GENERAL ASTRONAUTICS
ARCA SPACE

CER-1200MIRTV
MULTIPLE INDEPENDENT REENTRY TARGET VEHICLE

USER GUIDE

14 October 2024, pre-release version 3

Content

1. Introduction

1.1 Overview

CER-1200MIRTV is an ecological, extremely cost effective rocket system, build as a target rocket employing a separable Multiple Independent Reentry Target Vehicle (MIRTV) for anti-ballistic training.
The rocket could be launched from the ground, from vehicles, directly from the sea, or from a ship.
The rocket vehicle together with the MIRTV is expendable, however the ground support equipment is fully reusable.
Contrary to al present-day rockets, the CER-1200MIRTV and the MIRTV booster itself use no flammable or explosive propellants, but a mixture of water and hydrogen peroxide 30%-70% making it benign for the environment, simple and cost effective.
Also, the system employs no electronics, and it has just a single valve for engine start, making it extremely easy to operate, requiring no prior aerospace training.
Another important feature of the CER-1200MIRTV and the MIRTV booster is related to the fact that the amount of propellant in the tank can be adjusted prior to launch, accordingly to the needed flight trajectory.

1.2 Applications

CER-1200MIRTV could be used as targets to simulate Reentry Vehicles (RV) launched by Medium Range Ballistic Missiles (MRBM) flying at altitudes up to 40km and high supersonic speeds of Mach 4.4.
The range of simulated targets makes the CER-1200MIRTV system suitable for users from the ground, naval and air forces.

2.Product presentation

The CER-1200MIRTV is a rocket system made of CER-1200 rocket and three MIRTV and booster, designed as a target for antiballistic applications.

2.1 Technical characteristics and performances

CER-1200MIRTV

Characteristic	Data
Diameter (body only)	1.2 m
Diameter over fins	3.6 m
Length	18.4 m
Dry weight	300 kg
Propellant weight	10,000 kg
Payload weight, maximum	1,000 kg
Launch weight, maximum	11,300 kg
Engine run time	60 s
Altitude with maximum payload	40 km
Speed with maximum payload	2.6 Mach
Launch angle from horizontal	60 - 90°

MIRTV

Characteristic	Data
Diameter (body only)	0.46 m
Length	1.5 m
Dry weight	300 kg
Propellant weight	700 kg
Launch weight, maximum	1,000 kg
Engine run time	30 s
Speed, maximum	4.4 Mach
Number of MIRTV	3

Fig.1 - CER-1200MIRTV comparison with a person.

