



**Assessment of the occupational risks in the
workplace (multiplicative method):
Appendix 5 - Short-term physical risk
(safety)**

	Group guide and manual		
	Assessment of the occupational risks in the workplace (multiplicative method): short-term physical (security) risk (Appendix 5)		
PSR/HSE Division	HSE		GM-GR-HSE-300 Rev. No.: 01 Date: 17/06/2020


Foreword	This English version is translated from the original French reference version.
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It is usual to take account of health and safety aspects when assessing risks in the workplace. In this new version of the Group guide, we focus on the short-term physical risks.


In the general section, we set out an assessment method based on the probability of an undesirable event (UEE). This method cannot be used when there is a lack of statistically exploitable historical UEE data.

In this appendix, we provide examples of situations in which we take account of the probability of exposure to a physical risk to help you assess the short-term physical risks in the workplace.

The risks associated with workplace safety are assessed in normal conditions and in subnormal conditions that can be reasonably anticipated.

The experts can increase or reduce the rating by one level as needed, based on their experience and the specific conditions at their site. To ensure assessments can be properly traced, the reasons for this change of rating should be documented.

Note : P = 1 is the maximum probability of an acceptable situation (equivalence: 1 END every 5 years)

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1 ASSESSMENT OF RISK ASSOCIATED WITH MECHANICAL HAZARDS

The mechanical risk is the result of the combination of three aspects: a person, an object and energy.

When an object makes contact with a person, regardless of which one is moving, the impact can result in an injury (cutting, pinching, jamming, crushing, perforation, wrenching, etc. of all or part of the body). Objects include machines, tools and parts.

There are two sources of mechanical energy:

- Kinetic energy: energy resulting from motion.
- Potential energy: energy stored up and released by a mass, a system (e.g. spring, hydraulic arm, ventilator blade driven by wind) or an action.


The energy remaining after mechanisms stop moving and the isolation of their (electrical, hydraulic) driving energy, related to the inertia, stiffness (compressed springs), gravitation or pressure (hydraulic accumulator) also causes accidents. This is especially common when equipment is subjected to several energy sources.

All these energy sources cause serious injuries or even death. In this case, G = 15 and P is very low and sometimes difficult to estimate. Based on the available data, G can be one of three levels. In this case, the probability is higher and more accessible.

1.1 Severity rating G

Rating G	Tools/machines or other mechanical hazards
15	<u>Rotating machines, unprotected moving parts that can have an impact on the whole body or a large part of the body:</u> <ul style="list-style-type: none"> - Pipe cutters, calenders, mixers, presses, roll benders, conveyers, movement of high kinetic loads (wagons), etc.
7	<u>Small turning machines, unprotected moving parts:</u> <ul style="list-style-type: none"> - Clippers, drills, grinders, lathes, winches, hydraulic presses, etc. <u>Other energy sources:</u> <ul style="list-style-type: none"> - Air-driven ventilator blades, compressed springs, jacks, etc.
3	<u>Manually operated tools or objects:</u> <ul style="list-style-type: none"> - Cutters, knives, scissors, staplers, hammers, small tools, saws, mincers, skips, bins, strapping, etc. <u>Energy of the body striking fixed objects:</u> <ul style="list-style-type: none"> - Corners of unprotected equipment, open drawers, low shelves, clutter, etc. - Objects that hit, cut, pinch, jam, etc., such as windowpanes and springs.
1	-

Table 1: Matrix - Severity G.

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1.2 Potential exposure probability rating P


Rating P	Probability of potential exposure P to situations that can lead to shocks
10	Passing through or changing a protective barrier: unblocking, stripping, picking up fallen/incorporated parts or any other intervention when the machine is not stopped, etc.
6	Intervening on equipment at a standstill on a "blocked movement", etc. Make adjustments, etc. Maintenance with co-activity: without disconnecting all energy sources, etc. Use a machine that is not secured by a guard, etc.
3	Use suitable tools or machines, possible access to moving parts, etc.
1	- Using a modified machine made secure by the operator, difficult access to moving parts, etc.
0.5	- Working on a machine made secure (no access to moving parts possible except for maintenance), etc.

Table 2: Matrix - *Probability of potential exposure to situations that can lead to shocks P.*

1.3 Residual potential exposure probability rating P'

Reduction of P	Shock prevention/protection measures
-1	<u>At least two procedural or organizational measures from:</u> <ul style="list-style-type: none"> - See <u>Mp-type</u> matrix - Apply the golden rules 3, 5 and 7 the manufacturer's instructions, provide user training, etc. - Machine/tool inspected and marked as compliant in accordance with a recognized standard (EC in Europe), etc. - Use of appropriate PPE - Authorization covering the task to be performed
-2	Safety of installations and machinery provided for in the design and installation rules AND appropriate maintenance AND consignment of installations and machinery when they are not in use (holster/box/container/sharp part protection device when the equipment is not in use, separate storage, ...).

Table 3: Matrix - *Reduction in potential exposure probability P.*

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2 ASSESSMENT OF RISK ASSOCIATED WITH TRAFFIC AND MOVEMENTS


2.1 Severity rating G

Rating G	Movement of pedestrians or vehicles	
	On foot	Traffic on site and off site
15	- N/A	<ul style="list-style-type: none"> - Intersection of pedestrian/cycle and motorized vehicle flows in noisy environment - Intersection of flows of vehicles in the case of heavy traffic and high speeds - Intersection of truck flows in buildings - Use of forklift truck on an irregular surface at excessive speed - Use of quad bike, motorbike, cycle on an irregular surface at excessive speed
7	- N/A	<ul style="list-style-type: none"> - Intersection of vehicle flow and unexpected obstacle/stationary vehicle, etc. or between vehicle flows with low visibility.
3	- Movement on one level.	<ul style="list-style-type: none"> - Cycle on gravel/irregular surface, etc. - Ordinary conditions
1	- N/A	<ul style="list-style-type: none"> - Reduced vehicle flow on separated, well-lit and well-maintained roads, etc.

Table 4: Matrix - Severity G.

