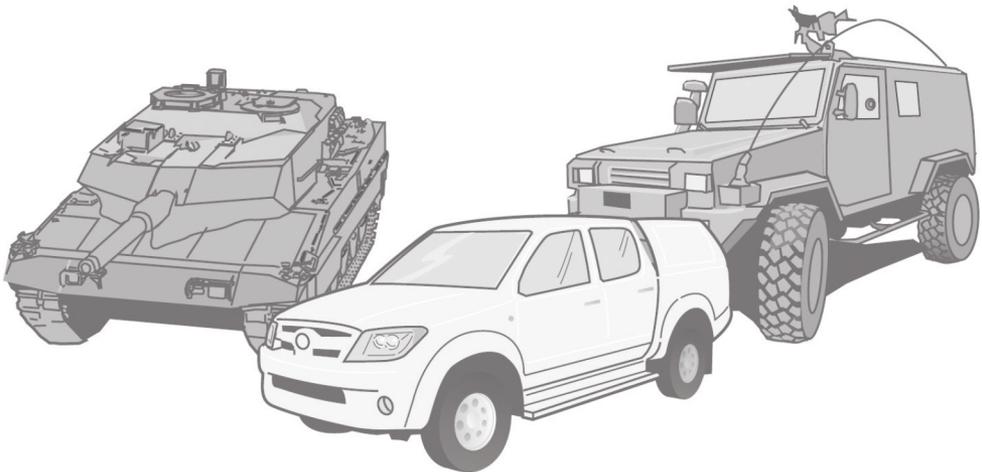


# Vehicle Safety Handbook



**2015**



**The Swedish Defence Materiel  
Administration's Vehicle Safety  
Handbook**

# H FORDONSÄK E

Reading Instructions

1. Introduction

2. Vehicle Legislation

3. Activities and  
Documentation

4. Function-oriented  
System Safety  
Requirements

5. Summary of  
Requirements/Checklist

Acronyms

References

Figures and Tables

Index



Öppen/Unclassified

Datum  
2016-03-30

Diarienummer  
15FMV2367-16:1

Ärendetyp  
Beslut

Dokumentnummer

Sida  
1(1)

## Approval of Vehicle Safety Handbook 2015 (H FordonSäk E 2015)

Vehicle Safety Handbook, H FordonSäk E, edition 2015 (English edition), M7762-000991, is hereby approved for use from 2016-04-01.

This English edition is a translation of the Swedish edition (Handbok för Fordonssäkerhet, M7762-000961). In case of difficulties with regard to interpretation, the Swedish version applies.

FÖRSVARETS MATERIELVERK



Kristin Strömberg  
Chief Technical Officer

## READING INSTRUCTIONS

The Vehicle Safety Manual (H FordonSäk E) contains principles for applying and interpreting legislation, experience-based function-oriented system safety requirements, including interfaces that should be considered, as well as recommended activities in order to achieve a tolerable risk level for complete vehicle systems.

This English edition is a translation of the Swedish edition. In case of difficulties with regard to interpretation, the Swedish version applies.

Readers who are unfamiliar with system safety activities should read the Armed Forces' Handbook on System Safety (H SystSäk E). For material requirements that can be applied to weapons or ammunition or both, the Weapons and Ammunition Safety Manual (H VAS E) must be used. For corresponding requirements on software, the Handbook for Software in Safety-Critical Applications (H ProgSäk E) must be used. For the design of working environment in huts, the Safe Temporary Workplaces Manual (H SäkFältmArb E) must be applied. The publication years and stock numbers of the manuals can be found in the reference section of this manual.

The Vehicle Safety Manual (H FordonSäk E) can substantially be read and applied standalone but references to the text in the Handbook on System Safety (H SystSäk E) exist in some chapters. For certain functions or subsystems, H FordonSäk E, H VAS E, H ProgSäk E and H SäkFältmArb E must be applied in parallel.

H FordonSäk E consists of five chapters:

*Chapter 1 Introduction* specifies the basis for vehicle safety, the purpose of the manual and how it can be applied.

*Chapter 2 Vehicle Legislation* includes a summary of the laws, ordinances, regulations, standards, instructions etc. that control/regulate the vehicle field.

## Reading Instructions

*Chapter 3 Activities and Documentation* specifies the specific activities (including documentation) that need to be carried out regarding vehicle safety. Among other activities, the chapter describes the military registration inspection of vehicle systems.

*Chapter 4 Function-oriented System Safety Requirements* specifies suggestions for system safety requirements for military vehicle systems beyond existing vehicle legislation described in *Chapter 2*.

*Chapter 5 Summary of Requirements/Checklist* is a compiled list of all of the requirements proposed in the manual.

Note! The references and document designations in the manual are those that were current at the time of this manual's creation. In case a certain reference needs to be applied, it is recommended that a check for a later edition is carried out.

## IMPROVEMENT SUGGESTIONS

Comments and suggestions for improvement on H FordonsSäk E are sent to:

Försvarets materielverk

Systemsäkerhet

115 88 Stockholm

## Table of Content

Reading Instructions .....	3
<b>1 Introduction .....</b>	<b>9</b>
1.1 Purpose of the MANUAL.....	11
1.2 Application .....	12
General .....	12
International .....	13
Other Customers.....	13
1.3 Selecting requirements.....	13
1.4 Basic concepts and definitions .....	14
<b>2 Vehicle Legislation .....</b>	<b>19</b>
2.1 The Swedish Code of Statutes (SFS) .....	21
2.2 The Transport Agency Regulations (TSFS).....	22
2.3 The Working Environment Authority's Regulations (AFS).....	24
2.4 The Swedish Civil Contingencies Agency Regulations (MSBFS) .	25
2.5 The Swedish Armed Forces' Statutes book (FFS) .....	26
2.6 The Swedish Armed Forces' internal stipulations (FIB).....	27
2.7 The Swedish Armed Forces' Safety Regulations, SäkI, etc.....	27
<b>3 Activities and Documentation.....</b>	<b>29</b>
3.1 Process Description .....	29
3.2 User Requirements .....	31
3.3 Classification of Vehicles.....	31
Commercial Off The Shelf (COTS) .....	33
Military Off The Shelf (MOTS).....	34
Vehicles Designed for Specifically Military Purposes .....	35
3.4 CE Marked Vehicles and Products .....	35
CE Marked Vehicles.....	36
Integration of CE Marked Product.....	37
Modification of CE Marked Vehicle or Product.....	37
3.5 Supplier's Technical Documentation to FMV .....	38
3.6 FMV Delivery to the Swedish Armed Forces .....	39
Application of Vehicle Legislation to Military Vehicles .....	39
Single Vehicle Approval .....	40
FMV Safety Statement.....	43
3.7 The Swedish Armed Forces' Decision on Use .....	43

<b>4</b>	<b>Function-oriented System Safety Requirements.....</b>	<b>45</b>
4.1	Engine Systems .....	45
	Engine Housing, Lubrication System, Engine .....	46
	Fuel Systems and Fuel Tanks .....	47
	Inlet and Exhaust Systems .....	49
	Cooling System .....	50
	Engine Controls .....	51
	Pressure Vessels.....	51
	Exhaust Emission Control.....	51
4.2	Transmission System .....	52
4.3	Brake System .....	52
	Hydraulic Driving Brake System .....	53
	Pneumatic Brake System (Service Brake).....	53
	Auxiliary Brakes and Electronic Brake Systems .....	54
	Parking Brake System.....	55
4.4	Steering System.....	55
4.5	Wheel System and Track Assembly .....	56
4.6	Hydraulic and Pneumatic Systems and Springs.....	58
	Hydraulic and Pneumatic Systems.....	58
	Springs .....	59
4.7	Electrical System and Electrical Equipment .....	60
	Electrical Environment and Communication Equipment .....	61
	Batteries .....	63
	Generator, Charging System, Starter Motor, Ignition System .....	66
	Power Outlets .....	67
	Displays, Instruments, Indicators and Interior Lighting.....	67
	Wiring, Fuses and Emergency Stop.....	69
4.8	Safety-critical Electronics and Software .....	71
4.9	Lighting Equipment.....	71
4.10	Chassis, Cab, Interior and Chassis Body.....	74
	Chassis/Chassis Body .....	74
	Ballistic Protection .....	75
	Engine Hood, Fenders, Footsteps, Roof Rack and Masking ..	76
	Doors, Hatches, Portholes, Windows and Prisms .....	78
	The Driver and Crew Compartments and Interior Equipment.....	81
	Climate Control .....	85
	Equipment for Transporting Injured .....	85
4.11	Fire-fighting Equipment, Vehicle Mounted and Separate Respectively.....	86
	Level 1 Basic Fire Protection .....	87
	Level 2: Enhanced fire protection .....	88
	Level 3: Advanced Fire Protection .....	89
	Level 4: Complete Fire Protection .....	91
4.12	Load and Other Equipment.....	93
4.13	Weapon Installations.....	95

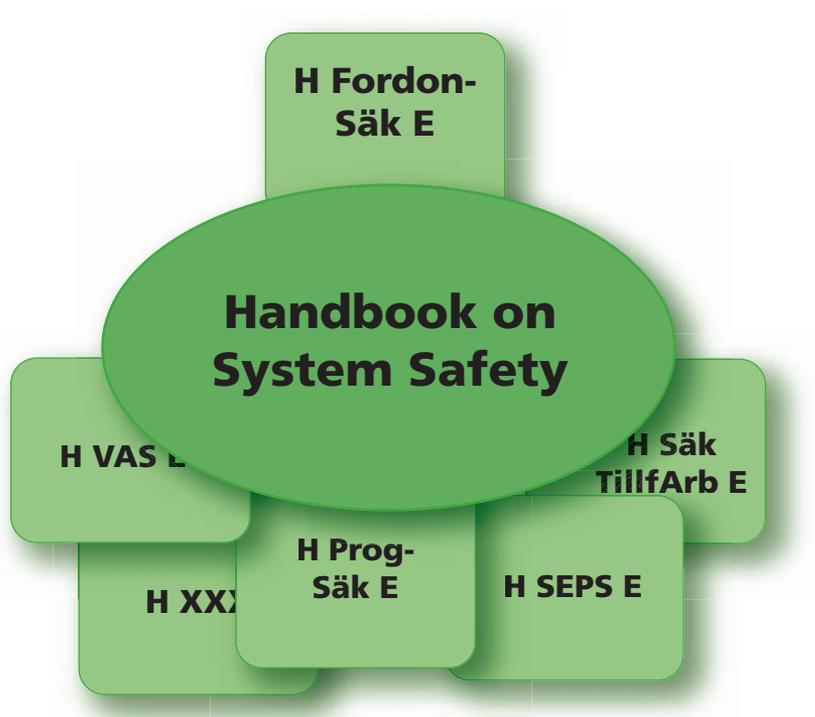
4.14	Lifting Equipment .....	99
4.15	Connecting Equipment .....	100
4.16	Chemical Substances and Properties of Materials .....	102
	The Defence Sector's Criteria Document .....	102
	Product Catalogue of Fuels used by the Swedish Armed Forces.....	102
	Material Properties.....	103
4.17	Use, Operation .....	104
	Driving in General.....	104
	Washing and Rinsing .....	106
	Fording, Floating and Ice Transition .....	107
	Supervision and Monitoring.....	108
	Internal Communication .....	109
	Collision.....	109
	Noise and Vibration.....	110
	Salvaging and Towing.....	112
<b>5</b>	<b>Summary of Requirements/Checklist .....</b>	<b>115</b>
	<b>Acronyms .....</b>	<b>157</b>
	<b>References .....</b>	<b>161</b>
	<b>Figures and Tables .....</b>	<b>163</b>
	<b>Index .....</b>	<b>165</b>



The Vehicle Safety Manual (H FordonSäk E) contains a compilation of legislations as well as a record of the experience that the Swedish Armed Forces (SwAF), the Swedish Defence Materiel Administration (FMV) and relevant Swedish industry have accumulated over the years relating to safety for vehicle systems, combat vehicles as well as other types of vehicles and trailers. The manual is to be considered as a complement to the Armed Forces' Handbook on System Safety (H SystSäk E).

The formal foundation for the Vehicle Safety Manual consists of the service regulations within the system safety program.

H SystSäk E must always be applied. If the vehicle system also contains weapons or ammunition or both, the Weapons and Ammunition Safety Manual (H VAS E) must also be used together with this manual. If the vehicle system contains software, the Handbook for Software in Safety-Critical Applications (H ProgSäk E) must also be used together with this manual. If the vehicle system contains huts, the Safe Temporary Workplaces Manual (H SäkFältmArb E) must be applied. If a vehicle system contains electrical installations that come under the Low Voltage Directive (2006/95/EG), the Handbook on Safe Electrical Products and Systems (H SEPS E) must be applied. For more information, see *References*. *Figure 1:1* shows schematically the connection between H FordonSäk E and other documents that govern and affect vehicle safety.



*Figure 1:1 H FordonSäk E relative to other documents*

The Armed Forces' Handbook on System Safety (H SystSäk E) states how system safety activities can be appropriately conducted and contains also certain materiel specific requirement.

The REQDOC Technical Specification Manual (H Kravdok E) states how requirements shall be formulated in the work undertaking (VÅ) and technical (materiel related) requirements in a technical specification (TS).

The Handbook for Software in Safety-Critical Applications (H ProgSäk E) states directives relating to the programming of safety critical software.

The Weapons and Ammunition Safety Manual (H VAS E) states design principles, guidelines for requirements and the experience accumulated over the years relating to weapons and ammunition.

The Safe Temporary Workplaces Manual (H SäkFältmArb E) states requirements for temporary work environments, for example huts.

The Safe Electrical Products and Systems Manual (H SEPS E) states requirements on electrical installations in vehicle systems that come under the Low Voltage Directive (2006/95/EG).

## 1.1 PURPOSE OF THE MANUAL

The purpose of H FordonSäk E is to:

- State guidelines for military registration inspection as well as principles for applying and interpreting legislation concerning when amendments or exemptions must be used for vehicle systems.
- Be a complement to H SystSäk E concerning experience-based function-oriented safety requirements in addition to legislation for vehicle systems.
- Identify the characteristics and interfaces of vehicle systems that should be considered and verified during the development and procurement of, for example, weapons, ammunition and communication material.
- State the required activities to ensure that vehicle systems and vehicle-related materiel reach a tolerable safety level for the current operational profile throughout the vehicle system's entire lifespan.
- Provide guidelines to staff at SwAF, FMV and other supporting agencies and suppliers on issues relating to system safety in connection with the study, development, procurement, manufacture, operation and decommissioning of the vehicle system.

### 1.2 APPLICATION

#### 1.2.1 General

---

H FordonSäk E is a guide to vehicle safety and provides support for the organization with design responsibility (DesignA) when determining requirements. The manual in itself is not a governing document, which means that the proposed requirements presented in this manual only serve as a basis for requirement specifications. The individual project must always be adapted based on the type of technical system, complexity and estimated risk. Therefore, there may be preconditions that render a specific requirement in the manual not applicable for a particular technical system.

The requirement definition is ultimately the responsibility of the DesignA/project, and which requirements that apply to a specific vehicle system must be stated in the requirement specification of the order/contract.

At procurement, the tender (order) must state that a system safety plan (SSPP) must be created. Normally, the supplier creates a draft of the SSPP which is confirmed by FMV when ordering. The SSPP controls other safety related activities. See also *H SystSäk E* for more information concerning SSPP.

H SystSäk E and H FordonSäk E provide support for what activities and requirements that must or should be implemented. Other system safety related manuals can also control and affect vehicle safety during the requirement definition of the vehicle system.

### 1.2.2 International

---

---

When producing this manual, EU directives and standards used internationally have been taken into account, so the manual is considered to be applicable in its entirety, even for an international procurement. For development projects awarded to a foreign supplier, the system safety activities must be carried out in the same manner as for development by Swedish suppliers.

When purchasing fully developed systems abroad, it must be ensured that information/documentation is obtained so that safety can be evaluated. In some cases, this documentation can be obtained from the country's authorities with which a so-called MOU (Memorandum of Understanding) has been prepared.

### 1.2.3 Other Customers

---

---

This manual is mainly aimed at operators who acquire and modify vehicle systems for the Armed Forces. Other agencies, such as The Swedish National Defence Radio Establishment (FRA), can apply selected parts of this manual, for example regarding registration inspection.

## 1.3 SELECTING REQUIREMENTS

The requirements in H FordonSäk E *Chapter 3* are for legislative compliance and must be met for vehicles before delivery to and use in SwAF organization. These requirements are all marked in dark green and have a bold requirement number to highlight the importance of these requirements.

The requirements in H FordonSäk E *Chapter 4* are guidelines for vehicle safety and consist of function-oriented requirements that can be used when determining requirements in a specification. The requirements are either marked in dark green with bold requirement numbers or in light green with normal text style. It is particularly recommended that requirements marked in dark green with bold requirement numbers are included in the requirement specification. However, all requirements, regardless of col-

our marking, include the word “shall” so that they can be easily included in the requirement specification. Note that all requirements in *chapter 4* are not applicable to all vehicle systems, which means that it is up to the project to select requirements based on vehicle classification. This also applies when selecting the requirement level, that is, if each selected requirement is “mandatory” or “optional”.

The requirements in this manual are numbered according to the following principle: for example requirement 3.402.04 where:

- 3            prefix for requirement in H FordonSäk E
- 402        chapter 4, section 2
- 04        consecutive number in the section

### 1.4 BASIC CONCEPTS AND DEFINITIONS

The concept *military motor vehicle examiner* refers in this manual to a military motor vehicle examiner who is qualified to perform registration inspection and is employed by FMV.

*Accident risk* refers to a risk of harm to people, property and/or the external environment.

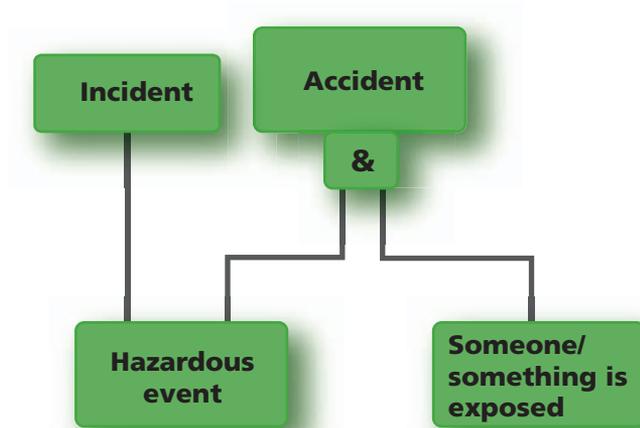
*Hazardous event* is an undesirable event. It is unplanned and without intent and may result in an accident if someone or something is exposed.

*Accident* occurs when someone/something is exposed to a hazardous event and is thereby injured/damaged (injury/damage to persons, property or the external environment). Accidents are always unintentional, not the result of for example a hostile act.

*Incident* is a hazardous event that will not cause an accident because nothing is exposed/damaged during the hazardous event.

The concept of *safety* in this manual refers to the absence of accident risk.

*Figure 1:2* illustrates the connection between the concepts listed above. For a more detailed account of the accident model, see *H SystSäk E 2011 Part 1 Chapter 3*.



*Figure 1:2 The accident concept*

All activities with technical systems involve the risk of accidents. Complete freedom from the risk of accidents, or vice versa, absolute safety, is therefore an unattainable “ideal state”. The aim of risk reducing activities and measures is to reduce the risks of accidents to a level that can be considered tolerable for the user.

The majority of the Armed Forces’ vehicles are used to move personnel and equipment in different ways and to protect them from hostile attacks, or are platforms for various types of functions such as weapons, health care equipment or Command and Control sites. The vehicles always pose a potential risk to the user, as they contain various types of kinetic or stored energy, such as fuel, ammunition, heavy objects, moving parts, radiation sources and batteries. Performance requirements can be contrary to the safety requirements since complex safety devices may reduce tactical ability and availability. When designing a vehicle system, the aim must always be to achieve a tolerable risk level during the technical system's entire lifespan without incurring limitations on the tactical use.

*Vehicle safety* is defined as the property of a vehicle system that does not intentionally cause injury/damage to a person, property or the external environment. By identifying, analysing and evaluating possible accident risks, these can then be either eliminated or reduced to a tolerable level of risk. Already at the design/con-

struction stage, many accident risks can be removed or reduced. Some accident risks may remain after construction/production. These accident risks can then be limited by restrictions on usage and safety regulations as well as safety training for the users.

Examples of important preconditions for the safety of a vehicle system are:

- stated user training is carried out,
- specified requirements on material environmental tolerance are not exceeded,
- operating profile is maintained,
- it is used and maintained properly, that is, the instructions are followed,
- control inspection and periodic inspection are performed,
- status inspections are carried out when required.

*Figure 1:3* provides an explanation to how vehicle safety can be related to other safety concepts. The concepts below may be part of a larger technical system, for example a vehicle system. Hereby vehicle safety, weapons safety and ammunition safety constitute elements within the broader concept of system safety.



*Figure 1:3 System safety for a vehicle system*

In this principle example, vehicle safety is affected directly by weapons and ammunition safety. A vehicle mounted weapon must be able to be fired without damaging the vehicle or other vehicle mounted equipment, hence mechanical, electrical and infological interfaces must be considered.

Ammunition as well must withstand the specific vehicle environment regarding vibration, electrical environment, temperature, humidity, and so on, without safety or functionality being compromised. The vehicle and ammunition safety of the system are overlapping in such a way that neither the vehicle nor the ammunition can be considered safe independently of each other.



# 2 VEHICLE LEGISLATION

The manual does not claim that the included legislation is a complete list of vehicle legislation. Referenced legislation is current at the completion of the manual. The reader is advised to always identify the current vehicle legislation.

Swedish laws are passed by the Parliament after a proposal from the Government. Regulations are issued by the Government. Laws and regulations are published in the Swedish Code of Statutes (SFS). EU Regulations take precedence over Swedish legislation and do not need to be incorporated into Swedish legislation to take effect. EU Directives, however, must be incorporated into Swedish legislation to take effect.

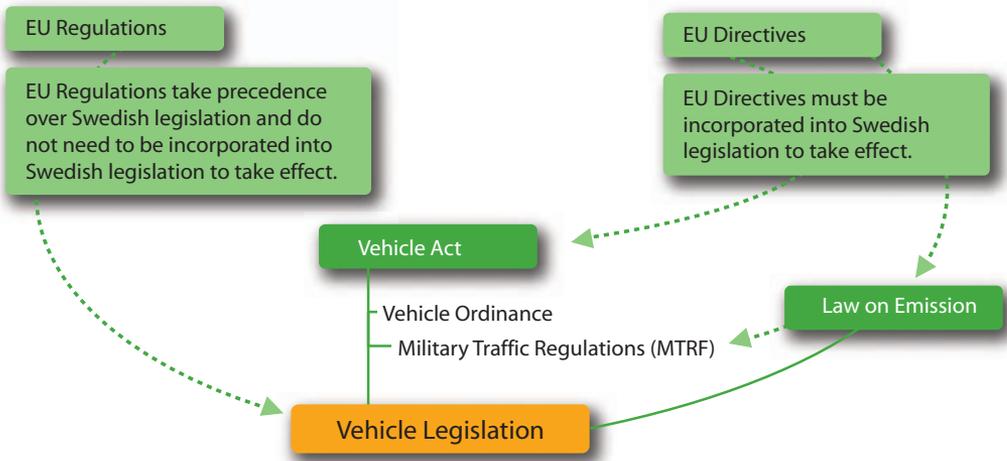
With the support of laws and regulations, government agencies issue regulations concerning the application of statutes. Regulations are normally published in each agency's statutes book. Detailed safety requirements for vehicles are implemented in TSFS (the Transport Agency's Statutes Book). The Armed Forces' Statutes Book (FFS) and the Armed Forces' internal stipulations (FIB) are issued by the Armed Forces.

Civil law permits certain exceptions for vehicles designed for specific military purposes when civil rules would otherwise prevent the Armed Forces from using the vehicles. Some exceptions may also apply to vehicles not designed for specific military purposes, such as being allowed to remove underrun protection on trucks driven in rough terrain. The Armed Forces' approach is that the civilian requirements shall be followed and that exceptions should be avoided as far as possible. Current legislation can be found on each authority's website. Notwithstanding the above exemptions, the Working Environment Act applies for FMV when acting as the transferor, see the Working Environment Act (AML) Chapter 3, 8-10 §§.

”Any person manufacturing, importing, delivering or providing a machine, implement, protective equipment or other technical device shall ensure that the device affords adequate security against ill-health and accidents ...”

*AML Chapter 3, 8 §*

H FordonSäk E is to be seen as a complement to the civil law, including EU regulations, through the application of the system safety activities described in *Chapter 3* and the experience-based, safety enhancing function oriented requirements contained in *Chapter 4*. *Figure 2:1* gives a schematic view of the governing legislation and its internal relationships within the automotive field.



