EPSC
THE PROCESS SAFETY NETWORK

PROCESS SAFETY FUNDAMENTALS

PHARMACEUTICAL AND FOOD INDUSTRY

INTRODUCTION

Annual studies conducted within the EPSC membership demonstrate a consistent trend indicating around half of all significant process safety incidents (recorded under ICCA/CEFIC or API-754 criteria) arise primarily due to issues in how processes and equipment are operated, rather than latent design issues, or asset integrity failures.

In 2021 EPSC published a set of "Process Safety Fundamentals" (PSF) which describe a set of basic principles intended to support front line workers, supervisors and managers in the Process Industries. These describe common situations which could result in a loss of containment of hazardous materials, and good practices which help ensure these risks are well managed operationally.

This booklet is a development of the original Process Safety Fundamentals specifically targeted at hazards within the pharmaceuticals and food industries, recognising that pharma/food plant and equipment and operations often differ significantly from oil and gas and bulk chemical industries.

PHARMA / FOOD	CHEMICAL / O&G
Batch manufacturing	Continuous manufacturing
Low volume, multi-product with high frequency of turnarounds	Dedicated plant, high volume, infrequent turnarounds
Manufacturing inside highly manned buildings with people typically close to the hazard. Hazards rarely extend offsite.	Manufacturing typically outside/ non enclosed with lower manning levels. Hazards typically extend to offsite communities.

Three new fundamentals have been included in this guide, specifically for food/pharma; These relate to critical ventilation systems in buildings, combustible dust management and controlling ignition risks associated with static electricity.

EPSC Pharma group have also developed a guidance document on Process Safety Hazards in Pharmaceutical Operations which can be downloaded from the EPSC website.

The Fundamentals on the following pages are a set of operating principles which are key to ensure the strength of our barriers preventing, or protecting against, Process Safety Incidents.

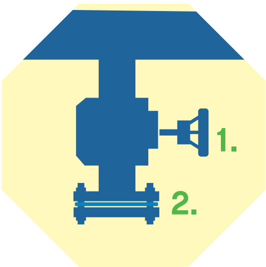
The fifteen fundamentals cover a range of aspects such as plant integrity, operating within the plant design envelope, management of safety critical equipment, reporting culture. The core concept is to promote awareness and understanding of these safe operating principles, identify situations which may arise where hazards may be increased and to provide examples of good practices which minimise risk.

- These are not new requirements. They are good operational principles.
- They enhance awareness and behaviours. They support operational excellence in Process Safety execution.
- Emphasis is placed on critical tasks being fully understood and supported by operational leaders.
- The fundamentals take into account the dilemmas that front line staff may face when attempting to comply with the safe operating principles.
- They can be used as a tool to make Process Safety an everyday frontline conversation.
- They help avoid risk normalisation and the decay of barriers over time.
- Whereas Life Saving Rules typically define a set of non-negotiable requirements, Process Safety Fundamentals are focused specifically to help teams working in high hazard environments navigate complex and dynamic situations by following safe practices and escalating where conflicts arise.

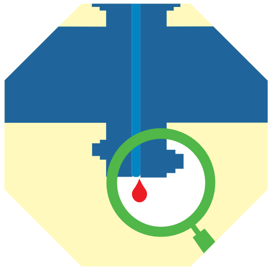
HOW TO APPLY

1. To start, select a limited number of Process Safety Fundamentals relevant for your operation and focus on embedding these.
2. Use the PSF slides to start the discussion. It is the discussion that provides the understanding of where you really are and what can be improved!
3. Establish clear agreement on execution & improvement steps to take around the PSF before moving on. Over time, more PSF can be tackled.

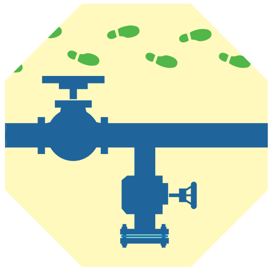
PS FUNDAMENTALS FOR PHARMA AND FOOD



Safe Isolation and Draining Practices

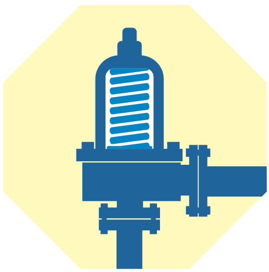


Verify Leak Tightness after Interventions.