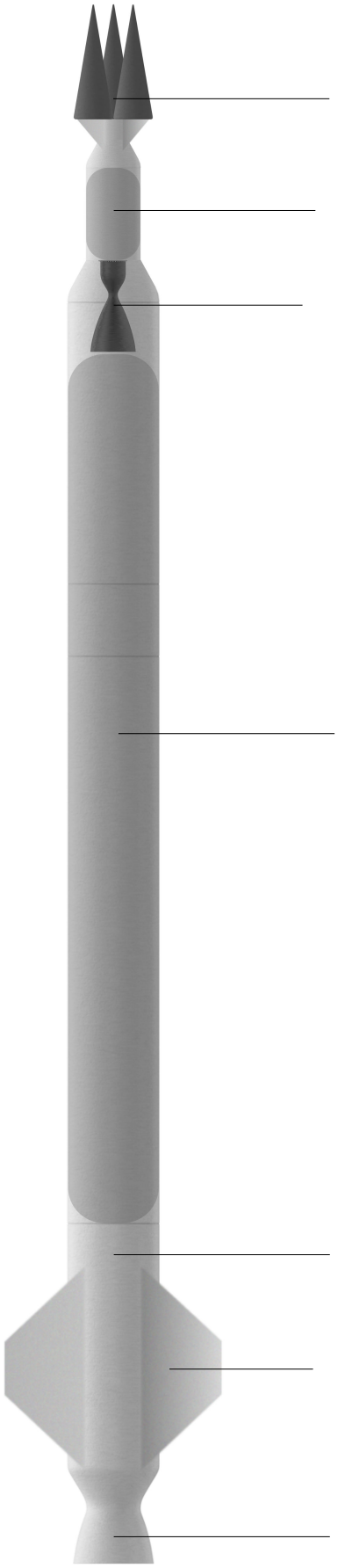
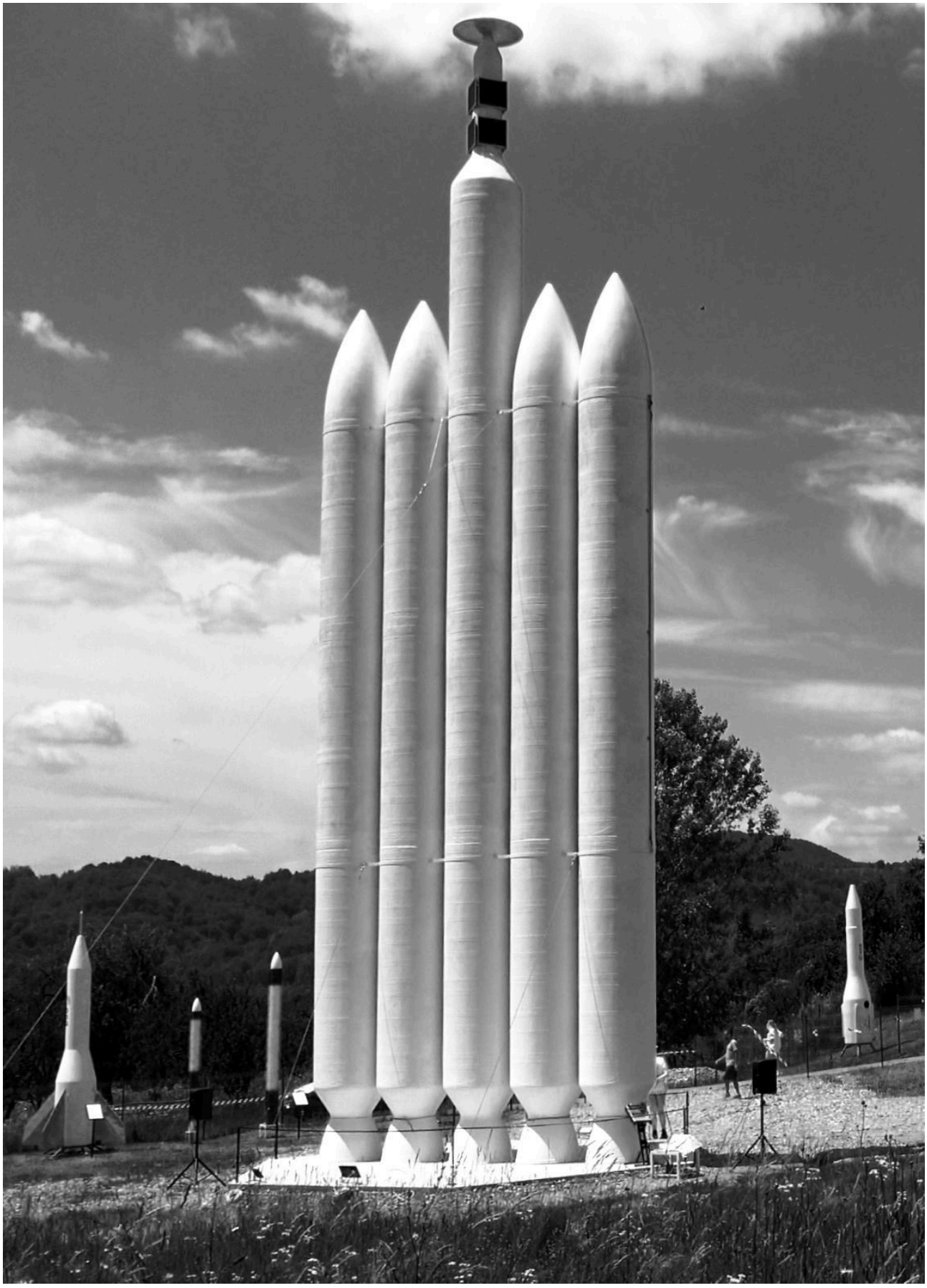
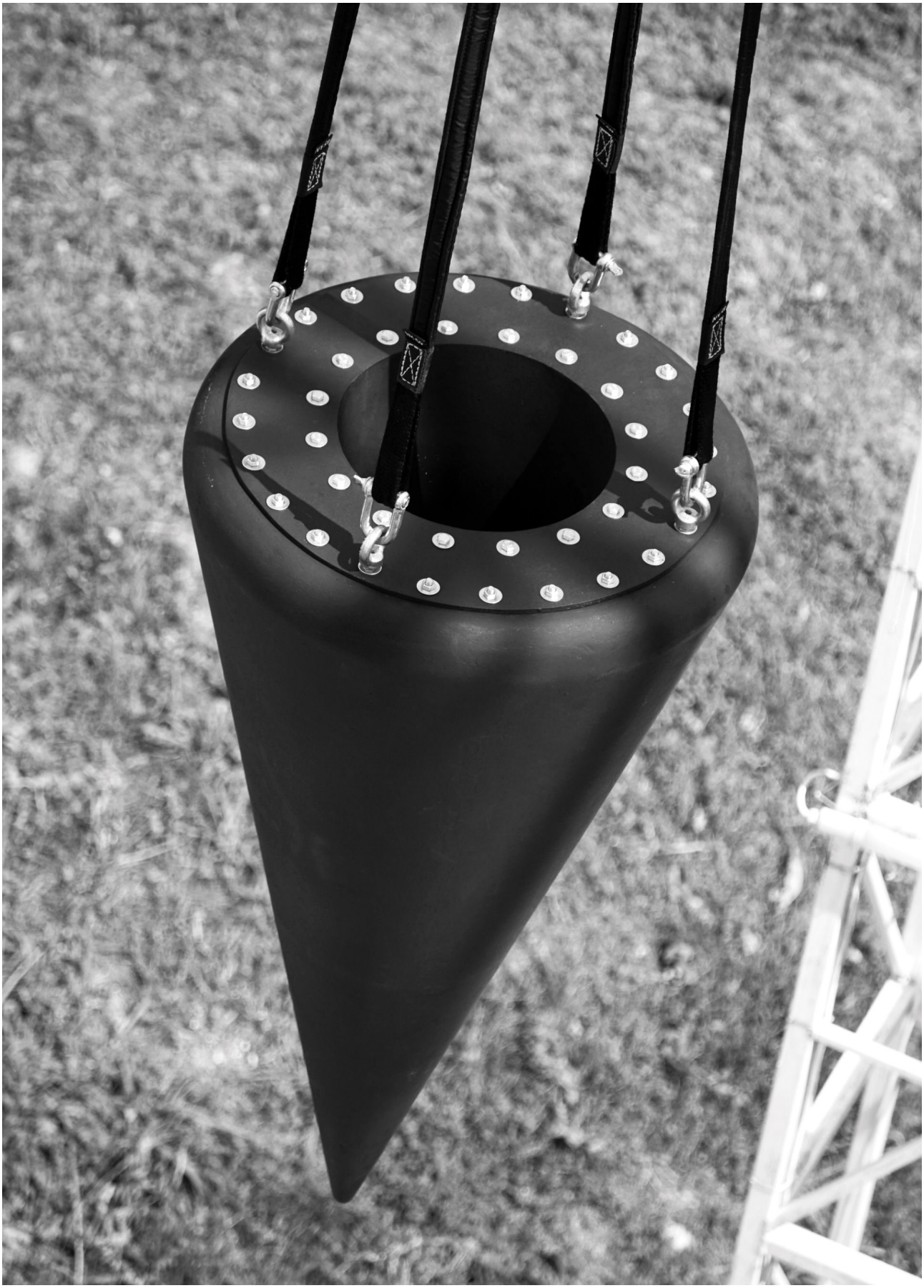


Fig.2 - CER-1200MIRTV elements



CER-1200MIRTV, four units. The MIRTV in the below photo.



MIRTV, one unit in the Dynamic test Stand (DTS).

2.2 Performance data

The performance diagram of the CER-1200MIRTV mated with the MIRTV is presented below:

- Launch angle vs. altitude vs speed vs time vs. range

The simulations are considering the maximum payload of 400 kg.
The launch angle is considered from horizontal.

