New generation Influence Mine classified as 1.6N

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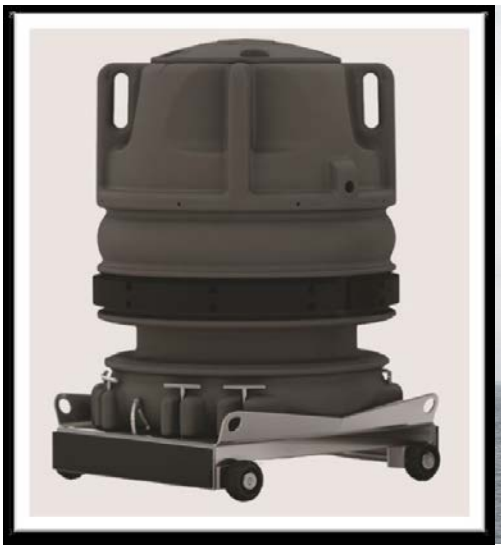
Introduction

A new underwater Influence Mine, BLOCKER, is a cost effective Influence Mine equipped with advanced sensor systems (acoustic-, pressure- and magnetic sensors, optionally UEP), customer programmable algorithms/parameters and Insensitive Munitions Plastic Bonded Explosives, exercise systems and an impressive total energy output equivalent of over 1000 kg of TNT.

The Blocker is operational in Climate Categories C1 (Cold -33 °C) to B2 (wet warm +63 °C) and the operational depth is down to 100 meters (optionally to 200 meters). Operational time underwater is 1 year (optionally to 2 years) and the shelf-life is 25 years.



This Mine fulfils all the IM requirements, it has no mass explosion hazard and therefore hazard classification 1.1 does not make justice to this system. During the last years after completing the extensive testing, the work to reclassify the Underwater Influence Mine to 1.6N has started in Finland.

BLOCKER PHYSICAL CHARACTERISTICS	
Shape	Barrel
Height	Max. 1300 mm
Length	Max. 900 mm
Width	Max. 900 mm
Gross weight	~750 kg
Net explosive quantity	~600 kg
OPERATIONAL CHARACTERISTICS	
Shelf-life	25 years
Climate categories	C1-B2, -33 °C up to +63 °C
Main charge (EIDS)	FOXIT-Plastic Bonded Explosive
Booster charge	FPX R1- Plastic Bonded Explosive
Life in water	Minimum 1 year (option min 2 years)
Underwater Shock energy (50 m)	1,4 x TNT
Underwater Bubble energy (50 m)	2,2 x TNT
Maximum operational depth	100 meters (option 200 meters)

The BLOCKER is manufactured by OY FORCIT AB in Finland. It was developed for the Finnish Navy with serial production starting in 2013. Explosives in this product are plastic bonded explosives FOXIT (main charge) and FPX R1 (booster). Both of these explosives are widely tested and qualified.

The main charge FOXIT has been tested according to UN Recommendations on the Transport of Dangerous Goods, Manual of Test and Criteria and qualification testing has been performed by Finnish Defence Forces Research Agency. Based on the tests, FOXIT meets the requirements of EIS-material (Extremely Insensitive Substance).

Qualification for the explosive in the booster FPX R1 has been performed by both Swedish Defence Forces and Finnish Defence Forces. Sensitivity and quality tests for the booster explosive FPX R1 have been performed at Finnish Defence Forces research Agency (FDRA). Swedish Defence Materiel Adminstration's FSD 0214 standard test methods for booster explosives were used as test guidelines. Underwater Influence Mine, BLOCKER system and its main charge (FOXIT) and booster (FPX R1) combination have proven to be insensitive enough to be classified to class 1.6N.

The current transport classification for the Underwater Influence Mine, BLOCKER is UN 0137 1.1D. The aim is to get international transport classification in hazard division 1.6 and compatibility group N under the UN 0486.

Tests performed

In addition to STANAG IM tests, the UN Tests 7 (g) - 7(k) have been conducted to the whole Underwater Influence Mine (Article) and series 3, 5 and 7 (a) – 7(f) tests have been made on the FOXIT (Substance). According to tests performed by FDRA, the Underwater Influence Mine is not too dangerous to transport (the Manual of Tests and Criteria, Series 4) and it is thermally stable (the Manual of Tests and Criteria, Series 3). The Underwater Influence Mine passes all the test series 7 tests, and therefore the Underwater Influence Mine could be assigned to division 1.6.

