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GUDN propellants and the UNIFLEX 2 IM modular charge system

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GROUPE SNPE

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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 where high muzzle velocity is important.



Multiperforated monograin of FOX-7 propellant

Propellants Containing GUDN



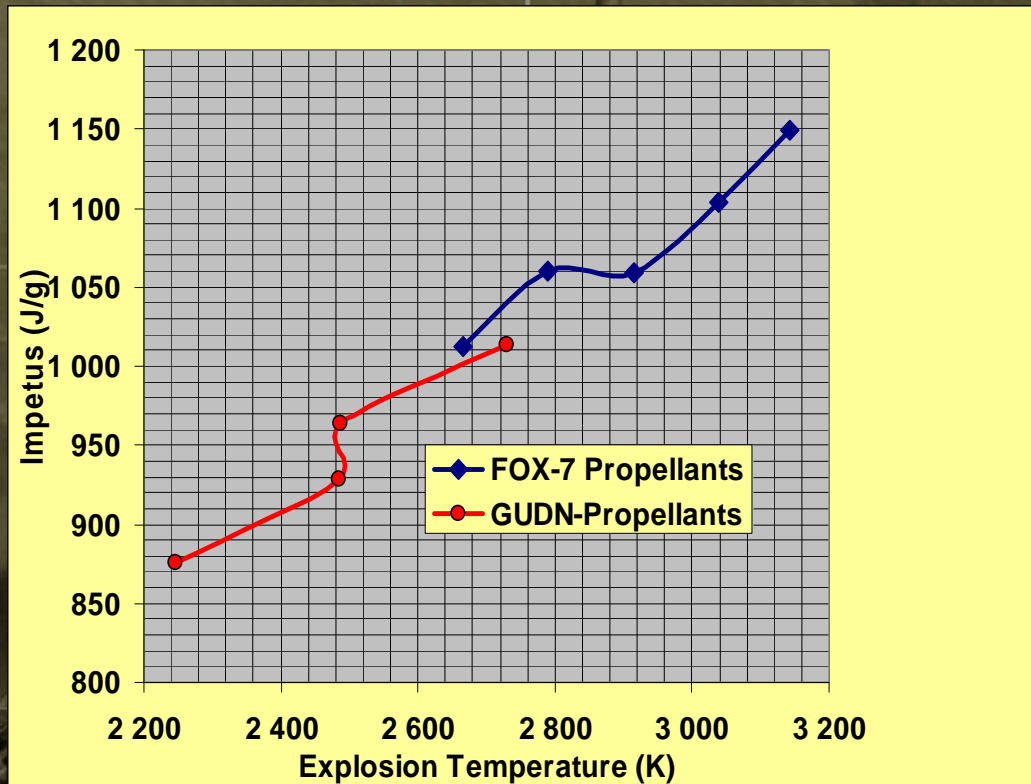
GUDN propellant

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

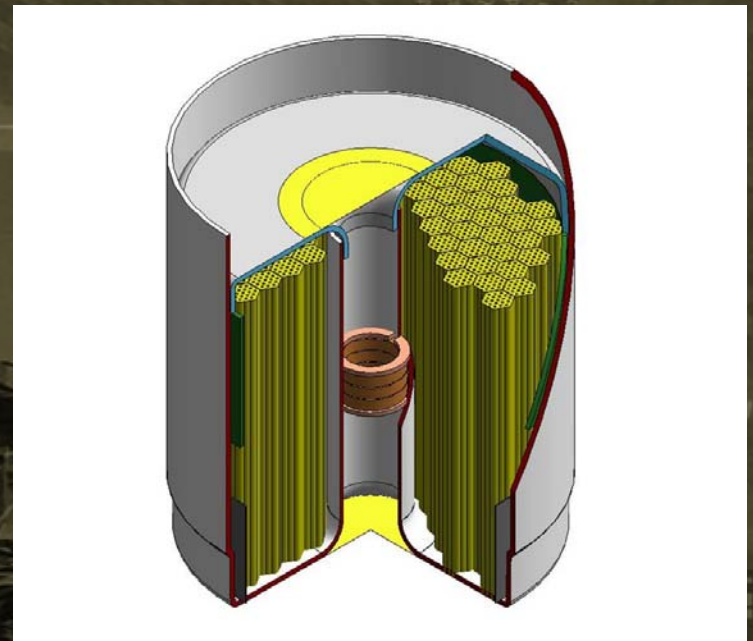
- The low sensitivity of GUDN makes it an excellent energetic filler in the propellant manufacturing process.
- The performance of a GUDN-propellant is adequate for the artillery application at the same time as the explosion temperature is relatively low. This keeps the barrel wear at a low level.
- 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

Enheten är avsedd för styrning av raketens riktning och för att ge den den nödvändiga kraften för att kunna flyga. Enheten består av en motor och en styrapparat. Motorerna är avsedda för att ge raketens riktning och för att ge den den nödvändiga kraften för att kunna flyga. Enheten består av en motor och en styrapparat.



