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DEVELOPMENT AND PRACTICE OF ACCESS AUTHORIZATIONS FOR WORKS IN CONFINED SPACES IN THE WATER UTILITIES SECTOR

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Abstract
We present the work permit system for the most common operations in the water utilities sector and the hazards of confined work. In addition to outlining the options for employer action under the regulations, the mechanism of the authorization procedures is outlined. On this basis, a detailed form for an access authorization has been developed and a guide outlining the obligations and responsibilities of employers and workers involved in the authorization process has been produced.

Keywords: *water utilities sector, on-boarding, safety at work*

1. Introduction

Our model boarding permit and its instruction manual can provide comprehensive assistance for boarding work that is part of the daily work of water utility companies, but which is considered hazardous. When issuing a boarding permit, it is often difficult to fill in the form correctly and to clarify and record responsibilities, while considering the specificities of the boarding work. The documents produced by our work set out the requirements and propose the procedure for issuing an embarkation permit, taking into account the technological specificities of the water utility companies. A permit that complies with the regulations and takes into account the characteristic of the work is the basis for making boarding work safer.

2. Regulatory tools for boarding works

In order to ensure safe and healthy working conditions, the requirements, the monitoring of compliance with those requirements and the means of monitoring should be defined. Standards set out the specific (normative) values to be met, including the management and control tasks of occupational safety and health (Feicht, 2015).

In Hungary, the safety requirements for working in dangerous equipment are regulated by the Act XCIII of 1993 on Occupational Safety (Mvt.), and the standards are MSZ-09-57.0033-1990. In addition, the individual branches also have their own regulations. For example, the Water Safety Regulation is defined in the Decree 24/2007 (VII. 3.) KvVM. The application of the standard is regulated by Mvt. According to § 11 of the Act on National Standardization, a national standard with a full Hungarian-language content on occupational safety and health is considered a rule on occupational safety and health, taking into account the Act on National Standardization. Employers are thus obliged to use the provisions of standard MSZ-09-57.0033-1990 for all work involving boarding.

3. Types of work permits

The general requirement for organised work, with the right staff and equipment, to regulate the performance of tasks. Employees (including, of course, employees of water utility companies) may carry out the tasks defined in their job descriptions in the manner laid down in the work instructions without the need for authorisation. This includes minor maintenance and installation work necessary for the operation of water utilities. These tasks may only be carried out by workers who have a job description or a mandate for the activity, have the appropriate qualifications and have received theoretical and practical training in the work (FGSZ, 2018). In general, three types of work permits are distinguished for water utility companies:

- work permit,
- occasional activities involving a fire hazard (e.g. welding, flame cutting, etc.),
- permit for work with boarding (work in a manhole, tank, hydroglobe bus, etc.).

In the next chapter, we look at the latter in more detail.

3.1. Formal and substantive requirements for boarding permits

Entering, cleaning, maintenance, repair or modification of dangerous equipment may only be carried out in the presence of the head of the department using the equipment for its intended purpose (the head of the workplace of the operator) or his representative, or of the head of the workplace (the head of the workplace of the person carrying out the work), or of a person authorised to carry out such work, on the basis of a permit issued by the head of the department (the head of the workplace of the operator) or his representative. The form of the permit for boarding is proposed in Appendix 2 of the relevant standard, but in all cases the permit must be drawn up on the basis of the characteristics of the work to be carried out (Tasi, 2012).

The permit must be drawn up in duplicate, the original must be kept at the place of work, cancelled after the work is completed and the copy that remains with the permit holder must be kept on file (according to the relevant standard, it must be kept for at least one year).

The boarding pass shall specify the minimum (according to point 6.2 of the relevant standard):

- the equipment in an identifiable way,
- the task to be done,
- the name and signature of the authorising person,
- the name and signature of the person responsible for managing the work,
- the names of the people involved in the work,
- a list of operations in preparation for boarding, and
- a list of the required protective equipment.

