

CONSIDERATIONS REGARDING THE IMPROVEMENT OF THE MILITARY DRIVER'S SEAT COMFORT FOR THE MILITARY SPECIAL INTERVENTION VEHICLES

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Abstract: *Subjectively speaking, the comfort of vehicles is closely related to a number of factors which together generate a state of comfort and satisfaction of those who are inside it and have the effect of moving safely with a sufficiently high speed, without causing physical and mental fatigue or damage the goods which are being carried. Since seat comfort is a feature of the ergonomics, it has been addressed in various ways by engineering firms, but also by various researchers in the field of ergonomics, who have demonstrated that this feature needs to be thoroughly approached by taking into account the anatomical shapes of the drivers and their needs in relation to the vehicle and the activities performed.*

Keywords: *comfort, vehicle comfort, intervention vehicles, driver seat's ergonomics*

1. THE COMFORT

The comfort feeling could be appreciated as an assembly of mental and physical reactions due to all the factors involved in this state which act on it in different ways.

It could not be said that there is only one widely accepted single criterion which can offer an objective appreciation to evaluate vehicle comfort.

The vehicles comfort is closely connected with the postural stress of the driver and the passengers because of their subjective perceptions on the environmental factors and any mental and physical exposures during missions.

Driving a military vehicle during specific mission is a complex action characterised by the quick succession of the external factors and the reaction rate of the drivers.

The postural comfort is evaluated by taking into account aspects such:

- the distance to the pedals and the necessary forces to act on them;
- the distance to the levers and handles and the necessary force to act on them;
- the type and possibilities to adjust the chair;
- the construction system and the comfort provided by the chair;
- the mode of operation for the rest of the board controls;
- the ventilation and air conditioning system.

The comfort sensation is closely connected to the interior space of the vehicle. The driver working space is calculated by taking into account the anthropometric characteristics and the requirements for a normal evolution of the person in order to accomplish the specific functional assignments [5].

2. THE DRIVER SEAT – GENERAL CONSIDERATIONS

The driver seat is a device which has to ensure a driver's comfortable position during the handling of the vehicle devices and board gadgets. It has to decrease the level of the body vehicles vibrations felt by the driver.

The international standards, such as SAE J941 and J4002, recommend some optimal dimensions for the seats in order to ensure the drivers' and passengers' comfort (Fig. 1), and, from the military point of view, MILSTD-1472 is "The Guide for the Military Vehicles Seat Design".

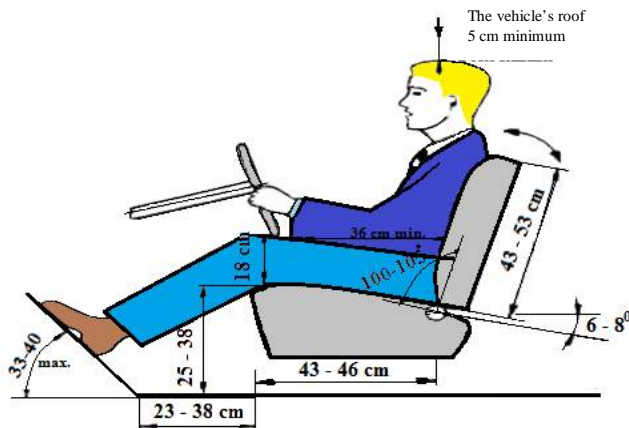


FIG. 1. The main dimensions recommended for the seat driver [5]



FIG. 2. Live images during a demonstrative exercise (the driver is 1,74 m tall)

Another standards which require comfort-specific requests are:

- ISO 3411 – The human physical dimensions and the minimum interior space;
- ISO 6682 – The comfort areas and the minimum necessary spaces for the vehicle handling commands;
- BS ISO 4513:2010 – Road vehicles. Visibility. Methods to determine the driver's visibility area.

The pad and the backrest design do not break to a sufficient extent the vibrations taken over by the chair because of the very large spectre of magnitudes and frequencies.

According to [4], the chair pad provides an decrease in the very frequency of vertical vibrations up to 2,5 Kz towards the vibrations sent by the general structure of the vehicle body. Also, improved vibration isolation could be realised by an elastic supporting structure of the chair.

