PROCEDURE FOR CONVERSION OF THE DUAL CODED ICC CONTAINER

1	Původní vydání / Original Issue	31.08.2010	Bureš	Kala	Matl
Rev.č. Rev.No.	Revize Revision	Datum Date	Provedl Drawn	Přezkoušel Checked	Schválil Approved

ZT005501EN_R1

Introduction

The prevailing practice is that the container is either EN Coded or ASME DOT coded without possibility to change it later on in the of need.

The DUAL CODED ICC containers allow such conversion between the both approvals during life time.

In areas accepting EN codes DUAL CODED container is operated at standard pressure (MAWP) while for ASME/DOT areas pressure (MAWP) must be reduced to comply with different regulations (see Table), otherwise DUAL CODED container is designed, approved, manufactured and inspected in compliance with both codes.

TYPE	**MAWP**	
	EN coded area bar	**ASME/DOT coded area** psi /bar
Either ICC-20-P/E-10/DUAL CODED Or ICC-54-P/E-100/DUAL CODED	10	100 / 7
Either ICC-20-P/E-18/DUAL CODED Or ICC-53-P/E-180/DUAL CODED	18	180 / 12,5
Either ICC-20-P/E-24/DUAL CODED Or ICC-53-P/E-230/DUAL CODED	24	230 / 15,9

Table: Summary of MAWPs for DUAL CODED container

The DUAL CODED container is supplied from Chart Ferox facility ready for use in specified area. On top of that second document folder for alternative code is supplied including this conversion procedure and parts list of components which need to be replaced during conversion. To ensure correct specification of parts is recommended to order them at Chart Ferox.

Conversion procedure

- The conversion to be done under supervision of the third independent authority (re-assessment of the container). Even though any authority can be used it is recommended to use Det Norske Veritas as they are familiar with DUAL CODED concept. This will ensure smooth conversion process.
- The conversion to be done with the support of documents from the second folder
- The container to be renamed to the second type name (see table above)

- Main relief valves and pressure manometers have to be substituted by new ones as specified in the tables below

Main relief valves	Component spec and Chart Ferox PN for order	
	EN coded area	ASME/DOT coded area
Either ICC-20-P/E-10/DUAL CODED Or ICC-54-P/E-100/DUAL CODED	IMI Bailey 776/3 (3/4"x1-1/4"), PN 0501771	IMI Bailey 776/3 (3/4"x1-1/4"), PN 0513465
Either ICC-20-P/E-18/DUAL CODED Or ICC-53-P/E-180/DUAL CODED	Bestobel V2798 (3/4"x1-1/4"), PN 0504059	IMI Bailey 776/3 (3/4"x1-1/4"), PN 0512810
Either ICC-20-P/E-24/DUAL CODED Or ICC-53-P/E-230/DUAL CODED	IMI Bailey 776/2 (3/4"x1"), PN 0506278	IMI Bailey 776/2 (3/4"x1"), PN 0513466

Manometer PI1 (and PI2 if applied)	Component spec and Chart Ferox PN for order	
	EN coded area	ASME/DOT coded area
Either ICC-20-P/E-10/DUAL CODED Or ICC-54-P/E-100/DUAL CODED	Wika 232.50.100 (0÷16bar), PN 0101942	Wika 232.50.100 (0÷160psi), PN 0513463
Either ICC-20-P/E-18/DUAL CODED Or ICC-53-P/E-180/DUAL CODED	Wika 232.50.100 (0÷25bar), PN 0475804	Wika 232.50.100 (0÷250psi), PN 0513224
Either ICC-20-P/E-24/DUAL CODED Or ICC-53-P/E-230/DUAL CODED	Wika 232.50.100 (0÷40bar), PN 0475805	Wika 232.50.100 (0÷400psi), PN 0513464

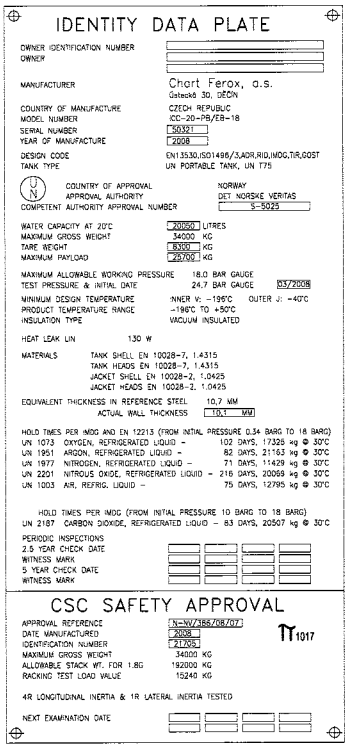
- Substitution of the differential manometers is not mandatory but it is reccommended. The reason for substitution may be request for different units (bar to psi or vice versa).

Liquid level gauge LL1	Component spec and Chart Ferox PN for order	
	EN coded area	ASME/DOT coded area
Either ICC-20-P/E-10/DUAL CODED Or ICC-54-P/E-100/DUAL CODED	Wika 232.51.160 (0÷2500mm H2O), PN 0503923	Wika 232.51.160 (0÷100inch H2O), PN 0513225
Either ICC-20-P/E-18/DUAL CODED Or ICC-53-P/E-180/DUAL CODED		
Either ICC-20-P/E-24/DUAL CODED Or ICC-53-P/E-230/DUAL CODED		

- Nameplate to be substituted by new one as specified in the table below

Identity Data Plate – carbon steel outer jacket (sample see below table)	**Component spec and Chart Ferox PN for order**	
	EN coded area	**ASME/DOT coded area**
Either ICC-20-P/E-10/DUAL CODED Or ICC-54-P/E-100/DUAL CODED	K3015870	K200xxxx/CS-100
Either ICC-20-P/E-18/DUAL CODED Or ICC-53-P/E-180/DUAL CODED	K3015813	K200xxxx/CS-180
Either ICC-20-P/E-24/DUAL CODED Or ICC-53-P/E-230/DUAL CODED	K3015743	K200xxxx/CS-230

