Measure of the Director

of the Central European Institute of Technology of Masaryk University

No. 2/2024

Operational Safety Regulation for the Operation, Handling and Maintenance of Pressure Vessels

(wording effective as of 1st March 2024)

Pursuant to Article 7 (4) g) of the Rules of Organization of the Central European Institute of Technology of Masaryk University and pursuant to the provisions of Act No. 250/2021 Coll., on occupational safety in connection with the operation of reserved technical equipment and on amendments to related acts, Government Order No. 192/2022 Coll., on reserved technical pressure equipment and requirements to ensure their safety, ČSN standard 69 0012 - Stable pressure vessels. Operational requirements, and pursuant to the Chancellor's Guideline No. 10/2009 Determining the organization of ensuring occupational safety and health at work within MU, I hereby issue the following Measure:

Article 1

Subject Matter

(1) The purpose of this Measure of the Director of CEITEC MU (hereinafter the "Measure") is to regulate the operation of pressure vessels so as to reduce, to the maximum extent possible, the risk of extraordinary events and occupational injuries of employees operating these appliances. This Measure further points out particular life and health threatening hazards occurring during the work with these appliances and specifies possibilities of their reduction.

(2) This Measure applies to the operation, handling and maintenance of pressure vessels at CEITEC MU. It is binding on all employees and other persons involved in the aforementioned activities.

Article 2

Definitions

(1) The following pressure vessels and boilers with a maximum working pressure greater than 0,5 bar are considered as reserved pressure equipment:
   a. steam and liquid boilers whose maximum working pressure exceeds 0,5 bar and the temperature of the working liquid exceeds the boiling point of the working liquid at this pressure;
   b. pressure vessles whose maximum working pressure exceeds 0,5 bar and which:
      i. contain gases, vapours; or
      ii. corrosive, toxic and explosive liquids of Group 1 at any temperature; or
      iii. any liquids having a temperature above their boiling point at a pressure of 0,5 bar;

iv. steam/steam and hot water/steam steam generators and steam generators without overheating hazard are also considered as pressure vessels;

c. gas containers used to transport gases whose critical temperature is less than + 50 °C or whose absolute vapour pressure (tension) at + 50 °C is greater than 3 bar from the source to the point of consumption.

(2) A revision technician is a professionally qualified natural person (individual) authorized to carry out revisions and tests of reserved technical equipment who has a certificate of professional competence issued under Act No. 250/2021 Coll.

(3) Maintenance is an activity carried out on the reserved technical equipment or its parts to ensure safe and serviceable condition of such equipment, except for repairs or installation of the reserved technical equipment.

Article 3

Documentation

(1) The following documentation must be permanently available for each pressure vessel:

a. revision book - manufacturer's passport, in which, among other things, the construction test and initial pressure test are confirmed; it is kept on file by the relevant worksite;

b. instructions for use of the pressure vessel prepared by the manufacturer of the equipment; the instructions are kept on file by the worksite to which the equipment belongs;

c. manuals of manufacturers of individual machinery, which describe in detail the procedure for starting up, operating and shutting down machinery outside pressure vessels and these manuals are binding for the operation of the equipment; the manuals are kept on file by the worksite to which the equipment belongs;

d. declaration of conformity, which the manufacturer of the equipment is obliged to provide in accordance with the requirements of Act No. 22/1997 Coll., on technical requirements for products, as amended, i.e. that the products meet the requirements of applicable legislation for this area; the declaration of conformity is kept at the worksite to which the equipment belongs;

e. revision reports, both for electrical equipment and individual machinery units; revision reports are kept by the Operations Department;

f. the appointment of the person responsible for the operation of pressure vessels, which must be made in writing and signed by a representative of the organisation and the acceptance of which must be confirmed in writing by the person responsible for the operation of pressure vessels; the duties of the person responsible for the operation of pressure vessels are set out in Annex to CSN 69 0012. A model authorization of the person in charge is set out in Annex No. 2 hereof.

(2) All documentation must be available to the person in charge of pressure vessels, the Operations Department and the revision technician.

Article 4

Personnel Training and Competence

(1) Reserved pressure equipment may only be operated by designated personnel over 18 years of age, physically fit and practically trained.

(2) Any new employee who will be working with reserved pressure equipment must be notified well in advance to the Operations Department to ensure their physical fitness and professional competence.

