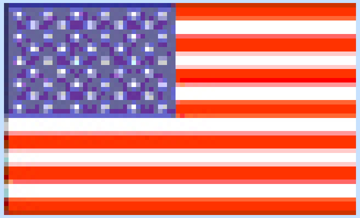

Insensitive Munition Tests for Artillery Fuzes

JUNGHANS Feinwerktechnik

presentation for the

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by

J. Fitzgerald-Smith & A. Nolte

contact at JUNGHANS: andreas.nolte@junghans-fwt.de

Contents

1. Background

- Dutch Army Contract for the DM 84 artillery multi option fuzes required JUNGHANS to conduct full scale IM Testing
- The Tests are part of the type classification programme for the fuze and also to provide an IM Assessment
- Full Accordance with STANAG 4439

2. Aim

- Provide a description of a full scale IM testing programme process
- Illustrate the difficulties of providing an IM Assessment against the various types of response specified in the STANAGs from this case study
- Involving small quantities of explosives

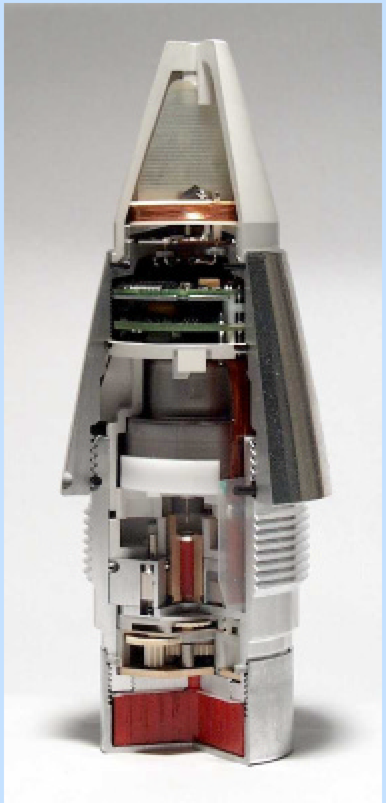
3. Fuze Description and Packaging

3.1 DM84 - multi option fuze for Artillery / 120 mm rifled mortar weapons

- Functions: Prox. / Time / PD / PD - Delay
- Inductively Settable
- Overflight Safety T-3
- Not Jammable
- Fielded in

  Germany, Canada, Denmark and under production for the Dutch Army
- DM84 also for 120 mm rifled mortars
- DM84 with 2nd HOB (4m + 10m)
- Flick-Ramming Safe
- mechanical back-up
- RDX / TNT booster (25 gr.)
- more than 250.000 ea. produced

This fuze was also presented at NDIA in 2000



3. Fuze Description and Packaging

3.2 Packaging versions

Packing as for Dutch Army Contract

Metalbox (M2A1) with foam furnituring

Packing as for the German BWB

Plywood Box with Carton containers per single fuze

4. IM Test Programme

Following The Netherland's THA (Thread Hazard Assessment)the fuzes were required to be tested against these environments:

- Fast Heating (Liquid Fuel Fire Test of STANAG 4240)
- Slow Heating (Slow Heating Test of STANAG 4382)
- Small Arms Attack (Bullet Impact Test of STANAG 4241)
- Shape Charge Weapons Attack (Shape Charge Jet Test of STANAG 4526)
- Detonation in Magazine (Sympathetic Reaction Test of STANAG 4396)

Note:

Tests conducted against latest STANAG versions and certain recommendations from the NIMIC IM Testing workshop of 1997

5. Key Issues Concerning The Testing

5.1 Interpretation of IM Test Regime, Guidance on test Tailoring and cost-effective testing demands specialist knowledge from NSAA or assistance from NIMIC

5.2 Lack of information on explosive outcome from small scale testing required „guestimates“ for instrumentation positioning

5.3 COTEC, part of the Shrivenham University / UK, was able to provide excellent expertise in ensuring measuring data devices were correctly positioned and tested prior to the tests

5.4 Dependance on such level of expertise requires detailed documentation for best practices as already recommended in the NIMIC workshop of 1997 and provided by COTEC

6. Contents of IM Full Scale Tests

- 40 fuzes in Liquid Fuel Fire Test — 4 tests (3x NL / 1x GE configuration)
- 8 fuzes in Slow Heating Test — 1 test (NL configuration preconditioned to +63°C.)
- 24 fuzes in Bullet Impact Test — 3 tests (NL configuration - 3 orientations of attack)
- 8 fuzes in Shape Charge Jet Test — 5 tests (4 on single fuze - 1 on NL box)
- 25 fuzes in Sympathetic Reaction Test — 4 tests (3 x NL / 1x GE configuration)

Total qty. of 105 fuzes tested against the various environments !

