

Risk Type	Subtype	Applicable to System Types	Cause	Risk Assessment	Measures; Relevant Regulations	Implementation of Measures	Applicability				
							Installation ¹⁾	Operation ²⁾			
								Acting of Staff ³⁾	Inspection ⁴⁾	Maintenance ⁵⁾	
Mechanical risk	Randomly moving of parts	all	Extinguishing agent line (pipe or hose) is moving while the extinguishing agent escapes	Increased risk in case of high operating pressures who may occur especially with gas extinguishing systems using high operating temperatures	Inspect connection of pipes and hoses after installation and during periodic inspections; inspect pipe mounting for tight connection and; if applicable, document		x		x	x	
		all	Extinguishing agent container is not protected against toppling	Toppling extinguishing containers may injure persons	Use suitable mountings; check during periodic inspections	Only use components with proven suitability		x		x	x
		all	Damages of the mounting of the extinguishing agent containers due to mechanical or corrosive impact	Secondary damages may occur due to detached or damaged components; mainly risk of uncontrolled discharge of propellant and/or extinguishing agent, repulsion powers may cause the container to fly across the room and injure persons	Avoid accidental deployment when mounting and removing, especially in case of gas containers; keep the nozzle closed until the container is brought in a safe position	Assembly and maintenance of the extinguishing system must be conducted by instructed personnel				x	x
		all	Loosening or detachment of the mounting of the extinguishing agent container or pipes due to vibrations		Conduct assembly and installation in a way that guarantees that the container and the pipes are not affected by any vibrations If this is impossible, check the connections regularly in shorter intervals; use attenuator if applicable	Select suitable mountings; reconsider choice of site; adapt inspection intervals to the mechanical load; if applicable schedule checks to be conducted by the operator in addition to the required inspections		x		x	x
		all	Objects are pushed over by escaping extinguishing agent	Low risk if objects are pushed over by a stream of extinguishing agent If, however, the object contains combustible liquids, its content may be released and lead to an unexpected extension of the burning area	Consider the environment of the burning area when selecting the nozzle types and their arrangement Check during inspection whether the operating environment changed			x	x		x

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Mechanical risk	Randomly moving of parts	all	Increase of pressure in the object or the room due to escaping extinguishing agent; especially in case of gas extinguishing systems and chemical extinguishing agents	Even small increase of pressure may cause damages to or total destruction of the housing or parts of the building	release, if natural pressure release cannot be guaranteed through existing vents that cannot be blocked Design must be according to the technical regulations in force	Verify necessity and prove acceptability of installation; check function during maintenance	x		x	x
	Slipping	Aqueous extinguishing agents	In accessible protection areas, a puddle of liquids may reduce the stiction between footwear and floor	Risk of injury by tumbling		Clean circulation spaces before re-entering		x		
Electrical risk	Electric shock	Especially aqueous extinguishing agents	If liquid extinguishing agents coat a live electrical system, a person touching the system or walking into the room may get a flashover.	High risk of death		Instruct the employees; during or after operation of the extinguishing systems, switch off the electrical systems if applicable; conduct professional cleaning		x		
		Aqueous extinguishing agents	Electrical flashover in aqueous extinguishing agents spreading over the floor as a puddle and thereby building a connection to live parts of electrical systems (e.g. loose-hanging cables)	High risk of death		Verify that the working place is correctly equipped with suitable fire extinguishers as; if applicable, do not use aqueous extinguishing agents Instruct employees	x	x		
	Electrostatic charges	Carbon dioxide extinguishers and extinguishing powder	Escape of extinguishing agent leads to electrostatic charges	The employee may be frightened by a discharge In general, injuries are impossible	Define measures for prevention of electrostatic discharge	Instruct employees	x	x		
Hazardous substances	Contact of skin and hazardous substances	all	Extinguishing agents may get in contact with the skin of the person using the extinguishing system	Low risk; no health hazard; however a short skin irritation is possible	Rinse contaminated skin areas	Provide safety data sheet for extinguishing agents; instruction	x	x		
			Substances resulting from the fire (smoke, soot, etc.) may be toxic	Substances resulting from the fire that may deposit on the skin may lead to skin irritations; the risk depends on the type of substance		Clean contaminated skin areas by rinsing; if applicable, take measure according to the special substances resulting from the fire		x		

