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RESOLUTION A.692(17)
adopted on 6 November 1991

GUIDELINES AND SPECIFICATIONS FOR HYPERBARIC EVACUATION SYSTEMS

THE ASSEMBLY,

RECALLING Article 15(j) of the Convention on the International Maritime Organization concerning the functions of the Assembly in relation to regulations and guidelines concerning maritime safety,

NOTING the current extensive use of saturation diving techniques in the offshore industry during the installation, subsequent maintenance and decommissioning of subsea facilities for the recovery of hydrocarbons from the sea-bed,

ALSO NOTING the use of such techniques in marine salvage operations,

RECALLING resolution A.536(13), Code of Safety for Diving Systems, and resolution A.583(14), amendments to the Code of Safety for Diving Systems, by which the Assembly adopted proposals for common emergency fittings,

RECALLING ALSO the intent of the 1983 amendments to chapter III of the International Convention for the Safety of Life at Sea, 1974, regarding availability of life-saving appliances,

BEING OF THE OPINION that hyperbaric evacuation systems are of value in certain circumstances for the rescue of divers involved in saturation diving operations where support ships may have to be abandoned,

RECOGNIZING THEREFORE the need for the development of guidelines and specifications for hyperbaric evacuation,

HAVING CONSIDERED the recommendation made by the Maritime Safety Committee at its fifty-ninth session,

1. ADOPTS the Guidelines and Specifications for Hyperbaric Evacuation Systems set out in the annex to this resolution;

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2. INVITES Governments:

(a) to take appropriate steps to give effect to the Guidelines and Specifications as early as possible;

(b) to inform the Organization on measures taken in this respect.

ANNEX

GUIDELINES AND SPECIFICATIONS FOR HYPERBARIC EVACUATION SYSTEMS

PREAMBLE

1 INTRODUCTION

These Guidelines and Specifications for Hyperbaric Evacuation Systems have been developed with a view to promoting the safety of all divers in saturation and achieving a standard of safety for divers which corresponds, so far as is practicable, to that provided for other seagoing personnel, and which will satisfy chapter 3 of the Code of Safety for Diving Systems (resolution A.536(13), as amended by resolution A.583(14)).

2 HYPERBARIC EVACUATION METHODS

It is recognized that there are various methods available for evacuating divers in an emergency and that the suitability of the various options for a safe hyperbaric evacuation depends on a number of factors including the geographical area of operation, environmental conditions, and any available offshore or onshore medical and support facilities. Options available to diving contractors will include:

.1 hyperbaric self-propelled lifeboats;

.2 towable hyperbaric evacuation units;

.3 hyperbaric evacuation units which may or may not be towable suitable for offloading on to an attendant vessel;

.4 transfer of the diving bell to another facility;

.5 transfer of the divers from one diving bell to another when in the water and under pressure;

.6 negatively buoyant unit with inherent reserves of buoyancy, stability and life support capable of returning to the surface to await independent recovery.

The guidelines and specifications do not therefore attempt to specify which particular type of hyperbaric evacuation system should be employed and recommend that clients and diving contractors examine and identify the option most suited for the area and type of operation in which they are engaged. Consideration may have to be given to the provision of separate evacuation facilities for divers in saturation at significantly different depths.

3 CONTINGENCY PLANNING AND EMERGENCY INSTRUCTIONS

3.1 A potentially dangerous situation can arise if a floating unit, from which saturation diving operations are being carried out, has to be abandoned with a diving team under pressure. While this hazard should be reduced by pre-planning, under extreme conditions consideration may have to be given to hyperbaric evacuation of the divers. The hyperbaric evacuation arrangements should be studied prior to the commencement of the dive operation and suitable written contingency plans made. Where, in the event of diver evacuation, decompression would take place in another surface compression chamber the compatibility of the mating devices should be considered.

3.2 Once the hyperbaric evacuation unit has been launched, the divers and any support personnel may be in a precarious situation where recovery into another facility may not be possible and exposure to seasickness and accompanying dehydration will present further hazards. It is, therefore, necessary that diving contractors ensure that any such contingency plans include appropriate solutions. It should be emphasized that hasty or precipitate action may lead to a premature evacuation situation which could be more hazardous in the final analysis.

