

INTEGRATED SIMULATOR OF BMP-1 INFANTRY COMBAT VEHICLE CREW



- ✦ Adequacy of compartment interior and algorithms of equipment operation
- ✦ High quality of visualization
- ✦ 3-D models of tank training area, mean line of fire, tactical field
- ✦ 6-degree dynamic platforms
- ✦ Full scope of exercises of the Driving Course of combat vehicles
- ✦ Full scope of Firing Course
- ✦ Wide range of terms of exercises and trainings
- ✦ Fairness of assessment of trainees actions
- ✦ Results documentation

Simulator designation

Simulator is designed for solving tasks of the combat training program of the units provided with BMP-1 infantry combat vehicles and ensures :

a) individual preparation of crew members: studying of BMP-1 structure and operating procedure during preparation of armament and equipment to use as intended, formation of skills in target reconnaissance using optical observation and sighting devices, firing from the BMP-1 weapon system in various weather conditions, day and night, on various terrain;

б) training of driver mechanicals

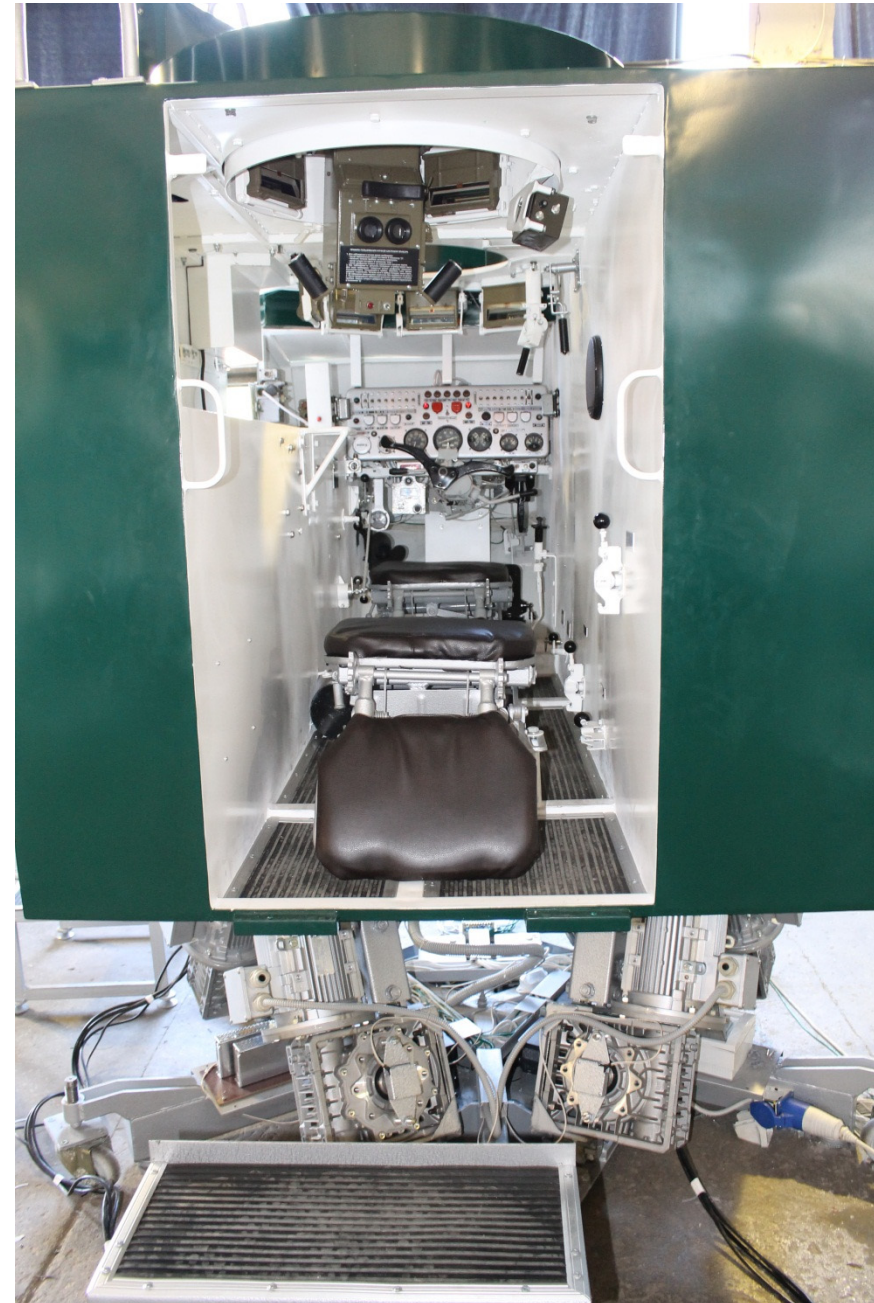
в) fire training of crew according to the full course volume, fire and tactical training, training of BMP-1 crew

