

Safe Operating Procedure – On safety aspects of high-pressure cleaning* (HPC) activities

Topic: **How to use safely the high-pressure cleaning equipment**

Release date: 10. February 2022

*As per HSE MS App 2 the HPC/ washing/ flushing are high pressure water (above 100 bars) industrial cleaning, and all blast cleaning (including the dry-ice blasting as well) activities.

Version: 2

Background

- In March 2021 a HiPo LTI (P4 potential, P2 actual) happened during HPC – see Att.1, HSE Newsflash. Since this was not the only case in the Group in last 5+ years, the lessons learned of similar cases were collected from SN (1 case) and MOL (4 cases). INA didn't experience any related events.
- In August 2021 a HiPo FAC (P4 potential, P1 actual) happened during HPC – see Att.2, HSE Newsflash.

Main reason of implementation of SOP:

Avoid potential unwanted HSE events, accidents, injuries, or any damages while using HPC equipment/ executing HPC activities.

It is important:

At any HPC activities/ use of HPC equipment.

Warning!

Since the **HPC is considered Safety-critical** (HSE MS, app 2.), when it becomes a part of complex high-risk work, an HSE Plan is mandatory to be prepared. In these cases, this SOP doesn't replace the HSE Plan, it only supports considering some main aspects for the safety of work. Besides these aspects all further elements of the HSE Plan are still mandatory! If no HSE Plan is required, at least a JSA shall be prepared. Occupational safety guidelines for risk control hierarchy (elimination, substitution, isolation, engineering controls, administrative controls, PPE) shall be considered when preparing the HSE plan or the JSA.

Potential scenarios and consequences:

Severe (even fatal) personal injury due to


- **Wildly moving hoses at pressure release**
 - Improper coupling gets loose
 - Use of inappropriate / damaged device
 - Inappropriate handling
 - The HP hose loses its tightness / punctures
 - Use of inappropriate / damaged devices, hoses
 - Lack of regular inspection (visual/ pressure-test)
 - Inappropriate mechanical protection of hose during activity (breaking, cutting, vehicles)
- **Incorrect, dangerous high-pressure jet direction**
 - Bad/ unintentional manipulation
 - Lack of experience
 - Lack of enough space for the activity
 - Having unauthorized staff in the vicinity
 - Not using the right type and size of device for the purpose (surface cleaning, pipe/tube cleaning, tank cleaning, etc.)
- **Slip and trip hazard**
 - Slipping due to frozen water caused icy surfaces or due to spilled shot blasting material
 - Tripping due to hoses crossing traffic routes or detached pieces on the floor


Necessary Technical Conditions

What to do / Troubleshooting

All parts of HPC equipment – especially its hoses, cleaning gun/ head / nozzle (including the connections) must be inspected and periodically checked on a documented way by an authorized person/body

- Ensure that all relevant parts, the high-pressure cleaner, hoses, gun, and the connections are in a good technical condition.
- Hoses, hose lines and connections intended to be used with high-pressure cleaner machines **must meet European Standard for High-pressure water jet machines** – Safety requirements – Part 2: Hoses, hose lines and connectors (EN 1829-2:2008/AC:2011)
 - **Visual inspection** must be done **before every use** (daily).

	<ul style="list-style-type: none"> - The regularity of deeper inspection (e.g. pressure test) shall be over minimally required by law or manufacturer, adjusted to conditions of use: <ul style="list-style-type: none"> o in case of „migrating” HPC equipment before each campaign-like work (e.g. in case of TA works, before mobilization to the given place); o in case of „stationary” equipment at least in each 6 months. o pressure tests should be carried out with a safety factor of at least 1.5 times - Every four years, a pressure test must be carried out on site, in the assembled state, with all the serviceable parts of the equipment and a pressure test report must be drawn up and presented to the operators at the place of work.
<p>All high-pressure parts must be tagged and included in the maintenance schedule</p>	<p>Tagging of all necessary parts (minimally the high-pressure cleaner, hoses, and gun/ head (including their connections)) shall be maintained and regularly checked during site visits, the above-mentioned visual inspections and deeper inspections must be continuously recorded.</p>
<p>All high-pressure hose connections/ joints must be secured with safety clamps or with metal safety binders</p>	<p>Hoses must be connected by means of properly rated couplings, and in addition with safety clamps (whip check) or metal safety binders in place to prevent the ends of the hoses from whipping around if the coupling breaks.</p> 
<p>If required, mark, replace any inappropriate part of the equipment (e.g. based on a preventive maintenance schedule) and remove all inappropriate hoses, guns from the site to avoid their reuse.</p>	<p>Realizing hoses, cleaning guns, any further parts in wrong technical conditions, those must be immediately removed from the site by stopping the work to avoid any accident and their latter intentional or unintentional usage. Waiting till end of the work session or end of the day is not an option.</p>
<p>Always ensure the proper mechanical protection of high-pressure hoses, cleaning guns, their connections – in storage, during transportation and on worksites as well.</p>	<p>Select proper technical solution when storing, moving, using the equipment, to protect especially the high-pressure hoses from external mechanical effects, like its breaking, cutting, or damage caused by crossing vehicles. Avoid/ fence/ cover all dangerous</p>