CER-1200MIRTV

Launch angle	Alt.	Max. speed	Max. speed altitude
90°	40 km	2.6 Mach	18 km
80°	39 km	2.55 Mach	17.5 km
70°	38 km	2.5 Mach	17 km
60°	35 km	2.45 Mach	16.5 km

MIRTV

Launch angle	Max. speed	Max speed altitude	Range	Flight time
90°	4.4 Mach	26 km	0 km	232 s
80°	4.3 Mach	26 km	15 km	234 s
70°	4.2 Mach	26 km	30 km	230 s
60°	4 Mach	26 km	40 km	222 s

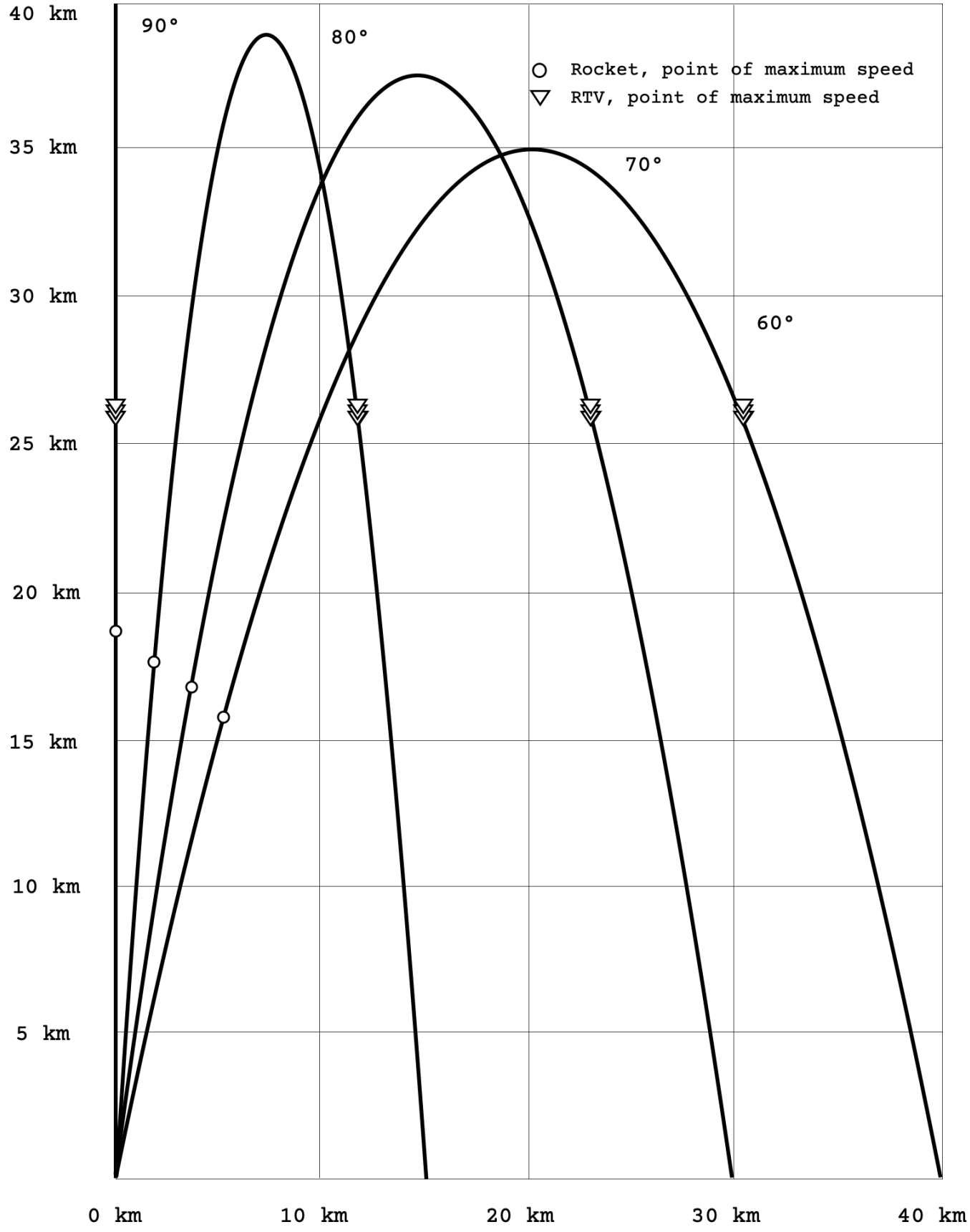


Fig.3 - CER-1200MIRTV flight envelope.

3. Ground Support Equipment

Each CER version has a dedicated ground support system needed to fuel and launch both the CER-1200MIRTV as well as the MIRTV vehicles.

3.1 Launch canister

The launch canister has a diameter of 2.4 m and it is standing 18 m tall. Inside of the canister there are two launch rails on which the rocket is sliding from the engine start until it reaches minimum velocity for stable flight.

3.2 Propellant transfer pump

The propellant transfer pump is a stainless steel, hydrogen peroxide compatible pump able to transfer the 10,000 kg and the 700 kg mixture of water and hydrogen peroxide in the CER-1200MIRTV and MIRTV tanks.

One MIRTV unit during Mission 16 drop test.

4. Prerequisites

The CER-1200MIRTV system needs three major elements that must be provided locally by the end user in order to be able to launch the rocket:

4.1 Propellant
The propellant for the CER160 rocket is a mixture of water and hydrogen peroxide in the 30-70 ratio. The hydrogen peroxide already prepared in this ratio is commercially available everywhere in the world, and sold as hydrogen peroxide 70% concentration.
The user must procure locally 10,700 kg of 70% concentration hydrogen peroxide in order to fuel the rocket and the MIRTV for launch. Also, the rocket works with 50% concentration hydrogen peroxide found in stores, but with flight performance loss.

4.2 Pressurant
After the rocket and the MIRTV are fuelled, the tanks must be pressurised at a pressure of 14 bar, prior to launch.
Various hydrogen peroxide compatible gases could be used. We recommend air from an air compressor (the most affordable option), helium (for the highest rocket performance), nitrogen, argon.

4.3 12V power source
A 12V, 5A external power source is needed. The MIRTV has it’s own internal battery.

5. Applications

5.1 List of compatible Medium Range Ballistic Missiles

The CER-1200MIRTV is suitable to simulate the flight of Medium Range Ballistic Missiles (MRBM) with Multiple Independent Reentry Vehicles (MIRVs). CER-1200MIRTV is suitable for this taking into account its similar size, weight and flight profile compared to the currently operational MRBM and MIRVs.