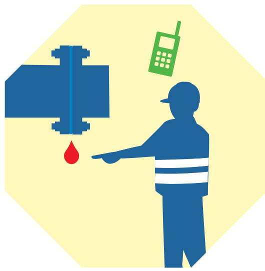


Verify before transfers "Walk the Line"

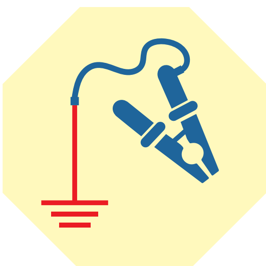
Manage Overrides of Safety Critical Systems



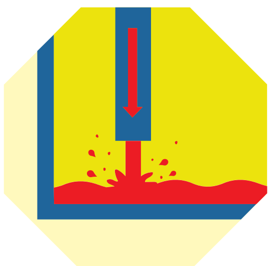
Report deficiencies on Safety Critical Equipment



Report Process Safety Incidents



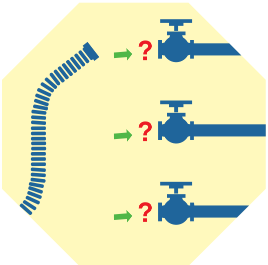
Electrostatics



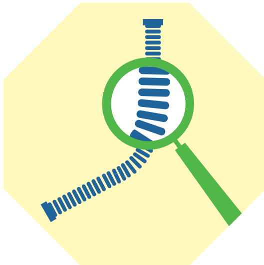
Avoid Splash Filling

Stay out of the Line of Fire

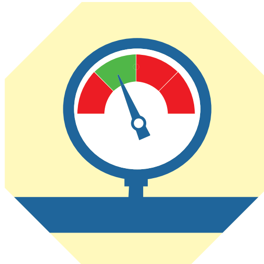
PICTOGRAMS



Connection and Unloading

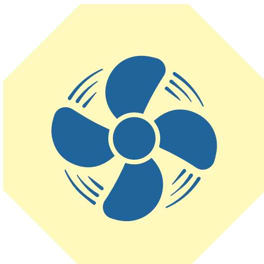


Flexible Hose Management



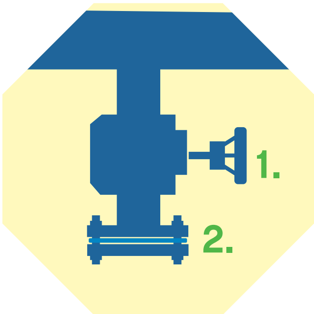
Operate within safe limits

Prevent run-away reaction



Ventilation in Hazardous Areas

Combustible Dust Housekeeping



1. SAFE ISOLATION AND DRAINING PRACTICES

HAZARDS

Hazardous materials such as steam and pressurized solvents and gases can leak through a valve.

WHEN IMPORTANT

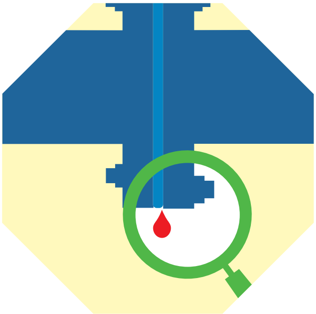
After draining, sampling and non-routine activities such as line-breaks and maintenance.

CHALLENGES IN THE FIELD

- Blind flanges or end caps may be missing or not replaced after draining or maintenance work leaving open ends.
- Drain valves not fully closed e.g. due to fouling.
- Valve handles that can be opened accidentally.

RECOMMENDED PRACTICES

- Label pipelines containing hazardous fluids like steam / solvents.
- Drain and flush drain hazardous fluids from plant before working on it.
- Apply two points of isolation for hazardous or pressurised services.
- "Prove" the isolation, by checking valves hold through a drain point before disconnecting pipework.
- Ensure all points of isolation are locked-out & tagged.
- Fit routine points of isolation with spectacle blinds, valve locking kits etc.
- Point of isolation should be as close as possible to where you are working.
- Do not accept missing blind flanges or missing bolts on blind flanges.
- Ensure there is an emergency plan if an isolation leaks.



2. VERIFY LEAK TIGHTNESS AFTER INTERVENTIONS

HAZARDS

When a flange or other equipment is closed, it can still leak, when hazardous chemicals are introduced later.