Reminder: the minimum recommended task-specific lighting levels are:


* Selected reference values for lighting (EN 12464-1 and -2)							
Internal locations				External locations			
Reception	Archives, canteen, locker rooms, bathrooms	Stairways Loading bays	Corridors, stores Roads	Pedestrians, loading and unloading of vehicles	Regular vehicle traffic	Vehicle traffic areas	Pedestrian-only paths
300 lux	200 lux	150 lux	100 lux	50 lux	20 lux	10 lux	5 lux

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2.2 Potential exposure probability rating P

Rating P	Probability P of being exposed to level falls or collisions	
	Movement on site (pedestrians) (ground conditions, elevation, space/access/obstacle, lighting*)	Traffic on and off site (co-activité, visibilité suffisante, vitesse adaptée) (conducteurs & missions)
10	<ul style="list-style-type: none"> - Moving on ice, in mud, oil, etc. - Move with almost zero visibility near the void or significant drop in elevation. 	<ul style="list-style-type: none"> - Driving under the influence of <u>psychoactive substances</u>.
6	<p><u>Moving in poor conditions in relation to:</u></p> <ul style="list-style-type: none"> - <u>State of the ground/floor</u>: slippery, irregular, very steep, etc., not maintained or irregularly maintained, etc. - <u>Space</u>: moving in a blocked, cluttered or reduced zone (hoses, electric cables, boxes, tools, truck hatches, rail sleepers, etc.) etc. - <u>Equipment</u>: ladder with narrow, irregular steps, etc., defective duckboards, false ceilings, sloping roofs, unstable gangways, hatches, etc. - <u>Vision</u>: poorly lit, half-light, unlit routes at night, obstructed view, etc. - <u>HOF</u>: moving in a production unit while performing a task or with hand occupied in an unstable/cluttered/irregular zone, passing a protective barrier, etc. 	<ul style="list-style-type: none"> - Driving when tired - Driving at excessive speed - Driving while on the phone, etc. - Driving a vehicle that has not been serviced (brakes or lights, worn tires, etc.) - Driving where black ice, aquaplaning, etc. is common - Driving when visibility is low, sight or hearing is impaired, etc.
3	<p><u>Moving in tricky conditions:</u></p> <ul style="list-style-type: none"> - Moving on a site* while conducting a visual inspection in a traffic zone for vehicles, hand trollies, etc. - Unmarked dangerous zone, etc. - Outdoor stairways (see "Work at height" matrix) - Movement on an unstable level (that moves or slides) with deteriorated covering, on gravel, narrow passage, poorly lit, etc. 	<ul style="list-style-type: none"> - Driving for a long time - Driving in a parking lot, co-activity, production or logistics zone, hand trolley traffic zone, without up-to-date traffic plan and/or with faulty or no signage - Driving on untarmacked tracks - Driving heavy vehicles with reduced visibility (cranes, loaders, mechanical diggers).
1	<p><u>Moving in normal conditions:</u></p> <ul style="list-style-type: none"> - Well-lit, daylight - Regularly cleaned - No obstacles, no height differences, etc. 	<ul style="list-style-type: none"> - Traffic controlled on site, etc. - Moving in a zone with separate pedestrian/vehicle traffic, etc.


Table 5: Matrix - Probability of potential exposure to situations that can lead to falls at one level or collisions

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2.3 Residual potential exposure probability rating P'

Reduction of P	Means/measures of prevention/protection	
	Movements	Traffic on and off site
-1	<p><u>At least two procedural or organizational measures from:</u></p> <ul style="list-style-type: none"> - See Mp-type matrix - Cleaning and clearing ground/floors and traffic roads, checking the duckboards, gritting or sanding in winter, absorbing spreading, clean and tidy audit, 5S - Wearing appropriate shoes in a good state of repair - Setting up and maintaining appropriate lighting (permanent and temporary) - Organizing the work so that tasks can be performed without hurry - Ensuring best practices are followed (hold the hand-rail, do not walk while using a smartphone, avoid moving when performing another task, keep office drawers and cabinets closed), etc. 	<p><u>At least two procedural or organizational measures from:</u></p> <ul style="list-style-type: none"> - See Mp-type matrix, apply golden rule 2, CR-GR-HSE-404; - Demarcating the ground/floor of pedestrian zones - Limiting movements (video conferences, etc.) - Taking the train rather than the car, etc. - Displaying a site traffic plan and associated signs - Gritting/sanding in winter - Servicing vehicles and checking vehicles before use - Taking sufficient regular breaks when driving for a long time, etc. - Specific training (CACES...), regular preventive driving training, traffic risk awareness and prevention programs, alcohol, drug and addiction approach, etc. - Medical surveillance (e.g. sight, hearing, sleep apnoea, stress, etc.)
-2	<ul style="list-style-type: none"> - Provide anti-slip floor covering, sufficient working space, etc. - Fill holes, repair coverings - Install ramps and handrails for stairways and to get down from trucks and forklifts - Install cable ducts for electrical cables to improve traffic, etc. 	<ul style="list-style-type: none"> - Optimize the state and layout of roads and crossings: <ul style="list-style-type: none"> o Protect pedestrian zones with physical obstacles, install paths that can be used by cyclists, etc. o Install and maintain traffic lights/signs/markings, restrict access (place blocks) - Adapt the lighting to the working hours - Equip the forklift with an obstacle detection system - Equip trucks with an alcohol interlock
-3	<ul style="list-style-type: none"> - Design access to the workplace with due consideration for the ergonomic, lighting and traffic flow segregation rules, etc. - Sheathe electrical cables on the ground, etc. 	<ul style="list-style-type: none"> - Physically separate pedestrian and vehicle flows, etc. - Implement anti-collision/warning/speed restriction systems, etc. - Ban personal cars from the site, etc.

Table 6: Matrix - Reduction in potential exposure probability P.

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3 ASSESSMENT OF RISK ASSOCIATED WITH HEIGHT


There are many situations in which work is done at height (work and movement generating risks of a fall):

- Roof of a building, awning, tank, rig floor, ceiling/glass roof/framework, gangway...
- above or close to a landing stage, fire pit/decantation basin, sea platform, boat, terminal...
- truck/wagon hatch, truck/crane cab, pylon...
- MEWP (Mobile elevating work platforms)/scaffolding/ropes/ladders/stepladders/IMP & ILMP (Individual (lightweight) moving platform)s/steps/chairs/stools/boxes or other makeshift solutions, etc.

3.1 Severity rating G

Rating G	Height	
	Work at height (distance from foot to floor)	Object at height (with helmet) (to be adapted based on the size and shape of the object)
40	<u>Work by several people at more than 3 metres from the ground or a body of water</u>	<u>Simultaneous work</u> : - Scaffolding in a busy zone (during a major shutdown), etc. - Cradle above a busy zone, etc. - Loaded duckboard above an activity zone - Wall of an excavation/pit/gallery (crush syndrome), etc.
15	<u>Working at a height of more than 3 metres above the ground</u> <u>Work above a body of water</u>	<u>Objects from</u> : - 2m cabinet: $\geq 7\text{kg}$ - 5m shelving: $\geq 2.5\text{kg}$ - high shelving (7.2m): $\geq 2\text{kg}$ - 12m scaffolding: $\geq 1\text{kg}$
7	<u>Working at a height of 1.5 to 3 metres above the ground</u>	For objects of intermediate mass, use: <u>Electronic calculator</u> : http://www.dropsonline.org/resources-and-guidance/drops-calculator/e-drops-calculator/ or <u>DROPS METRIC table</u> : see below.
3	<u>Work performed at between 0.5 and 1.5 meters above the ground</u>	
1	<u>Work performed at less than 0.5 meters above the ground</u>	<u>Objects located at a distance of</u> : - 2m: $< 3\text{kg}$ - 5m: $< 1\text{kg}$ - 7.2m: $< 0.6\text{kg}$ - 12m: $< 0.4\text{kg}$

