2007 Insensitive Munitions & Energetic Materials Technology Symposium

GUDN propellants and the UNIFLEX 2 IM modular charge system

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Miami, October 15-18, 2007

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Contents

- Background
- LOVA-propellants at Eurenco Bofors
- Propellants containing FOX-7
- Propellants containing GUDN
- GUDN-propellant for UNIFLEX 2 IM
- UNIFLEX 2 IM
- UNIFLEX 2 IM for ARCHER
- UNIFLEX 2 IM in L/39 gun systems
- IM-tests
- Summary

Background

- 1998: FOX-7 and GUDN becomes available in larger quantities at Eurenco Bofors AB.
- 1999: Small scale testing of GUDN and FOX-7 as fillers in NC-based propellants.
- 2000: FOX-7 is introduced in propellants for Bofors 40 mm ETC gun.
- 2003: Trials with GUDN propellants for Bofors 155 mm modular charge system (UNIFLEX 2).
- 2005: 4500 kg of GUDN propellant delivered for UNIFLEX 2 IM. Trials in Bofors ARCHER and FH 77 B artillery system.
- 2007: Product definition phase of UNIFLEX 2 IM ended.
- 2007: The optimization of the continuous manufacturing process for GUDN propellants is started.

LOVA-propellants at Eurenco Bofors AB

1st generation LOVA

- Produced in manufacturing scale for Bofors 40 and 57 mm AA gun.
- The propellants are based on NC, CAB, RDX and inert or energetic plasticizers (M39, M43).

2nd generation LOVA

- Presently tested in different applications.
- The propellants are based on NC, low-sensitive FOX-fillers and low-sensitive energetic plasticizers.

NL-propellants , 1st generation

Propellants containing FOX-7

FOX-7 or DADNE, is a low-sensitive explosive with relatively high energy content.

FOX-7 propellants have the same level of performance as double base propellants.

FOX-7 is therefore suited for propellants were high muzzle velocity is important.

Multiperforated monograin of FOX-7 propellant

Propellants Containing GUDN

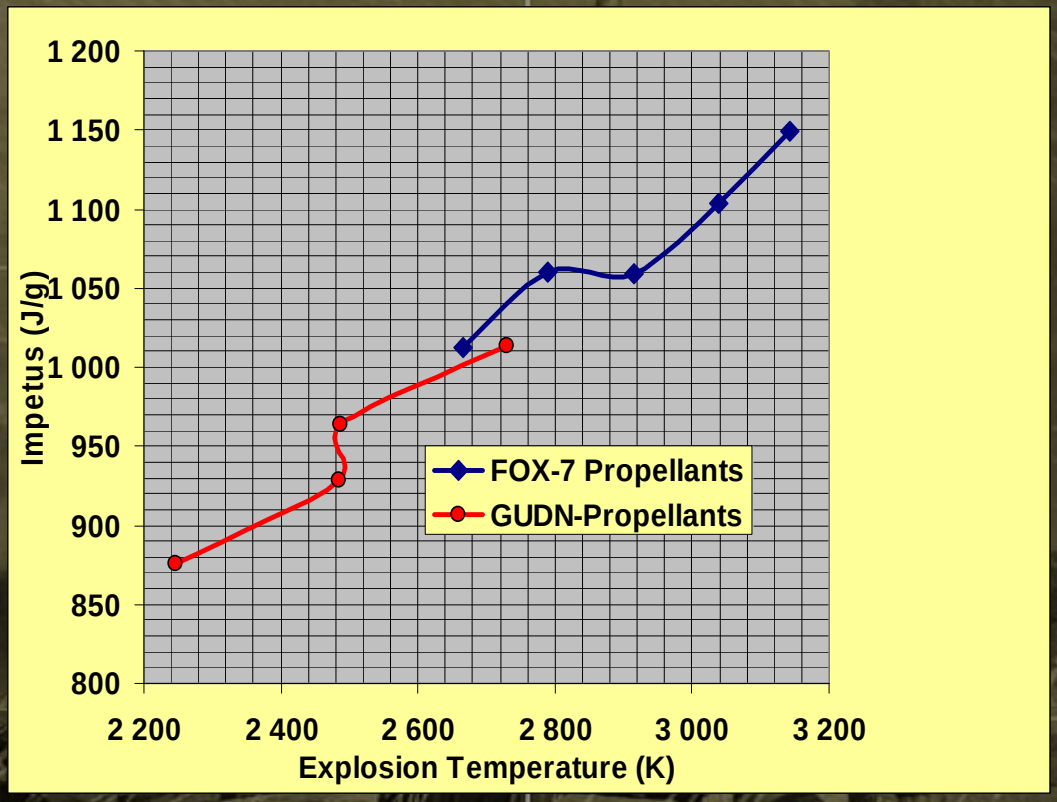
GUDN propellant

FOX12 or GUDN, is a low sensitive energetic material with a relatively low energy content.