WHEN IMPORTANT

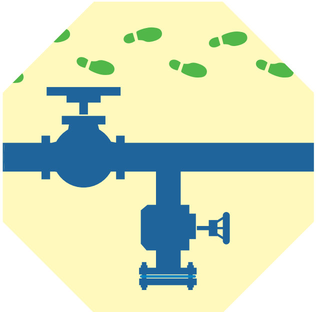
After work where equipment and flanges have been opened. Temperature change can influence bolt tension and create leakages.

CHALLENGES IN THE FIELD

- Insufficient bolting / flange packing.
- Delays before introducing hazardous fluids.
- Inert fluids for leak testing not available.
- Leak verification competency or procedures are missing.

RECOMMENDED PRACTICES

- Minimise flanges / connections for hazardous fluid duties.
- Perform a leak test before introducing hazardous chemicals
- Leak testing options:
  - Introducing a less hazardous fluid and perform a pressure hold test, with clear criteria on time and allowed pressure drop.
  - 'Soap testing' on flanges that have been opened.
  - Ultrasound measurements or gas detectors can be used to detect leaks.
  - Use of gas detection to detect presence of tracer gases like Helium.
- Use a flange register to record the status of flanges. Flange tag provide visual indication of status from opened to validated closed.
- Monitor connections for leaks during first time introduction of hazardous chemicals.
- Use torque wrenches to ensure correct torque applied.
- Validate and adjust bolt tension after heating-up equipment.
- If using tri-clamps (sanitary), use heavy duty clamps or safety clamps for frequently opened connections.
- Use of spray caps/flange guards around fittings/connections to limit the spray of aggressive chemicals in the event of gasket failure and inspect frequently under the guard.



3. VERIFY BEFORE TRANSFERS "WALK THE LINE"

HAZARDS

Spillage from pipework which is not correctly configured. Misrouting and unintended mixing of chemicals if the correct route is not selected leading to reaction hazards.

WHEN IMPORTANT

Plant reconfiguration is frequent in the pharmaceutical and food industry especially for multi-purpose plants. Batch and campaign start-up and cleaning can be complex. Configuration checks and line walks are also important after any maintenance which breaks containment.

CHALLENGES IN THE FIELD

- Transfers occurring around shift change-over.
- Connections may be assembled but not spanner tight.
- Long transfer lines, not fully accessible or visible.
- Complex configuration routes.

RECOMMENDED PRACTICES

- Ensure the Permit-to-Work system clearly identifies where invasive work has taken place and there is a reassembly and re-testing process. [Fundamental 2]
- Label equipment in the field, like valves, pipelines and pumps to help with the field check.
- Use P&IDs or isometric drawings to trace pipework during line check.
- Conduct a physical line-walk to validate correct configuration (valves, tanks, pumps), before starting the pump / transfer operation.
- Perform a check after a transfer starts, to detect leaking drains, hoses, flanges or pump seals.
- Tag all the bleeds and drains.
- Validate the transfer regularly by checking the levels of the vessels/tanks.
- Gas detection systems can be used to detect losses of hazardous materials and activation of the detectors interlocked to stop transfers.

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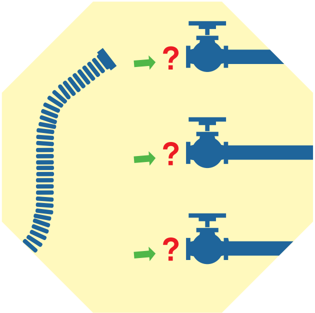


4. CONNECTION AND UNLOADING

HAZARDS

Unexpected chemical reaction hazards in waste tanks, or when unloading chemicals can result in exothermic (hot) reactions or gases. Overfilling.

WHEN IMPORTANT

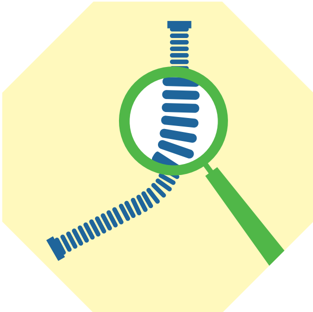
Receiving of chemicals at your site.
Transferring chemicals to a tank/reactor.

CHALLENGES IN THE FIELD

- Knowledge of the chemical interactions and hazards.
- Lack of guidance of the contractor involved.
- Complex piping configuration with multiple routes and valves.
- Chemical identification unclear.