3.3 In preparing the contingency plans, the various possible emergency situations should be identified taking into consideration the geographical area of operation, the environmental conditions, the proximity of other vessels, and the availability and suitability of any onshore or offshore facilities. The facilities for rescue, recovery and subsequent medical treatment of divers evacuated in such circumstances should be considered as part of the contingency plan. In the case of unattended hyperbaric evacuation units, consideration should be given to providing equipment to transfer the towline to an attendant vessel before launch of the evacuation unit. Such an arrangement would enable the unit to be towed clear immediately after launching. Copies of contingency plans should be available on board the parent vessel, ashore and in the hyperbaric evacuation unit.

4 TRAINING AND EVACUATION DRILLS

Periodic training exercises should be carried out to test the operation of the hyperbaric evacuation system and the efficiency of the personnel responsible for the hyperbaric evacuation of the divers. Such training exercises should not normally be carried out while the chambers are pressurized, but should be carried out at each available opportunity.

GUIDELINES AND SPECIFICATIONS FOR HYPERBARIC EVACUATION SYSTEMS

1 PURPOSE

The purpose of these Guidelines and Specifications is to recommend design and construction criteria, equipment, survey standards and contingency planning for the evacuation systems referred to in chapter 3 of the Code of Safety for Diving Systems (resolution A.536(13)).

2 APPLICATION

The Guidelines and Specifications apply to new hyperbaric evacuation units which are constructed more than twelve months after the date on which the Assembly of the International Maritime Organization adopts these guidelines and specifications for units which can be mated to a surface compression chamber. However any existing system which complies with the provisions of these Guidelines and Specifications may be considered for endorsement of the safety equipment certificate in accordance with 4.2.

3 DEFINITIONS

For the purpose of these Guidelines and Specifications the terms used have the meanings defined in the following paragraphs unless expressly provided otherwise:

3.1 Administration means the Government of the State whose flag a ship or floating structure which carries a diving system is entitled to fly or in which the ship or floating structure is registered.

3.2 Bottle means a pressure container for the storage and transport of gases under pressure.

3.3 Breathing mixture means air or any other mixture of gases used for breathing during evacuation and, if applicable, during decompression.

3.4 Depth means the pressure, expressed in metres of seawater, to which the diver is exposed at any time during a dive or inside a surface compression chamber or a diving bell.

3.5 Diving bell means a submersible compression chamber, including its ancillary equipment, for transfer of divers under pressure between the work location and the surface compression chamber, and vice versa.

3.6 Diving system means the whole plant and equipment necessary for the conduct of diving operations using transfer-under-pressure techniques.

3.7 Hyperbaric evacuation system means the whole plant and equipment necessary for the evacuation of divers in saturation from a surface compression chamber to a place where decompression can be carried out. The main components of a hyperbaric evacuation system include the hyperbaric evacuation unit, handling system and life-support system.

3.8 Hyperbaric evacuation unit means a unit whereby divers under pressure can be safely evacuated from a ship or floating structure to a place where decompression can be carried out.

3.9 Handling system means the plant and equipment necessary for raising, lowering and transporting the hyperbaric evacuation unit from the surface compression chamber to the sea or on to the support vessel, as the case may be.

3.10 Hazardous areas means those locations in which an explosive gas-air mixture is continuously present, or present for long periods (zone 0); in which an explosive gas-air mixture is likely to occur in normal operation (zone 1); in which an explosive gas-air mixture is not likely to occur, and if it does it will only exist for a short time (zone 2).

3.11 Life-support system means the gas supplies, breathing gas system, decompression equipment, environmental control system, heating or cooling and other equipment required to provide a safe environment for the divers in the hyperbaric evacuaton unit under all ranges of pressure that they may be exposed to during evacuation and, if applicable, during the decompression stages.

3.12 Mating device means the equipment necessary for connecting and disconecting a hyperbaric evacuation unit and a surface compression chamber.

3.13 Maximum operating depth of the diving system is the depth in metres of seawater equivalent to the maximum pressure for which the diving system is designed to operate.

3.14 Pressure vessel means a container capable of withstanding an internal maximum working pressure greater than or equal to 1 bar.

3.15 Compression chamber means a pressure vessel for human occupancy with means of controlling the differential pressure between the inside and outside of the chamber.