(3) The operators must undergo periodic training and re-testing once every 3 years. Training is provided by the Operations Department with an external pressure equipment revision technician.

(4) Each research group operating reserved pressure equipment is entitled to reimbursed training for two CEITEC MU employees. This training takes place in spring each year in both Czech and English. Additional training can be provided on an individual basis in coordination with the Operations Department; the payment for that training is charged to the relevant research group.

(5) The training validity can be checked here: https://inet.muni.cz/app/osoby/persdata.

(6) The Operations Department collects records of all training and, once entered into the personnel system, such records will be kept in the personnel files of employees.

(7) Employees must be trained on the specific equipment. Instructions for use are available for example here: https://is.muni.cz/auth/do/ceitec/bozp_po/manualy/. This shall be ensured by each worksite.

Article 5

Safety Requirements Applicable to the Equipment

(1) A list of reserved pressure equipment with technical descriptions and persons in charge is available here: https://is.muni.cz/auth/do/ceitec/bozp_po/vyhrazena_technicka_zarizeni/vyhrazena_tlakova_zarizeni/.

(2) The vessels must be equipped with:
   a. shut-off and drainage valves;
   b. pressure gauge;
   c. safety device;
   d. venting cap.

(3) It is not necessary to equip the vessel with a pressure gauge and a safety device if the maximum working overpressure of the vessel is higher than the achievable overpressure of the pressure source and at the same time an increase in overpressure in the vessel is avoided.

(4) A vessel heated by flue gas, where lowering the liquid level below a specified limit could cause the walls to overheat, shall have at least one status gauge and a vessel handling superheated vapours or liquids above 50 °C shall have a thermometer.

(5) An openable vessel shall have a device which enables the working pressure to be reduced to atmospheric pressure before opening, or the inner contents to be cooled to a safe temperature.

(6) A vessel with a quick-release closure or, where appropriate, a central closure, shall be fitted with a device to prevent the vessel from being opened before the working

pressure is reduced to atmospheric pressure and the working substance from being released into the vessel unless the vessel is securely closed.

(7) Openable medical and sterilization appliances shall be fitted with a device by which it can be ascertained, independently of the pressure gauge reading, that the pressure compartment is free from overpressure.

(8) Liquefied gas vessels shall be fitted with a device for checking the liquid level.

(9) Safety valves (except gas-tight valves) shall be such that their passage can be easily and safely verified; valves and exhaust pipes shall be so located and arranged that their operation cannot endanger the operator or other persons. The exhaust pipe of the safety valve must not form a loop.

(10) Vessels placed in the open space must be secured against tampering by unauthorized persons and against the weather.

(11) Pressure vessels must be decommissioned immediately if any of the following hazardous conditions occur:

a. if a crack develops in the pressure vessel;
b. if the device becomes leaky at the dismountable connections;
c. if the safety equipment – safety valve – fails;
d. if there is a direct risk of injury to persons;
e. if wall deformations occur;
f. if the maximum working temperature is exceeded, where the strength of the material could be compromised;
g. if the pressure equipment cannot be operated safely.

(12) When a vessel is decommissioned, the operator must immediately report this fact to the Operations Department and make an entry in the operations log.

(13) The vessel decommissioning shall be governed by any applicable requirements specified in the manufacturer's operating instructions for the equipment.

(14) Occupational hazards and measures for their elimination are set out in Annex No. 1 hereof.

Article 6

Safety Requirements Applicable to the Operator

(1) The operator is obliged:

a. to know the operation of the pressure vessel;
b. to intervene even in extraordinary circumstances to ensure safe operation, while being obliged to comply with the principles of safe conduct at the workplace and the established working procedures, which are based, inter alia, on the manufacturer's operating instructions;
c. to follow the orders of the supervisor, the person responsible for the operation of pressure vessels and the revision technician;
d. to comply with applicable legal regulations for this field;
e. to carry out the prescribed checks on the vessels and to record these checks in the operations log;
f. to report immediately any malfunction, defect or unusual occurrence in the operation of the vessel and its accessories to the head of the research group or to immediately decommission the vessel;

g. to ensure order, cleanliness and accessibility in the area where the boiler or vessel is located;
h. to make the prescribed entries in the operations log of the equipment;
i. to undergo a test of professional competence in specified cases, at least once every 3 years;
j. to undergo medical examinations;
k. the operator shall carry out a visual inspection before starting any work on the pressure equipment.