	<p>edges, use hose-ducts and hose-bridges/ramps on roads. Note: using insufficient hose-duct or its improper use can cause itself the damage (by pinching) of the hose!</p>
<p>Always plan the activity and ensure enough free space for safe execution of the given activity.</p>	<p>Based on the physical parameters of the equipment and circumstances of the activity, the use of a HPC equipment/ executing the activity requires enough free space around the equipment to be cleaned. This equipment and work area must be easily and safely accessible. The area must be enclosed along the entire length of the hose to reduce the risk of failure (puncture). The hose must be securely anchored in the area behind the operator to avoid accidents. The section of pipe running alongside the operator must be protected. These always must be ensured for safe work execution.</p> <p><i>Note: if in exceptional cases these requirements objectively must be compromised, additional safety measures must be applied as per the HSE Plan (if required) or an additional written work instruction.</i></p> <p>Stop the work if not enough space for safe execution/ access and no additional safety measures are introduced defined in a written form (HSE Plan or work instruction).</p> <p>If necessary, place a suitably fixed protective barrier (e.g. Plexiglas of adequate strength) between the operator and the part to be cleaned.</p> <p>High pressure water jets must be prevented from backflowing or from reversing the cleaning nozzle by means of a cleaning nozzle of suitable design and/or size (a cleaning nozzle of a size that prevents the cleaning nozzle and hose from reversing for a given hose diameter) or by physical protection that prevents the water jet from causing injury or any damage (e.g. : when cleaning a pipeline, use of a pipe cleaning head of a size appropriate to the diameter of the pipe to prevent the hose from turning back; passing a high-pressure hose through a blind flange with a bore to protect the operator from the return flow of water).</p>  <p>- in cases where the above technical solution is not feasible, the cleaner must wear protective clothing with adequate protective capacity to withstand the pressure range used.</p>

	<p>In case of a risk of backflow of high-pressure water jets, the operator should be positioned and the work area should be designed in such a way that in case of backflow/turning the operator is not exposed to the water jet (e.g. in case of pipe cleaning, not facing the inlet opening but to the side of the imaginary extension of the pipe).</p>
<p>HPC activity can be executed only by trained and experienced personnel.</p>	<p>As a condition of using a HPC equipment, a written statement (Letter of Authority) is needed for the operator from his/ her employer, available on site.</p> <p><i>Note: the right training and experience of the operator is the employer's responsibility (training record, and/ or written exam as evidence is required, at least one-year experience is advised).</i></p> <p>Check the Letter of Authority on site, stop the work if not available/ not appropriate.</p> <p>Education and training of HPC operator should minimally contain:</p> <ol style="list-style-type: none"> 1. General safety rules and OHS Regulation. 2. Understanding basic waterjet hazards 3. Basic principles of HPC 4. High pressure washing principles (pressure and flow) 5. Equipment and nozzle selection principles 6. Main components of high-pressure pumps 7. Manufacturer's operating manual 8. Emergency shutdown procedures 9. Hazard identification and risk controls 10. Personal protective equipment 11. First aid and medical treatment for HPC activity 12. A card with the listed topics, the name of the operator, the MOL pass number and the date of the last training, valid for 1 year.
<p>Except the authorized staff no one can be in the hazardous vicinity of activity.</p>	<p>Fence the area, with a safe radius, restrict entrance, apply visible rules/ safety signs (e.g. „STOP! Do not enter!“).</p> <p>Stop any HPC activities if executed on unprotected/ unfenced areas, or unauthorized person(s) appear within the fence during ongoing cleaning.</p>
<p>Prevent the HPC equipment from unintentional/ unpermitted use.</p>	<ul style="list-style-type: none"> - Ensure the equipment is protected from unauthorized manipulations – fence the area, restrict entrance, apply visible rules/ safety signs (e.g. „Don ot touch!“). - Stop the activity immediately when unauthorized people appear within the fenced area; - Secure the equipment from unintentional operation (even by its operator) when not in use (e.g. switch off the power supply during its cleaning, any other manipulation); - Switch off the equipment when doing any manipulation on or moving it!
<p>The necessary special personal protective equipment must be determined, provided and used according to the working conditions.</p>	<p>In addition to the basic personal protective equipment generally required at the work site, the use of specific personal protective equipment certified for the pressure range of the high-pressure cleaning operation is required in all cases where technical measures or collective protective equipment cannot prevent injury to the worker in the event of a malfunction or inattention. Such personal protective equipment must provide adequate protection for the head, the whole upper body, the feet, arms and legs against the hazards of high-pressure activities. The personal protective equipment required must be certified by the manufacturer.</p> <p>Stop the work if not all defined PPEs are used during HPC.</p>