4 SURVEYS

4.1 Each hyperbaric evacuation system should be subject to:

.1 an initial survey before being put into service. This should comprise a complete and thorough examination of the hyperbaric evacuation system, equipment, fittings, arrangements and materials including functional tests which should be such as to ensure they are suitable for the intended service and in compliance with these guidelines and specifications;

.2 a survey at intervals specified by the Administration but not exceeding 2 years; and

.3 an annual inspection within 3 months of each anniversary date of the survey to ensure that the hyperbaric evacuation system, fittings, arrangements, safety equipment and other equipment remain in compliance with the applicable provisions of the Guidelines and Specifications and are in good working order.

4.2 Where a hyperbaric evacuation system complies with the provisions, as applicable, of the Guidelines and Specifications and has been duly surveyed it may be recorded on the supplement to the Cargo Ship Safety Equipment Certificate as providing the life-saving appliances and arrangements for divers in compression.

5 DESIGN AND CONSTRUCTION

5.1 The design and construction of the hyperbaric evacuation system should be such that it is suitable for the environmental conditions envisaged, account being taken of the horizontal or vertical dynamic snatch loads that may be imposed on the system and its lifting points particularly during evacuation and recovery.

5.2 The hyperbaric evacuation unit should be capable of being recovered by a single point lifting arrangement and means should be provided on the unit to permit a swimmer to hook on or connect the lifting arrangement.

5.3 In the design of pressure vessels including accessories such as doors, hinges, door landings, closing mechanisms, penetrators and viewports, the effects of rough handling should be considered in addition to design parameters such as pressure, temperature, vibration, operating and environmental conditions. In general, piping penetrations through the chamber should have isolating valves on both sides.

5.4 Materials used in the construction of hyperbaric evacuation systems should be suitable for their intended use.

5.5 Component parts of a hyperbaric evacuation system should be designed, constructed and tested in accordance with standards acceptable to the Administration.

5.6 Components in the hyperbaric evacuation system should be so designed, constructed and arranged as to permit easy inspection, maintenance, cleaning and, where appropriate, disinfection.

5.7 The hyperbaric evacuation system should be provided with the necessary control equipment to ensure its safe operation and the well-being of the divers.

5.8 Special arrangements and instructions should be provided externally to enable the hyperbaric evacuation unit to be recovered safely. The instructions should be located where they will be legible when the hyperbaric evacuation unit is floating.

5.9 Hyperbaric evacuation system should not be located in zone 0 or zone 1, hazardous areas and high fire risk areas should be avoided as far as is reasonably practicable.

6 HYPERBARIC EVACUATION UNITS

6.1 The hyperbaric evacuation unit is to be designed for the rescue of all divers in the diving system at the maximum operating depth. The compression chamber should provide a suitable environment and adequate facilities, including, where appropriate, seat belts, for the maximum number of persons for which the unit is designed. The seating or other arrangements provided should be designed to provide an adequate degree of protection to the divers from impact collisions during launch and while the unit is afloat. Where the chamber is intended to be occupied for more than 12 hours arrangements for the collection or discharge of human waste should be provided. Where discharge arrangements are provided they should be fitted with suitable interlocks.

6.2 The means provided for access into the compression chamber should be such as to allow safe access to or from the surface compression chambers. Interlocks should be provided to prevent the inadvertent release of the hyperbaric evacuation unit from the surface compression chamber while the access trunking is pressurized. The mating flange should be adequately protected from damage at all times including during the launch and recovery stages.

6.3 Arrangements should be provided to enable an unconscious diver to be taken into the unit.

6.4 Compression chamber doors should be so designed as to prevent accidental opening while pressurized. All doors should be so designed that, where fitted, the locking mechanisms can be operated from both sides.

6.5 Arrangements should be provided to allow the occupants to be observed. If viewports are provided they should be situated so that risk of damage is minimized.

6.6 Where it is intended to carry out decompression of the divers after hyperbaric evacuation in another surface compression chamber, then consideration must be given to the suitability of the mating arrangements on that surface compression chamber. Where necessary, a suitable adapter and clamping arrangements should be provided.

6.7 A medical lock should be provided and be so designed as to prevent accidental opening while the compression chamber is pressurized. Where necessary, interlock arrangements should be provided for this purpose. The dimensions of the medical lock should be adequate to enable essential supplies, including CO_2 scrubber canisters, to be transferred into the compression chamber, and be of such dimensions as to minimize the loss of gas when the lock is being used.