*Figure 2:1 Schematic view of governing legislation in the automotive field.*

## 2.1 THE SWEDISH CODE OF STATUTES (SFS)

The Swedish Code of Statutes in the automotive field include, among other publications, the following. The Swedish title of each publication is shown in brackets.

- |                     |  |
|---------------------|--|
| <b>SFS 1993:185</b> | Regulation of Working Conditions for Certain International Road Transports<br>(Förordning om arbetsförhållanden vid vissa internationella vägtransporter)                        |
| <b>SFS 2001:558</b> | Law on Road Traffic Registry<br>(Lag om vägtrafikregister)   |
| <b>SFS 2001:559</b> | Law on Road Traffic Definitions<br>(Vägtrafikdefinitioner lag)   |
| <b>SFS 2001:651</b> | Road Traffic Definitions Act<br>(Vägtrafikdefinitioner förordning)   |
| <b>SFS 2002:574</b> | The Vehicles Act<br>(Fordonslag)   |
| <b>SFS 2006:311</b> | The Ordinance on Carriage of Dangerous Goods<br>(Förordning om transport av farligt gods)  |
| <b>SFS 2009:211</b> | Vehicle Ordinance<br>(Fordonsförordning)   |
| <b>SFS 2009:212</b> | Military Traffic Regulations (MTRF)<br>(Militärtrafikförordning (MTRF))  |
| <b>SFS 2011:846</b> | Act on Environmental Requirements for Procurement of Cars and Certain Public Transport Services<br>(Lag om miljökrav vid upphandling av bilar och vissa kollektivtrafiktjänster) |

## 2.2 THE TRANSPORT AGENCY REGULATIONS (TSFS)

The Transport Agency's regulations include among other publications the following.

- VVFS 2003:17** Transport Agency's Regulations on Terrain Motor Vehicles  
(Vägverkets föreskrifter om terrängmotorfordon)
- VVFS 2003:20** Transport Agency's Regulations on Towed Equipment, Terrain Trailers and Certain Towed Vehicles Towed at a Maximum Speed of 50 km/h  
(Vägverkets föreskrifter om efterfordon, terrängsläp, släpplåda samt vissa släpfordon som dras i högst 50 km/h)
- VVFS 2003:23** Transport Agency's Regulations on Motorcycles and Trailers Drawn by Motorcycles  
(Vägverkets föreskrifter om motorcyklar och släpvagnar som dras av motorcyklar)
- VVFS 2003:26** Transport Agency's Regulations on Tractors  
(Vägverkets föreskrifter om traktorer)
- VVFS 2003:27** Transport Agency's Regulations on Motorized Equipment  
(Vägverkets föreskrifter om motorredskap)
- VVFS 2004:2** Transport Agency's General Advice on Exceptions from Regulations on Length of Vehicles or Road Trains  
(Vägverkets allmänna råd om undantag från bestämmelser om fordons eller fordonstågs längd)

- TSFS 2010:2** Transport Agency's Regulations and General Recommendations on Cars and Trailers Towed by Cars which are Taken Into Use on 1 July 2010 or Later  
(Transportstyrelsens föreskrifter och allmänna råd om bilar och släpvagnar som dras av bilar som tas i bruk den 1 juli 2010 eller senare)
- TSFS 2010:4** Transport Agency's Regulations and General Recommendations on Individual Approval  
(Transportstyrelsens föreskrifter och allmänna råd om enskilt godkännande)
- TSFS 2010:87** Transport Agency's Regulations and General Recommendations on Registration Inspection, Moped Inspection and Suitability Inspection  
(Transportstyrelsens föreskrifter och allmänna råd om registreringsbesiktning, mopedbesiktning och lämplighetsbesiktning)
- TSFS 2010:141** Transport Agency's Regulations on Transport of Wide and Undividable Load  
(Transportstyrelsens föreskrifter om färd med bred odelbar last)
- TSFS 2010:142** Transport Agency's Regulations on Transport of Long and Undividable load  
(Transportstyrelsens föreskrifter om färd med lång odelbar last)
- TSFS 2013:54** Transport Agency's Regulations on Exceptions from the Requirement for Registration Inspection of a Modified Vehicle  
(Transportstyrelsens föreskrifter om undantag från kravet på registreringsbesiktning av ett ändrat fordon)

- TSFS 2013:63** Transport Agency's Regulations and General Recommendations on Cars and Trailers Towed by Cars (*applicable to vehicles which are taken into use prior to 1 July 2010*)  
(Transportstyrelsens föreskrifter och allmänna råd om bilar och släpvagnar som dras av bilar (*gäller fordon som tagits i bruk före 1 juli 2010*))
- TSFS 2013:106** Transport Agency's Regulations and General Recommendations on Maritime Transport of Packaged Dangerous Goods (IMDG code)  
(Transportstyrelsens föreskrifter och allmänna råd om transport till sjöss av förpackat farligt gods (IMDG-koden))

### 2.3 THE WORKING ENVIRONMENT AUTHORITY'S REGULATIONS (AFS)

The working environment authority's regulations (AFS) consist of some one hundred regulations. In accordance with AFS 2008:3 regarding machinery §2, the regulations do not apply to "machines specially designed and constructed for military or police purposes". A military motor vehicle examiner at FMV determines whether or not the exception in AFS 2008: 3 applies. AFS 2006: 4 relates to safety when working with vehicles (for example provisions for working at heights).

- AFS 1987:02** High Frequency Electromagnetic Fields  
(Hörfrekventa elektromagnetiska fält)
- AFS 2005:15** Vibrations  
(Vibrationer)
- AFS 2005:16** Noise  
(Buller)
- AFS 2006:04** Use of Work Equipment  
(Användning av arbetsutrustning)



## 2.5 THE SWEDISH ARMED FORCES' STATUTES BOOK (FFS)

FFS is the Swedish Armed Forces' Statutes Book and it must be applied by the Swedish Armed Forces as well as by other agencies. The current FFS is published on the Swedish Armed Forces' website. The following parts of FFS are relevant to vehicles.

**FFS 2007:1** Handling, Storage and Transport of Firearms and Ammunition

(Hantering, förvaring och transport av skjutvapen och ammunition)

**FFS 2013:2** Control Inspection of Vehicles

(Kontrollbesiktning av fordon)

Control inspection of vehicles that belong to FMV or FRA, and which are registered as civilian vehicles, must follow the same regulations that apply to vehicles registered in the vehicle registry (Vtr, see Transport Agency). Continuous control of vehicles that belong to the Swedish Armed Forces, FMV or FRA, and which are registered as military vehicles, is performed in accordance with the regulations provided by the Swedish Armed Forces under the Military Traffic Regulations, MTRF. The Swedish Armed Forces have also announced this in FIB 2013: 4 and in the Swedish Armed Forces' Stipulations on Periodic Inspection of Vehicles, (FAG F).

## 2.6 THE SWEDISH ARMED FORCES' INTERNAL STIPULATIONS (FIB)

FIB is the Swedish Armed Forces' internal stipulations that must be applied internally within the Swedish Armed Forces. A FIB can also apply to agencies such as FMV in accordance with certain decisions. The current FIB is published on the Swedish Armed Forces' website. The following parts of FIB are relevant to vehicles.

- |                   |   |
|-------------------|---|
| <b>FIB 2007:3</b> | Concerning handling, storage and transport of firearms and ammunition<br>(om hantering, förvaring och transport av skjutvapen och ammunition) |
| <b>FIB 2013:4</b> | Concerning periodic inspection of military vehicles<br>(om grundtillsyn av militära fordon)   |

See also FM2013-2369:1 Application regulations for FIB 2013:4, requirements on vehicles transporting dangerous goods.

## 2.7 THE SWEDISH ARMED FORCES' SAFETY REGULATIONS, SÄKI, ETC.

Vehicle related safety instructions in the Säki series.

- |                    |  |
|--------------------|--|
| <b>Säki G</b>      | Common part (Equipment for Vehicles Carrying Explosives at Exercises in the Field)<br>Gemensam del (Utrustning för fordon som transporterar explosiva varor vid fältmässig övning) |
| <b>Säki Fordon</b> | Shooting and Exercising with Light Vehicles / Combat Vehicles<br>(Skjutning och övning med lätta fordon/stridsfordon)  |
| <b>Säki Trafik</b> | Military Traffic Safety<br>(Militär trafiksäkerhet)  |

<b>Säki Ögång vatten</b>	Crossing Water Course (Övergång av vattendrag)
<b>Säki Tp farligt gods</b>	Transport of Dangerous Goods on the Road or in the Terrain (Transport av farligt gods på väg och i terräng)

Other vehicle related instructions:

<b>BVKF</b>	The Swedish Armed Forces' Instruction for Actions Against Fire and Explosion Hazards, Water Pollution, and Chemical Health Impacts from Flammable Goods (Försvarmaktens instruktion för åtgärder mot brand- och explosionsfara, vattenförorening samt kemisk hälsopåverkan från brandfarliga varor)
<b>FAG F</b>	The Swedish Armed Forces' Stipulations on Periodic Inspection of Vehicles (see also MVIF) (Försvarmaktens regler för grundtillsyn av fordon (se även MVIF))
<b>IFTEX</b>	The Swedish Armed Forces' Instructions for Storage and Transport of Ammunition and Other Explosives (Försvarmaktens instruktion för förvaring och transport av ammunition och övriga explosiva varor)

For directions and information concerning the use and continuous control, refer to the Swedish Armed Forces' rules and instructions. Relevant documents include Säki Trafik and FAG F.

BVKF contains five chapters (14, 15, 18, 20 and 21) that concern vehicles (including trucks and garaged vehicles). For example, the resistance to environmental conditions can be affected, since fuel laden vehicles should for safety reasons assemble outdoors.

# 3

## ACTIVITIES AND DOCUMENTATION

This chapter provides guidance for the implementation of activities related to vehicle safety for procurement and modifications of vehicle systems.

### 3.1 PROCESS DESCRIPTION

The SwAF – FMV Coordination Agreement (SamO) states the principles for how vehicle safety activities should be conducted between the two authorities. Each agency has complementary operational procedures and the requirements for how the activities are implemented are regulated at each activity location. A principal diagram of the process for procurement or modification of a vehicle system is shown in *Figure 3:1*.

When procuring or modifying a vehicle, system safety activities that are specific to vehicle systems must be integrated with other program activities. Required activities must be described in the project's System Safety Program Plan (SSPP) and/or in the DesignA's System Safety Management Plan (SSMP) in accordance with H SystSäk E. Other general system safety activities are described in H SystSäk E and are chosen by the respective location of business for the procurement and modification.

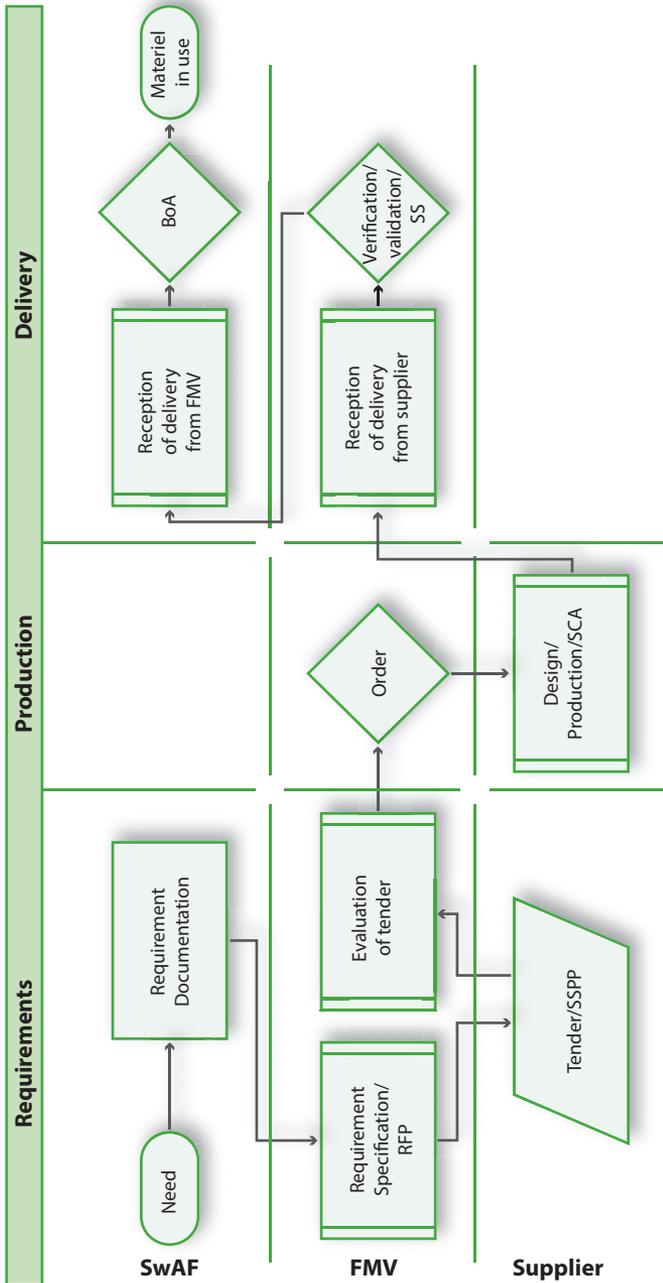


Figure 3:1 Outline of the process for procurement or modification of a vehicle system

## 3.2 USER REQUIREMENTS

The Swedish Armed Forces train units with special abilities to meet identified needs. On behalf of the units, the Swedish Armed Forces put forward capacity requirements to FMV.

When developing equipment, FMV converts the capacity requirements to functional requirements to be included in the requirement specification. Documentation and conditions for the contents of the requirement specification consist of regulatory requirements, harmonised standards etc., based on civilian classification of the vehicle, see *Section 3.3*. Any exception from civil law in order to meet the Swedish Armed Forces' capacity requirements can be obtained through military classification carried out by a military vehicle inspector. When required, the specification is supplemented with the applicable function-oriented system safety requirements in accordance with *Chapter 4* of this handbook, but system safety requirements in other manuals such as H VAS E may also be relevant.

The supplier then specifies the design-oriented requirements for the development and manufacture of the vehicle system. The supplier meets the FMV requirements for system safety activities in a System Safety Program Plan, (SSPP).

## 3.3 CLASSIFICATION OF VEHICLES

For FMV to be able to produce requirement specifications for vehicles based on the Swedish Armed Forces' requirement document with unit objectives, vehicles must first be classified according to the Law on Road Traffic Definitions SFS 2001: 559 and the Ordinance on Road Traffic Definitions SFS 2001: 651. Civil law states technical requirements for vehicles based on the classification that the vehicle receives. The classification is done according to established designations which are shown in *Figure 3:2*.

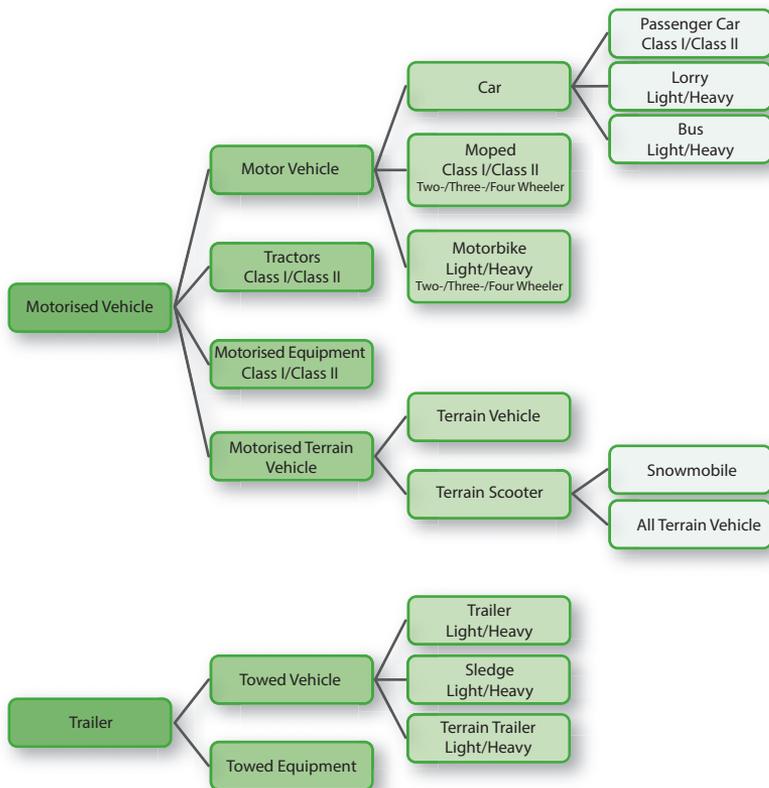


Figure 3:2 Selected parts of the civil vehicle designations (for more information see SFS 2001:559)

Designations according to the law are also used in the Military Vehicle Register (MIFOR). It is the classification of a military vehicle that governs which civil law to apply and what requirement level to meet. Below is a simplified description of vehicles intended for specifically military purposes and COTS and MOTS.

**3.303.01** Classification of vehicles shall be conducted by military vehicle inspectors at FMV.

*Comment:* Classification is normally done in consultation with the supplier/industry.

### 3.3.1 Commercial Off The Shelf (COTS)

---

Vehicles classified as Commercial Off The Shelf (COTS) are civilian vehicles used in military operations and where the intended use is no different from civilian use. COTS also include civilian vehicles with simple modifications for use in military activities, such as a heavy truck equipped with military towing equipment. According to the Vehicles Act, COTS vehicles are normally not classified as “vehicles designed for specifically military purposes”. In H SystSäk E, COTS vehicles are defined as “standard vehicles”.



*Figure 3:3 Example of vehicle classified as COTS*

#### 3.3.2 Military Off The Shelf (MOTS)

---

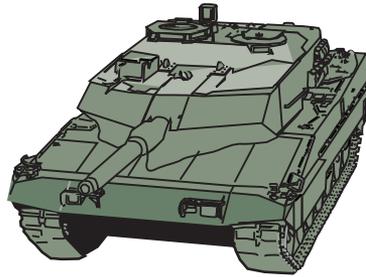
Vehicles classified as Military Off The Shelf (MOTS) are vehicles adapted for military activities and are delivered by a supplier to the Swedish Armed Forces as a complete system. According to the Vehicles Act, MOTS vehicles can be vehicles that must comply with civil law in all respects, as well as vehicles covered by the exemptions for “vehicles designed for specifically military purposes”. In H SystSäk E, MOTS vehicles are defined as “special vehicles”.



*Figure 3:4 Example of vehicle classified as MOTS*

### 3.3.3 Vehicles Designed for Specifically Military Purposes

According to the Military Road Traffic Ordinance, the Swedish Armed Forces are entitled to provide for vehicles made for specifically military purposes, and provide for which requirements that should apply to these vehicles. Until the Swedish Armed Forces provide for vehicles made for specifically military purposes, FMV's vehicle registration, together with the prescribed civil authority (Transport Agency) decide this on a case-by-case basis. In H SystSäk E, vehicles made for specifically military purposes are defined as "special vehicles".



*Figure 3:5 Example of vehicle classified made for specifically military purposes*

## 3.4 CE MARKED VEHICLES AND PRODUCTS

It is relevant to clarify whether the Swedish Armed Forces' intended use of a CE marked vehicle or CE marked product is covered by the defined area of use for which the supplier's certificate is based. That is, a declaration that the vehicle or the product will be used in accordance with the supplier's technical documentation.

Integration, modification or altered conditions of use of a CE marked vehicle or a CE marked product can render the supplier's CE certificate obsolete or not applicable. In cases where the CE marking cannot be applied or where the intended use of the vehicle or the product is not covered by the certificate, a CE similar process must be implemented where the requirements that cannot be met according to EU directives must be documented. For the requirements that cannot be met, a system safety analysis is performed in accordance with H SystSäk E.

### 3.4.1 CE Marked Vehicles

---

---

Motorised equipment (loaders, excavators, forklifts, etc.) as well as snowmobiles and ATVs (All Terrain Vehicles), must be CE marked. Also vehicle mounted equipment such as cranes, tail lifts, load shifters, winches, lifts, pressure vessels etc. must be CE marked by the manufacturer with an attached declaration of conformity. Exemptions may apply to certain motorised equipment specifically designed for military activities (MOTS). For these, complete system safety activities in accordance with H SystSäk E must be performed.

If there are additional military requirements for a CE marked vehicle, for example, regarding mine and shrapnel protection, these requirements may be incompatible with the CE marking. If that is the case, a system safety analysis must be carried out in accordance with the methodology described in H SystSäk E to handle additional accident risks that may be the result of the modification.

Single vehicle approval and registration in MIFOR are necessary for CE marked vehicles in accordance with the Military Traffic Ordinance, for example, motorised equipment class II. The authority in question sets requirements on which vehicles that must be registered in the Vehicle Registry (Vtr). Vehicles procured to be operated within SwAF/FMV/FRA must follow the requirements for military registration. Note that the civil and military demands for registration requirement differ.

### 3.4.2 Integration of CE Marked Product

---

---

For the integration of CE marked products in a military vehicle, for example radio, GPS, night sight etc, a system safety analysis must be carried out. The interface between the CE marked product and other COTS, MOTS or GFE products that are not CE certified must be treated with special consideration in the system safety analysis.

If two or more products integrated in a vehicle system are CE marked and will be used together, it must be stated in the respective CE certificates that the CE marking covers the intended use.

If that is not the case, a system safety analysis must be carried out in accordance with the methodology described in H SystSäk E concerning mechanical, electrical and infological interfaces.

In addition, if the CE marked products do not meet the requirements mentioned in the operational profile, a system safety analysis must be carried out for these products.

### 3.4.3 Modification of CE Marked Vehicle or Product

---

---

If a CE marked vehicle or a CE marked product is equipped with new, added or modified parts, these parts as well as the interfaces between the vehicle or the product and the new parts must also undergo a system safety analysis. It is of great importance that modifications are not made with the intent to circumvent civil laws or CE marking, but only in order to simplify integration, improve performance and enhance safety.

- 3.304.01** Decisions shall be provided if the product is classified as designed for specific military purposes.  
*Comment:* Products must not be modified in order to evade compliance with civil law, such as CE marking.

### 3.5 SUPPLIER'S TECHNICAL DOCUMENTATION TO FMV

FMV stipulates requirements on which technical documentation that must be included for the vehicle system and that must accompany the vehicle when delivered to the Swedish Armed Forces. The supplier produces the required documentation. In addition to legal requirements and requirements in EU directives, FMV's requirement specifications (RFP) states what language the documentation must be written in.

In addition to documentation required for the single vehicle approval, see *Section 3.6.2*, a Safety Compliance Assessment (SCA), with attachments, and the required technical documentation are also delivered. The requirements regarding an SCA can be found in H SystSäk E. Below are examples of generic technical documentation for a vehicle system.

Table 3:1 Examples of technical documentation for vehicle systems

Technical documentation	Documentation Stock Name	Documentation Stock Number
Instruction manual	IBOK	M7786-XXXXXX
Equipment maintenance schedule for daily/specific maintenance	MVSCHDS	M7782-XXXXXX
Lubrication chart	SMSCH	M7782-XXXXXX
List of supplies	TBHL	M7777-XXXXXX
Instruction manual function installation communication	IBOK FUNKINST SAMB	M7786-XXXXXX
Equipment maintenance schedule for periodic maintenance	MVSCHG	M7782-XXXXXX
Equipment maintenance schedule for storage	MVSCHF	M7782-XXXXXX
Rust protection chart	ROSKSCH	M7782-XXXXXX
Repair manual	REPBOK	M7787-XXXXXX
Type catalogue sheet	TYPKATALOGBLAD (TKLB)	M7789-XXXXXX
Spare parts catalogue	RDKAT	M7776-XXXXXX

Technical documentation	Documentation Stock Name	Documentation Stock Number
Batch list (subsystem)	SATSLISTA XXX	M7777-XXXXXX
Installation instructions (subsystem)	MONTANV XXX	M7786-XXXXXX
Training package		M7730-XXXXXX
CD consolidated data	CDSMSTD	M7771-XXXXXX

### 3.6 FMV DELIVERY TO THE SWEDISH ARMED FORCES

All vehicles delivered by FMV to the Swedish Armed Forces must have gone through a single vehicle approval as well as have an issued Safety Statement (SS). The concept of vehicle delivery refers both to newly procured vehicles as well as modified, already approved vehicles. Modified vehicles may require both a new approval and a new issue of an SS. Whether a new approval is required is decided by a military vehicle inspector at FMV.

In the event that FMV prepares a Technical Order (TO) for the modification of a vehicle system, FMV is responsible for updating the existing technical documentation, see *Table 3:1*.