GUDN propellants performs like single-base propellants.

FOX12 is therefore suited for automated guns as well as artillery guns where parameters such as low barrel wear and low cost are important.

Performance range



Performance of nine different propellants containing GUDN or FOX-7. The propellants define two partially overlapping performance zones.

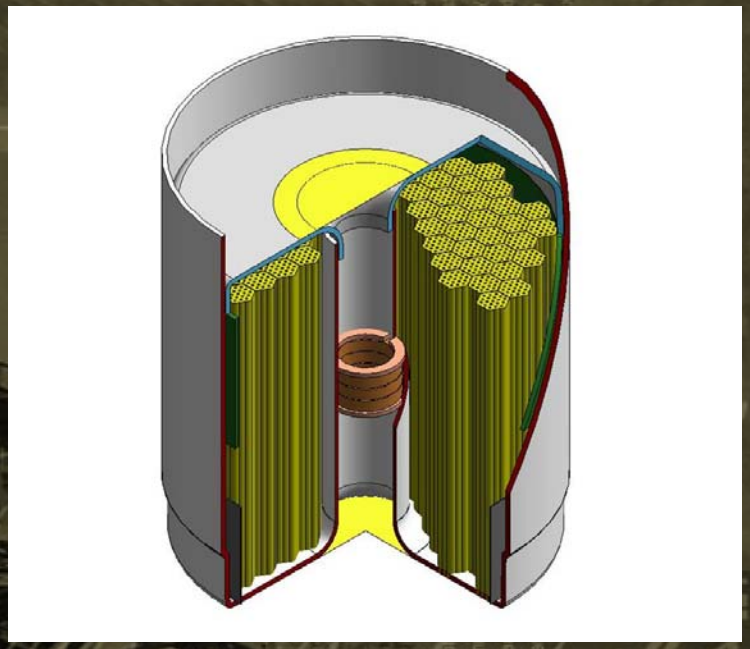
GUDN-propellant for UNIFLEX 2 IM

Advantages of GUDN

- The low sensitivity of GUDN makes it an excellent energetic filler in the propellant manufacturing process.
- The performance of a GUDN-propellant is adequate for the artillery application at the same time as the explosion temperature is relatively low. This keeps the barrel wear at a low level.
- GUDN promotes the use of one type of propellant through-out the pressure range due to the burn rate behavior at low pressure zones.
- GUDN is produced in production scale.

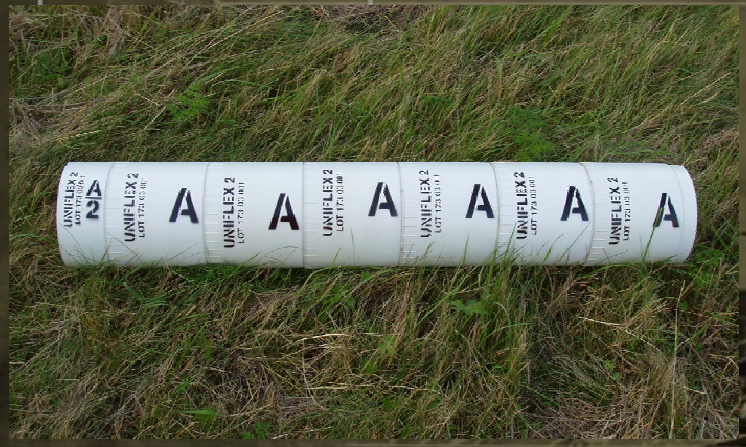
GUDN-propellant for UNIFLEX 2 IM

19-perf. kerfed rosette of GUDN-propellant.



UNIFLEX 2 IM

UNIFLEX 2 IM



155 mm UNIFLEX 2 IM

Status :

- Under development, will be qualified and ready for serial production in 2009.

Advantages:

- Low-sensitive propellant (GUDN).
- Low barrel wear.
- Production scale manufacturing capability.