The chair building implies analysing a large area of characteristics which have to be taken into account during their projecting and building processes. Special details are necessary to be obtained pertaining to biomechanics of the comfort, the pressure distribution on the level of the chair pad, the vibration transmission, the material which has to be used in the fabrication process etc.

3. THE ERGONOMIC SPECIAL FEATURES OF THE DRIVER'S SEAT FOR THE SPECIAL MILITARY INTERVENTION VEHICLE DAC 2.65 FAEG

The driver's seats have, in general, the same shape, but the internal structure and the supplementary systems for comfort differ from one vehicle to another. What is installed on the cars is not common for light trucks or for heavy vehicles, especially for military

vehicles. So, it could be said that the driver's seat ergonomics is realized completely differently and the driver's sensations differ as well.



FIG. 3. The 1-st position for a driver of 1,84 m



FIG. 4. The 2-nd position for a driver of 1,84 m

In the case of the light off-road articulated vehicle, DAC 2.65 FAEG, from the comfort point of view, one can notice the lack of suspension system, thus leading to transporting the crew over a long period of time without fatigue occurrence.

In order to compensate for this aspect, the vehicle driver's seat is located on the body of the vehicle by the means of a mechanic damper which has to damp the random vibrations resulted from the specific off-road tyre rolling conditions (Fig. 4).

Also, another black spot of this vehicle's driver's seat ergonomics is that the driver needs to stay in an uncomfortable position, mainly if the person is over 1,84 m tall (the regular height for a Special Forces soldier). The possible driving positions for a driver of 1,84 m in height can be seen in Fig. 3 and Fig. 4. The person has no special equipment for intervention mission. If they wore a special helmet and bulletproof vest, it would be more difficult to adopt an appropriate position.

In case the driver is 1,74 m tall (Fig. 2), the position behind the steering wheel is easier to be adopted but one has to sit leaning forward in order to have enough power to handle the steering wheel and to have good visibility at the same time.

In order to establish if the requirements for the basic rules of ergonomics are respected (Fig. 1), some measurements have been made for both types of drivers, as it can be seen in Fig. 2. Two models have been used: one driver is 1,84 m tall, and the other one, 1,74 m tall. The results are presented in table 1.

4. CONCLUSIONS

The driver's seat has to be studied very carefully in order to bring it up to the ergonomics dimensions and to delay as much as possible the appearance of the driver's fatigue.

As it could be seen under the former point, in case of DAC 2.65 FAEG vehicle, the ergonomics of the driving seat is far from the standard parameters.

Also, first a study must to be done for each type of vehicle in order to establish the standards for the ergonomics dimensions of the driver's seat. They will depend on the missions which are going to be carried out, the anthropometric dimensions of the soldiers and their special equipment.

Table 1 The results of measurements

Dimensional parameters	Value [cm]			Reviews
	According to SAE J941, J4002	Special Forces driver (1,84 m tall)	Regular height (1,74 m tall)	
a	5	10	15	The driver must lean forward in order to have enough visibility through the windshield
b	43-53	69	64	The chair backrest is extremely small and uncomfortable
c	43-46	34	34	The small chair favours the mobility – the civilian standard must be changed when used for the military vehicles
d	>36	43	43	Inadequate space for a massif soldier equipped with bulletproof vest – the standard must be changed when used for the military vehicles
e	25-38	20	20	The squatting position (of the driver) favours the mobility and... the fatigue
f	18	12	12	Very narrow space for a massif soldier
g	-	35	35	Specific dimensions for this kind of vehicle body
h	-	41	41	
i	23-38	45	45	The pedals are difficult to act on by a driver of regular height
j	-	89	85	The helmet presence influences negatively the mission
k	-	54	54	Specific dimension
l	-	15	12	The bulletproof vest decreases the distance to the steering wheel

Second, the ergonomics specialists will have to collaborate with body designers in order to establish the optimal dimensions of the driver's seat.

Eventually, the effect of the vibrations on the vehicle crew must not be neglected. In this situation, when such vehicles, which lack a suspension system and are compact, rigid and fast, are used for isolated targets intervention, the danger of vibrations can be relieved by using a magnetoreologic damper as a damper between the chair and the vehicle body, as well as a chair made of special materials, for example, ballistic jelly [7].

Applying these technical solutions improves the soldiers' protection, safety and comfort level by increasing the comfort of patrolling and fast intervention vehicles. This is the immediate effect. The most important effect is the increase in combat system viability.

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