#### 3.6.1 Application of Vehicle Legislation to Military Vehicles

In accordance with Vehicles Act (2002:574) § 2 item 1, the law does not apply to vehicles belonging to the state and that are made for specific military purposes. Military vehicle inspectors classify which vehicles that are designed for specific military purposes.

MTRF stipulates that motor vehicles and trailers that belong to or are operated by SwAF, FMV or FRA, and that are not eligible for single vehicle approval under the law for road traffic register, must be registered in the military vehicle register (MIFOR). Also towed equipment that is designed for hooking up to cars or motorised equipment must be registered in the military vehicle register. Examples are compressors and power trailers.

In accordance with MTRF, FMV may also register leased vehicles in MIFOR since the concept of MTRF is that vehicles used by SwAF, FMV and FRA and that are not eligible for single vehicle approval under the regulation for road traffic register must be registered in MIFOR.

When carrying out the single vehicle approval, the need for deviation from existing vehicle legislation is identified. Vehicles that are registered in other armed forces' vehicle registers should not be used by SwAF, FMV or FRA without first being registered in MIFOR. Exemptions apply to vehicles used in an international intervention force.

**3.306.01** Decisions on the use of FMV/SwAF exception shall be made by a military vehicle inspector at FMV.  
*Comment:* The application for an exception is sent to the Transport Board by a military vehicle inspector at FMV.

#### 3.6.2 Single Vehicle Approval

---

---

The concept of single vehicle approval refers to a formal approval to take a vehicle into use. The single vehicle approval aims to establish the vehicle's technical identity, verify that the vehicle meets the prescribed requirements regarding its properties and equipment, as well as determine the data to be entered into the military vehicle register.

The approval of a vehicle can be carried out in different ways according to requirement 3.306.02 below. Note especially that a single vehicle approval under paragraph e (military vehicle approval) can only be carried out by a military vehicle inspector. The requirement 3.306.02 concerning the delivery of vehicles is a clarification of requirement 2.659.01 in *H SystSäk E*.

## 3.306.02

For vehicle deliveries to SwAF/FMV, documentation for registration in MIFOR shall be provided in accordance with one of options a-e. Vehicles manufactured specifically for military purposes shall always undergo a single vehicle approval by a military vehicle inspector at FMV in accordance with option e. Thus, each individual vehicle is delivered either:

- a. with a CoC (Certificat of Conformity) (refers to vehicles approved in whole) in accordance with EU Directive 2007/46. (For motorcycles, EU Directive 2002/24 applies. As of 2016-01-01, EU regulation No 168/2013 applies.),
- b. with an individual approval certificate in accordance with Directive 2007/46 / EC or TSFS 2010:2,
- c. registered in the vehicle registry (Vtr) using the original registration certificate as documentation and with SwAF/FMV as the registered owner,
- d. with documentation from a single vehicle approval performed by an approved test body in accordance with SFS 2002: 574, Section 4,
- e. with a single vehicle approval performed by FMV in accordance with the applicable agreement between FMV and the vehicle supplier. The vehicle supplier shall order a single vehicle approval by FMV prior to the delivery of the vehicle. The project manager at FMV is responsible for seeing to it that a single vehicle approval is carried out.

*Comment:* When rebuilding or modifying a vehicle, or when issuing a TO that triggers the demand for a new single vehicle approval, any one of options b, d or e must be applied.

A military vehicle inspector authorised to carry out single vehicle approvals is certified by SwAF Safety Inspectorate in accordance with MTRF and is situated at FMV. The military inspector is responsible for carrying out single vehicle approvals of vehicles that belong to or are operated by SwAF, FRA and FMV.

FMV assigns vehicles their registration numbers, hands out license plates, prepares documentation for registration as well as keeps records of the original documentation. The individual vehicle goes through a single vehicle approval prior to handover to SwAF and prior to the issuing of an SS.

The checklist below is the basis for a single vehicle approval:

- Produce documentation for registration of supplies (stock name and number).
- Acquire a distribution list from SwAF and hand over the distribution list to the vehicle inspector or military vehicle inspector.
- Order license plates and hand these over to the supplier. This does not apply to vehicles where the military registration number is painted directly on the vehicle.
- Supplier hands over the current vehicle identification number to the military vehicle inspector who links the registration number with the vehicle identification number (serial number).
- Single vehicle approval is carried out (by military vehicle inspector at FMV or independent inspection body).
- Check whether there is a need to propose modifications and additions to the SwAF publications such as SäkI, UtbR Motortjänst, FAG F etc.
- Check whether there is a need to propose modifications and additions to publications previously published by FMV, for example MVIF.

**3.306.03** Vehicles to be registered in the military vehicle register (MIFOR) and that belong to or are intended to be operated by SwAF, FRA, or FMV, shall undergo military single vehicle approval.

*Comment:* When rebuilding or modifying a vehicle, or when issuing a TO that triggers the demand for a new single vehicle approval, any one of options b, d or e in requirement 3.306.02 must be applied.

### 3.6.3 FMV Safety Statement

---

---

To be able to issue a Safety Statement (SS) for a vehicle system, each individual vehicle must go through a single vehicle approval.

FMV examines the supplier's Safety Compliance Assessment (SCA) together with the accompanying documentation. Upon further integration, FMV performs supplementary system safety analysis.

After a single vehicle approval and when the overall system security documentation meets SwAF's requirements and is otherwise considered to be satisfactory, FMV issues the Safety Statement (SS).

For Safety Statement (SS), see also *H SystSäk E*.

## 3.7 THE SWEDISH ARMED FORCES' DECISION ON USE

SwAF produces additional documentation such as SäkI and regulations. Based on SwAF's overall documentation, a Decision Regarding Use (BoA) is taken.

For Decision Regarding Use (BoA), the Swedish Armed Forces apply a special routine. See also *H SystSäk E*.



# 4

## FUNCTION-ORIENTED SYSTEM SAFETY REQUIREMENTS

Vehicle legislation and harmonised standards are constantly evolving on the civilian market. Concerning vehicles developed for specific military purposes, or where new features are added to vehicles classified as COTS and MOTS, there are areas that are not covered. In addition to vehicle legislation, additional safety requirements can be needed for these vehicles concerning design, equipment and properties.

SwAF and FMV have learned from experience from previous military vehicle systems in use. In this chapter, these experiences have been compiled and formulated as proposals for safety enhancing function-oriented requirements. *H SystSäk E 2011 Part 2 Chapter 2* provides general safety requirements. The proposals of requirements in this chapter can be seen as a further development of these and are adapted for vehicle systems. Proposed requirements apply primarily to new development of vehicles designed for specific military purposes but the requirements can also be used when modifying existing vehicles and for COTS and MOTS.

### 4.1 ENGINE SYSTEMS

The engine system includes engine housing, lubrication system, fuel system, intake and exhaust systems, cooling systems, engine controls, pressure vessels, engine heaters and emission control systems.

The proposals in *Section 4.1* are not applicable to COTS and MOTS vehicles but apply only to new development of vehicles for specific military purposes.

### 4.1.1 Engine Housing, Lubrication System, Engine

---

Installation of and accessibility to the engine housing in the vehicle should, primarily related to care and maintenance, be designed so that injuries from rotating parts (fans, generators, propeller shafts, etc.) are minimised. The risk of injury exists if the engine must be running at the same time as work is in progress. Checks after completed work which require a running engine may also expose personnel to moving parts if the control requires that the engine hood must be removed.

Checking procedures related to the engine compartment must be possible without any contact with hot surfaces. Furthermore, the checks must be possible without human contact with dangerous substances in the form of oils, fuels or other liquids.

Leakage from connections to the engine system, such as oils, fuels, washer fluid, may cause a fire if liquid is exposed to hot surfaces, such as turbochargers, manifolds or turbines. The probability of leakage and the subsequent probability of leaking liquid's being exposed to hot surfaces must be minimised.

3.401.01 Rotating parts and hot surfaces shall be located or separated so that the likelihood of injury is minimised during maintenance.

*Comment:* This requirement can be met by providing barriers or by ensuring that personnel cannot or is not required to get close to the source of risk.

3.401.02 Enclosed engine compartments must have adequate ventilation.

### 4.1.2 Fuel Systems and Fuel Tanks

---

The fuel system includes fuel injection system or carburettors, valves, fuel lines, fuel tanks, both fixed and removable, and portable tanks.

Leakage from both fuel systems and fuel tanks should be minimised. This also applies if the vehicle overturns. Leakage of fuel/propellant in the engine compartment may result in a fire. Leaks may be caused by damaged fuel lines or leaking gaskets/connections. The fuel tank should be located between the vehicle's axles to be protected in a collision. The underside of the fuel tank should be protected by protective shields or similar to prevent damage during off-road driving.

It is important that the appropriate containers are used and that the drainage of fuel from the fuel system can be done so that a free-falling stream of fuel and static electricity is avoided. For petrol, a free-falling stream can be a maximum of 40 cm. At 60 cm or more, petrol may spontaneously combust if static electricity is generated.

In tank connections, located more than 40 cm above the bottom of the tank, a filter that disperses the stream should be installed, preventing spontaneous combustion of the petrol and removing any foreign particles when refuelling from portable tanks. The design of the filter should make accidental or intentional removal of the filter from the tank difficult. An arrangement that secures the filter, for example a locking ring or chain, should be installed to prevent easy removal of the filter.

If the fuel tanks are to be removed from their ordinary locations due to replacement, maintenance, etc., the fuel tanks must first be emptied of fuel. The likelihood of injury is reduced if eye bolts are installed which enables the use of lifting equipment. Draining fuel from the vehicle's fuel tanks should be done using the intended draining equipment. It is important that the petrol is not handled where its vapours may be ignited, for example, in the proximity of welding, cutting and drilling, smoking etc. Work on an empty fuel tank must not be undertaken without all the compartments,

spaces, fuel lines, etc. having been degassed and found to be free of flammable vapour or completely filled with water. See BVKF for rules regarding this.

To avoid both spillage and vapour in personnel compartments, filling equipment for propellants/fuels should be located so that the filling can be carried out with the doors and hatches to personnel compartments closed.

Draining engine fuels from fuel tanks must be done using the intended draining equipment. It is important that the handling of petrol does not occur where its vapours can be ignited, for example in the proximity of welding, cutting and drilling work, smoking etc.

- 3.401.03 Substances adjacent to and included in the propellant shall be compatible.  
*Comment:* This can apply to inner protective paint, sealants, gaskets, insulation materials, corrosion protection, hoses etc.
- 3.401.04 Portable fuel tanks shall be fitted with eye bolts.
- 3.401.05 The probability that the fuel tank explodes and the fuel ignites shall be analysed and minimised.  
*Comment:* Verification can be done through a fire test or, alternatively, by a certificate from the manufacturer.
- 3.401.06 The probability that the fuel tank explodes due to bullet attack shall be analysed and minimised.  
*Comment:* Firing tests of the fuel tank should be carried out.
- 3.401.07 The fuel tank shall be protected against sparks caused by static electricity.  
*Comment:* For example, by earthing/equipotential bonding.
- 3.401.08 The fuel tank shall be positioned so that reasonable protection is obtained at a collision from the rear, from the side or from below.

- 3.401.09 The fuel tank shall be protected to prevent damage during off-road driving.
- 3.401.10 Draining equipment for the fuel tank shall be designed so that the probability of static electricity being generated is minimised.  
*Comment:* The risk exists when the height of a free-falling stream of petrol exceeds 40 cm.
- 3.401.11 Fuel tank with a depth of 40 cm or more shall be equipped with a filter that cannot be removed.
- 3.401.12 The filling equipment for propellants/fuels shall be positioned so that the filling can be carried out with the doors and hatches to personnel compartments closed.

### 4.1.3 Inlet and Exhaust Systems

---

Impact on exhaust pipe, muffler or tail pipe may cause leakage of exhaust fumes into the vehicle's personnel compartments. The design should minimise the likelihood of such leakage. Internal engine hoods/hatches or corresponding equipment only offers partial protection. Exhaust systems should be fastened with spring-loaded mounting screws that must not be tightened rigidly, in order to minimise the likelihood of leakage. Also the positioning and design of the air intake for ventilation, as well as doors and hatches may reduce the likelihood of exhaust fumes penetration.

If carbon monoxide (CO) is inhaled, it is absorbed in the blood and binds to haemoglobin. Since the haemoglobin has a greater tendency to bind carbon monoxide than the oxygen in the air, the carbon monoxide rapidly displaces the oxygen in the blood. An "internal asphyxia" gradually occurs. The majority of nitrogen oxides (nitrous gases) in exhaust fumes consists of nitrogen monoxide (NO). In the air, oxidation to nitrogen dioxide (NO<sub>2</sub>) occurs. Inhalation of low levels of nitrogen oxides does not normally result in any irritation symptoms or only slight irritation of the throat and eyes. However, they may cause adverse effects in the bronchi and lungs.

3.401.13 The placement and design of the exhaust system shall be such that personnel in the vehicle's personnel compartments are not exposed to exhaust fumes.

*Comment:* This requirement shall be verified during unfavourable circumstances and under field conditions.

3.401.14 Hot surfaces of the exhaust system shall be fitted with protective barriers or be shielded.

### 4.1.4 Cooling System

---

The cooling system includes coolant pump, radiator, expansion tank and hoses, thermostat and heating elements.

Radiator and expansion tank can become very hot. Burns may be caused at physical contact with these parts, for example, when checking the coolant level or the freezing point of the coolant. Personal injury may also be caused if the radiator cap on the expansion tank in a closed system is opened too quickly before the cooling system has cooled down or pressure equalization has occurred.

At normal operating temperature of the coolant, the pressure is not expected to be so high that coolant or steam is ejected due to overpressure. However, if the temperature of the coolant is above +100 °C, the coolant or steam may eject and cause severe eye and skin injuries.

Crushing injury may be caused at contact with rotating drive belts to the coolant pump and the cooling fan.

3.401.15 The overpressure in the expansion tank shall be possible to equalise to the environment before opening the cap completely.

*Comment:* This can be solved with a two-step valve/cap opening.

### 4.1.5 Engine Controls

---

---

The design and construction of the pedals must be adapted for the specified footwear (boots/Wellingtons). The adaptation can concern the distance between individual pedals and should be great enough to avoid multiple pedals accidentally being pressed simultaneously.

The braking effect may be reduced or cease if the driver drives with the brake pedal applied. A temperature increase may then appear in the friction pads which may cause the friction characteristics to cease.

3.401.16 The design and spacing of the individual pedals shall be adapted to the specified type of footwear.  
*Comment:* Applies to gas, brake and clutch pedal.

3.401.17 The surface of the brake pedal shall be slip-resistant.

### 4.1.6 Pressure Vessels

---

---

Pressure vessels of different kinds occur in a variety of applications. As a basis for approval, strength calculations and pressure testing must always be carried out. Pressure vessels must be approved in accordance with the EU directives for CE marking.

### 4.1.7 Exhaust Emission Control

---

---

The legislation requires that military vehicles must follow the rules on emission limits. If the vehicle type is to be operated in international service, where fuel of a lower quality may be the only fuel available, exemptions from the applicable civil rules may be allowed.

## 4.2 TRANSMISSION SYSTEM

To reduce the likelihood of damage to drive-train systems equipped with differential lock, an indication should exist, for example, a warning light, at the driver's seat which indicates if the differential lock is engaged. An indicator, for example a control lamp, indicating if the differential lock is switched on can be placed at the driver's seat.

To further enhance safety while driving normally, vehicles should be equipped with traction control and/or anti-skid control.

3.402.01 An indication of an activated differential lock shall be installed at the driver's seat.

3.402.02 The vehicle shall be equipped with traction control that can be switched off.

*Comment:* When driving in rough terrain at low speeds, improved accessibility can be achieved without activating the traction control and/or anti-skid control system.

3.402.03 The vehicle shall be equipped with an anti-skid control system that can be switched off.

*Comment:* When driving in rough terrain at low speeds improved accessibility can be achieved without activating the traction control and/or anti-skid control system.

## 4.3 BRAKE SYSTEM

Hydraulic as well as pneumatic brakes can be equipped with an ABS system to prevent the wheels from locking when braking. The purpose and advantages of an ABS system are that the steering capability is maintained during hard braking, wear is reduced, and the braking distance is usually shortened, especially in wet and icy road conditions. As the ABS system allows control of the vehicle when braking hard, the vehicle system as a whole is safer than a vehicle without an ABS system. This applies to all types of vehicles.

The brake system design must withstand the strains associated with storage without any decrease in braking performance. This applies to all types of brake systems.

#### 4.3.1 Hydraulic Driving Brake System

---

---

Brake failure may be due either to failure in the hydraulic system, failure in the pedal assembly or brake linkage. Failure in the pedal assembly or brake linkage may be caused by foreign objects obstructing the brake pedal or leakage in the hydraulic system.

If a pressure difference occurs in the brake circuits, this must be indicated by some kind of indication. This does not require a fail-safe functionality if the same indication is used when the parking brake is applied, which provides a frequent control of the warning light or equivalent.

#### 4.3.2 Pneumatic Brake System (Service Brake)

---

---

It must be possible to drain the pneumatic brake system to ensure braking function. The drain valve must be positioned so that the draining is done behind a protective barrier so that a directed jet of air towards the operator is avoided. As far as possible, the drainage should be located outside personnel compartments and be equipped with silencers.

To avoid health problems caused by exhaust fumes when manoeuvring a vehicle in storage or workshops, the facilities should be equipped with external outlets for filling of brake systems. Otherwise, the vehicle must be left idling until the brake system is filled which causes the facilities to be quickly filled with exhaust fumes.

The requirements proposed in *Section 4.3.2* are not applicable to COTS and MOTS vehicles but apply only to new development of vehicles for specific military purposes.

- 3.403.01 The drain valve for the compressed air system shall be positioned so that personnel are not exposed to harmful noise or “targeted” jets of air.
- 3.403.02 Vehicles shall be fitted with external outlet for the filling of the brake system.
- 3.403.03 Vehicles shall be equipped with one test outlet per axle.

### 4.3.3 Auxiliary Brakes and Electronic Brake Systems

---

---

Ordinary friction brake systems may suffer from “fading” (the braking effect is quickly reduced) when used intensively over an extended period of time, for example when driving down a long steep downhill grade. Many heavy vehicles are therefore equipped with a supplementary brake system such as an auxiliary brake in the form of an exhaust brake or retarder, which are not friction-based. This enables smooth braking and reduces the likelihood of overheating of the brakes.

The retarder and the exhaust brake apply, unlike the main brake system, only on the drive wheels, that is, not on the steering wheels, running wheels or support wheels. However, this may lead to an increased skid risk in very slippery road conditions. Therefore, the retarder should be completely switched off or set to low power when driving on slippery roads.

Electronically controlled brake systems should be supplemented by at least one mechanical emergency brake system.

- 3.403.04 Vehicles shall be equipped with an auxiliary brake.  
*Comment:* Refers to heavy vehicles. However, the requirement is not applicable to vehicles designed to be driven outside the regular road network.
- 3.403.05 Electronically controlled brake systems shall have a mechanical emergency brake function as a supplement.  
*Comment:* Faults in the brake system's software may affect safety.

#### 4.3.4 Parking Brake System

---

The vehicle's parking brake must be sufficiently strong to prohibit the vehicle from rolling when parked on inclines and therefore constitute a risk of causing harm to people or property in the direction of its movement. Requirements on maximum gradient when marshallings/parking must be specified and the parking brake must be designed accordingly.

3.403.06 Requirements on maximum gradient for parking of the vehicle shall be specified.

### 4.4 STEERING SYSTEM

The steering system links the wheels and tracks respectively with the steering wheel or other steering controls. The design of the steering systems differs between wheeled and tracked vehicles.

Failure in or reduction of the steering function of the vehicle may cause road accidents and cause very serious damage to persons and property, both own and third person. Steering failure may be due to a failure in the steering controls, actuators, steering cylinder or failure of the hydraulic system through leakage (equivalent). Breakdown of the steering controls may be caused by a detachment of the fastening of the steering wheel or linkage. Breakdown of actuators or steering cylinder may occur on articulated vehicles when exceeding permissible angles of rotation between the front and rear suspension, for example, while driving off-road, overturning etc.

Power steering is a hydraulic, electro-hydraulic or electric auxiliary system in the vehicle. Servos enable less force to be required in order to turn the steering wheel without having to turn several turns. If the hydraulic pump on a tracked vehicle breaks down, it should be possible to control the vehicle with the help of a backup steering system. When using the backup steering system, the resistance of the steering wheel or steering lever should not be significantly greater than the regular steering function. The number of steering wheel turns lock to lock when driving must only increase moderately in order not to surprise the driver.

- 3.404.01 Tracked vehicles shall have a reserve steering system.
- 3.404.02 The turning resistance of the steering wheel or steering lever when using the backup steering system should not be significantly greater than the regular steering function.
- Comment:* For wheeled vehicles, there are legal requirements that the torque resistance for the backup steering system should be less than 600 N while driving at a speed of 10 km/h on dry asphalt.

### 4.5 WHEEL SYSTEM AND TRACK ASSEMBLY

The track assembly includes torsion bars, swing arms, drive, road and idler wheels, track tensioning device and tracks. Personal injury may be caused during maintenance of the track assembly, for example, when replacing torsion bars, drive wheels, road wheels, idler wheels or when adjusting the track tensioning device. Separation of tracks or replacement of track shoes may cause injury from shrapnel and loss of hearing.

The construction of the track assembly must ensure that drive wheels or road wheels (or equivalent) cannot be dislodged while driving. Dislodged wheels in the track assembly may occur when wheel bolts become unthreaded or break. The reason that carrier wheels are dislodged is usually that the carrier wheel bearings have become so loose that the bearing races separate and the wheel is thus dislodged from the swing arm.

A tracked vehicle's road-worthiness is estimated only to be marginally affected if one or two road wheels come off as long as the track is not thrown off. However, personal injury and damage to property may be caused when a track is thrown off or a track breaks and the ability to steer is lost. A broken track may cause the vehicle to turn uncontrollably in the opposite direction relative the affected track which may lead to collisions. The broken/ thrown track may also get stuck in the track assembly and cause an abrupt and uncontrolled turn.

Regarding wheeled vehicles, personal injury may be caused for example during care or maintenance of the wheel assembly when a person is located underneath the vehicle and it is poorly supported. The vehicle body must have a sufficient number of lifting jack mounting points and these must be clearly described in the technical documentation.

Personal injury may also be caused when dismounting and replacing the spare wheel from the spare wheel bracket on the vehicle. The greatest risk is when the spare wheel is located in a high position on the vehicle. Requirements for cranes including lifting equipment should be put forward to avoid heavy manual lifting or dropping the spare wheel, mainly during field repairs.

Tyre pressure control systems are utilised to increase terrain manoeuvrability. The safety is affected when driving at high speed with low air pressure in the tyres. Vehicles must be fitted with tyres that correspond to the environment and the regulatory requirements in which the vehicle is to be used. Note that the term M&S on the tyre can stand for both “Mud&Snow” and “Mud&Sand”.

Puncture proof tyres allow continued driving, albeit with limited speed and manoeuvrability. Some tyres are built with extra reinforcements in either the tyre walls or inside the tyre itself, which strengthen the tyre and relieve the weight of the vehicle. The extra reinforcement must hold the tyre in place even when the air is completely exhausted. Other tyres have a second layer of rubber that seals the hole automatically, thereby minimizing air loss.

There are no specific civil stipulations for motorcycles regarding winter or studded tyres. Studded tyres are often a prerequisite for safe driving on snow and ice surfaces. Another alternative for driving on snow and ice can be to mount skis.

- 3.405.01 The vehicle body shall have a sufficient number of mounting/lifting points for lifting jack.
- 3.405.02 Lifting surfaces/lifting jack points shall be documented in the technical documentation.

- 3.405.03 Lifting equipment shall be provided for handling of the spare wheel to and from the spare wheel bracket.  
*Comment:* Refers to heavier wheels that cannot be handled by one person.
- 3.405.04 Support legs or similar shall, for the safety of maintenance work, be included in the vehicle system with pressurised suspension.
- 3.405.05 Vehicles shall have puncture proof tyres.
- 3.405.06 Two-wheeled motorcycles shall be designed so that it is possible to mount studded tyres.
- 3.405.07 Two-wheeled motorcycles shall be designed so that it is possible to mount skis.
- 3.405.08 Vehicles shall be equipped with tyres that match the vehicle's operating environment.

### 4.6 HYDRAULIC AND PNEUMATIC SYSTEMS AND SPRINGS

#### 4.6.1 Hydraulic and Pneumatic Systems

---

---

Hydraulic and pneumatic systems are constructions intended to use a streaming pressurised liquid or gas to transfer, and often also control the energy from a power source (electric motor or combustion engine), to a hydraulic (or pneumatic) cylinder or motor.

