MLRS “GRAD”

AND IT’S MODIFICATIONS

"G-M" ROCKET

"G-M" rocket is basically a refurbished original rocket GRAD. The overhaul objectives were just a few changes resulting in the best possible performances.

WHY THE OVERHAUL?

- The lifetime of the existing rocket has been extended for another 10 years
- Considerable range increment (see Diagram D-1)
- Saving of financial funds
- Packing of the rocket, launcher and logistics remain the same
- No additional training of personnel for its application is required
- The overhaul is easy, quick and carried out with the Customer

The modification is primarily made in the propellant grain (which has the shortest life). The new propellant grain is in one piece, star shaped and inhibited along the outer surface at one end. The rocket propellant used in its production is the modern thermoplastic composite propellant made according to the original technology. The propellant has a similar burning temperature as the original one, but has a higher specific impulse, which enables the use of the original nozzle assembly. The propellant grain is not bounded to the new motor combustion chamber, which enables the overhaul of the rocket to be performed at the premises of the End User.

The overhaul of the rocket is quick and easy without requiring any special technology or machinery. By using a large number of components from the existing rockets with expired propellant grain life, the overhaul saves a lot of money if compared to supply of new rockets.

The outer appearance of the new rocket remains the same as the original one. The conditions of storage, transportation and handling remain also the same.

Main new rocket parts:

- Propellant grain
- Combustion chamber
- Motor igniter assembly
- Motor closure
- Parts for thermal isolation

Main existing rocket parts:

- Warhead with fuse
- Nozzle assembly with fins
- Rocket guide
- Contact cover
- Packing of the rocket

Schematic review of the overhaul is given in Figure 1.

