CAD/PAD Ordnance Assessment

26 June 2018

Overview

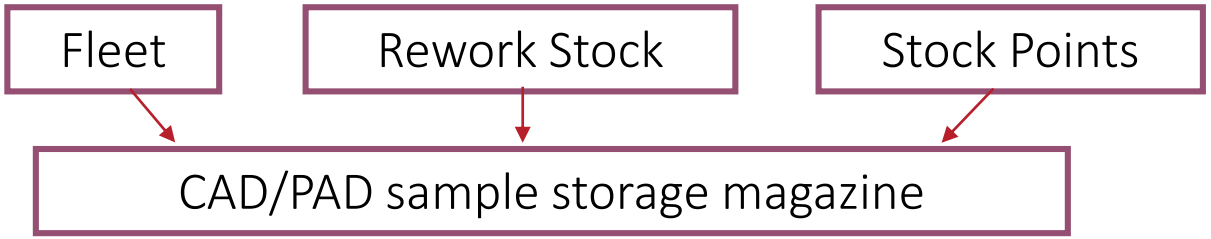
- Purpose, Sponsors & Test Considerations
- Acquiring Samples
- OA Process Steps
- Sample Test
- Recent OAs, Findings & Analysis
- Recent Work
- Summary
- Questions

Purpose, Sponsors, & Test Considerations

- The Ordnance Assessment (OA) programs assess the quality, reliability, and serviceability of all CADs/PADs.
- End-User Benefit
  - Identifies and analyzes aging trends to assign appropriate service lives
  - Identifies deficiencies due to environmental conditions and/or maintenance procedures
  - Ensures CAD/PAD are working as intended within requirements of system or end-item application
- Typically conduct 60-70 new OAs yearly for various sponsors on 3-5 year cycle.
  - US Navy, US Air Force, US Army, NASA, and other sponsors when requested and funded.
- Emphasis on items that have been installed into their intended applications, exposed to associated environment
  - Tracked in Virtual Fleet Support (VFS).
- CAD/PAD design or production changes, aircraft configuration changes, material performance / reliability level, logistical needs, obsolete/suspect items, new qualified items, etc…are all taken into consideration when conducting OA tests.

Acquiring Samples

- Annual sample requirement to Fleet
  - Sample Acquisition initiated at least 1 year in advance
  - Identified by DODIC for upcoming year
  - Administrative Naval Message (US Navy Only*)
  - Fleet Return Module (Currently USMC Only, US Navy Implementation scheduled for FY19*)
- NSWC IHEODTD rework stock
- Coordinated with NAVSUP Ammo Logistics Center (NALC) Mechanicsburg (US NAVY & USMC Only*)
- A good OA depends on a good sample
  - A good sample is determined by what we get back from the fleet
  - A quality sample boosts confidence in the test results



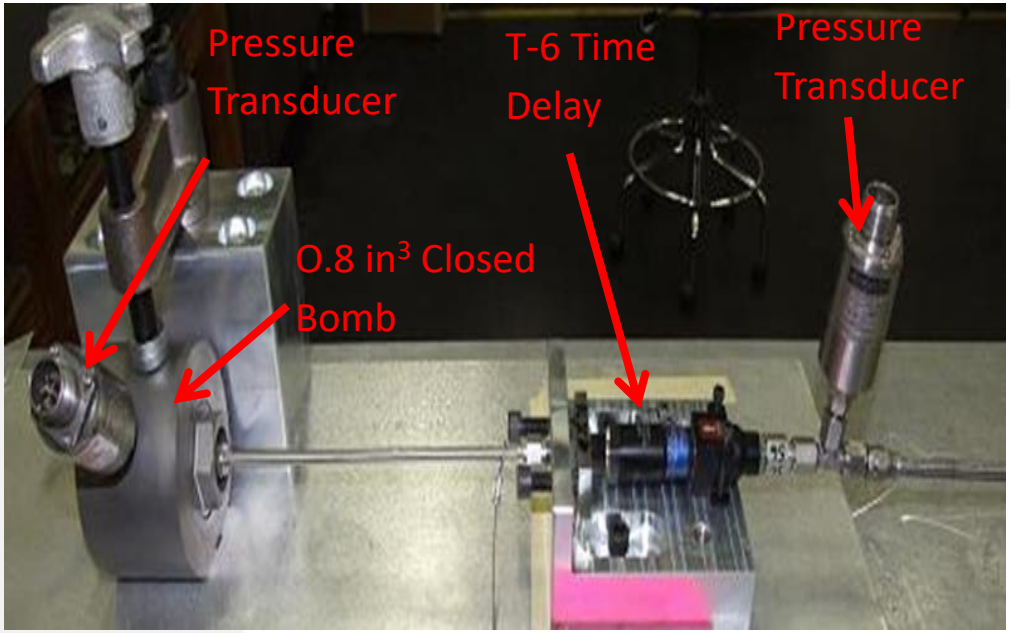
*Other sponsors responsible for their own OA sample collection