Identity Data Plate – stainless steel outer jacket (sample see below table)	**Component spec and Chart Ferox PN for order**	
	EN coded area	**ASME/DOT coded area**
Either ICC-20-P/E-10/DUAL CODED Or ICC-54-P/E-100/DUAL CODED	K2005354/10	K200yyyy/SS-100
Either ICC-20-P/E-18/DUAL CODED Or ICC-53-P/E-180/DUAL CODED	K2005354/18	K200yyyy/SS-180
Either ICC-20-P/E-24/DUAL CODED Or ICC-53-P/E-230/DUAL CODED	K2005354/24	K200yyyy/SS-230



IDENTITY DATA PLATE

OWNER IDENTIFICATION NUMBER
OWNER
MANUFACTURER: Chart Ferox, a.s. Gatech6 30, DĚČÍN
COUNTRY OF MANUFACTURE: CZECH REPUBLIC
MODEL NUMBER: ICC-20-PB/EB-18
SERIAL NUMBER: 50321
YEAR OF MANUFACTURE: 2008
DESIGN CODE: EN13530,ISO1496/3,ADR,RID,IMDG,TR,GOST
TANK TYPE: UN PORTABLE TANK, UN T75
COUNTRY OF APPROVAL: NORWAY
APPROVAL AUTHORITY: DET NORSKE VERITAS
COMPETENT AUTHORITY APPROVAL NUMBER: S-5025
WATER CAPACITY AT 20°C: 20050 LITRES
MAXIMUM GROSS WEIGHT: 34000 KG
TARE WEIGHT: 6300 KG
MAXIMUM PAYLOAD: 28700 KG
MAXIMUM ALLOWABLE WORKING PRESSURE: 18.0 BAR GAUGE
TEST PRESSURE & INITIAL DATE: 24.7 BAR GAUGE 03/2008
MINIMUM DESIGN TEMPERATURE: INNER V: -196°C OUTER J: -40°C
PRODUCT TEMPERATURE RANGE: -196°C TO +50°C
INSULATION TYPE: VACUUM INSULATED
HEAT LEAK U/N: 130 W
MATERIALS: TANK SHELL EN 10028-7, 1.4315
TANK HEADS EN 10028-7, 1.4315
JACKET SHELL EN 10028-2, 1.0425
JACKET HEADS EN 10028-2, 1.0425
EQUIVALENT THICKNESS IN REFERENCE STEEL: 10,7 MM
ACTUAL WALL THICKNESS: 10,1 MM
HOLD TIMES PER IMDG AND EN 12213 (FROM INITIAL PRESSURE 0,34 BARG TO 18 BARG)
UN 1073 OXYGEN, REFRIGERATED LIQUID – 102 DAYS, 17325 kg @ 30°C
UN 1951 ARGON, REFRIGERATED LIQUID – 82 DAYS, 21163 kg @ 30°C
UN 1977 NITROGEN, REFRIGERATED LIQUID – 71 DAYS, 11429 kg @ 30°C
UN 2201 NITROUS OXIDE, REFRIGERATED LIQUID – 216 DAYS, 20059 kg @ 30°C
UN 1003 AIR, REFRIG. LIQUID – 75 DAYS, 12795 kg @ 30°C
HOLD TIMES PER IMDG (FROM INITIAL PRESSURE 10 BARG TO 18 BARG)
UN 2187 CARBON DIOXIDE, REFRIGERATED LIQUID – 83 DAYS, 20507 kg @ 30°C
PERIODIC INSPECTIONS
2.5 YEAR CHECK DATE
WITNESS MARK
5 YEAR CHECK DATE
WITNESS MARK

CSC SAFETY APPROVAL

APPROVAL REFERENCE: N-NV/385708707
DATE MANUFACTURED: 2008
IDENTIFICATION NUMBER: 21705
MAXIMUM GROSS WEIGHT: 34000 KG
ALLOWABLE STACK WT. FOR 1.8G: 192000 KG
RACKING TEST LOAD VALUE: 15240 KG
4R LONGITUDINAL INERTIA & 1R LATERAL INERTIA TESTED
NEXT EXAMINATION DATE

1017

Identity Data Plate - sample

- Liquid level labels have to be substituted by new ones as specified in the table below

Liquid Level Label	Component spec and Chart Ferox PN for order	
	EN coded area	**ASME/DOT coded area**
Either ICC-20-P/E-10/DUAL CODED Or ICC-54-P/E-100/DUAL CODED	Either 0506101, LOX or/and 0506102, LAR or/and 0506103, LIN or/and 0509888, LCO2 or/and 0509989, LN2O	Either LOX-100 or/and LAR-100 or/and LIN-100 or/and LCO2-100 or/and LN2O-100
Either ICC-20-P/E-18/DUAL CODED Or ICC-53-P/E-180/DUAL CODED	Either 0501662, LOX or/and 0501661, LAR or/and 0501663, LIN or/and 0509625, LCO2 or/and 0509624, LN2O	Either 0501666, LOX or/and 0501665, LAR or/and 0501667, LIN or/and LCO2 or/and LN2O
Either ICC-20-P/E-24/DUAL CODED Or ICC-53-P/E-230/DUAL CODED	Either 0506104, LOX or/and 0506105, LAR or/and 0506106, LIN or/and 0508729, LCO2 or/and 0509626, LN2O	Either LOX-230 or/and LAR-230 or/and LIN-230 or/and LCO2-230 or/and LN2O-230

OPERATION MANUAL
ISO container

TVS-20-P/E-10/18/24

ICC-20-P/E-10/18/24

ICC-54-P/E-100/150

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ICC-53-P/E-180/230/350

Rev.č. Rev.No.	Revize Revision	Datum Date	Provedl Drawn	Přezkoušel Checked	Schválil Approved
5	Container types added.	2.6.2010	Jančárek	Vogl	Bureš
4	Marked changes	1.4.2010	Vogl	Jančárek	Bureš
3	Changed paragraph Ventilation and added Safety instructions for operation	8.7.2008	Vogl	Jančárek	Bureš
2	Added paragraph Ventilation and new type of container	4.6.2008	Vogl	Jančárek	Bureš
1	Původní vydání / Original Issue	12.5.2008	Vogl	Jančárek	Bureš