Hydraulic and pneumatic pressure during the operation or accumulated hydraulic pressure after the operation may cause accidents. Therefore it is important that the operator can determine if a system is pressurised or dormant.

Hydraulic/pneumatic pressure can constitute a hazard via its connected equipment (hydraulic cylinders, motors, hoses, etc.), especially if release of pressure is not possible as a security measure for example during maintenance.

- |          |  |
|----------|--|
| 3.406.01 | Components and systems with an accumulated pressure in excess of 0.5 bar shall be marked with warning labels.  |
| 3.406.02 | It shall be possible to drain the pressure from a pressurised system.<br><i>Comment:</i> Instructions describing how safe release of built-in pressure is carried out shall be provided to ensure safe work at for example maintenance and care. It shall also be possible to subsequently check whether or not pressure has been drained from the system. |
| 3.406.03 | Hydraulic hoses or hydraulic components shall be located in confined spaces outside personnel compartments or behind protective barriers.  |
| 3.406.04 | Leaking hydraulic oil shall be prevented from penetrating into personnel compartments.   |
| 3.406.05 | It shall be possible to determine whether a hydraulic or pneumatic design contains stored energy/ accumulated pressure.  |
| 3.406.06 | Service modes where stored energy is required/ exists shall be possible to secure mechanically.  |

#### 4.6.2 Springs

---

A spring is a device intended to be elastically deformed to apply a force, absorb impact or store energy. Spring forces occur in many different designs of a vehicle system. The energy stored in the spring may constitute a hazard and may cause damage if released accidentally.

When personnel are present within a danger area, they must be able to ensure that the designated safety devices have been engaged correctly. The attachment element of a spring may constitute a more serious hazard than the spring itself. Loaded springs should be fitted with anti-tampering protection to prevent crushing and bruising.

- 3.406.07 A spring shall be equipped with a locking device or anti-tampering protection to prevent accidental release of the spring forces.  
*Comment:* Refers to springs whose force may cause injury.
- 3.406.08 A spring and its fastening elements shall be dimensioned for its intended purpose.  
*Comment:* Refers to springs used in a locking function that may cause injury if malfunctioning. The dimensioning shall include both the fastening devices and fatigue resistance.
- 3.406.09 A spring that may cause serious injury in the event of malfunction shall have a duplicate or have a fail-safe function.
- 3.406.10 Springs shall be located in a protected position in such a way that accidental contact is not possible.  
*Comment:* Refers to springs that constitute a safety-related locking function.

### 4.7 ELECTRICAL SYSTEM AND ELECTRICAL EQUIPMENT

This section covers the vehicle's own electrical system, most commonly 12/24 V. If a vehicle system contains electrical installations that come under the Low Voltage Directive (2006/95/EG), the Handbook on Safe Electrical Products and Systems (H SEPS E) must be applied.

### 4.7.1 Electrical Environment and Communication Equipment

---

Vehicle systems are subjected to both an external as well as an internal environment generated by the vehicles own electrical equipment. Electrical equipment in the vehicle is to some extent protected from the influence of the external electrical environment. The vehicle body has a defined internal electrical environment to take into account. Externally positioned electrical equipment may be interfered with by, for example, power lines, aerials, radio and radar radiation etc. in the vehicle's surroundings. Placement of equipment inside and outside the vehicle may thus be affected.

Protection against high-frequency electromagnetic radiation applies in accordance with AFS 1987:02 and SäkI G. Different electrical environmental effects with requirements on protection and protective technology are described in the EMMA handbook 2nd edition, see *References*.

When using for example hand-held radio equipment, mobile phones, satellite phones, GPS etc., the integration risks for the vehicle system must be considered. This must also consider the likelihood of accidental activation of a system that is carried by the personnel and what consequences this may have.

In order to drive unrestrictedly on European and national roads in Sweden, the vehicle's height (including cargo) should be a maximum of 4.50 m. The Electrical Safety Board recommend that the vehicle's height is a maximum of 4.30 m (4.30 m + 0.20 m of snow). The Swedish National Rail Administration specifies that the clearance to the overhead power line at railway crossings is 5 m. The likelihood of running into a bridge or equivalent or flash-over between a vehicle aerial and a high-voltage power line must be considered. See also *Section 4.10.1*.

3.407.01	<p>The vehicle's electric and magnetic fields shall be identified and the risk of human exposure to radiation shall be considered.</p> <p><i>Comment:</i> Refers to the entire vehicle system including integrated systems.</p>
3.407.02	<p>Safety-critical electronics shall have an adequate resistance against electromagnetic and electrostatic energy and the influence of laser light.</p> <p><i>Comment:</i> Refers to both the interference generated by other electrical installations on the vehicle as well as from external noise sources, for example, radar, radio etc. up to specified values. The exposure to external sources of interference can be significantly stronger in a military vehicle environment than in an equivalent civilian vehicle environment.</p>
3.407.03	<p>The vehicle's electrical system shall not interfere with the radio system used in the vehicle.</p> <p><i>Comment:</i> Correspondingly, the radio system used in the vehicle shall not interfere with the vehicle's electrical system.</p>
3.407.04	<p>Aerials shall be placed/designed to meet RADHAZ requirements for personnel and minimise the likelihood of interference with other electrical equipment in the vehicle.</p> <p><i>Comment:</i> See SäKI G for requirements related to high frequency electromagnetic radiation.</p>
3.407.05	<p>Harmful noise shall not occur in telecommunication helmets and headsets.</p> <p><i>Comment:</i> Harmful noise may occur if the cable to the device is short-circuited or be generated by the vehicle's electrical system.</p>
3.407.06	<p>Vehicle aerial that exceeds the height of 4.30 m from the ground shall be foldable without having to remove the aerial rod.</p>

### 4.7.2 Batteries

---

---

Batteries contain both stored electrical energy and hazardous substances that can be in both solid and liquid form. Personal injury may be caused if the batteries are overturned when driving, which may cause battery electrolyte leakage. The construction should ensure that the electrolyte can be collected if there is leakage from the battery group. The structure should be adapted to allow collection of leakage when at maximum allowed gradient of the vehicle. Corrosion damage can occur on unprotected parts of the body or on parts in the vehicle.

Burns may be caused if batteries are short-circuited when replacing batteries. In vehicles with 24 V systems implemented with two 12 V batteries connected in series, this could result in additional hazards that must be handled. It should be ensured that the cables to the batteries can be hung up without coming into contact with earth and thus avoiding short-circuit if the cables are connected or removed in the wrong order. To minimise the probability of a short-circuit, the battery's earth connection must always be removed first and connected last. The cables must at least be marked with "+" and "-" respectively. The cables can also be designed asymmetrically, which means that they are different in length to only fit to one pole. The plus cable should be red and the earth cable black to further make it easier for the personnel. A sign should exist regarding the order in which cables should be removed and connected. The sign should also show the location and wiring. The sign should be located in the immediate vicinity of the batteries.

External charging or defective charging regulators may cause overcharging of batteries with some oxyhydrogen gas as a result. Oxyhydrogen gas (hydrogen + oxygen) may explode if exposed to sparks or open flames. Thus the battery compartment needs to be ventilated (vented). If the batteries are equipped with a thermostatically controlled heating plate, the heating plate must only be switched on when the alternator is charging and the temperature of the electrolyte drops below approximately +15 °C. An indicator on the driver's control panel should indicate when the battery heater is switched on.

Injury/damage to property may be caused if the heating plate's thermostat does not switch off at the required temperature. The driver should be able to break the current to the heating plate if the thermostat does not switch off. If the batteries are overheated, oxyhydrogen gas can be produced as a result.

To ensure that a vehicle can be started, it should be equipped with a built-in maintenance battery charger. The maintenance battery charger must be dimensioned for the vehicle's 12 V or 24 V electrical system, as well as for the battery's/batteries' current. It should also be able to have the maintenance charger connected for extended periods of time without damaging the batteries. The maintenance battery charger and engine heater should not be connected to the same electrical circuit. If they are connected to the same electrical circuit, a selector switch should be installed, which makes it possible to choose whether to deploy the maintenance battery charger or to deploy both the maintenance battery charger and the engine heater. When vehicles are parked for extended periods of time, unnecessary wear on the engine heater may be caused if it is only deployed when the maintenance battery charger is needed.

A battery switch can be used to cut the power from a battery or other power sources. Battery switches are available in different versions depending on the battery type and the type of vehicle. For more demanding environments, battery switches designed for marine use can be used.

Heavy batteries should be fitted with lifting equipment if the batteries are located where they must be lifted into place or lowered into a box, or if the personnel cannot stand on the ground when handling the batteries.

3.407.07 Enclosed battery compartments shall be ventilated (vented) if the battery type emits hydrogen gas when being charged.

*Comment:* Certain types of batteries emit hydrogen gas, which may lead to increased risk of explosion if the gas accumulates. The bleed valve on the outside of the vehicle should not be located at face level.

- 3.407.08 Batteries shall be selected according to water resilience and positioned so that the vehicle's requirements on fording capabilities are met.  
*Comment:* This can be achieved through the battery's own properties or by using a protective enclosure or equivalent.
- 3.407.09 The battery shall be placed/enclosed so that the consequences in the event of leakage are minimised.  
*Comment:* This also applies at the maximum permissible gradient of the vehicle.
- 3.407.10 A sign shall be placed in the immediate vicinity of the battery, and the sign shall display the circuit diagram and the order in which cables shall be disconnected/connected.  
*Comment:* Refers to vehicles with more than one battery in the same battery group.
- 3.407.11 The vehicle shall be equipped with a mechanically operated main switch/battery switch.  
*Comment:* The power should be cut off as close to the source of energy as possible. Some specific functions such as communications equipment and auxiliary heaters (regarding cool down period) shall, however, be functioning when the main switch is switched off. Take also into account that special requirements to avoid static electricity can apply to ammunition and hangar forklifts.
- 3.407.12 Batteries shall be fitted with lifting equipment.  
*Comment:* Dedicated lifting equipment can be attached to the batteries.

### 4.7.3 Generator, Charging System, Starter Motor, Ignition System

---

---

The generator and electrical system in a vehicle equipped with computers, GPS equipment, radios, extra lights etc, must be dimensioned so that the system can supply power to all power consumers and still have capacity remaining. Communications equipment and other external power consumers should be connected to a separate battery circuit to ensure that the vehicle can be started.

The service battery must be equipped with a low voltage protection system that switches off the voltage before the battery reaches a dangerously low voltage, the so-called life-limiting level. The batteries should also be equipped with an alarm that indicates when it is time to switch them off or start recharging them in order to reduce the likelihood that communication is interrupted or data is lost.

3.407.13 Vehicles shall be equipped with a separate battery circuit for communications equipment and other external power consumers.

*Comment:* Relates primarily to vehicles whose external power consumers require power of such quantity that the vehicle's battery would quickly be exhausted if the equipment is used when the engine is switched off.

3.407.14 Service batteries shall be equipped with a low voltage alarm.

#### 4.7.4 Power Outlets

---

To reduce the likelihood of injury, anti-handling devices and splash protection must be installed over detached power outlets. A control indicator for when the power outlet is connected must exist at the driver's/manoeuvre seat. Electrical outlets and connections must be equipped with a sign that displays the system voltage to avoid electric shock and damage to property. Outlets, for example, 12/24 V, that are positioned horizontally<sup>1</sup> should be equipped with protective covers to prevent items from falling into the outlet and causing a short circuit.

3.407.15 Detached power outlets shall be fitted with anti-handling devices and splash protection for live parts.

*Comment:* IP class is chosen based on required environment according to electrical standards.

3.407.16 All electrical outlets and connections shall be equipped with a sign that displays the system voltage.

3.407.17 Horizontally placed power outlets shall be equipped with protective covers to reduce the likelihood of a short circuit.

#### 4.7.5 Displays, Instruments, Indicators and Interior Lighting

---

It is important that safety critical information that is presented on monitors/displays is legible in all light conditions, including in darkness.

Symbols or texts on switches and other controls must be clear and unambiguous in accordance with applicable standards. In general, information in the form of symbols is preferable to written information.

---

1. In the Swedish version of the handbook, it says “vertically” but it should be “horizontally”.

Interior lighting and instrument lighting must be possible to switch off completely when the driver in some situations wishes to drive the vehicle with completely extinguished lights and use night vision goggles (NVG). When driving without the lights turned on, the alarm device for vital functions must not consist of the regular light signal such as the main warning light.

Vehicles designed for specific military purposes should not be equipped with electronically coded ignition keys, as these keys may be an additional source of error if the vehicle will not start, and if the keys are lost, the replacement of the ignition system is made more difficult.

- 3.407.18 Monitors/displays shall be adapted so that they are legible in the existing interior lighting, even outdoors in direct sunlight or in darkness if the usage so requires.  
*Comment:* Relates to information on monitors/displays that may be considered as safety critical.
- 3.407.19 Turning on the normal interior lights and instrument lights shall only be possible through a deliberate act.  
*Comment:* When night vision goggles (NVG) are used there is a risk of loss of eyesight if the interior lights or instrument lights are switched on and may even cause a traffic hazard as the driver's eyesight becomes impaired.
- 3.407.20 In positions where night vision goggles (NVG) are intended to be used, the personnel shall be able to temporarily disengage as well as engage the airbag after driving in low light conditions.
- 3.407.21 Systems for performance monitoring and fault detection in subsystems with safety critical functions shall be provided.  
*Comment:* Scope and fault detection capabilities shall be specified.
- 3.407.22 If blackout lights are installed, an alarm device for vital functions shall exist and cannot constitute of the ordinary light signals.

3.407.23 The alarm device for emergency vehicles shall only be possible to operate from the driver's seat.

3.407.24 The driver shall be able to receive an indication/warning when hatches and doors, support legs, cranes, ramps etc. are open, extended, or in such a position that they may affect the driving of the vehicle.

*Comment:* Note that this only applies to indication/warning. The ability to quickly move the vehicle must be taken into account.

#### 4.7.6 Wiring, Fuses and Emergency Stop

---

---

To obtain a safe working environment when using vehicle-mounted equipment when personnel are within the equipment's work or danger area, a safety circuit that contains emergency stop or directional switches are required. It is recommended that there should always be at least two geographically separated emergency stops or directional switches where at least one is positioned outside the danger zone. There are a number of basic conditions which should be considered for emergency stops or directional switches for a safety-critical system. At least one switch must be mechanical. The ongoing activity must always be immediately terminated and must not be able to be restarted only by releasing the emergency stop or directional switch. Furthermore, a release function for the emergency stop or directional switch should be selected which requires a certain degree of turning to prevent accidental reset. For example, clothes that get stuck in the switch should not release the emergency stop or directional switch. This is to increase the possibility of a quick stop if the person in the danger zone is not able to activate the emergency stop or directional switch himself/herself.

Electrical systems are usually fused to a certain level of current and power output. If these levels are exceeded, the load on cables and wires may lead to overheating and at worst a cable fire. Cables or wires with outer sheaths made of PVC may in the case of fire emit hydrochloric acid which is highly toxic if inhaled.

Hydrochloric acid is also difficult to remove from surrounding electronics and other equipment. Therefore, cables and wires without outer sheaths made of PVC should be prioritised.

For vehicles designed for specific military purposes, self-extinguishing cables and wires should be selected as fire in the vehicle may occur that is not caused by overheating of the cables. The fire in the cables will then be extinguished as soon as the open flame is removed.

- |          |   |
|----------|---|
| 3.407.25 | At least one mechanical switch (safety switch) shall be installed between the power source and safety-critical consumers.   |
| 3.407.26 | Breaking the electrical circuit shall disconnect the power source.<br><i>Comment:</i> The breaking of the circuit should be done as close to the power source as possible.  |
| 3.407.27 | Locks for emergency stops shall lock directly in the emergency stop and not via links or similar devices.   |
| 3.407.28 | An activated emergency stop, that is, a stopped system, shall keep the system in an inactive mode until a deliberate resetting of the emergency stop has been done.   |
| 3.407.29 | Resetting the emergency stop function, that is, enabling start of the system after an emergency stop has been activated, shall only be possible using a special manual operation.   |
| 3.407.30 | Emergency stops shall be located both within and outside the working area.<br><i>Comment:</i> This must be weighed against the vehicle's tactical properties during operation so that the possibility for unauthorised personnel to disrupt the ongoing operation by activating the emergency stop is obstructed. |
| 3.407.31 | The emergency stops shall be marked.<br><i>Comment:</i> The marking shall indicate which system that is stopped.  |

- 3.407.32 The concentration of toxic gases that may be produced in the personnel compartments during a cable fire, shall be analysed and the consequences of a fire shall be minimised by the choice of cabling.
- 3.407.33 Cable's outer sheaths shall be self-extinguishing.  
*Comment:* Self-extinguishing means that the material stops burning if the external fire source is removed.

## 4.8 SAFETY-CRITICAL ELECTRONICS AND SOFTWARE

This section refers to safety critical software that is further described in H Progsäk E. The development and/or modification of vehicle functions that are realised through the use of programmable electronic systems must be applicable in accordance with the standard "ISO 26262 - Road vehicles - Functional safety". In cases where deviations from ISO 26262 are considered appropriate for parts of the requirements considering the intended use or operating environment of the vehicle in question, FMV can make a decision after suggestions and justification from the supplier.

## 4.9 LIGHTING EQUIPMENT

Lighting equipment on vehicles exists to make the vehicle visible as well as to assist the driver of the vehicle with lighting during reduced visibility. The lighting is designed in such a way that bystanders can determine the vehicle's size, position, speed and intentions in traffic in both daylight and in reduced visibility. Military vehicles can be equipped with dedicated lighting equipment beyond what is stipulated by laws, ordinances and regulations for civilian vehicles.

The design of the lighting equipment on vehicles and trailers is to a large extent regulated by the civil legislation. Generally, all vehicles supplied to the Swedish Armed Forces must be equipped in accordance with the requirements of the Transport Authority Statue Book (TSFS). The Swedish Armed Forces and FMV can,

with the support of the exemption rules such as TSFS 2010: 2, Annex 5, deviate from these requirements. The extent of, and how these deviations must be handled, are determined by a military vehicle inspector at FMV.

Decisions on the current design of lighting equipment must be made by a military vehicle inspector at FMV as part of the single vehicle approval. Military vehicles must in some cases be provided with supplementary and dedicated lighting devices to ensure the functionality and safety for military use.

A list of electrical and lighting equipment designed for military use, including equipment that constitutes accessories or ancillary equipment to military vehicles, that are used for new acquisitions or modifications of vehicles, is documented in the Handbook for Lighting Equipment. Additional technical information regarding military lighting equipment can be found in Spare Parts Catalogue for Military Vehicle Equipment, see *References*.

Vehicles designed for specific military purposes and intended for use in the international intervention forces require in most cases supplementary dedicated lighting equipment in addition to the civilian lighting requirements in order to function tactically in their intended operations.

Reflective materials designed for resistance to shock damage must be used in combination with civilian reflective materiel as civilian reflective material is usually made of plastic and can easily break when driving in terrain.

Trucks to be equipped with quick release, roller hook lift or other fixed mounting or separate cargo carriers that require operation from the cab (does not apply to radio-controlled equipment) must at acquisition be equipped with connection possibilities for controls in the cab. This is especially applicable to forward-built vehicles with cabs that can be tilted where it is complicated to install cables afterwards because the wiring must be installed through the cab tipping joint in the front. Cables should be placed together with the vehicle's standard cabling in order to avoid damages.

All electrical connections in the form of trailer connectors, sockets, etc. must be clearly labelled with the system voltage of the vehicle. Labelling is preferably done with signs in accordance with Spare Parts Catalogue for Military Vehicle Equipment. In case the vehicle has an electrical system that includes various subsystems, it is vital that all affected outlets are labelled with the current voltage for the outlet.

- 3.409.01 Trailers with lighting requirements shall be equipped in such a way that the lighting functions can be powered from the towing vehicle.
- 3.409.02 Device sockets and plugs intended primarily for booster start shall not be used for power supply from the carrier vehicle.  
*Comment:* This is because of the likelihood of confusion.
- 3.409.03 Connectors designed for high voltage power systems shall not be used in automotive electrical lighting systems.
- 3.409.04 Reflective material developed for resistance to shock damage shall be used in combination with civilian reflector material.
- 3.409.05 Trucks, especially forward-built vehicles with cabs that can be tilted, to be equipped with quick release, roller hook lift or other fixed mounting or loose cargo carriers that require manoeuvring from the driver's cab, shall be equipped with connection possibilities for controls in the cab.  
*Comment:* Not applicable to radio-controlled equipment.
- 3.409.06 All electrical connections in the form of trailer connectors, electrical outlets, etc. shall be clearly marked with the existing system voltage of the vehicle.  
*Comment:* In case the vehicle has an electrical system that includes different subsystems, it is vital that all affected outlets are labelled with the current voltage for the outlet.

## 4.10 CHASSIS, CAB, INTERIOR AND CHASSIS BODY

### 4.10.1 Chassis/Chassis Body

For all vehicles not designed for specific military purposes, the Vehicle Act (2002: 574) regulates the maximum permitted dimensions. For vehicles that are designed for specific military purposes, the maximum permitted dimensions according to Vehicles Act (2002: 574) should be used as guidance.

In order to drive unrestrictedly on European and national roads in Sweden, the height of the vehicle (including cargo) should be a maximum of 4.50 m and the length of the vehicle a maximum of 24 m. For the rest of Europe, however, the maximum vehicle height is 4.0 m and the maximum vehicle length is 16,5 m and 18 m. See also *Section 4.7.1* concerning the vehicle aerial.

In accordance with the Vehicles Act (2002: 574), the width of the vehicle must not exceed 2.60 m. Specific regulations relating to wide loads are specified in TSFS. If the overall width of the vehicle when driving exceeds 2.60 m, a holder for a sign reading “WIDE LOAD” must be fitted. Width markers must be made of impact resistant material and should be fitted with hinged struts to minimise the likelihood of damage to property. Width markers should be retractable or removable. Reflectors and lighting must be in accordance with regulatory requirements.

For vehicles that are developed for international use, special rules and recommendations apply concerning the vehicle’s exterior dimensions. See *table 4:1* below.

Table 4:1 Vehicle outer dimensions

Dimensions/country	Sweden	Europe
Vehicle height	4.50 m	4.0 m
Vehicle width	2.60 m	2.55 m
Vehicle length incl. load	24 m (25.25 m <sup>a</sup> )	16.5 and 18 m

- a. Provided that the vehicle can handle requirements on turning radius etc. according to TSFS 2012:126

In addition to the above stated maximum dimensions, considerations should be taken to SJ's loading profile concerning possible rail transport and maximum dimensions for air transport (C17 and C130/TP84).

Trucks must by law be equipped with underrun and side protection. This is regulated for military vehicles in TSFS 2010: 2. Terrain ability must be weighed against the reduction of the impact of an accident. Removable or vertically adjustable underrun protections can possibly be used.

Requirements on ground clearance, front and rear angles of incidence and ramp angles (between the axles) should be defined in the requirement specification. This also applies to angles within a vehicle, for example for tracked vehicles (front and rear), and between towing vehicle and trailer (angle of incidence = approach angle, ramp angle = clearance angle).

#### 4.10.2 Ballistic Protection

---

---

Adding ballistic protection to a vehicle may affect other functions or parts of the vehicle. When designing the ballistic protection, the required adjustments to the total vehicle system must to the greatest extent possible be made so that all other safety requirements are still met. However, it can be difficult to design a vehicle with ballistic protection without making deviations from the safety regulatory requirements why exceptions can be necessary, see requirement 3.306.01. Examples of functions/aspects that can be altered or adversely affected due to the design of the ballistic protection are visibility, transmission of light, emission control and the vehicle's centre of gravity. Also hatches and doors fitted with ballistic protection can, due to the extra weight, be difficult to open if the vehicle for example overturns. These aspects, and more, must be considered with regard to the possible accident risks that are added due to the changed properties of the vehicle.

### 4.10.3 Engine Hood, Fenders, Footsteps, Roof Rack and Masking

For all types of ascent and descent and when walking on the vehicle, slip and fall injuries may occur. Natural steps and handles must exist and be equipped with anti-slip protection. This also applies to the walkways required on the vehicle to access the compartments at the top of the vehicle, for example, tools, cargo carriers or rooftop boxes.

Footsteps and handles must be placed at such a distance from the ground and with such frequency and otherwise be designed in a way that the likelihood of slips and falls is minimised. At least two-thirds of the foot should fit on the step. Handles must be able to use when wearing gloves. Natural locations for foothold should be marked and equipped with anti-slip protection. Loose ladders should be avoided due to the likelihood that they can be forgotten to be removed when driving and that they might not be used when needed. Furthermore, ascents and descents should take place in a location that can be observed from the driver's and/or vehicle commander's positions.