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

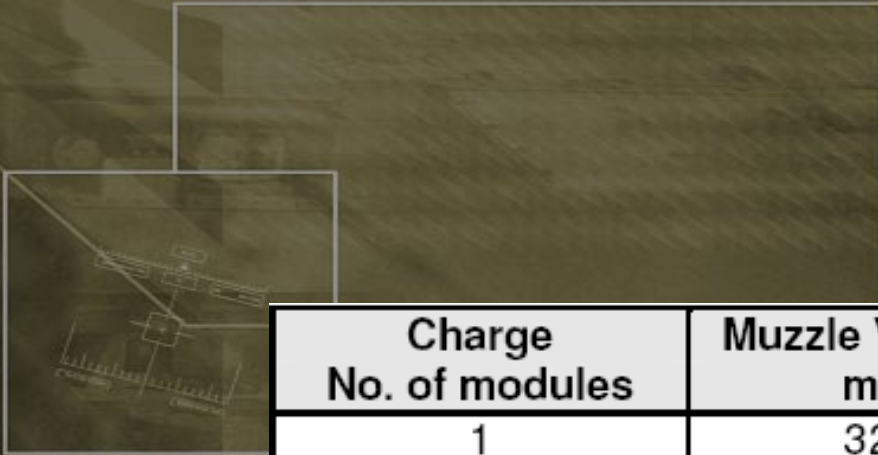


BAE Systems Bofors
FH 77BW L52
Gun and Run Version

Advantages:

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

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



Бронетанк
Бронетанк
Бронетанк
Бронетанк
Бронетанк



320 → 825 m/sec.

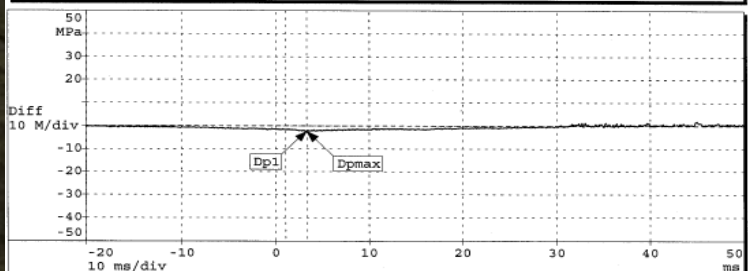
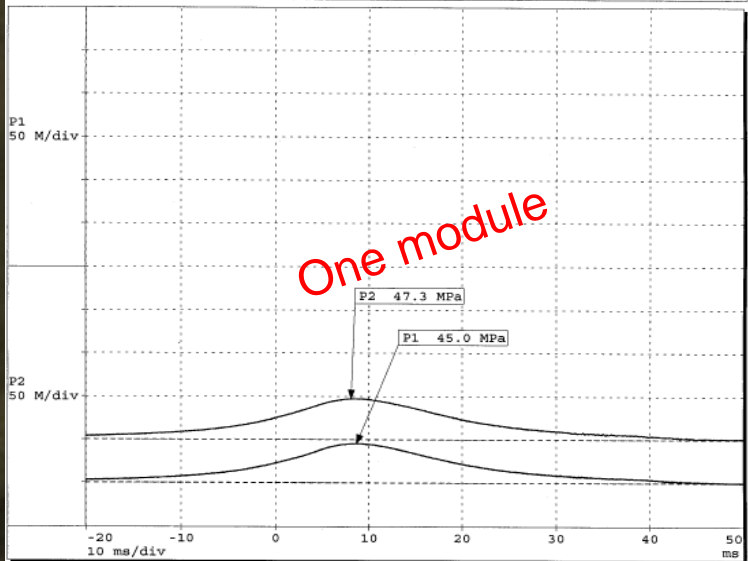
9 increment steps of approximately 60 m/sec.