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Hazardous substances	Inhaling of hazardous substances	Carbon dioxide extinguishers	Carbon dioxide impairs breathing even in low concentrations and may lead to health problems	High risk of death because air charged with carbon dioxide may lead to unconsciousness or death when in high concentrations The risk is especially high in sunken rooms due to the fact that carbon dioxide is heavier than air	Observe critical values according to CEA 4001, CEA 4008, CEA 4045 and EN 15004	Identify risk for staff; plan extinguishing system and safety measures according to the risk (signage, evacuation before activation, odorisation, etc.). After activation of the extinguishing system, reenter danger area only after clearance. Block the flooded area for visitors and outside companies or give instruction on behavior in case of activation; if applicable put the extinguishing system out of service if safe evacuation cannot be guaranteed in case of activation. During maintenance work, check whether the operating conditions changed; complete signage and instruction. Verify free accessibility, signage and possibility of opening escape ways and doors	x	x	x	x
		Inert gases	Inert gases such as nitrogen or argon reduce the oxygen concentration of the air during extinguishing	Low to high risk because reduced oxygen content may result in shortness of breath or even suffocation			x	x	x	x
		Extinguishing powder	Extinguishing powder escapes, spreads out as a cloud and may be inhaled by employees	Low risk; no health hazard; however, a temporary irritation of the respiratory system is possible; panic or anxiety states are possible		Instruction of the employees; evacuation of the protection area when extinguishing system is activated		x		
		Chemical extinguishing agents	When inhaled, chemical extinguishing agents may have a toxic or physiological effect, depending on the concentration	Low to high risk	Observe critical values according to CEA 4001, CEA 4008, CEA 4045 and EN 15004	Measures as in case of carbon dioxide and inert gases Identify risk for employees; design the extinguishing system and safety measures accordingly; after activation of the extinguishing system, reenter danger area only after clearance. During maintenance work, check whether the operating conditions changed	x	x	x	x
		all	The activation of extinguishing systems is part of firefighting operations Gases generated in a fire may be toxic	Inhaling of fire gases may lead to breathing problems and intoxications or even to suffocation		Leave fire area immediately and reenter only after clearance.		x		

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Hazardous substances	Explosion risk	Powder and carbon dioxide extinguishers	Escaping extinguishing agent leads to electrostatic charges	In areas with an explosion hazard, discharge as a result of electrostatic charges may lead to an ignition spark that could cause an explosion	Initiate measures for prevention of electrostatic charges In areas with a risk of explosion, prevent accidental activation of extinguishing systems.	The extinguishing system controls must impede accidental activation; Instruction of the employees	x	x		x
Fire and explosion hazard	Fire protection installations are not available or inoperable	all	Firefighting is impossible because the extinguishing system is not in working order	Increased risk of fire damage due to inoperative or unavailable protective measures Firefighting and if applicable self-rescue from a burning area are impossible	Manual must include information on obligations to check and inspect; determine intervals based on manufacturer's recommendation; select suitable technical experts and qualified persons Document conducted inspections and checks by keeping records	Guarantee operability of the extinguishing systems; regular checks concerning manipulation by the operator; regular maintenance and inspection; observe the operating manual	x	x	x	x
Thermal hazard	Cold media/surfaces	Carbon dioxide	Carbon dioxide expands during escape from the extinguishing nozzle. The extinguishing agent stream cools down to -78 degrees Celsius	Frostbites after contact with the extinguishing agent or the extinguishing agent container or components carrying the stream of extinguishing agent	Use intended operating devices	Instruction of the employees		x		
Special physical effects	High pressure	all	Loosening of connections as a result of vibrations	Loose connections may lead to leakage Components may loosen due to the high pressure	Conduct assembly and installation of the system in a way that guarantees that the system is not affected by vibrations. If this is not possible, check connections in shorter intervals	Reconsider choice of site; adapt inspection intervals to the mechanical load Schedule checks to be conducted by the operator, if applicable in addition to the required inspections; if applicable, use attenuators	x		x	
		all	Damage of the container walls due to vibrations	Vibrations may cause abrasion between mounting and container which leads to a risk of damage of the container wall and eventually its breakdown			x		x	
		all	Damage of the container walls or pieces of equipment under pressure e.g. by means of transport, persons or moving machine parts after strike or collision (e.g. on transport or traffic routes)	Damage of the container and/or the equipment parts under pressure may lead to explosion of the container, leakage and escape of extinguishing agents		Schedule and conduct periodic inspections	x	x	x	x