Anti-slip protection must not exist on hatches or anything that is inappropriate to step on, such as equipment or inclined surfaces. Anti-slip protection must exist on level surfaces underneath equipment that can be removed. Seats should be placed relative the entry and exit points so that personnel do not use these as a natural foothold, which can lead to both slip and impact injuries, and also to avoid stepping on control panels, connectors or controls which may result in an unintentional activation of a function.

Specifically adapted masking equipment should be developed to facilitate masking of the respective vehicles. Special consideration should be taken to the weight of the individual parts of the masking equipment. When masking high vehicles, the vehicles should be designed to minimise the likelihood of falls, for example with level surfaces, necessary anti-slip protection and the possibility to use fall protection equipment.

Regarding masking equipment to be used while driving, considerations must be taken to the likelihood that the equipment can come loose and obstruct the driver's visibility. Necessary mounting fixtures for the masking equipment should be developed for the specific vehicle type.

The vehicle's centre of gravity is altered when the roof is overloaded, and the vehicle may have other road characteristics that can cause the vehicle to be more likely to overturn. To reduce the likelihood of overload, the maximum allowed weight of the load must be clearly marked.

**3.410.01** Footsteps, handles and walkways on the vehicle shall be designed so that the likelihood of slipping, falling, hitting or getting stuck on protruding parts is minimised.

*Comment:* Walkways, footsteps and handrails leading to, as well as at, locations on the vehicle where masking equipment is attached to the vehicle shall exist. At least two-thirds of the specified footwear should fit on footsteps. Handles must be designed so that the specified gloves can be used. This also applies to surfaces that are exposed when equipment is removed.

**3.410.02** Footholds must be fitted with appropriate anti-slip protection.

*Comment:* Anti-slip protection shall also exist on level surfaces underneath equipment that can be removed.

**3.410.03** It shall be possible to use handles while wearing gloves.

*Comment:* The handle shall be designed so that the specified gloves can be used.

**3.410.04** Sensitive areas that cannot withstand being walked on shall be marked.

- 3.410.05 Load carriers shall be marked with the maximum load.  
*Comment:* This mainly applies to load carriers on the vehicle's roof.
- 3.410.06 Masking equipment to be used while driving (masked moving vehicle) shall have the necessary mounting fixtures for the vehicle type.

### 4.10.4 Doors, Hatches, Portholes, Windows and Prisms

---

Hatches and doors must meet certain specific requirements. On a combat vehicle for example, the doors and hatches must be sufficiently stable to withstand shock-waves close to a detonation and subsequently still be able to open at specified inclines. Specific safety requirements concerning design, manoeuvrability, locking, opening, securing etc. must be met.

Personal injury may be caused when opening and closing hatches or doors. Hatches and doors should be opened downwards or sideways. Heavier hatches and doors that can fall or slam shut should be secured in an open, self-locking position by a latch that should also withstand the dynamic forces which occur when driving. Hatches and doors must not only be held open by means of spring force. For crew hatches on top of the vehicle, it should be possible to use a sequential, two-handed grip. Hatches or doors that overlap the body of the vehicle, which can sever fingers when being closed, should be avoided.

All personnel must be able to evacuate the vehicle in at least two different directions in an emergency situation. It must be possible to unlock hatches and doors from the inside. In an emergency situation, it must be possible to open hatches and doors from the outside. The size of the evacuation hatch must allow evacuation of persons wearing personal equipment, field uniform, combat vest, body armour, protective mask and personal weapon. When designing escape routes and the ability to rescue injured persons in the vehicle, considerations must always be taken to the ability of protecting against intrusion by unauthorised persons during a combat situation.

For civilian vehicle types such as trucks, wheel loaders etc. that are supplemented with shrapnel protection, the changed possibility to evacuate should be taken into account. Doors equipped with shrapnel protected windows are usually much heavier resulting in that the driver/crew can have trouble opening them in relatively small gradients. Protected windows can also reduce the number of escape routes.

- |          |  |
|----------|--|
| 3.410.07 | The locking mechanism on hatches and doors, both in closed and open position, shall be dimensioned to withstand the stresses arising during operational use.                           |
| 3.410.08 | Heavy hatches and doors shall be equipped with locking devices in both an open (fully open or ajar position) as well as in a closed position.  |
| 3.410.09 | Hatches shall be secured automatically in the open position with a self-locking latch.   |
| 3.410.10 | The locking mechanism on personnel hatches and doors should be accessible and manoeuvrable from both inside and outside.   |
| 3.410.11 | Locks on hatches and doors should be manoeuvrable by crew wearing regulation personal protective equipment.<br><i>Comment:</i> The equipment may vary between different climate zones. |
| 3.410.12 | Heavy personnel hatches shall be fitted with soft closing brakes or counterbalancing function.   |
| 3.410.13 | When closing personnel hatches on top of the vehicle, it shall be possible to use a sequential, two-handed grip.   |
| 3.410.14 | Emergency evacuation of the vehicle shall always be possible.<br><i>Comment:</i> Technical features shall not come into conflict during an emergency evacuation.                       |

- 3.410.15 Prerequisites for rapid evacuation of the vehicle shall be considered when designing doors/hatches.  
*Comment:* This includes the choice of the number of doors, positioning, size, weight, opening function etc.
- 3.410.16 In an emergency evacuation situation, it shall be possible to evacuate the vehicle in at least two different directions.  
*Comment:* Verification of the emergency evacuation shall be done when the vehicle is tilted at different angles.
- 3.410.17 In case of an emergency, all doors/hatches leading to/from personnel compartments shall be possible to be opened from the inside.
- 3.410.18 In case of an emergency, at least two doors/hatches in different directions to the personnel compartments shall be possible to be opened from the outside.  
*Comment:* Special tools are allowed when opening doors from the outside in case of an emergency.
- 3.410.19 The bottom hatch for emergency evacuation shall be possible to open both from the inside and the outside.  
*Comment:* Requirements for mine protection shall be considered when selecting the design solution.
- 3.410.20 Windows and prisms shall not cause injury to personnel in the vehicle at external impact.  
*Comment:* When reinforcing glass and prisms, the entire surface shall be strengthened to prevent shrapnel.

#### 4.10.5 The Driver and Crew Compartments and Interior Equipment

---

---

For compartments where the vehicle crew and passengers normally reside, safety and usability must be considered regarding ergonomics, choice of materials, safety equipment, as well as the location and stowage of equipment must be factored into the overall solution. In addition to the regular use of the vehicle, safety considerations must also be taken concerning undesirable events such as a collision, overturn and fire. More serious consequences regarding personal injury can result if personnel do not have access to or do not use seat belts in a collision or overturn and this must be considered in the design of the different seating positions.

Interior and upholstery must be fire-resistant. The combination of materials for the interior and upholstery and the need for treatment with fire retardants must be considered.

To create alternative evacuation routes if the vehicle's ordinary hatches cannot be opened, it may be required that backrests of seats can be folded alternatively be turned and thus create more space. A folded or turned backrest may be required to be locked in case of an emergency evacuation if the vehicle has turned over.

Seats can for various reasons need adjustment (raised, lowered, rotated or folded). Personal injury can be caused both during deliberate adjustment of the seat as well as during unintended movement of the seat if the adjustment control is inadvertently activated. Controls should therefore only be activated by a deliberate action. Controls should be placed in such a way that the crushing of hands and of personnel seated behind the seat is avoided.

Furthermore, leg and foot space for the current location should be designed so that the likelihood of crush injuries is minimised when adjusting the seat. This also applies for personnel on adjacent seats that can be injured when adjusting the seat.

If the vehicle overturns, the severity of the event can be further increased if personnel get stuck in their seats and are not able to evacuate the vehicle in the event of for example fire or flooding.

Seats must be designed in such a way that the probability of getting stuck is minimised if the vehicle overturns and lands on its side or upside down. This can be achieved by introducing a device that releases the seat and which can be accessed by the person in the seat even if the vehicle has turned over.

Easily accessible parts inside the vehicle must be equipped with protection against unintended contact if the surface temperature of the parts can reach such levels that can cause burns when touched. Methods for determining surface temperatures for different materials that from a burn perspective correspond to the surface temperature of metal, are described in SS-EN ISO 13732-1.

Equipment in the vicinity of seats, for example monitors/displays, must not have sharp corners or edges, and be positioned with regard to the risk of injury in a collision or sudden braking. Protruding corners and edges should be padded.

Interior fittings must be made of materials that prevent the growth of mould.

- |          |   |
|----------|---|
| 3.410.21 | Seating and work areas shall be designed according to ergonomic principles, taking into account the anthropometric data (variation of human body measurements including both men and women).  |
| 3.410.22 | Type approved three-point or four-point seat belts in all seats shall be striven for.<br><i>Comment:</i> Lap seat belts may be permissible in special cases. Five-point seat belts generally require an exemption.  |
| 3.410.23 | Seat belts shall be adapted to use together with regulation personal equipment.<br><i>Comment:</i> The requirement specification must specify the size of the soldier as well as the personal equipment the seat belts must be adapted for. Extra-long seat belts are normally required in order for the soldier to wear regulation personal equipment. |
| 3.410.24 | It shall be able to use seats both with and without regulation personal equipment.  |

- 3.410.25 Neck protection shall be installed in all seats in the vehicle, and neck protection shall be designed so that the helmet can be worn.  
*Comment:* This requirement does not apply to motorised equipment (ATV's, snowmobiles, motorcycles, etc.).
- 3.410.26 It shall be possible to adjust seats manually (raise, lower, rotate or fold).  
*Comment:* If the seat is electrically operated, a quick and simple manual backup operation shall be possible.
- 3.410.27 Operation of an adjustable seat shall be possible without the risk of crushing injuries.
- 3.410.28 Seats shall be designed so that the probability of getting stuck between the seat and the body of the vehicle if it lands on its side or upside down is minimised.  
*Comment:* This can be achieved by introducing a device that from the seating position can be reached to adjust the position of the seat, even if the vehicle has overturned.
- 3.410.29 It should be possible to fold the seat's backrest in all combinations of the seat's height and length positions and it shall be possible to lock the backrest in the folded position.  
*Comment:* An alternative design solution can be that the seat's backrests can be turned and locked instead of folded. Backrests shall not come into conflict with other safety-critical controls or functions, see 3.410.14.

- 3.410.30 Easily accessible parts inside the vehicle shall be equipped with protection against unintentional contact if the surface temperature of the parts can reach such levels that when touched can cause burns.  
*Comment:* Methods for determining surface temperatures for different materials from a burn perspective are described in SS-EN ISO 13732-1.
- 3.410.31 Personnel shall, by means of protective devices/ anti-tampering devices, be prevented from inserting body parts in areas with moving parts.
- 3.410.32 Potentially dangerous parts/components (start batteries, oil, cables, etc.) that can cause injuries in case of fire, collision, explosion in or near the vehicle shall as far as possible be separated from the crew and personnel compartments.
- 3.410.33 Fixed installed accessories or equipment shall be positioned and fastened with regard to personal injuries in the case of a crash, explosion in or near the vehicle or emergency evacuation.  
*Comment:* This refers for example to weapon holders and communication equipment. Levels of resistance shall be specified. In a crash and explosion in or near the vehicle, the likelihood of impact or that equipment detaches and hits personnel, must be analysed and taken into account. At an emergency evacuation, the placement of equipment shall be such that the equipment does not impede or delay the evacuation.
- 3.410.34 Protruding parts and sharp corners in personnel compartments shall be fitted with padding.  
*Comment:* Special attention shall be paid to equipment in the vicinity of seats.
- 3.410.35 Interior and upholstery shall be selected with regard to fire hazard and the risk of toxic gas being produced in a fire.

- 3.410.36 Organic materials shall be avoided in the interior and upholstery.  
*Comment:* The purpose is to prevent mould growth and reduce the need for dry-aeration.
- 3.410.37 The air quality in crew and personnel compartments shall correspond to requirements relating to temporary workplaces according to AFS 2009:02 Workplace Design.  
*Comment:* Note that vehicles are exempt regarding requirements for air quality in civil law.

#### 4.10.6 Climate Control

---

---

Vehicles should be equipped with climate control system that can regulate the temperature in the personnel compartments during both cold and warm climates.

- 3.410.38 Vehicles shall be equipped with a climate control system for the regulation of workplace temperature.  
*Comment:* This requirement applies to vehicles in which the climate control system for both heating and cooling fulfils a function and shall be adapted to the defined operating environment. A warning device can be installed for loss of function of the climate control system if the crew and personnel compartments are separated.

#### 4.10.7 Equipment for Transporting Injured

---

---

Occasional transport of injured personnel on stretchers must be possible in as many vehicles as possible. To accomplish this, vehicles need to be equipped with fasteners for stretchers in accordance with the specification.

- 3.410.39 Vehicles shall be equipped with fasteners for stretchers for occasional transport of injured personnel on stretchers.

### **4.11 FIRE-FIGHTING EQUIPMENT, VEHICLE MOUNTED AND SEPARATE RESPECTIVELY**

A vehicle fire can have major consequences for both the personnel and the vehicle. In peace time, a fire can for example be caused by leakage, overheating or electrical faults. The root cause can be an accident, negligence, defects in the design or insufficient maintenance. In a combat situation, fire can also occur when fired upon or after a mine detonation.

Fire protection can be divided into passive and active fire protection. Passive fire protection means material solutions and measures incorporated in the vehicle's basic design. The purpose is mainly to prevent the ignition and spreading of fire by reducing heat conduction and radiation. Examples of measures are insulation of pipes containing flammable liquids, use of fire-retardant materials and fire isolation between the engine compartment and the driver's seat. Another passive fire protection measure is using fire resistant paint in order to protect the load-bearing structures against weakening in case of fire.

Active fire protection means systems with moving mechanical and/or electrical components that are activated if a fire is detected. Examples of active fire protection is fire extinguishing system with associated detection system. The category additional fire protection includes, for example, portable fire extinguishers, fire blankets and escape hoods.

Fire protection can be divided into four different levels of protection. When selecting fire protection for a vehicle, the consequences of the fire for the personnel, the equipment and the environment are considered.

The consequences of a fire depend on several parameters, for example the threat that exists in the environment in which the vehicle is to be used, access to replacement vehicles or the economic and tactical value of the vehicle. When selecting the level of fire protection in a vehicle, the stand-alone fire extinguishing equipment of co-operating vehicles can in some instances be included.

### 4.11.1 Level 1 Basic Fire Protection

---

Basic fire protection refers to protection against fire in brakes, hydraulic systems, deck and engine room, and protection against liquid fire on the outside of the vehicle after being attacked by a “Molotov cocktail” or equivalent.

During a fire in the vehicle with basic fire protection, the driver or the passengers extinguish the fire with portable extinguishers. If the driver and the passengers are injured, other personnel must be able to fight the fire, which means that portable fire extinguisher must be accessible from the outside of the vehicle. If the crew and personnel compartments are separated, there must be portable fire extinguishers installed in both compartments, for example in a tracked vehicle or in a hut. A probable cause of fire in the rear compartment of a vehicle is electrical failure of some kind and that is why portable fire extinguisher 0.7 kg CO<sub>2</sub> should always be installed.

Basic fire protection is intended to prevent loss of equipment in case of a small fire.

Examples of basic fire protection are portable fire extinguishers on personnel transports, trucks and buses.

For vehicles classified in Level 1, basic fire protection, the requirements below apply:

**3.411.01** The fire extinguishing medium shall be selected so that no danger to the personnel and the environment can be caused during fire-fighting.

**3.411.02** Vehicles shall have at least one portable fire extinguisher, P6 (powder extinguisher 6 kg), or equivalent that shall be easily accessible from the outside of the vehicle and shall be easily accessible for a person on the ground next to the vehicle.

*Comment:* Appropriate efficiency rating for fire extinguishers are selected according to standard SS-EN 3-7:2004 + A1:2007.

The requirement does not apply to motorcycles, mopeds and snowmobiles.

- 3.411.03 Vehicles shall have one portable fire extinguisher, P2 (powder extinguisher 2 kg) or equivalent that shall be easily accessible from the outside of the vehicle and shall be easily accessible to the driver.  
*Comment:* Appropriate efficiency rating for fire extinguishers are selected according to standard SS-EN 3-7:2004 + A1:2007.  
This applies only for level 1 where fire extinguishing systems exist in the engine compartment.
- 3.411.04 If crew compartments are separated, and by decision by FMV, an additional portable fire extinguisher, P2 (powder extinguisher 2 kg) or equivalent, alternatively a 0.7 kg CO<sub>2</sub> equivalent shall be installed in the separated compartment.
- 3.411.05 A sign indicating the location of the portable fire extinguisher shall exist on/next to the closest door or hatch.  
*Comment:* The sign informs both own personnel as well as rescue personnel where portable fire extinguishers are located.
- 3.411.06 Confined spaces that are not personnel compartments shall be equipped with automatic fire detection systems.  
*Comment:* Drivers and vehicle commanders shall have the possibility to get an indication from the fire detection system both when sitting in their regular seats and when standing in open hatch mode.

#### 4.11.2 Level 2: Enhanced fire protection

---

---

Enhanced fire protection refers to protection against fire according to Level 1.

Enhanced fire protection refers to a system in which a fire in the engine room is extinguished with an automatic extinguishing system, which increases the likelihood of a successful fire-fighting operation. At a collision, when fire often occurs in the engine

compartment due to ignition of gasoline, diesel or washer fluid and the vehicle crew is injured, there are no dependencies on external help.

Enhanced fire protection is intended to prevent loss of equipment after a fire in the engine compartment.

Examples of enhanced fire protection are the fire extinguishing systems in the engine compartments of Bv 206, 208, 309 and 410.

For vehicles classified in Level 2, enhanced fire protection, the requirements of Level 1, in addition to the requirements listed below, apply:

**3.411.07** Engine compartments shall be equipped with a permanently installed fire extinguishing system with both automatic and manual activation.

#### 4.11.3 Level 3: Advanced Fire Protection

---

Advanced fire protection refers to protection against fire according to Level 1 and fire after a mine detonation or attack by small arms fire.

Advanced fire protection means that the vehicle is equipped with a more advanced extinguishing system in the engine compartment. The extinguishing system must react so quickly that secondary damage is avoided. The extinguishing system can be activated twice in succession, which increases the possibility of leaving the position, for example when under bullet attack. The vehicle must also be equipped with a CO<sub>2</sub> fire extinguisher to fight a “minor” fire without immediately having to evacuate the vehicle. A minor fire can be caused by igniting spilled methylated spirits from a kerosene stove inside the vehicle.

Advanced fire protection is intended to prevent elimination, which means that no secondary damage must occur after a fire in the engine compartment (maintained combat capability of the vehicle).

Examples of advanced fire protection are the fire extinguishing systems in the engine compartments of Tgb 16, Strf 90 A/B and Patgb 203.

For vehicles classified in Level 3, advanced fire protection, the requirements of Level 1, in addition to the requirements listed below, apply:

- 3.411.08 Motor and ammunition compartments shall be equipped with a permanently installed fire extinguishing system with both automatic and manual activation.
- 3.411.09 Fire extinguishing systems in the engine compartments and ammunition compartments shall be possible to activate from two different locations in the vehicle, of which one location shall be the driver's seat.  
*Comment:* Activation devices shall be possible to seal.
- 3.411.10 A single failure in the fire extinguishing system's detectors, activation devices, etc. shall not cause loss of function.
- 3.411.11 Fire extinguishing system in the engine compartment shall be able to extinguish two in time separated fires.
- 3.411.12 Each vehicle shall have additional portable extinguishers (in addition to the requirements for portable fire extinguishers according to Level 1) located inside the vehicle. The portable fire extinguisher shall be P2 (powder extinguisher 2 kg) or equivalent.

#### 4.11.4 Level 4: Complete Fire Protection

---

---

Complete fire protection refers to protection against fire in accordance with Level 3 and being attacked with light anti-armour weapons.

Complete fire protection means that the vehicle is equipped with a system according to Level 3 and an explosion suppressive system. One of the reasons for the system is to fight a so-called EFFM fire (Explosively Formed Fuel Mist) in which a warhead first penetrates the fuel tank/pipe and then continues through the crew compartment. A fine mist of fuel is dispersed into the crew compartment and ignites, resulting in an explosive process. Extinguishing system must detect the flame and extinguish the fire within 250 ms.

Complete fire protection is intended to prevent elimination, which means that no secondary damage must occur after a fire in the engine compartment (maintained combat capability of the vehicle). In addition, damage to the equipment and the crew must be minimised after being attacked.

Examples of complete fire protection are the extinguishing systems in the engine compartments, explosion suppressive systems in the crew compartments of Strv 122, Patgb 360 and Strf 90 C.

In addition to civil legal requirements, such as ADR which is regulated by MSBFS 2015:1 – Regulations on the transport of dangerous goods by road and in terrain (ADR-S) or later edition, vehicles classified in Level 4, complete fire protection, the requirements of Level 1, in addition to the requirements listed below, apply:

- 3.411.13 Motor, crew and ammunition compartments shall be equipped with a permanently installed fire extinguishing system with both automatic and manual activation.
- 3.411.14 Fire extinguishing systems in the engine compartments and ammunition compartments shall be possible to activate from two different locations in the vehicle, of which one location shall be the driver's seat.  
*Comment:* Activation devices shall be possible to seal.
- 3.411.15 A single failure in the fire extinguishing system's detectors, activation devices, etc. shall not cause loss of function.
- 3.411.16 Fire extinguishing system in the engine compartment shall be able to extinguish two in time separated fires.
- 3.411.17 Each vehicle shall have additional portable extinguishers (in addition to the requirements for portable fire extinguishers according to Level 1) located inside the vehicle. The portable fire extinguisher shall be P2 (powder extinguisher 2 kg) or equivalent.

## 4.12 LOAD AND OTHER EQUIPMENT

There must exist holders for securing load and other loose equipment in and on the vehicle. It is very important that the load and equipment are stowed and secured in a proper and well planned manner before driving. Equipment that is not secured or improperly secured can detach from the vehicle and cause injury to personnel and damage on property in the vicinity of the vehicle. Loose equipment must not make the vehicle wider or hang out from the intended load space.

Personal injury can be caused when driving off-road, at a collision or overturning if personal weapons or other equipment are thrown around in the crew compartment. All crew members must have holders for their weapons (such as anti-tank weapons, machine guns, handguns, etc.), positioned so that the weapons are easily accessible during entry and exit.

Personal injury can occur during various types of lifting of materiel or equipment up and down on the vehicle or in and out of doors and hatches. This also applies to equipment inside the vehicle which requires slanted lifts for fitting or removal. All equipment that is heavier than 20 kg should be equipped with handles and all equipment that is heavier than 40 kg should be labelled with the weight. When lifting equipment that weighs 20 kg or more or when lifting batteries, two persons should, if possible, be able to help each other.

Crush injury can be caused when handling a jack and eventual jack plate. Requirements must be placed that proper jack insertion points must be available and in sufficient numbers for all possible work on the vehicle.

For vehicles intended to be used on airfields, it is especially important that everything is secured so that no equipment is dropped on the runway, so-called "Foreign Object Damage" (FOD). This relates to larger objects such as screws, pins etc. why these should be locked and fixed.

- 3.412.01 Vehicles shall be equipped with required mounting attachments for all load and additional equipment not permanently attached.  
*Comment:* Enemy fire and other types of attacks shall be considered, for example IEDs or mines.
- 3.412.02 The method for stowing equipment in racks and bins in various stowage locations shall be developed so that the equipment during and after transport and redeployment does not constitute a hazard to the crew.
- 3.412.03 Locks and other load securing equipment shall be designed to minimise the risk of accidents during the unloading of equipment after transport.  
*Comment:* Methods to loosen locks and other load securing equipment safely shall be developed. The maximum tilt angles of the vehicle during loading/unloading shall be considered.
- 3.412.04 Weapon holders shall exist for the type of weapons to be used by personnel in the vehicle. Weapon holders shall be positioned considering the accessibility of the weapon as well as with regard to the likelihood of impact, and that the weapon is triggered accidentally.
- 3.412.05 Screws, pins, etc., that need to be loosened every day shall be locked and fixed.  
*Comment:* For vehicles intended to be used on airfields, it is especially important that everything is secure so that no equipment is dropped on the runway, so-called “Foreign Object Damage” (FOD).

## 4.13 WEAPON INSTALLATIONS

The various tactical purposes of the vehicle, as well as the variety of threats in the intended operation environment, place different demands on the need for armament. The need for weapons can differ between vehicles and can vary from heavy assault weapons for combat vehicles and artillery for support vehicles to lighter armament for close protection of troop and supply transport vehicles. Different weapon integrations entail hazards related to the weapon system in combination with the vehicle as weapon carrier.