7 STABILITY AND BUOYANCY

7.1 Hyperbaric evacuation units designed to float should be provided with adequate stability for all envisaged operating and environmental conditions and be self-righting. In determining the degree of stability to be provided, consideration should be given to the adverse effects of large righting moments on the divers. Consideration should also be given to the effect equipment and rescue personnel, required to be placed on the top of the system to carry out a recovery from the sea, may have on the stability of the hyperbaric evacuation unit.

7.2 Towing attachment points should be so situated that there is no likelihood of the hyperbaric evacuation unit being capsized as a result of the direction of the tow line. Where towing harnesses are provided they should be lightly clipped or secured to the unit and, so far as is possible, be free from snagging when pulled free.

7.3 Hyperbaric evacuation units designed to float should have sufficient reserves of buoyancy to enable the necessary rescue crew and equipment to be carried.

7.4 Where hyperbaric evacuation units are designed to be placed on board a rescue vessel, attachment points should be provided on the unit to enable it to be secured to the deck.

7.5 Hyperbaric evacuation units provided on ships required to be provided with fire-protected lifeboats should be provided with a similar degree of fire protection.

8 LIFE-SUPPORT SYSTEM

8.1 Means should be provided to maintain all the occupants in thermal balance and in a safe and breathable atmosphere for all environmental conditions envisaged - air temperature, sea temperature and humidity - and with the maximum and minimum number of divers likely to be carried. In determining the duration and amount of life support necessary, consideration should be given to the geographical and environmental conditions, the O_2 and gas consumption and CO_2 generation under such conditions, the heat input or removal and the emergency services that may be available for the decompression of the divers. Gas losses as a result of using toilet facilities which discharge to outside the hyperbaric evacuation unit and medical lock operation should be taken into account in determining the amount of gases required. The effects of hypothermia should be considered and the effectiveness of the arrangements provided should be established as far as is reasonable and practicable under all conditions envisaged. However in no such case should the duration of the unit's autonomous life-support endurance be less than 72 hours.

8.2 In addition to any controls and equipment fitted externally, compression chambers should be provided with adequate controls within for supplying and maintaining the appropriate breathing mixtures to the occupants, at any depth down to the maximum operating depth. The persons operating the chamber, whether they are within or outside it, should be provided with adequate controls to provide life support. As far as practicable, the controls should be capable of operation without the person who operates them having to remove his/her seat belt.

8.3 Two separate distribution systems should be provided for supplying oxygen to the compression chamber. Components in the system should be suitable for oxygen service.

8.4 Adequate equipment should be provided and be suitably situated to maintain oxygen and carbon dioxide levels and thermal balance within acceptable limits while the life-support equipment is operating.

8.5 In addition to any instrumentation necessary outside the compression chamber, suitable instrumentation should be provided within the chamber for monitoring the partial pressures of oxygen and carbon dioxide and be capable of operation for the duration of the available life-support period.

8.6 Where it is intended that divers may be decompressed within the hyperbaric evacuation unit, provision should be made for the necessary equipment and gases, including therapeutic mixtures, to enable the decompression process to be carried out safely.

8.7 An adequate supply of food and water should be provided within the hyperbaric evacuation unit. In determining, in particular, the amount of water to be provided, consideration should be given to the area of operation and the environmental conditions envisaged.

8.8 A breathing system should be provided with a sufficient number of masks for all the occupants under pressure.

8.9 Provision should be made external to the hyperbaric evacuation unit, and in a readily accessible place, for the connection of emergency hot or cold water and breathing therapeutic mixture. The dimensions of the connections provided should be as follows:

3/4 inch NPT (female) - hot or cold water

1/2 inch NPT (female) - breathing mixture

The connections should be clearly and permanently marked and be suitably protected.

8.10 In hyperbaric evacuation units designed to pass through fires the breathing gas bottles and piping systems and other essential equipment should be adequately protected. In addition, thermal insulation should be non-toxic and suitable for this purpose.

8.11 First-aid equipment, sickness bags, paper towels, waste disposal bags and all necessary operational instructions for equipment within the compression chamber should be available within the chamber, on board the parent vessel and ashore.