The following relevant MRBM that the CER-1200MIRTV could simulate are presented below compared to the CER-1200MIRTV:

- DF-16 - China
- DF-21 - China
- Agni-P - India
- Shahab-3 - Iran
- Ababeel - Pakistan

– DF-16 - China

Characteristic	DF-16	CER-1200MIRTV
Diameter (body only)	1.2 m	1.2 m
Length	7.8 m	18.4 m
Launch weight, maximum	N/A	11,300 kg
Altitude	N/A	40 km
Reentry speed, maximum	6.5 Mach	4.4 Mach
Range, maximum	1,000 km	40 km
Number of MIRV	N/A	3
Cost/unit	N/A	€294,500

– DF-21

Characteristic	DF-21	CER-1200MIRTV
Diameter (body only)	1.4 m	1.2 m
Length	10.7 m	18.4 m
Launch weight, maximum	14,700 kg	11,300 kg
Altitude	N/A	40 km
Reentry speed, maximum	10 Mach	4.4 Mach
Range, maximum	1,700 km	40 km
Number of MIRV	5-6	3
Cost/unit	~ $10,000,000	€294,500

– Agni-P

Characteristic	Agni-P	CER-1200MIRTV
Diameter (body only)	1.15 m	1.2 m
Length	10.5 m	18.4 m
Launch weight, maximum	11,000 kg	11,300 kg
Altitude	900 km	40 km
Reentry speed, maximum	N/A	4.4 Mach
Range, maximum	2,000 km	40 km
Number of MIRV	2	3
Cost/unit	N/A	€294,500

- Shahab-3

Characteristic	Shahab-3	CER-1200MIRTV
Diameter (body only)	1.2 m	1.2 m
Length	9.1 m	18.4 m
Launch weight, maximum	6,200 kg	11,300 kg
Altitude	N/A	40 km
Reentry speed, maximum	7 Mach	4.4 Mach
Range, maximum	1,000 km	40 km
Number of MIRV	5	3
Cost/unit	N/A	€294,500

- Ababeel

Characteristic	Shahab-3	CER-1200MIRTV
Diameter (body only)	1.7 m	1.2 m
Length	21.5 m	18.4 m
Launch weight, maximum	6,200 kg	11,300 kg
Altitude	N/A	40 km
Reentry speed, maximum	N/A	4.4 Mach
Range, maximum	2,200 km	40 km
Number of MIRV	3-8	3
Cost/unit	N/A	€294,500

5.4 List of compatible anti-ballistic systems

Defending against SRBM and MRBM is a task that was successfully solved in the past decades and currently there is a serious number of anti-SRBM/MRBM operational systems around the world.

The following anti-SRBM/MRBM systems that are combat-proven or tested can be used for training against the CER-1200MIRTV:

- MIM-104 Patriot - US
- MIM-23 Hawk, Phase III - US
- S-300 - Russia
- S-400 - Russia
- S-500 - Rusia
- Arrow 2 - Israel
- David’s Sling - Israel

– MIM-104 - PAC 3 - Patriot

The Patriot rocket system is one of the most combat-proven systems with a high record of SRBM and MRBM successful interceptions.

Characteristic	Data
Diameter (body only)	0.255 m
Length	5.2 m
Launch weight, maximum	312 kg
Intercept altitude, maximum	20 km
Intercept range, maximum	20 km
Speed, maximum	4.1 Mach
Cost/missile	~ $2,000,000

– MIM-23J/K Hawk, Phase III

Although unexpected due to its age, the Hawk rocket system makes this list due to the fact that it is still in service with a large number of countries and recent warhead improvements for the J/K types give the system a lower-end antiballistic capability.

Characteristic	Data
Diameter (body only)	0.37 m
Length	5 m
Launch weight, maximum	590 kg
Intercept altitude, maximum	20 km
Intercept range, maximum	45 km
Speed, maximum	2.4 Mach
Cost/missile	$250,000

– S-300V - 9M82 antiballistic rocket

Another highly successful and combat-proven system is the S-300 that is both land based as well as sea-based.

Characteristic	Data
Diameter (body only)	0.85 m
Length	9.9 m
Launch weight, maximum	5,800 kg
Intercept altitude, maximum	40 km
Intercept range, maximum	30 km
Speed, maximum	~ 7.2 Mach
Cost/missile	~ $2,000,000

– S-400 - 9M96 antiballistic rocket

Similar to the S-300, the S-400 can operate as an anti-aircraft as well as an anti-ballistic system. The 9M96 rocket is specifically designed to intercept ballistic missiles through direct kinetic impact.

Characteristic	Data
Diameter (body only)	0.24 m
Length	4.75 m
Launch weight, maximum	333 kg
Intercept altitude, maximum	30 km
Intercept range, maximum	120 km
Speed, maximum	~ 2.9 Mach
Cost/missile	N/A

– S-500

The S-500 anti-ballistic system is designed to replace the A-135 system deployed for Moscow’s defense and to increase the armed forces interception capabilities beyond the ones offered by the S-400.

Characteristic	Data
Diameter (body only)	N/A
Length	N/A
Launch weight, maximum	N/A
Intercept altitude, maximum	200 km
Intercept range, maximum	600 km
Speed, maximum	7 Mach
Cost/missile	N/A