This section presents the requirements to avoid/reduce a number of hazards related to weapon installations, but each specific weapon installation on a vehicle platform must always be based on additional system safety analyses according to the methodology in *H SystSäk E*. See also *H VAS E 2012 3.1.2 Safety of friendly forces, 3.3.5 Weapon platforms, 3.1.16 Mechanical stability, 3.1.17 Transport, 4.5 Packaging for ammunition*.

If the barrel reaches outside the vehicle's outer contour, the barrel can hit an object next to the vehicle while driving. The consequences can be injury to personnel, damage to the barrel, the elevating mass or the mounting of the elevating mass. The probability of impact can be reduced if the vehicle is equipped with a turret position indicator to be used by, for example, the driver and vehicle commander to facilitate the orientation of the barrel's direction and the direction of travel.

An alternative method to reduce the likelihood of damage to property can be to introduce the ability to limit the manoeuvring area when needed so that the barrel is kept inside the vehicle's outer contour. When driving on public roads, there should be a fixed lashing position for the barrel.

Personnel must be able to wear regulation equipment at their operator stations of the weapon. The design of the operator station must be adapted to the specified equipment and the equipment must be considered in the risk analysis.

Aiming and firing systems must be adapted to the vehicle's outer contour, it must be possible to add extra aiming and firing restrictions, for example due to load options, etc.

When positioning smoke grenade launchers, the weapon's system safety zone (danger zone) must be considered. It can be difficult to achieve a good solution in all aspects when the requirements are many and sometimes contradicting. For example, as the risk area is wind-dependent and coverage is often desired in all directions around the vehicle, at the same time as personnel must be able to enter and leave the vehicle.

The environmental durability requirements placed on and verified for ammunition must not be exceeded which is why the storage compartments must be adapted to meet the specified requirements. See also *H VAS E 2012 Section 4.5 Packaging for ammunition*.

If manual weapon installations up to and including 12.7 mm are not equipped with a device that collects empty shells casings, ammunition belts and belt links, these objects can cause damage or injury. For example, empty shell casings may end up in the turret ring which can prevent rotation of the turret, get stuck in grooves/seals so that gaps cannot be closed, or end up on the floor which constitutes a slip hazard. Live cartridges could also be left in the vehicle in hidden places and be found first in connection with the discontinuation of the vehicle.

3.413.01 Personnel shall be able to wear regulation equipment at a weapon's operator station.  
*Comment:* See the corresponding requirement in *H VAS 2012 E, requirements 1.31.007*. The protective equipment necessary for safe handling of the weapon shall also be adapted/selected so that the risk of injury caused by deliberate or undeliberate actions with the vehicle, does not increase.

3.413.02 Main and secondary armament shall have a fixed lashing position, alternatively be locked in both traverse and elevation.  
*Comment:* When driving, a protruding barrel can collide with, for example, trees, poles, buildings or oncoming traffic.

3.413.03 Vehicles with turrets shall be equipped with a turret position indicator.

- 3.413.04 Personnel in open-hatch mode shall be protected from the operating area of the turret or the barrel.  
*Comment:* Considerations must also be taken regarding unexpected movement of the barrel caused by collisions with, for example trees, poles, buildings or oncoming traffic. This can entail that the weapon's operating area, in some cases needs to be limited so that the barrel is mainly kept inside the vehicle's outer contour.
- 3.413.05 Aiming systems shall be designed so that an externally applied force, for example from a collision between the barrel and objects in the environment, does not harm the operator or other personnel who are located in an open hatch in the battle compartment as well as in other hatches.  
*Comment:* The system must be self-locking.
- 3.413.06 Weapon systems shall be designed with aiming and firing restrictions to avoid firing in undesirable directions.  
*Comment:* It shall be possible to limit the direction of the fire in order to avoid damage to the own vehicle or injury to personnel in hatches due to friendly fire.
- 3.413.07 During weapons integration, the risk area shall be determined for all combinations of weapons, ammunition and firing process, using analysis and testing as a base.
- 3.413.08 During weapons integration, firing conditions related to safety shall be analysed and the design/integration shall be adapted and implemented in accordance with the analysis.  
*Comment:* This may entail that some doors and hatches shall be closed, support legs extended etc.
- 3.413.09 The weapons integration in and on the vehicle shall be designed to minimise the risk of exposing personnel to hot weapon parts.

- 3.413.10 The vehicle's prescribed compartments for ammunition shall provide the resistance to environmental conditions that the ammunition requires with regard to mechanical, electrical, chemical, climatic and biological environmental stresses.  
*Comment:* See *H VAS E 2012 Section 4.5 Packaging for ammunition* for more information.
- 3.413.11 The concentration of air pollutants shall be less than the specified limits according to AFS 2011:18 Occupational Exposure Limits. Verification shall be done during the most unfavourable firing conditions and in field conditions.  
*Comment:* See the corresponding requirements 1.31022 and 1.31023 in *H VAS E 2012*.
- 3.413.12 Manually operated weapon installations up to and including 12.7 mm shall be equipped with a device that collects empty shell casings, ammunition belts and belt links.
- 3.413.13 Manually operated weapon installations up to and including 12.7 mm shall be equipped with containers on the inside or on the outside of the vehicle for collecting empty shell casings, ammunition belts and belt links in.

## 4.14 LIFTING EQUIPMENT

Lifting equipment (excavators, mobile cranes, loading planes, winches, tail lifts etc.) is used to lift parts of or a complete vehicle system. Stress calculations and lift tests are always done to use as basis for an approval. All lifting equipment must be CE marked. For lifting equipment on vehicles designed for specific military purposes, a military vehicle inspector at FMV determines any deviations from the CE marking.

When winding in a winch cable, it is important that the speed is controlled to prevent personnel or equipment from getting caught in the winch cable.

- |          |   |
|----------|---|
| 3.414.01 | The danger area of the lifting equipment shall be determined and be taken into account when establishing the safety instructions.<br><i>Comment:</i> The danger area is typically larger than the area directly below the suspended load. |
| 3.414.02 | It shall be possible to observe the entire danger area from the lifting equipment's operator station.<br><i>Comment:</i> The driver can be guided by aides using for example signals or the internal communication equipment.             |
| 3.414.03 | It shall be possible to operate the lifting equipment from outside the danger area.   |
| 3.414.04 | The winch cable shall be controlled when being wound in.<br><i>Comment:</i> This is done in order to avoid crush injuries.  |
| 3.414.05 | The vehicle shall be equipped with a load sensor that automatically switches off the crane when overloaded.   |

### 4.15 CONNECTING EQUIPMENT

Military vehicles can be equipped with special coupling equipment beyond what is regulated by laws, ordinances and regulations. A list of tow hitches and towing eye bolts of military design to be used for new acquisitions or that are to be fitted to vehicles acquired by FMV, is documented in the Handbook Connecting Equipment. Additional technical information on military connecting equipment can be found in Parts Catalogue for Military Vehicle Equipment, see *References*. Which connecting devices of military design that functionally and dimensionally can be connect can be found in Handbook Connecting Equipment, see *References*.

The design and fitting of connecting equipment for vehicles and trailers are mainly based on Swedish and international standards as well as regulated by civil legislation. Generally, all vehicles supplied to the Swedish Armed Forces are equipped in accordance with the requirements in the Transport Authority Statue Book (TSFS). The Swedish Armed Forces and FMV, however, can, with the support of rules of exemption, such as TSFS 2010:2, Appendix 5, make deviations from these requirements. The extent of, and how these deviations must be handled, is determined by a military vehicle inspector at FMV.

Decisions on the current implementation of connecting equipment must be taken by a military vehicle inspector at FMV in connection to the registration inspection. Military vehicles must be fitted with adapted towing equipment to ensure the function and safety of military use.

Connecting equipment should have equal or higher performance characteristics than the estimated vehicle combination. Considerations must also be taken to the type of trailer, the vehicle's intended use, the towing vehicle in question, the trailer's brake system, design and size.

Towing forks on trailers should be designed so that towing eyelets of both military and civilian design can be used. Alternatively, a construction with a reversible towing fork can be used where the alternative types of towing eyelets are welded to the towing fork.

- 3.415.01 For vehicles and trailers used outside public roads, the coupling devices shall have the required turn angles.  
*Comment:* This refers mainly to trucks used in the international intervention forces. In addition to the above, connecting equipment of civilian design (towing fork couplings) shall be used restrictively as they limit the vehicle's ability to handle military trailers, both nationally and internationally.
- 3.415.02 Selected connecting equipment shall have equal, or higher performance characteristics than the estimated vehicle combination.
- 3.415.03 When selecting the coupling device for the vehicle and trailer, considerations shall be taken to the type of trailers, the vehicle's intended use, the towing vehicle in question, the trailer's brake system, design and size.
- 3.415.04 Towing forks on trailers must be designed so that towing eyelets of both military and civilian design can be used. Alternatively, a construction with a reversible towing fork shall be used where the alternative types of towing eyelets are welded to the towing fork.

## 4.16 CHEMICAL SUBSTANCES AND PROPERTIES OF MATERIALS

### 4.16.1 The Defence Sector's Criteria Document

---

---

Chemical products and chemical substances in goods (materiel) are regulated by both Swedish legislation and regulations, directives and other legislative provisions (for example EU regulations REACH and CLP) decided by the EU. In addition to the applicable section of the law, *The Defence Sector's Criteria Document – Chemical Substances, Chemical Products and Goods* must be enforced. The requirements in the criteria document restrict the chemical substances that may be included in the goods/materiel used in the defence sector and in the chemical products used for operation and maintenance. See [www.fmv.se](http://www.fmv.se).

### 4.16.2 Product Catalogue of Fuels used by the Swedish Armed Forces

---

---

Within the framework of the technical design responsibility, FMV have produced a product catalogue of fuels used by the Swedish Armed Forces that provides information on the standardised fuels in the Swedish Armed Forces' fuel range. This includes, for example:

- fuels
- lubricants
- greases
- hydraulic oils
- brake fluids
- coolants.

The product catalogue is to be used for procurement of systems where fuel is prescribed in order to ensure the quality, product range and supplies. There are also environmental benefits to limiting the number of fuel products. It can, for example, result in more efficient transports. See [www.fmv.se](http://www.fmv.se)

### 4.16.3 Material Properties

---

All materials and chemical products delivered to the defence sector's authorities must, as far as possible, be free of substances that are very toxic, carcinogenic, affect the genome, are disruptive to reproduction, sensitizing, dangerous to the environment, affect the climate and the ozone layer. This also applies to materials that can release toxic smoke and what to consider when choosing different materials.

- |          |   |
|----------|---|
| 3.416.01 | All included materials shall be selected and combined so that no detrimental effects on safety will occur during the life time of the system.<br><i>Comment:</i> For example, as a result of fire, adhesion (abrasion), corrosion, mechanical fatigue, mutual influence, insufficient chemical stability aging, or chemical change. For sensitive systems, a life time analysis shall be performed. |
| 3.416.02 | The probability of human exposure to harmful substances and harmful substances being released into the surrounding environment shall be analysed and minimised.   |
| 3.416.03 | Hazards associated with pyrotechnic and explosive batches shall be analysed and assessed against the benefits.<br><i>Comment:</i> Does not apply to safety enhancing components such as airbags, safety belt tensioners etc.  |
| 3.416.04 | When using hardened steel, the surface treatment shall be selected so that hydrogen brittleness or harmful corrosion will not occur.  |

### 4.17 USE, OPERATION

This section covers the requirements for safe use of the vehicle system.

#### 4.17.1 Driving in General

---

---

Look-outs are routinely used when driving vehicles, primarily in international operations. The task of the look-out is mainly to warn of enemy forces and thereby offer the individual vehicle and/or vehicle units the opportunity to reach protective cover. The look-out stands in a roof hatch when the vehicle is driven with the head/face in the direction of travel and must be able to deliver fire with vehicle-mounted weapons.

Personal injury can occur if the look-out is thrown forward, hitting the front rim of the roof hatch and/or hitting personnel sitting in the vehicle in a crash or a sudden stop while crossing very wide ditches or other obstacles in the terrain. The consequence can be worsened since the look-out cannot wear a seat belt. The look-out can also be thrown out of the vehicle in a crash and if the vehicle overturns. Personal injury can also occur if the look-out uses the associated wind protection, gets stuck in it and does not have time to assume a low position inside the vehicle if the vehicle overturns. The normal working position of the look-out should be such that the waist is located below the rim of the hatch. Rules for the look-out can be found in *SäKI Trafik*.

Wires or power lines that are stretched across the road or in the terrain where the vehicle is advancing can constitute a serious hazard to personnel standing in open hatches while the vehicle is driving. This is particularly relevant in the dark or if the look-out does not have time to localise the obstacles due to the speed of the vehicle or when he stands facing the opposite direction of travel (towing look-out). Therefore, wire cutters must be installed to protect the look-out.

All personnel in the vehicle must be able to wear regulation equipment both when entering and exiting the vehicle, as well as while working at their operator stations. Such equipment may comprise uniform, personal weapon, protective clothing, body armour, gloves, helmet, goggles, protective mask, anti-laser goggles, CBRN protective clothing, etc.

All work and risk areas of the vehicle must be identified. This data will form the basis when identifying risk areas.

In case the vehicle is driven when personnel are standing in hatches or when the driver has the hatch open while driving, it must not be possible to spray washer fluid in their faces.

If the vehicle's main engine is idling, it should require at least two independent actions in order for the vehicle to move. Furthermore, controls for other security-critical functions should be equipped with protection against accidental operation.

- 3.417.01 Look-out stations shall be designed so that the waist of the person is located below the rim of the hatch in a normal working position.
- 3.417.02 Wire cutters shall be installed on vehicles where personnel are positioned in open hatches while driving.
- 3.417.03 Impact surfaces in and around the personnel hatches shall be fitted with padding.
- 3.417.04 Supporting handles shall be installed for all personnel travelling in open hatches.
- 3.417.05 Brackets for safety harness shall be installed for all personnel travelling in open hatches.  
*Comment:* This is to prevent personnel from being thrown out.
- 3.417.06 Washer fluid shall not be sprayed in the faces of personnel travelling in open hatches.  
*Comment:* This also applies to other locations inside the vehicle while driving with open hatches.

- 3.417.07 Personnel shall be able to wear regulation equipment both when entering and exiting the vehicle as well as while working at their operator stations.  
*Comment:* Such equipment may comprise uniform, personal weapon, protective clothing, body armour, gloves, helmet, goggles, protective mask, anti-laser goggles, CBRN protective clothing, etc.
- 3.417.08 Upon visual inspection and testing, work and risk areas for all possible situations of the vehicle shall be defined and documented.
- 3.417.09 Controls and/or switches shall be designed/ arranged so that the probability of inadvertent operation and thus uncontrolled movement or other movement of the vehicle, is minimised.  
*Comment:* Other movement can be for example dozer blades, winches etc.  
*Comment:* This requirement is not applicable to the steering wheel, joystick, the brake or accelerator pedal and the gear lever in the driver's position.

### 4.17.2 Washing and Rinsing

---

---

The vehicle must be able to withstand specified water spray. Water spraying means both washing in vehicle wash facility, and when decontaminating from chemical weapons. The vehicle should withstand water pressure of 15-20 bar from all directions.

### 4.17.3 Fording, Floating and Ice Transition

---

---

Injury/damage to property can be caused when fording and floating because the vehicle can take on water and sink. Bottom plugs must always be fitted while driving so that water does not leak into the vehicle. If doors and hatches are not tight because the hinges and door locks are misaligned, the misalignments can cause water leakage. The vehicle should be equipped with splash protection. The position of the battery group or selection of batteries can be a limiting factor. Mechanical protection that covers sensitive material should be installed.

The vehicle must meet specified wading depth and sealing requirements for floating. Specific actions may be required before fording, floating and ice transition. Fording and floating require additional driver's training.

- 3.417.10 Vehicles shall be designed so that the likelihood of personal injury caused by water seepage while fording and spraying the vehicle with water is minimised.
- 3.417.11 Vehicles with amphibious capabilities shall have markings showing the lowest permissible float depth.
- 3.417.12 A check that bottom plugs are properly fitted shall be easy to perform.

#### 4.17.4 Supervision and Monitoring

---

Injury/damage to property may be caused by a collision that results from the driver's and/or vehicle commander's inability to have a sufficiently good view of the vehicle's surroundings. Before the vehicle can be driven off, the driver and/or vehicle commander must have had the opportunity to check that the vehicle's surroundings are clear of personnel and property.

Poor supervision can also lead to the vehicle rolling over if the side incline becomes too great when parking or when driving. Factors affecting rolling over when driving, in addition to construction, include vehicle speed and the driver's driving skills.

- 3.417.13 A graphic representation that shows the driver's and vehicle commander's field of vision 360° around the vehicle shall be developed.
- 3.417.14 Vehicles shall be designed so that the driver along with the crew (gunner and vehicle commander) can observe people around the vehicle as well as when they are entering and exiting the vehicle.
- 3.417.15 Supervision cameras shall be installed on working vehicle. The driver shall be able to survey the work area through a monitor located in the driver's compartment.
- 3.417.16 A rear-view camera shall be installed. The driver shall, when reversing, be able to survey the area behind the vehicle through a monitor located in the driver's compartment.
- 3.417.17 Rear parking sensors that warn the driver if the vehicle is close to an object while reversing shall be installed.
- 3.417.18 The driver must have a clear view backwards.  
*Comment:* Good rear visibility can be achieved with rear-view mirrors, rear-view cameras or equivalent. This applies in all situations, for example where a driver's windshield is used, or when the driver's hatch is closed.

#### 4.17.5 Internal Communication

---

---

The vehicle commander should in two independent ways be able to communicate with the driver, for example through internal communication system and by physical contact. In situations where the vehicle commander cannot communicate with the driver due to a broken internal communication system, personal injury and/or damage to property can be caused. This mainly applies when reversing or in similar situations where the driver does not have a clear view of the surroundings and can therefore run into and over personnel or materiel, alternatively drive off a precipice.

- 3.417.19** The vehicle commander shall in two independent ways be able to communicate with the driver.  
*Comment:* If one of the communication methods is direct voice communication, it is sufficient that the reserve option consists of, for example, body language (nods, winks, etc.) which clearly can catch the driver's attention and in the same way be confirmed by the driver.

#### 4.17.6 Collision

---

---

In certain situations, especially in international operations, it may be necessary to not have airbags engaged and not use seat belts. Therefore, the vehicle should be equipped with airbags that can be disconnected, see requirement 3.407.20. Flashing/lit seat belt reminders can reveal the vehicle's location to the enemy and should therefore, for tactical reasons, also be able to disconnect.

- 3.417.20** Personnel seats equipped only with three point safety belts shall be equipped with airbags.
- 3.417.21** Personnel seats equipped only with three point safety belts shall be equipped with seat belt tensioners.
- 3.417.22** The vehicle shall be equipped with a seat belt knife for cutting off seat belts.

- 3.417.23 It shall be possible to temporarily disconnect the seat belt reminder from the driver's or vehicle commander's locations.
- 3.417.24 The vehicle shall be equipped with safety hammer for smashing windows.  
*Comment:* Does not apply to vehicles with shrapnel protected glass.

#### 4.17.7 Noise and Vibration

---

---

Sudden changes in air pressure, referred to as sound pressure, can damage the hearing but also other organs of the body. The sound pressure pattern within and outside the crew compartment can be complex and testing is required under field conditions. Measurements in the vicinity of the vehicle must also be carried out in order to estimate the risks of troops located in the immediate vicinity of the vehicle.

Hearing damage can be caused when located in an environment with permanent noise above 80 dB (A). Noise measurements must be conducted to ascertain the risks in and around the vehicle. In cases where the noise measurement indicates noise levels above 80 dB (A) in the vehicle, ear plugs and/or acoustic ear muffs, alternatively a telecommunications helmet, must be stipulated. Provisions for protection against continuous noise can be found in SäKI G.

Injury/damage to property can be caused by vibrations generated from the vehicle and the terrain while driving. Furthermore, the use of anti-slip protection (snow chains) must be taken into account. The human body's own frequencies, such as heartbeat frequency, eye blinking frequency, etc., must be avoided so that discomfort and nausea are not caused. Frequencies between 3-5 Hz affect the sense of balance.

- 3.417.25 The sound pressure level inside and outside the vehicle shall be measured and documented.  
*Comment:* The use of regulation personal protective equipment shall be assumed. Also consider the sound pressure of weapons and weapon systems integrated in the platform, see H VAS E.  
Test method and criteria for noise shall be implemented according to rules established by HQ.
- 3.417.26 The number of impulse sounds that affected personnel are exposed to at a given time shall be identified and documented.  
*Comment:* The use of regulation personal protective equipment shall be assumed. Also consider ambient effects both in and outside the vehicle and impulse sound from weapons and weapon systems integrated in the platform, see H VAS E.  
Test method and criteria for noise shall be implemented according to rules established by HQ.
- 3.417.27 The amount of vibration in all seats in the vehicle shall be identified and documented.  
*Comment:* Test method and criteria for vibration impulses shall be implemented according to rules established by HQ.
- 3.417.28 The location and any protection of the personnel relative the sound source shall be documented.

#### 4.17.8 Salvaging and Towing

---

---

The basics and safety regulations for towing and salvaging are available in the manual Technical Service Regulations Salvage of Vehicles, TTR Salvage of Vehicles, see *References*.

Required attachments shall be installed both at the front and rear of the vehicle. When towing, only a triangle tow bar or tow rod should under normal circumstances be permitted and tow rope/belt is used as backup.

Injury/damage to property can be caused when towing if the towing connection breaks or the triangle tow bar is detached from one side of the towed vehicle and the towed vehicle turns into oncoming traffic.

If the angle is too great between the vehicles when the towing starts, the towed vehicle may turn over. A maximum angle in the horizontal plane when connecting the vehicles should be stated in the specification (approximately 30°).

When designing equipment for towing or salvaging of vehicles with articulated steering, for example, tracked vehicles, this aspect must be taken into account.

Injury and damage to property may be caused if a working vehicle such as a mobile crane, bridge builder or wheel loader performs work for which it does not have the required stability. It must be ensured that the vehicle has the required stability for the tasks it is intended for.

3.417.29 Attachments for triangle tow bar and/or tow rod shall be installed at the front and rear of the vehicle.

3.417.30 Towing equipment shall be equipped with a secondary locking.

- 3.417.31 Attachments for salvaging the vehicle shall be installed both at the front and rear of the vehicle.
- 3.417.32 The vehicle shall have the required stability for its work tasks.  
*Comment:* Refers to crane trucks, bridge builders, wheel loaders etc.



# 5

## SUMMARY OF REQUIREMENTS/ CHECKLIST

The lists on the following pages are intended to be used by projects as a checklist when specifying requirements and to handle regulatory compliance. Whether a requirement is met or not, or if it is not applicable, can be specified in the Regulatory Compliance column in the MS Word file. (Yes/No/Not applicable).

Note that all examples of requirements in this chapter, regardless of marking, are written using the word “shall” so that they can be easily included in the requirement specification. If needed, they can be rephrased to non-compulsory requirements.

### CHAPTER 3 ACTIVITIES AND DOCUMENTATION

#### Section 3.3 Classification of Vehicles

---

---

Req. No.	Content
3.303.01	Classification of vehicles shall be conducted by military vehicle inspectors at FMV. <i>Comment:</i> Classification is normally done in consultation with the supplier/industry.

#### Section 3.4 CE Marked Vehicles and Products

---

---

##### Section 3.4.3 Modification of CE Marked Vehicle or Product

---

Req. No.	Content
3.304.01	Decisions shall be provided if the product is classified as designed for specific military purposes. <i>Comment:</i> Products must not be modified in order to evade compliance with civil law, such as CE marking.

## Section 3.6 FMV Delivery to the Swedish Armed Forces

---

---

### Section 3.6.1 Application of Vehicle Legislation to Military Vehicles

---

Req. No.	Content
<b>3.306.01</b>	Decisions on the use of FMV/SwAF exception shall be made by a military vehicle inspector at FMV. <i>Comment:</i> The application for an exception is sent to the Transport Board by a military vehicle inspector at FMV.