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CONTENTS:

INTRODUCTION:

5 ISO container is intended for transport of refrigerated liquid gases of class 2 according to ADR or DOT, RID or AAR-600, IMDG. The container fulfils requirements of the following rules and codes: CSC, ISO1496, ADR or DOT, RID or AAR-600 and IMDG. The operator is obliged to elaborate the operation procedure for ensuring of safe and faultless operation of the ISO container. The instruction manual is background material for elaboration of the operation procedure. Simultaneously, also operation procedure of individual parts of the ISO container must be taken into account (particularly pump and switchboard). Further, the operator is then obliged to make acquainted the employees intended for operation of the ISO container with the operation procedure. Ignorance of the operation procedure, or non-adherence to it, can cause endangering of the attendance health, respectively the equipment failures.
The ISO container manufacturer is not responsible for faults, which were caused by non-observing of the instructions and principles provided for in the operation manual. The manufacturer is also not responsible for common wearing of parts caused by the equipment operation, repairs of which are covered by common maintenance of the equipment (e.g. re-tightening of valve glands, removal of humidity etc.).

1 Diagram of pipe connection, specification of valves and accessories see dossier.

2 Definitions

2.1 Cavitations

Partial or complete pump filling loss caused by insufficient subcooling (less than 0.5 bar ÷1 bar). The pressure of the liquid incoming into the pump decreased under saturated vapour tension. Acoustic changes during pump operation are often indications of partial loss of filling. By complete loss of filling, the pump stops to pump out. The cavitation can cause even damage of the pump.

2.2 Condensing

Change of the vapour gases into liquid by cooling. The liquid can be changed to vapours by heating and the vapour can be changed into liquid by cooling.
The pressure in the ISO container will increase above the saturated vapour tension of the liquid during normal operation. The warmer gas shall condensate to the pressure of cooler liquid during the transmission. During normal stay in the ISO container, the liquid will spray itself into the gas area. The spraying causes the gas condensation and decrease the pressure.
Upper filling of the ISO container without venting is possible due to condensation of the warmer gas to lower pressure.

2.3 Cryogenic temperatures

Cryogenic ISO containers effectively store the gases in cryogenic liquid state.
CRYOGENIC (generally): Product preserving the temperature –100°C or lower.
The gases can be most effectively stored as liquids. E.g., the liquid nitrogen increases the volume by 750 times during heating up into gas state. The gases can be liquidized by their pressurizing of by cooling into the liquid state. Each gas must be maintained on/under its respective boiling temperature to be stored into the gas state.

Gas	Boiling temperature (by 0 bar)
Argon	-186°C
Nitrogen	-196°C
Oxygen	-183°C

Table 1- Boiling temperatures

2.4 Losses caused by pressure decrease

Pressure decrease in the vapour area under the saturated vapour tension of liquid will cause boiling of the water, which leads to considerable losses the medium. During venting of the tank below the saturated vapour tension of liquid, the liquid temperature decreases, the density increases, the liquid weight decreases and saturated vapour pressure decreases.

2.5 Losses caused by carrying forward

Liquid carried forward by the gas during venting. This can occur during rapid tank depressurisation or during upper filling of the tank with open venting valve. Large losses of the medium occur during above-given situation.

2.6 Balanced state

The temperatures of gas and liquid are the same in sealed vessel. If there is a temperature difference between gas and liquid (in sealed vessel), the gas and the liquid change their temperature, until they are the same.

2.7 Liquid volume increasing

As the liquid is warmed up to higher saturated vapour tensions, the volume increases. The warm liquid has lower density. The liquid of lower density occupies larger volume. The liquid volume increasing is linked with the safety, if the liquid can increase its volume up to the storage vessel filling. This state is called liquid filling or hydraulic filling. During these states, the pressure rapidly increases, the safety elements are activated and the liquid is released from the tank.

2.8 Pressure gradient

Decompression due to liquid flow. The more rapidly the liquid flows through the system, the higher is the pressure gradient.

2.9 Saturation

State in sealed container, when there exist simultaneously the liquid and gas states at the same temperature (balanced). The density, temperature and liquid balance pressure are changed with the level of liquid saturation.
The saturation can be also described as an energy state. The liquid molecules at higher energy state (warmer) occupy more space.

2.10 Saturated vapour tension

Pressure (usually in bars), that is used for description of the liquid and gas state inside sealed container.

2.11 Substance state (phase)

The substance may exist as gas, liquid or as solid matter. Double-phase liquid is liquid with gas bubbles or with gas cores due to insufficient pressure for balance maintaining. The gas and the liquid can exist at various temperatures. The temperature is measure of energy amount inside the solid matter, liquid or gas.

2.12 Stratification

The warm liquid has lower density. In high vertical tank, the liquid of lower density can find its way up to the upper part of the tank. The cooler liquid remains at the bottom. The temperature change from upper to bottom is called the stratification.

2.13 Subcooling

Pressure increase in gas area above the saturated vapour tension. If the liquid is moved from the tank, the subcooling is important for maintaining of liquid in liquid state, while the liquid flows from the tank through the piping system.
In case of the ISO container, the required subcooling is 0.5 bar ÷1 bar to prevent the occurrence of the double-phase liquid. The liquid leaving the pump must be replaced in the pump by the same quantity. The flowing liquid creates the pressure gradient, as it flows through filling line. If the pressure decreases below the saturated vapour tension of the liquid, it starts to boil.

2.14 Double-phase liquid

By the decompression below vapour tension of liquid caused mixture of liquid/gas.

2.15 Liquid pressure

In the vapour area pressure. It is measured by pressure gauge value on the tank.

2.16 Evaporation

Change of the liquid into the gas by the liquid warming up due to sub cooling or usage of the gas.

3 DESCRIPTION

The ISO container consists from the vessel itself, from control panel, pump and supplementary evaporator and from supporting frame.

