

# **BM-21MT MLRS dynamic crew simulator**



## **The main characteristics**

- ❑ The design adequacy of the BM-21MT cabin mock-up
- ❑ Functional adequacy of algorithms and operating models of systems and equipment of a combat vehicle BM-21MT
- ❑ High quality of the visualization
- ❑ 3D models of a driving range, and a tactical field
- ❑ 6DOF motion platform
- ❑ Full package of the Driving Course exercises
- ❑ A wide range of scenarios for exercises and training events
- ❑ Unbiased evaluation of crews' actions
- ❑ Training results documenting
- ❑ The capacity of combining into a simulator of shooting and fire control of an artillery battery, a battalion

# The simulator capabilities to train crews

## training of drivers of the basic vehicle Tatra T-815

- performing driving exercises an all-wheel-drive vehicle at a driving range in the full scope of the Driving Course requirements
- driving on an unfamiliar terrain
- occupation of the combat vehicle position and preparing for firing

## Training of combat vehicles' commanders:

- work of the commander with the fire control and the aiming system of the BM-21MT combat vehicle in automatic, semiautomatic, and manual modes
- firing single and multiple launch rockets day and night, under different meteorological and ballistic conditions, on different terrain

## Crews collective training

- movement in the specified staging area
- occupation a firing position, topographic geodetic referencing
- preparation for firing
- firing

## The simulator structure

- 1 Instructor's workstation (including software and hardware suite)
- 2 The functional BM-21MT cabin mock-up



## **The simulator technical characteristics**

No seq.	Characteristics	Measuring units	Parameter's value
1	Quantity of simultaneously trained person	---	3 (driver, commander, the 2nd driver)
2	The minimum area of training class	m <sup>2</sup>	30
3	Premises type	---	Classroom
4	Actuation time	min	up to 5
5	Duration of continuous work,	hours	at least 12
6	Electric	voltage	220±10%
		Frequency	50±1
7	Maximum consumed power	kW	10
8	The range of operating temperatures	degrees C	from +5 till +40
9	Diagnostic system	---	In-build semiautomatic
10	3D model of track driving range	km	4x4
11	Tactical field dimensions	km	8x8
12	Evaluation of trainees' actions and its documentation	Automated, following criteria and values of the Driving and Gunnery Courses	
13	The possibility to edit tactical scenarios	With the use inbuilt editor	
14	Training scenarios (terms and conditions)	Day, night, winter, summer, dust storm, fog, various optical visibility range, temperature range from - 20° C up to +50° C	
15	Capacity to input (inject) combat vehicle equipment failures and malfunctions	---	Is implemented
16	Error-free running time	hours	1000
17	Specified lifetime	years	10
18	Warranty period	years	3

## The functional BM-21MT cabin mock-up

It is a cabin that is structurally and functionally adequate to the cabin of the BM-21MT combat vehicle, equipped with mock-ups of devices, controls, indication, and signalling means.

The mock-up is mounted on a motion platform that reproduces the inclinations and accelerations characteristics of a combat vehicle movement under various terrain conditions.

