





"GENERAL M.R. STEFANIK" ARMED FORCES ACADEMY SLOVAK REPUBLIC

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EVALUATION METHODS FOR AERIAL TARGET-TYPE SELF-CONFIGURATION SYSTEMS DESIGNATED FOR TRAINING FIRING WITH SELF-DIRECTED AIR-TO-AIR AND GROUND-TO-AIR OPERATIONAL MISSILES

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Abstract: The purpose of this paper is to expound testing and evaluation methods for aerial target-type self-configuration systems, designated for training firing of A/A and G/A operational missiles, in order to integrate them on MiG-21 Lancer and IAR-99 §OIM aircraft.

A. GENERAL

Since 1994, RoAF MiG-21 aircraft have undergone a comprehensive modernization program aimed both for integration of modern avionics and weapons system and for developing of a new weapons configuration; this process led to expanded opportunities to address combat missions, improved operational performance of aircraft and their approach in terms of requirements applied in NATO.

Both verification and validation of ammunition performance for air-to-air missions as well as crew training run by real firing against air targets imitating the essential characteristics of operational targets. For IR/radar homing air-to-air missiles, this requirement implies the use of air targets, consistent in terms of the IR radiation wavelength with missile detection systems and capable of reflecting the radar energy emitted by guiding system or/and missile seeker head. Currently, the products observing these conditions are small air parachuted target type self-configured systems.

The constructive solution proposed by S.C. ELECTROMECHANICAL S.A. Ploiesti, integrating components made by suppliers in the field of domestic defense industry, has resulted in a product type parachuted aerial target, which obtained the validation by going through a comprehensive program of testing and evaluation, both on the ground (using existing test facilities of the national industry in field or belonging to MoD) and in flight (using RoAF MIG 21 Lancer and IAR 99 SOIM aircraft and ground based and airborne testing facilities owned or developed by R&FTC Craiova for this program).

The purpose of the testing was to check how the parachuted aerial target type selfconfigured system meets the Air Force requirements stipulated the product in specification and to establish the kev functional performance that enable the develop of an operational use for this product. This paper dealt with the assessment methods used to achieve the objectives contained in the test and evaluation plan of aerial target type self-configured systems, created and produced by R&FTC Craiova.

B. ISSUES ON THE METHODS USED FOR EVALUATION

The methods used for evaluation aimed to deal with three main aspects, namely:

- 1. Checking the interfacing and the separation of aerial target type selfconfigured systems and IAR 99 SOIM and MIG-21LANCER aircraft;
- 2. Validation of IAR 99 SOIM and MIG-21 LANCER aircraft armament configurations including aerial target type self-configured systems with parachute, as following:
 - Checking products reaction in the aircraft flight envelope for armament configurations with these products;
 - Checking the products separation from aircraft, checking the operational safety and establishing the launch envelopes;
 - Assessing the product safety in operation, highlighting the peculiarities of operation and validation of operating procedures;
 - 3. Determination of operating performance and demonstrating the operational performance of the products.

C. OVERVIEW OF EVALUATION METHODS USED

1. Products assessment methods based on processing, analysis and interpretation of data obtained from tests performed on the ground and CFD simulations.

Assessmen t Method	Products subject to testing /	Test and Evaluation Objectives
	Test	
	facilities /	
	Specialized	
	equipment	

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Assessmen	Products	Test and	Assessmen	Products	Test and
t Method	subject to	Evaluation	t Method	subject to	Evaluation
	testing /	Objectives		testing /	Objectives
	Test			Test	
	facilities /			facilities /	
	Specialized			Specialized	
	equipment			equipment	
Preliminar	FLUENT	proximity, during	moment of		launch envelope.
У	simulation	the separation	becoming		Estimating the
calculation	environment	process.	target.		risk of product
of vertical		Estimation of			interference with
distances		product			the carrier
covered by		trajectory during			aircraft, in the
the product		the separation			launch diagram;
from the		from aircraft, for			
separation		launching points			
until the		to establish the			

The tests course:

The evaluated	Aircraft Type	
objectives	IAR 99 SOIM	MIG-21 LANCER
Fixing the product on aircraft hardpoints and checking the interfacing between aircraft and product.		
Verification of product separation from the aircraft and determination of product motion parameters in terms of launch without aerodynamic load.	Point#3 Point#4	Point#1 Point#1 Point#4 Point#5 Point#4
	 Acquired and analyzed parameters: Speed on the two axes; Pitch angle; Time; Covered distance in free fall from lau Launch synchronizing with the move Measuring the interfacing electrical sectors. 	nch; ment of product; ignal.