General view
of simulator



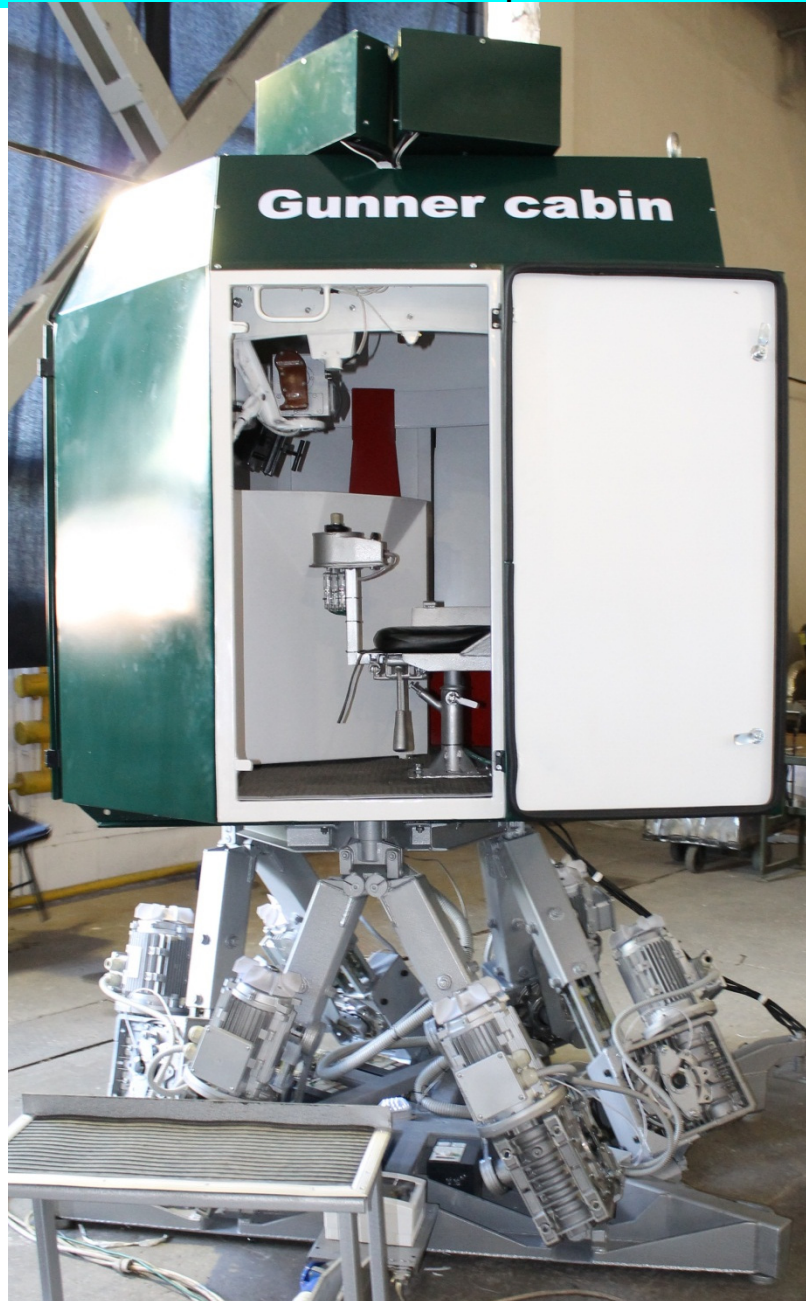
Commander's and driver-mechanic control compartment

