HOVERCRAFT TRIALS ON SONG-HUA RIVER
(ESSAI D'UN AÉROGLISSEUR SUR LA RIVIÈRE SONG-HUA)

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ABSTRACT

At the higher latitudes of northern China, rivers are frozen from October to May. Crossing the rivers by boat, or on ice by foot during the period of freezing and thawing is dangerous. Communications are suspended at this time. An amphibious hovercraft, MARIC model 7210, satisfied user's demands on the Song-Hua river. However, ice cresting on other rivers exceeded one metre and could not be overflown with the 7210 hovercraft. A number of observations are made concerning skirt flexibility at low temperature, freezing spray and general low temperature behaviour of this hovercraft.

RÉSUMÉ

Aux latitudes élevées du nord de la Chine les rivières gèlent d'octobre à mai. La traversée par bateau ou sur la glace durant les périodes de gel ou de dégel est dangereuse et les communications sont alors suspendues. Un aéroglisseur amphibie, le modèle 7210 de MARIC, a satisfait les demandes des usagers sur la rivière Song-Hua. Cependant, sur d'autres rivières les crêtes de glaces dépassaient un mètre, ce qui excède les possibilités de l'aéroglisseur 7210. Des observations ont été faites sur la flexibilité des jupes à basse température, le gel des embruns, ainsi que la réaction générale de cet aéroglisseur à basse température.

INTRODUCTION

Hovercraft trials were carried out on the Song-Hua river in the northeast part of China in 1986, at the beginning of the freezing season. The specifications of the hovercraft used, MARIC model 7210, satisfied user's demand. However, obstacle clearance capability of the craft was not quite satisfied for the Heilongziang and Wusuli rivers, where ice obstacles always exceeded one metre.

The rivers in the higher latitudes of northeast China remain frozen from October to May each year. Horses, persons and vehicles may cross when the rivers are fully frozen. During May and October, the thawing and freezing periods, the temperature differences between day and night are very large. This results in the ice surface fracturing during the day, with ice pans floating away. The surface is thus very unstable making it dangerous for crossing. At night, the frigid wind causes the floating ice to accumulate into ice rafts with individual floes overriding each other resulting into sharp crests pointing downwind (figure 1).

Those periods place great difficulties on the local people, with the lack of communications giving rise to a number of social problems.

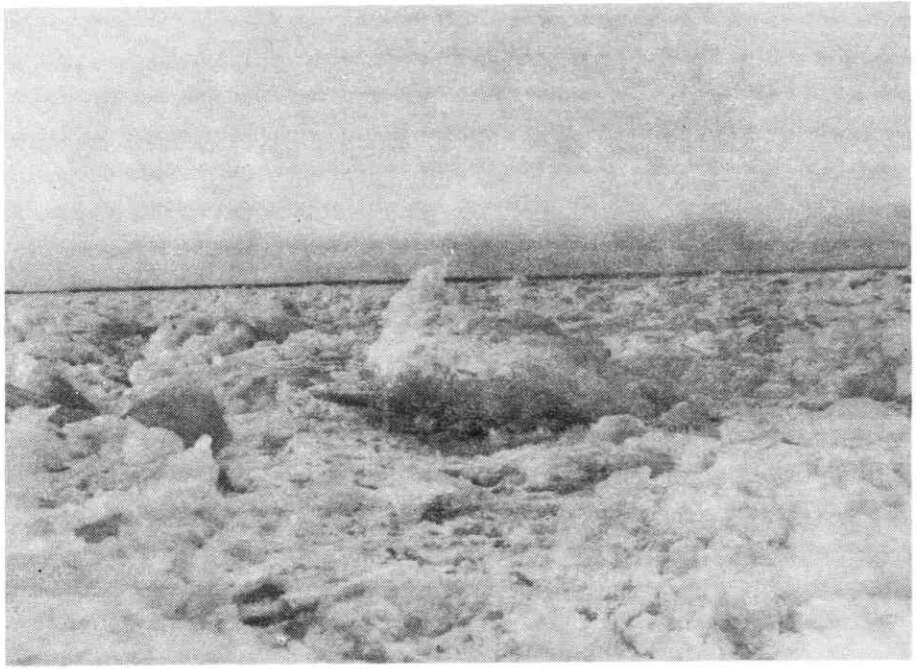

Figure 1. View of Ice Surface on the River

USER'S REQUIREMENTS

The users hope the hovercraft may be useful for the traffic mission at this period of time. The main requirements specified by the users are:

1. The hovercraft is of a size that can be moved by trucks or wagons.

2. The hovercraft can be started conveniently in the morning after a night in the open at minus 20 degree Celsius.

3. The hovercraft must be supplied with a heater able to maintain a temperature of ten degree Celsius in the cabin. The cabin humidity and/or the window insulation must be controlled so that the operator view remains undisturbed by misting.

4. The hovercraft skirts will rwmain supple at a temperature of minus twenty degree Celsius and will not accumulate ice from water spray.

5. The hovercraft is expected to clear ice ridges up to 0.5 metre in height; it is to detour around areas where this height is exceeded.

HOVERCRAFT MODIFICATIONS

In order to meet the users' requirements, the following modifications were proposed on the MARIC 7210, the hovercraft used for the evaluation:

1. Double windows were installed, with sealed inner space filled with a dry inert gas.

2. An air-cooled diesel engine with flame pre-heating was adopted so that the engine could be ignited and started at minus twenty degree Celsius.

3. The accumulators were installed in an insulated box so that they could provide the necessary engine starting current when the hovercraft has been standing in the open after twelve hours at minus twenty degree Celsius.

4. Skirt fabric and coating materials, which can be operated at low temperatures of at least minus twenty degree Celsius should be developped.

MARIC 7210 HOVERCRAFT

The leading particulars of the test hovercraft MARIC 7210, shown in figures 2 and 3, are as follows:

Length overall (on cushion)	11.0m
Beam overall (on cushion)	4.5m
All up weight	5.0t
Crew	2 persons
Passengers	9 persons
Maximum fuel capacity	0.336t
Maximum calm water speed	43.8km/h
Endurance	6 hours
Skirt depth	0.5m
Skirt type	Bag-fingers

Propulsion System:

A Deutz air cooled diesel type BF6L913 rated up to 198 hp at 2500 rpm is mounted behind the cabin to drive a five bladed fixed pitch GRP air ducted propeller with a diameter of 1.80m

Lift Engine:

A Deutz air cooled diesel type BFL913 rated up to 198 hp at 2500 rpm is mounted forward to drive an aluminium centrifugal fan with a diameter of 1.20m

Figure 2 MARIC 7210 Hovercraft

TRIALS OBJECTIVES

Trials have been carried out in order to test the capability of the MARIC 7210 with regard to the following characteristics:

1. Ice obstacles clearance from various directions.

2. Crossing of open leads between ice pans on the river.

3. Crossing of various type of ditches or trenches.

4. Handling at wind speeds up to Beaufort force 6.

5. Operational reliability of the skirts, propeller, fan, etc., under various operating conditions, from in situ inspections.

TRIALS RESULTS

1. Some of the measures taken into consideration for operating at low temperature were effective.

2. As the temperatures were always higher than minus twenty degree Celsius, the original skirt fared very well during the trials. Water spray did not freeze on the skirt and its flexibility did not change in an obvious manner.

3. The drag of the craft was small on flat ice surface but increased drastically in the areas with floating ice, just as it did on the rough ice surfaces.

4. Since no reverse thrust device had been installed on the craft, it had to be operated at sub-hump speed when crossing gaps between ice floes. In this way the craft was kept from damaging its skirt and structure by collision with ice obstacles.

5. The craft could clear rafted ice and floating ice with height not exceeding 0.5m.

6. Since the craft was operated intentionally at sub hump speed over the river ice, only a little water spray splashed on the craft. A thin ice coating of about 2mm was collected on the deck, railings, lift fan, hub of propeller and propeller bearing supports. At the same time an identical craft was operated at sub hump speed on an unfrozen lake at a temperature of minus six degree Celsius. A large water spray was generated and, consequently, very thick ice was collected on these same parts. Therefore, the key point for reducing icing is the suppression of water spray.