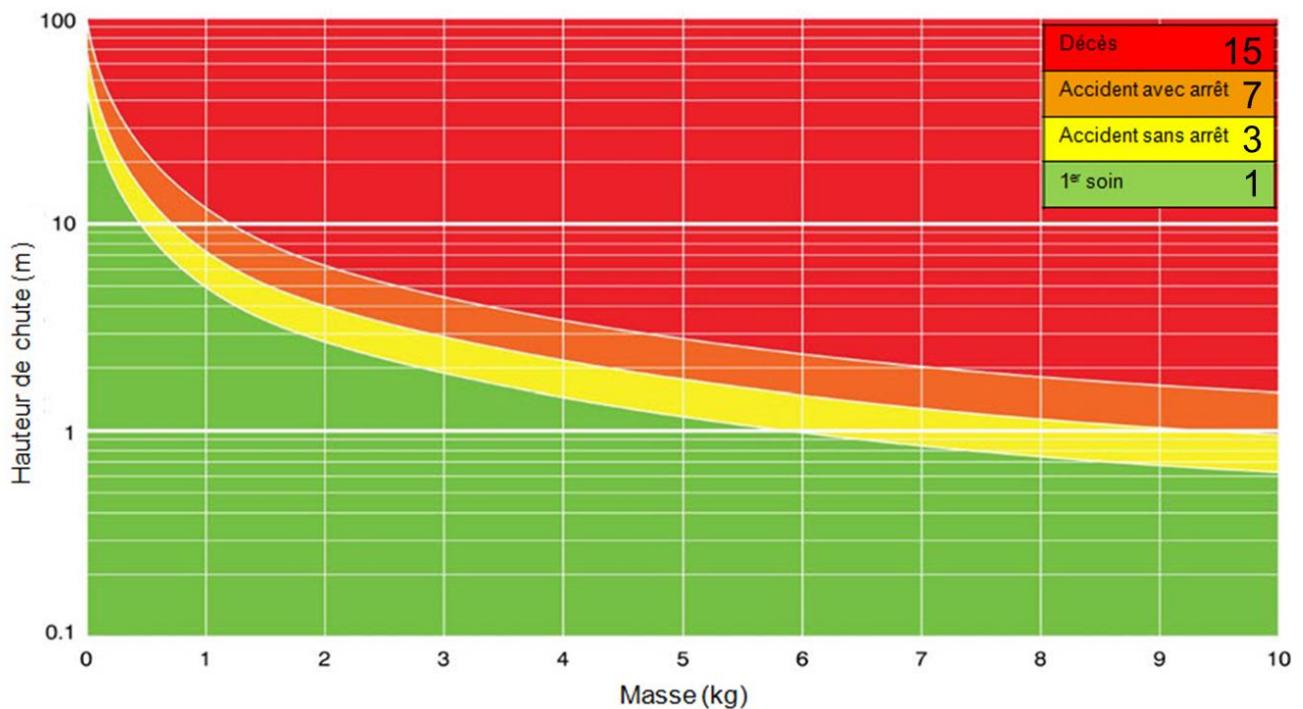
Table 7: Matrix - Severity G.

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* **The DROPS METRIC table** estimates the effects of blunt objects, such as tools, metallic parts, etc.


Note: The shape and hardness of the object should be taken into account. A high rating should be set for broken glass, metal splinters, while a lower rating should be set for low-density objects such as pieces of insulation and empty packaging.

Note : abaque prenant en compte le port des EPI standards (y compris le casque)



3.2 Potential exposure probability rating P

Rating P	Probability of potential exposure P to situations that can lead to: falls from height or into water	
	Work at height	Object at height
10	<p><u>Working in prohibited conditions:</u></p> <ul style="list-style-type: none"> - Use of a cradle that does not meet design conditions - Working on a ladder, a roof with a considerable slope, a truck hatch without side rail, passing a protective barrier, etc. <p><u>Working/moving above a body of water</u></p>	<p><u>Working below or close to:</u></p> <ul style="list-style-type: none"> - Objects that are likely to move significantly in the wind or poorly tied by rope when being lifted manually - Mechanical digger and material excavated less than a meter from excavation site, etc. <p><u>Changing price boards</u> on a non-electronic totem pole at a service station, etc.</p>

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Rating P	Probability of potential exposure P to situations that can lead to: falls from height or into water	
	Work at height	Object at height
6	<u>Working in degraded conditions:</u> <ul style="list-style-type: none"> - Working on corroded/poorly fixed equipment without a guard rail or anchoring point, etc. - Moving a deployed MEWP, etc. - Using an inappropriate ladder/stapladder/gangway to access a boat - Working at height when it is windy, snowing, icy, etc. - Working on ground/floors in poor condition, roofing and false ceilings, truck hatches, etc. <u>Working/moving close to a body of water</u>	<u>Working in unfavourable conditions below or close to:</u> <ul style="list-style-type: none"> - Scaffolding cluttered or without toeboards, tools not put away - Unstable storage of materials in bulk at a height (loose pieces of scaffolding, etc.) - Difficult to reach storage zones at a height (e.g. in stores), etc.
3	<u>Delicate operations:</u> <ul style="list-style-type: none"> - Putting up/taking down scaffolding - Working at a loading bay, close to a drop, etc. - Taking a fixed ladder, external stairway, etc. - Climbing into/out of a truck cabin, etc. - Using scaffolding that is in poor condition / poorly built, not level, uninspected - Riding on a palletizer or other equipment during maintenance - Working with inadequate collective protective barriers compared to the size of the truck (loading/unloading stations), uneven platform, etc. - Working in unfavourable weather: rain, etc. 	<u>Working below or close to:</u> <ul style="list-style-type: none"> - Equipment installed at a height with corroded/damaged attachments (light support on platform) - Lifting objects above an activity zone when people are present, etc.  <u>Working in a warehouse/storeroom with:</u> <ul style="list-style-type: none"> - Overloaded storage (weight and volume) - Storage in poor condition or inappropriate (racks, pallets...) - Parcels not secured on to pallets, not neatly stacked, etc. - Pallets, boxes etc. stacked too high and/or limited resistance of packaging over time, etc. - Bulk materials <u>Transfer of loads</u>
1	<u>Working in normal conditions</u> <ul style="list-style-type: none"> - Using a ladder, etc. - Moving on duckboard, etc. <u>Working in a zone close to a body of water</u> with aggravating factors (instability of the work zone, clutter, reduced accessibility, inadequate visibility, etc.).	<u>Working below or close to:</u> <ul style="list-style-type: none"> - Scaffolding not equipped with toeboards, etc. - Sling breaking during a lift, etc.


