

New Generation Mk 82 General Purpose Bomb: Development and Assessment of IM Signature

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ABSTRACT

EURENCO is a world leader for Insensitive Munitions development, design and production.

In the frame of a new development for DGA, EURENCO, in cooperation with RWM Italia, has developed enhanced MK82 General Purpose bombs for the French Air Force.

These bombs are filled with EURENCO Cast PBX including its insensitive RDX, and the RWM Italia designed bomb body incorporates specific venting devices, providing excellent IM signature, as proven by qualification tests performed by DGA.

1. Background

In 2015 RWM Italia and EURENCO were selected by the French Ministry of Defence (DGA) for a public procurement contract for the development, qualification and production of new generation MK82 General Purpose bombs.

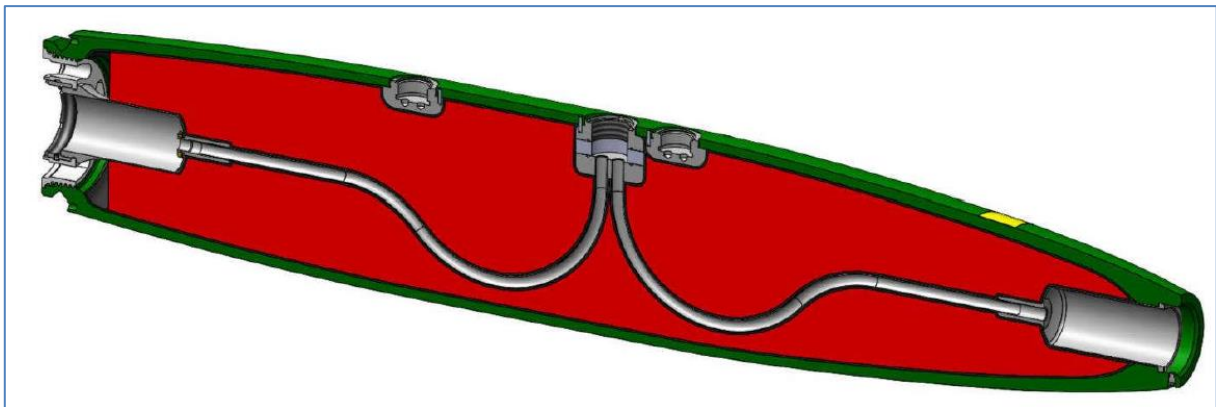
This public procurement contract was following a DGA research and technology program launched in 2009 with Eurenco participation, and aiming to enhance both the performance and IM signature of GP bombs [1].

In the frame of this contract, RWM Italia is the prime contractor and is responsible for the bomb body; EURENCO is the subcontractor and is responsible for the explosive loading.

1.1 Bomb Body

The bomb body is manufactured by RWM Italia, and meets the standard requirements for a Mk 82 500 lb bomb:

- External profile dimensions
- Suspension lug pockets for NATO 14-inch adapter
- Arming well pocket
- Aft fuze well
- Forward fuze well
- Aft V groove



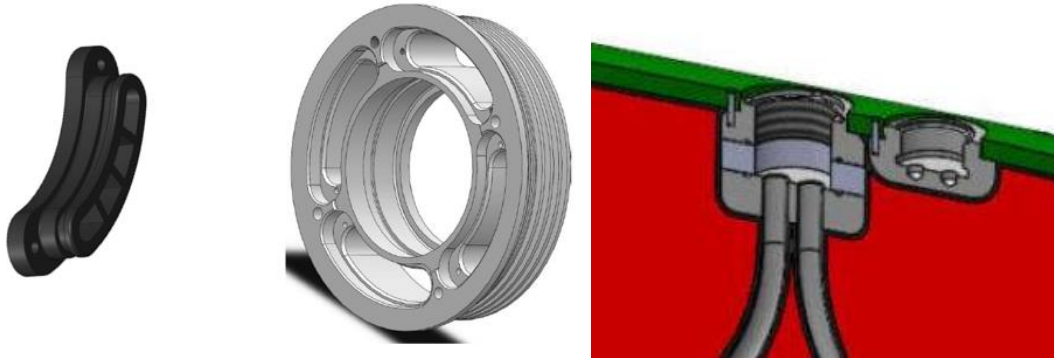
As a result, it is fully adaptable to current bombs kits:

- DSU-33 proximity sensor
- MXU-735 penetrator nose
- Tail fins
- Paveway or AASM guidance kits
- FBM21 fuze
- ...

The loaded MK82 GP meets MK82 standards requirements for weight and CoG.

The bomb body is forged from high strength steel tubes without welding, providing high penetration performance and effective fragmentation. It incorporates venting devices:

- 4 in the base plug
- 1 in the arming well pocket



The aft storage protector is specifically designed in order not to cover the aft venting plugs.