It is also included in the sample in the appendix of the relevant standard:

- how and when to clean, check
- separation operations and their control
- results of airspace analysis and ventilation operations
- additional necessary measures (fire extinguishing conditions, lighting, need for spark-proof tools, deactivation of radiation-hazardous process instruments) [ISO-09-57.0033:1990]

An access permit may only be issued for one shift or one working day, and in the case of continuous work, the circumstances must be checked daily, and a new permit issued. To complete the access permit, the person authorising access must have a good knowledge of the standard, safety procedures and technological characteristics. The standard MSZ-09-57.0033:1990 does not contain a decision flow chart for the permit procedure, which would be helpful for the issuance of boarding permits in the water utility sector. Part 146 A of US-OSHA (United States Occupational Safety and Health Administration) Standard 1910 contains a decision flow chart, and the following general diagram for the Hungarian standard has been created based on this (Figure 1).

Flammable and explosive vapours, gases, liquids, corrosive, toxic or infectious substances may be present in waterworks, pipelines and process tanks.

3.2. Procedure for issuing and issuing boarding permits

The work permit determines what work boarding workers can do. The boarding pass completion guide helps the person responsible to enter the information correctly and accurately on the boarding pass. The water utility companies do not use a guide for issuing boarding permits, but this "pre-codes" the possibility of errors by the workplace managers, especially in the absence of sufficient experience and knowledge. The following model document (Figure 2) provides detailed point-by-point guidance on how to fill in the form correctly:

0. Basic data for on-board work:

- The details of the client of the work carried out by boarding, the operator of the work area or equipment concerned (as the issuer of the boarding permit) and the person carrying out the work as the permit applicant must be entered.
- The location and designation of the equipment or technology concerned must be indicated precisely and clearly (without confusion).
- The work permit is for one occasion, one shift, so the duration of the work must be specified in relation to this (from when to when).

1. Names of employees/supervisors and details of their qualifications:

- The details of the persons performing boarding work (boarders), the observers must be provided with the required qualifications (fire safety qualification).
- The most important data for the issuing of a permit include the details of the permit issuer, the permit applicant and its work manager, and any necessary operators or supervisors.
- Participants must sign the boarding pass to confirm their acceptance, failing which boarding will not commence.

2. Nature of activity, hazardous conditions and hazardous substances present:

- By specifying the nature of the work, the type of work is recorded, as the permit to board is for a specific work, the preparation, detachment and conditions are specified accordingly.
- By identifying sources of risk, boarding workers can be prepared for the risks and it can be decided whether the preparations and disconnections to be indicated later are complete.

- The list of material properties and hazardous substances provides guidance for the necessary airspace analysis and selection of protective equipment. In providing this information, water utilities should also take into account the technology of the dischargers connected to the network (e.g. industrial effluents from industrial plants) when carrying out works involving the connection of the sewerage network.