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Special physical effects	High pressure	all	Damage of the container wall or pieces of equipment under pressure by aggressive substances or permanent influence of humidity		Positioning of the container in a place protected from substances, if applicable, use protective covers or housings	Schedule and conduct periodic inspections of the installation conditions; determine protective measures; reduce intervals of inspection in accordance with the level of influence; self-checks to be conducted by the operator	x		x	
		Carbon dioxide	Unallowable increase of pressure due to exceeding of the maximum allowable operating temperature	The extinguishing agent escapes after the bursting disc ruptured	Avoid solar radiation and other sources of heat; select an installation place in which the carbon dioxide escaping through the bursting disc cannot put any persons at risk Protect especially the extinguishing agent container against toppling		x		x	x
		all	Material aging	Risk of breakdown when put under pressure in case of components that may undergo changes of their properties during their working life due to the materials used in their production		Observe manufacturer's information on working life and inspection periods	x	x	x	x
		all	Breakdown of the container as a result of corrosion of the outer face	Risks due to bursting of the extinguishing agent container; severe injuries of persons possible		Select an installation place that prevents corrosion Regular checks; maintenance and inspection according to schedule; decision to continue operation in case of exceeded inspection period	x	x	x	x
		Extinguishing systems with mobile pressure devices	Breakdown of containers as a result of exceeded inspection period	Risk due to bursting of the extinguishing agent container; severe injuries of persons possible		Decision of the operator: if containers are not empty, mobile pressure equipment may be used until the inspection period passed twice if there are no operational risks. Assessment and documentation must be conducted by a person authorized for inspection			x	

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Special physical effects	High pressure	Aqueous extinguishing agents	Breakdown of the container as a result of inner face corrosion	Risk due to bursting of the extinguishing agent container; injuries of persons possible Unavailable fire protection due to failure of the extinguishing system	Regular checks of the internal coating of the container (if applicable); containers made from stainless steel may leak due to the manufacturing process, especially along the welded seams; conduct periodic inspections of the containers	Observe maintenance and inspection periods; in case of special conditions, shorter intervals are recommendable			x	x
Special physical effects	Uncontrollable physical and chemical reactions	all	Use of unsuitable extinguishing agents when fighting metal fires	Explosive reactions (intense chemical reaction) due to decomposition of the extinguishing agent because of high temperatures occurring in metal fires. The risk is especially high when aqueous extinguishing agents are used	Observe technical guidelines and information on metal fires	Use extinguishing agents that are suitable for the purpose and tested and approved for the scope of application	x	x		
		Containers with aqueous extinguishing agents	Damages to the container wall due to freezing	The container may be damaged when the extinguishing agent freezes which may lead to its bursting	Positioning in consideration of the allowable operating temperatures Use only frost-resisting extinguishing agents in unheated working places and outdoors	Observe maintenance and inspection periods; in case of special conditions, shorter intervals are recommendable	x			
	Noise emission	all	Escaping extinguishing agent causes extreme noises, especially with gas extinguishing systems	Low risk; however, it may result in confusion and consequently a panic reaction and disorientation	Mandatory instruction of employees especially with object extinguishing systems which do not require an advance warning time before evacuation	Instruction		x		
Conditions of the working environment	Dust pollution	Extinguishing powder containers	Escaping extinguishing powder may lead to visual obstructions	Possible disorientation; compromised evacuation and use of escape paths; risk of panic reactions	Avoid extinguishing powders in public buildings and especially in escape paths for large crowds	Use suitable extinguishing agents; Instruction of the employees	x	x		

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- ¹⁾ The installer/manufacture of the extinguishing system must guarantee compliance of the system with the requirements of the legal regulations and technical guidelines in force.
The installer/manufacture must prove the extinguishing capabilities and operational safety in consideration of the expectable operating conditions
 - ²⁾ The employer is responsible for the employees' actions during operating life of the system.
The employer must arrange for the instruction of the employees and the conduction of the necessary maintenance measures and required inspections.
 - ³⁾ The correct acting of the employees depends mainly on the provided operating manuals and instructions.
The employer is responsible for this.
 - ⁴⁾ The operator must determine the inspection periods, competences and scopes of the inspections based on the installer/manufacture extinguishing system information.
Intervals for the inspections must be determined in accordance with the identified hazards.
 - ⁵⁾ Measures, inspection intervals and experts required for regular maintenance work must be determined in consideration of generally accepted rules of technology and the operating conditions.