UNIFLEX 2 IM in L/39 gun systems

PROVNUMMER 2006293 SKOTTNR 9

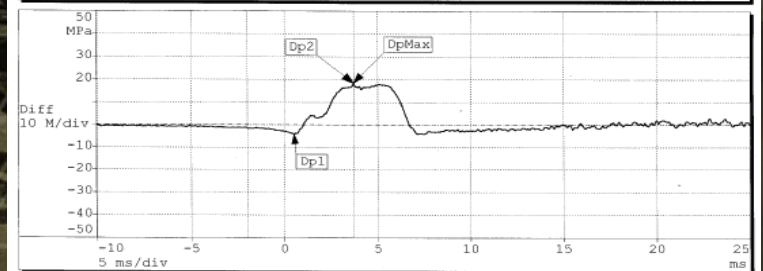
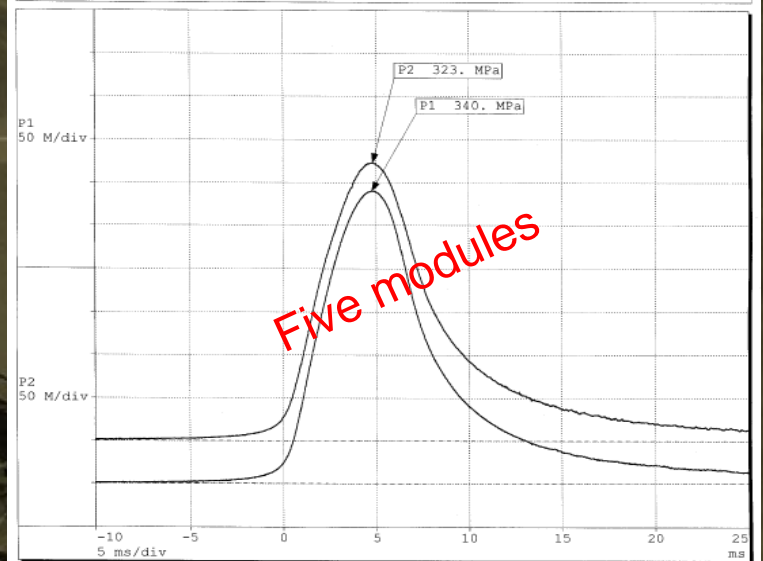
	Modular L/39	PROVNUMMER 2006293 SKOTTNR 9	sida 1 (1)
Recid : 20189982	Skjled : Sok	Mättekn : Gdr/Lfb	2006-03-23 Kl 14:09:03

P1	P2	DIFFTRYCK
Beteckning : P 320	Beteckning : P 838	Dp1 : -2.38 MPa
Givare : 2116-0142	Givare : 2116-0138	Dp2 : --Pa
Max : 45.0 MPa	Max : 47.3 MPa	Dpmax : -2.38 MPa
Stigtid : 21.8 mS	Stigtid : 23.4 mS	
Anm : V0 : 3157 m/s 4MPa-Pmax: 21.8 ms		



	Modular L/39	PROVNUMMER 2006293 SKOTTNR 13	sida 1 (1)
Recid : 20189986	Skjled : Sok	Mättekn : Gdr/Lfb	2006-03-23 Kl 14:54:29







P1	P2	DIFFTRYCK
Beteckning : P 320	Beteckning : P 838	Dp1 : -4.21 MPa
Givare : 2116-0142	Givare : 2116-0138	Dp2 : 18.5 MPa
Max : 340. MPa	Max : 323. MPa	Dpmax : 18.5 MPa
Stigtid : 3.30 mS	Stigtid : 3.45 mS	
Anm : V0 : 807.7 m/s 4MPa-Pmax: 7.6 ms		



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

IM testing







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Threat Type	Stimuli	Test Procedures
Thermal Threats	Fast Cook-off (FCO) or Fast Heating (FH) 	STANAG 4240 Edition 2
	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

MIL-STD-2105 C

IM testing

1. 2010-01-01
 2. 2010-01-01
 3. 2010-01-01
 4. 2010-01-01
 5. 2010-01-01
 6. 2010-01-01
 7. 2010-01-01
 8. 2010-01-01
 9. 2010-01-01
 10. 2010-01-01

Threat Type	Stimuli	Result
Thermal Threats	Fast Cook-off (FCO) or Fast Heating (FH) 	Type V
	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

MIL-STD-2105 C

Test conducted at naked charges.

IM testing

Bofors Test Center



svenskarna i världen har ett stort intresse för att se till att Sverige är redo för eventuella kriser och krig. För detta har Bofors utvecklat och tillverkat en mängd olika vapen och utrustning som är avsedda att skydda Sverige och dess allierade mot eventuella hot.



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



A type IV reaction.

Extended IM testing Bofors Test Center

Swedish Defence Research Agency (FMV) is conducting extended impact testing at the Bofors Test Center. The tests are performed on concrete structures using a 84 mm HEAT war head. The results show that the structures are able to withstand the impact and maintain their structural integrity.



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



A type V reaction.

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.

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