Table 8: Matrix - *Probability of potential exposure to situations that can lead to falls at height or drowning.*

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3.3 Residual potential exposure probability rating P'

Reduction of P	Measures to prevent/protect against falls from height	
	Work at height	Object at height
-1	<u>At least two measures from:</u> <ul style="list-style-type: none"> - Apply golden rule 10 - Wedge/attach/stabilize the ladder/scaffolding/MEWP, etc. - Ladder/scaffolding/MEWP user training and inspection, etc. - Inspect scaffolding, ladders, etc. - Set up an access restriction system (signposting, marking, etc.) - Wear a safety harness with appropriate connecting devices - Provide sufficient life preservers, etc. - Working in twos, do not work when the wind is strong, ensure three attachment points, etc. - Perform periodical inspections/servicing (duckboards, harness, etc.) - Warn about the risk of drowning with a sign and control access, etc. 	<u>At least two measures from:</u> <ul style="list-style-type: none"> - Apply the golden rules 6 and 10 - Hold an excavation permit - Use of toeboards, signage, net, etc. - Tie packages to pallets - Maintain storage shelves/racks - Wear a helmet and safety shoes - Prohibit storage on top of cabinets - Neatness and tidiness: store tools/materials on work equipment at a height; implement storage rules in storerooms, etc. - Transport tools safely (rucksacks, tool belts, etc.)
-2	<ul style="list-style-type: none"> - Access to a well-anchored lifeline that meets the regulations - Put permanent protective equipment in place (1m guard-rail, fixed platform in the installations, access stairways, etc.) - Use temporary equipment that is safer than ladders/stepladders/stools (IMP/ILMP, mobile scaffolding, MEWP, etc.) - Put temporary protective equipment in place (nets on the underside, etc.) - Put nets in place around the basins, safety vests, etc. - Build an embankment or reinforce the trench, etc. 	<ul style="list-style-type: none"> - Use a wrist-strap for hand tools - Use nets along the guard-rails, 10cm toeboards, groundsheets on duckboard, etc. - Use a cable to secure objects at height (lights, chain wheels, etc.) - Organize storage (appropriate shelving/racking, manoeuvring space, etc.) - Limit heights (< 7.2m for pallets, < 2m for parcels), etc. - Adapt and check the lifting means (ropes, winches, slings etc.)
-3	<ul style="list-style-type: none"> - Implement technical changes to allow work to be done at ground level (mechanism to change light bulbs from the ground, measuring/control instruments at ground level for equipment at height, replacement of service station totem poles by electronic systems, etc.) - Build on the ground, then lift hydraulically (e.g. FAST canopy), etc. 	<ul style="list-style-type: none"> - Use a permanent tool attachment system, including when switching from hand to hand, etc.

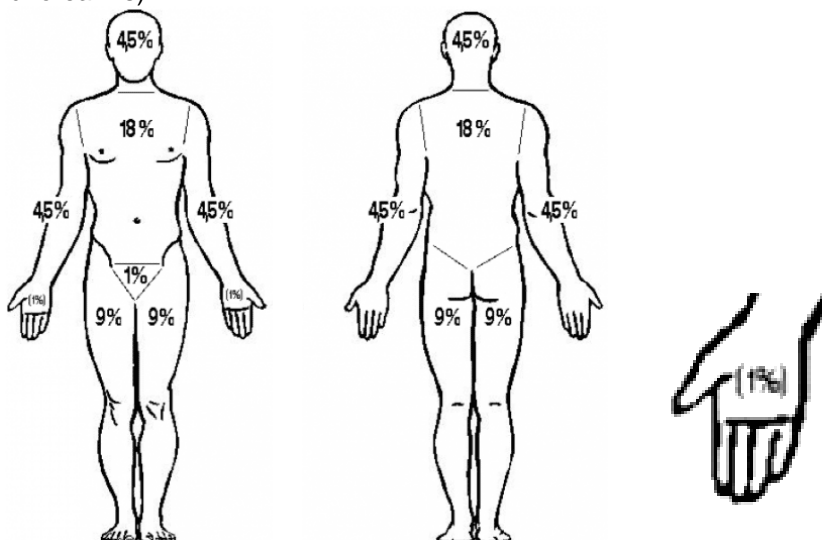
Table 9: Matrix - Reduction in potential exposure probability P.

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4 ASSESSMENT OF THE RISK ASSOCIATED WITH A HEAT/COLD SOURCE

The severity of the burns is measured against the following criteria:

- The temperature and predictable duration of contact
- The surface and depth of the burn: an extensive burn covers more than 10% of the body (e.g. hands and forearms)





- The surface material (metal, ceramics, plastic, wood) and its condition
- The sensitivity of the person in question (child, adult, senior)

The values in the severity matrix relate to adults in contact with a bare metal surface for 1-10 seconds.

- 1 second: Unintentional contact
- 10 seconds: Intentional contact, fall with slow recovery, handling of bare metal

4.1 Severity rating G

Rating G	Heat source	Cold source
15	<u>Third degree burn (damage to the dermis and the epidermis) over more than 10% of the body</u>	
	<ul style="list-style-type: none"> - Unintentional contact with a hot part: $T^{\circ} > 70^{\circ}\text{C}$ (bare metal), $> 80^{\circ}\text{C}$ (ceramics/glass), $> 95^{\circ}\text{C}$ (plastic). - Contact with a hot product E.g. boiling oil, steam, flashback, bitumen, drain protection, vacuum/atmospheric residues, distillation furnace, etc. 	 <ul style="list-style-type: none"> - & H281 Contains refrigerated gas; can cause cryogenic burns or injuries. - Involuntary contact with gases compressed at very low boiling temperatures (liquid nitrogen, liquid oxygen, liquid ethylene, etc.). - Prolonged contact with propylene and propane.

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7	<u>Third degree burn over less than 10% of the body or deep second degree burn</u> (deep damage to the dermis).	
	<ul style="list-style-type: none"> - Unintentional contact with a hot part: > 70°C (bare metal) or > 80°C (ceramics/glass) or > 95°C (plastic) if less than 10% of the body makes contact. - 65-70°C* (bare metal) if more than 10% of the body makes contact. - Handling an object at a temperature of: 50-52°C* (bare metal). - Contact with a hot product. <p>E.g. plates/shelves from the oven, high temperature equipment, plancha grill, double-boiler/dish warmer, arc welding, blowtorching, bitumen, autoclaves, etc.</p>	 <p>& H281 Contains refrigerated gas; can cause cryogenic burns or injuries.</p> <ul style="list-style-type: none"> - Unintentional contact with gases compressed at low boiling temperatures (propylene, propane, butane, etc.).
3	<u>Second degree burn (blisters)</u>	
	<ul style="list-style-type: none"> - Unintentional contact with a hot part: 60-65°C* (bare metal). - Handling an object at a temperature of: 44-50°C* (bare metal). <p>E.g. hot meals service, water-heater water, outside of a kitchen oven door, radiator, etc.</p>	<ul style="list-style-type: none"> - Unintentional contact with a metallic part at: < -20°C - Handling a metallic object at a temperature of: < -7°C <p>E.g. frozen products, chain wheels in periods of frost, etc.</p>
1	<u>First degree burn (red blotches/sunburn)</u>	
	<ul style="list-style-type: none"> - Unintentional contact with a hot part: 50-60°C* (bare metal). 	<ul style="list-style-type: none"> - Work with water at < 4°C <p>E.g. kitchen work, cleaning work during period of frost, fire water (firefighters), etc.</p>

Table 10: Matrix - Severity G.

