Chapter 1 – INTRODUCTION

1.1 BACKGROUND AND PROBLEM DEFINITION

1.1.1 Background

Mines, and specifically Anti-Tank (AT) mines, are a significant threat for military vehicles and their occupants [Radonić, 2004]. The AT mines are designed for the destruction and damage of armored and other vehicles, usually by using them in mine fields on routes used by vehicles of the enemy. These mines, with huge variation in charge mass and initiation types, a huge amount of strong explosive, and great destructive forces, can be buried in all soil types, on railroad lines, in coastal areas and river approaches, and they can be buried separately or in groups to form minefields.

The first modern antitank mines appeared in World War I as a weapon against the first armored vehicles. During World War II, technological progress in the production of antitank mines enabled their widespread tactical application. One-fourth of all German tanks were destroyed by mines in the Russia-German conflict [Mitchel, 1964; Utter, 1960]. Further technological improvement after World War II made the antitank mine one of the most efficient and least expensive lethal weapons. There are several hundred different types of antitank mines in the world today and millions of mines are left behind in several (post-war) countries. The number of antitank landmines in the world is difficult to estimate. For example, antitank mines are estimated to account 20% of the presumed total 2 millions landmines laid during the war of Croatia from 1991 to 1995 [Radonić, 2004].

In the past ten years, national and international projects for the improvement of the mine protection of several military vehicles from trucks up to main battle tanks have been performed (see Figure 1.1). Purchasers and users of military vehicles are becoming more aware that apart from vehicle integrity, personnel safety is crucial in operations where mines pose a threat. Especially, in peacekeeping and peace-enforcing operations occupant safety has the highest priority. In case of a mine detonation under a vehicle, a vehicle rupture can occur resulting into effects like fragments, fire, gases, blast overpressure as well as the mechanical shock and a vertical impulse load. All these effects will affect (psychologically and physically) the occupants inside the vehicle. In the same case, but without structural rupture, the occupants might still be affected by the mechanical effects like shock, structural deformation and the vertical impulse load.

Figure 1.1: Example of Mine Detonation under a Logistic Vehicle.

1.1.2 Problem Definition

NATO countries realize that the mine threat to military vehicles and their crew is of urgent and great importance. Therefore, many countries started the development of mine protection systems, which resulted into different requirements and test methods per country. Several attempts were made for standardization, for example by The Technical Cooperation Program (TTCP: a co-operation between the GBR, USA, CAN, AUS) [TTCP, 1998] and in international co-operation projects (e.g. the mine protection project of the Leopard II main battle tank involving NLD, NOR, DEU, SWE, CHN). NATO STANAG 4569 addresses the landmine problem with respect to establishing standards for protection levels for logistic and light armored vehicles.

The new HFM-090/TG-25 on test methodology for protection of vehicle occupants against anti-vehicular landmine effects was created in order to establish common injury criteria and assessment procedures for qualification.

Later, STANAG 4569 asked for assistance from the HFM-090/TG-25 for establishing the standard for protection of vehicle occupants against anti-vehicular landmine effects.

1.2 THE OBJECTIVE AND APPROACH OF THE HFM-090/TG-25

1.2.1 Objective

The mandate and objective of the HFM-090/TG-25 (see also Terms of Reference in Annex A) are:

- Describe blast mine effects resulting human physical injuries based on various countries experiences with mine incidents and tests;
- Propose injury assessment criteria and tolerance levels for occupant injuries during AV (anti-vehicular) mine strike tests; and
- Describe test methods and equipment to assess occupant injuries during AV mine strike tests.

1.2.2 Approach

First, the background of the mine detonation process and the consequent injuries expected were discussed. Also the discussion of the injury criteria was started. Additionally, the Terms of Reference were redefined. It was decided that each country would be responsible for a body region. This approach was followed throughout the entire process. Information was shared and each country prepared summary documents on the injury criteria and their tolerance levels. Based on these summaries discussion took place and decisions were made. Separate topics included were the measurement methods and test procedures, which were then discussed as well. The progress was presented by members of TG-25 to the STANAG 4569. Finally, this report was written with contribution from all TG-25 members.

The work by the HFM-090/TG-25 is restricted to the biomechanical effects on land based vehicle occupants (crew and troops) caused by the mechanical loading and overpressure effects occurring during an AP (Anti-Personnel) or AT (blast) mine detonation anywhere under a vehicle. Detonations in front or to the side of the vehicle are not considered here. Although not negligible, the psychological and social effects caused by a mine strike are out of the scope of this report. The work by the HFM-090/TG-25 focuses on describing criteria, tolerance levels and test methods used in occupant safety studies for mine protection qualification trials. Rather than to develop an overall criterion, the goal was to discuss and propose injury criteria and tolerance levels for all the different vulnerable body regions.

1.3 ORGANIZATION OF THIS REPORT

Starting with this introduction this report is built around five (5) chapters. Chapter 2 provides background information on the anti-vehicle mine detonation process and the injuries that can occur. The next chapter (Chapter 3) contains the core subject of this report: the injury criteria and tolerance levels. It is subdivided into several sections, each focusing on a body region. Chapter 3 finalizes with conclusions on the injury criteria and tolerance levels. Chapter 4 describes the measuring methods and the test set-up and procedure. Finally, the conclusions are presented in Chapter 5 along with recommendations.

Annexes supplement the main body of the report. These annexes contain mainly information that relates to the medical aspects and the injury criteria, but was too detailed for inclusion in the main text. Additionally, the Terms of References of the HFM-090/TG-25 are included in the annexes.

1.4 REFERENCES

Mitchell, D.W. (1964), Russian mine warfare: the historical record, *Royal United Services Institution J,* 109 32-9.

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