9 FIRE PROTECTION AND EXTINCTION

9.1 Materials used in the construction and installation should so far as is possible be non-combustible and non-toxic.

9.2 A fire-extinguishing system should be provided in the hyperbaric evacuation unit which should be suitable for exposure to all depths down to the maximum operating depth.

9.3 In hyperbaric evacuation units that are designed to float and may be used to transport divers through fires, consideration should be given, where practicable, to providing an external water spray system for cooling purposes (see 7.5).

10 ELECTRICAL ARRANGEMENTS

10.1 All electrical equipment and installation, including the power supply arrangements, should be designed for the environment in which they will be required to be operated and designed to minimize the risk of electrical capacity depletion as a result of a fault, fire or explosion, electric shock, the emission of toxic gases and galvanic action. Electrical equipment within the compression chamber should be designed for hyperbaric use, high humidity levels and marine application.

10.2 Power supplies required for the operation of life-support systems and other essential services should be sufficient for the life-support duration. The battery charging arrangements should be designed to prevent overcharging under normal or fault conditions. The battery storage compartment should be provided with means to prevent overpressurization and any gas released be vented to a safe place.

10.3 Each compression chamber should be provided with a source of lighting sufficient for the life-support time and of sufficient luminosity to allow the occupants to read gauges and operate essential systems within the chamber.

11 LAUNCH AND RECOVERY OF HYPERBARIC EVACUATION UNITS

Where appropriate:

11.1 Means should be provided for the safe and timely evacuation and recovery of the unit and due consideration should be given to the environmental and operating conditions and the dynamic snatch and impact loadings that may be encountered. Where appropriate, the increased loadings due to water entrainment should be considered. Where the primary means of launching depends on the ship's main power supply then a secondary and independent launching arrangement should be provided.

11.2 If the power to the handling system fails, brakes should be engaged automatically. The brake should be provided with manual means of release.

11.3 The launching arrangements provided should be designed to ensure easy connection or disconnection of the hyperbaric evacuation unit from the surface compression chamber and for the transportation and removal of the unit from the ship under the same conditions of trim and list as those for the ship's other survival craft.

11.4 Where a power-actuated system is used for the connection or disconnection of the hyperbaric evacuation unit and the surface compression chamber then a manual or stored power means of connection or disconnection should also be provided.

11.5 The means provided for release of the falls or lift wire after the unit is afloat should provide for easy disconnection, particular attention being given to units not provided with an attendant crew.

11.6 Where the hyperbaric evacuation unit is designed to be recovered from the sea, or from a ship in a seaway, consideration should be given to the mode of recovery. Adequate equipment to enable a safe recovery of the unit should be provided on the unit. Permanently marked clear instructions should be provided adjacent to the lifting equipment as to the correct method for recovery, including the total weight of the hyperbaric evacuation unit. Consideration should be given to the effect which entrained water and any bilge water may have on the total weight to be lifted by the recovery vessel. Consideration should also be given to any means that can be provided for the absorption of the dynamic snatch loads imposed during the recovery of the hyperbaric evacuation unit from the sea.

12 COMMUNICATIONS AND LOCATING SYSTEMS

12.1 If breathing mixtures containing helium or hydrogen are used, a self-contained primary communication system fitted with an unscrambler device should be arranged for direct two-way communication between the divers and those outside the compression chamber. A secondary communication system should also be provided.

12.2 In addition to the communication system referred to in 12.1 a standard bell emergency communication tapping code should be provided which meets the requirements of that specified in the amendments to the Code of Safety for Diving Systems (resolution A.583(14)). Copies of the tapping code should be permanently displayed inside and outside the hyperbaric evacuation unit.