(2) Prohibited activities:
a. Any manipulation of the pressure vessel fittings, especially the safety valve, is prohibited.
b. It is prohibited to remove the cover while the device is running.
c. It is prohibited to interfere with the electrical parts of the equipment.
d. It is prohibited to store materials and objects within the working area of the equipment, i.e. it is necessary to ensure permanent access to the vessel equipment and the pressure vessel handling area.

Article 7

Inspections, Maintenance and Reviews

(1) The equipment must always be inspected before starting work; the inspection is carried out by the operator of the equipment. In the event of a malfunction, the operator shall mark the device "DO NOT USE!" and report the malfunction to the head of the research group, who shall arrange for its repair.

(2) Once a month the operator shall test the safety valve on the pressure vessel, the responsibility lies with the head of the research group to which the vessel belongs.

(3) Once every 6 months, and then as required, the compressor must be decalcified at operating pressure. When opening the drain plug, it is necessary to make sure that it is passable and, when closed, that it is tight. Flushing is carried out by the operator, the responsibility lies with the head of the research group to which the vessel belongs.

(4) Maintenance is carried out by each research group individually, the responsibility lies with the head of the research group.

(5) Maintenance in terms of servicing and repairs is provided by an external company, the responsibility lies with the head of the research group to which the pressure vessel belongs.

(6) The head of the research group shall arrange for the equipment to be repaired by an external company that carries out maintenance.

(7) Types of revisions:
a. Initial revision
i. carried out for new vessels, reconstructed or repaired vessels, requiring drilling of holes, welding, riveting or the manufacture of

new pressure parts, where the use or location has been changed, with the exception of mobile, transportable and portable vessels
   ii. arranged for by the supplier of the reserved pressure equipment, unless otherwise contractually stipulated
   iii. the revision report must be submitted to the Operations Department
b. Operational revision
   i. verification of the condition of the reserved pressure equipment and its safety and pressure fittings
   ii. carried out once a year
   iii. performed by the revision technician, ordered by the Operations Department based on input from the research group
c. Internal revision
   i. verifies the condition of the reserved pressure equipment both internally and externally
   ii. carried out if the pressure vessel has been out of service for more than 3 years or after any incident which has caused or may have caused damage to the boiler pressure unit or pressure vessel
   iii. carried out once every 5 years
   iv. performed by the revision technician, ordered by the Operations Department based on input from the research group
d. Tightness test
   i. verification of the leak tightness of the reserved pressure equipment and its safety and pressure fittings at operating pressure
   ii. carried out each time after the pressure unit has been opened before the commissioning of the reserved pressure equipment, if internal testing or maintenance operations have been carried out which may have affected the leak tightness of the pressure unit
   iii. if a pressure test is carried out before commissioning of the reserved pressure equipment, the tightness test need not be carried out
   iv. performed by the revision technician, ordered by the Operations Department based on input from the research group
e. Pressure test
   i. verification of the strength and tightness of the reserved pressure equipment under testing pressure after installation and repair of the pressure unit
   ii. carried out once every 10 years
   iii. performed by the revision technician, ordered by the Operations Department based on input from the research group
f. Construction test
   i. verification whether the overall installation and repair of the pressure vessel complies with applicable safety requirements
   ii. performed by the revision technician, ordered by the Operations Department based on input from the research group
g. Periodic test
   i. consists of an inspection of the external and internal condition of the vessel and a pressure test
   ii. performed by the revision technician, ordered by the Operations Department based on input from the research group

(8) Revision reports are archived at the Operations Department.

(9) The Operations Department ensures the publication of revision reports in the Archibus system.

(1) Sterilization is usually performed at 121 °C, which corresponds to a steam pressure of approximately 2 bar. Such high temperatures and resulting pressure can pose a risk if the sterilization process is not carried out correctly.

(2) Never use the autoclave to sterilize corrosive products such as: acids, bases and phenols, volatile compounds or solutions such as ethanol, methanol or others, chloroform, or radioactive substances.

(3) Always wear heat-resistant gloves and do not touch hot material before unloading.

(4) When sterilizing plastic materials, make sure the item can withstand the sterilization temperature. Plastic that melts in the chamber can cause damage.

(5) When closing the door, make sure it is locked.