7. In the case of an hovercraft operating over floating ice, it has to possess good manoeuvrability with short turning diameter in order to avoid collision with ice obstacles higher than its skirt clearance.

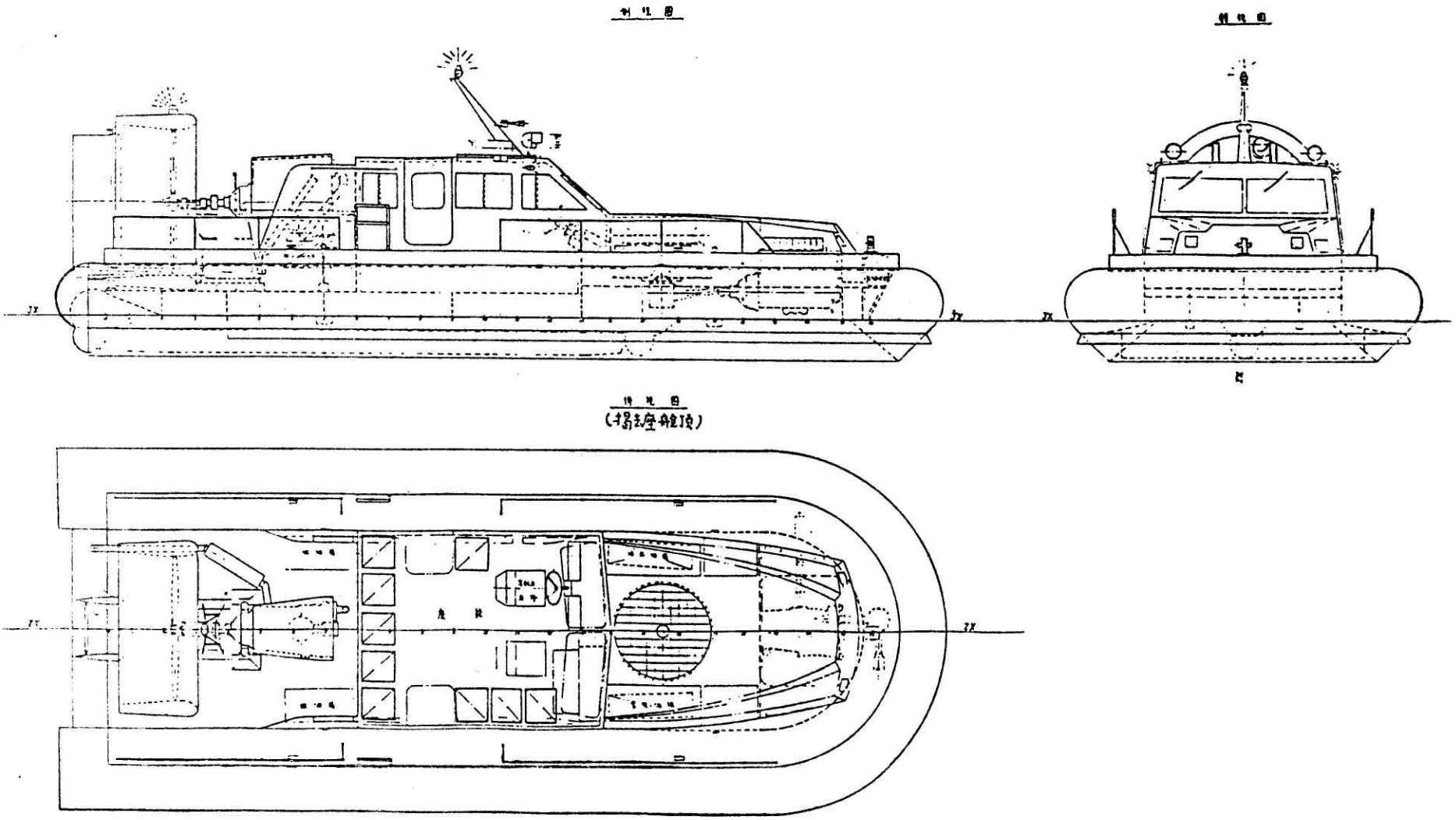

Figure 3 MARIC 7210 Sectional Diagrams