The view of the functional cabin mock-up of the during classes



## **The motion platform**

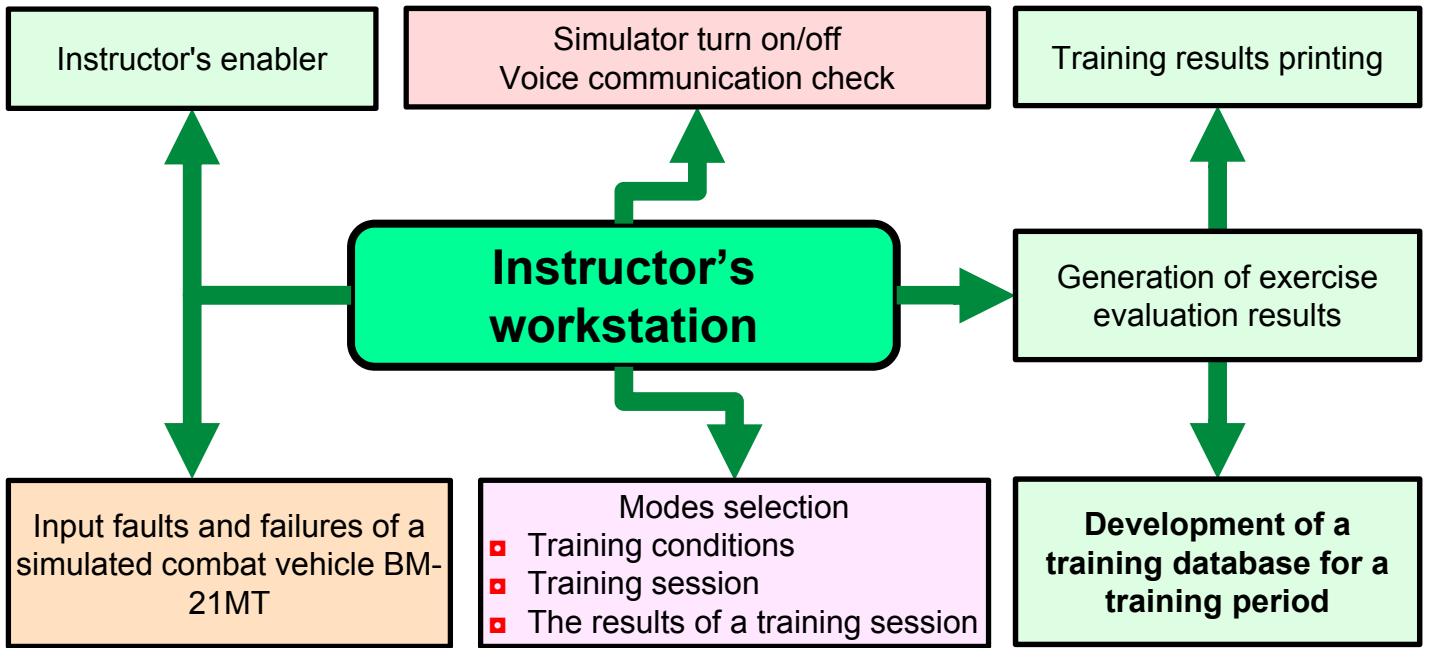
The 6DOF motion platform provides reproduction of the BM-21MT combat vehicle tilts when moving as per terrain relief, oscillations, as well as acceleration effects when pulling away, accelerating, braking, turning a combat vehicle, colliding with obstacles, with single and salvo firing



**Characteristics of the 6DOF motion platform**

№	Designation	Value
1	The type of drives of motors	Asynchronous with a short-circuited rotor
2	Driving motor Controls	Frequency by speed and position
3	Pitch angle	+/- 20 degree
4	Roll angle	+/- 20 degree
5	Heave	+/- 100 mm
6	Yaw	+/- 30 degree
7	Surge	+/- 300 mm
8	Sway	+/- 300 mm
9	The angular speed of movement along the axes	0-20 degree/sec
10	Accuracy of control signals processing	< 0,2 degree at the corners
		<10 mm positionally
11	Maximum consumed power, kW	11.4