### Section 3.6.2 Single Vehicle Approval

---

Req. No.	Content
3.306.02	<p>For vehicle deliveries to SwAF/FMV, documentation for registration in MIFOR shall be provided in accordance with one of options a-e. Vehicles manufactured specifically for military purposes shall always undergo a single vehicle approval by a military vehicle inspector at FMV in accordance with option e. Thus, each individual vehicle is delivered either:</p> <ol style="list-style-type: none"><li>with a CoC (Certificat of Conformity) (refers to vehicles approved in whole) in accordance with EU Directive 2007/46. (For motorcycles, EU Directive 2002/24 applies. As of 2016-01-01, EU regulation No 168/2013 applies.),</li><li>with an individual approval certificate in accordance with Directive 2007/46 / EC or TSFS 2010:2,</li><li>registered in the vehicle registry (Vtr) using the original registration certificate as documentation and with SwAF/FMV as the registered owner,</li><li>with documentation from a single vehicle approval performed by an approved test body in accordance with SFS 2002: 574, Section 4,</li><li>with a single vehicle approval performed by FMV in accordance with the applicable agreement between FMV and the vehicle supplier. The vehicle supplier shall order a single vehicle approval by FMV prior to the delivery of the vehicle. The project manager at FMV is responsible for seeing to it that a single vehicle approval is carried out.</li></ol> <p><i>Comment:</i> When rebuilding or modifying a vehicle, or when issuing a TO that triggers the demand for a new single vehicle approval, any one of options b, d or e must be applied.</p>

Req. No.	Content
3.306.03	<p>Vehicles to be registered in the military vehicle register (MIFOR) and that belong to or are intended to be operated by SwAF, FRA, or FMV, shall undergo military single vehicle approval.</p> <p><i>Comment:</i> When rebuilding or modifying a vehicle, or when issuing a TO that triggers the demand for a new single vehicle approval, any one of options b, d or e in requirement 3.306.02 must be applied.</p>

## CHAPTER 4 FUNCTION-ORIENTED SYSTEM SAFETY REQUIREMENTS

### Section 4.1 Engine Systems

#### Section 4.1.1 Engine Housing, Lubrication System, Engine

Req. No.	Content
3.401.01	<p>Rotating parts and hot surfaces shall be located or separated so that the likelihood of injury is minimised during maintenance.</p> <p><i>Comment:</i> This requirement can be met by providing barriers or by ensuring that personnel cannot or is not required to get close to the source of risk.</p>
3.401.02	<p>Enclosed engine compartments must have adequate ventilation.</p>

## Section 4.1.2 Fuel Systems and Fuel Tanks

---

Req. No.	Content
3.401.03	<p>Substances adjacent to and included in the propellant shall be compatible.</p> <p><i>Comment:</i> This can apply to inner protective paint, sealants, gaskets, insulation materials, corrosion protection, hoses etc.</p>
3.401.04	<p>Portable fuel tanks shall be fitted with eye bolts.</p>
3.401.05	<p>The probability that the fuel tank explodes and the fuel ignites shall be analysed and minimised.</p> <p><i>Comment:</i> Verification can be done through a fire test or, alternatively, by a certificate from the manufacturer.</p>
3.401.06	<p>The probability that the fuel tank explodes due to bullet attack shall be analysed and minimised.</p> <p><i>Comment:</i> Firing tests of the fuel tank should be carried out.</p>
3.401.07	<p>The fuel tank shall be protected against sparks caused by static electricity.</p> <p><i>Comment:</i> For example, by earthing/equipotential bonding.</p>
3.401.08	<p>The fuel tank shall be positioned so that reasonable protection is obtained at a collision from the rear, from the side or from below.</p>
3.401.09	<p>The fuel tank shall be protected to prevent damage during off-road driving.</p>
3.401.10	<p>Draining equipment for the fuel tank shall be designed so that the probability of static electricity being generated is minimised.</p> <p><i>Comment:</i> The risk exists when the height of a free-falling stream of petrol exceeds 40 cm.</p>

Req. No.	Content
3.401.11	Fuel tank with a depth of 40 cm or more shall be equipped with a filter that cannot be removed.
3.401.12	The filling equipment for propellants/fuels shall be positioned so that the filling can be carried out with the doors and hatches to personnel compartments closed.

### *Section 4.1.3 Inlet and Exhaust Systems*

---

Req. No.	Content
3.401.13	<p>The placement and design of the exhaust system shall be such that personnel in the vehicle's personnel compartments are not exposed to exhaust fumes.</p> <p><i>Comment:</i> This requirement shall be verified during unfavorable circumstances and under field conditions.</p>
3.401.14	Hot surfaces of the exhaust system shall be fitted with protective barriers or be shielded.

### *Section 4.1.4 Cooling System*

---

Req. No.	Content
3.401.15	<p>The overpressure in the expansion tank shall be possible to equalise to the environment before opening the cap completely.</p> <p><i>Comment:</i> This can be solved with a two-step valve/cap opening.</p>

### Section 4.1.5 Engine Controls

---

Req. No.	Content
3.401.16	The design and spacing of the individual pedals shall be adapted to the specified type of footwear. <i>Comment:</i> Applies to gas, brake and clutch pedal.
3.401.17	The surface of the brake pedal shall be slip-resistant.

### Section 4.2 Transmission System

---

Req. No.	Content
3.402.01	An indication of an activated differential lock shall be installed at the driver's seat.
3.402.02	The vehicle shall be equipped with traction control that can be switched off. <i>Comment:</i> When driving in rough terrain at low speeds, improved accessibility can be achieved without activating the traction control and/or anti-skid control system.
3.402.03	The vehicle shall be equipped with an anti-skid control system that can be switched off. <i>Comment:</i> When driving in rough terrain at low speeds improved accessibility can be achieved without activating the traction control and/or anti-skid control system.

## Section 4.3 Brake System

---

### Section 4.3.2 Pneumatic Brake System (Service Brake)

---

Req. No.	Content
3.403.01	The drain valve for the compressed air system shall be positioned so that personnel are not exposed to harmful noise or “targeted” jets of air.
3.403.02	Vehicles shall be fitted with external outlet for the filling of the brake system.
3.403.03	Vehicles shall be equipped with one test outlet per axle.

### Section 4.3.3 Auxiliary Brakes and Electronic Brake Systems

---

Req. No.	Content
3.403.04	Vehicles shall be equipped with an auxiliary brake. <i>Comment:</i> Refers to heavy vehicles. However, the requirement is not applicable to vehicles designed to be driven outside the regular road network.
3.403.05	Electronically controlled brake systems shall have a mechanical emergency brake function as a supplement. <i>Comment:</i> Faults in the brake system's software may affect safety.

### Section 4.3.4 Parking Brake System

---

Req. No.	Content
3.403.06	Requirements on maximum gradient for parking of the vehicle shall be specified.

## Section 4.4 Steering System

---

---

Req. No.	Content
3.404.01	Tracked vehicles shall have a reserve steering system.
3.404.02	The turning resistance of the steering wheel or steering lever when using the backup steering system should not be significantly greater than the regular steering function. <i>Comment:</i> For wheeled vehicles, there are legal requirements that the torque resistance for the backup steering system should be less than 600 N while driving at a speed of 10 km/h on dry asphalt.

## Section 4.5 Wheel System and Track Assembly

---

---

Req. No.	Content
3.405.01	The vehicle body shall have a sufficient number of mounting/lifting points for lifting jack.
3.405.02	Lifting surfaces/lifting jack points shall be documented in the technical documentation.
3.405.03	Lifting equipment shall be provided for handling of the spare wheel to and from the spare wheel bracket. <i>Comment:</i> Refers to heavier wheels that cannot be handled by one person.
3.405.04	Support legs or similar shall, for the safety of maintenance work, be included in the vehicle system with pressurised suspension.
3.405.05	Vehicles shall have puncture proof tyres.
3.405.06	Two-wheeled motorcycles shall be designed so that it is possible to mount studded tyres.

Req. No.	Content
3.405.07	Two-wheeled motorcycles shall be designed so that it is possible to mount skis.
3.405.08	Vehicles shall be equipped with tyres that match the vehicle's operating environment.

## Section 4.6 Hydraulic and Pneumatic Systems and Springs

### Section 4.6.1 Hydraulic and Pneumatic Systems

Req. No.	Content
3.406.01	Components and systems with an accumulated pressure in excess of 0.5 bar shall be marked with warning labels.
3.406.02	It shall be possible to drain the pressure from a pressurised system. <i>Comment:</i> Instructions describing how safe release of built-in pressure is carried out shall be provided to ensure safe work at for example maintenance and care. It shall also be possible to subsequently check whether or not pressure has been drained from the system.
3.406.03	Hydraulic hoses or hydraulic components shall be located in confined spaces outside personnel compartments or behind protective barriers.
3.406.04	Leaking hydraulic oil shall be prevented from penetrating into personnel compartments.
3.406.05	It shall be possible to determine whether a hydraulic or pneumatic design contains stored energy/accumulated pressure.
3.406.06	Service modes where stored energy is required/exists shall be possible to secure mechanically.

## Section 4.6.2 Springs

---

Req. No.	Content
3.406.07	<p>A spring shall be equipped with a locking device or anti-tampering protection to prevent accidental release of the spring forces.</p> <p><i>Comment:</i> Refers to springs whose force may cause injury.</p>
3.406.08	<p>A spring and its fastening elements shall be dimensioned for its intended purpose.</p> <p><i>Comment:</i> Refers to springs used in a locking function that may cause injury if malfunctioning. The dimensioning shall include both the fastening devices and fatigue resistance.</p>
3.406.09	<p>A spring that may cause serious injury in the event of malfunction shall have a duplicate or have a fail-safe function.</p>
3.406.10	<p>Springs shall be located in a protected position in such a way that accidental contact is not possible.</p> <p><i>Comment:</i> Refers to springs that constitute a safety-related locking function.</p>

## Section 4.7 Electrical System and Electrical Equipment

---

### Section 4.7.1 Electrical Environment and Communication Equipment

---

Req. No.	Content
3.407.01	<p>The vehicle's electric and magnetic fields shall be identified and the risk of human exposure to radiation shall be considered.</p> <p><i>Comment:</i> Refers to the entire vehicle system including integrated systems.</p>
3.407.02	<p>Safety-critical electronics shall have an adequate resistance against electromagnetic and electrostatic energy and the influence of laser light.</p> <p><i>Comment:</i> Refers to both the interference generated by other electrical installations on the vehicle as well as from external noise sources, for example, radar, radio etc. up to specified values. The exposure to external sources of interference can be significantly stronger in a military vehicle environment than in an equivalent civilian vehicle environment.</p>
3.407.03	<p>The vehicle's electrical system shall not interfere with the radio system used in the vehicle.</p> <p><i>Comment:</i> Correspondingly, the radio system used in the vehicle shall not interfere with the vehicle's electrical system.</p>
3.407.04	<p>Aerials shall be placed/designed to meet RADHAZ requirements for personnel and minimise the likelihood of interference with other electrical equipment in the vehicle.</p> <p><i>Comment:</i> See SäkI G for requirements related to high frequency electromagnetic radiation.</p>

Req. No.	Content
3.407.05	<p>Harmful noise shall not occur in telecommunication helmets and headsets.</p> <p><i>Comment:</i> Harmful noise may occur if the cable to the device is short-circuited or be generated by the vehicle's electrical system.</p>
3.407.06	<p>Vehicle aerial that exceeds the height of 4.30 m from the ground shall be foldable without having to remove the aerial rod.</p>

### Section 4.7.2 Batteries

Req. No.	Content
3.407.07	<p>Enclosed battery compartments shall be ventilated (vented) if the battery type emits hydrogen gas when being charged.</p> <p><i>Comment:</i> Certain types of batteries emit hydrogen gas, which may lead to increased risk of explosion if the gas accumulates. The bleed valve on the outside of the vehicle should not be located at face level.</p>
3.407.08	<p>Batteries shall be selected according to water resilience and positioned so that the vehicle's requirements on fording capabilities are met.</p> <p><i>Comment:</i> This can be achieved through the battery's own properties or by using a protective enclosure or equivalent.</p>
3.407.09	<p>The battery shall be placed/enclosed so that the consequences in the event of leakage are minimised.</p> <p><i>Comment:</i> This also applies at the maximum permissible gradient of the vehicle.</p>

Req. No.	Content
3.407.10	<p>A sign shall be placed in the immediate vicinity of the battery, and the sign shall display the circuit diagram and the order in which cables shall be disconnected/connected.</p> <p><i>Comment:</i> Refers to vehicles with more than one battery in the same battery group.</p>
3.407.11	<p>The vehicle shall be equipped with a mechanically operated main switch/battery switch.</p> <p><i>Comment:</i> The power should be cut off as close to the source of energy as possible. Some specific functions such as communications equipment and auxiliary heaters (regarding cool down period) shall, however, be functioning when the main switch is switched off. Take also into account that special requirements to avoid static electricity can apply to ammunition and hangar forklifts.</p>
3.407.12	<p>Batteries shall be fitted with lifting equipment.</p> <p><i>Comment:</i> Dedicated lifting equipment can be attached to the batteries.</p>

#### **Section 4.7.3 Generator, Charging System, Starter Motor, Ignition System**

Req. No.	Content
3.407.13	<p>Vehicles shall be equipped with a separate battery circuit for communications equipment and other external power consumers.</p> <p><i>Comment:</i> Relates primarily to vehicles whose external power consumers require power of such quantity that the vehicle's battery would quickly be exhausted if the equipment is used when the engine is switched off.</p>
3.407.14	<p>Service batteries shall be equipped with a low voltage alarm.</p>

#### Section 4.7.4 Power Outlets

---

Req. No.	Content
3.407.15	Detached power outlets shall be fitted with anti-handling devices and splash protection for live parts. <i>Comment:</i> IP class is chosen based on required environment according to electrical standards.
3.407.16	All electrical outlets and connections shall be equipped with a sign that displays the system voltage.
3.407.17	Horizontally placed power outlets shall be equipped with protective covers to reduce the likelihood of a short circuit.

#### Section 4.7.5 Displays, Instruments, Indicators and Interior Lighting

---

Req. No.	Content
3.407.18	Monitors/displays shall be adapted so that they are legible in the existing interior lighting, even outdoors in direct sunlight or in darkness if the usage so requires. <i>Comment:</i> Relates to information on monitors/displays that may be considered as safety critical.
3.407.19	Turning on the normal interior lights and instrument lights shall only be possible through a deliberate act. <i>Comment:</i> When night vision goggles (NVG) are used there is a risk of loss of eyesight if the interior lights or instrument lights are switched on and may even cause a traffic hazard as the driver's eyesight becomes impaired.
3.407.20	In positions where night vision goggles (NVG) are intended to be used, the personnel shall be able to temporarily disengage as well as engage the airbag after driving in low light conditions.

Req. No.	Content
3.407.21	<p>Systems for performance monitoring and fault detection in subsystems with safety critical functions shall be provided.</p> <p><i>Comment:</i> Scope and fault detection capabilities shall be specified.</p>
3.407.22	<p>If blackout lights are installed, an alarm device for vital functions shall exist and cannot constitute of the ordinary light signals.</p>
3.407.23	<p>The alarm device for emergency vehicles shall only be possible to operate from the driver's seat.</p>
3.407.24	<p>The driver shall be able to receive an indication/warning when hatches and doors, support legs, cranes, ramps etc. are open, extended, or in such a position that they may affect the driving of the vehicle.</p> <p><i>Comment:</i> Note that this only applies to indication/warning. The ability to quickly move the vehicle must be taken into account.</p>

#### Section 4.7.6 Wiring, Fuses and Emergency Stop

Req. No.	Content
3.407.25	<p>At least one mechanical switch (safety switch) shall be installed between the power source and safety-critical consumers.</p>
3.407.26	<p>Breaking the electrical circuit shall disconnect the power source.</p> <p><i>Comment:</i> The breaking of the circuit should be done as close to the power source as possible.</p>
3.407.27	<p>Locks for emergency stops shall lock directly in the emergency stop and not via links or similar devices.</p>

Req. No.	Content
3.407.28	An activated emergency stop, that is, a stopped system, shall keep the system in an inactive mode until a deliberate resetting of the emergency stop has been done.
3.407.29	Resetting the emergency stop function, that is, enabling start of the system after an emergency stop has been activated, shall only be possible using a special manual operation.
3.407.30	<p>Emergency stops shall be located both within and outside the working area.</p> <p><i>Comment:</i> This must be weighed against the vehicle's tactical properties during operation so that the possibility for unauthorised personnel to disrupt the ongoing operation by activating the emergency stop is obstructed.</p>
3.407.31	<p>The emergency stops shall be marked.</p> <p><i>Comment:</i> The marking shall indicate which system that is stopped.</p>
3.407.32	The concentration of toxic gases that may be produced in the personnel compartments during a cable fire, shall be analysed and the consequences of a fire shall be minimised by the choice of cabling.
3.407.33	<p>Cable's outer sheaths shall be self-extinguishing.</p> <p><i>Comment:</i> Self-extinguishing means that the material stops burning if the external fire source is removed.</p>

## Section 4.9 Lighting Equipment

Req. No.	Content
3.409.01	Trailers with lighting requirements shall be equipped in such a way that the lighting functions can be powered from the towing vehicle.
3.409.02	Device sockets and plugs intended primarily for booster start shall not be used for power supply from the carrier vehicle. <i>Comment:</i> This is because of the likelihood of confusion.
3.409.03	Connectors designed for high voltage power systems shall not be used in automotive electrical lighting systems.
3.409.04	Reflective materiel developed for resistance to shock damage shall be used in combination with civilian reflector material.
3.409.05	Trucks, especially forward-built vehicles with cabs that can be tilted, to be equipped with quick release, roller hook lift or other fixed mounting or loose cargo carriers that require manoeuvring from the driver's cab, shall be equipped with connection possibilities for controls in the cab. <i>Comment:</i> Not applicable to radio-controlled equipment.
3.409.06	All electrical connections in the form of trailer connectors, electrical outlets, etc. shall be clearly marked with the existing system voltage of the vehicle. <i>Comment:</i> In case the vehicle has an electrical system that includes different subsystems, it is vital that all affected outlets are labelled with the current voltage for the outlet.

## Section 4.10 Chassis, Cab, Interior and Chassis Body

---

### Section 4.10.3 Engine Hood, Fenders, Footsteps, Roof Rack and Masking

---

Req. No.	Content
3.410.01	<p>Footsteps, handles and walkways on the vehicle shall be designed so that the likelihood of slipping, falling, hitting or getting stuck on protruding parts is minimised.</p> <p><i>Comment:</i> Walkways, footsteps and handrails leading to, as well as at, locations on the vehicle where masking equipment is attached to the vehicle shall exist. At least two-thirds of the specified footwear should fit on footsteps. Handles must be designed so that the specified gloves can be used. This also applies to surfaces that are exposed when equipment is removed.</p>
3.410.02	<p>Footholds must be fitted with appropriate anti-slip protection.</p> <p><i>Comment:</i> Anti-slip protection shall also exist on level surfaces underneath equipment that can be removed.</p>
3.410.03	<p>It shall be possible to use handles while wearing gloves.</p> <p><i>Comment:</i> The handle shall be designed so that the specified gloves can be used.</p>
3.410.04	<p>Sensitive areas that cannot withstand being walked on shall be marked.</p>
3.410.05	<p>Load carriers shall be marked with the maximum load.</p> <p><i>Comment:</i> This mainly applies to load carriers on the vehicle's roof.</p>
3.410.06	<p>Masking equipment to be used while driving (masked moving vehicle) shall have the necessary mounting fixtures for the vehicle type.</p>

Section 4.10.4 Doors, Hatches, Portholes, Windows and Prisms

Req. No.	Content
3.410.07	The locking mechanism on hatches and doors, both in closed and open position, shall be dimensioned to withstand the stresses arising during operational use.
3.410.08	Heavy hatches and doors shall be equipped with locking devices in both an open (fully open or ajar position) as well as in a closed position.
3.410.09	Hatches shall be secured automatically in the open position with a self-locking latch.
3.410.10	The locking mechanism on personnel hatches and doors should be accessible and manoeuvrable from both inside and outside.
3.410.11	Locks on hatches and doors should be manoeuvrable by crew wearing regulation personal protective equipment. <i>Comment:</i> The equipment may vary between different climate zones.
3.410.12	Heavy personnel hatches shall be fitted with soft closing brakes or counterbalancing function.
3.410.13	When closing personnel hatches on top of the vehicle, it shall be possible to use a sequential, two-handed grip.
3.410.14	Emergency evacuation of the vehicle shall always be possible. <i>Comment:</i> Technical features shall not come into conflict during an emergency evacuation.
3.410.15	Prerequisites for rapid evacuation of the vehicle shall be considered when designing doors/hatches. <i>Comment:</i> This includes the choice of the number of doors, positioning, size, weight, opening function etc.

Req. No.	Content
3.410.16	<p>In an emergency evacuation situation, it shall be possible to evacuate the vehicle in at least two different directions.</p> <p><i>Comment:</i> Verification of the emergency evacuation shall be done when the vehicle is tilted at different angles.</p>
3.410.17	<p>In case of an emergency, all doors/hatches leading to/from personnel compartments shall be possible to be opened from the inside.</p>
3.410.18	<p>In case of an emergency, at least two doors/hatches in different directions to the personnel compartments shall be possible to be opened from the outside.</p> <p><i>Comment:</i> Special tools are allowed when opening doors from the outside in case of an emergency.</p>
3.410.19	<p>The bottom hatch for emergency evacuation shall be possible to open both from the inside and the outside.</p> <p><i>Comment:</i> Requirements for mine protection shall be considered when selecting the design solution.</p>
3.410.20	<p>Windows and prisms shall not cause injury to personnel in the vehicle at external impact.</p> <p><i>Comment:</i> When reinforcing glass and prisms, the entire surface shall be strengthened to prevent shrapnel.</p>

### Section 4.10.5 The Driver and Crew Compartments and Interior Equipment

---

Req. No.	Content
3.410.21	Seating and work areas shall be designed according to ergonomic principles, taking into account the anthropometric data (variation of human body measurements including both men and women).
3.410.22	Type approved three-point or four-point seat belts in all seats shall be striven for. <i>Comment:</i> Lap seat belts may be permissible in special cases. Five-point seat belts generally require an exemption.
3.410.23	Seat belts shall be adapted to use together with regulation personal equipment. <i>Comment:</i> The requirement specification must specify the size of the soldier as well as the personal equipment the seat belts must be adapted for. Extra-long seat belts are normally required in order for the soldier to wear regulation personal equipment.
3.410.24	It shall be able to use seats both with and without regulation personal equipment.
3.410.25	Neck protection shall be installed in all seats in the vehicle, and neck protection shall be designed so that the helmet can be worn. <i>Comment:</i> This requirement does not apply to motorised equipment (ATV's, snowmobiles, motorcycles, etc.).
3.410.26	It shall be possible to adjust seats manually (raise, lower, rotate or fold). <i>Comment:</i> If the seat is electrically operated, a quick and simple manual backup operation shall be possible.
3.410.27	Operation of an adjustable seat shall be possible without the risk of crushing injuries.