(6) Before opening the door, check that the chamber pressure is equal to the atmospheric pressure (the chamber pressure is shown on the display).

(7) When opening the door, stand back, do not put your hand, head, etc. above it. Open the door to the minimum necessary to allow residual steam to escape from the chamber. Only when there is no more steam left, open the door wide and unload the chamber.

(8) Do not stand near the rear panel of the autoclave while the autoclave is in operation; hot steam may escape from the safety valve.

(9) Do not touch hot surfaces, especially the area adjacent to the chamber opening.

Sterilization of liquids and liquid waste in bottles

1) The bottles must be open, some of the liquid will boil off, the liquids may boil out and the bottles may even burst.
2) Sterilization of liquids is divided into three stages:
    a. Heating stage and equilibration time (H).
    b. Sterilization stage, e.g. 121 ºC for 20 minutes (S).
    c. Cooling stage to a safe temperature for removal (C).
3) The sterilization process is shown in Figure 1, the blue line shows the temperature inside the autoclave, the red line shows the temperature of the liquid.

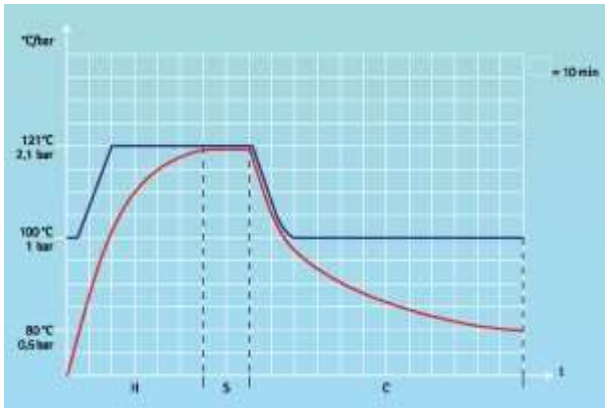

Figure 1 – sterilization process

4) The temperature inside the autoclave pressure vessel reaches the desired temperature of 121 ºC quickly, while the liquids inside the bottles take much

longer to reach the sterilization temperature. During the heating stage, the thermal energy of the steam is transferred to the bottles through steam condensation. This condensation process and the subsequent transfer of heat energy takes a relatively long time. The time required to reach the same temperatures inside the autoclave pressure vessel and inside the liquids is called the equilibration time.

5) By measuring the temperature inside the reference vessel using a temperature sensor, the exact temperature of the sterilized liquid can be determined and then used to control the sterilization process. Sterilization will only start after the desired sterilization temperature has been reached inside the liquid.
6) Measuring the temperature inside the reference vessel
    a. The reference vessel is filled with water. It is important that the size and fill level of the reference vessel corresponds to the largest vessel filled with sterilized liquid.
    b. A temperature sensor for measuring inside the reference vessel is required to ensure that the sterilization temperature inside the liquid is achieved, see Figure 2.
    c. Autoclaves are equipped with a safety device that prevents the autoclave from being opened until the liquids have cooled to a temperature at which it is safe for the operator to remove them.
    d. The cooling process may take longer if the autoclave is not equipped with a re-cooling system.

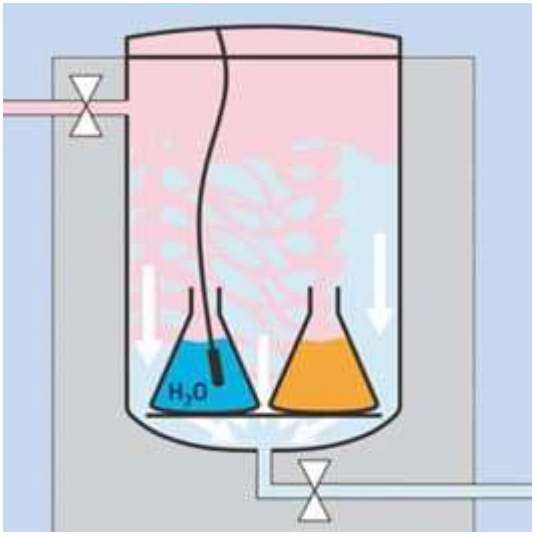

Figure 2 – sensor placement in the reference vessel

Sterilization of solid waste and waste in autoclavable bags

1) For the sterilization of solids (e.g., instruments, empty glass, pipette tips, filters and textiles) and waste in autoclavable bags, ensure that steam is generated on all internal and external surfaces of the sterilized product.
2) Autoclavable bags are procured by each research group itself. Standard hazardous waste bags cannot be used!
3) It is necessary to ensure that no air remains inside the autoclave during the process, so fractionated vacuum (usually triple) is used if the autoclave is equipped with a vacuum system.
4) Drying usually takes place directly in the autoclave. In the case of older autoclave types, drying can be performed at a designated area.

