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## The Module for Inside Fire Fighting in Remote Areas

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# The Module for Inside Fire Fighting in Remote Areas

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**Abstract.** Analysis of existing designs showed that for the basing of the module on vehicles it is possible only with the use of load-lifting equipment with a load capacity of 5-6 tons, which is not always possible to realize in remote areas. The design of the module for extinguishing residential and industrial premises in remote settlements, as well as for their protection against forest fires, is proposed in the form of a draft design. The modules can also be used as a reserve of fire fighting equipment in district centers, as well as in specialized forest divisions of the GUIN system. The fireman module is designed for installation on trucks with a platform having openable sides, a load capacity of 4 or 6 tons without changing their design and without the use of load lifting mechanisms. The module has indicators of technical characteristics similar to those used in fire protection for road tankers, but significantly less. Its use does not require the purchase and maintenance of a fire truck with a driver, the construction of a fire station, the cost of operation is minimal.

## 1. Introduction

The forest fire protection is one of the most important problems of modern age. The problem solving of effective fire control requires the creation of such fire-fighting equipment that would meet the requirements of forestry in firefighting equipment and at the same time would not cause tractors and vehicles decommissioning [1].

## 2. Relevance, scientific significance of the question

According to the information of the Ministry of Emergency Situations of the Krasnoyarsk Territory about three thousand villages here are located at a distance from the regional centers this fact does not ensure the timely standard arrival of fire fighting vehicles. Moreover, the poor condition of roads or even their complete absence in muddy season make the problem of houses and industrial facilities fire protection in remote areas too relevant. There are fire brigades in a number of remote villages, but they are supplied as a rule only with fire power pumps.

If there is fire in a village in windy weather, the fire effects can be tragic. The availability of fire power pumps without providing them with water supply (a water pipe line in small villages is absent, as a rule) doesn't solve the problem of fire control in remote areas. The houses there still have got signs with a painted bucket, a fire hook, a shovel people should come to a fire with. A fire equipment storage in a separate room does not solve the task of fire brigade operate deployment.



Fire fighting vehicles in regional centers aren't used frequently too, their number is limited and the increasing of fire teams number is irrational, first of all according to economic calculations. At the same time because of large fire sizes the reserves coming from nearby regional centers or towns can take several hours.

### 3. Problem formation

The villages equipping with modern technical firefighting means or reserve forces maintenance in regional centers is impossible. The way out of this situation can be the development, producing and villages equipping with fire modules, which look like a self-contained fire fighting vehicle superstructure, it is used only in fire time and is kept up in arms standby.

There is experience of fire modules building in Russian forestry sector, where portable fire tanks for logging tractors were produced (1957 – 65 - DSP and etc.), as well as the module for tracked cross-country vehicle the GAZ-71 designed by the Far Eastern Forestry Research Institute with small batch production in 1990. The benefits of above modules are the possibility of using available firefighting vehicles in villages for fire control. As for drawbacks – the installation of the Far Eastern Forestry Research Institute module must be done in advance, as it takes 4-6 hours and requires the presence of a crane truck.

### 4. Theoretical part

In 1993 the forest fire module MF-4 was developed, produced and recommended for serial production. The module design provided its installation on any models on-board vehicles with appropriate carrying capacity by the forces of one driver for 4 to 6 minutes without using special lifting equipment. When fire team works, module installing time on a vehicle is reduced to 1 - 2 minutes. At the end of firefighting the module is dismantled from a vehicle that makes it possible to use for its designated purpose [2].

The module looked like a container, the front end of which was made in the form of a water tank, and on the side frames of the back end there were shelves in the form of cells opening from the center body section, equipped with a landing ramp. There were set telescopic pads with screw jacks in the bottom of the module. The module was accompanied with fastener assemblies for timber trucks and logging tractors.

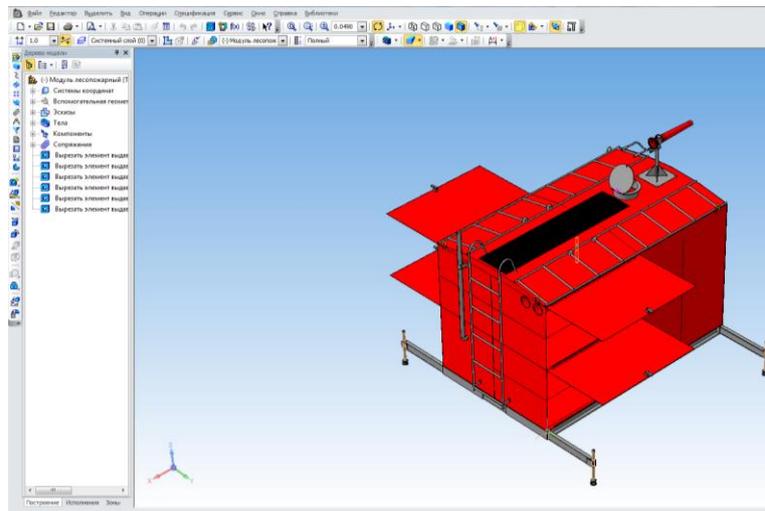
The complete set of the MF - 4 module included backpack forest sprayers BFS-M (5 pcs.); a petrol-driven saw "Taiga-214" (1 pc.); a power pump PMP-1L on the basis of a petrol-driven saw "Druzhba-4" (1 pc.); 26 mm in diameter hoses on reels (240 m); a hand-held branch (1 pc.); a wye (1 pc.); a 51-26 mm adapter (2 pcs.); a set of hand tools for parachute jumpers and paratroopers LK-3; shovels (3 pcs.); fire guns (3 pcs.); a forest fireproof portable blower BFP-2,5 (2 pcs.); a pull module MP-1 for control strips laying (1 pc.); cans for water and petroleum products (4 pcs.); crash helmets (6 pcs.); a first aid kit (1 pc.); respiratory protection equipment (6 pcs.).

