THE IMPLICATIONS OF DEEP WADING ON THE DESIGN AND OPERATION OF ARMOURED VEHICLES

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Abstract. This paper reviews the features of armoured vehicles that have been designed or adapted to wade through water up to five metres deep. The problems facing the designer are highlighted, including water exclusion, air supply, heat rejection, underwater navigation and mobility. The operational difficulties facing the crew are discussed, including the need for extensive vehicle preparation immediately prior to deep wading.

INTRODUCTION

Deep water has always presented a major obstacle for heavy armoured vehicles such as main battles tanks. Lighter vehicles, such as armoured personnel carriers (APC), *can* be designed with the ability to swim but the demand for increasing levels of heavy armour protection makes this option less viable for modern vehicles. This, together with the uncertain theatre of operation for future deployments, has resulted in renewed interest in vehicles with the capability to wade in water to a depth of up to 5m.

This paper comprises a brief description of the techniques which have been used hitherto to enable armoured vehicles to deep-wade, a critique of these techniques and suggestions on how they might be applied to modern armoured vehicles, including possible enhancements.

FORDING AND SCHNORKELLING - BACKGROUND

Shallow Fording

Shallow fording is the ability of a vehicle, with its wheels or tracks in contact with the ground, to negotiate water obstacles without prior preparation. In practice, some minor preparation by crews is usually necessary, for example the checking of access plates and their gaskets, and treatment of any doubtful ones with sealant. Allowance must be made for the pitch attitude of vehicles on entry and exit. Fording depths vary according to particular equipments; Def Stan 00-6/Issue 1 specifies several categories varying from 0.5m to 3.25m, dependent on the vehicle type:

- Typically, for turreted vehicles the shallow fording depth will normally be slightly less than the height of the hull.
- For vehicles of box-like configuration, for example APCs, the same consideration applies. Provided doors, firing ports and vision slits are properly sealed, the shallow fording depth achievable is higher than that for tanks and SP guns, which have relatively shallow hulls.
- For B vehicles, the fording depth without preparation is usually comparatively small, for example, 0.5m in the case of Landrover and 0.75m for medium mobility load carriers.

Deep Fording

Deep fording is the ability of a vehicle, with its wheels or tracks in contact with the ground, to negotiate water obstacles greater in depth than those that it can shallow ford. This is achieved by prior application of special waterproofing kits which may need significant time and engineering support to fit. Deep fording for both A and B vehicles implies the capability to ford to a depth of at least 1.5m, and for fully enclosed armoured vehicles, to the top of the roof or turret. For vehicles of box-like configuration, there will be little difference between shallow fording and deep fording depths.

Schnorkelling

Schnorkelling, or schnorkel fording, is the ability of a vehicle, with its wheels or tracks in contact with the ground to negotiate water obstacles while completely immersed by using special schnorkel fording kits or built-in schnorkelling equipment.

The height of the schnorkel intake should be about 1.5m greater than the water depth to allow for sinkage on the bottom, waves and splash, and entry and exit angles. The schnorkel is required to provide air for the engine and crew, and a means of communication.

SCHNORKELLING - DESIGN CONSIDERATIONS

Schnorkel Design

Two basic approaches to schnorkel design have been employed: a *tube* or a *tower*.

Tube-type Schnorkel

In some French and Russian practice, all hatches are sealed and a relatively narrow breather tube (diameter ~150mm) is fitted to a special aperture on the turret or roof (Figures 1 and 2). The tube can also be used as a rudimentary periscope for the commander, though the normal means of navigating across a river is via radio directions from a crossing commander on the bank. Stowage of the schnorkel tube when not in use is facilitated by splitting into several shorter lengths, which stack inside one another.

Tower-type Schnorkel

US and UK practice has generally been to fit a large schnorkel, usually to the commander's hatch. This is in effect a conning tower, at the top of which the commander can stand and look out (Figures 3 and 4). The use of a conning tower offers an important advantage in commanding and navigating the vehicle. This is particularly important for a vehicle that may operate in isolation.

The tower serves as an emergency escape route for the crew should the vehicle become immobile or flooded while under water. In this system, radio communication while immersed is not essential, although still desirable. Stowage of the large diameter tower on the vehicle is difficult, even in sections, and presents a substantial logistic burden when separated from the vehicle. Cranage may be required to erect the tower. A typical tower is shown in Figure 5.