RECOMMENDED PRACTICES

- Validate that the right chemical is loaded by a positive identification: analysis of a sample, inline analysis (density), certificate of analysis, barcode, labelling.
- Ensure there are clear and robust procedures for connection and loading operations with second person checks for critical operations where a mix-up could lead to a serious incident.
- Provide a unique coupling for very hazardous chemicals (e.g. chlorine, ammonium hydroxide, ethylene oxide) to avoid a wrong line-up.
- Use colour codes (or bar codes that can be scanned) on pipelines, tubing and connection point. Ensure pipework is labelled with contents and flow direction.
- Use professional firms for transporting the chemicals.
- Supervise contractors that are involved in (un)loading operations, at location.
- Assure that the receiving equipment has sufficient volume available.
- Have a compatibility matrix available to understand the hazards and Emergency Response arrangement.



5. FLEXIBLE HOSE MANAGEMENT

HAZARDS

Hazardous fluid release due to hoses failures. Loose hoses can move wildly if they are released under pressure release.

WHEN IMPORTANT

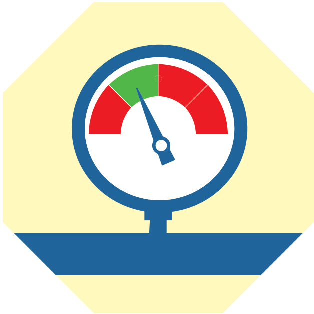
When using flexible hoses. When disconnecting hoses that still contain pressure or flammable or toxic material.

CHALLENGES IN THE FIELD

- Poorly specified hoses – too long/short resulting in hoses becoming damaged.
- Lack of good storage resulting in damage.
- No hose inspection / management program.
- Use of non static dissipative hoses that generate electrically charged liquids.

RECOMMENDED PRACTICES

- Use piping (do not use hoses) for very toxic chemicals (like phosgene).
- Robust controls over the selection of hoses including material of construction, temperature & pressure rating and static dissipative construction.
- Visually inspect hoses before using them and check for defects like corrosion, wear or mechanical damage.
- Hoses (including the connections) with hazardous fluids should be tagged and inspected periodically by a competent person or approved body.
- Replace hoses preventively and remove rejected hoses from the site.
- When not in use, hoses must be properly stored, with the appropriate bend radius, hanging straight down, or laying straight.
- Hoses must not be twisted or forced when connected.
- Assure good reliable fittings that can be easily operated.
- Road tanker hoses should have self-sealing disconnect fittings in the event of drive-away incidents.
- Ensure hoses are depressurized and drained before disconnecting.



6. OPERATE WITHIN SAFE LIMITS

HAZARDS

Hazardous reactions or equipment damage can be caused when safe operating limits are exceeded.

WHEN IMPORTANT

Deviations from normal operation.
Transient operations, batch processing, start-up shut-down and cleaning process.
New processes and equipment modification.
Multipurpose plant.

CHALLENGES IN THE FIELD

- Safe process limits (pressure, temperature etc) not well known or identified.
- Management of Change (MoC) process not effective.
- Pressure on staff to maintain production.

RECOMMENDED PRACTICES

- Establish safe operating limits for key process variables and for all operating phases. Make these parameter settings easily visible to operators.
- Understand where a loss of control of critical process parameters (e.g. due to loss of cooling or agitation) could lead to pressurization events or overtemperature causing damage to the integrity of equipment.
- Understand chemical/thermal reaction hazards, exotherms, gas evolution etc.
- Ensure appropriate instrumentation is in place to monitor critical parameters and ensure instruments are working.
- Define actions to bring the process variable back within the operation limit.
- Define clear responses to process alarms.
- Critical alarms must be distinct with clear annunciation.
- For high severity scenarios, provide process interlocks to take action to return the process to a safe condition automatically.
- Ensure functional testing of safety critical interlocks.
- Investigate the causes when operating limits are exceeded.

7. MANAGE OVERRIDES OF SAFETY CRITICAL SYSTEMS

HAZARDS

When a safety critical system is not working properly or is bypassed the level of risk of an incident is increased.

WHEN IMPORTANT

When a safety system fails or is unreliable.

During the testing of a safety system.

