

## **Fire-fighting training simulator**

# JAKUB FIRE



# FIRE-FIGHTING TRAINING SIMULATOR JAKUB FIRE

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*Statistics of traffic accidents are still worrying and their consequences alarming. Involved vehicles are often set on fire. The risk increases enormously for endangered persons. Fire puts high requirements on early arrival of help, technical level of action, coordination of rescue operation, skills and cooperation of rescue teams. Rescue of persons from burning vehicles also means high risk for them.*

*Training of fire-fighting and rescue forces in liquidation of fire of vehicles and rescue of endangered persons have own specifics. It requires creating various model situations, which verify effectiveness, of chosen procedures and create, develop and test special skills and abilities of the rescue team when extracting and rescuing endangered persons. It is also important to model risk factors when simulating operation.*

*Creating model conditions and providing simulation of requirements and activities for effective eradication of fire and rescue of persons from burning vehicles assumes that adequate training means are used for the training.*

*Fire-fighting training simulator JAKUB FIRE fulfills all requirements of effective, intense, safe as well as ecologically acceptable training of eradication of fire in vehicles and extraction and rescue of endangered persons.*

## FUNCTION

**Fire-fighting training simulator JAKUB FIRE** is a modern training facility with wide range of model conditions, situations and activities for training of effective dealing with critical situations involving fire and rescue of persons. It is one of training elements of Fire-fighting and Rescue Training System JAKUB (HZVS).

Fire-fighting training simulator JAKUB FIRE thanks to its multi-functionality allows:

### **a) training of fire-fighting and rescue activities in case of traffic accidents**

- coordinating rescue operations in case of traffic accidents,
- fire-fighting evaluation of causes, scope and consequences of danger to persons in crashed vehicles,
- protection of endangered persons in crashed vehicles in case of growing danger (fire, hazardous substances, smoke etc.),
- first aid to persons in danger,
- liquidation of fire in vehicles,
- liquidation of hazardous substances from crashed vehicles,
- extraction of endangered persons from burning vehicles,

- extraction of endangered persons from vehicles contaminated by hazardous substances,

#### **b) training of fire-fighting and rescue activities in closed spaces**

- controlling rescue activities in closed spaces,
- fire-fighting survey of closed spaces,
- movement of fire-fighters in closed spaces with direct danger of fire or explosion of inflammable gases and vapors of inflammable liquids,
- liquidation of fire in closed spaces,
- extraction and evacuation of endangered persons from closed spaces,
- liquidation of burning canisters containing inflammable liquids,
- liquidation of burning pressure vessels with inflammable gases,
- evacuation of hazardous substances from closed spaces,
- ventilation of smoked closed spaces,
- situational measurement of temperatures in closed spaces and on surfaces of stored materials,
- cooling of inside spaces endangered by fire, inflammable gases and vapors of inflammable liquids.

**Fire-fighting training simulator JAKUB FIRE** offers effective and intense training for:

- professional fire-fighting rescue forces,
- volunteer firemen units,
- medical rescue forces.

The simulator can also be used for training of securing the place of a traffic accident and rescue of endangered persons also for other groups of persons, which are potential participants of traffic accidents:

- policemen – state police, foreign police, customs administration police, municipal police.
- soldiers – members of automobile units and army drivers, army rescue forces, army forces and peace corps.
- employees of transportation institutions – drivers and crews of trucks and personal vehicles, bus drivers and organizing heads of recreational trips.
- population – school children, special interest groups of population and pupils and students of different types of school with rescue elements.

**Fire-fighting training simulator JAKUB FIRE** complies with the following requirements:

- a) simulation training – training of specialists allowing perfect mastering of individual partial activities in case of traffic accidents and critical situations in closed spaces,
- b) situational training – training of specialists for mastering complex tactical situations by teams of specialists (preparation of an operation, managing operation, carrying out operation, communication, safety etc.)
- c) methodological training – training of specialists with examples, control, evaluation, succession and continuity,
- d) safety training – training of specialists carried out on models of crashed vehicles and closed spaces with high level of passive and active safety elements,
- e) ecological training – training of specialists, with limited negative impact on the environment,
- f) economical training – intense and frequent training of specialists using training facility with high level of robustness.

## **CONSTRUCTION**

**Fire-fighting training simulator JAKUB FIRE** is a modular construction system. Using modules it is possible to create various dimensional and functional variants of the simulator.