– Arrow 2

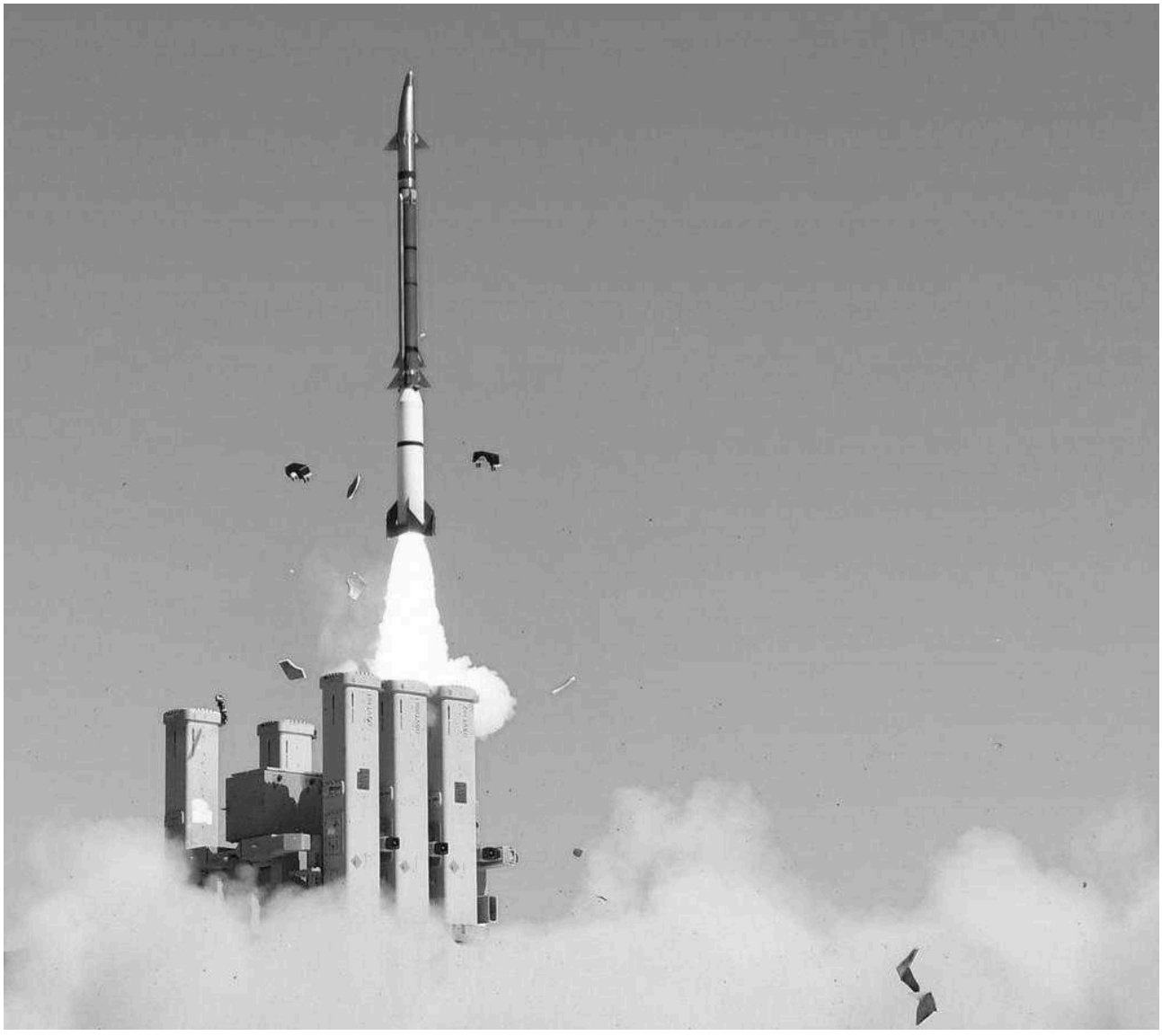
It is a dedicated anti-ballistic rocket system developed by Israel in cooperation with the US.

Characteristic	Data
Diameter (body only)	0.8 m
Length	6.95 m
Launch weight, maximum	1,300 kg
Intercept altitude, maximum	50 km
Intercept range, maximum	100 km
Speed, maximum	9 Mach
Cost/missile	$3,000,000

– David’s Sling

David’s Sling is a medium antiballistic defence system, that fills the gap between Israel’s Iron Dome and the Arrow 2 systems.

Characteristic	Data
Diameter (body only)	0.35 m
Length	4.6 m
Launch weight, maximum	400 kg
Intercept altitude, maximum	15 km
Intercept range, maximum	300 km
Speed, maximum	7.5 Mach
Cost/missile	$1,000,000



5.7 Engagement envelope for the presented anti-SRBM/MRBM systems

The following table presents the engagement envelopes for the above-presented anti-SRBM/MRBM systems.

System	Engagement altitude	Engagement range	Target speed	Time to intercept
MIM-104 - PAC3	< 20 km	< 20 km	< 3.5 Mach	< 60 s
MIM-23 J/K	< 20 km	< 45 km	< 3.5 Mach	< 60 s
S300V - 9M82	< 30 km	< 30 km	< 4.4 Mach	< 80 s
S400 - 9M96	< 30 km	< 100 km	< 4.4 Mach	< 80 s
S-500	< 30 km	< 100 km	< 4.4 Mach	< 80 s
Arrow 2	< 30 km	< 100 km	< 4.4 Mach	< 80 s
David’s Sling	< 15 km	< 100 km	< 3 Mach	< 40 s

How to read the table:

Example 1
In the case of the MIM-104 - PAC 3 - Patriot system, the MIRTV could be intercepted at altitudes up to 20 km, and speeds below Mach 3.5, with a theoretical interception time of 60 s, while the maximum engagement range is up to 20 km.

Example 2
In the case of the Arrow 2 system, the MIRTV could be intercepted at altitudes of 30 km and a speed of Mach 4.4, with a theoretical interception time of 120 s, while the maximum engagement range is 100 km.