No. in sequence	Name, designation	Number of pieces
1	Simulators of devices and equipment	
	Surveillance device TNPO-170	3
	Sweep drive with speed change lever, creeping speed change lever, signal button and direction indicator switch	1
	Central shield of driver mechanical's devices with swinging lantern lights and board «Release Handbrake»	1
	Intercom unit A3	1
	Fuel feed pedal	1
	Clutch pedal	1
	Brake pedal	1
	Stopping brake drive handle	1
	Inlet shutters gate drive lever	1
	Air cylinder with valve	1
	Pressure gauge of compressed air supply system	1
	Fuel distributing cock	1
	Traffic signal board	1
	Condensate removal cock from water and oil cleaning system	1
	Heater fuel system cock	1
	Blocked pneumatic drive	1
	Water deflection shield control cock handle	1
	Direction gyro GPK-59	1
2	Equipment	
	Summer headset	1
	Seat of driver mechanical	1
	Interior lamp	1
	Fan	1
	Audio system	1



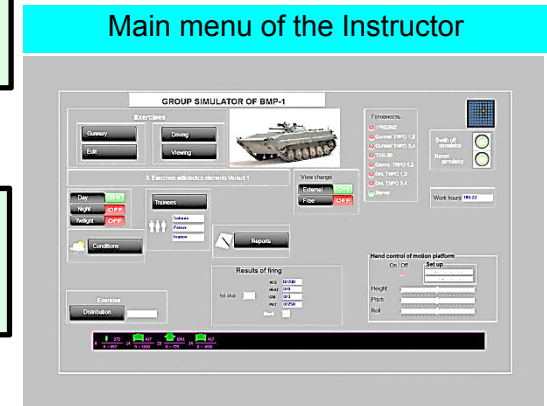
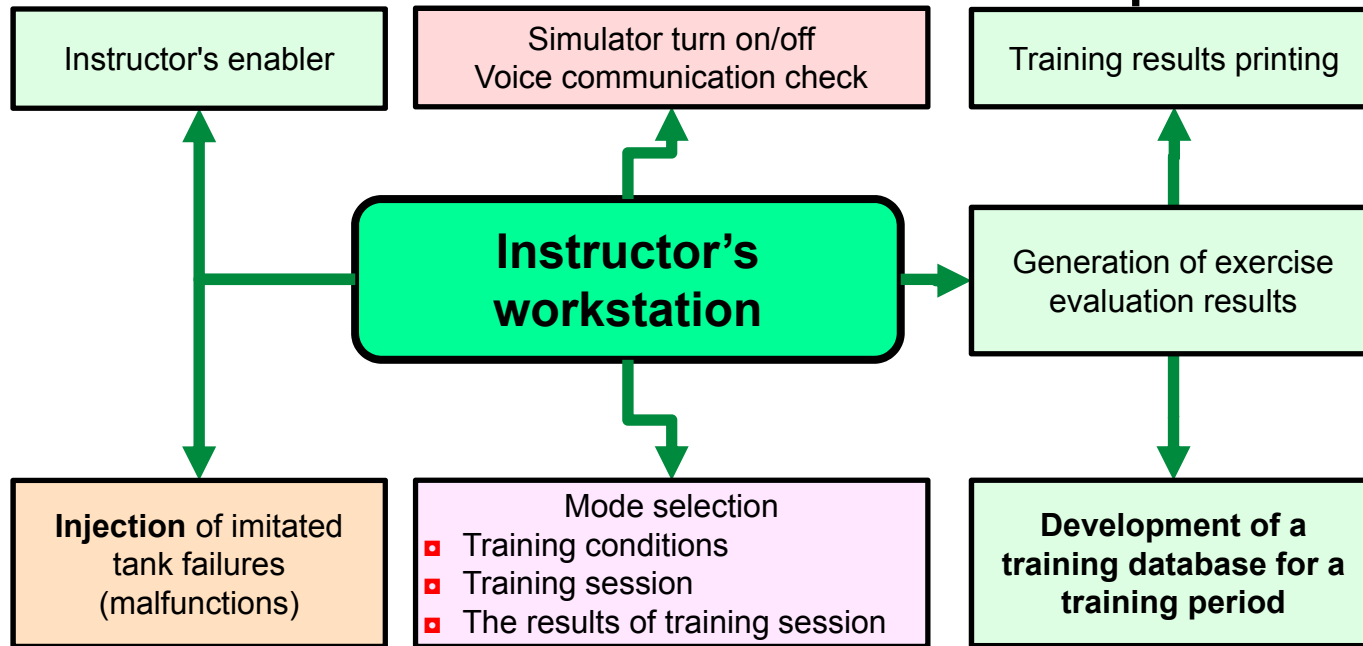
Simulator of combat compartment