Flexibility:

- UNIFLEX 2 IM can be fired with only one module in the chamber.

UNIFLEX 2 IM for Archer

BAE Systems Bofors
FH 77BW L52
Gun and Run Version

Advantages:

- Reduced vulnerability of loaded automated magazine and ammunition boxes.
- The Charge System allows for better logistics and enhanced automated loading.

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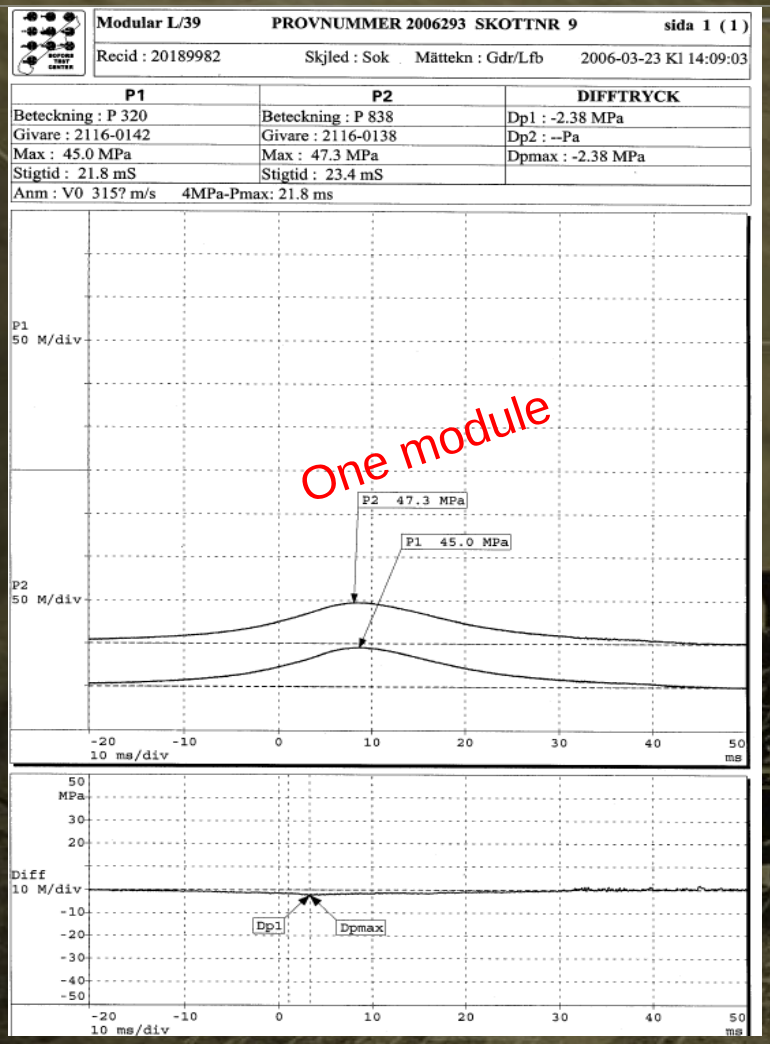
UNIFLEX 2 IM in L/39 gun systems