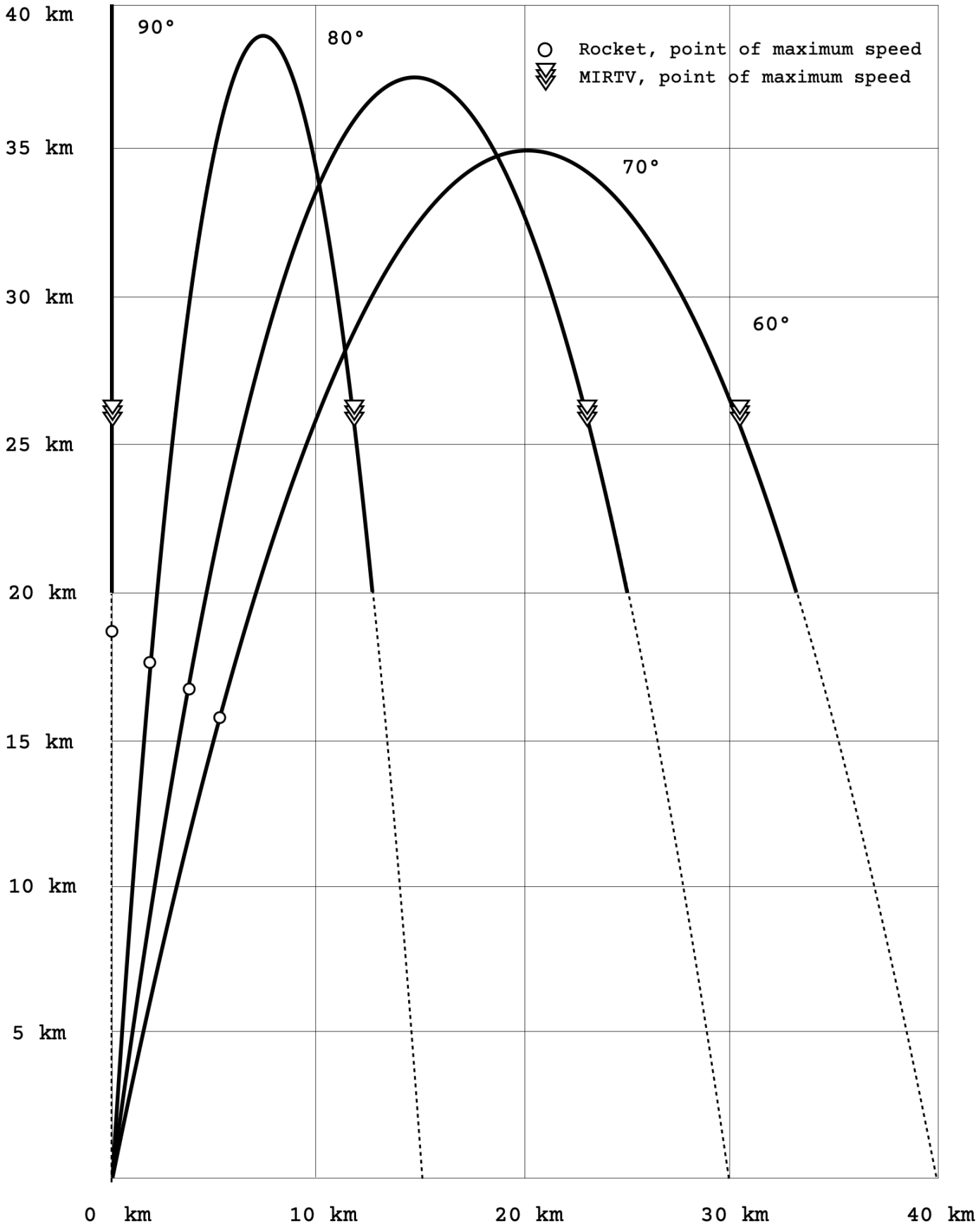


Fig.4 - MIM-104 - PAC 3 - Patriot and MIM-23 J/K Hawk, estimated interception envelope of MIRTV.

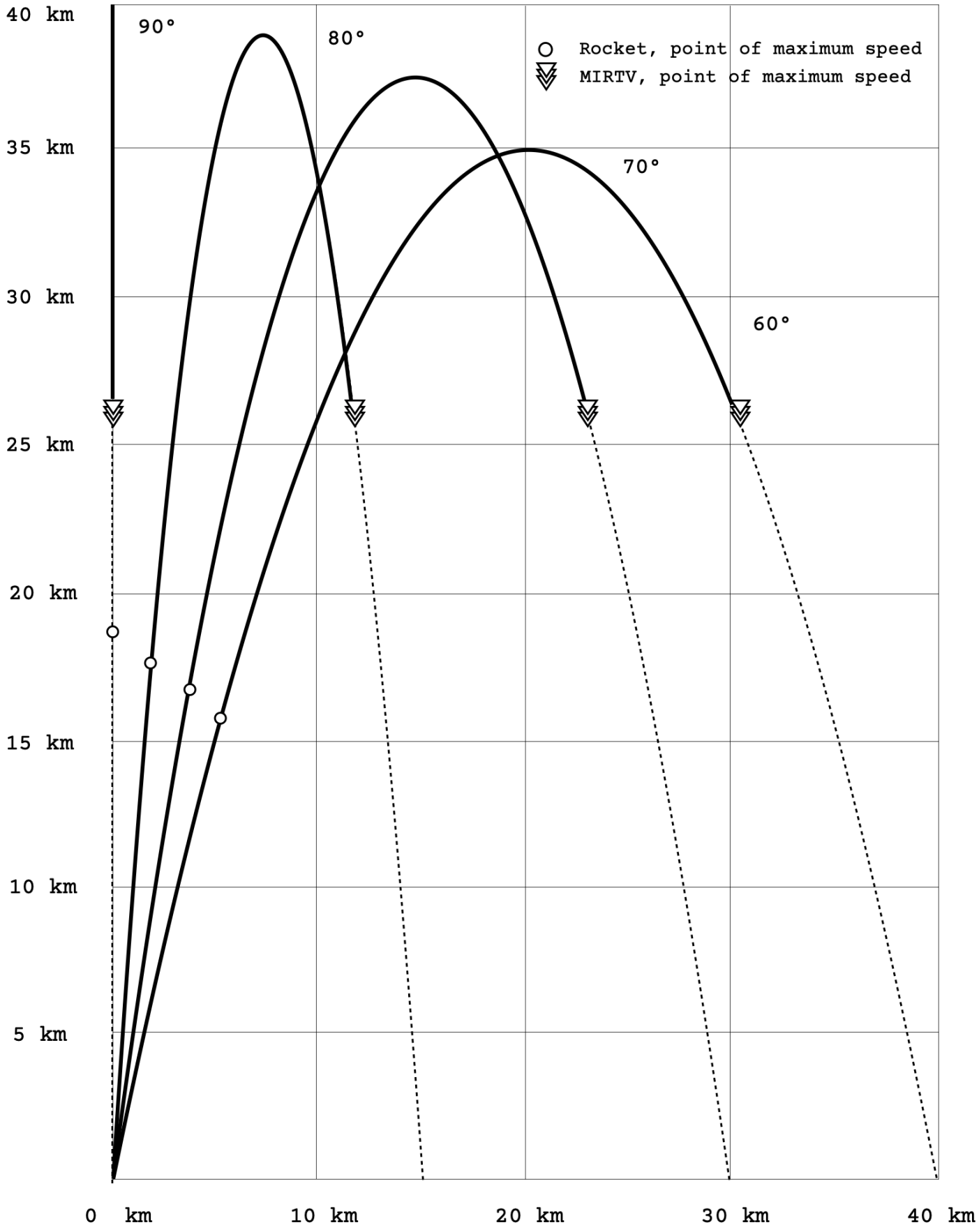


Fig.5 - S-300V, S-400, S-500 and Arrow-2 estimated interception envelope of MIRTV.