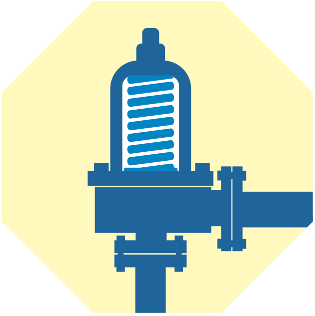
At start-up.

CHALLENGES IN THE FIELD

- Override hazard is unknown
  Safety systems that prevent start up
- Lack of knowledge of override procedure

RECOMMENDED PRACTICES

- Review active overrides daily. Reassess risks during every shift handover.
- Every bypass or override requires a formal authorization documented in a bypass procedure. The level of authority depends on the function criticality.
- Define substitute protection measures during the override period.
- The bypasses must be registered in an override log accessible in the control room.
- Limit the maximum period for override to be active or initiate a formal MoC for longer terms.
- Label equipment in the field which is associated with the override.
- Ensure safety interlocks are protected against easy bypass in the field (including consideration of cybersecurity)
- Review statistics on bypassed equipment – look for adverse trends.
- Test safety functions after they have been returned to their original situation.
- Ensure "end-to-end" testing (e.g. sensor to final element) when re-instating safety critical systems.



8. REPORT DEFICIENCIES ON SAFETY CRITICAL EQUIPMENT

HAZARDS

Safety Critical Equipment provides a barrier to prevent or limit the effect of a major incident. Failed equipment won't protect in a real safety event.

WHEN IMPORTANT

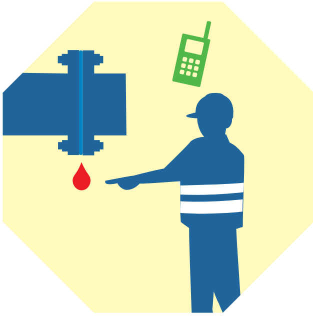
When Safety Critical Equipment is not working as designed.

CHALLENGES IN THE FIELD

- Failures of Safety Critical Equipment (instruments, safety valves) are not always immediately obvious.
- Testing of safety devices often requires the plant/equipment to be taken offline resulting in downtime.
- After testing or calibration equipment may not be correctly returned to service.

RECOMMENDED PRACTICES

- Determine which equipment is safety critical and make this clear.
- Ensure teams understand which equipment is safety critical, why it is safety critical and the potential hazards if the equipment fails.
- Safety Critical Equipment must have a testing protocol and test frequency (e.g. PSV testing, SIL loop testing).
- Report failures or deviations observed on safety critical systems during plant operation and during calibration or testing.
- If safety critical equipment is not fully functional, the "override/ bypass process" (see Fundamental 7) is required to continue production.
- Repair or replace safety critical equipment with priority.
- Analyse why equipment failed to prevent recurrence.
- Keeping a log on safety critical equipment out of service.



9. REPORT PROCESS SAFETY INCIDENTS

HAZARDS

Normalisation of small leakages, near misses or substandard practices.

WHEN IMPORTANT

When observing leaks or equipment failure.

CHALLENGES IN THE FIELD

- Reporting may be assumed to be "someone else's responsibility". It is everyone's responsibility.
- Investigating near misses and failure takes time.
- Production pressure puts challenge on staff to continue operating.
- Perception of negative feedback.
- Promoting an open learning culture that stimulates intervention by all on safety.
- Difficult reporting tools.

RECOMMENDED PRACTICES

- Create a culture where reporting "bad news" items is considered valuable feedback and an opportunity to learn and improve.
- Recognise that safety is linked to reliability and therefore supports productivity.
- Follow-up on reported issues and provide feed-back to the initiator.
- Report all spills: create an easy reporting tool and database.
- Classify releases and spillages according to a standard and set improvement targets.
- Ensure teams recognise and report lower tier incidents; weak signals or leading indicators including:
  - Small leaks.
  - Failures of safety critical systems.
  - Activation of a last line of defence like a safety interlock.
  - Fire; Smouldering; liquid hammering; vibrations; corrosion.
  - Pressure or temperature outside design.
  - Long standing or nuisance alarms.
  - Ignition sources in zoned area's & deficiencies of explosion safe equipment.
  - Deviation from critical procedures.