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4.2 Potential exposure probability rating P


Potential rating P	Probability of potential exposure P to situations that can lead to: contact with a hot or cold source
10	Welding, flame working, etc. ; Working on steam/condensate/hot product/hot product/propan/etc. unblocked pipe; Take a bitumen sample. Serve hot dishes coming out of the oven. Handling frozen products.
6	Purge LPG, ethylene, propylene.
3	Utiliser une friteuse (contrôle température, filtrage et vidange) ou une étuve (équipement à point chaud).
1	Work on a blocked steam/hot product line. Work under normal conditions near hot or cold uninsulated/protected rooms, etc.

Table 11: Matrix - *Probability of potential exposure to situations that can lead to contact with a hot or cold source.*

4.3 Residual potential exposure probability rating P'

Reduction of P	Burn prevention/protection measures
-1	<u>At least two procedural or organizational measures from:</u> <ul style="list-style-type: none"> - See Mp-type matrix - Apply golden rule 7 - Use appropriate thermal protective gloves, goggles and special clothing - Use insulated tools/chain wheels, etc. - Use showers close to the Bitumen station, etc.
-2	<ul style="list-style-type: none"> - Specific PPE (soldering equipment, etc) - Use thermal screens to protect the neighbouring workplace, etc.
-3	<ul style="list-style-type: none"> - Insulating/weather stripping equipment (collective protection), etc.

Table 12: Matrix - *Reduction in potential exposure probability P.*

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5 ASSESSMENT OF RISK ASSOCIATED WITH ELECTRICITY

5.1 Severity rating G

“Volts burn”, “intensity kills”.


Rating G	Electricity (In humid conditions, divide the voltage values by two)	
15	<ul style="list-style-type: none"> Body constant for irreversible cardiac fibrillation (electrocution): <ul style="list-style-type: none"> - $I \geq 75 \text{ mA}$ in case of brief contact (1/2 s) - $I > 30 \text{ mA}$ in case of prolonged contact (> 5 s) Severe burns, organ injury: <ul style="list-style-type: none"> AC: > 1000 V (high voltage) DC: > 1500 V 	E.g. power line, solar panel, HV transformer, 220 V** in humid conditions, direct lightning strike, etc.
7	<ul style="list-style-type: none"> Bodily constant for contractions (not loosening grip), respiratory paralysis, disruption of heart and breathing rate: <ul style="list-style-type: none"> - $30 \text{ mA} > I > 75 \text{ mA}$ in case of brief contact (1/2 s) - $10 \text{ mA} > I > 30 \text{ mA}$ in case of prolonged contact (5 s) Burns: <ul style="list-style-type: none"> AC: 50 V (12 V in humid conditions) < U ≤ 1000 V (low voltage) DC: 120 < U ≤ 1500 V 	E.g. 220 V** in humid conditions, condensers (even after shutting off equipment), lightning strike at 30m, etc.
3	<ul style="list-style-type: none"> Bodily constant for an electric shock with reversible effects (muscle reflex with loosening of grip): <ul style="list-style-type: none"> - $0.5 \text{ mA} > I^* > 10 \text{ mA}$ in case of prolonged contact - $0.5 \text{ mA} > I^* > 30 \text{ mA}$ in case of brief contact (1/2s) <p>However, the shock can result in a sudden reaction that leads to a minor injury</p> Burns related to strong intensity: <ul style="list-style-type: none"> AC < 50 V DC < 120 V 	The protection devices of a differential type 30 [mA] break the circuit in around one tenth of a second. E.g. static electricity, etc.
1	<ul style="list-style-type: none"> Bodily constant of a human in AC without notable effect: $I^* < 0.5 \text{ mA}$ 	E.g. Use of electrical equipment recommended.

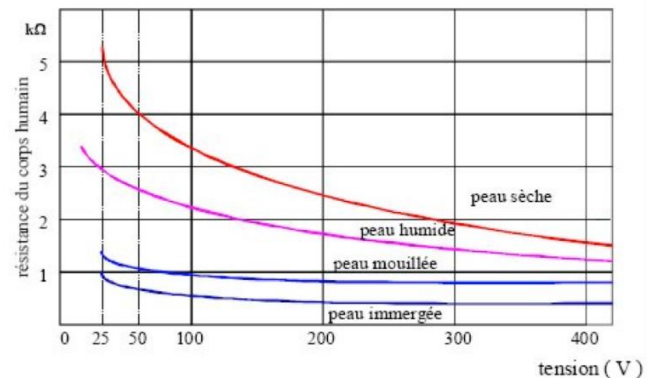
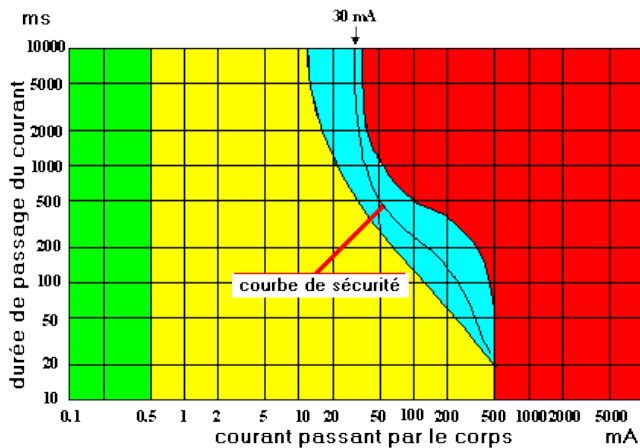
Table 13: Matrix - Severity G.

* By approximation, take: Intensity I (ampere) = tension U (volt) / average resistance R (ohm)

** The average resistance R of a person subjected to 230 V in humid conditions is 1000 Ω (e.g. stepping out of the shower, perspiring in summer). In case of contact with an active conductor in U: 230 V, the current value I ($I = U / R$) is 0.23 A. The irreversible cardiac fibrillation threshold is reached and the longer the contact with the active conductor, the lower the resistance of the body, the current will increase and reach the electrocution threshold leading to death.

Green zone: severity 1 Yellow zone: severity 3 Blue zone: severity 7 Red zone: severity 15

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Resistance of the human body in different conditions. Wearing safety shoes and insulating clothing can clearly increase the resistance of the body. An antistatic shoe has an electrical resistance $> 100 \text{ k}\Omega \leq 1000 \text{ M}\Omega$, which provides protection from low-voltage electric shocks, but it must be noted that other parts of the body are able to circulate the current.

5.2 Potential exposure probability rating P

Rating P	Probability of potential exposure P to situations that can lead to: contact with an electricity source
10	Working in direct contact with an electricity source.
6	Co-activity: indirect contact with a part accidentally switched on.
3	General maintenance and repair work on circuits: looking for failures, taking measurements, tests, operations, replacing defective materials, etc. Using temporary installations with poorly protected conductors or inappropriate provisional protective equipment.
1	Switching off or on of an equipment or an installation
0.5	Working on electrical equipment: replacing a light/switch/electric socket/bulb, etc.
0.2	Using electrical equipment, etc.
0.1	No contact possible


Table 14: Matrix - Probability of potential exposure to situations that can lead to contact with an electricity source.