OVERHAUL OF THE ORIGINAL "GRAD" ROCKET

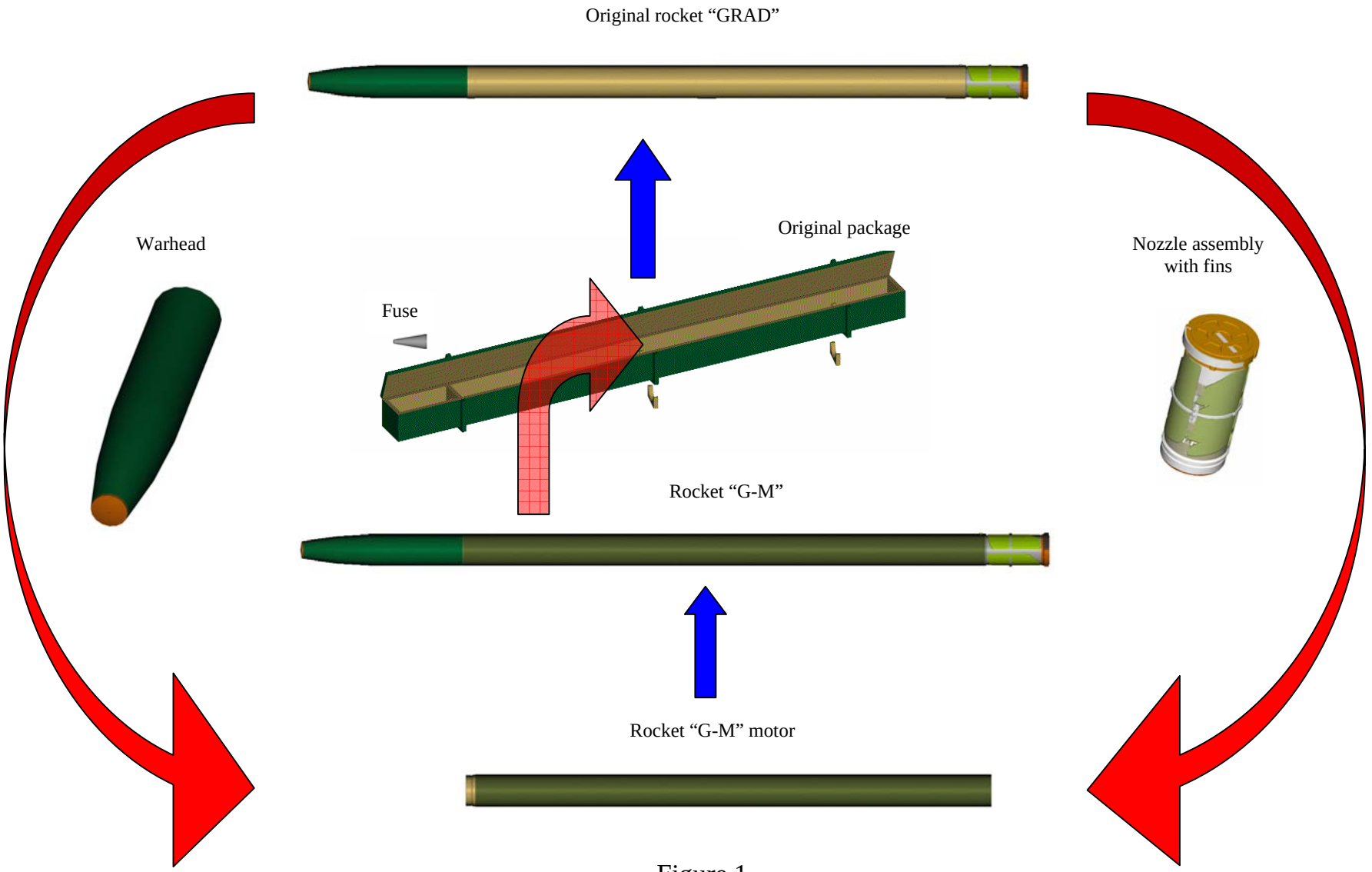


Figure 1.

Rocket "G-M" is fully compatible to the mobile multi tube rocket launchers such as BM-21 and RM-70, or similar existing launchers.

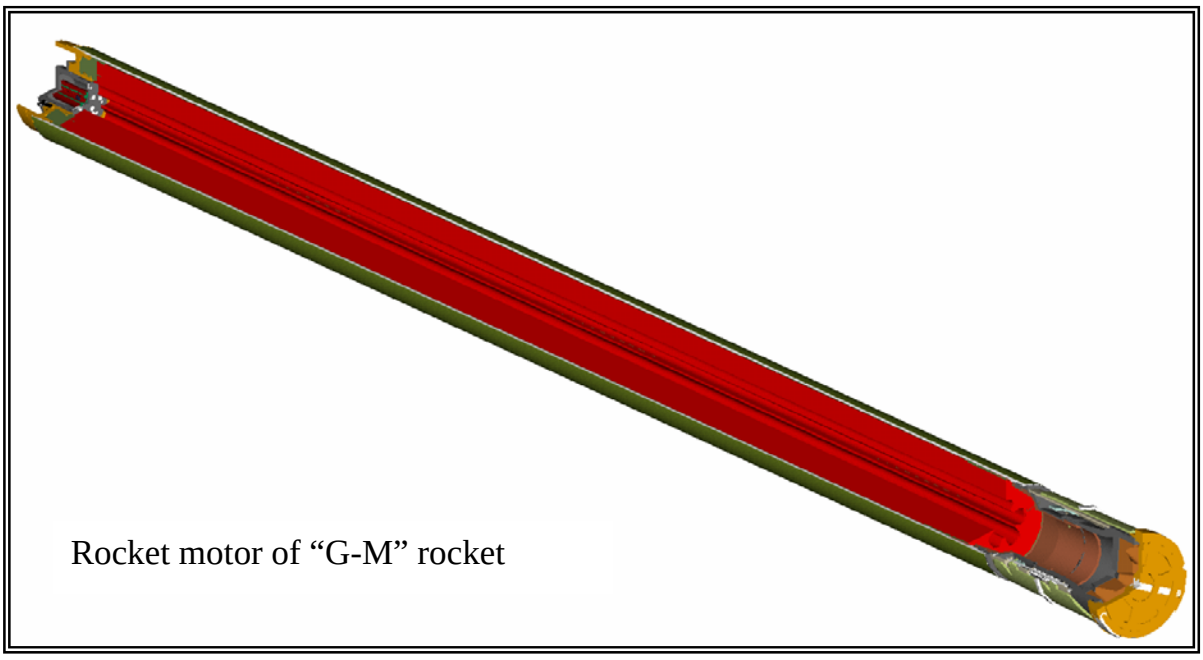
Underlining that this modified (overhauled) rockets also may use the original rings for range reduction.