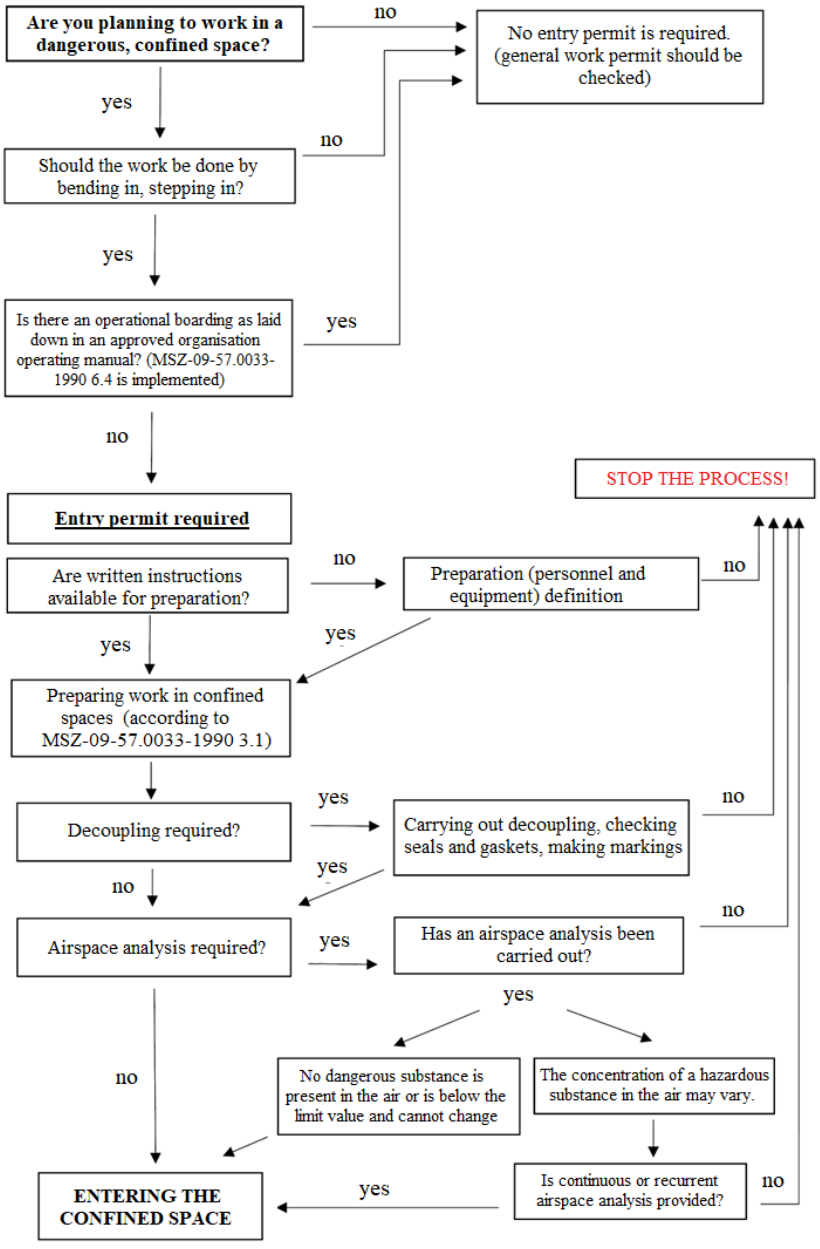

Figure 1. *Decision flow chart*

CONTRIBUTOR:	**Permit serial number:**

0. BASIC DATA FOR WORK WITH BOARDING

Order number / contract number:

Facility/Technology:	**Exact location of work:**	**Name of the company:**
A precise description of the work:		

Working time: from day of the month, year month day from hour of the day of the year, hour minute

1. NAMES OF WORKERS/SUPERVISORS AND DETAILS OF THEIR QUALIFICATIONS

Persons authorised to carry out the work	**Fire safety examination**		**Signature of employers**
	Identifier/Art.fig.1	**Identifier/Art.fig.2**	
1.			
2.			
3.			
4.			
5.			
Persons responsible for supervision	**Fire safety examination**		**Signature of employers**
	Identifier/Art.fig.1	**Identifier/Art.fig.2**	
1.			
2.			
3.			

The Contractor shall take into account that, despite the safety measures taken, the presence of risk sources still represents a potential danger and shall carry out his work in the knowledge of this, and shall instruct his employees to do the same.

