

NUMBER 1: SACK RIP AND TIP STATIONS

Note: This guidance note is produced in good faith and may not cover all risks and eventualities with all equipment of this type. If in doubt, our process safety specialist team will be delighted to help you navigate risk assessment, basis of safety definition and testing requirements.

POTENTIAL FIRE AND EXPLOSION CONSEQUENCES

- Ignition of a dust cloud external to the Rip and Tip station resulting in a flash fire which could envelop the operator causing potentially serious burns.
- Dust cloud deflagration within the adjoining vessel/equipment resulting in blast effects including, flame ejection, pressure effects and/or projectiles with possible explosion propagation into upstream interconnected equipment.

OVERVIEW

Manual charging of flammable powders is often undertaken using proprietary sack rip and tip stations. There are many variants available and used in industry. Some stations are provided with forced ventilation to aid in the removal of fugitive, airborne dust roused as a result of the tipping operation. Mechanical ventilation serves to limit the risk of exposure to the operator and equally reduce the longevity of a flammable dust concentration persisting within the station. This assumes the level of ventilation is sufficiently high.



Photograph 1: Sack rip and tip station (with mechanical ventilation and shelf)



Photograph 2: Sack rip and tip station (no ventilation or shelf)

SUMMARY OF DUST EXPLOSION RISKS

Most likely intrinsic ignition sources	Most common basis of safety	Test required to support Basis of safety
<ul style="list-style-type: none"> • Unsuitable or malfunctioning electrical apparatus • Mechanical friction and hot surfaces • Mechanically generated sparks • Static electricity 	Avoidance of ignition sources	<ul style="list-style-type: none"> • Ignition temperature of cloud and layer (MIT and LIT) • Minimum ignition energy (inductive spark) • Minimum ignition energy (capacitive spark)

Peripheral / associated risks to consider:

- Flammable atmosphere inside dust extraction system – may require suitable ATEX electrical equipment (e.g. fan).
- Dust filter system at end of extraction should be subject to separate ATEX / DSEAR assessment.

RISKS

Risk of rousing the dust to form a flammable dust concentration in air - especially for fine, free flowing powders. Where effective extraction is provided, the extent and duration of any dust cloud should be limited. However, problems arise when forced extraction is not installed or not effective and the dust cloud extends out of the station encompassing the operator.

- Owing to the close proximity during powder discharging operations, there is the potential of spark discharge to occur from operators who are isolated from ground. If the powder has a high sensitivity to ignition from spark discharges, this could result in ignition of the dust cloud.
- Spillages are always a possibility and a well-designed station should include a suitably robust shelf to allow the operator to rest the sack whilst it is opened and to provide stability whilst discharging. All too many discharge stations have no shelf which increases the potential of the sack toppling and raising a flammable dust cloud external to the station where there could be non ATEX compliant equipment present which would pose a potential ignition risk.

- Retractable knives are often used to open the sacks. The knives are typically of metal construction which, if accidentally dropped whilst discharging the powder, would result in the introduction of foreign metal debris to the process. If rotating equipment is present this would pose a mechanical friction or mechanical spark risk in connected equipment where other flammable atmospheres may be present.

POTENTIAL SOURCES OF IGNITION

From the 13 identified sources of ignition taken from EN 1127-1, those which are considered most likely to occur with sack rip and tip stations are:

1. Flames and hot gases (including hot particles)
2. Unsuitable or malfunctioning electrical apparatus
3. Mechanical friction and hot surfaces
4. Mechanically generated sparks
5. Static electricity

TESTING REQUIRED TO MITIGATE THE POTENTIAL SOURCES OF IGNITION

- Minimum Ignition Energy (Capacitive assessment) – to assess the potential of incendive spark discharges from isolated conductors and personnel;
- Minimum Ignition Energy (Mechanical spark assessment) – to assess the potential of mechanical sparks;
- Minimum Ignition Temperature (dust cloud) – for correct specification of Temperature Class rating of ATEX equipment and used in conjunction with MIE (mechanical) to assess the potential of mechanical sparks;
- Layer Ignition Temperature (5mm layer) – used with MIT (dust cloud) for the correct specification of Temperature Class rating of ATEX equipment.

Typical Basis of Safety

A proposed Basis of Safety for the Sack Rip and tip Stations would be the Avoidance of a Flammable atmosphere by way of suitable mechanical extraction in normal operation.

In abnormal operation the Basis of Safety should be the Avoidance of Ignition Sources by suitable mitigation of spark discharges and correct ATEX equipment specification (where equipment encroaches a Hazardous Zone).

Other Considerations

Where mechanical ventilation is provided to the station, the concentration of the dust entrained within the extraction ducts could be high enough to justify a Hazardous Zone designation. Therefore, the extraction fan may need to be ATEX compliant. Fans which pre-date the DSEAR 2003 deadline can be retrospectively assessed for suitability (NEEIRA, Non-Electrical Equipment Ignition Risk Assessment).

Where a proprietary dust filter is used this will require a separate DSEAR risk assessment including Hazardous Area Classification and ignition source review to allow for a robust Basis of Safety to be determined.

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Process Safety Information/Data (Laboratory Testing)

- Flammability/combustibility properties of dusts, gases, vapours, mists, and hybrid atmospheres
- Chemical reaction hazards and chemical process optimisation (reaction and adiabatic calorimetry RC1, ARC, VSP, Dewar)
- Thermal instability (DSC, DTA, and powder specific tests).
- Energetic materials, explosives, propellants, pyrotechnics to DOT, UN, etc. protocols.
- Regulatory testing: REACH, UN, CLP, ADR, OSHA, DOT
- Electrostatic testing for powders, liquids, process equipment, liners, shoes, FIBCs

Process Safety Management (PSM) Programmes

- Design and creation of relevant PSM Programmes.
- Support the implementation, monitoring, and sustainability of PSM Programmes.
- Audit existing PSM Programmes, comparing with best practices around the world.
- Correct and improve deficient programmes.

Specialist Consulting (Technical/Engineering)

- Dust, gas, and vapour flash fire and explosion hazards
- Electrostatic hazards, problems, and applications
- Reactive chemical, self-heating, and thermal instability hazards
- Hazardous area classification
- Mechanical equipment ignition risk assessment
- Transport & classification of dangerous goods

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

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