THE SYSTEM OF SIMULATORS FOR DRIVING, FIRE AND TACTICAL TRAINING OF MECHANIZED SUB-UNITS ARMED WITH ARMoured TROOP CARRIERS (ATC) BTR-3E1
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1. THE SYSTEM OF SIMULATORS

Intended for:
providing the effective solution of the wide range of combat training tasks for sub-units armed with armoured troop carriers BTR-3E1.

Provides:
a) individual training at the actions of arming, creation of the constant skills of target reconnaissance, firing with ATC armament in main and alarm modes, in the day or night; and training of the drivers in driving of ATC in full range of Driving course;
b) fire training in full range of Firing course, coordination of ATC crews;
c) tactical training and combat coordination of mechanized platoons in conditions approximated to battle ones, including conditions of two-sided battle;
d) increasing the intensity and results of combat training;
e) keeping the necessary level of combativey of mechanized sub-units during all training period.
2. THE STRUCTURE OF THE SYSTEM OF SIMULATORS

**TYPES OF SIMULATORS**
- driving simulator
- gunnery simulator
- integrated simulator
- tactical (platoon) simulator

**APPROPRIATE QUANTITY OF SIMULATORS IN MECHANIZED COMPANY**
- 2 driving simulators
- 2 gunnery simulators
- 1 integrated simulator
- 2 tactical (platoon) simulator

**FEATURES OF THE SYSTEM OF SIMULATORS**
- providing the conditions to form and keep the appropriate skills level and combat coordination of ATC crews and platoons
- intensification of the process of crews and platoons training
- objectivity in evaluation of the training level of crews and combat coordination of platoons
- forming of training conditions approximated to the combat ones
- organizational and methodical connection of studies and trainings on simulators with tactical studies and manoeuvres, including combat firing
2.1. Driving simulator

Purpose of driving simulator
► forming the skills in ATC preparation to motion, engine start, ATC driving, negotiation of obstacles and barriers, including water barriers, execution of driving exercises according to requirements of Driving course
► education and training in driving of ATC with consideration of its motion features in different terrain conditions

Structure of the simulator
► driver’s workplace equipped with simulators of controls and indicators of ATC
► motion platform reproducing the fluctuation and acceleration loads typical for ATC in different terrain types
2.1.1 Driving simulator vehicle dynamics

MATHEMATICAL MODEL (VEHICLE DYNAMICS MODEL)
\[ f = ma \]

TERRAIN MODEL
- TERRAIN RESISTANCE
- SLIPAGE
- ANGLE OF INCL

ENGINE MODEL
- ENG RPM
- TERRAIN TOPO
- ACCEL ANGLE

TRANSMISSION MODEL
- OUTPUT SPEED TORQUE
- GEAR POSN
- SHAFT RPM

STEERING & BRAKE MODEL
- STEERING ANGLE
- BRAKE ANGLE

HULL MODEL
- PITCH TORQUE
- ROLL TORQUE
- SUSP STROKE

SUSPENSION MODEL
- FORCE ON TRACKS
- BRAKE FORCE

DRIVER COMPARTMENT
- O/P FORCE ON HULL

AURAL CUES
- PARKING BRAKE STATUS

VIS SYS CUES
- SPRUNG MASS
- MOM OF ELASTIC INERTIA

MOTION SYS CUES
- MASS, MOM OF HULL

DRIVER COMPT INDICATORS
- VIS SYS CUES
- MOTION SYS CUES

TERRAIN HEIGHTS SLOPES
- ENG TORQUE

MOTION SYS CUES
- OUTPUT SPEED TORQUE

OUTPUT SPEED TORQUE
- ENG TORQUE

SHAFT RPM
- ACCEL ANGLE

GEO POSN
- TERRAIN RESISTANCE

ACCEL ANGLE
- TERRAIN TOPO

PITCH ANGLE
- TERRAIN HEIGHTS SLOPES.
2.1.2. Driving simulator block diagram

- Driver's Cabin
  - Controls
  - Interface
  - Display Computer for Driver
  - Audio System in Driver's compartment
  - Intercom driver
  - Monitor of TNPO-170 vision device
    - (TVNE-1PA night vision device)

- Local area network

- Instructor station
  - Computer of instructor station
  - Video splitter
  - Instructor monitor
  - Instructor
  - Keyboard
  - Mouse
  - Printer
  - Screen (monitor) for the group of students

- Motion platform
  - 220V, 50Hz
  - Frequency converter
  - Electric drive
2.2. Gunnery simulator