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5.3 Residual potential exposure probability rating P'



Reduction of P	Means/measures of prevention/protection against electrical risk
-1	<u>At least two procedural or organizational measures from:</u> <ul style="list-style-type: none"> - See Mp-type matrix - Stay at least five meters away from power lines (Golden rule 7), distances from neighbours, mark off hazardous zones, etc. - Following the safety rules (disconnect equipment before starting work, etc.) - Giving adequate training, etc. - Periodically checking electrical installations, etc.
-2	<ul style="list-style-type: none"> - Holding authorization covering the task to be performed - Making electrical installations and materials safe (locking), etc.
-3	<ul style="list-style-type: none"> - Having electrical installations and materials made safe in accordance with the design and installation rules AND maintained appropriately in accordance with the schedule, etc.


Table 15: Matrix - Reduction in potential exposure probability P.

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6 ASSESSMENT OF RISK ASSOCIATED WITH PRESSURE

6.1 Severity rating G

Rating G	Hydraulic pressure	Pneumatic pressure
40	-	 <p>& H 280: Contains a pressurized gas; can explode under the influence of heat</p> <ul style="list-style-type: none"> - Pneumatic test, HP steam piping, capacity (LPG truck, sphere...)
15	Hydraulic pressure > 25 bar and more than 10 kW: - Very high pressure industrial cleaner, etc.	Pressurized pneumatic hose with gas flow
	Hydraulic pressure > 250 bar: - Pressurized water nozzle, snake, etc. - Pressurized hydraulic hose with liquid flow, etc.	<p>Oversize tire inflation point (heavy vehicles/buses/tractors) at a service station</p>  <p>& H 280: Contains a pressurized gas; can explode under the influence of heat</p> <ul style="list-style-type: none"> - Gas bottle ((nitrogen, acetylene, oxygen, breathable air for SCBA etc) in the event of high temperatures, etc.
7	Hydraulic pressure (150-250 bar) and less than 10 kW: - Industrial pressure cleaner, etc.	- Sand blasting or shot-blasting
	Pressurized hydraulic equipment: - Drainage for sampling or provision of equipment (water, oil, HCA), etc.	Pressurized pneumatic equipment: - Drainage for sampling or provision of equipment (air, steam, gas) - Air compressors, blow nozzle, jacks, autoclaves, pressure cookers, boilers, exchangers, compressed air bottles, etc.
	-	Underwater welding of pipes or repairs of underwater oil and gas production equipment. <u>Working at a relative pressure* higher than 100 hectopascals (0.1 bar)</u> (*: absolute maximum pressure less the local atmospheric pressure around the airways during the work).
3	Re-test of LPG bottles at a filling centre, projection of objects	<u>Targeted</u> pressurized air or gas jet more than 7 bar

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Rating G	Hydraulic pressure	Pneumatic pressure
	Fire post, monitor nozzle, etc.	
1	Hydraulic pressure (25-150bar) <u>and</u> less than 10 kW Household pressure cleaner, etc.	<u>Targeted</u> pressurized air or gas jet < 7 bar

Table 16: Matrix - Severity G.

6.2 Potential exposure probability rating P

Rating P	Examples of tasks by type of potential exposure probability P for a pressure source	
	hydraulic	pneumatic
10	Work in contact or in direct presence of pressure : Working in HP in manual. Intervene on poorly depressurized equipment, purge, etc...	Work in contact or in the direct presence of pressure : - when inerting pressure equipment (in degraded mode) ; - during leak testing, testing, etc., (in degraded mode).
6	Working in HP manually (with a mechanism that fixes the equipment, the forces are not supported by the human body) (GM-GR-HSE-412), Working with corroded or shocked equipment, etc.	- Working with an old hose, an unpredictably overpressurized network -
3	Travailler en HP semi-automatique dans la zone d'opération (GM-GR-HSE-412). Intervenir sur un équipement vétuste ou mal entretenu, sur un flexible.	- purge (with sprayed debris, knob, faucet, etc.), etc.
1	Working in semi-automatic HP out of operation area (GM-GR-HSE-412), etc. Tare valves, perform tests or re-tests, etc.	-
0.5	Working automatically with high pressure.	-


Table 17: Matrix - Probability of potential exposure P to situations that can lead to contact with a hydraulic or pneumatic pressure source.

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6.3 Residual potential exposure probability rating P'

Reduction of P	Means/measures of prevention/protection against pressure risk	
	Hydraulic	Pneumatic
-1	<u>At least two procedural or organizational measures from:</u> <ul style="list-style-type: none"> - See Mp-type matrix - Wear HP-appropriate PPE: pressure-resistant boots, watertight goggles, face guard, safety helmet, rubber gloves, impermeable clothing, and ear protectors - Having a HP procedure in place - Use of staff trained in HP work - Putting in place specific HP signage - Checking the validity of HP hose test certificates - Adequate supervision of HP work 	<u>At least two procedural or organizational measures from:</u> <ul style="list-style-type: none"> - See Mp-type matrix - Apply golden rule 7 - Systemizing the installation of drains on pneumatic hose connections - Check hoses before any use - Restrict access when raising pressure for the test - Secure the gas bottles with a chain - Have the gas bottles checked annually by an agency (SCBA, etc.) - Wearing watertight goggles, face guard, shield, gloves, etc. - Having a large hose to keep an appropriate distance from the tire cage, Having a quick coupling to disconnect fast, having a pressure regulator, etc.
	<ul style="list-style-type: none"> - Periodically inspecting pressurized equipment (premature wear, impacts, lower rate of flow, retest) - Restricting access during tests - Having a work isolation diagram (golden rule 7). 	
-2	<ul style="list-style-type: none"> - Use of staff trained and experienced in HP work - Installing an anti-backlash system, covered hose connections-projection accessory - Use an appropriate safety extension cord, snake with reservoir system, etc. - Use physical barriers (screens in resistant materials), etc. See GM-GR-SEC-008 - Lock the process during the work (physical disconnection, platinizing, insulation), etc. (Golden rule 7) 	<ul style="list-style-type: none"> - Use an anti-backlash system - Hang hoses at a height - Lock - Use an appropriate cage to inflate a truck/bus/tractor tire - etc.
-3	<ul style="list-style-type: none"> - Use HP-trained and certified staff (e.g. SIR, S3C, WJA) - Have an extra double maintenance control, an extra thrust control nozzle, etc. 	<ul style="list-style-type: none"> - Get a recognized inspection service to periodically check equipment (hoses, containers, equipment).

Table 18: Matrix - Reduction in potential exposure probability P.

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7 ASSESSMENT OF RISK ASSOCIATED WITH A CONFINED ATMOSPHERE

A confined space is defined as a totally or partially enclosed space, which has not been designed and constructed for or intended to be permanently occupied by persons, but which may occasionally be temporarily occupied for the performance of work such as inspection, maintenance or repair, emptying/loading operations and within which the atmosphere may present a risk to the health and safety of anyone entering it due to either :


- the design and the location of the equipment;
- insufficient natural ventilation;
- the materials, substances or fluids it contains;
- the equipment used in it;
- the nature of the work carried out there.