	Name (printed)	**Contact**	**SUBSCRIBE**
Authorisation Applicant / Boarding Executor			
On-site work manager			
Authoriser / Operator			
Operational supervision			
Others concerned			

2. CHARACTERISTICS OF THE ACTIVITY, AVAILABLE LIQUID MATERIALS, LIQUID MATERIALS (mark with an X)

Nature of work:	Welding/ soldering	Machine/technology installation	Electrical work
Instrumental work	Pressure test	Review by	Lifting/ Dismantling
Scaffolding	Earthworks	Insulation	Painting, surface treatment
Masonry work	High pressure cleaning	Other:	Other:
Hazard sources:	Moving, rotating machine parts	Risk of collapse (collapse/impact)	Falling objects
Noise / vibration	Electricity	High pressure (gas, liquid)	Extreme temperatures
Hydraulics / Pneumatics	Unclogging	Inert atmosphere, lack of oxygen	Parallel works
Infection, biological hazard	Insufficient ventilation	Fall / fall down	Insufficient lighting
Drowning	Burning hazard	Frost risk	Other:
Material characteristics:	Robb hazardous material	Flammable material	Toxic substance
Throttling / suffocating material	Corrosive substance - acid/alkali	Hot surface / material	Infectious material
Radioactive material	Red-hot, self-heating material	Other:	Other:
Hazardous substances:	Methane (CH4)	Hydrogen sulphide (H2S)	Hydrocarbons
Nitrogen oxide (NOx)	Carbon monoxide (CO)	Waste water	Chlorine and its derivatives
Ozone:	Other:	Other:	Other:

3. GENERAL PREPARATION OF THE WORKSITE (mark with an X)

Delimitation (method):	Cleaning the area	Insulation/demolition	Providing manhole, manhole cover
Work area closure	Construction of scaffolding	Escape route marking	Placing a security sign
Protection against falling in/out	Covering with wet tarpaulin	Area watering/wetting	Other: .....

☐ General site preparation not required
☐ The general preparation and provision of the work area/equipment has been done according to specifications.
Comment: .....

Celtic, ...
name and signature of the preparer

4. PREPARATION, REPAIR OF SENSITIVE DEVICE(S) (mark with X)

Carrying out an inertia test	Placing under an inert atmosphere (if technology requires)	Free opening/ Mechanical ventilation	Marking isolation points
Washing with water	Roughing	Material-free cleaning	Preparation for fire work
Preparing for boarding	Preparation for review	Drain	Other: .....

☐ Preparation and cleaning of equipment before boarding not required
☐ The equipment has been prepared and cleaned according to specifications.
Comment: .....

Celtic, ...
name and signature of the preparer

5. REPLACEMENT OPERATION(S) OF SENSITIVE ENVIRONMENT(S) (mark with an X)

No technological connection	Heating disconnection / deactivation	No instrument connection	No electrical connection
Shutdown	Pipe section packing	Rotating part mechanical locking	Electrical disconnection, log number: .....
Separation with split fitting (opening of intermediate free	Pressure relief	Disable instrument link	Electrical isolation and earthing
Blinding (instruction ssz:.....)	Disconnection with occasional shut-off (e.g. hose clamp)	Preventing unauthorised boarding/entry	Other: .....

☐ Disconnection of equipment before boarding not required
☐ The equipment has been disconnected as required.
Comment: .....

Celtic, ...
name and signature of the person who carried out the separation

6. DATA FOR AIRSPACE ANALYSIS (combustible gas - ARH, oxygen concentration, toxic gases)

Instrument and measurement data		**Measurement results**			
Type of instrument		**Measurement time**	**Measured characteristic**	**Value**	**Minor.***
Instrument ID			Combustible ARH [%]		
The benchmark for instrument calibration gas:			Oxygen [v/v%]		
Verified condition (bump test/calibration) compliance?			Toxic gas [mg/m3] (CH4 / H2S /NOx)		
Person who carried out the measurement (name, position)			Other:		
Periodic measurement required	..... per hour	**Measurement time**	**Measured characteristic**	**Value**	**Minor.***
Periodic measurement of measured characteristic			Combustible ARH [%]		
Periodic measurement required	..... per hour		Oxygen [v/v%]		
Periodic measurement of measured characteristic			Toxic gas [mg/m3] (CH4 / H2S /NOx)		
Continuous measurement required	yes / not		Other:		
Comment		**Measurement time**	**Measured characteristic**	**Value**	**Minor.***
			Combustible ARH [%]		
			Oxygen [v/v%]		
			Toxic gas [mg/m3] (CH4 / H2S /NOx)		
			Other:		

* Rating: M - meets / NM - does not meet

☐ B Airspace analysis of erendezés not required
☐ The airspace analysis of the installation has been carried out in accordance with the specifications .
Comment: .....

