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General technical requirements of modular integrated system for emergency medical use

应急医用模块化集成系统通用技术要求

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3 Terms and definitions

3.1 Module for medical use is defined as a functional unit that provides, separately, medical diagnosis, medical treatment, the related logistic support or a specific medical function, that can be flexibly combined with others and that is convenient to transport. A note states that the main structure of such a unit is normally a container or a shelter.

3.2 Modular integrated system for emergency medical use is defined as a combined space made up of medical modules, able to be moved quickly to a designated area and deployed there as an integrated whole, meeting the basic requirements of a medical treatment environment; it can be assembled and dismantled repeatedly and used again. A note gives the short form used throughout the document, integrated system.

4 Technical requirements

4.1 General. The system shall carry at least the facilities needed to sustain vital signs and to give emergency medical treatment. Once deployed, the main body is normally made up of three parts, medical treatment, wards and logistic support; the treatment part uses a high-strength material such as an air-beam tent for the corridor roof that links the medical modules, and the ward part may be placed next to the treatment part and connected to it. Modules are selected and combined as needed from emergency care, medical technical support, admission and treatment, information technology, logistic support, and medical waste and wastewater disposal; configuration follows Annex A, use follows Annex B, maintenance is described in Annex C and layout in Annex D. Functional units should be self-contained movable equipment that can be set up quickly and whose internal space can

be adjusted within limits. Escape routes and emergency exits shall be provided together with fire-fighting facilities. Tents shall meet GB/T 3917.3 and GB/T 3923.1; containers shall meet GB/T 1413, GB/T 5338.1 and GB/T 17382; the main environmental parameters of a clean operating module shall meet GB 50333; the main functions of an intensive care unit shall meet WS/T 509; and an isolation unit shall meet WS/T 311. Shelters are of the fixed or the expandable kind, built from rigid materials into a movable whole, and shall be reasonably airtight, lighttight, watertight and thermally insulated. Materials shall be flame retardant, corrosion resistant, resistant to disinfection and easy to wipe clean. In the transport and storage state the preferred main structure is a shelter or container plus box sets. Tents shall have a service life of not less than 3 years and a storage life of not less than 10 years; shelters and containers not less than 20 years for both.

4.2 Application environment. On siting, the ground should be regular in shape, geologically stable, high-lying and free of flood threat; the site shall be level, open, well drained and firm, preferably with a natural slope of less than 5 %. Where the incident site is hard to reach, a site nearby should be chosen that suits helicopter connection without being affected by helicopter movements, and a site with access to municipal mains water or class III river water is preferred. A system for respiratory infectious disease should be placed on the upwind side of the least frequent annual wind direction, with the treatment modules at least 20 m from surrounding buildings or public areas. The system shall work normally in the natural environment of most of the country and shall still be usable after storage at the stated limits. Table 1 fixes those conditions: working temperature -40 °C to +46 °C; storage limit temperature -30 °C and +60 °C for shelters, containers, tents and the medical facilities fixed inside them, and, for other equipment, whatever its own manual requires; relative humidity not more than 95 %; wind speed not more than 9.4 m/s during deployment and withdrawal and not more than 20.7 m/s in operation; rainfall 2 mm/min for 1 h for tents and 6 mm/min for 1 h for shelters and containers; altitude not more than 3 500 m.

4.3 Shelter loading and module requirements. The floor shall carry, without plastic deformation or damage, a uniformly distributed load of 3 kN/m2, a concentrated load of 10 kN over an area of 500 mm x 500 mm, and a point load of 1 kN on each of four bearing points of 10 mm x 10 mm arranged at the corners of a square with 300 mm between the centres of adjacent points. The roof shall carry a uniformly distributed load of 2 kN/m2 and a concentrated load of 3 kN over an area of 300 mm x 600 mm. Temperature, relative humidity, illuminance, air supply rate and air change rate or fresh air volume inside each module should be controllable, and Table 2 sets values for twenty-six modules grouped as emergency care, medical technical support, admission and treatment, information technology, logistic support, and medical waste and wastewater disposal. Clinical modules are held at 18 °C to 26 °C or 20 °C to 26 °C with relative humidity in the band 30 % to 70 % or 30 % to 65 %; illuminance runs from not less than 100 lx in wards and delivery rooms to not less than 750 lx in the operating module, with the pharmacy at not less than 500 lx; supply air is not less than 6 changes per hour, and the air change rate is not less than 2 per

hour or the fresh air volume not less than 40 cubic metres per hour per person, the isolation ward being set at not less than 12 changes per hour. Logistic modules are given an illuminance figure only, the fuel supply module none. Further sub-clauses place the emergency care module where an ambulance can reach it and stretcher trolleys and wheelchairs can be parked, ask the operating module to support remote consultation, apply GBZ 130 to the X-ray protection design of the imaging module and the equipment documents to magnetic resonance shielding, apply WS 310.1 to the sterile supply module, require enough general ward capacity and internal clearances for medical equipment to pass, require connecting corridors sized for the scale and flow of the system with a buffer zone between the contaminated and the clean corridor, require the information module to network internally by cable or radio and externally by mobile network or satellite, apply GB 5749 to the water of the domestic water supply module, leave the purified water quality of the medical water module to the relevant rules and the disinfectant water quality to the medical process, require the fuel supply module to support 48 h of full-load running with a refuelling interval of not less than 24 h, require the waste collection module to collect and bale waste in a closed way, and require the medical waste treatment module to render medical and domestic waste harmless with exhaust emissions meeting GB 18484 or local environmental rules.