The basic module of the construction of mobile fire-fighting training simulator JAKUB FIRE is a steel self-supporting object with dimensions:

<b>Length: 12 m</b>	<b>Width: 7 m</b>	<b>Height: 5 m</b>
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**In basic variant** the simulator complies with all specified training and safety functions.

**In extended variants** the quantitative parameters of the simulator and its use for training, e.g. number of training persons, number of crashed vehicles and more generous concept of rescue operation. In these cases the basic modules can be interconnected in length and width to create larger constructional and functional wholes, while using one technological facility.

**Fire-fighting training simulator consists of:** 1. skeleton of the simulator, 2. training area, 3. coordinating and observing area, 4. technological part, 5. additional facilities.

## 1. SKELETON OF THE SIMULATOR

Skeleton of the simulator (container) consists of:

- a) carrying steel construction
  - made of roll profiles that are welded and screwed,
  - carrying construction guarantees static stability of the entire simulator,
- b) cladding of the walls
  - steel profile plates attached to the load carrying construction,
  - surface finish is colored and treated with anticorrosion finish,
- c) roof
  - reinforced with steel girders with steel plates and surface finish,
- d) floor
  - reinforced with steel girders with steel plates,
  - between the floor of skeleton of the simulator and the foundation there is dilatation gap for ventilation and technological elements,
  - in the area under the training facility the floor of the skeleton creates a tub for capturing pollution from training, which is drained from here into cleaning facilities of the simulator.

## 2. TRAINING AREA

Training area of the simulator takes up significant part of it. The construction and functionality of the area are designed for training purposes. Into the training area the user can put various hazardous items, materials and vehicles and simulate their accident with deformation, fire, leakage of operational liquids, manipulation and rescue of endangered persons.

The training area of the simulator allows extinguishing simulated fire by high-pressure water, air-mechanical foam, extinguishing powder, gas extinguishing substances and their combination. It consists of inside steel cage with dimensions  $l=11.5$  m,  $w=5$  m,  $h=4.25$  m, which is installed into the skeleton of the simulator. Between the inside cage and the outside skeleton there is a dilatation gap of 0.25m, which provides outlet for heat from the walls of the cage, cooling of the inside cage and prevents adverse effects of heat on deformation and static of the carrying construction of the simulator skeleton.

Walls of the cage, ceiling and floor are covered by fire-resistant material. The floor of the cage contains movable rail for outlet of exhaust from the training into the tub.

Both short sides of the training area have closing and lockable two-wing gates with total size:  $w=4$  m and  $h=4$  m

Each of the long sides contains closing and lockable emergency door exit of size:  $w=1$  m and  $h=2.5$  m.

Training area is provided with various technological facilities of the simulator simulating fire, smoke, heat etc.

Training area can be set as:

- a) **Monolithic** (single space) – for training of different variants of traffic accidents,

- b) Separate single-floor** – for training of different variants of activities in closed space. Using mobile vertical partitions the training area can be divided into functional parts with open and closing door openings and various training facilities (gas bottles, canisters, furniture etc.)
- c) Separate two-floor** – for training of different variants of activities in closed spaces divided by means of mobile vertical partitions into functional parts and using mobile assembled ceiling into two floors.

### 3. COORDINATING AND OBSERVING AREA

Coordinating and observing area with dimensions  $l=6m$ ,  $w=2m$ ,  $h=3m$  is located in one of the longer sides of the skeleton of the simulator. It is a working place for the operator of the simulator coordinating the simulation and observing persons and switching shift personnel. It contains control panel with controlling elements for all technological processes, warning signals and optical and acoustic effects. The outlook into the training area contains safety windows for monitoring the training. Lockable door leads to the training area and outside area of the simulator. Between controlling and observing area, training area and other areas (preparing shift, emergency etc.) there is main and backup connection.

### 4. TECHNOLOGICAL PART

Technological part of the simulator allows controlled simulation of all training stimuli. It consists of central part, located on the control desk of the operator, and peripheral technological elements, located inside of the training area, as well as outside of the simulator.

- a) facility for simulation of fire** allows controlled application of fire in:
  - vehicle
    - in engine part,
    - cabin,
    - cargo part,
    - under the vehicle.
  - closed space
    - on the floor,
    - on the walls,
    - under the ceiling,
    - various objects (canisters, pressure bottles, furniture, etc.)