The End Customer will receive a full set of all new components required for overhaul as well as the instruction manual for overhaul, quality control and acceptance of the rockets.

If the Customer is interested it is possible to supply all tools and accessories required for the overhaul as well as to train the Customer's personnel.

The modified rocket "G-M" may be delivered as a completely new rocket, without using any components from the old rockets.

In that case this rocket will be delivered in its original package with required documentation for application.



Rocket motor of "G-M" rocket

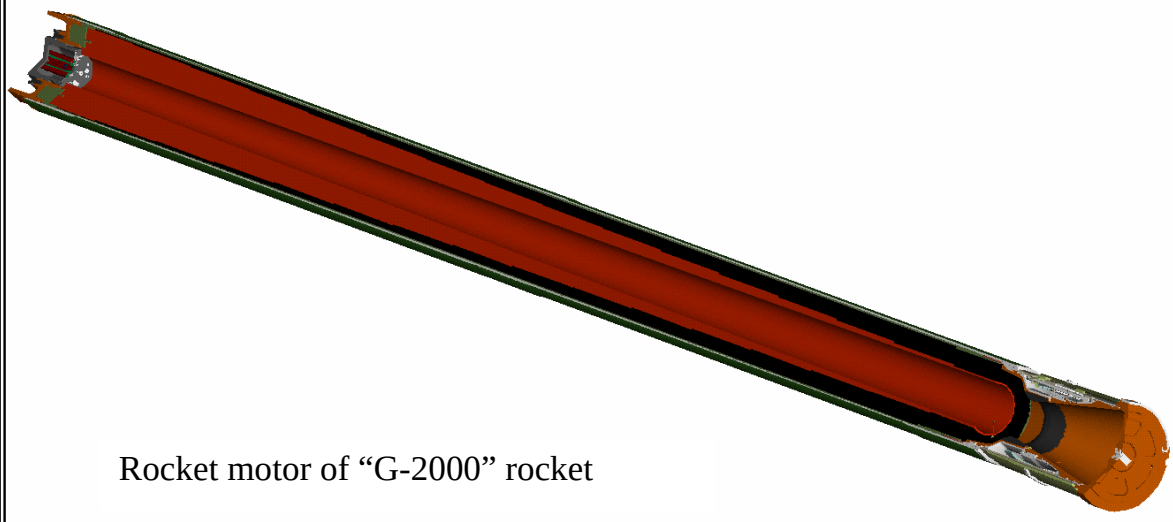
Comparative technical characteristics of the rocket are given in Table T-1. and on Diagram D-1.

“G-2000” ROCKET

Rocket “G-2000” within its caliber is currently the longest-range rocket. Its rocket motor has a completely new and the latest state-of-art design, which is also very simple. Warhead with fuse, rocket guide and contact cover are identical with the original rocket “GRAD”.

Rocket “G-2000” is fully compatible to the mobile multi tube rocket launchers such as BM-21 and RM-70, or similar existing launchers.

Underlining that this rockets also may use the original rings for range reduction.



Rocket motor of “G-2000” rocket

Propellant grain is a single piece of cylinder shape, which is inhibited along the outer surface and front end. It contains two types of propellant, which differ in the burning rate. This has resulted in a high level loading factor, almost neutral burning and the sliver has been minimized.

Rocket propellant, which is used for grain production, is a modern thermoplastic composite propellant with a high percentage of aluminium, burning temperature exceeding 3000K and high value of specific impulse.

The steel nozzle with abounded ablative material has one graphite throat.

Comparative technical characteristics of the rocket are given in Table T-1. and on Diagram D-1.