3.1 ISO container itself

ISO container is made from internal and external vessel of cylindrical shape closed from both sides by rounded covers.
The multi-layer isolation from the aluminium foil and glass-paper is wound up on internal vessel and the vacuum of 1 Pa is in the space between the two vessels.
The internal storage space of the ISO container is interconnected by technologic piping brought-out via penetrations in bottom of the outer vessel, to which the outer interconnecting pipes located in the control panel is linked.
Internal vessel and interconnecting piping are made from austenitic stainless steel (except for ICC-53-P/E-350, which inner vessel is made from carbon steel) for cryogenic temperatures. All parts are welded; only the pump is connected by flanges. All welded joints affect the vacuum tightness of internal and outer vessel is during manufacture checked by helium sensor.
Outer vessel is made from carbon or stainless steel.

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3.2 Control panel

Outer interconnecting piping with valves, safety valves, measuring devices, and control panel (electro-switchboard) for the pump is located in the control panel, which is at the side of the vessel.

3.3 Air evaporator

The ISO container is fitted by supplementary pressure circuit via the air evaporator, which is located at the bottom and top at the side along the vessel. It serves for pressurizing of internal vessel to required operation pressure.
Further, the ISO container is fitted by additional pressure circuit via the air evaporator, which is located at the upper along the vessel. It serves for pressurizing of the internal vessel to required pressure during the pump operation. The liquid flow is limited by orifice with bored opening of the 2 mm.

4 GENERAL SAFETY INSTRUCTIONS

A. **Ventilation**

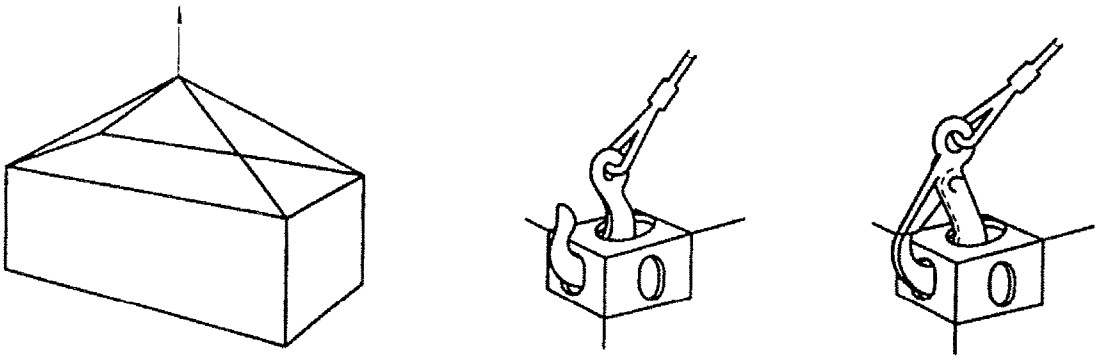
- Adequate ventilation of the space, where ISO Container is stored, manipulated, transported, used or maintained must be ensured. Some products stored in ISO containers are colorless and odorless inert gases, which can dilute air to unsafe oxygen levels. Respiratory and asphyxiation hazards can exist in confined, non-ventilated spaces.

B. **Safety instructions for operation**

5 – The operation of the container has to follow requirements given by following rules and codes: CSC, ISO1496, ADR or DOT, RID or AAR-600, IMDG, ISO 3874 (Handling and securing), local rules and operator rules.

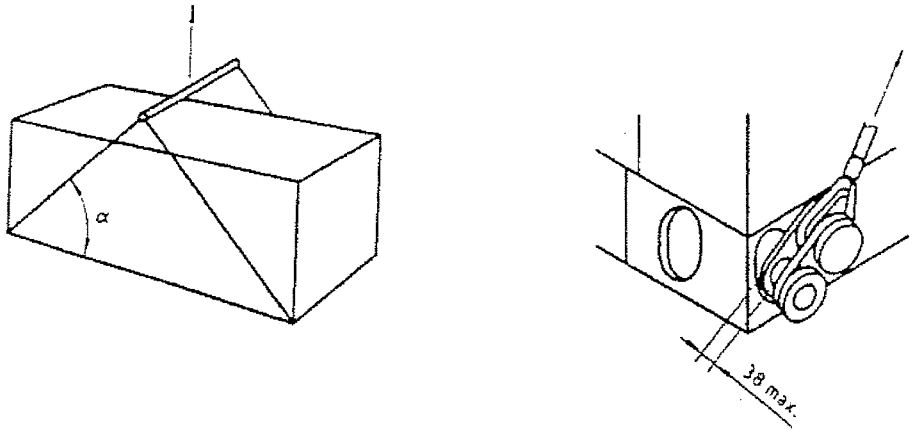
C. **Manipulation** (excerpt from ISO 3874)

The most used techniques for container handling (without usage the special device):
"6.3 Lifting by rope attachment – top lift" – **for empty container only (table 4 of ISO 3874)!**



The container has been lifted using all 4 top corner pieces, the forces are not vertical.
The lifting device must be connected properly. The hooks must be always inserted in direction from inside to outwards.

"6.4 Lifting by rope attachment – bottom lift".
The side holes of 4 bottom corner pieces are used for the lifting, the rope attachment is used.
The rope atachment connection can take effect only into bottom corner pieces and the maximum distance between lifting force and the external surface of the corner piece can be 38 mm.



Minimum angle α=45° for 20´ container

C. **Safety instructions for operation of the truck combination**

– The vehicle must be marked in compliance with relevant regulations in force.

D. **Safety instructions for work with oxygen and nitrogen**

During operation of the ISO container, it is necessary to maintain the operational and safety regulations. The ISO container can be operated only by employees older than 18 years, which passes through the training of the operation and safety regulations for the pressure vessels and for the ISO container were provably tested from their content, and which were practically acquainted with the operation of the ISO container.
The testing of the attending personnel by their supervisor should take place regularly at least once a year from the equipment operation procedure and at least twice a year from the safety regulations.