## Instructor's workstation



The instructor's workstation



## The functional BM-21MT cabin mock-up

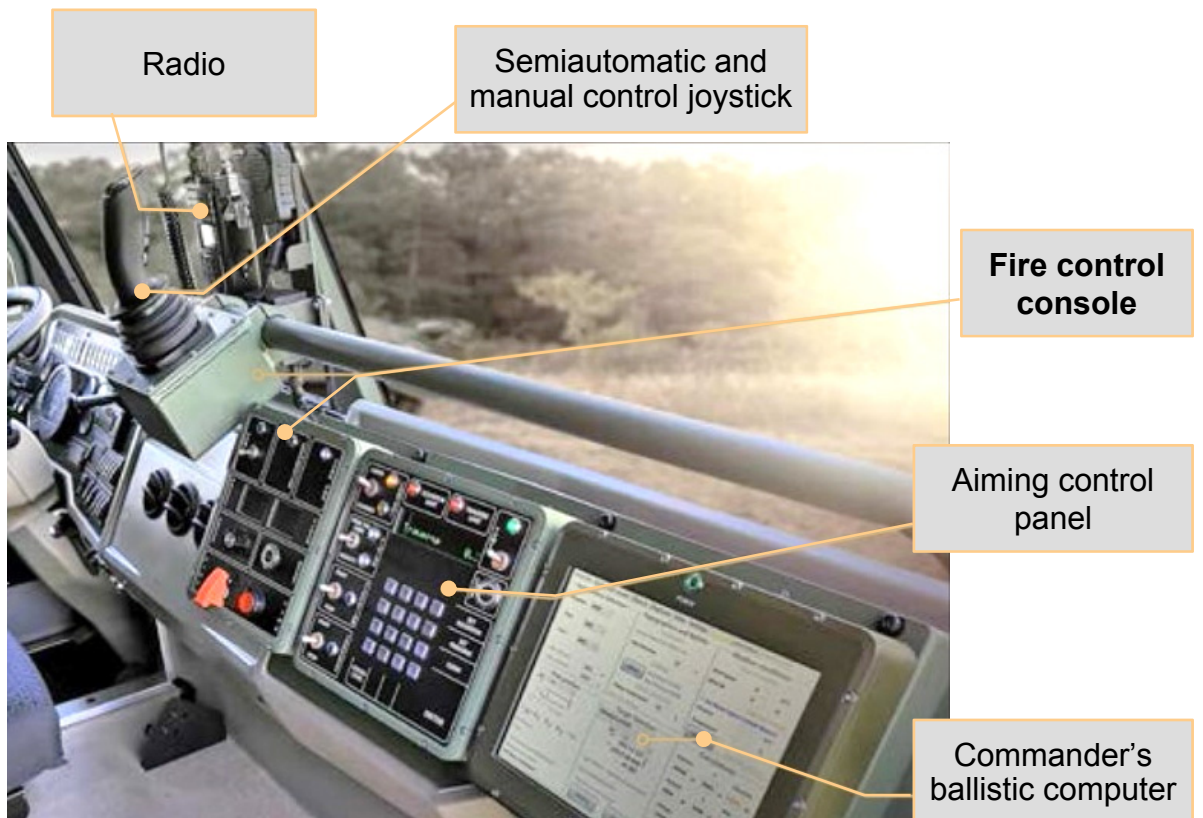
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Tatra 850 driver's workplace



Tatra 850 commander's workplace



## **The functional BM-21MT cabin mock-up equipment set**

№ seq.	Designation, title	Quant ity, pcs.
1	<b>Functional controls and instruments mock-ups, kit, including</b>	<b>1</b>
	<i>Instructor's work station, set, including:</i>	1
	Instruments panel with illumination light	1
	Steering wheel with the column and ignition, turning and lighting switch, horn button	1
	Accelerator pedal	1
	Clutch pedal	1
	Brake pedal	1
	Gear-change lever with a low-gear drive	1
	Parking brake lever in the instruments panel	1
	Central tire inflation system controls	1
	<i>Commander's workplace, kit, including:</i>	1
	Commander's ballistic computer	1
	Aiming control panel	1
	<b>Fire control console</b>	<b>1</b>
	Semi-automatic and manual aiming modes control joystick	1
	Radio	1
2	<b>Equipment, kit, including</b>	<b>1</b>
	Driver's seat	2
	Commander's seat	1
	audio system	1
	RM-70 artillery telescope	1
	Launcher handwheels	2
	Panoramic projection system for windshield and side windows	1



## Adequacy

The simulator ensures the performance of at least 90% of the actions of a driver and a commander of the BM-21MT