General view of combat compartment cabin



<i>Simulators of control devices and instruments, set, including</i>	1
Sighting device 1PN22M1	1
Observation device TNPO-170	2
Power drive control panel	1
Change lever of shell types	1
Hang gear of gun lift	1
Hand gear of turret rotation	1
PTURS 9K14 "Malyutka" 9S428 control panel	1
panel lock handle PTURS in fire position or through position	1
A-3 device of tank interphone	1
Turret lock	1
Signal panel	1
Turret switch board	1
PKT receiver	1
Commander's surveillance device TKN-3	1
Radio station R-123M (full-scale mock-up)	1
A-4 device of tank interphone	1
<i>Equipment, set, including</i>	1
Headset	2
Commander's seat	1
Gunner's seat	1
Interior lamp	2
Fan	2
Audio system	1

Instructor's workplace



Functional capabilities of instructor's workplace

- determination of the order and selection of training conditions and modes
- registration of crews and units
- control over the trainees actions and training progress
- generation of assessment of the fire exercise execution
- analysis of trainees actions in the course of training, dynamics of the level of trainees skills
- formation of individual instruction and training programs
- fair assessment of training ability level of crews
- documentation of exercise and training results



Specifications of simulator

Adequacy

- ▶ compliance of geometric dimensions of the simulator cabin and placement of kit simulators and equipment of real BMP-1
- ▶ maximum similarity of front panels of manufactured simulators of devices and equipment with real ones, compliance of illumination of equipment, instrument scales, transparencies or plates with real BMP-1
- ▶ full list of functions of observation and sighting devices, control and indication devices of infantry combat vehicle
- ▶ compliance of the movement range, forces and response of levers, pedals, hand wheels and switches with characteristics of BMP-1
- ▶ compliance of algorithms and functioning modes of simulators of devices and equipment in all modes and responses of control and indication devices to the control effect of the trainees
- ▶ calculating the flight paths for bullets and shells on the basis of ballistic characteristics of PKT gun of 7.62 mm and gun of 73 mm and ammunition applied
- ▶ calculating the flight path for the anti-tank guided missile on the basis of control loop for the semi-automatic guidance
- ▶ considering the targetability of ground targets in the course of simulation of its fire from BMP-1 armament
- ▶ calculating the visibility of targets subject to optical characteristics of surveillance and sighting devices
- ▶ considering all characteristics of BMP-1 (engine power at different transmissions, transmission characteristics, BMP weight) in the motion model, as well as peculiarities of the terrain (relief, type of soil, condition of road surface)
- ▶ considering the water motion principle of BMP-1 in the cruising model
- ▶ compliance of sound effects of operation of the propelling engine and firing with real ones
- ▶ simulation of the BMP-1 cabin's slope angles on the move and acceleration effects at speed set-up, braking and turns, overcoming obstacles and bumping up against objects

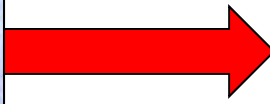
Simulator ensures at least 90% coverage of combat performance of BMP-1 crew

Equipment in the combat compartment cabin



Visualization quality of target environment

Simulator provides a possibility for conducting the visual reconnaissance and firing with account for optical visibility, target range and type, weather conditions