This space offers limited or difficult evacuation possibilities for personnel :

- Containers: tanks, reservoirs, tank trucks, silos, floating roofs, etc.
- Ducts, deep trenches, ditches, access hole shafts, basins, cesspools, decantation tanks, sewers, sight holes, etc.
- Column bases, ovens, boilers, crawl spaces, etc.
- Certain rooms, shelters or tarpaulin covered zones, etc.

Three types of risk associated with the quality of the atmosphere:

- Lack of oxygen in the air: tiredness, faintness, asphyxia, hypoxia, anoxia (e.g. due to too much nitrogen (N₂) as a consequence of inertness, injection of argon (Ar) for welding, etc.)
- The risk of explosion due to the presence of gas or dust generating a flammable atmosphere
- Presence of a toxic gas or dust in the air (e.g. H₂S in refinery units or sewers, CO in boiler rooms, benzene-type leftover chemical products in a container, CH₄/CO₂ in fermentation tanks, etc.)


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7.1 Severity rating G

Rating G	Confined atmosphere
40	<p>Several people working in a confined space and:</p> <ul style="list-style-type: none"> - Presence of a non-breathable atmosphere (inert or other gases): oxygen level less than 10%. - Presence of an explosive or oxygen-enriched atmosphere (LI >10 % LEL or oxygen level in the atmosphere greater than 23.5 %). - Presence in the atmosphere of a level of a gas with acute toxicity higher than IDHL (Immediately Dangerous for Life or Health - threshold for irreversible effects)
15	<ul style="list-style-type: none"> - Presence of a non-breathable atmosphere (inert or other gases): oxygen level less than 10%. - Presence of an explosive or oxygen-enriched atmosphere (LI >10 % LEL or oxygen level in the atmosphere higher than 23.5 %). - Presence in the atmosphere of a level of a gas with acute toxicity higher than IDHL (Immediately Dangerous for Life or Health - threshold of irreversible effects).
7	<ul style="list-style-type: none"> - Presence of an oxygen-depleted atmosphere: oxygen level between 10% and 16%. - Presence in the atmosphere of a level of acutely toxic gases between the 15-minute OEL and the IDHL.
3	<ul style="list-style-type: none"> - Presence of an oxygen-depleted atmosphere: oxygen level between 16 and 19.5 %. - Presence in the atmosphere of a level of chronically toxic gases between the 8-hour OEL and the 15-minute OEL.
1	<ul style="list-style-type: none"> - Presence of an atmosphere around the normal: oxygen level between 19.5% and 23.5%. - Presence in the atmosphere of a level of chronic toxic gas below the 8-hour OEL.

Table 19: Matrix - Severity G.

Some thresholds as of November 22, 2019	8h OEL (EU)	15 min OEL or ST (EU)	IDHL (NIOSH)
H ₂ S	7 mg/m ³	14 mg/m ³	100 ppm
CO	20 mg/m ³	100 mg/m ³	1200 ppm
CO ₂	9100 mg/m ³	18200 mg/m ³	40000 ppm
1.3-butadiene	2.21 mg/m ³	-	2000 ppm
Benzene	3.25 mg/m ³	-	500 ppm
n-hexane	72 mg/m ³	-	1100 ppm
Toluene	192 (76.8 ^{FR}) mg/m ³	384 mg/m ³	500 ppm

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7.2 Potential exposure probability rating P


Rating P	Probability of potential exposure P to situations that can lead to: Respiratory failure
10	- Work in an uncleaned/undegassed/unventilated enclosure or during inerting.
6	- Work in inadequately cleaned/gassed/ventilated enclosure or in a sewer. - Working in a vessel polluted by untimely arrivals of inert gas or hydrocarbons, etc. from hard/flexible connections on the enclosure (leakage due to a leak in the insulation device).
3	- Working in a perfectly provided/ventilated enclosure, but desorption of products by heat. - Work in a poorly ventilated and highly corroded enclosure (slow consumption of O ₂ by chemical reaction).
1	- Working in an open vessel with unplanned arrivals of outdoor pollutants from neighbouring facilities. - Working in pits, trenches, etc. at low points and possible arrival of pollutants. - Working in a slightly polluted enclosure with suitable but failing respiratory protection. - Working in a well-ventilated enclosure, but where a very specific type of chemical reaction can generate an oxygen-depleted atmosphere (absorption of O ₂ by wet activated carbon, reaction with oxidising catalyst remains,...).

Table 20: Matrix - Probability of potential exposure P to situations that can lead to respiratory failure.

7.3 Residual potential exposure probability rating P'

Reduction of P	Means/measures of prevention/protection
-1	<u>At least two procedural or organizational measures from:</u> <ul style="list-style-type: none"> - see Mp-type matrix ; - apply golden rule 8; - have a permit to enter; implement an entry control process; - have a process for isolating product/pollutant arrivals; spot-check O₂ levels and air pollutants; - Wear a cartridge mask adapted to the pollutant (except if O₂ level < 19.5%); - monitor work in the vicinity of the confined space; have means of communication available; - limit the duration of the intervention; - have tested means of emergency evacuation, etc.
-2	<ul style="list-style-type: none"> - Constantly check the atmosphere - Ensure continuous ventilation, etc.
-3	<ul style="list-style-type: none"> - Constantly check and continuously ventilate and have a permit - Physically disconnect the product/pollutant inlets on the capacity - Wear insulating breathing protection with air adduction for O₂ < 19.5% and have the PPE certificates and staff aptitude certificates

Table 21: Matrix - Reduction in potential exposure probability P.

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8 ASSESSMENT OF RISK ASSOCIATED WITH THE PERSON AT WORK

The criteria developed in the preceding matrices are based on adults in possession of all their faculties: normal vigilance, able to follow instructions.

The mental burden and physical limits of people often lead to incidents/accidents classified as “human error”.



Example 1: Talking while performing a task occupies 60% of brain capacity. That's why using the phone while driving is prohibited.

Example 2: It takes 20 minutes to regain your full concentration when you are disturbed during your work.

8.1 Taking the workload into account

Over-rate of P	Aggravation of the probability P of being exposed to workloads
+	More tiring work with one part of the body (arms or legs) while driving heavy machines (jackhammers, welding) or sustained walking by pulling/pushing light objects. Moving without planned breaks and frequent ascents/descents.
++	Intense arm or trunk work, carrying heavy objects.
+++	Very intense work at very high speed, the operator gets tired very quickly: stairs, ladders, etc.

Table 22: Table 22 : Over-rate matrix of the probability P’.


8.2 Other human factors

The risks for everyone in the company, including young people, pregnant women, seniors, disabled people and people under the influence of substances that can cause an accident, who cannot follow all instructions to the letter – in whatever form and for whatever reason (lack of information, lack of motivation, wish to harm, inability, tiredness, ...) – who could generate a health, safety and sanitary or legal risk should be assessed.