Req. No.	Content
3.410.28	<p>Seats shall be designed so that the probability of getting stuck between the seat and the body of the vehicle if it lands on its side or upside down is minimised.</p> <p><i>Comment:</i> This can be achieved by introducing a device that from the seating position can be reached to adjust the position of the seat, even if the vehicle has overturned.</p>
3.410.29	<p>It should be possible to fold the seat's backrest in all combinations of the seat's height and length positions and it shall be possible to lock the backrest in the folded position.</p> <p><i>Comment:</i> An alternative design solution can be that the seat's backrests can be turned and locked instead of folded. Backrests shall not come into conflict with other safety-critical controls or functions, see 3.410.14.</p>
3.410.30	<p>Easily accessible parts inside the vehicle shall be equipped with protection against unintentional contact if the surface temperature of the parts can reach such levels that when touched can cause burns.</p> <p><i>Comment:</i> Methods for determining surface temperatures for different materials from a burn perspective are described in SS-EN ISO 13732-1.</p>
3.410.31	<p>Personnel shall, by means of protective devices/ anti-tampering devices, be prevented from inserting body parts in areas with moving parts.</p>
3.410.32	<p>Potentially dangerous parts/components (start batteries, oil, cables, etc.) that can cause injuries in case of fire, collision, explosion in or near the vehicle shall as far as possible be separated from the crew and personnel compartments.</p>

Req. No.	Content
3.410.33	<p>Fixed installed accessories or equipment shall be positioned and fastened with regard to personal injuries in the case of a crash, explosion in or near the vehicle or emergency evacuation.</p> <p><i>Comment:</i> This refers for example to weapon holders and communication equipment. Levels of resistance shall be specified. In a crash and explosion in or near the vehicle, the likelihood of impact or that equipment detaches and hits personnel, must be analysed and taken into account. At an emergency evacuation, the placement of equipment shall be such that the equipment does not impede or delay the evacuation.</p>
3.410.34	<p>Protruding parts and sharp corners in personnel compartments shall be fitted with padding.</p> <p><i>Comment:</i> Special attention shall be paid to equipment in the vicinity of seats.</p>
3.410.35	<p>Interior and upholstery shall be selected with regard to fire hazard and the risk of toxic gas being produced in a fire.</p>
3.410.36	<p>Organic materials shall be avoided in the interior and upholstery.</p> <p><i>Comment:</i> The purpose is to prevent mould growth and reduce the need for dry-aeration.</p>
3.410.37	<p>The air quality in crew and personnel compartments shall correspond to requirements relating to temporary workplaces according to AFS 2009: 02 Workplace Design.</p> <p><i>Comment:</i> Note that vehicles are exempt regarding requirements for air quality in civil law.</p>

### Section 4.10.6 Climate Control

---

Req. No.	Content
3.410.38	<p>Vehicles shall be equipped with a climate control system for the regulation of workplace temperature.</p> <p><i>Comment:</i> This requirement applies to vehicles in which the climate control system for both heating and cooling fulfils a function and shall be adapted to the defined operating environment. A warning device can be installed for loss of function of the climate control system if the crew and personnel compartments are separated.</p>

### Section 4.10.7 Equipment for Transporting Injured

---

Req. No.	Content
3.410.39	<p>Vehicles shall be equipped with fasteners for stretchers for occasional transport of injured personnel on stretchers.</p>

## Section 4.11 Fire-fighting Equipment, Vehicle Mounted and Separate Respectively

### Section 4.11.1 Level 1 Basic Fire Protection

Req. No.	Content
3.411.01	The fire extinguishing medium shall be selected so that no danger to the personnel and the environment can be caused during fire-fighting.
3.411.02	<p>Vehicles shall have at least one portable fire extinguisher, P6 (powder extinguisher 6 kg), or equivalent that shall be easily accessible from the outside of the vehicle and shall be easily accessible for a person on the ground next to the vehicle.</p> <p><i>Comment:</i> Appropriate efficiency rating for fire extinguishers are selected according to standard SS EN 3-7:2004 + A1:2007.</p> <p>The requirement does not apply to motorcycles, mopeds and snowmobiles.</p>
3.411.03	<p>Vehicles shall have one portable fire extinguisher, P2 (powder extinguisher 2 kg) or equivalent that shall be easily accessible from the outside of the vehicle and shall be easily accessible to the driver.</p> <p><i>Comment:</i> Appropriate efficiency rating for fire extinguishers are selected according to standard SS-EN 3-7:2004 + A1:2007.</p> <p>This applies only for level 1 where fire extinguishing systems exist in the engine compartment.</p>
3.411.04	If crew compartments are separated, and by decision by FMV, an additional portable fire extinguisher, P2 (powder extinguisher 2 kg) or equivalent, alternatively a 0.7 kg CO <sub>2</sub> equivalent shall be installed in the separated compartment.

Req. No.	Content
3.411.05	<p>A sign indicating the location of the portable fire extinguisher shall exist on/next to the closest door or hatch.</p> <p><i>Comment:</i> The sign informs both own personnel as well as rescue personnel where portable fire extinguishers are located.</p>
3.411.06	<p>Confined spaces that are not personnel compartments shall be equipped with automatic fire detection systems.</p> <p><i>Comment:</i> Drivers and vehicle commanders shall have the possibility to get an indication from the fire detection system both when sitting in their regular seats and when standing in open hatch mode.</p>

#### *Section 4.11.2 Level 2: Enhanced fire protection*

Req. No.	Content
3.411.07	<p>Engine compartments shall be equipped with a permanently installed fire extinguishing system with both automatic and manual activation.</p>

#### *Section 4.11.3 Level 3: Advanced Fire Protection*

Req. No.	Content
3.411.08	<p>Motor and ammunition compartments shall be equipped with a permanently installed fire extinguishing system with both automatic and manual activation.</p>
3.411.09	<p>Fire extinguishing systems in the engine compartments and ammunition compartments shall be possible to activate from two different locations in the vehicle, of which one location shall be the driver's seat.</p> <p><i>Comment:</i> Activation devices shall be possible to seal.</p>

Req. No.	Content
3.411.10	A single failure in the fire extinguishing system's detectors, activation devices, etc. shall not cause loss of function.
3.411.11	Fire extinguishing system in the engine compartment shall be able to extinguish two in time separated fires.
3.411.12	Each vehicle shall have additional portable extinguishers (in addition to the requirements for portable fire extinguishers according to Level 1) located inside the vehicle. The portable fire extinguisher shall be P2 (powder extinguisher 2 kg) or equivalent.

#### *Section 4.11.4 Level 4: Complete Fire Protection*

Req. No.	Content
3.411.13	Motor, crew and ammunition compartments shall be equipped with a permanently installed fire extinguishing system with both automatic and manual activation.
3.411.14	Fire extinguishing systems in the engine compartments and ammunition compartments shall be possible to activate from two different locations in the vehicle, of which one location shall be the driver's seat. <i>Comment:</i> Activation devices shall be possible to seal.
3.411.15	A single failure in the fire extinguishing system's detectors, activation devices, etc. shall not cause loss of function.

Req. No.	Content
3.411.16	Fire extinguishing system in the engine compartment shall be able to extinguish two in time separated fires.
3.411.17	Each vehicle shall have additional portable extinguishers (in addition to the requirements for portable fire extinguishers according to Level 1) located inside the vehicle. The portable fire extinguisher shall be P2 (powder extinguisher 2 kg) or equivalent.

#### Section 4.12 Load and Other Equipment

Req. No.	Content
3.412.01	Vehicles shall be equipped with required mounting attachments for all load and additional equipment not permanently attached. <i>Comment:</i> Enemy fire and other types of attacks shall be considered, for example IEDs or mines.
3.412.02	The method for stowing equipment in racks and bins in various stowage locations shall be developed so that the equipment during and after transport and redeployment does not constitute a hazard to the crew.
3.412.03	Locks and other load securing equipment shall be designed to minimise the risk of accidents during the unloading of equipment after transport. <i>Comment:</i> Methods to loosen locks and other load securing equipment safely shall be developed. The maximum tilt angles of the vehicle during loading/unloading shall be considered.

Req. No.	Content
3.412.04	Weapon holders shall exist for the type of weapons to be used by personnel in the vehicle. Weapon holders shall be positioned considering the accessibility of the weapon as well as with regard to the likelihood of impact, and that the weapon is triggered accidentally.
3.412.05	Screws, pins, etc., that need to be loosened every day shall be locked and fixed. <i>Comment:</i> For vehicles intended to be used on airfields, it is especially important that everything is secure so that no equipment is dropped on the runway, so-called “Foreign Object Damage” (FOD).

#### Section 4.13 Weapon Installations

Req. No.	Content
3.413.01	Personnel shall be able to wear regulation equipment at a weapon’s operator station. <i>Comment:</i> See the corresponding requirement in <i>H VAS E 2012, requirements 1.31.007</i> . The protective equipment necessary for safe handling of the weapon shall also be adapted/selected so that the risk of injury caused by deliberate or undeliberate actions with the vehicle, does not increase.
3.413.02	Main and secondary armament shall have a fixed lashing position, alternatively be locked in both traverse and elevation. <i>Comment:</i> When driving, a protruding barrel can collide with, for example, trees, poles, buildings or oncoming traffic.
3.413.03	Vehicles with turrets shall be equipped with a turret position indicator.

Req. No.	Content
3.413.04	<p>Personnel in open-hatch mode shall be protected from the operating area of the turret or the barrel.</p> <p><i>Comment:</i> Considerations must also be taken regarding unexpected movement of the barrel caused by collisions with, for example trees, poles, buildings or oncoming traffic. This can entail that the weapon's operating area, in some cases needs to be limited so that the barrel is mainly kept inside the vehicle's outer contour.</p>
3.413.05	<p>Aiming systems shall be designed so that an externally applied force, for example from a collision between the barrel and objects in the environment, does not harm the operator or other personnel who are located in an open hatch in the battle compartment as well as in other hatches.</p> <p><i>Comment:</i> The system must be self-locking.</p>
3.413.06	<p>Weapon systems shall be designed with aiming and firing restrictions to avoid firing in undesirable directions.</p> <p><i>Comment:</i> It shall be possible to limit the direction of the fire in order to avoid damage to the own vehicle or injury to personnel in hatches due to friendly fire.</p>
3.413.07	<p>During weapons integration, the risk area shall be determined for all combinations of weapons, ammunition and firing process, using analysis and testing as a base.</p>
3.413.08	<p>During weapons integration, firing conditions related to safety shall be analysed and the design/integration shall be adapted and implemented in accordance with the analysis.</p> <p><i>Comment:</i> This may entail that some doors and hatches shall be closed, support legs extended etc.</p>
3.413.09	<p>The weapons integration in and on the vehicle shall be designed to minimise the risk of exposing personnel to hot weapon parts.</p>

Req. No.	Content
3.413.10	<p>The vehicle's prescribed compartments for ammunition shall provide the resistance to environmental conditions that the ammunition requires with regard to mechanical, electrical, chemical, climatic and biological environmental stresses.</p> <p><i>Comment:</i> See <i>H VAS E 2012 Section 4.5 Packaging for ammunition</i> for more information.</p>
3.413.11	<p>The concentration of air pollutants shall be less than the specified limits according to AFS 2011: 18 Occupational Exposure Limits. Verification shall be done during the most unfavourable firing conditions and in field conditions.</p> <p><i>Comment:</i> See the corresponding requirements 1.31022 and 1.31023 in <i>H VAS E 2012</i>.</p>
3.413.12	<p>Manually operated weapon installations up to and including 12.7 mm shall be equipped with a device that collects empty shell casings, ammunition belts and belt links.</p>
3.413.13	<p>Manually operated weapon installations up to and including 12.7 mm shall be equipped with containers on the inside or on the outside of the vehicle for collecting empty shell casings, ammunition belts and belt links in.</p>

## Section 4.14 Lifting Equipment

---

---

Req. No.	Content
3.414.01	<p>The danger area of the lifting equipment shall be determined and be taken into account when establishing the safety instructions.</p> <p><i>Comment:</i> The danger area is typically larger than the area directly below the suspended load.</p>
3.414.02	<p>It shall be possible to observe the entire danger area from the lifting equipment's operator station.</p> <p><i>Comment:</i> The driver can be guided by aides using for example signals or the internal communication equipment.</p>
3.414.03	<p>It shall be possible to operate the lifting equipment from outside the danger area.</p>
3.414.04	<p>The winch cable shall be controlled when being wound in.</p> <p><i>Comment:</i> This is done in order to avoid crush injuries.</p>
3.414.05	<p>The vehicle shall be equipped with a load sensor that automatically switches off the crane when overloaded.</p>

## Section 4.15 Connecting Equipment

Req. No.	Content
3.415.01	<p>For vehicles and trailers used outside public roads, the coupling devices shall have the required turn angles.</p> <p><i>Comment:</i> This refers mainly to trucks used in the international intervention forces. In addition to the above, connecting equipment of civilian design (towing fork couplings) shall be used restrictively as they limit the vehicle's ability to handle military trailers, both nationally and internationally.</p>
3.415.02	<p>Selected connecting equipment shall have equal, or higher performance characteristics than the estimated vehicle combination.</p>
3.415.03	<p>When selecting the coupling device for the vehicle and trailer, considerations shall be taken to the type of trailers, the vehicle's intended use, the towing vehicle in question, the trailer's brake system, design and size.</p>
3.415.04	<p>Towing forks on trailers must be designed so that towing eyelets of both military and civilian design can be used. Alternatively, a construction with a reversible towing fork shall be used where the alternative types of towing eyelets are welded to the towing fork.</p>

## Section 4.16 Chemical Substances and Properties of Materials

---

### Section 4.16.3 Material Properties

---

Req. No.	Content
3.416.01	<p>All included materials shall be selected and combined so that no detrimental effects on safety will occur during the life time of the system.</p> <p><i>Comment:</i> For example, as a result of fire, adhesion (abrasion), corrosion, mechanical fatigue, mutual influence, insufficient chemical stability aging, or chemical change. For sensitive systems, a life time analysis shall be performed.</p>
3.416.02	<p>The probability of human exposure to harmful substances and harmful substances being released into the surrounding environment shall be analysed and minimised.</p>
3.416.03	<p>Hazards associated with pyrotechnic and explosive batches shall be analysed and assessed against the benefits.</p> <p><i>Comment:</i> Does not apply to safety enhancing components such as airbags, safety belt tensioners etc.</p>
3.416.04	<p>When using hardened steel, the surface treatment shall be selected so that hydrogen brittleness or harmful corrosion will not occur.</p>

## Section 4.17 Use, Operation

---

### Section 4.17.1 Driving in General

---

Req. No.	Content
3.417.01	Look-out stations shall be designed so that the waist of the person is located below the rim of the hatch in a normal working position.
3.417.02	Wire cutters shall be installed on vehicles where personnel are positioned in open hatches while driving.
3.417.03	Impact surfaces in and around the personnel hatches shall be fitted with padding.
3.417.04	Supporting handles shall be installed for all personnel travelling in open hatches.
3.417.05	Brackets for safety harness shall be installed for all personnel travelling in open hatches. <i>Comment:</i> This is to prevent personnel from being thrown out.
3.417.06	Washer fluid shall not be sprayed in the faces of personnel travelling in open hatches. <i>Comment:</i> This also applies to other locations inside the vehicle while driving with open hatches.
3.417.07	Personnel shall be able to wear regulation equipment both when entering and exiting the vehicle as well as while working at their operator stations. <i>Comment:</i> Such equipment may comprise uniform, personal weapon, protective clothing, body armour, gloves, helmet, goggles, protective mask, anti-laser goggles, CBRN protective clothing, etc.

Req. No.	Content
3.417.08	Upon visual inspection and testing, work and risk areas for all possible situations of the vehicle shall be defined and documented.
3.417.09	<p>Controls and/or switches shall be designed/ arranged so that the probability of inadvertent operation and thus uncontrolled movement or other movement of the vehicle, is minimised.</p> <p><i>Comment:</i> Other movement can be for example dozer blades, winches etc.</p> <p><i>Comment:</i> This requirement is not applicable to the steering wheel, joystick, the brake or accelerator pedal and the gear lever in the driver's position.</p>

#### *Section 4.17.3 Fording, Floating and Ice Transition*

Req. No.	Content
3.417.10	Vehicles shall be designed so that the likelihood of personal injury caused by water seepage while fording and spraying the vehicle with water is minimised.
3.417.11	Vehicles with amphibious capabilities shall have markings showing the lowest permissible float depth.
3.417.12	A check that bottom plugs are properly fitted shall be easy to perform.

### Section 4.17.4 Supervision and Monitoring

---

Req. No.	Content
3.417.13	A graphic representation that shows the driver's and vehicle commander's field of vision 360° around the vehicle shall be developed.
3.417.14	Vehicles shall be designed so that the driver along with the crew (gunner and vehicle commander) can observe people around the vehicle as well as when they are entering and exiting the vehicle.
3.417.15	Supervision cameras shall be installed on working vehicle. The driver shall be able to survey the work area through a monitor located in the driver's compartment.
3.417.16	A rear-view camera shall be installed. The driver shall, when reversing, be able to survey the area behind the vehicle through a monitor located in the driver's compartment.
3.417.17	Rear parking sensors that warn the driver if the vehicle is close to an object while reversing shall be installed.
3.417.18	The driver must have a clear view backwards. <i>Comment:</i> Good rear visibility can be achieved with rear-view mirrors, rear-view cameras or equivalent. This applies in all situations, for example where a driver's windshield is used, or when the driver's hatch is closed.

### Section 4.17.5 Internal Communication

---

Req. No.	Content
3.417.19	<p>The vehicle commander shall in two independent ways be able to communicate with the driver.</p> <p><i>Comment:</i> If one of the communication methods is direct voice communication, it is sufficient that the reserve option consists of, for example, body language (nods, winks, etc.) which clearly can catch the driver's attention and in the same way be confirmed by the driver.</p>

### Section 4.17.6 Collision

---

Req. No.	Content
3.417.20	Personnel seats equipped only with three point safety belts shall be equipped with airbags.
3.417.21	Personnel seats equipped only with three point safety belts shall be equipped with seat belt tensioners.
3.417.22	The vehicle shall be equipped with a seat belt knife for cutting off seat belts.
3.417.23	It shall be possible to temporarily disconnect the seat belt reminder from the driver's or vehicle commander's locations.
3.417.24	<p>The vehicle shall be equipped with safety hammer for smashing windows.</p> <p><i>Comment:</i> Does not apply to vehicles with shrapnel protected glass.</p>

### Section 4.17.7 Noise and Vibration

---

Req. No.	Content
3.417.25	<p>The sound pressure level inside and outside the vehicle shall be measured and documented.</p> <p><i>Comment:</i> The use of regulation personal protective equipment shall be assumed. Also consider the sound pressure of weapons and weapon systems integrated in the platform, see H VAS E.</p> <p>Test method and criteria for noise shall be implemented according to rules established by HQ.</p>
3.417.26	<p>The number of impulse sounds that affected personnel are exposed to at a given time shall be identified and documented.</p> <p><i>Comment:</i> The use of regulation personal protective equipment shall be assumed. Also consider ambient effects both in and outside the vehicle and impulse sound from weapons and weapon systems integrated in the platform, see H VAS E.</p> <p>Test method and criteria for noise shall be implemented according to rules established by HQ.</p>
3.417.27	<p>The amount of vibration in all seats in the vehicle shall be identified and documented.</p> <p><i>Comment:</i> Test method and criteria for vibration impulses shall be implemented according to rules established by HQ.</p>
3.417.28	<p>The location and any protection of the personnel relative the sound source shall be documented.</p>

### Section 4.17.8 Salvaging and Towing

---

Req. No.	Content
3.417.29	Attachments for triangle tow bar and/or tow rod shall be installed at the front and rear of the vehicle.
3.417.30	Towing equipment shall be equipped with a secondary locking.
3.417.31	Attachments for salvaging the vehicle shall be installed both at the front and rear of the vehicle.
3.417.32	The vehicle shall have the required stability for its work tasks. <i>Comment:</i> Refers to crane trucks, bridge builders, wheel loaders etc.



## ACRONYMS

ADR	European Agreement Concerning the International Carriage of Dangerous Goods by Road Accord Européen Relatif au Transport International des Marchandises Dangereuses par Route
AFS	The Working Environment Authority's Regulations
BVKF	The Swedish Armed Forces' instruction on measures against fire and explosion hazards, water pollution and chemical health effects from flammable goods etc.
CBRN	Chemical, biological, radiological and nuclear weapons
CLP	“CLP regulations” on classification, labelling and packaging of chemicals and substances and mixtures (EC no 1272/2008, 16 December 2008)
COTS	Commercial of the Shelf
FAG F	The Swedish Armed Forces' stipulations on Periodic inspection of vehicles
FFS	The Swedish Armed Forces' statutes book
FIB	The Swedish Armed Forces' internal stipulations
FMV	The Swedish Defence Materiel Administration
FOD	Foreign Object Damage
FRA	The Swedish national defence radio establishment
GFE	Government Furnished Equipment
IFTEX	The Swedish Armed Forces' instruction for storage and transportation of ammunition and other explosives

## Acronyms

ISO	International Organization for Standardization
MIFOR	Military Vehicle Register
MOTS	Military of the Shelf
MoU	Memorandum of Understanding between two countries
MSB	The Swedish Civil Contingencies Agency
MSBFS	The Swedish Civil Contingencies Agency Regulations
MTRF	Military traffic regulations
MVIF	Equipment maintenance for the Swedish Armed Forces
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) (EC no 1907/2006, 18 December 2006)
SCA	Safety Compliance Assessment
SFS	Swedish Statue Book
SS	Safety Statement
SSMP	System Safety Management Plan
SSPP	System Safety Program Plan
SwAF	The Swedish Armed Forces
Säki	The Swedish Armed Forces' safety instruction for weapons and ammunition etc
TO	Technical Order
TS	Technical Specification
TSFS	The Transport Agency's Regulations
TTR	Technical Service Regulations
Vtr	Traffic Registry

VVFS	National Road Administration's Code of Statutes
VÅ	Work undertaking



## REFERENCES

M7739-352031	H SystSäk E 2011 part 1
M7739-352032	H SystSäk E 2011 part 2
M7739-351100	SäKI G 13
M7762-000881	H VAS E 2012
M7762-000531	H ProgSäk 2001
M7762-001001	H SEPS E 2015
M7762-001011	H SäkFältmArb E
M7773-001271	EMMA ENG VER
M7751-714001	FAG F
M7751-170211	TTR Salvage of Vehicles TTR Omhntag ford
M7773-001151	Handbook Connecting Equipment HDB Kopplingsmtrl
M7773-001161	Handbook Lighting Equipment HDB Belysningsmateriel
M7776-000010	Spare Parts Catalogue for Military Vehicle Equipment Reservdelskatalog militär fordons- utrustning

## OTHER DOCUMENTATION

The documents listed below may be of help when procuring vehicles:

- DEF STAN 23-06 Guide to the Common Technical Requirements for Military Logistic Vehicles and Towed Equipment.
- ISO 26262 Road Vehicles – Functional Safety.



## FIGURES AND TABLES

### FIGURES

<i>Figure 1:1</i>	<i>H FordonSäk E relative to other documents</i>	<i>page 10</i>
<i>Figure 1:2</i>	<i>The accident concept</i>	<i>page 15</i>
<i>Figure 1:3</i>	<i>System safety for a vehicle system</i>	<i>page 16</i>
<i>Figure 2:1</i>	<i>Schematic view of governing legislation in the automotive field.</i>	<i>page 20</i>
<i>Figure 3:1</i>	<i>Outline of the process for procurement or modification of a vehicle system</i>	<i>page 30</i>
<i>Figure 3:2</i>	<i>Selected parts of the civil vehicle designations (for more information see SFS 2001:559)</i>	<i>page 32</i>
<i>Figure 3:3</i>	<i>Example of vehicle classified as COTS</i>	<i>page 33</i>
<i>Figure 3:4</i>	<i>Example of vehicle classified as MOTS</i>	<i>page 34</i>
<i>Figure 3:5</i>	<i>Example of vehicle classified made for specifically military purposes</i>	<i>page 35</i>

### TABLES

<i>Table 3:1</i>	<i>Examples of technical documentation for vehicle systems</i>	<i>page 38</i>
<i>Table 4:1</i>	<i>Vehicle outer dimensions</i>	<i>page 74</i>



## INDEX

### A

Accident 14  
Accident risk 14  
ADR 25, 91  
Aerial 62  
Aerials 62  
AFS 24  
AFS 1987  
    02 61  
AFS 2009  
    02 Workplace Design 85  
AFS 2011  
    18 Occupational Exposure  
        Limits 98  
Airbag 103, 109  
Anti-slip protection 76  
ATV 36

### B

Backup steering system 55  
Battery heater 63  
BoA 43  
BVKF 28, 48

### C

CE marking 36, 37, 51, 99  
Classification 31  
CLP 102  
Compartment  
    ammunition 90  
COTS 32, 33, 37, 45

### D

DesignA 12  
Differential lock 52

### E

Energy  
    kinetic 15  
    stored 15

Exhaust brake 54

### F

FAG F 26, 28, 42  
FFS 26  
FIB 27  
Fire retardants 81

### G

GFE 37

### H

Hazardous event 14

### I

IFTEX 28  
Incident 14  
Interior 81

### L

Leakage 46  
Leased vehicles 40  
Lifting jack 57

### M

MIFOR 32, 36, 39, 41, 42  
Military motor vehicle examiner  
    14  
MOTS 32, 34, 36, 37  
MOU 13  
Mould 82  
MSBFS 25  
MTRF 21, 26, 39, 41  
MVIF 42

### N

Newly procured 39

### O

Oxyhydrogen gas 63

## R

RADHAZ 62  
REACH 102  
Retarder 54

## S

Salvaging 112  
SamO 29  
SCA 38  
SFS 21  
Side protection 75  
Single vehicle approval 39  
SS 43  
SSMP 29  
SSPP 12, 31  
SäKI 27, 42, 43  
SäKI G 61

## T

Technical documentation 38  
    language 38  
Technical Order 39  
Tow rod 112  
Towing 112  
Track  
    breaks 56  
    thrown off 56  
Traction control 52  
Triangle tow bar 112  
TSFS 23  
Turret position indicator 95

## U

U 75  
Upholstery 81

## V

Vehicle safety 15  
Vtr 26, 36  
VVFS 22

## W

Weapon holders 93

*Project Manager*

Lars Lange, FMV

Martin Dalaryd, Combitech AB

*Subject Experts*

Peter Ekman, FMV Besiktningsenheten

Per Löow, FMV Besiktningsenheten

*Translation*

Lars Sjögren, Combitech AB

*Illustrations and cover*

Leif Sundberg, Combitech AB

Mats Lundgren, Combitech AB

*Original*

Mats Lundgren, Combitech AB

*Digital edition*

Mats Lundgren, Combitech AB







---

Swedish Defence Material Administration  
SE-115 88 STOCKHOLM  
SWEDEN

M7762-000991