**Purpose of the simulator**
- operator’s training in actions on preparation of armament for firing in various modes
- forming of constant skills in doing reconnaissance and firing with system of armament to various targets in the day or night, in a motion or at short stops, in various weather conditions in full range of Firing course

**Structure of simulator**
- simulator of operator’s display
- control panel
- simulators of controls and devices involved in the combat work
- motion platform
- instructor’s workplace
2.3. **Integrated simulator**

**Structure of the simulator**
- gunnery simulator on a motion platform
- driving simulator on a motion platform
- Instructor’s workplace

**Features of integrated simulator**
- joint education and training of commander and operator of ATC BTR-3U, forming and maintaining of constant skills in target reconnaissance using low-level TV cameras, firing using system of fire control with 30mm automatic gun, machine-gun PKT, automatic grenade launcher AGS-17, anti-tank missile system in basic and alarm modes, in day or night, in various weather conditions, to land and aerial targets in full volume of Firing course, in conditions approximated to the battle ones
- coordination of ATC crews
- obtaining the objective level of crews attainment
2.4. Tactical (platoon) simulator

Tactical simulator – fully functional training and simulation system as a interrelated system of semi-actual ATC integrated simulators for platoon with regular communication facilities networked by LAN and working in a real-time in a common simulated tactical environment

Purpose of tactical simulator:
Combat coordination of crews and platoon, formation of stable skills on control of platoon and fire in the battle for platoon commanders

Features of tactical simulators:
► Wide range variations of tactical situation and battle conditions
► Two-sided combating
► Managing over the process of each training and the whole training process
► Documentation of training results and training process over any period
► Providing ATC or platoon commanders with a possibility to manage the crew and sub-unit in battle dynamics at complex environmental conditions
► Applying the elements of uncertainty during tactical training of crews and sub-units
► The comparative assessment of the effectiveness of commander decisions and platoon actions in a battle
► Playback of the ways and modes of tactical actions through repeating of the tactical situations
3. THE ADEQUACY OF THE SYSTEM OF SIMULATORS

3.1. Adequacy of a sensory-motor field of workplaces of a simulator to real workplaces in ATC

The design of simulators includes models of devices and the equipment, made on the basis of the real equipment of an ATC.

Efforts to levers, pedals, control panels of workplaces of simulators correspond to real ATC.

Indication facilities allow to reproduce operation of units and the equipment of workplaces of simulators in full compliance with workplaces of crew of ATC.
3.2. Compliance of parameters simulation model with characteristics of real ATC.

Simulation model of ATC provides
► adequacy of operation algorithm of devices and equipment in simulator in basic and alarm modes and feedback of simulator to trainee’s actions;
► adequacy of motion model of ATC, considering the terrain relief, type and condition of ground;
► proper considering of weather conditions, season and daytime during firing;
► doing visual reconnaissance and firing considering capabilities of observation and sight devices, range of optical visibility, target types;
► adequacy of land targets (size, colour, character and parameters of motion, fixing the fact of hit or miss during firing with the ATC armament);
► considering the terrain conditions (cross country, desert, mountainous), season, daytime, weather

The system of simulators provides the coverage of combat work operations of ATC crew at level not less than 80%
3.3. High quality visualization of background and target conditions

- perspective, clarity and clearance of image
- detailed development of terrain relief, compliance of color palette with the real background
- compliance of the angular dimensions, shape, colour, contrast of local objects, plants, land targets with the real objects in the field of view of optical devices in ATC
- adequacy of the motion characteristics of moving objects (targets) and ATC
- adequacy of visual, sound and motion effects in simulator operation and firing

View of background and target conditions from external guided camera at instructor’s workplace
3.4. Creation of common tactical area for ATC platoon in tactical simulator

Software of the tactical simulator provides:
► simultaneous function of platoon integrated simulators in a common simulated tactical environment in the real-time according to the place of each ATC in battle array and battle mission;
► representation of enemy forces and facilities disposition and own forces with necessary level of details;
► possibility to grow the tactical situation, use of tactical “jumps” according to purpose of trainings and manoeuvres;
► proper considering of the combat tactical and technical characteristics of enemy’s armament and own forces, missile and ammunition presence before the beginning of battle and its consumption;
► simulation of enemy firing to own sub-units and enemy actions considering possible variants of enemy decisions for the battle, considering the weapon application and actions of own sub-units;
► the features of evaluation of results of commander decisions;
► replay of tactical situations and battle episodes.

Studies and training with use of tactical simulators
► Working-out the full range of battle organization and running.
► Running of two-side battle in various conditions against well trained enemy.
► Managing over platoons and fire during the battle.
► Working-out the most effective tactical tricks and methods of solving the complex fire and tactical tasks.