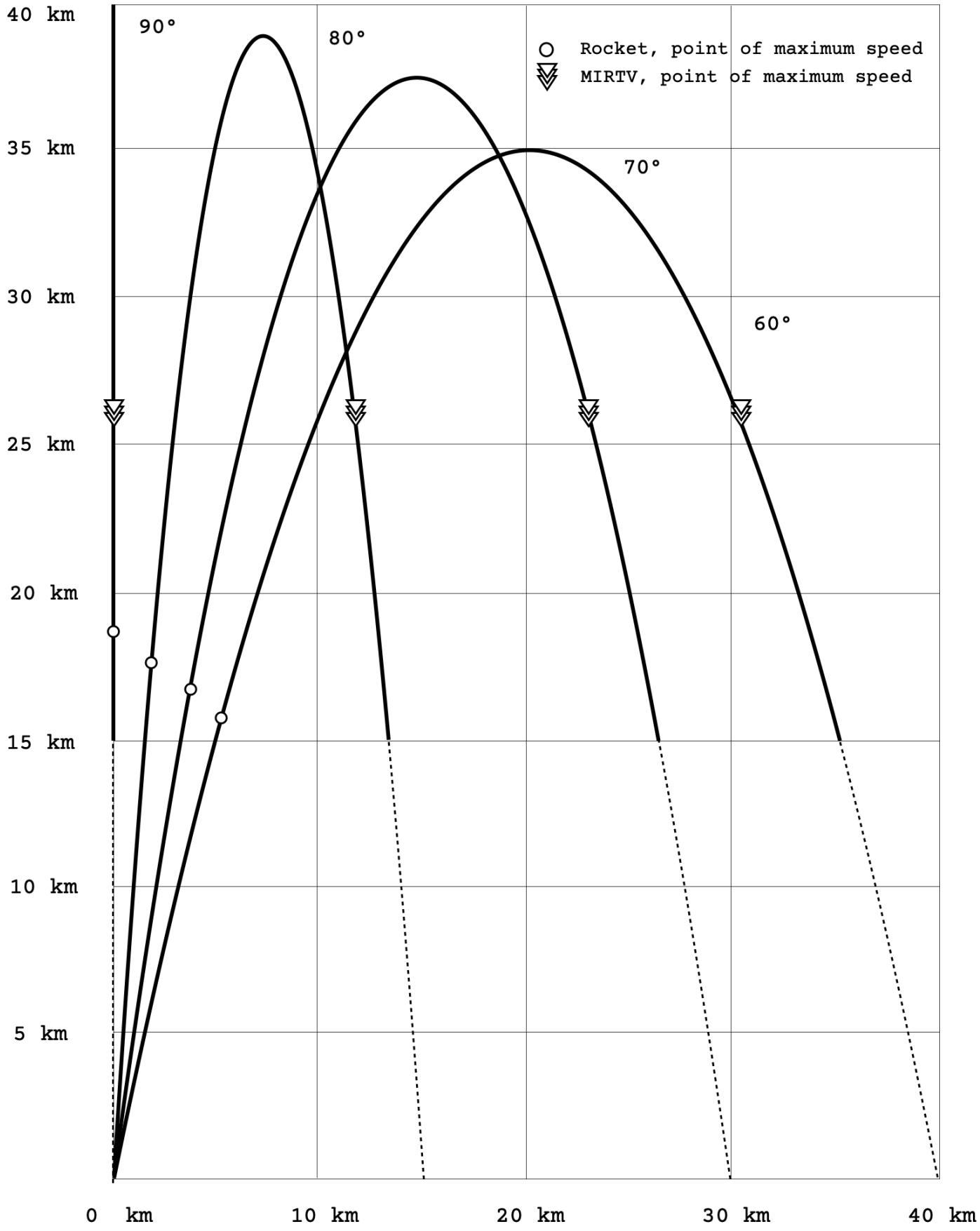


Fig.6 - David’s Sling, estimated interception envelope of MIRTV.

6. Launch options

The product can be launchd from:

- ground - in this case, the vehicle will be firmly fixed to the ground inside dedicated military launch ranges. The target vehicle could be placed in the same firing range as the interceptor, or in a different firing range.

- terrestrial vehicles - it will require a special order to fit the system on a vehicle. The multiple launcher configuration is also possible, allowing the operator to launch multiple targets at very short interval.

- from ships - taking into account the benign nature of rocket engine’s exhaust gases, the vehicle could be launched from the decks of naval ships. The ship that is intercepting could be the same that is launching the target. Also, a different ship than the one that is performing the interception could launch the target from a further distance.

- directly from the sea - the rocket could be launched directly from the sea, while being placed in the water by the ship that is performing the interception, or by a different ship.

7. Payload integration

The CER-1200MIRTV vehicle has the MIRTV as payload which can be accommodated via the payload interface during the ground preparations for launch.

Although the rocket and the MIRTV can fly without any avionics onboard, the payload space allows the integration of various equipment, such as telemetry hardware and optional Luneburg lens radar reflector for a specifically desired RADAR signature.

8. Prices

All prices are given in EURO. However, those who will pay in AMiE, ARCA Space's own crypto token will benefit from a 10% price discount.

8.1 Complete system the CER-1200MIRTV, including the MIRTV

Component	Price [€]	Price [€] if purchased in AMiE
CER-1200MIRTV rocket	199,900	179,900
MIRTV, 3 units	29,700	26,700
MIRTV booster	39,900	35,900
Launch canister	49,900	44,900
Transfer pump/accessories	9,900	8,900
Adjustable angle support*	89,900	80,900
TOTAL	419,200	377,200

* If the rocket will be launched exclusively vertical, the adjustable angle support might not be required.

NOTE: The price of additional options including painting for the rocket, launch canister, custom avionics, etc is not included in these prices.