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10. PREVENT RUN-AWAY REACTION

HAZARDS

Runaway reactions can have devastating consequences. Bhopal & Seveso incidents occurred after an exothermic exponential runaway reaction started.

WHEN IMPORTANT

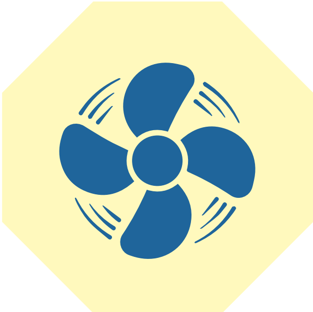
Exothermic batch reactions, thermally unstable chemicals, reactive chemicals, managing critical utilities

CHALLENGES IN THE FIELD

- Chemistry at increased temperature can be different or to operators.
- Reduced reaction rate (low temp, no stirring) can cause accumulation and later a run-away reaction.
- Cooling can malfunction or have insufficient capacity to remove the heat of increased reaction rates.

RECOMMENDED PRACTICES

- Where possible, operate strongly exothermic reactions in continuous to prevent accumulation of unreacted which could lead to runaway reactions.
- Conduct calorimetry studies to measure the exotherms/gas evolution from the process chemistry in normal and abnormal conditions (like wrong addition rate or processing temperature)
- Scale up the calorimetry data to assess the hazards at industrial reactor scale and identify critical requirements e.g. pressure relief vent sizing, jacket or coil cooling capacity, utility sizing, quench tank sizing.
- Conduct stability studies (ARC/DSC) on isolated materials for thermal stability.
- Ensure the process has appropriate instrumentation. Use redundant and diverse measurement technologies where necessary.
- Define a reactivity matrix & procedures to avoid critical combinations
- Identify and prevent critical errors such as charging the wrong material, or to the wrong location, too much, too little, no charge, wrong order.
- Assess the reliability of the cooling / quench utilities. Consider need for backups.
- Ensure there are site emergency procedures in place for specific runaway reactions that can cause major emergencies



11. VENTILATION IN HAZARDOUS AREAS

HAZARDS

Accumulation of flammable concentrations of vapours leading to an explosion.
Toxic gases and vapours and asphyxiants such as nitrogen or carbon dioxide.

WHEN IMPORTANT

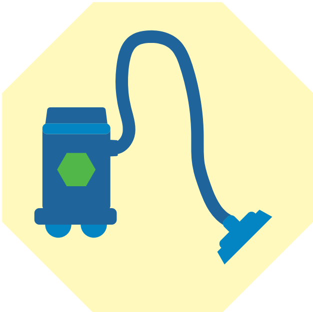
Plant areas where flammable, toxic or asphyxiant gases can be present.

CHALLENGES IN THE FIELD

- Ventilation requirement unknown (air change rate).
- Ventilation systems may not have monitoring instrumentation to validate it works (like flow, motor rpm, oxygen).
- Systems with recirculating air can accumulate gasses.
- Powders can be difficult to remove/ collect through ventilation.
- Changes to HVAC settings can compromise the safety function if the MoC process is not robust.

RECOMMENDED PRACTICES

- Minimise sources of release (welded pipe is better than flanged).
- Provide good local ventilation near release points (sample points, charge ports, manholes etc.).
- Conduct Hazardous Area Assessments and specify suitable equipment in these zones.
- Install low flow alarms/trips on critical ventilation systems.
- Use of gas detection systems to detect onset of unsafe conditions such as low oxygen concentration, presence of toxic gases (e.g. carbon dioxide) and raise alarms or activate safety interlocks.
- Where spills could occur, minimise the floor/spill area to reduce evaporation.
- Ventilation systems should be considered safety critical devices with planned preventative maintenance programmes.
- Document the ventilation requirements (flowrates, pressure cascades, critical alarms) and make them easily available.



12. COMBUSTIBLE DUST HOUSEKEEPING

HAZARDS

Flammable dusts can cause fires and explosions. Many API pharmaceutical dusts are highly toxic.

WHEN IMPORTANT

When handling e.g. transferring / charging / offloading combustible dusts which could become dispersed.

