THERMALLY INSULATED CONTAINERS FOR
TRANSPORT AND TEMPORARY STORAGE
OF DONATED BLOOD

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Containers previously available had poor insulation and considerable weight, which not only re-
stricted the working range of field teams but also hampered the preservation of the blood during transport.
Extension of the working range without risk to the blood requires new containers, which would store blood
for 1-2 days while maintaining a temperature of 2-12° in the blood and also should be suitable for outside
temperatures within the limits of ± 30°.

This Institute has developed three standard containers: the TKM-14, TKM-7, and TKM-3.5.

The containers are boxes with three-layer walls. The outer and inner layers are made of glass-fiber
material based on resins PN-1, PN-3, or NPS-609-21M, with STS-41 glass-fiber cloth, while the space be-
tween them is filled with unpressed polystyrene PSB, whose density is only 0.04 g/cm³.

For convenience in handling, the end walls of the containers have reinforced metallic handles. The
hinged lids are joined to the body and have limit stops.

To prevent heat leakage at the opening surface, the lid has cemented to it with 88-N rubber cement a
sheet of soft technical rubber or else a profile rubber bead. Two clamps provide for compression of this
rubber when the lid is closed.

The insulated TKN-14 container (Fig. 1) is intended for supplying field teams preparing donor blood
and also for temporary storage and transport of blood by any means of transport. The container will take
four grids each with 14 flasks of blood of 250 ml each. To maintain the best temperature within the cham-
ber, vessels containing coolants or heating agents can be inserted between the two tanks along vertical
lines. The foam-insulated tanks will take 7 liters of water or 6 kg of ice, which can be frozen directly in
the tank, or else 4.5 kg of crushed ice. The length of the container is 720 mm, and the width is 500 mm,
while the height is 570 mm. The thermal insulating layer is 70 mm thick.

If the outside temperature is 30° and the tank has been loaded with lump ice, the time for the blood to
heat from 3-4° to 12° is 53-55 h, while 6 kg of ice frozen directly in the tank extends this to 70-72 h (Fig.
2). The initial temperature of the blood placed in the container is 3-4°.

If the outside temperature is -30° and the tank is filled once with water at 50°, the blood at first is
heated at 1.6-1.7 deg/h; the maximum temperature rise of the blood in 8 h is 12-13°; subsequently there is
slow cooling to 2° (Fig. 3). The blood stays in the range 2-12° for 24-25 h. Tests on the blood have shown
that such heating and cooling during transport does not affect its value. The temperature of the heating
agent in the tank can be reduced when the temperature of the outside air is above -30°.

The TKM-7 and TKM-3.5 are intended for synchronized handling of blood within a city, for blood
transfusion sections in hospitals, and for carrying donor blood in aircraft.

The TKM-7 has two grids taking eleven flasks each of 250 ml for blood, together with three polymer
tanks with sealed lids for the heating or cooling agents. The capacity of the tank is 2.1 liters of water.

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Fig. 1. General view of the TKM-14 container with fittings.

Fig. 2. Blood temperature in the TKM-14 with an outside temperature of 30°: 1) with lump ice; 2) with ice enclosed in foam plastic.

Fig. 3. Blood temperature in the TKM-14 with an outside temperature of -30°.

The dimensions of the container are as follows: length 680 mm, width 280 mm, height 530 mm.

To transport blood when the outside temperature is above the blood storage temperature, the upper grid will take four tanks containing cooling agent, with two in the lower one. The arrangement has been determined because the flow of warm air from the lower grid will rise up, and the cooling of the upper flasks will be rather slower. On the other hand, the flow of cold air from the upper grid will tend to flow downwards, and so there will be a convection circulation of the air, which tends to equalize the temperature within the chamber, and the cooling of the flasks will go more uniformly in the two grids. When the outside temperature is 30°, the blood temperature remains in the range 2-12° for 23-24 h when ice is frozen in the tanks or 18-20 h when lump ice is used. Similarly, at low temperatures the four tanks are filled with heating agent, namely, water at 50°, and also the two in the lower section. Tests at an outside temperature of -20° have shown that the temperature of the blood in the upper section rises to 12°, while that in the lower only reaches 10.5°. Then the proper arrangement of the heating and cooling agents in the container not only means that the blood does not become overheated but also enables one to maintain a temperature in the range 2-12° for 15-24 h.

The TKM-3.5 has one grid taking eleven flasks of 250 ml each for blood and three polymer tanks for the heating and cooling agents.

The dimensions of the container are: length 680 mm, width 280 mm, height 335 mm.

The TKM-3.5 containing donor blood will keep the blood in the range 2-12° for 15-16 h when the outside temperature is 30° and the tanks have been filled by freezing with ice. The initial blood temperature is 3-3.5°. If the tanks are filled with lump ice, the unit will keep the temperature in the range 3-12° for 11 h.

If the air temperature is below the blood storage temperature, the three tanks are filled with water at 50°. Tests have shown that an outside temperature of -20° allows the blood to rise to 10.5-11.5° in 5 h;