8.2 Orders including more CER-1200MIRTV rockets and MIRTVs

For orders including more complete systems or rockets, discounts will apply.

9. Licensing

General Astronautics could license the product fabrication and sale to third parties, presumably a valid fabrication control and technology use is secured.

10. Order and Shipment

To place an order for the CER-1200MIRTV system, send us an email at contact@arcaspace.com
The shipment will be made in standardised, 6m long containers. Each container could accommodate two CER-1200MIRTV complete systems with one CER-1200MIRTV rocket each.
The order will be ready for shipment depending on the order size. Usually for a complete CER-1200MIRTV system, with a single rocket, the shipment will start 30 days after the payment was received.
For larger orders, the shipment date will be communicated before the payment.

11. Purchase eligibility

In general, a rocket falls into the category of a dual use product.
However, due to CER-1200MIRTV's limited features, like the lack of guidance system, the use of liquid propellant leading to a long launch preparation time, and the engine's performance three to four times less than in the case of a regular military rocket, the product's application as a weapon and therefore as a dual use product is a non-realistic prospect.
However, we reserve the right to sale the product depending on our internal specific criteria.
Don't hesitate to contact us and we will promptly inform you if we can go forward with your purchase request.

12. FAQ

12.1 Operations

How difficult is to prepare the CER-1200MIRTV system for launch?

The CER-1200MIRTV system is very easy to operate and prepare for launch. Follow the instructions from the User Guide and Operation Manual that are provided together with the product and the process should be straightforward.

How difficult it is to mount the payload in a CER-1200MIRTV rocket?

The CER-1200MIRTV rocket came with a removable nose-cone and the access to the interface plate is made by unscrewing the bolts that are keeping the cone in place.

What propellant does the CER-1200MIRTV system use?

The CER system uses a mixture of 30-70 water and hydrogen peroxide, commercially available as hydrogen peroxide 70%. A concentration of 50% is also an option but with a performance loss.

How much does the hydrogen peroxide 50% and 70% costs?

Depending on the region, for hydrogen peroxide 70% prices are between €1 to €2 per kg while for 50% concentration, prices are between €0.5 to €1 per kg.

How difficult is to procure hydrogen peroxide 70%?

The hydrogen peroxide 70% is commercially available and easy to procure in virtually any part of the world. 50% hydrogen peroxide is also available in stores.

How dangerous is hydrogen peroxide 50% and 70%?

You must avoid ingesting hydrogen peroxide 50-70% or getting in contact with your eyes and skin, by wearing googles and gloves during manipulation. In case of contact with your eyes and skin, always have fresh sweet closely available and apply abundent sweet water on the the contact region. The skin will become white on the contact region and it will regain the normal color in around two hours.

Please read carefully the Safety Data Sheet that will be provided with the product.

12.2 Features

Is the CER-1200MIRTV system reusable?

The CER-1200MIRTV rocket is not reusable after flight. However, the launch canisters and the propellant transfer tanks as well as the accessories are reusable.

Is it possible to use the CER-1200MIRTV system as weapon?

The lack of guidance system and any form of avionics onboard, as well as the use of liquid propellant leading to non-responsive operation, makes the CER-1200MIRTV system a completely unsuitable option for military offensive use.

12.3 Launch approvals

Do I need a launch clearance for the CER-1200MIRTV rocket?

It depends on what altitude do you plan to launch it and on the country on which you intend to launch it. The legislation may vary from country to country. We strongly advise you to contact your Military Aviation Authority, and seek guidance, prior to launch.

12.4 Eligibility

Who is eligible to purchase the CER-1200MIRTV system?

In general, a rocket falls into the category of a dual use product.
However, due to CER-1200MIRTV’s limited features and characteristics, like the lack of guidance system, the use of liquid propellant leading to a launch preparation time longer than in the case of regular military rockets and the engine’s performance three to four times less than in the case of a military rocket, the product’s application as a weapon and therefore as a dual use product is a non-realistic prospect.
In spite of this, we reserve the right to sale the product depending on our internal specific criteria.
If the purchaser’s country of origin is currently involved in combat activities, then the purchase request might be denied.
Please don’t hesitate to contact us and we will promptly inform you if we can go forward with your order.

11.5 Reservations and orders

How can I order the CER-1200MIRTV system?

The CER-1200MIRTV system will be available for purchase starting with March 2024. However, if you want to reserve one, you ca do it by placing a preorder at contact@arcaspace.com
The deliveries for the systems will be made in the order of reservations.

How long it will take until I'll receive my CER-1200MIRTV system once ordered?

The order will be ready for shipment depending on the order size. Usually, for a complete CER-1200MIRTV system, with a single rocket, the shipment will start 30 days after the payment was received.
For larger orders, the shipment date will be communicated before the payment.

Can I get a refund after I placed an order for a CER-1200MIRTV system?

Immediately after you placed an order and paid for a CER-1200MIRTV system our company will start preparing and implementing the fabrication process and a refund will no longer be an option.

Will I a get a discount for a CER-1200MIRTV system if paid with the AMiE token?

Yes, you will get a 10% discount if you'll pay for the ERC-160TR system with the AMiE Token.

What is the cost of delivery for the CER-1200MIRTV system?

It depends on what region it needs to be shipped from Romania. For instance, for the delivery of an CER-1200MIRTV system, to North America, the shipment costs around €19,000. For deliveries in Europe, the cost is significantly lower.

13. Legal considerations, risks disclaimer

PLEASE READ THE ENTIRETY OF THIS “Legal Considerations, Risks and Disclaimer” SECTION CAREFULLY.

The issuer is solely responsible for the content of this User Guide. This User Guide has not been reviewed or approved by any competent authority in any member state of the European Union. To the best knowledge of the issuer, the information presented in this User Guide is correct and complete without any significant omission.

The information shared in this User Guide is not all-encompassing or comprehensive and does not in any way intend to create a direct or indirect contractual relationship. The primary purpose of this User Guide is to provide potential product buyers with pertinent information so as to help them thoroughly analyze the CER-1200MIRTV project and make an informed decision.

IF YOU ARE UNCERTAIN AS TO ANYTHING IN THIS USER GUIDE, WE STRONGLY URGE YOU NOT TO PURCHASE THE CER-1200MIRTV PRODUCT.

14. Contact

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