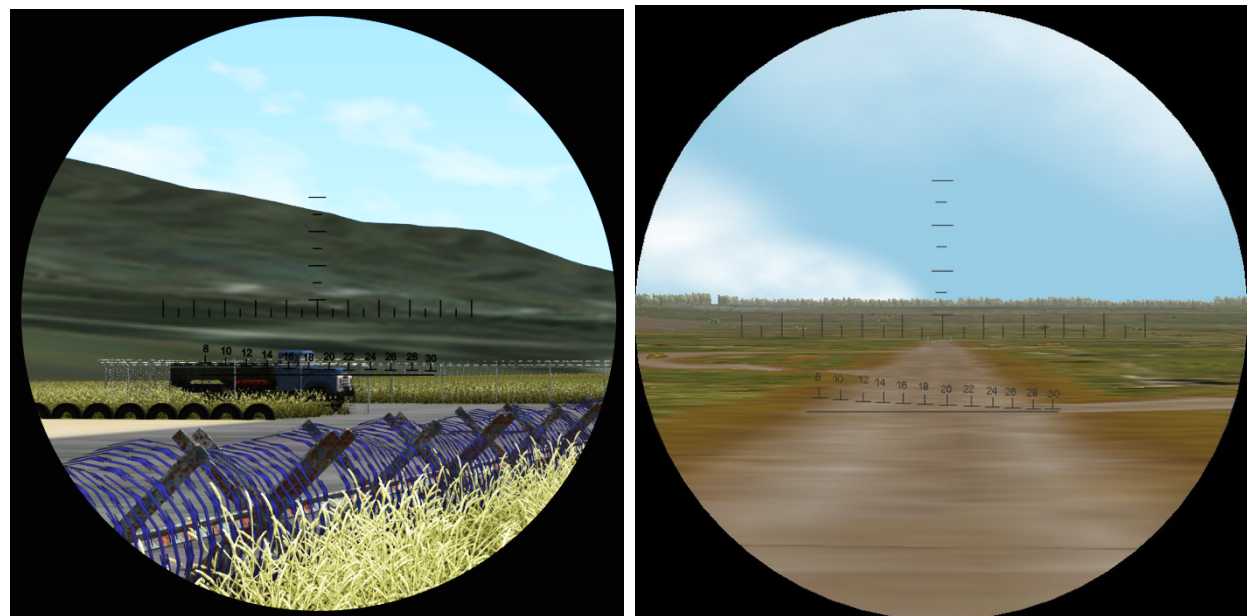
Line of sight of sighting device 1PN22M2 of the gunner in simulator



High quality of visualization of target environment is achieved by:

- ▶ using LCD high-resolution monitors and matrix in the simulators of optical sighting devices
- ▶ detailing and drawing the terrain texture
- ▶ compliance of color range of terrain texture and objects with the real colors and contrast
- ▶ compliance of angular sizes, shapes, local objects, vegetation, ground targets with the real objects within line of sight of optical observation and sighting devices

Line of sight of commander's observation device TKN-3B in simulator



View from the external controlled camera on tactical field

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Examples of visualization of terrain in simulator



Reliability



Liability program of the simulator is based on the following principles:

- Use of reliable components proven by operating experience in production, input control
- Development of software solutions eliminating conflicts of special software with the general one, as well as with the hardware
- Repeated verification of developed engineering solutions
- Use of engineering solutions ensuring continuous work of mechanical assemblies
- Step-by-step and stage-by-stage quality control of mechanical and electrical assembly of the simulator
- Use of only noncontact rate-of-turn and displacement sensors in the assembly structure (on the basis of magnetosensitive microcircuits)
- Use of protection means of printed boards of electronic devices and connectors against environmental impact
- Use of computers of industrial (armored) version
- Use of uninterruptible power supply for computers
- Provision of necessary temperature conditions of simulator devices
- Provision of power margin of power supply

Simulator ensures fail-free operation over the whole operational life (warranty (3 years) and post-warranty periods)

Warranty and Service Life

- ▶ Warranty period of the simulator is 2 years in compliance with the rules of operation and maintenance in accordance with the operational documentation.
- ▶ The service life of the simulator is at least 10 years in compliance with the rules of operation and maintenance or repair in accordance with the operational documentation.