Recommended protective equipment to consider:

- Protective helmet with face shield (the mechanical resistance of the face shield must be at least grade "B" (120/sec))
- Cut-resistant suits to help protect workers from contact with HC
- Hand Protection (rubber gloves)
- Rubber boots with shin and metatarsal protection
- Hearing Protection
- Breathing apparatus (in case of risk of hazardous and/or carcinogen chemical exposure (in concentrations exceeding the health limit value) or lack of oxygen)



The HPC equipment shall only be used for its intended purpose and in accordance with the operating instructions.

According to the experiences gained on the on-site inspections the following two main violations occur:

- operators use wooden sticks to fix the trigger in the handle in OPEN position;
- operators use wipes and other objects to fix the operating foot pedal in OPEN position.

Stop HPC activities if safety devices (e.g. dead man's switches) are bypassed!

Prevention of slipping and tripping during work

Clean up spilled shot-blasting material (slip hazard) or detached pieces (tripping hazard) from the floor regularly!

Good practices:

Fencing HPC area against unauthorized entry.



Using hose-ducts and hose-bridges on roads to prevent mechanical damages on hoses.



Using hose holders to avoid tripping in the hoses



Unsafe conditions:

Lack of safety clamping (whip check).

Hoses must be connected by means of properly rated couplings, and in addition with safety clamps (whip check) or metal safety binders in place!



Unsafe acts:

Using wooden stick to fix the trigger in OPEN position.

Fixing the trigger in OPEN position is strictly forbidden!



Using duct tape and wipes to fix the foot pedal in OPEN position.

Fixing the foot pedal in open position is **strictly forbidden!**



Other information sources: Attachment 1

Hose puncture during high-pressure cleaning – subcontractor injury



HSE NEWSFLASH

#007.2021/Group

Incident: Hose puncture during high pressure cleaning – subcontractor injury

Site: JMSR plant, V-0603

Date: 28 / 02 / 2021

Consequence: Actual: P2 – Low (HIPO)
Potential: P4 – High

Target group: MOL Group, all operations

WHAT HAPPENED

During the high-pressure cleaning of the V-0603 line section, the high-pressure (1100 bar) hose punctured (in 2 places) for an unknown reason. The leaving high-pressure water's energy caused the uncontrolled movement of the hose on a way that it hit a subcontractor on his left leg. As a result of the pressure loss, the cleaning equipment stopped automatically immediately so the safety system functioned properly. The visual inspection founded cracks on the hose in 2 places. One of the cracks is approx. 15 meters from end of the hose, the other is on the side of the cleaning head, next to the factory pressed „signal ring“. When the hose punctured, the abnormal release of pressure caused a whip-like blow from the hose, which hit the worker's left leg, resulting in a contusion of the ankle area and fractured his left tibia. The worker was transported to the hospital for further treatment by an ambulance.



POTENTIAL OUTCOME: Serious personal injury / fatality

WHY DID IT HAPPEN (FIRST ESTIMATION)

- Invisible hose damage (metal fiber breakage under the rubber cover): this seems to be the most likely error currently. During about one year of operation of the hose, high-pressure water cleanings were already carried out in several plants. There is a real risk for the hoses crossing and running on service roads that, despite the use of a hose bridge, different wheelbase vehicles can drive through some mechanically unprotected parts of the hose, or even the hose bridge could pinch the hose under it.
- The probable failure of the hose will be investigated by the manufacturer.
- Technical failure of pressure generating equipment: the pressure generated by the cleaning equipment used max. 1100 bar, even in the event of a failure, it is unlikely that the resulting pressure will even approach the pressure value of 1650 bar used in the pressure test. Nevertheless, the normal operation and condition of the equipment will be tested.

LESSONS LEARNED (FIRST EVALUATION)

1. Extraordinary inspection of the high-pressure hoses – visual inspection, leak test with functional test – required.
2. The damaged hose (DBS 04564055-19) was returned by the subcontractor to the manufacturer for inspection.
3. Additional high-pressure hoses with serial number „DBS 04564055“ have been temporarily suspended until completion of the investigation.
4. It must be ensured that all high-pressure hoses have a valid manufacturer's pressure test report before using (it must be documented).



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