Concordance by
Intention and methods
Grade levels
Time of running

Studies and training with use of combat materiel and simulation facilities on a real terrain
► Working-out of the extension, deployment to battle array, running the offensive battle.
► Taking defence stand and its running.
► Manoeuvre during the battle.
► Control of independent tricks and methods of solving the fire and tactical tasks.
4. INSTRUCTOR’S WORKPLACE

**Purpose**
Instructor’s workplace is intended for managing over the process of crews or sub-units studying and training, controlling of its actions in completing the educational tasks.

The software of computing complex works under the Microsoft Windows operating system and has simple graphical interface.

**Instructor’s workplace provides**
- determination of order and choice of training conditions and modes
- registration of trainee crews and sub-units
- control the trainee actions and managing over the training process (corrective actions in running of exercise, repeat of single exercises elements and tactical situations, change of training conditions)
- forming the mark for completing of the firing and driving exercises
- analysis of trainee actions during the training, performance evaluation of decisions taken by trainee during training
- analysis of dynamics of trainee skills
- forming of the individual studying and training programs
- objective evaluation of the attainment level of crews and sub-units
5. TRAINING AND METHODICAL FEATURES OF THE SYSTEM OF SIMULATORS

1. Providing the effective solution for 70% of tasks defined by combat drill program for mechanized sub-units of Land forces.

2. Working-out of fire and tactical training tasks in various conditions (cross country, mountainous, desert terrains, in the day or night, in winter or summer, in different weather conditions).

3. Providing the main stages of combat training – individual training, training in a crew, combat coordination in a platoon.

4. Providing the study principle “from simple to complex”, realization of individual training approach, providing the study and training continuity.

5. Organizational and methodical connection of studies and trainings on simulators with tactical studies and trainings in a battlefield.

6. Objective evaluation of attainment level for each specialist, the crew, sub-unit, determination of dynamics of skills and coordination level.

7. Controllability of the study and training process, changing of training process intensity.

8. Decrease of conventionality of studies and training, approximation of studying conditions to the combat ones.

### 6. BASIC TECHNICAL FEATURES

<table>
<thead>
<tr>
<th>Type of simulator</th>
<th>Integral adequacy</th>
<th>Power consumption, KWH</th>
<th>Weight, kg</th>
<th>Area room, sq.m.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driving simulator on a motion platform</td>
<td>&gt;0,8</td>
<td>6,6</td>
<td>1 200</td>
<td>20</td>
</tr>
<tr>
<td>Gunnery simulator on a motion platform</td>
<td>&gt;0,8</td>
<td>2,5</td>
<td>1 200</td>
<td>20</td>
</tr>
<tr>
<td>Integrated simulator on a motion platform</td>
<td>&gt;0,8</td>
<td>5,5</td>
<td>1 200</td>
<td>30</td>
</tr>
<tr>
<td>Platoon (tactical) simulator</td>
<td>&gt;0,8</td>
<td>18,0</td>
<td>3 000</td>
<td>120</td>
</tr>
</tbody>
</table>

Power supply of simulators is carried out by three-phase AC network 200V, 50Hz; Warranty period of simulators is 12 months with unrestricted operating time. Warranty term starts from the date of commission of simulator to the Customer.

**Technical documentation**
Set of simulator includes the raw of operational documentation. Set of documentation includes:
- logbook
- operation manual
- manual for assembling and tuning at the place of installation
- spare parts list
7. MILITARY AND ECONOMIC EVALUATION OF THE SYSTEM OF SIMULATORS

Involving of the system of simulators into the combat training practice allows:

1. To realize the main principles of combat training
   ► to make a combat training the real basis of all forces activity
   ► to exclude simplification during studies and manoeuvres
   ► to create the study conditions approximated to the real combat ones
   ► to provide the intensive training of all sub-units staff
   ► to provide the objective control of crews training and sub-units coordination level

2. To solve the combat training tasks
   ▼ to teach crews with different tricks and methods of combat operations in the sub-unit, effective use of armament in complex conditions of combat situation, in the day or night
   ▼ to work-out commander skills of continuous sub-units direction and firing in the battle
   ▼ to prepare sub-units for running the effective and coordinated actions in modern battle
   ▼ to form the crews’ high fighting morals

3. To decrease the combat training expenditures by 70-80% on conditions of achievement of necessary attainment and combat coordination level

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Dynamics of level of operator’s attainment

Expenditures for mechanized company combat training using different study and training basis

- Traditional form of training
- Training on the simulators system basis

Training on the simulators system basis
- Training on the simulators system basis
- Traditional form of training