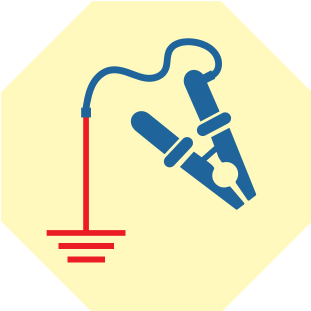
CHALLENGES IN THE FIELD

- Powder properties not well identified especially for new products.
- Electrostatic and mechanical ignition risks can be difficult to control.
- Leaks from equipment can give rise to external dust zones and dust layers.

RECOMMENDED PRACTICES

- Use "closed" containment systems and local ventilation to minimise dust escaping from equipment and forming combustible layers in the plant.
- Avoid horizontal surfaces where dust can collect on ledges.
- Ensure regular cleaning of facilities to prevent layers forming. Apply the same controls in utility areas (dust collectors etc) as in the manufacturing areas.
- Review SDS sheets or conduct tests to determine dust safety data (Minimum Ignition Energy MIE, KSt, Pmax etc).
- Conduct Hazardous Area assessments for all areas where flammable dust is handled; include equipment internals and externals.
- Ensure equipment handling combustible dusts is Hazardous Area Rated (ATEX) to control electrical, mechanical and electrostatic ignition hazards.
- Ensure operation is well below dust ignition temperatures.
- Identify all ignition sources such as electrostatics, hot surfaces, mechanical impacts or frictions.
- Ensure ATEX equipment is regularly inspected and maintained.
- Pay particular attention to locations where flammable gases may also be present creating "hybrid" mixtures which are more sensitive to ignition.
- Train staff on combustible dust hazard awareness.


Corroflon FP



13. ELECTROSTATICS (GROUNDING AND BONDING)

HAZARDS

Most materials in the pharmaceutical and food industry are flammable (including solvents, vapours and dusts).

WHEN IMPORTANT

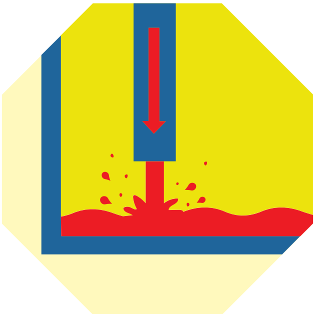
When transferring flammable gases, vapours and dusts. When performing manual handling such as loading powders When spraying flammable liquid.

CHALLENGES IN THE FIELD

- Maintaining continuity of earthing and bonding especially after maintenance/ modification.
- Earthing of mobile equipment including tanks, scoops, vessels.
- Earthing of process operators during open handling of materials.

RECOMMENDED PRACTICES

- Verify continuity of grounding and bonding on a regular basis by both physical inspection and use of a resistance meter.
- Ensure operators and maintenance staff are trained to check continuity after performing interventions.
- Use appropriate (e.g. ATEX rated) equipment in zoned area's.
- Hazardous area equipment for handling flammable materials and follow the correct maintenance and inspection regime.
- People can accumulate static electricity - use static dissipative footwear and flooring where handling operations take place.
- Limit the transfer velocities for flammable liquids in pipelines and give particular attention to non conductive liquids (<1m/s).
- Use an inert gas to remove oxygen from equipment where possible.
- Use dense phase powder transport in preference to manual loading.
- Ensure earthing straps are applied before filling or emptying mobile containers such as tankers, drums, IBC and FIBCs.
- Provide specific process safety training in electrostatics to process Operators and Maintenance teams.



14. AVOID SPLASH FILLING

HAZARDS

When loading non conductive flammable liquids, an explosive atmosphere will be created in the tank, that can ignite when electrically charged droplets generate a spark.

WHEN IMPORTANT

When transferring flammable liquids especially non conductive liquids.
When liquids fall down and form droplets.

CHALLENGES IN THE FIELD

- Design of tanks and reactor systems.
- Failure to restrict transfer rates.
- Cleaning in Place systems typically use spray balls or spray nozzles which create mists and aerosols.

RECOMMENDED PRACTICES

- Avoid charging/dropping liquids into an empty tank/vessel. Consider alternative techniques such as bottom filling.
- When top filling, minimise the fall height by using a dip pipe.
- Reduce the transfer velocity to minimise splashing. For low conductivity liquids maintain this velocity <1m/s.
- Understand which chemicals are flammable liquids with very low conductivity (e.g. benzene, kerosene, butane, toluene and heptane). These are highly hazardous as they form an explosive mixture with air and dissipate static electricity very slowly.
- Inerting (removing oxygen) can help to avoid explosive atmospheres.
- Pay particular attention to Clean In Place systems which can create fine mists / droplets which become highly charged.