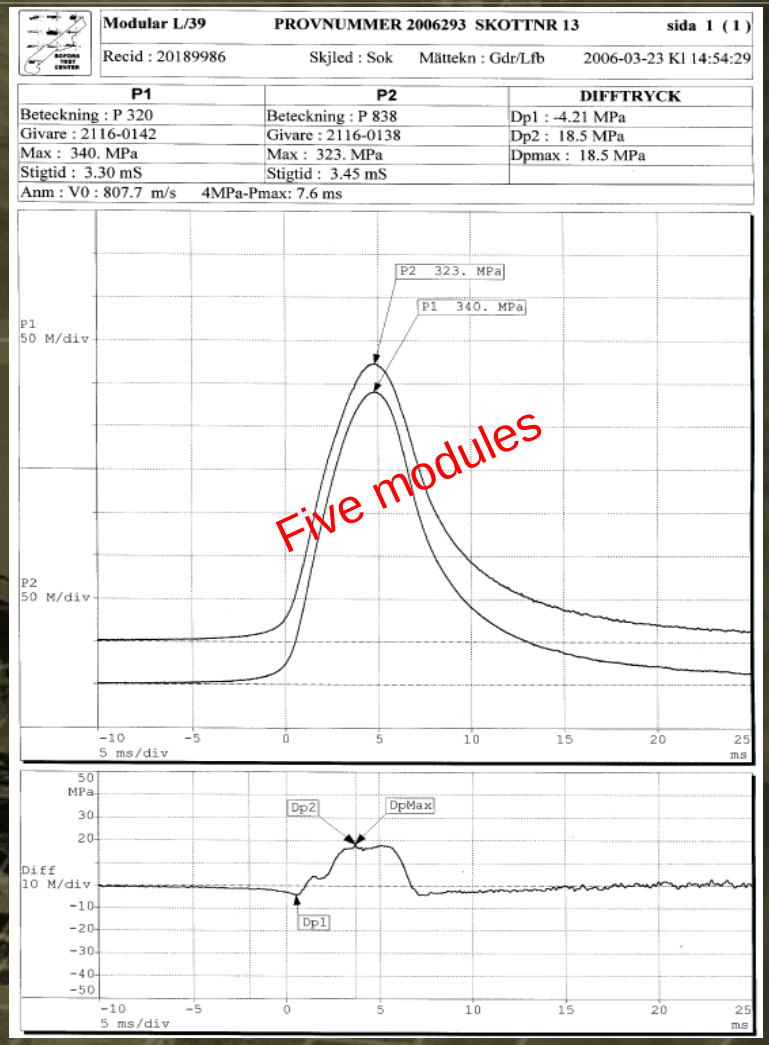
Charge No. of modules	Muzzle Velocity m/s	Chamber Pressure MPa
1	320	50
2	460	85
3	565	125
4	690	200
5	825	340

Calculated internal ballistics in AS 90 L/39 gun with L 15 shell.

Uniflex 2 IM in L/39 gun systems

UNIFLEX 2 IM in L/39 gun systems





Gun: FH 77B L/39 Chamber volume 19 lit (~0, 5 litre larger than AS 90). Projectile: HE 77 (Similar to L15)

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IM testing

Threat Type	Stimuli	Test Procedures	
Thermal Threats	Fast Cook-off (FCO) or Fast Heating (FH) 	STANAG 4240 Edition 2	MIL-STD-2105 C
	Slow Cook-off (SCO) or Slow Heating (SH) 	STANAG 4382 Edition 2	
Mechanical Threats	Bullet Impact (BI) 	STANAG 4241 Edition 2	
	Fragment Impact (FI) 	STANAG 4496 Edition 1	
	Shaped Charged Jet Impact (SCJI) 	STANAG 4526 Edition 1	
Combined Threats	Sympathetic Reaction (SR) 	STANAG 4396 Edition 2	

IM testing

Threat Type	Stimuli	Result	
Thermal Threats	Fast Cook-off (FCO) or Fast Heating (FH) 	Type V	MIL-STD-2105 C
	Slow Cook-off (SCO) or Slow Heating (SH) 	Type V	
Mechanical Threats	Bullet Impact (BI) 	Type N.R.	
	Fragment Impact (FI) 	Type IV	
	Shaped Charged Jet Impact (SCJI) 	Type IV	
Combined Threats	Sympathetic Reaction (SR) 	Type v	

Test conducted at naked charges.

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IM testing
Bofors Test Center

SCJI-test with UNIFLEX 2 IM and the FFV551 84 mm HEAT war head.

A type IV reaction.

Extended IM testing
Bofors Test Center

Spall impact test with UNIFLEX 2 IM and the FFV551 84 mm HEAT war head.

A type V reaction.

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Summary

- A new low-sensitive propellant is under development for BAE Systems Bofors UNIFLEX 2 IM modular charge system.
- The propellant is based on low-sensitive GUDN and performs like a single base propellant but at a significantly reduced flame temperature.
- The new propellant allows for a uni-modular charge system, since one single module can be fired with full performance in the L/39 system.
- The UNIFLEX 2 IM system has several tactical advantages. By using the optional half module, nine velocity increments are achieved for the L/39 system. This enhances the MRSI capacity significantly.
- IM-tests have been performed according to STANAG4439 with good results.
- The charge system will be qualified and ready for serial production in 2009.

Acknowledgements

Swedish Defence Material Administration (FMV)

Per Cederberg and Abraham Langlet

BAE Systems Bofors AB

Villy Johansson, Niklas Eriksson and Lars-Eric Larsson

Eurenco Bofors AB

Erik Eklund, Nisse Nilsson, Anders Hultman, Jan-Åke Bengtsson and Carina Bergvall-Laitala

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