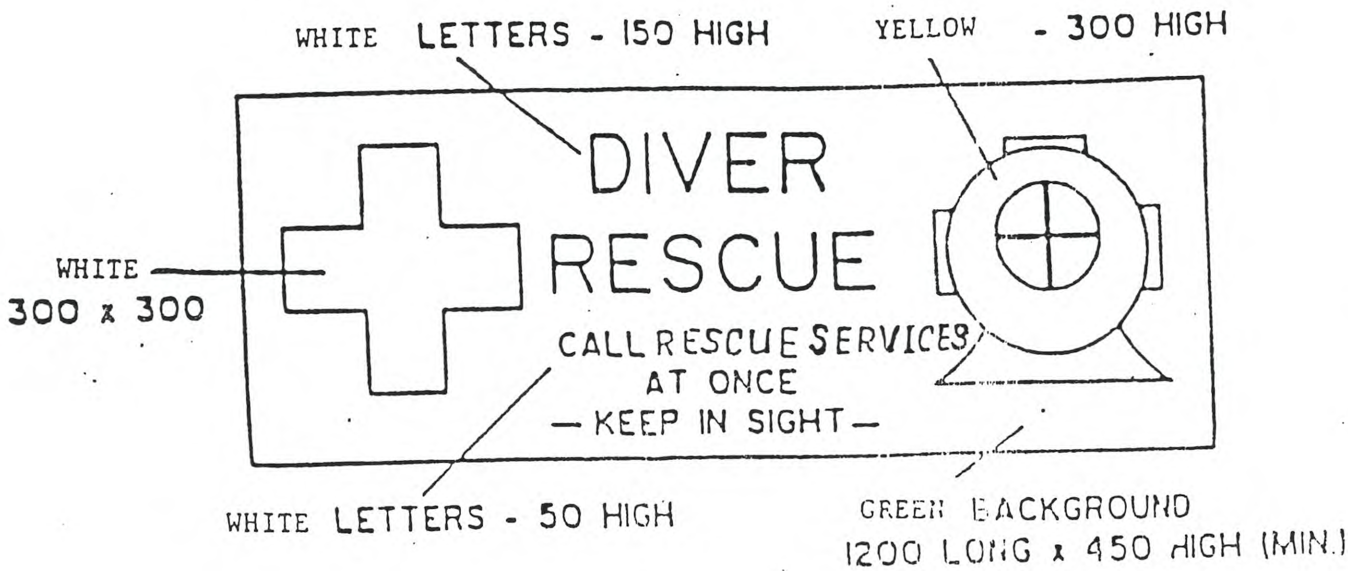
12.3 Hyperbaric evacuation units designed to be waterborne should be provided with a strobe light and radar reflector.

12.4 Hyperbaric evacuation units designed to be placed on the sea-bed to await independent recovery should be provided with an acoustic transponder. The transponder should be suitable for operation with a diver-held interrogator-receiver which will be retained on board the parent ship. The equipment provided should meet the requirements specified in the amendments to the Code of Safety for Diving Systems (resolution A.583(14)).

13 MARKING AND INFORMATION TO BE PROVIDED ON HYPERBARIC EVACUATION UNITS

13.1 Dedicated hyperbaric evacuation units should be coloured orange and be provided with retro-reflective material to assist in their location during hours of darkness.

13.2 Each hyperbaric evacuation unit designed to be waterborne should be marked with at least three identical signs as shown below. One of these markings should be on top of the unit and be clearly visible from the air and the other two be mounted vertically on either side and as high as possible and be capable of being seen while the unit is afloat.



Note: Dimensions in millimetres

13.3 Where applicable, the following instructions and equipment should be clearly visible and be kept readily available while the unit is afloat:

.1 towing arrangements and buoyant towline;

.2 all external connections, particularly for the provision of emergency gas, hot/cold water and communications;

.3 maximum gross weight of unit in air;

.4 lifting points;

.5 name of the parent ship and port of registration; and

.6 emergency contact telephone, telex and facsimile numbers.

13.4 Warning instructions

Where appropriate, the following instructions should be permanently displayed on every hyperbaric evacuation unit in two separate locations so as to be clearly visible while the unit is afloat:

"Unless specialized diving assistance is available:

.1 do not touch any valves or other controls;

.2 do not try to get occupants out;

.3 do not connect any gas, air, water or other supplies;

.4 do not attempt to give food, drinks or medical supplies to the occupants; and

.5 do not open any hatches."

14 MAINTENANCE AND TESTING

The availability of any hyperbaric evacuation system provided is dependent on the regular testing and maintenance of the system. A planned maintenance and testing programme should be devised with the responsibility for carrying out the maintenance tasks being allocated to specific crew members. A maintenance and testing schedule should be available for recording the execution of the tasks and the signatures of the persons allocated the tasks. Such schedules should be maintained on board and be available for inspection.

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