1.2 Explosive Loading

The explosive proposed by EURENCO for the Mk 82 GP was PBXN-109. This RDX-based explosive provides high detonation velocity, and aluminium powder in the formulation increases blast performance.

It is a cast-cured polymer-bonded explosive that guarantees no risk of exudation and has very good ageing characteristics, meaning no degradation of mechanical or insensitivity properties.

The EURENCO vacuum filling process minimises defects in the explosive loading.

EURENCO's unique i-RDX ensures very good IM properties:

- Low friction sensitivity: no positive results in 30 tests at 283 N
- High progressive heating ignition temperature: > 200 °C
- Low shock sensitivity : 140 cards / 5600 MPa
- Low friability sensitivity : < 10 MPa/ms

2. IM Assessment

At the end of the development phase, 12 specimens have been manufactured and delivered to DGA for an extensive qualification test program. IM tests have been performed by DGA EM and results are shown here after.

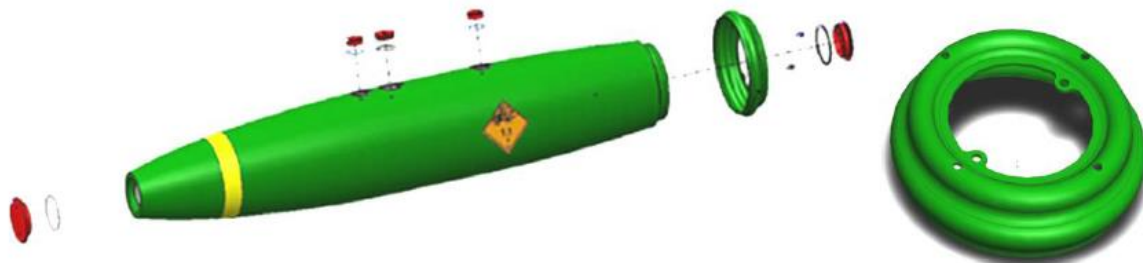
2.1 Fast Cook-Off

2.1.1 Logistical Configuration

A Mk 82 GP bomb in its logistical configuration was tested against a fuel fire (Fast Heating or Fast Cook-Off test) according to STANAG 4240 (Issue 2). The test was performed by DGA EM Gironde.

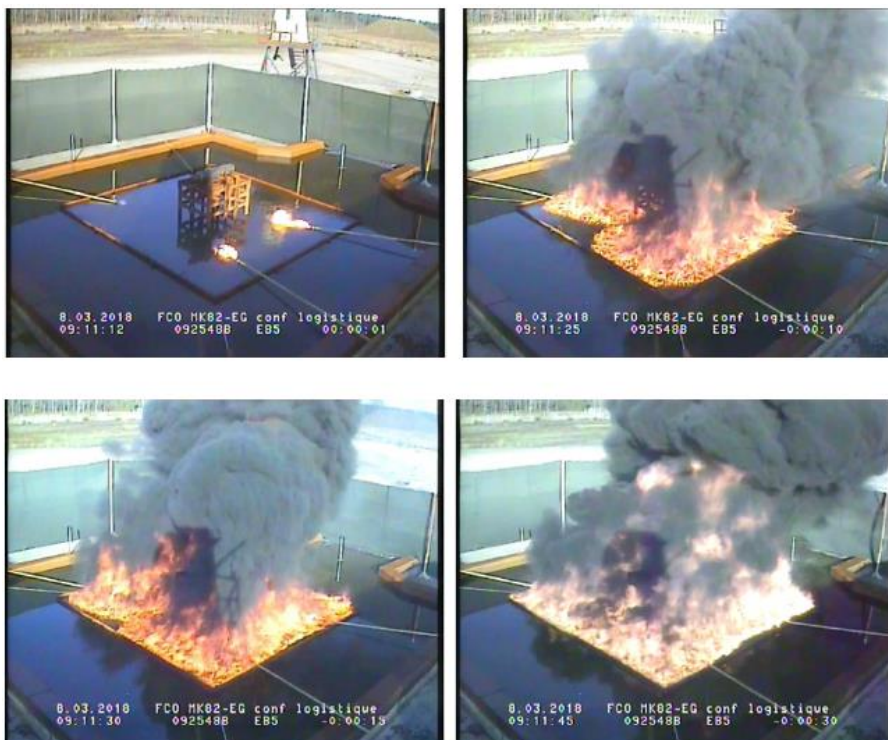
The logistical configuration includes:

- plastic storage plugs in the nose and rear fuze wells, arming well pocket, and suspension lug wells
- the aft storage protector



The bomb was suspended over a kerosene hearth and ignited. The temperatures recorded were in accordance with the requirements of STANAG 4240:

- time to reach 550 °C: < 30 sec
- minimum temperature: 800 °C



The reaction started approximately 5 minutes after the beginning of the test. The explosive material burned for 12 minutes.