4.4 External envelope. The envelope should meet requirements for heat insulation, sound insulation, vibration isolation, impact resistance, insect proofing, corrosion protection and sealing, and materials with few and tightly fitting joints should be chosen. Tent fabric shall meet GB/T 5455 for flame retardance. Sealed windows shall be used and wooden doors and windows are not preferred; glazing shall resist impact and be shatterproof. Door and window materials shall have a long service life, resist corrosion, not shed, be easy to maintain, light, strong, colourfast and well sealed.

4.5 Interior finishes. Shelter and container interiors shall meet GB 8410 and use materials that meet the flame retardance requirement. Finished surfaces shall resist weak acid and alkali attack, withstand medical detergents and disinfectants and offer some impact resistance and weathering resistance. Finishes and floors shall not generate or accumulate dust and shall be easy to sweep or wash. The harmful substance content of the materials shall meet GB 50325 and GB 18582.

4.6 Electrical system. Power shall be distributed on a central supply, zoned control basis, the main power module feeding zone power modules and those feeding the using modules, forming a three-phase four-wire network. One or more supply modes shall be supported, including but not limited to generating sets and a mains connection. Generating sets shall be provided so the system can run on its own, small sets shall be provided for key areas such as the operating room, and equipment with a high continuity requirement shall be given a dedicated uninterruptible supply. Over-voltage, under-voltage, earth leakage and overload alarm and protection shall be provided. Power and signal earthing shall follow GB 14050. The input of each using module shall have induced lightning protection and, where

the application calls for it, direct strike protection; external cabling shall be protected by design. Electromagnetic compatibility of medical electrical equipment shall meet YY 9706.102. Warning lamps shall be fitted at the entrance of the operating, delivery and imaging modules. Modules needing sterilization, such as operating, clinical laboratory and ward modules, shall have germicidal lamps switched separately from the other lighting, with switches that are easy to identify and operate. Lighting shall use high-efficiency, high colour rendering sources; where LED luminaires are used, photobiological safety shall be tested to GB/T 20145 and reach the no risk class, free of blue light and ultraviolet hazard.

4.7 Intelligent systems. The system shall be able to communicate remotely and its modules shall interconnect easily. An emergency call and answer function for medical staff shall be provided. A video surveillance system shall be provided so that the condition of the casualties in each module can be watched in real time where needed. The power supply state of each module and the running state of important equipment such as ventilation, air conditioning and oxygen shall be monitored in real time. An electronic medical record system, a hospital information system, a laboratory information system and a picture archiving and communication system should be provided.

4.8 Water supply and drainage. A zoned arrangement should be used. Surface water used as a source shall meet GB 3838 and groundwater GB/T 14848. The medical water and domestic water modules shall be placed in clean, well ventilated areas, and floor drains shall be fitted where water can collect. External pipe runs should not be too long or too numerous, the pipe itself should be of a material that is easy to stow and quick to deploy, joints should be of the quick-insert kind, and there shall be no leakage or poor supply and drainage. Medical wastewater discharge shall meet GB 18466 and HJ 2029. For a respiratory infectious disease system there are three further requirements: water outlets shall be non-contact or non-manual, sanitary fittings shall be easy to clean and disinfect, and wastewater shall be disinfected before discharge.

4.9 Oxygen. Oxygen cylinders or oxygen generating equipment should be used, the generating equipment meeting YY 9706.269. External oxygen piping shall be of a material that is easy to stow and quick to deploy, with quick-insert joints and a good seal. External oxygen piping shall be designed for reliability and routed away from areas where an ignition source can arise; when the pipe is damaged at one point it shall be possible to shut off the pipe locally at both ends without affecting the other oxygen terminals. Supply pressure at the terminal shall be 0.4 MPa to 0.45 MPa. The oxygen supply module shall be designed with a back-up and fitted with an abnormality alarm.

4.10 Ventilation and air conditioning. Each module should have its own independent air conditioning system. Direct expansion units are preferred as the source of heating and cooling, with auxiliary heat sources such as electric heating or oil-fired warm air units. Exhaust shall be provided where odour, water vapour or damp work arises, and local exhaust in heavily contaminated modules such as the clinical laboratory and the sterile