bearings, belts, etc.)
- Hot surfaces, often in connection with leaks of lubricants, hydraulic oil, diesel or HC
- Static electricity
- Auto-ignition

The report also states that ‘with simple measures, it is possible to increase awareness of non-electrical ignition sources and establish “best practice” for their control.’

Typical non-electrical ignition sources include hot surfaces, flames and sparks, in addition to other phenomena such as static electricity, the auto-ignition of dust, shock waves and chemical reactions, etc. A dedicated ISO standard regarding non-electrical ignition sources has recently been published (2016)¹.

Purpose

The purpose of this recommended practice regarding the handling of non-electrical ignition sources is to increase competence within this area, and thereby help to ensure that such ignition sources do not result in fire or explosion.

Target group

The target group for this document is everyone who works with potential non-electrical ignition sources. This recommendation may also be useful for HSE and management personnel, to improve management and follow-up in this area.

Links and references

- 1) ISO standard regarding non-electrical ignition sources (ISO 80079-36)
- 2) SINTEF report: Control of non-electrical ignition sources 2017:00629 (available in Norwegian only)
- 3) “What went wrong”: Case histories of plant disasters by Trevor A. Kletz
- 4) Norwegian Oil and Gas guidelines 088: Common model for work permits (WP)
- 5) Area classification and regulations – Appendix 2

Handling of non-electrical ignition sources

General measures:

Conditions at the individual installation should be surveyed in order to provide a basis for handling ignition sources. One of the most important measures is the use of the common model for work permits⁴.

Be aware that the use of ATEX-approved tools (such as air-driven tools) may still represent a source of ignition during use (e.g. overheating during drilling, grinding with incorrect discs, static electricity, etc.). Maintenance routines must ensure that tools, equipment and systems maintain their approval/integrity.

In the event of a gas alarm, instructions shall be issued to stop all hot work. Personnel performing work that may represent a non-electrical ignition source must then stop their work. This includes securing the work site and eliminating potential ignition sources, for example by shutting off the air supply to rotary tools. All personnel must be familiar with how tools shall be secured.

Specific measures – recommended practice:

Hot surfaces

- 1) Survey all hot surfaces and ensure that these are monitored as necessary
- 2) Consider additional insulation of hot surfaces
- 3) Ensure that the condition of rotating equipment is monitored (preferably online)
- 4) Follow up and prevent leaks in the vicinity of hot or potentially hot surfaces

Static electricity

- 1) Ensure that equipment and vehicles/vessels have adequate electrical earthing or bonding
- 2) Use anti-static work clothes, hoses, tarpaulins, etc. Ensure that anti-static hoses are clearly labelled as such along the entire length of the hose
- 3) Use brass or copper caps and tools (also prevents sparks)
- 4) Use cans/containers made of anti-static materials when emptying/filling with flammable fluids
- 5) Be aware of possible static electricity when changing ventilation system filters

Flames and sparks

- 1) Ensure that exhaust outlets / vent lines have flame/spark arrestors
- 2) Remember that collisions, dropped objects and tools (e.g. hoses to pneumatic tools) may also cause sparks
- 3) Establish an overview of old tools and equipment that do not comply with the ATEX directive, and consider purchasing new tools and equipment that are ATEX compliant, such as:
 - Manual and air-operated lifting tackle
 - Rotating air-driven tools and cranking/torque tools

Exothermic reactions

- 1) Dispose of all waste (particularly oily rags and the like) in appropriate waste containers
- 2) Be aware that heat-generating chemical reactions (thermite reactions) may occur in the event of contact between rusty steel and certain light metals (e.g. aluminium scaffolding)

Appendix 1 – Overview of non-electrical ignition sources

ISO 80079-36 and SINTEF's report² provide a good overview of the most common non-electrical ignition sources. A brief overview is provided below.

Hot surfaces

A flammable medium that comes into contact with a hot surface may be heated to a temperature above the auto-ignition point, and thereby become an ignition source without the presence of any open flame. Hot surfaces may be more or less permanent (e.g. exhaust manifolds), may arise due to faults (e.g. in the event of equipment overheating), or may be a result of work (pre-heating/welding, drilling of holes, etc.).

Flames and sparks

Mechanically generated sparks may arise from the use of various tools such as impact tools (e.g. sledgehammers), rotating equipment, dropped objects, tackle, etc. These ignition sources may occur in addition to flames.

Be aware that incidents that cause gas emissions may also cause sparks that can result in immediate ignition. Examples include vessel collisions with risers, and equipment falling onto the process plant.

Unpredictable power sources and cathodic corrosion

An unpredictable power source is inadvertent current (e.g. short circuit or lightning strike) which may arise in equipment and conductive materials. Backfeeding during power distribution may also be a source of unpredicted power.

Static electricity

Static electricity may arise unexpectedly, and several types of materials may become electrically charged through normal use. This can result in discharging and sparks that may potentially ignite flammable media in the area.

In order for static electricity to be felt, it must have an energy of at least 1 mJ. For comparison, just 0.2 mJ is required to ignite a flammable gas mixture³.

Exothermic reactions

Many chemical reactions produce heat (exothermic reactions) – some to such an extent that the surroundings or the substances themselves may ignite. One example of this is cotton rags and oil. Accumulations of dust may also auto-ignite under certain conditions.

Microbiological processes in organic material (hay, paper, bark, etc.) may also result in auto-ignition.

Aluminium, titanium, magnesium and other light metals may cause powerful exothermic reactions (thermite reactions) in the event of friction contact with metal oxides, such as rusty iron.³

Other possible non-electrical ignition sources

ISO 80079-36 also mentions some other possible ignition sources without going into these in depth. Electromagnetic radiation over a broad frequency range; both radio communication, ranging from $1 \cdot 10^4$ to $3 \cdot 10^{12}$ Hz, and electromagnetic radiation (light) ranging from $3 \cdot 10^{11}$ to $3 \cdot 10^{15}$ Hz, are discussed as a potential ignition source, as is ionising radiation in general. Ultrasonic noise is also mentioned.

Appendix 2: Area classification and regulations

Classification of areas that may contain explosive atmospheres:

Zone 0: Areas in which explosive atmospheres are always present, or present for long periods.

Zone 1: Areas in which explosive atmospheres are expected to be present on occasion during normal operating conditions.

Zone 2: Areas in which explosive atmospheres arise only rarely and for short periods.

Unclassified areas: Areas in which hydrocarbons are not usually present.

Relevant regulations:

For petroleum activities at sea, the regulations relating to the design and outfitting of facilities, etc. in the petroleum activities (the facilities regulations) apply. The regulations require that areas that may contain explosive atmospheres shall be classified (section 5 concerning the design of facilities). See also section 10a concerning ignition source control. The technical and operational regulations contain corresponding requirements for onshore petroleum facilities. See section 6 concerning the design of onshore facilities, and section 10a concerning ignition source control.

For mobile facilities with production installations, the regulations relating to mobile offshore facilities with production plants and equipment (section 14 concerning area classification) apply.

The regulations regarding the construction and operation of gas-driven passenger ships also contain area classification requirements (section 10 concerning area classification).

Upon the application of maritime regulations, the regulations regarding maritime electrical installations apply, cf. section 3 of the framework regulations concerning the application of maritime regulations in the offshore petroleum activities. During planning, which areas may be categorised as containing explosive atmospheres shall be surveyed (see section 20 concerning protection against ignition in areas containing explosive atmospheres).

The regulations regarding the handling of explosive substances require that the organisation shall survey hazards and problems that may arise during the handling of explosive substances and assess the risk on this basis (section 2-2 concerning the organisation's requirements).