The technical information of Underwater Influence Mine, test results (FOXIT) from UN Test series 3, 5 and 7, other performed tests and FPX R1 (qualification tests according to FSD 0214 and AOP-7):

FOXIT-properties:

PERFORMANCE/PROPERTY	RESULT
DENSITY	1.78 g/cm3
VELOCITY OF DETONATION	5 500 m/s
CRITICAL DIAMETER (in plastic pipe)	>110 mm
MINIMUM BOOSTER TEST	150-200 g
SCB-TEST (12 °C/min)	168 °C / fire
HYGROSCOPICITY (57 % / 6 weeks)	< 0.06 %
HEAT EXPANSION (-47 … +83 °C)	0.01 %
HARDNESS (Shore A. 24 °C)	62
TENSILE STRENGTH	0.93 Mpa
ELONGATION	39

Performed tests on the main explosive, Foxit:

Test results from UN Test series 3 and 5

TEST	RESULT	
3 (a)(iv) 30 kg Fall hammer Test	3,6 m, OK	Passes
3 (b)(i) BAM Friction Test	92 N	Passes
3 (c) Thermal Stability at 75 °C	OK	Passes
3 (d) Small-scale Burning Test	Burning	Passes
5 (a) Cap Sensitivity Test	-	Passes
5 (b)(i) DDT Test	-	Passes
5 (c) External Fire Test	-	Passes

Test results from UN Test series 7 (EIDS test result)

TEST	DESCRIPTION	RESULT
7 (a) EIDS Cap test	Shock test to determine the sensitivity to detonation by a standard detonator.	no reaction – pass
7 (b) EIDS Gap test	Shock test with defined booster and confinement to determine the sensitivity to shock. The gap is defined as thickness of PMMA. The substance will pass the test if there is no transmission with the gap thickness of 70 mm or less with the used test assembly.	50 mm - pass
7 (c) EIDS Impact Sensitivity	Test to determine the sensitivity of the explosive substance to deteriorate under the effect of an impact.	Not applicable since the diameter of test charges is well below the critical diameter.
7 (d) EIDS Bullet Impact Test	Test to determine the degree of reaction of the explosive substance to impact or penetration resulting from a given energy source.	Fire - pass
7 (e) EIDS External Fire Test	Test to determine the reaction of	Pressure burst – pass

Close to SCB-test (Stanag 4491)	the explosive substance to external fire when the material is confined.	
7 (f) EIDS Slow Cook-off Test Close to SCB-test (Stanag 4491)	Test to determine the reaction of the explosive substance in an environment in which the temperature is gradually increased to 365 °C.	Pressure burst – pass

Properties of FPX R1:

PERFORMANCE/PROPERTY	RESULT
COMPOSITION	RDX, binder
DENSITY	1,50 g/cm3
CRITICAL DIAMETER	< 7 mm
VELOCITY OF DETONATION	7 600 m/s

Qualification tests performed on FPX R1:

Test results according to FSD 0214 for FPX R1

TEST	RESULT
NOL LSGT	59 mm
Fall hammer test	20 J (Powder form 20J, chip form 22,5)
Ignition temperature	216°C (1 min)
Friction sensitiveness	>360N
Shooting test	~900 m/s (no detonation 876 m/s, detonation 990 m/s)
Koenen test	< 1,5 mm
Electric spark test	0,5 – 5 J (lower reaction level than with reference material, tetryl)
Detonation velocity	7 598 m/s
Vacuum stability	0,3 ± 0,01 ml/g

Performed tests on Influence Mine

Test results from UN Test series 7 (EIDS test result)

TEST	ARTICLE	DESCRIPTION	RESULT
7 (g) 1.6 Article External Fire Test	Complete influence mine	Test to determine whether there is a mass explosion or a hazard from dangerous projections, radiant heat and/or violent burning when involved in a fire.	Burning - pass
7 (h) 1.6 Article Slow Cook-off Test	Complete influence mine	Test to determine the reaction of the article in an environment in which the temperature is gradually increased to 365 °C.	Burning - pass
7 (j) 1.6 Article Bullet Impact Test	Tests performed separately on booster and main charge	Test to determine the degree of reaction of the article to impact or penetration resulting from a given energy source.	**FPX R1 booster:** **Burning – pass** **Foxit -main charge:** **Burning - pass**
7 (k) 1.6 Article Stack Test	Complete influence mine	Test to determine whether a detonation of an article, as offered for transport, will initiate a detonation in an adjacent, like article.	30 cm – detonation 40 cm - pass

Additional tests performed on Influence Mine

TEST	RESULT
4 (b) (ii) 12 meter drop test	No fire or explosion - pass
4 (a) Thermal stability test	No external effects, no temperature rise exceeding 3 °C – pass
SCJ Impact test according to STANAG 4526	Deflagration/burning - pass

Current status

The concept has been discussed with the Finnish Safety and Chemicals Agency and also with the Finnish Transport Safety Agency. The Sub-Committee of Experts on the Transport of Dangerous Goods (Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonized System of Classification and Labelling of Chemicals) had this topic on their agenda during their meeting in Geneva November 2017. There was an international consensus, providing that if all the tests required has been performed acceptably, the classification to 1.6N should be possible for the system. According to the decision of the Sub-Committee of Experts on the Transport of Dangerous Goods, the package type (ADR P101) does not exclude the possibility to classify the article as 1.6N.

At the moment the application is under evaluation by the Finnish Safety and Chemical Agency. We expect to have the approval by summer 2018.