Note:

When tests are repeated, consideration should be given to correcting positioning of instrumentation, gauges and cameras or improving the opportunity for retrieving further data

7. Measurement of the Results

To maximize the collection of data following instrumentation was employed:

- **Blast pressure gauges at distances positioned at distances of 2 m, 5 m and 15 m**
- **Digital video camera**
- **High speed video**
- **35 mm camera**
- **Metal witness plates**
- **Fragment screens**
- **Heat flux gauges (added for the Fast Heating Test conducted on the fuzes in the GE packaging)**

8. IM Test Results and Assessment

Type of Test	Results of Pressure Readings			Heat Flux	Fragment	Time to	Type of	Level of
	2m	5 m	15 m	Readings at 5m	Projection	Reaction	Reaction	Response
Liquid Fuel Fire 1 NL	n.a.	11.2 mBar	30.8 mBar		13 m.	2:27 min	< Type III	L15
Liquid Fuel Fire 2 NL	n.a.	11.2 mBar	9.1 mBar		12 m.	2:48 min.	< Type III	L15
Liquid Fuel Fire 3 NL	n.a.	n.r.	n.r.		12 m.	5:29 min.	< Type IV	L15
Liquid Fuel Fire 4 GE	n.a.	n.r.	n.r.	20.000 Watts/sqm	15 m.	20:00 min.	Type V	L5- L15
Slow Heating	n.r.	n.r.	n.r.	at 180° C. ---------->		39.7 hrs.	Type III	L 15
Bullet Impact 1	n.a.	6.1 mBar	0.7 mBar				Type 5	L 5
Bullet Impact 2	n.a.	n.r.	n.r.				N.R.	L 5
Bullet Impact 3	n.a.	n.r.	n.r.				N.R.	L 5
Shape Charge 1	238 mBar	n.r.	n.a.				Type I	L 50
Shape Charge 2	273 mBar	n.r.	n.a.				Type I	L 50
Shape Charge 3	n.a.	209 mBar	n.r.				Type I	L 50
Shape Charge 4	n.a.	161 mBar	n.r.				Type I	L 50
Shape Charge 5	n.a.	133 mBar	n.r.				Type I	L 50
Sympathetic Reaction 1 NL	486 mBar	10.5 mBar	n.r.				Type I	L 50
Sympathetic Reaction 2 NL	n.r.	n.r.	n.r.				Type I	L 50
Sympathetic Reaction 3 NL	n.a.	161 mBar	n.r.		one box ejected 2 m.		Type I	L 50
Sympathetic Reaction 4 GE	n.a.	n.r.	n.a.				N.R.	L 5

Note:

Assessments based on measured readings and at distances closer than required for categorizing these reaction types

9. IM Signature

9.1 Assigning types of reaction against the IM tests of small quantities of explosive stores such as fuzes demonstrated the results being

- subjective
- not scientific
- not useful for any form of risk assessment

9.2 NIMIC‘s 1997 workshop realized this issue and recommended levels of response (the distance in a horizontal plane where overpressures, thermal energies and fragment through did not exceed a set of values i.e. levels 5, 15 or 50)

9.3 Following yardsticks were set :

2nd degree burns (142 Kj/sqm)

loss of hearing (5 kPa)

no fragment projection

9.4 The yardstick the DM 84 fuze could be assigned as Level 15 for fast and slow heating,

a level 5 for bullet impact and sympathetic reaction test and a Level no greater than 50 for the

Shape Charge Jet Test

10. Conclusions

10.1 Before commencing an Im Test Programm it is essential to have dialogue with IM specialists in the NSAA or at NIMIC

10.2 pre-tests and small scale testing or modelling are highly recommended to obtain possible instrumentation positioning data

10.3 it is recommended that a best practice guide is produced to assist test engineers with the intracacies of IM testing

10.4 max. use of instrumentation and equipment to record the test outcome is essential for any full scale testing

10.5 even with max. use of gauges and visual recording devices it was very difficult to assign types of reactions when an event was less than a detonation

10.6 it is recommended that explosive output is recorded in terms of over pressure, thermal flux and fragment throw against the level of response criteria suggested by NIMIC workshop of 1997