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The evaluated	Aircraft Type	
objectives	IAR 99 SOIM	MIG-21 LANCER
Checking electrical	PARAMET	RUFB
control signals – Fuse arming.	Acquired and analyzed parameters: • Control signal time; • Time of 28V signal that appears o • Time of 28V signal that appears o	n MTI (A1); n cable Bomb (A1-MTI)):
	• Time interval between signal A1 a	and A1-MTI signal occurrence
Estimation of the	Estimation of product aerodynamic c	characteristics for different conditions
product trajectory	of release. Distribution of static and dyn	namic pressure for an angle of
during separation and	incidence of 5 degrees and Mach $= 0.2$	- undisturbed current;
after separation		
during the		
reconfiguration as a target. Determination of the product aerodynamic characteristics in undisturbed current and in proximity to aircraft. Risk assessment of interference between released product and carrier aircraft in the estimated launch envelope;	1.03 e+00 1.04 e+00 0.04 e+01 0.95 e+01	Dat 22, 2010 FLUENT 6.3 (3d, pbns, sslw)









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The evaluated	Aircraft Type	
objectives	IAR 99 SOIM	MIG-21 LANCER
	point for which $X = Y = Z = t = 0$.	

2. Products assessment methods based on processing, analysis and interpretation of data obtained from tests performed in flight.

Assessment Method	Specialized equipment	Test and Evaluation Objectives
Checking the products	- Flight data acquisition and	- Products operational safety (in all
reaction in flight	recording system ACRA	stages of their use);
envelope of MiG-21	KAM-500;	- Products reaction in aircraft flight
Lancer and IAR-99	- loaded aerial target type	envelopes;
SOIM aircraft.	self-configured systems;	- Products technical state after the
		flight.
Checking the products	- Flight data acquisition and	- Product reaction during separation
separation from	recording system ACRA	from the aircraft;
aircraft, operational	KAM-500;	- Product reaction on the trajectory
safety and determining	- Real aerial target type self-	after separation;
the launching	configured systems;	- Determination of the launching
envelope for MiG-21	- Airborne video container	envelope;
Lancer and IAR-99	boats;	
SOIM aircraft	- Video recorder system on	
	attendant aircraft;	
	- EOTS system;	
	- CRT system;	
Verification of	- video recording system on	- Products reaction after launch;
products operational	the aircraft;	- Products reaction on launching of
performance and	- Real aerial target type self-	
safety in operation.	configured systems;	self-directed air to air missile MAGIC -
	- IR self-directed air to air	2;
	missiles, MAGIC -2; - Video recorder system on escort aircraft;	- aiming the products after forming
		them as targets and igniting the torch,
		by IR missiles;
		- targeting IR guided missiles toward the product.

Objectives assessed	Results and issues concerning the objectives assessed
Product reaction during separation from the aircraft;	• Launching the product from IAR99-SOIM – left pylon
	PoRoi#1#6 Point#8 Poinf@Tht#2
	Point#3 Point#5
	×
	X







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Objectives assessed	Results and issues concerning the objectives assessed
Verification de product reaction on the trajectory after separation;	Launching the product from aircraft MIG- 21 LANCER
	• Forming (reconfiguration) as target of the product
	Formare tinta
	• The product operation as target
	1089

Objectives assessed	Results and issues concerning the objectives assessed
Determination of launching envelope.	Launching envelope IAR-99 SOIM INVELOPACE LANSARE MR-89 SOM ECHPAT CU 2XTPOM/MASA DE REDUCERE 500 Kg CONDITI STANDARD



ROMANIA



GERMANY



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Objectives assessed	Results and issues concerning the objectives
	assessed
Aiming the products after forming them as targets and igniting the torch, by IR missiles.	Launching to MMR
targets and igniting the torch, by ik missiles.	Image: Contract of the set of the s
	CON1 115.40 HRADSP 54 1007 115.40 HRADSP 54 1007 115.40 000 35:22 C/F PROS 1 HRADSP 54 17:47:43

- D. RESULTS OBTAINED AFTER CARRYING ON THE TEST ACTIVITIES AND USING THE PRESENTED EVALUATION METHODS
- 1. During testing there were no incidents of malfunctions to affect the safety of crew or carrier aircraft.
- 2. The aircraft reacted normally in all phases of flight test, the flight parameters recorded during the launch showed no significant influence on the aircraft due to flight and launching the products, mounted on launching stations 1 and 2.
- 3. Integrated avionics and weapons system behaved according to the normal operation documentation of IAR 99 SOIM and MiG-21 Lancer aircraft, for the mode used to launch products.
- 4. All of the products launched by aircraft separated normally from hardpoints, were stable on the trajectory, the warheads were armed normally on the trajectory and have worked in accordance with technical specifications, so all technical and performance parameters were fulfilled.
- 5. Operational tests to verify operational performance on launch air-to-air missiles type 2 Magic have shown that TPDM-01M product can be discovered, aimed and followed by missiles, missiles launch

is running normally and they are directed toward the target.

6. Tests have achieved the objectives, the results have provided the information necessary for validate product configuration and validate new aircraft configurations used during testing and have allowed validation of the procedures for on ground and in flight operation of these products.