TACTICAL AND TECHNICAL CHARACTERISTIC OF THE 122mm ROCKETS "GRAD" AND THEIR MODIFICATIONS

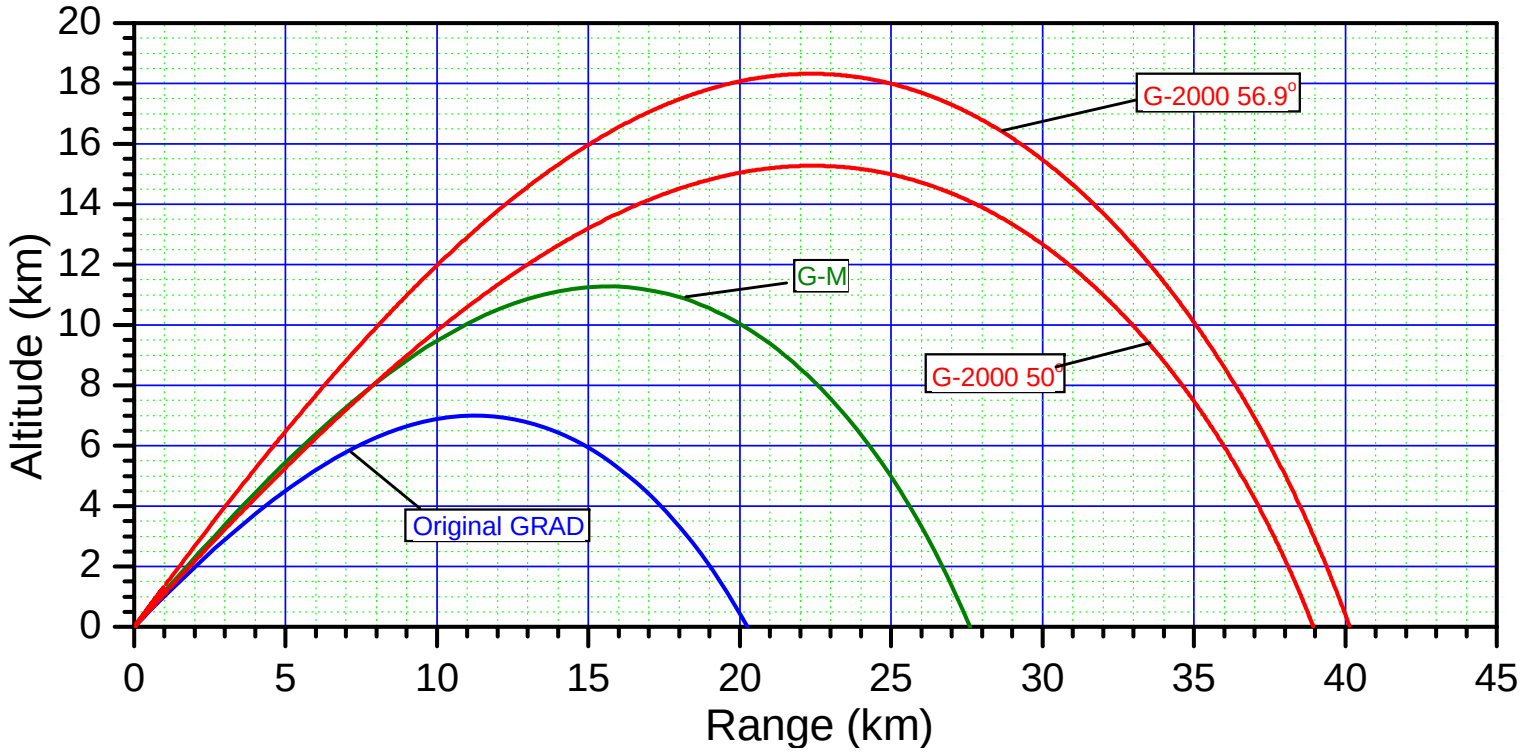
Basic characteristics of the existing "GRAD", "G-M" and "G-2000" at nominal (firing-table) conditions are given in following table.

Table T-1.