The water supply in the module tank is 4 m<sup>3</sup>, the filling time of the tank by means of a power pump is 11 min, the time for a 100 m long hose line laying is 10 min., the overall dimensions are 3 x 1.8 x 1.8 m, the operating weight is 6300 kg.

The module equipment set made it possible to lay out 0.6 m wide control mineralized strips, to put out ground fire with an airflow using blowers; to play water to the forest fire edge and for refilling backpack forest sprayers BFS; to lay out control strips with hand tools; to lay out and reel in hose lines; to make back fire; to put out fire edge directly with help of the power pump or backpack forest sprayers BFS; to protect brigade members from forest fire disadvantages.

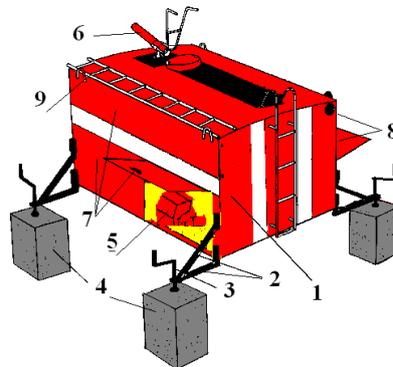
The module application made it possible to increase the efficiency of forest fire fighting in the early stages by means of general-purpose vehicles and tractors working in forest, to cut down special fire equipment costs of forestry stations, and cut down firefighting and chemical stations construction costs.

The design of the MF - 4 module does not entirely meet the requirements of firefighting system in terms of deployment efficiency, the kind of a power pump and the hoses size.



**Figure 1.** 3D pattern of fire module.

Based on the working experience with the MF - 4 module the authors propose the 3D pattern (Figure 1) module design for living and industrial rooms firefighting in remote areas. The modules can also be used as a firefighting equipment reserve in regional centers, as well as in special forest divisions of Chief Directorate for Punishment Implementation system.



**Figure 2.** The arrangement of fire module for rural settlements protection MF-1  
 1 - module body, 2 - pods, 3 - screw jacks, 4 - stands, 5 - power pump, 6 – deck pipe, 7 - equipment and tools compartments for firefighting in villages, 8 – equipment and tools compartments for firefighting in nearby villages forests, 9 – ladder.

The fire module MF-1 (Fig. 3) is intended for installation on platform trucks with opening sides, with 4 or 6 tons' load-carrying capacity without the using of materials-handling vehicle or systems.

The module has technical characteristics similar to tank trucks used in firefighting system, but it has much lower cost. Its application does not require the buying and maintenance of a fire truck with a driver, the fire station construction, its maintenance cost is minimal. The module complete set meets the requirements of the Russian Federation firefighting system.

The firefighting capacity of the edge of forest ground fire with high, medium and low water rate along hose line is 200 - 400, 400 - 600 and 600 - 1000 m/h, at a fire flow of 3, 2 and 1 dm<sup>3</sup> per 1 running meter of the fire edge. On condition that a fire seat is 200 m as a maximum far from the module a fire flow will be 180, 120 and 60 m<sup>3</sup>/min, respectively. By a long distance from a fire seat a hose line can be used for BFS filling [11].

## 5. Practical significance

The special features of the proposed modules are:

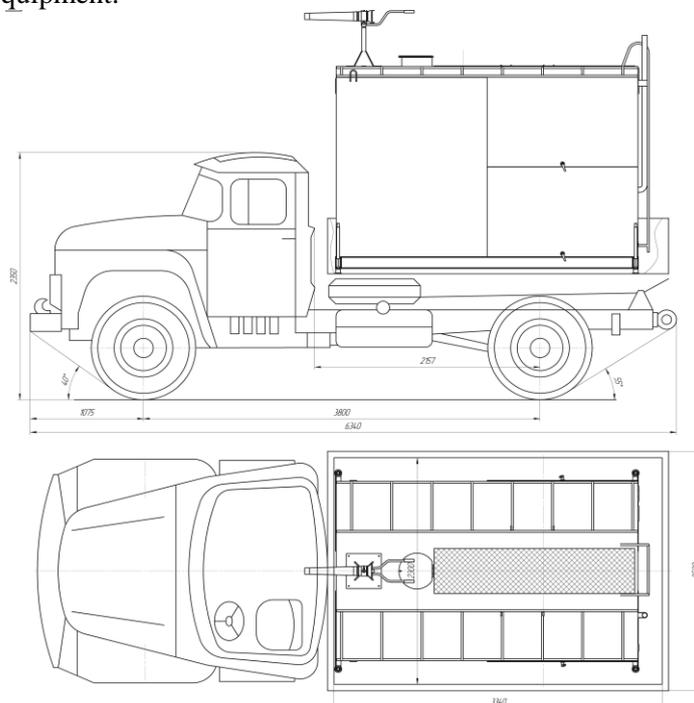
- the providing of fire equipment, tools and life support means keeping up in arms in time between firefighting using;
- rapid trucks re-equipment into a firefighting vehicle without using of load-lifting mechanisms;
- efficient water and fire equipment delivery to a fire point;
- water supply along hose line or by means of a deck pipe to a fire seat;
- wetted control strips laying and back fire making (clean burn) to protect the villages from forest fires.

The module has technical characteristics similar to tank trucks used in firefighting system, but it has much lower cost. Its application does not require the buying and maintenance of a fire truck with a driver, a fire station construction, its maintenance cost is minimal. The module production doesn't need expensive and nonferrous metals and alloyed steel; its complete set meets the requirements of the Russian Federation firefighting system.

The made technical calculations of the module base show the effectiveness of the proposed design taking into account loads acting on them from the weight of a water tank, the module pads taking into account the loads acting on them in the vertical plane from the weight of a tank, the pads screw in the module lifting mechanism, the torsion bar lifting of the bay doors, efforts for vehicle module holding, dynamic vehicle stability with the module.

The technical and economic study showed the appropriateness of the projected equipment introduction. The firefighting module application reduces the work cost due to the cost of equipment reduction and reduction of maintenance cost rate. The payback period of the projected equipment is 0.4 of a year.

The module can be produced in factory conditions or in rather equipped workshops without using sophisticated special equipment.



**Figure 3.** Firefighting module installation on a truck.

The introduction of fire modules in remote areas let reduce the damage from fires, prevent the possibility of tragic fires and destroying of living and industrial rooms.

**Table 1.** technical characteristics of the fireman module MP-1.

Name of indicators	MP-1
Constructive weight, kg	1300
Operating weight, kg	5800
Overall dimensions, mm	2,8x1,8x1,8
Water tank capacity, m <sup>3</sup>	4.0
Loading time in the body by two people, min	2 – 3
Completeness of equipment:	
pump built-in	MP1600
fire hoses 51 mm long 20 m, PCs.	6
three-way branching, PCs	1
the trunk is Used	2
axe, shovel, hook, saw, crowbar, scissors, a dielectric, a ladder-a stick, rope, pieces	1
helmets, clothing, fire gloves	5 sets
first aid kit, PCs.	2
device for laying support strips in the localization of forest fires, PCs	2
incendiary device, PCs	2

## 6. Conclusion

The application of the module will allow to solve the following tasks:

- to bring the timing of the arrival of firefighting vehicle to the fire seats in line with standards (no more than 10 minutes);
- to eliminate effectively the building inflammation in the initial stage with minimal costs and damage;
- to reduce the costs for fire equipment buying and the construction of standard firefighting system rooms;
- to reduce fire danger in near-villages forests and the transition of forest fires passing on villages buildings.

## 7. References

- [1] Karnaukhov A I 2015 Fires, Technology and practice of extinguishing [Electron. ed.]: *textbook for students of the direction 23.03.02 "Land transport and technological complexes" and 20.03.02 "nature management and water use" full-time education* (Krasnoyarsk)
- [2] Orlovsky S N 1995 Forest fire module ML-4 *Construction and road machines*
- [3] Orlovsky S N 2006 On the problem of fire extinguishing in remote villages *Agricultural science at the turn of the century Materials of regional NPK (November 30, 2005) Part 1* (Krasnoyarsk. Krasgau) 353-355
- [4] Orlovsky S N 2009 The system of machines in forestry: *Fighting peat fires* (Krasnoyarsk: SibSTU)
- [5] Kuhar I V 2009 Machines and equipment for environmental engineering: *lectures* (Krasnoyarsk: SibSTU)
- [6] Kurbatsky N P 1962 *Technique and tactics of forest fire fighting* (Moscow)
- [7] Matveev AM 1992 The Nature of forest fires and the connection with the practice of extinguishing them in Siberia (Pushkino)
- [8] Valendik E N 1979 *Large forest fires* (Moscow)
- [9] Orlovsky S N 1996 Assembly of ALT-55 for fighting forest fires *Forestry* **3** 26-27
- [10] Orlovsky S N 1995 An instrument for localization of peat fires *Forestry* **2** 34-35
- [11] Ivanov V A 2011 A Handbook on fighting wildfires *The Expansion of the PA network for conservation of the Altai* (Krasnoyarsk)