Celtic, ...
name and signature of the person who carried out the airspace analysis

7. SAFETY TECHNICAL CONDITIONS, MINIMUM APPLICABLE DEFENCE DEVICES, REQUIRED BY THE CONTRACTOR (to be marked with an X) (to be marked with an X)

Commission technical regulation	Protective equipment required and available	Detailed Operating Instructions required	Rescue plan required
RB Electrical equipment, lighting	Non-sparking tools	Extra-low voltage devices	Isolating transformer
On-site coordination required	First aid equipment, type:	Ongoing communication (URH/ Visual/ Signposting/ .....)	Supervision required for the ..... by, Continuous/... per hour
.....type, ... fire extinguisher	..... size, ... fire blanket	Alk. permit flammable activity.	Other:
Protective equipment	Protective footwear	Antistatic protective clothing	Eye and face protection for welding
Head protection	Hand protection mech. prote.	Other body protection	Headlamp, work lamp
Eye protection	Hand protection chemical protection.	Bottle (compressed air) respiratory protection	Rescue sling, rescue scaffold
Arc protection	Hand protection against heat v.	Hose/fresh air breathing protection	Anti-fall harness + rope
Hearing protection	Flame resistant protective clothing	Compressed air breathing protection	Other:

8. END OF ACTIVITY / CLOSURE OF AUTHORISATION

Full completion, closure of work	Continuation of work with a new authorisation	Extraordinary closure of work

Comment:

Claiming is compulsory!

	Name	**Position**	**Signature**
Authorisation applicant / On-site manager			
Authoriser (representative)			

Completion, end date - year month day hour minute

One copy of the permit is for the person performing the Work (to be kept on the premises), one copy for the Licensor, and one copy for each additional person involved in the exhibition!

Figure 2. *Model for the authorisation of boarding in the water utility sector*

3. General site preparation:

- In this section, operations that facilitate boarding in the broader working environment of boarding work are described. In areas affected by road or site traffic or other construction work, the work area must be delimited and marked, and the conditions for escape and for keeping openings free (fixing of cover plates) must be provided.
- If the boarding requires the construction of a scaffolding, the documentation for the use of the scaffolding must also be attached to the work permit.
- The person who prepares the work area shall sign a certificate attesting to the preparatory operations carried out and indicated in this point.

4. Preparation and cleaning of the equipment(s) concerned:

- According to the relevant standard, written instructions for the preparation must be drawn up or specific requirements must be defined. Such requirements (e.g. protective equipment for preparation, area containment, neutralisation, etc.) should be included in the comment box next to each preparation or cleaning operation. The extent and time of mechanical ventilation, the amount of washing or rinsing may also be indicated.
- The person who prepares the equipment shall sign the document certifying that the preparatory operations referred to in this point have been carried out.
- In the case of water utility companies, the preparation tasks should be carried out by a person or department who is familiar with and operates the technology and equipment.

5. Disconnection operation of the equipment concerned:

- Similar to the preparation operations in point 4, the necessary separations should be specified. If the equipment is not connected to any other technology, electrical system or even to installed instrumentation, this must also be indicated in the permit.
- If a documented (e.g. recorded, worksheet), instructed operation is carried out during the separation, it should be indicated in the relevant section or in the comment box.
- The decommissioning of the equipment is carried out by a department familiar with the technology, as for the preparation, and the person carrying out the decommissioning must sign the decommissioning operations carried out and indicated in the permit.