Sterilization of hazardous biological agents

1) The air discharged from the autoclave must be filtered.
2) The condensate must also be filtered before sterilization.

3) BSL 2 lab coats can be washed only after autoclaving.

Article 9

Safety Instructions for Operating the Compressor

(1) Before using the compressor
   a. Check the condition and proper operation of the equipment, including checking the switches;
   b. Check the oil level and all moving parts for binding and damage;
   c. Check the safety covers, their installation and functionality.

(2) Instructions for safe work
   a. Ensure sufficient ventilation;
   b. Do not lean over the compressor or touch hot parts (risk of burns).

(3) Additional safety Instructions
   a. Adequate space and access must be provided to the compressor for operation, maintenance and possible repairs;
   b. Do not carry out modifications or temporary repairs; in the event of damage, switch off, mark and contact the head of the research group;
   c. Follow the operating instructions;
   d. Use only the oil recommended by the manufacturer, check the oil condition regularly;
   e. Do not transport when connected to a power source or when the air duct is under pressure.

(4) Prohibited activities
   a. Using the compressor if there is any malfunction or disturbance to its smooth operation (strange noises, vibrations, etc.);
   b. Using the compressor if the pressure gauge is defective;
   c. Overloading the compressor above the prescribed technical limits;
   d. Removing or disabling protective devices and covers;
   e. Changing the pressure at the safety valve set by the compressor manufacturer;
   f. Using the compressor in an explosion hazardous or humid/wet environment;
   g. Ingestion of flammable, corrosive or poisonous gases or vapours.

(5) The maintenance of piston compressors includes:
   d. Draining condensate from the pressure vessel – the condensate level should be checked regularly and drained using the drain valve on the bottom of the air duct, see Figure 3. This prevents frequent switching of the compressor and the formation of water in the pipes or hoses. More modern compressors may have automatic condensate drainage systems.
   e. Oil refilling – regular oil refilling is extremely important for oil lubricated compressors. Check the oil level diligently using the oil dipstick or a gauge that comes with every machine. Use only oils recommended by the manufacturer that have the required viscosity. This will prevent poor lubrication and high temperatures reducing the compressor service life.
   f. Checking and cleaning the air filter (if present) – if the filter cannot be cleaned, it must be replaced, the check must be carried out regularly.

Figure 3 – Model drain valve of a piston compressor

Article 10

Decommissioning Pressure Vessels

(1) Pressure vessels must be decommissioned immediately if any of the following hazardous conditions occur:
   a. if a crack develops in the pressure vessel,
   b. if the device becomes leaky at the dismountable connections,
   c. if the safety equipment – safety valve – fails,
   d. if there is a direct risk of injury to persons,
   e. if wall deformations occur,
   f. if the maximum working temperature is exceeded, where the strength of the material could be compromised,
   g. if the pressure equipment cannot be operated safely.

(2) After a vessel has been decommissioned, the operator is obliged to immediately report this fact to the person responsible for the operation of pressure vessels and to the head of the research group and to make a record in the operations log containing the date and the reasons for which the pressure vessel was decommissioned, and the person responsible for the operation of pressure vessels must confirm this state with their signature.

(3) The vessel decommissioning shall be governed by any applicable requirements specified in the manufacturer's operating instructions for the equipment. A record of this state must be made in the operations log.

Article 11

Important Telephone Numbers:

Central security desk	549 49 2929
Occupational safety, health protection and fire prevention manager	777 926 633 111
Emergency number	112
Fire brigade	150
Medical rescue service	155
Police	158

Article 12

Final Provisions

(1) Applies only to workplaces that handle reserved pressure equipment. Managing employees of CEITEC MU workplaces that handle reserved pressure equipment are obliged to acquaint all their subordinates with this Measure.

(2) The Head of the Operations Department shall be responsible for the interpretation of individual provisions of this Measure.