Observing of following points must be ensured:

4.1 Each employee attending the ISO container must have in mind, that careless and unprofessional handling with machine equipment and/or non-observing of safety, technological, and anti-fire regulations, can lead to equipment failures, to endangering of the health and lives of employees, to damaging of the production equipment etc.

4.2 All equipments must be maintained entirely clean and in order. In case of any failure occurrence in the equipment operation, it is necessary to take appropriate measures to remove the failures, to notify the supervisor and to make the record into operation log.

4.3 Following records must be written with regard to operation of the ISO container:
a) Daily records on the operation of the ISO container
b) Records on failures, their causes and method of their removal
c) Records and protocols on official revision tests and large repairs

4.4 Before operation launching and after repairs, the equipment must be tested in compliance with the regulations in force. It is necessary to make protocols and records into revision books with regarded to results of official revision tests. It is prohibited to operate the equipment, which is damaged, unprofessionally repaired, and which does not comply with official safety and anti-fire regulations. The repairs can be performed only by skilled employees with approval of relevant manager.

4.5. The diagram of ISO container interconnecting piping must be located in control panel of the ISO container. On the ISO container, there must be located instructions for the eventual accident in compliance with ADR.

4.6. Workplaces, where the ISO container is filled by liquefied gas, or where is the gas drawn into the storage tanks, must be maintained perfectly clean. It is unconditionally necessary to prevent the spilling of oils and greases and usage of greasy rags and greasy detergents in the workplaces. The workplace area must be maintained perfectly clean and equipped with extinguishers.

4.7. Releasing of liquefied gas from the ISO container on public roads is prohibited.

4.8. It is necessary to prevent saturation of working clothes by oxygen not to cause the ignition of the cloth by nearing to open flame, by ignition of match etc. If the working cloth is saturated with the oxygen, it is necessary to properly vent it in open space. The working clothes of employees attending the tank may not be polluted with grease.

4.9. All control and measuring devices on the ISO container must be maintained in perfect order. The correctness of the measuring devices data must be validated and their maintenance performed in compliance with relevant regulations. Maximal allowed pressures must be marked by red on the manometers. Faulty devices must be immediately repaired and adjusted, respective replaced.

4.10. All measuring devices working in direct contact with the gas must be protected against contamination by oil and/or grease. Before installation, they must be de-greased and provided with the text **GREASE-FREE.** During their repairs, the fact must be marked in the order and in accompanying documents.

4.11. All repairs of the ISO container related to usage of flame (welding, soldering) can be realised only by professionally skilled and trained personnel. During performing of the repairs, the ISO container must be emptied and properly purged by dry nitrogen without grease, during which time the residual concentration in the tank and in interconnecting piping must be lower than 21 % of oxygen.

4.12. Loosening of frozen valves is realised only after their warming up by the steam, hot water or hot air. It is prohibited to break away the ice from frozen parts of valves and piping with any subject. Usage of any levers is also prohibited.

4.13. Only Teflon according to technical specifications must be used for sealing of the valve wadding. It is strictly prohibited to use oiled or organic ropes.

4.14. Safety valves must be adjusted to relevant pressure. Inspection of their correct operation and adjustment must be realised in compliance with instructions of manufacturer and with relevant regulations for operation of pressure facilities. Record must be kept on the performed revision inspections.

4.15. Empty.

4.16. Small repairs of valves and re-tightening of loose connections must be performed according to principles provided for in Chap. 6. Forced closing and re-tightening of closing valve is prohibited. Repairs of sub-cooled valves must be performed just after their warming up.

4.17. Only the same parts and materials must be used for repairs of the ISO container.

4.18. During operation of the ISO container, the exceeding of highest working parameters, i.e. highest working overpressure 24 barg and maximal filling of the ISO containers, is prohibited.

4.19. Any handling with vacuum valves of the ISO container must be prevented (EP, (RF1), TC1, TV1).

4.20. We recommend not closing the liquefied gas in the piping lines between the valves.

4.21. During manipulation with liquefied gas, it is necessary to use only the equipment, vessels, and other accessories intended only for particular gas. Non-observance of the condition is extremely dangerous

during manipulation with liquefied oxygen. The oxygen may be filled only after checking, that the vessel and piping system was not contaminated by oils and greases, and that it complies with the regulations of the operator with regarded to filling by oxygen.

4.22. Sparkling of liquefied gas must be prevented.

4.23. During handling with liquefied gas protective means prescribed by the operator must be used.

4.24. Direct contact of skin both with the liquefied gas and with non-insulated parts of pipes and valves must be prevented.

4.25. Control panel must be locked to protect the control valves against unwilling handling.

4.26. Filling and emptying of the ISO container must be realised only on places assigned to it.

4.27. During operation of the ISO container, the occurrence of open flame at the distance min. 5 m from the ISO container must be prevented.

4.28. The pumps for liquefied gas must be operated according to manufacturer instructions.

Caution:
The operator should include into the chapter of safety instructions of the operation procedure also the instructions regarding the vehicle operation on public roads.

5 OPERATION

Operate pump in accordance with pump manuals (centifugal or gear-wheel pump).
Operate flow meter (if used) in accordance with manual.
For CO2 is minimum working pressure 10 bar.
If the ISO container filled with liquid CO2 we do not recommend later use for oxidizing gases (LOX and N2O).
Operate the ISO container filled with liquid CO2 according to EIGA document IGC Doc 56/09/E (CO2 tanker driver manual), or CGA G-6.4 (Safe transfer of Liquified CO2) 5
Operate the ISO container filled with liquid N2O according to EIGA document IGC Doc 116/07/E (Code of practice – Nitrous oxide).

5.1 Purging by gaseous nitrogen

The purging serves for humidity removing from internal vessel and interconnecting piping. It is realised by gaseous dry nitrogen (dew point -180°C) during launching of the operation in case that the humidity corresponds to dew point worse than for the temperature -40°C.

The dry nitrogen at the pressure bellow 1 bar is forced through the HC1 terminal connection by open valve V1 and V2 into the internal vessel and it outlets from the vessel through the V6 valve. The other valves are closed. The humidity-meter is connected on the outlet (behind the V6 valve) and after the required dew point of -40°C is achieved, the inlet of the dry nitrogen is closed, valves will be closed and the drying is terminated.