### The design adequacy

- ☐ compliance of geometric dimensions of a combat vehicle cabin mock-up and a placement of instruments, units, and equipment mock-ups of the simulator to the real BM-21MT combat vehicle
- ☐ the full resemblance of the front panels of devices and equipment mock-ups to real ones, correspondence of equipment illumination, instrument scales, tags to the BM-21MT combat vehicle
- ☐ the correspondence of ranges of movement, efforts and reaction of levers, pedals, switches, flywheels in the simulator to the characteristics of the BM-21MT
- ☐ reproduction of a combat vehicle cabin tilt angles when moving and acceleration effects when speeding up, braking, and turning; a hull oscillations when overcoming obstacles and colliding with objects using a 6DOF motion platform

### The functional adequacy

- ☐ the adequacy of the functioning systems' algorithms, instruments, and equipment of the Tatra T-815 vehicle chassis and the simulated BM-21MT combat vehicle in normal and emergency modes and the response of the simulator controls to the trainees control actions
- ☐ the adequacy of a combat vehicle movement model, as per terrain relief, type of soil, and road surface conditions
- ☐ the adequacy of a fire control system operating algorithms and the BM-21MT combat vehicle aiming system in automatic, semiautomatic, and manual modes
- ☐ the adequacy of rockets' firing model, correct accounting for an influence of an ammunition type, wind speed and direction, atmospheric pressure, the air temperature on the range of rockets flight
- ☐ adequacy of visual, sound and dynamic effects of the simulator functioning during movement and shooting
- ☐ accounting of terrain conditions, time of a day, season, air temperature

# Reliability

The simulator ensures reliable operating during whole exploitation period (warranted and post-warranted period)

The reliability-assurance program is based on the following principles:

- ⓐ use of proven by exploitation, the best quality and reliable components together with their incoming control
- ⓐ program solutions development that excludes conflicts between specific and general software, as well as conflicts between software and hardware elements
- ⓐ multiple repeated check of design solutions that provide long-term lifecycle of mechanical nodes
- ⓐ Application of design solutions, ensuring protracted work of mechanical nodes
- ⓐ functional and phased check of the quality of mechanical and electrical simulator assembly
- ⓐ use of the non-contacting angle of rotation sensors (based on magneto-sensitive microchips)
- ⓐ use of protective means of print boards of electronic devices and connectors from environmental effects
- ⓐ use of industrial computers
- ⓐ Use of uninterrupted power supply units
- ⓐ ensuring of required simulator hardware thermal conditions
- ⓐ providing a power margin of power supply equipment

## Service life and warranty period

- ⓐ The service life of Simulator (the life cycle of Simulator) is 3 years, under the condition of strict adherence to Operational Rules, and proper maintenance and repair per Operational Documentation.
- ⓐ The service life of Simulator is 10 years, under the condition of strict adherence to Operational Requirements, proper maintenance and repair per Operational Manual.

ⓐ Simulator ensures continuous operations for 12 hours a day

ⓐ Error-free running time is 1000 hours

## The quality of visualization of the environment

The simulator provides a capacity to drive under various road and off-road conditions, firing in single and salvo in various conditions

High-quality visualization of the background environment is provided due to:

- ☐ the use of liquid crystal monitors and a high-resolution video matrix in the RM-70 artillery optical sight simulator
- ☐ detailing and drawing of terrain textures
- ☐ correspondence of terrain textures color range and objects with real colour and contrasts
- ☐ compliance of angular size, shape, colour, the contrast of local objects, vegetations, ground target with real objects within the field of vision of optical devices
- ☐ reproduction of physical effects (dust, wheel tracks) during simulation of a combat vehicle movement on a ground





**Developer and manufacturer:  
LCC ' Research and Production Company 'Energy 2000'  
Povitroplotsky, 94-A, Kyiv, Ukraine  
[www.simulator.ua](http://www.simulator.ua)**

**Developer and manufacturer provide:**

- ☐ manufacturing the simulator
- ☐ assembly, adjusting, commissioning and acceptance testing at the site of intended use
- ☐ training of customer's technicians
- ☐ warranty service for 3 years
- ☐ Post-warranted maintenance (subject to separate contract)