The facility for simulation of fire using gas consist of: 1. source of gas, 2. gas mains, 3. gas burners, 4. control unit.

1. The simulator is fitted for two sources of gas:

- liquid gas – LPG is located in independent reservoir with volume greater than 500 l,
- natural gas – simulator is connected to low-pressure pipe of natural gas,
- combination of both sources.

2. Gas mains from training area of the simulator are made of prescribed pipes with regulated flow located in the outside area of the simulator, on the outside of skeleton and in dilatation gaps between the outside skeleton and inside cage of the training area in the simulator.

3. Gas burners from commercial supply with different outputs are located in dilatation gaps and lead to different rooms of the training area.

4. Control unit for simulation of fire is located on the control panel of the operator and when necessary also on portable electronic controller. It allows opening and closing the gas inlet, as well as initiation and termination of fire simulation.

Manual backup and emergency STOP buttons to terminate processes of simulated fire are also located in the coordinating and observing area and in the training area.

Automatic control of gas inlet into the burners is activated automatically when extinguishing fire, when extinguishing concentration was reached, reducing the temperature to the required temperature and when required intensity of extinguishing substances was reached.

**b) Facility for simulation of smoke** allows controlled application of smoke in

- vehicle
  - in engine part,
  - cabin,
  - cargo part,
  - under the vehicle.
- closed space
  - as a whole,
  - parts after partitioning,

The facility for simulation of smoke consists of: 1. source of smoke, 2. smoke mains, 3. smoke jets, 4. control unit.

1. Simulator allows three variants of smoke:

- dummy smoke (stage smoke),
- industrial smoke,
- smoke shell.

2. Smoke mains in case of industrial variant consist of pipes, which in parallel follow the gas mains for simulation of fire. In case of stage smoke and smoke shell, smoke is applied locally.

3. Smoke jets with different outputs are located in dilatation gaps and locally lead to selected rooms of the training area.

4. Control unit for smoke is located on the control panel of the operator and also on portable electronic controller.

**c) device for simulation of acoustic effects** allows controlled application of

- warning sounds and signals,
- situational acoustics of endangered area.

Device for simulation of simulation of acoustic effects consist of: 1. source of acoustic effects, 2. mains for acoustic effects, 3. speakers, 4. control unit

1. source of acoustic effects is a commercial device playing records and reproductions of real sounds.

2. mains of acoustic effects are wire and lead parallel to the gas mains for simulation of fire and smoke.

3. speakers are located in the training area in places, where they cannot be exposed to fire and high temperature.

4. control units for application of acoustic effects is located on the control panel of the operator.

**d) air-conditioning facility** of the simulator allows:

1. ventilation of air from the training area,
2. heating the inside of the training area,
3. cooling the inside of the training area,
4. cooling the dilatation gap between steel skeleton of the simulator and the steel cage of the training area.

1. ventilation of air provides overall exchange of air inside of the training area within 5 minutes.

2. heating and cooling of the inside of the training area is provided by air-conditioning facility in temperature range from -20°C to +40°C.

3. control unit of air-conditioning is located on the control panel of the operator.

**e) facility for filtration and cleaning of waste products of training** provides:

- filtration of all waste products and capturing solid particles,
- cleaning oil products,
- biological cleaning.

Three-stage system for cleaning waste products consists of: 1. filtration unit, 2. cleaning facility for oil products, 3. biological cleaning unit, 4. sewerage.

Control elements for the cleaning facilities are located on the control panel of the operator and locally on the devices.

Cleaning and control of outcomes are carried out according to valid ecological standards and legislation for the protection of environment.

The filtration and cleaning facility is portable and it is an inseparable part of the simulator. If the place of installation allows connecting the simulator to local stationary system – portable facilities of the simulator need not to be installed.

## **6. OTHER FACILITIES**

Other facilities of the simulator can be used to provide for material requirements of simulated training processes. It consists of:

- training figures with fire-resistant surface treatment of clothing
- portable thermometric tools:
  - thermo-vision,
  - pyrometer,
  - contact thermometers,
- radios,
- maquettes of vehicles for simulation of fire in different parts of vehicle,
- vehicles for simulation of traffic accidents in closed areas,
- canisters with “hazardous” liquid, models of gas bottles, steel cases with “unknown” materials,
- functional models of explosive and smoke objects,
- wooden furniture mattresses, pillows, etc.
- mechanical manipulation system for positioning vehicles..