® Continuous operation of the simulator is 12 hours a day.

® Mean time between failures of the simulator is minimum 1000 hours.

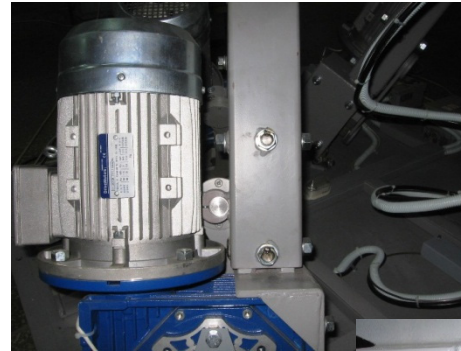
2.4. Specifications

Simulator is easy to operate and maintain and is designed for operation by troops

No. in sequence	Specification	Unit of measurement	Specification value
1	Minimum necessary area for placement	m ²	30
2	Type of room	---	Classroom
3	Operation readiness after turn-on	min	5
4	Duration of continuous work	hour	12
5	Electric supply: voltage	V	220±10%
	frequency	Hz	50±1
6	Maximum consumed power	kW	20
7	Mean consumed power	kW	10
8	High working and limit temperature	°C	+35
	Low working temperature		+5
9	Relative humidity at +25°C	%	80
10	Diagnostics system	---	Integrated semi-automatic
11	Failure time	hour	Minimum 500
12	On/off control	---	At the manager's workplace
13	Spare parts, tools and equipment	---	Individual and group (per 4 simulators)
14	Maintenance	---	Walk-around inspection, daily maintenance, 1 st maintenance (once every 6 month), 2 nd maintenance (once a year)
15	Operational liquid	---	Mineral oil in gear motors of dynamic platform
16	Electrical safety of trainees and service personnel	---	Hazardous voltage elimination in the simulator of combat compartment (24V DC). Short circuit protection
17	Recording of simulator time		Software hour meter
18	Assembled simulator weight	kg	1,250
19	Operational documentation	---	Logbook, operational manual, installation, start-up and on site commissioning instruction, SPTE list

Dynamic characteristics

Simulator ensures the adequacy of BMP-1 dynamic characteristics by using 6-degree motion platform in the compartment structure



Main characteristics of motion platform

Index	Values
Type of drive motors	Asynchronous with short-circuited rotor
Drive motor control	Frequency as per the velocity and as per the position
Pitch angle	+/- 20 deg.
Roll angle	+/- 20 deg.
Vertical movement	+/- 100 mm
Angular movement around the vertical axis	+/- 30 deg.
Longitudinal displacement value	+/- 250 mm
Transverse displacement value	+/- 250 mm
Angular velocity of axis motion	0-20 deg./sec
Accuracy of control signals drill	0.2 deg. as per the angles
	10 mm as per the position
Consumed power (mean)	12 kW

Training capabilities of simulator

Simulator capabilities for instruction and training:

- Individual fire training of BMP-1 gunners
- Individual training of BMP-1 driver mechanicals
- Individual training of BMP-1 commander
- Collective fire and tactical training of crews

Capabilities of the simulator to form conditions of instruction and training:

- Size of 3-D model of the terrain area – 4x4 km
- Types of terrain – median, mountain, desert (under the request of the Customer 3-D model of any area of terrain with size 8x8 km can be created)
- Types of roads – subsoil, hard surface, off-the-road
- Time of the day – day, twilight, night
- Weather conditions – sunny, cloudy, rain, snow, wind of different velocity and direction
- Season – summer, winter (under the request of the Customer in accordance with the conditions of the geographical region of instructions and trainings)

Simulator capabilities for instruction and training of BMP-1 crews:

- Execution of driving exercises in different conditions (median, mountain and desert terrain, day and night, winter and summer, different weather conditions) with computerized assessment of trainees actions
- Execution of a full list of exercises of the Fire Course (FC) with computerized assessment of trainees actions
- Execution of fire and tactical tasks by the crew

Examples of landscape synthesized in the simulator:

desert



plain



mountain and desert