15. STAY OUT OF THE LINE OF FIRE

HAZARDS

Sudden and violent release of pressure when equipment is opened or during clearance of blockages. This presents risk of projectiles and release hazardous materials.

WHEN IMPORTANT

When working on pressurised systems or systems prone to blockage.

CHALLENGES IN THE FIELD

- Manholes (or manway) that are stuck.
- Relief system activations (explosion vents/relief panels/steam relief).
- Working on incorrect equipment in error.

RECOMMENDED PRACTICES

- Release points from process vents, relief system vents and explosion vents should be routed to safe locations and clearly identified in the field.
- Limit access to these areas e.g. by barriers, locked doors etc.
- Protect yourself (location of your body) when opening equipment especially systems where residual pressure may be present.
- Ensure all pressure equipment is fitted with local gauges.
- Add physical barriers to prevent people from accidentally entering the danger zones, e.g. during pressure testing of pipework.
- Check and verify you are opening the correct equipment before any intrusive work.
- When opening flanges or connections, first loosen the bolts that are far away from you to direct any material away.
- Beware of blockages and plugging.
- Wear protective PPE for potential residual chemicals.

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DIFFERENCES BETWEEN PROCESS SAFETY FUNDAMENTALS AND LIFE SAVING RULES

	LIFE SAVING RULES: OCCUPATIONAL SAFETY	FUNDAMENTALS: PROCESS SAFETY
Objective	Reduce number of injuries/ fatalities.	Avoid loss of chemicals with potentially serious consequences for people, environment and Business.
HSE Domain	Behaviors in occupational safety.	Behaviors on operations involving hazardous chemicals.
Target	All.	Operation teams on hazardous sites (process operators, process engineers, maintenance technicians, operational management).
Nature and applicability	In principle simple rules that are easy to understand and apply in all circumstances.	More complex principles that cannot always be fully applied (e.g. in case of design issues).
Implementation method applicability	Non negotiable set of requirements "Life saving Rules" or "Golden rules".	Identify situations that are not in line with the Process Safety Fundamentals and start a discussion on how to proceed, avoiding uncontrolled initiatives "to get the job done".

GLOSSARY OF TERMS

P&ID	This refers to Piping and Instrumentation Diagrams or plant schematic drawings.
PSF	Process Safety Fundamentals – the focus of this guide!
MoC	Management of Change, or Change Control process, the management system by which modifications to plant and associated processing or safety parameters are controlled.
PSV	Pressure Safety Valve. A mechanical device for relieving pressure from a system to prevent rupture.
SIL	Safety Integrity Level. Applied to instrumented systems which have a safety critical role in the overall safety management system. The higher the SIL number assigned, the greater the criticality and the more robust the safety system must be.
ATEX	The set of European Regulations which govern the selection and use of equipment operating in hazardous areas (i.e. where flammable gases/vapours or dusts may be present. ATEX equipment is specially designed to reduce risk of ignition in such atmospheres.
ARC / DSC	Accelerated Rate Calorimetry and Differential Scanning Calorimetry are techniques to assess the sensitivity of materials to decomposition by heating. Other calorimetry techniques are also used e.g. in chemical reactions.
MIE, KSt, Pmax	These terms are related to properties of combustible dusts; MIE or Minimum Ignition Energy is a measure of sensitivity to ignition sources. Low MIE indicates easy to ignite e.g. by electrostatic discharges. KSt is the rate of pressure rise in the event of ignition - the higher the KSt value, the more violent and rapid the combustion and explosion and more damage caused. Pmax is the maximum pressure which can be attained in an explosion and helps determine whether the plant is mechanically strong enough to withstand the effects.

ACKNOWLEDGEMENTS
EPSC PHARMA AND FOOD MEMBERS

Dan Benton
Tijs Koerts
Eline Beulens
Jonathan Thompson
David Montgomery
Rainer Hoss
Mario Versteels
Michael Schoen
Franjo Jovic
Nico Scheffers
Andreas Ludwig
Chris Newlands
Lutz Heuer
Luke Matchett
Carlos Alvarez
Rita O'Sullivan
Fiona Burke

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THE PROCESS SAFETY NETWORK