5.2 Filling of non-sub cooled ISO container

If the filling is realised after longer operation outage, it is necessary to check the humidity of the internal vessel. The check is realised by dry gaseous nitrogen (dew point -180°C).
The dry nitrogen at the pressure bellow 1 bar is forced through the HC1 terminal connection by open valve V1 and V2 into the internal vessel and it outlets from the vessel through the V6 valve. The other valves are closed. The humidity-meter is connected at the outlet (behind the V6 valve). Maximal allowable humidity corresponds to the temperature of dew point -40°C. In case the measured dew point is of the higher temperature, it is necessary to perform the drying of the internal vessel.

5.3 Filling of sub cooled ISO container

During normal operation, the empty internal vessel is cooled and contains approx. 100 litres of residual liquefied gas before the launching of the filling.

Filling procedure:

1) Check that connected points are clean, clean them if needed.
2) Connect filling hose to the HC1 filling nozzle and to storage tank (sealing of the hose may not be damaged).
3) Open filling valve on the storage tank.
4) Open the V11 valve, purge filling line and close it.
5) Open the valve on the storage tank (and the V6 release valve, if the pressure in the tank is too high).
6) Slowly open the V1 valve and check the PI1 pressure in the vessel, do not exceed the allowable pressure in the vessel. If is the PI1 pressure low, the V1 valve can be fully opened. If the pressure increases, open the V3 valve and throttle the V1 valve, by which is the pressure reduced by condensation of evaporated gas above the liquid level.
7) Check the level-meter, open relevant overflow valve V9 at achieving ¾ of maximal filling of the vessel.
8) Stop the filling, when maximal allowable filling weight for given gas is achieved. (Maximal weight of the ISO container is 30480 kg.) The filling is terminated and the level-meter shows the required level. Close the V3 valve and relevant overflow valve V9.
9) Close the V3 valve and relevant overflow valve V9.
10) Close the V1 valve.
11) Let the hose be warmed up, until the liquid goes back to the filling storage tank and than close the filling storage tank valve.
12) Open the V11 valve, depressurise the hose and close it.
13) Remove the hose and cover the HC1 connection and connecting nozzle of the filling tank by caps.
14) Check, whether the PI1 shows the pressure in the vessel.
15) Check, whether all valves are closed.
16) Store the hose, shut the door.

5.4 Internal circuit of the ISO container (for pump version only)

By means of internal circuit of the ISO container, it is possible to draw the liquid by the pump to return the liquid back to the vessel. This is used firstly during pump tests and secondly during normal operation, during start-up of the pump. (It is necessary to proceed in compliance with the manual during manipulation with the electro-switchboard).

1) Check, whether all valves are closed.
2) Open the V7 and V17 valves. Cool down the pump.
3) Check, whether the main power switch is in position „0“.

4) Connect the cable with fork into the plug.
5) Switch the power switch on. The indicator lamp „POWER“ will lit on the control panel in the valve box.
6) After the pump is cooled down, the indicator lamp „READY“ is lit (the operator must wait, until the lamp is lit if the temperature probe is used).
7) Maintain the pressure in the vessel (working pressures for pump mechanical seal).
8) Entirely close the V17 valve and then open approx. of one turn.
9) Start the pump by pressing the „START“ button.
10) Check the pump pressure on PI2 and listen the noise of the pump.
11) Slowly open the V17 valve. When the liquid begins to flow, slowly close the V17 valve, adjust the pressure at the pump outflow to required value, until the noise is decreased and the PI2 manometer hand does not vibrate.
12) If the pressure at the pump outflow cannot be increased within default time, or if there is a pressure decrease during the pumping (if the pressure switch is used), or the pump temperature is increased, then there occurs automatic motor switch-off (if the temperature probe is used).
13) Switch off the pump by pressing the „STOP“ button on the control panel after the pumping termination.
14) Evaporate the liquid from the pump circuit.
15) Switch the power switch off.
16) Disconnect the cable with fork from the plug.
17) Check, whether the main power switch is in position „0“.
18) Close the V7 and V17 valves.

5.5 Pumping by overpressure in the vessel

1) Check, whether all valves are closed.
2) Open the pressurizing valve V5, increase the pressure in the vessel, and maintain required working overpressure. Do not exceed the highest working overpressure of the ISO container.
3) Check, if the pressure in the ISO container is higher than in the filled storage tank. (If it is not higher, then the pumping by overpressure in the ISO container cannot be realised.)
4) Connect interconnecting hose to the HC1 outlet nozzle and to filled tank (sealing of the hose may not be damaged).
5) Open filling valve on the filled storage tank.
6) Open the V11 valve, purge filling line and close it.
7) Open the release valve V1.
8) After filling of filled storage tank or emptying the ISO container, close the release valve V1.
9) Close the pressurizing valve V5.
10) Close the filling valve of filled storage tank (resp. other valves, with which was manipulated).
11) Open the V11 valve and depressurise the filling line.
12) Remove the hose and cover the HC1 connection and connecting nozzle of the filled tank by caps.
13) Close the V11 valve.
14) Check, whether all valves are closed.
15) Store the hose and shut the ISO container door.

5.6 Pumping by pump (for pump version only)

1) Check, whether all valves are closed.
2) Open the V7 and V17 valves. Cool down the pump.
3) Check, whether the main power switch is in position „0“.
4) Connect the cable with fork into the plug.