TECHNICAL CHARACTERISTICS	*"GRAD" ORIGINAL*	*"G-M "*	*"G-2000"*	*Units*
Caliber	122	122	122	**mm**
Length	2875	2875	2875	**mm**
Temperature range	-30 ÷ +50	-30÷+60	-30÷+60	**°C**
Total mass	66	68.7	69.0	**kg**
Warhead mass with fuse	19.1	19.1	19.1	**kg**
Propellant mass	20.45	25.8	27.3	**kg**
Burning time	2.0	2.5	2.7	**s**
Total motor impulse	39700	52700	62800	**Ns**
Specific motor impulse	1941	2042	2300	**Ns/kg**
Max. velocity at X_e	690.6	915	1100	**m/s**
Top of the trajectory at X_e	7100	11100	17800	**m**
Time of flight at X_e	76	96	126	**s**
Elevation	50.0	50.0	56.9	**°**
Range (Xe.)	20.3	27.5	40.2	**km**
CEP at max. range	1.27	0.96	0.96	**%**

CEP values of "G-M" and "G-2000" rockets are obtained in way that the tolerances of total mass of the rockets are kept below 0.1 kg and tolerances of the Total Impulse of Solid Rocket Motors are 0.1%.

In order to prove the quality of our rockets and accentuation of theirs advantages we are ready to perform flight tests on your or our flight-test facilities for both rockets "G-M" and "G-2000".



D-1. Ballistic trajectories of the rockets

NEW WARHEAD TYPE FOR "G-2000" ROCKET

Cargo type warhead is highly effective against armoured vehicles such as tanks, armoured personal carriers, light armoured vehicles and transport vehicles. Bomblets would be used to attack the vulnerable upper surfaces of armoured and other vehicles by cumulative, fragmentation and flammable effect.

The warhead main parts are:
- mechanical timing fuse TM 120–U or electronic time fuse type VTF-100, VTF-200
- container with hollow charge and flammable bomblets.

Rockets with cargo warheads are determined for firing single or salvo from MLRS launching vehicles BM-21 or compatible. Timing of fuse is executed by special timing key.

Cargo warhead with bomblets

Cargo warhead technical characteristics:

Length of warhead with fuse /with reducing piece/	1083 mm
Length of warhead without fuse /without plugs/	923,5 mm
Length of warhead without fuse /with plugs/	943,5 mm
Weight of warhead with bomblets /without fuse, with plugs/	23,8 kg
Weight of warhead with fuse	24,3 kg
Warhead centre of gravity, with fuse /from warhead tip/	611 mm
Thread in metal jacket for fuse	M64x3
Thread for connecting with rocket motor	M115x2

Submunition-bomblets:

Number of pieces	50 KTBP, 6 ZBP	
Weight of KTBP	0,275 kg	
Weight of ZBP	0,286 kg	
Penetration	130mm /vertical impact/ 90mm/impact angle 40°/	

Fuze TM 120-U:

Range of timing	4 - 120 sec	
Weight of fuse with reducing piece	0,9 kg	
Fuse thread/ without reducing piece/	M45x2	

Mine-laying type warhead is highly effective against armoured vehicles such as tanks, armoured personal carriers, light armoured vehicles and transport vehicles. Mine fields are possible to make on ranges from 11km up to 35 km. Each container contains 5 pieces of anti-tank mines.

Technical characteristics of the anti-tank mines and container with fuse:

Max. piercing of homogenous armour	130 mm
Number of mines in container	5 pieces
Auto-destruction time	3h or 48h ±5%
Weight of anti-tank mine	2,75 kg
Diameter of the mine	115,8±0,3 mm
Total height of mine /in container/	169 mm
Height of mine on terrain	133 mm
Height of mine with erected contact sensor	560 mm
Mine arming - executing	Contact-free, magnetic
Fuse TM-120U	0,9 kg
Thread in metal jacket for fuse	M64x3
Thread for connecting with rocket motor	M115x2
Total weight of container with plugs /without fuse/	23,6 kg
Total length of container /without fuse and plugs/	1051 mm

Mine-laying warhead

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