6. Data on airspace analysis:

- Only instruments that have been certified, tested and calibrated before use should be used.
- For the measurement of the measured characteristics, the following should be taken into account with regard to the measured values:
  - in the case of toxic gases, respiratory protection or restraint should be determined depending on the concentration level (CK, MK value)
  - for flammable substances, according to the lower explosive limit (ARH):
    - if the concentration ≤ 5 % of ARH, work may be carried out with a risk of fire
    - if ARH 5 % < concentration ≤ ARH 10 %, no flammable work can be carried out
    - if the concentration ≤ ARH 20 %, entry may be permitted, but only for cleaning and testing operations
    - if ARH 20 % < concentration, work is prohibited.
  - for measured values of oxygen concentration:
    - if the oxygen content can fall below 17 % tf, continuous measurement is required,
    - if the oxygen content is less than 17 % tf, an isolation respirator should be used.

- If the measured concentration is less than the permitted value and it is clear that it will not change during the work, the measurement should only be carried out before boarding, but if the contamination may increase, the air analysis should be repeated during the work.
- It is the responsibility of the boarding contractor to carry out continuous airspace measurements and to provide the personal airspace measurement device, but the airspace analysis in preparation for boarding clearance shall be carried out by the authorising operator.

7. Applicable safety standards to be observed by the worker (applicant), minimum protective equipment to be used:

- In this section, the information required can be divided into two groups: work equipment, collective protection, other protective equipment and procedures, and types of personal protective equipment.
- If a detailed operational instruction is available, its number and identification must be indicated in the authorisation, and the same applies to the rescue plan.
- The fire extinguishing equipment (type, number of pieces) to be used in the case of a fire hazard activity, as well as the work equipment and electrical equipment to be used in the case of an explosive atmosphere must be specified. The operator issuing the access permit must specify the protective equipment required for access in the case of personal protective equipment, and the worker must specify the protective equipment required for work in the equipment in confined spaces. However, both parties must agree on the compatibility and usability of each piece of protective equipment (e.g., in the case of respiratory protection, the suitability of a mask and face or eye protection together).

8. End of activity, closure of authorisation

- At the end of the boarding, the boarding and the permit issuer assess the work, any emergencies and sign the boarding permit.
- The work may also be closed down if the conditions set out in the access permit are not fulfilled and the access is directly dangerous.
- In the event that the work is to be continued (on another day or shift) and a new permit is to be issued, this must also be indicated.

The permit specifies the person or persons responsible for coordinating the work and giving instructions to the boarding workers. A very important procedural process can be that the work permit is always checked by a second person, who reads it and confirms that the safety measures specified in the permit are appropriate and then countersigns it - this is called the "four eyes principle". The involvement of a work safety specialist in the inspection of boarding work can be an important consideration on this basis

4. Summary

You may only enter or start work on dangerous equipment on the basis of an entry permit issued by the operator using the equipment for its intended purpose and in the presence of a manager responsible for the direction and permanent supervision of the work.

An accident at work or even death can be the direct consequence of inadequate preparation for work with boarding, or the improper issue of boarding passes. The large number of boarding jobs means that in many cases the issuing of permits becomes routine, or in the worst cases may not be necessary. Water utility companies do not use any instructions or manuals for issuing boarding permits, but this means

that the possibility of errors is "pre-coded" for the managers on the job, especially in the absence of sufficient experience and knowledge. The need to carry out ad hoc tasks as quickly as possible (e.g. burst pipes, repairs of a havoc nature) can lead to missed inspections, and boarding can be delayed by omitting preparation, disconnection or airspace analysis. Due to inadequate preparation of workers and failure to provide the necessary protective equipment, uncontrolled work can have serious consequences.

The safety of boarding work therefore depends to a large extent on whether the employer has complied with its legal obligation to issue boarding permits properly. On the other hand, it also depends on the training and professional experience of those issuing the permit, and on whether the procedure for issuing the permit is properly regulated by the employer. Once familiar with the requirements and conditions detailed in this thesis, water utility companies can put in place good practices for authorising boarding work by using the boarding permit and its completion guide in the Annex.

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