(3) The Occupational Health and Safety and Fire Prevention manager shall be responsible for updating this Measure from time to time.

(4) The heads of the respective workplaces shall be responsible for the supervision over the compliance with this Measure.

(5) This Measure shall become valid as of the date of signature hereof.

(6) This Measure shall become effective as of 1 March 2024.

Annexes: No. 1 - Occupational Hazards and Measures for their Elimination

Annex No. 2 - Authorisation of the person responsible for the operation of reserved pressure equipment

Pavel Plevka
Acting Director

Annex No. 1: Occupational Hazards and Measures for their Elimination

Occupational Hazards	Measures for their Elimination
Unqualified operator, lack of physical fitness.	▪ The person responsible for the operation of pressure vessels must provide the prescribed training by an external revision technician, including familiarization with the operating safety regulation and operating instructions. ▪ Periodic medical examinations of the operating personnel at prescribed intervals.
Use of hazardous work procedures.	▪ It is prohibited to perform any handling or work procedures that are not in accordance with the manufacturer's instructions or operating safety regulations. ▪ The operator's activity is inspected by the person responsible for the operation at least once every 3 months.
Scalding, injury to the operator in case of improper handling of the vessel, valve.	▪ The operating personnel are obliged to follow the prescribed work procedures. ▪ The organization's representative must designate in writing the employee responsible for the safe operation of the equipment and demonstrably acquaint them with the operating rules, instructions and manuals.

Technical Hazards	Measures for their Elimination
Increased pressure in the system above the set parameters, overheating of the device.	▪ The system must be secured against pressure increase by an automatic system. ▪ The vessel must be equipped with a safety valve adjusted to the maximum working overpressure.
Failure to provide, carry out prescribed revisions, inspections and tests – possibility of explosion, rupture of the vessel.	▪ Prescribed inspections by a pressure vessel and electrical inspection technician must be carried out on the equipment.
Poor maintenance, inspection, servicing of the equipment – possible technical failure.	▪ The operating personnel is obliged to check the functionality of the equipment on a regular basis. ▪ The person responsible for the operation is obliged to ensure regular servicing of the equipment as required by the manufacturer.
Poor technical condition of the vessel equipment, non-performance of prescribed tasks by the operator.	▪ It is necessary to ensure that the working and maximum overpressures in the vessels are marked on the pressure gauges, i.e. mark the lines on the pressure gauges with the value of the working and maximum overpressure. ▪ Pressure gauges should be properly zeroed and such zeroing should be recorded.
Damage to the vessel by mechanical or thermal energy when carrying out work or repairs in the vicinity of the vessel.	▪ Prescribed work procedures and safety requirements must be followed in the event of work or repairs in the vicinity of the equipment.

Annex No. 2 - Authorisation of the person responsible for the operation of reserved pressure equipment

AUTHORIZATION

in the sense of the provisions

- of Act No. 250/2021 Coll., on occupational safety in connection with the operation of reserved technical equipment and on amendments to related acts, as amended,
- Section 8 (4) of Government Order No. 192/2022 Coll., on reserved technical pressure equipment and requirements to ensure their safety, as amended,

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has been appointed for the workplace specified above as

PERSON RESPONSIBLE FOR THE OPERATION OF RESERVED PRESSURE EQUIPMENT

List of equipment:

Obligations of the person responsible for pressure equipment ensuring safe operation of reserved pressure equipment:

- attend prescribed training and knowledge testing,
- ensure that the equipment is used for the purposes and under the conditions for which it is intended, in accordance with the operation documentation,
- ensure that only persons qualified for the activity in question operate and work on pressure equipment,
- ensure the performance of inspections, tests, revisions, maintenance, repairs and reconstructions of the pressure equipment in operation within the specified dates, time limits and scope,
- ensure the removal of any identified defects and malfunctions,
- cooperate with the revision or testing technician,
- keep the prescribed operations documentation and records.

Further duties and authorities are set out in the internal documentation:

- Local operating regulation for pressure vessels
- Director's Measure No. 3/2023 – Safe working with liquid nitrogen and other cryogens

The authorization is valid from _____ until revoked.

In Brno, on

_____

On behalf of the reserved pressure equipment operator
(Name and surname, position, signature)

The mandate was taken over by the authorized person: _____

Date, signature of the authorized person