5) Switch the power switch on, the indicator lamp „POWER“ will lit.
6) Check that connected points are clean, clean them if needed.
7) Connect interconnecting hose to the HC2 outlet nozzle and to filled tank (sealing of the hose may not be damaged).
8) Open filling valve on the storage tank.
9) Open the V18 valve, purge filling line and close it.
10) After the pump is cooled down, the indicator lamp „READY“ is lit (the operator must wait, until the lamp is lit if the temperature probe is used).
11) Maintain the pressure in the vessel (working pressures for pump wadding).
12) Open the pressurizing valve V5, increase the pressure in the tank of 0.5 bar ÷1 bar as compared with the balance state.
13) Entirely close the V17 valve and then open approx. of one turn.
14) Start the pump by pressing the „START“ button.
15) Check the pump pressure on PI2 and listen the noise of the pump.
16) Slowly open the V17 valve. When the liquid begins to flow, slowly close the V17 valve, adjust the pressure at the pump outflow to required value, until the noise is decreased and the PI2 manometer hand does not vibrate.
17) If the pressure at the pump outflow cannot be increased within default time, or if there is a pressure decrease during the pumping (if the pressure switch is used), or the pump temperature is increased, then there occurs automatic motor switch-off (if the temperature probe is used).
18) Proportionally close the V17 valve and open the V35 valve, maintain the PI2 pressure at the requested value.
19) Entirely close the V17 valve, fully open the V35 valve. Do not exceed the maximal flow through the pump. (If there is instable operation of the pump, pressure variations on PI2, or too low pressure on the pump outlet and throttle the V35 valve).
20) Handle the valves of the storage tank according to the manual (upper and bottom filling).
21) Check the pressure in the vessel on PI1, maintain its value within working pressure of the pump mechanical seal by handling with the V5 valve. Do not exceed the pressure in the vessel (maximal allowable pressure for the pump mechanical seal, damage of the pump mechanical seal can be caused by exceeding of allowable overpressure). If the pressure in the vessel decreases even by fully opened V5 valve, open the V8 valve, and close the V5 valve.
22) After filling of the storage tank of emptying the ISO container, switch off the pump by pressing the „STOP“ button on the control panel.
23) Close the depressurising valve V5 (supplementary pressurizing valve V8).
24) Close the V35 valve.
25) Close filling valve on the storage tank (resp. other valves, which were manipulated with).
26) Open the V18 valve and depressurise the hose.
27) Close the V7 valve.
28) Open the V17 valve.
29) Evaporate the liquid from the pump circuit.
30) Switch the power switch off.
31) Disconnect the cable with fork from the plug.
32) Check, whether the main power switch is in position „0“.
33) Remove the hose and cover the HC2 connection and connecting nozzle of the filling tank by caps.
34) Check, whether the PI1 shows the pressure in the vessel.
35) Close the V17 valve.
36) Check, whether all valves are closed.
37) Store the hose, shut the door.

5.7 Adjustment of the LL1 level measurement

Before handling with the level measurement valves V14 and V15, open firstly the V16 valve (balancing), by which the impulse tubes are connected and differential manometer is reset.
Then connect the differential manometer by slight opening of the V14 and V15 valves and the pressure and level measurement is ready by closing the V16 valve. Correct measurement is conditioned by perfect tightness of the measurement system. The leakages on the impulse tubes will cause the vibration of the differential pressure and at larger leakages by freezing of the impulse piping.
The leakage of the system can be detected by closing the V15 or V14 valve and subsequent change of differential pressure (the V16 valve must be closed). The manipulation must be performed in a manner not to cause dropping of the differential manometer hand to zero nor to exceed the manometer range and subsequent damaging of the differential manometer.
Adjusting of the device mechanical zero (if not adjusted) can be performed according to the manufacturer manual after opening of the V16 valve and closing of the V15 and V14 valves.
If the differential manometer is connected and the system is tight, we do not recommend unnecessary handling with the system and let it permanently connected with suitable throttled impulse tubes by valves V15 and V14. The PI1 manometer must be permanently connected.

5.8 Control of V2 and V4 (if used) Fire block ball valves

The V2 and V4 ball valves are spring ones (protection against accident / closable by the spring initial stressing force. V2 opened clockwise (view from above) and V4 opened counter clockwise (view from above). For opening of the ball valve are needed following operations: turning of the lever against the spring and securing of the lever (by hooking up) by built-in fuse (fuses) with brass pin located on the holder of the spring actuator. The elongation rod can be used for stretching. Rapid closing of the ball valve is caused by pulling the brass pin down by switching-off lever. In emergency situation, both ball valves can be closed by pulling the rope, which is connected to both valves V2 and V4. In case of fire, both valves will be automatically closed, when the fuse achieves the temperature of 75°C (165°F) and breaks.

6 TRANSPORT

Internal vessel of the ISO container is protected against the exceeding of the working pressure connected safety valves. All valves must be closed during the transport. The only exceptions are level measurement valves V14, V15, pump pressure measurement valve V20, and the Fire block valves V2 and V4; the valves are permanently open and during the operation there is no handling with them.

7 POTENTIAL FAULTS AND METHOD OF THEIR REMOVAL

In the chapter, there are specified main principles, which may occur during the operation of the ISO container, and method of their removal.
It must be kept in mind during faults occurrence, that the de-greasing of the repaired and maintenance parts for the operation in oxygen must be realised before re-assembly.

7.1 Valve faults

Table 2

Fault	Cause	Method of removing
Freezing of wadding.	Leaking wadding.	Warm up the wadding closure from outside by the hot air or steam, eventually add and tighten the wadding. If the leakage is not removed, disassemble the valve and repair it by observing the rules according to table 3.
Freezing of piping, where nor liquid nor cold gas is flowing.	Leaky valve.	Warm up the valve body by hot air or steam and re-tighten after blowing off. If there is still leakage, replace the sealing under the valve plug respective replace all upper part of the valve by adhering to the rules according to table 3.
Releasing of the safety valve at the pressure lower than the opening pressure.	Contamination in the valve seat, resp. damage of the valve seat.	Warm up the valve body from outside by hot air or steam and blow off the valve. If the leakage is not removed, disassemble the valve by observing the rules according to table 3.
Loss of insulation properties.	Pressurizing of the insulation space due to following causes: a) Mechanical damage of safety vacuum valve b) Internal leakage c) Outer leakage.	Perform the repair in co-operation with the production plant.
The manometer shows lower value than the actual value. The piping is frosty.	a) Loosen connection of manometer. b) Damaged sealing.	a) Re-tighten the connection. b) Replace the sealing.
The LL1 differential manometer shows value different than the actual one. The intake piping is frosty.	a) Leakage of the V16 valve b) Outer leakage on connections of the V14, V15, V16 valves or of the differential manometer.	a) Check closing of the V16 overflow valve, repair the leakage. b) Re/tighten the connections.