8.3 Residual potential exposure probability rating P’

Reduction of P	Means/measures of prevention/protection
-1	<u>At least two procedural or organizational measures from:</u> <ul style="list-style-type: none"> - Knowledge: remind people of the instructions, train staff, define operating modes, etc. - Willingness: work on motivation (explain the issues...), etc. - Ability: set up a specific organization (e.g. work in twos, free up time...), propose support methods (course of treatment, relaxation...), etc.
-2	- Put in place organizational measures, particularly for <u>critical tasks</u> for people, a specific organization, etc.
-3	- Change the person in the position

Table 23: Matrix - Reduction in potential exposure probability P.

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9 TERMS AND DEFINITIONS

Accident

Any sudden, dated undesirable event that causes injury or illness, damage to property or installations, a production loss, environmental damage or damage to the Group's image.

ADA

Approach to alcohol, drugs and addiction

Acute effects (short term)

Result of accidental or short-term high-level exposure: accident notion However, the health effects can differ slightly in time (~ day). Examples: acute toxicity linked to exposure to a chemical agent; acute back problems linked to the handling of loads, etc.

PPE

Personal protective equipment

Experts

Operators, task observers, physician, internal or external HSE, employee representatives, health and safety committees, radiation hygiene expert, etc., results of audits.

Occupational exposure

Being in the vicinity of a (chemical, physical, biological, ergonomic, psychosocial) hazard as part of an occupational activity.

HOF

Human or organization factor.

Frequency and duration of the task entailing potential exposure (F)

The frequency takes account of the number of times the task is conducted and the duration a person is potentially exposed to the hazards identified.

Severity

Categorization of an actual or potential consequence associated with exposure to a hazard, using the Group risk matrix. The

severity level of an event is the highest level measured in the assessment, using one of the approved risk matrix consequence grids **CR-GR-HSE-801**: human, environment, equipment/production and media.

HP

High pressure

Risk reduction measure or means/measures of prevention/protection (Mp)

Action and/or measure taken as new obstacle to reduce the frequency or negative consequences of the associated risks.

Mp type

Means/measures of prevention/protection type These are defined in paragraph 3.9 "Calculation of residual risk R" of the **GM-GR-HSE-300**.

Simultaneous operations

Independent operations taking place on the same installation or close to an installation (e.g. drilling and production operations or construction and production operations) when the risk level can increase due to:


- The proximity between several potential sources of hazard
- The involvement of people who may not be aware of the inherent risks of the activities they are not familiar with
- The risk of physical interference
- The coexistence of different organizations requiring coordination

MEWP

Mobile elevating work platform

Probability of the occurrence of undesirable event (incident, exposure)

Probability in percentage form that this event will occur while the task is being performed,

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based on the existing protection, type of procedure, how the task is performed, etc.

Risk

Combination of the probability that a hazardous event will occur and the severity of the impact the exposure hazard could have.

Potential risk

This is the probability that the potential of inconvenience is reached in the exposure conditions. These conditions take account of the (fixed and permanent) intrinsic and collective protection. The notion of potential risk is used to identify critical tasks.

Residual risk


Risk that remains after all measures to reduce identified risks have been taken.

Critical task

Task that can lead to significant injury to people or damage to products, property, installations or the environment if it is not performed or it is performed incorrectly.

OEL

Occupational exposure limit

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10 REFERENCE DOCUMENTS

Reference	Title - Group documents
DIR-GR-SEC-004	Work in confined spaces
DIR-GR-SEC-006	Traffic on site
DIR-GR-SEC-007	Isolation of energy sources and dangerous products prior to work
DIR-GR-SEC-013	Preventing falls from height
CR-GR-HSE-405	Industrial hygiene
CR-GR-HSE-419	HSE requirements for excavation work
CR-GR-HSE-424	Work with high-pressure water jets
CR-GR-HSE-425	HSE requirements for work at height
CR-GR-HSE-801	Event management and HSE structured feedback
GM-GR-HSE-412	Cleaning with high-pressure water jets
GM-GR-HSE-460	Forklift truck safety
GM-GR-SEC-001	Traffic risk analysis
GM-GR-SEC-010	Electrostatic risks when handling flammable liquids
GM-GR-SEC-015	Best practices for accessing truck and car hatches

11 BIBLIOGRAPHY

11.1 Standards

Europe

EN 12464-1 to 2: Light and lighting. Lighting of work places - Part 1: Indoor work places - Part 2: Outdoor work places.

EN ISO 13732-1, 2 and 3: Ergonomics of the thermal environment – Methods for the assessment of human responses to contact with surfaces – Part 1: Hot surfaces, Part 2: Human contact with surfaces at moderate temperature, Part 3: Cold surfaces.

11.2 Guides


France

ND 2165-186-01: *Stratégie générale de gestion des risques professionnels – Annexe I, tableau AII – INRS. Températures extrêmes - page 10.*

ND 2298-213-08-3 : *Distance de dangerosité des jets d'eau très haute pression – INRS.*

OGP/IIPECA

Controlling Health Risks at Work: A roadmap to Health Risk Assessment in Oil & Gas industry, OGP/IIPECA, 2006.

	Group guide and manual		
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11.3 Tools

Calculator for falls of objects at height: <http://www.dropsonline.org/resources-and-guidance/drops-calculator/e-drops-calculator/>

Diagram: <http://www.dropsonline.org/assets/documents/DROPS-Calculator-Metric-A4.pdf>

11.4 Useful links

Object at height

<https://inspectioneering.com/blog/2017-12-29/7240/oshas-top-10-violations-from-2017>

Temperature/humidity/wind

OSHA: https://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_4.html

Contact temperature

Faculty of Jussieu: www.ergonomie.chups.jussieu.fr : Diplôme d'ergonomie et de physiologie du travail - Option 2: Ergonomie de l'ambiance physique et psychosociale (Faculté de Médecine Pitié-Salpêtrière - UPCM).

[fihttps://www.economie.gouv.fr/files/files/directions_services/cnc/Avis_CSC/2012_AVIS_RADIATEURS_ELECTRIQUES.pdf](https://www.economie.gouv.fr/files/files/directions_services/cnc/Avis_CSC/2012_AVIS_RADIATEURS_ELECTRIQUES.pdf) (pages 13 à 15).

Predicting Temperature Limit Values for Cold Touchable Surfaces - *EU-project ColdSurf SMT4-CT97-2149 (1997-2000)*.

Electricity

<https://www.cdg62.fr/index.php/prevention/hygiene-et-securite-au-travail/11-prevention/309-le-risque-electrique#a>



see the effects of electricity.

click the picture to

Pressure

IRRST: <http://www.irsst.qc.ca/media/documents/pubirsst/R-285.pdf>

See ARIA database for REX: <https://www.aria.developpement-durable.gouv.fr/accidentologie/equipements-sous-pression/>

Hyperbaric risk

Ministry of Health (France): <http://travail-emploi.gouv.fr/sante-au-travail/prevention-des-risques/autres-dangers-et-risques/article/activites-en-milieu-hyperbare>

Risks associated with human and organizational factors

Brochure "Analyse de l'activité humaine dans une situation de travail : Intégrer les Facteurs Humains et Organisationnels": <http://wat.corp.local/sites/s215/fr-FR/Pages/actualites/2018/P-NOEL-.aspx>