At the end of the test, the bomb body was found at its original location, with no damage to the structure. No projection of fragment nor significant overpressure were recorded.



In accordance with AOP-39, the response level is judged as a Type V "Burning" reaction.

2.1.2 Tactical Configuration

A Mk 82 GP bomb in a tactical configuration was tested against a fuel fire (Fast Heating or Fast Cook-Off test) according to STANAG 4240 (Issue 2). The test was performed by DGA EM Gironde.

The tactical configuration included:

- MXU-735 nose
- Tail fins
- FBM-21 fuze



The reaction started approximately 4 minutes after the beginning of the test. The explosive material burned during 11 minutes.



At the end of the test, the bomb body was found at its original location, with no damage to the structure. No projection of fragment nor significant overpressure were recorded.

In accordance with AOP-39, the response level is judged as a Type V "Burning" reaction.

2.2 Slow Cook-Off

A Mk 82 GP bomb in a tactical configuration was tested against Slow Heating (Slow Cook-Off test) according to STANAG 4382 (Issue 2). The test was performed by DGA EM Gironde.

The test specimen was placed in an oven equipped with an electric heating system in order to achieve the required heating rate of 3.3 °C/h. A witness plate is placed directly under the test specimen to ascertain whether or not a detonation occurs during the test.



A reaction was observed at 35 h after the start of the 3.3 °C/h slope, at an average measured temperature of 161.5 °C.



The explosive charge burnt entirely.

At the end of the test, the bomb body was found at its location, with no damage to the structure. No projection of fragment nor significant overpressure were recorded.



In accordance with AOP-39, the response level is judged as a Type V "Burning" reaction.

2.3 Bullet Impact

A Mk 82 GP bomb in a tactical configuration was tested against Bullet Attack (Bullet Impact test) according to STANAG 4241 (Issue 2). The test was performed by DGA EM Gironde.

The bullet impact point was the explosive in the FBM21 fuze.



A few seconds after the impact, some smoke started coming through the bullet hole. A short time later, the combustion gases started venting through the aft vent plugs. After a few minutes, the combustion rate increased and the flames could be seen through the aft vents as well as the arming well vent. The explosive charge burnt entirely over approximately 20 minutes.



At the end of the test, the bomb body was found at its location, with no damage to the structure. No projection of fragment nor significant overpressure were recorded.



In accordance with AOP-39, the response level is judged as a Type V "Burning" reaction.

2.4 Light Fragment Impact

A Mk 82 GP bomb in a tactical configuration was tested against Light Fragment Attack (Fragment Impact test) according to STANAG 4496 (Issue 1). The test was performed by DGA EM Gironde.

The fragment impact point was the explosive in the FBM21 fuze.

A few seconds after the impact, some smoke started coming through the bullet hole.

A short time later, the combustion gases started venting through the aft vent plugs.

After a few minutes, the combustion rate increased and the flames could be seen through the aft vents as well as the arming well vent.



The explosive charge burnt entirely over approximately 20 minutes.

At the end of the test, the bomb body was found at its location, with no damage to the structure. No projection of fragment nor significant overpressure were recorded.

In accordance with AOP-39, the response level is judged as a Type V "Burning" reaction.

3. IM Signature

3.1 Mk 82 GP Bomb

The IM signature of the Mk 82 GP bomb was established using analyses based on calculations or semi-empirical tools, as well as read-across from experimental results obtained in equivalent configurations.

| Threat | Response Level |
|-----------------------|------------------|
| Fuel fire | Type V (Burning) |
| Slow heating | Type V (Burning) |
| Bullet Impact | Type V (Burning) |
| Light Fragment Impact | Type V (Burning) |

3.2 Future Work

Further developments are currently on-going for a fully IM compliant Mk 82 type bomb, using the same bomb body but loaded with an even more insensitive polymer-bonded explosive based on NTO.

An improved IM signature is expected, including:

- Sympathetic Reaction: Type III
- Heavy Fragment Impact: Type V
- Shape Charge Jet: Type V

4. CONCLUSION

Constant EURENCO innovation, supported by DGA development contracts, has allowed to improve IM signature over the years.

The combination of EURENCO unique i-RDX with RWM Italia bomb body design, incorporating specific venting devices, provides to the French new generation MK82 General Purpose bomb an excellent IM signature.

5. REFERENCES

- [1] Toward New French IM General Purpose bombs
L. Chaffois, B. Nouguez, L. Delrieu, S. Regnaut ; IMEMTS, San Diego, 2013

Acknowledgements

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IM tests performed by DGA EM Gironde