Table 3 – valid for containers with pump (or ready for future pump installation).

Marking of the valve or measuring device	Disassembly conditions
C1, HC1, HC2, HC5, HC6, HC7, HC15, HC16, HC19, HC20, LL1, (P), PI1, PI2, (S), SV3, SV4, SV5, SV6, SV8, SV9, SV10, V1, V5, V7, V11, V16, V18, V20, V32, V33, V35, VE1, VE2	The disassembly can be performed at pressurized internal vessel of the ISO container provided other valves on the same line and connected with the line and located on the vessel direction are closed.
CV2, PB1, RR1, SV1, SV2, V3, V8, V6, V14, V17, V19, V31	Disassembly only after depressurising and closing of eventual liquid lines in the direction of the vessel of the ISO container.
V9A, V9B, V9C	Disassembly only after depressurising and lowering the level below the overflow level.
V2, V4, V15	Disassembly after release of the liquid from the internal vessel and depressurising.
EP, (RF1), TC1, TV1,	Disassembly and any manipulations are prohibited.

Table 3 – valid for containers without pump.

Marking of the valve or measuring device	Disassembly conditions
C1, HC1, HC2, LL1, PI1, PI2, SV1A, SV1B, SV2A, SV2B, SV3, SV4, SV5, SV8, SV10, V1, V11, V16, V18, V32	The disassembly can be performed at pressurized internal vessel of the ISO container provided other valves on the same line and connected with the line and located on the vessel direction are closed.
CV2, DRV, PB1, V3, V5, V6, V8, V14, V17, V31	Disassembly only after depressurising and closing of eventual liquid lines in the direction of the vessel of the ISO container.
V9A, V9B, V9C	Disassembly only after depressurising and lowering the level below the overflow level.
V2, V4, V15	Disassembly after release of the liquid from the internal vessel and depressurising.
EP, TC1, TV1	Disassembly and any manipulations are prohibited.

8 Regular maintenance and revision inspection of ISO container

8.1 Visual check

Check the internal vessel of the ISO container, valves, and evaporator regularly each 10 days during the operation of the ISO container.

8.2 Check of safety valves

Check the safety valves in compliance with the regulations in force in the country of operator.

8.3 Check of manometers and differential manometer

Check the manometers and the differential manometer at least once a year.

8.3.1 Adjustment of the differential pressure gauge LL1

The liquid level gauge indicates the differential pressure due to the depth of liquid and provides an approximation of the amount of liquid in the tank. It assumes a certain density of liquid and vapour. There is some uncertainty, due to unknown actual temperature gradients in the liquid and densities.. This system should not be considered accurate enough for precise measurement of liquid in the tank.

8.4 Vacuum level check measurement

It is possible to measure the vacuum level (absolute pressure) in the interspace between inner vessel and outer shell. The installed thermocouple / vacuum probe TC1 and the isolation valve TV1 are intended for this purpose. For the pressure measurement itself is recommended to use some of the Vacuum Meters from the Teledyne Hastings Instruments (producer of used Termocouple) for suitable range. It is necessary to follow the producer rules for Gauge / Meter use. If the pressure in the vacuum space is above 10 Pa (warm), the container would be evacuated.
It is recomended to consult the results of the measurement with Container producer (Chart Ferox, a.s. customer service), if any doubts about measurement results.

8.5 Revision inspections and leakage test

Perform revision inspections and leakage tests in compliance with relevant regulations and with regulations in force in the country of operator.

8.6 Revision inspections of electric devices

Perform the revision inspections of electric device in compliance with the regulations in force in the country of operator.

8.7 Taking the Container out of service

The taking of the Container out of service should be in compliance with the described procedure and results of individual steps should be recorded and archived at the operator.
Note: during emptying and depressurising of the inner vessels adhere to the safety measures related to the particular medium.

8.7.1 Working steps for temporary taking out of service (and further re-usage).

- Empty and depressurise the inner vessel, take care on potential risk caused by evaporated liquid and extreme low temperature of the liquefied medium and risk related to the type of stored medium.
- Purge the tank and accessories (all the pipe lines including fittings) with inert gas (nitrogen).

- Leave small pressure of inert gas (from 0.2 to 0.3 barg) in the inner vessel and mark the Container by relevant manner.
- Insert seal protecting plugs on all ends of the tubes up to pressure 0.7 barg. The plugs must resist to potential pressure drop due to ambient temperature and thus the pressure changes in the inner vessel.
- Keep the vacuum in the Container inter-space during whole period.

8.7.2 Working steps for scrapping of Container

- When the Container is put out of service and scrapped, proceed as follows:
- Empty and depressurise the inner vessel, take care on potential risk caused by evaporated liquid and extreme low temperature of the liquefied medium and risk related to the type of stored medium.
- Purge the inner vessel and all piping and fittings with nitrogen.
  Vent outlet must be oriented to a safe area. There can be dangerous of asphyxiation or explosion.
- Vent the vacuum inter-space.
  Either via the suction neck, or drill the hole into the outer jacket of the container (thus the air fill the vacuum inter-space).
- Recycling is to be carried out acc. to the chapter 8.6.3 Disposal of Container.

8.7.3 Disposal of Container

- If the Container is to be finally taken out of service, the Container may be disassembled to individual components in compliance with the local regulations.
- Generally the Container consists from the following materials:
- Stainless steel: inner and (optionally) outer vessel or some parts of the frame
- Carbon steel: outer vessel and the frame
- Non-ferrous metals (such as copper, aluminium, ...).
- Synthetic material (in devices, valves etc.)
- Glass (in devices).
- The materials may be recycled or disposed by usual manner. The competent staff of the service provider should sort and correctly process the used materials acc. to their nature.
- Local procedures and regulations must be adhered.