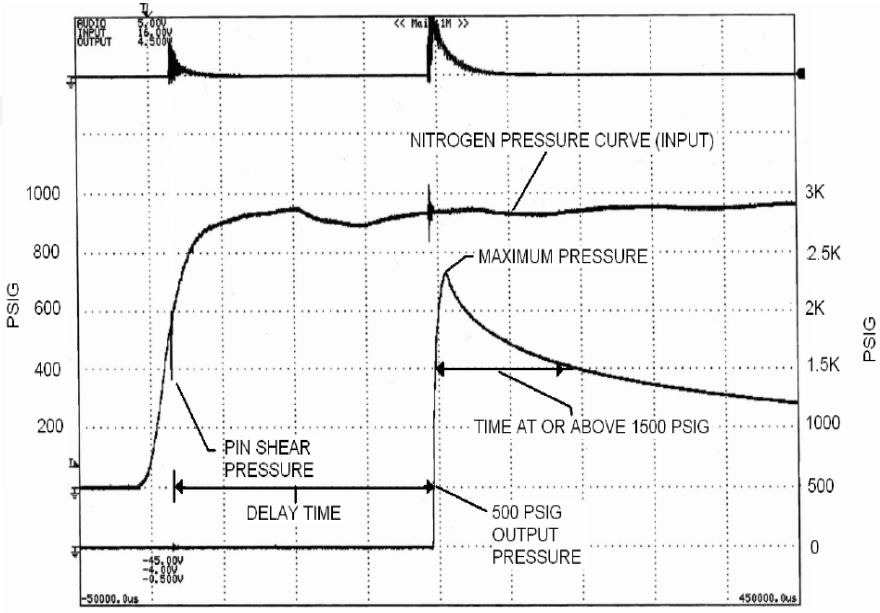
OA Process Steps

- Research Install History (Tracked in VFS – TRACE/LogBook)
- Non-Destructive Testing
  - Visual, Electrical Resistance, X-ray, Helium Leak, etc…
- Ballistic/Destructive Testing
  - Same as original Lot Acceptance Tests (LAT) in order to maintain commonality.
  - Fixtures designed to simulate end item use or configuration
  - Typically temperature conditioned at extreme temperatures (Cold/Hot) and ambient condition to ensure life cycle sustainment
- Propellant Stability Testing
  - Ensures CAD/PAD is safe to handle and store by analyzing stabilizer levels.
- Statistical Analysis
  - Generated Data compared to original LAT and prior OA data.
  - Plotted as a function of total age and installed time
  - Reliability Statistics
    - Functional Reliability – item performing within specification
    - Catastrophic Reliability - Ability of item to complete the firing cycle when initiated.

Sample Ballistic Test

- DODICs JL56/57 (T-6 Time Delays) & DODICs JN10-12 (T-38 Time Delays)
  - Delay Time (ms)
  - Maximum Pressure (psig)
  - Time at or above 1500 psig (ms)





Engineering Decisions

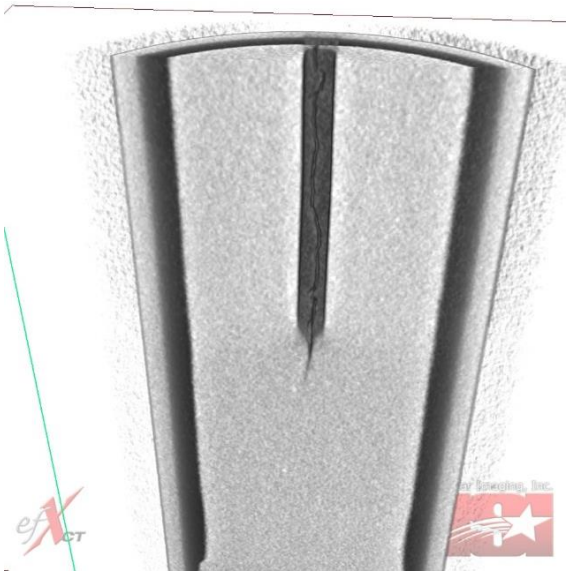
- Does item have relevant system/environmental exposure?
    - Install data (VFS – TRACE/Logbook)
- Does data represent the current fleet population?
    - Sample Quality
- Safe to store and handle at current lives?
    - Propellant Stability
- Reliable? Performance within required limits?
    - Statistical Analysis
- Effects of Fleet environment?
    - NDT and Ballistic Testing

Life Determination

Install History + Quality Sample + Test Performance + Safe Handling + Statistical Analysis

Recent Findings & Analysis

- DODIC JM51 (U-2 ROCAT - Dec 2017)
  - Computed tomography (CT) scans revealed that cracks were developing in the finocyl and liner regions of the grain at exposure to temperature conditions below 40˚F (4˚C).
  - Risk analysis was completed and determined there was a 12% increase in pressure in the worst case sample, but occurred early in the burn process prior to achieving peak operating pressures.
  - Risk Analysis determined the worst case scenario would be if cracks propagated down the entire length of the rocket catapult grain, resulting in a pressure increase between 9,000-12,000 psi and cause case rupture.
  - Scenario was deemed as low probability and ballistic testing was completed successfully.



Recent Findings & Analysis

- DODICs JL56/57 (T-6 Time Delays - Current):
  - Small Column Insulated Delay (SCID) Failures (2012 to current)
  - Catastrophic failures and increasing delay times lead to service life reductions.
  - In March 2018, another catastrophic failure occurred.
  - Post-fire CT scans revealed the primers successfully functioned with the SCID never actuating.
  - Failure led to additional 4 lots being removed from service in 2018

Failed Unit

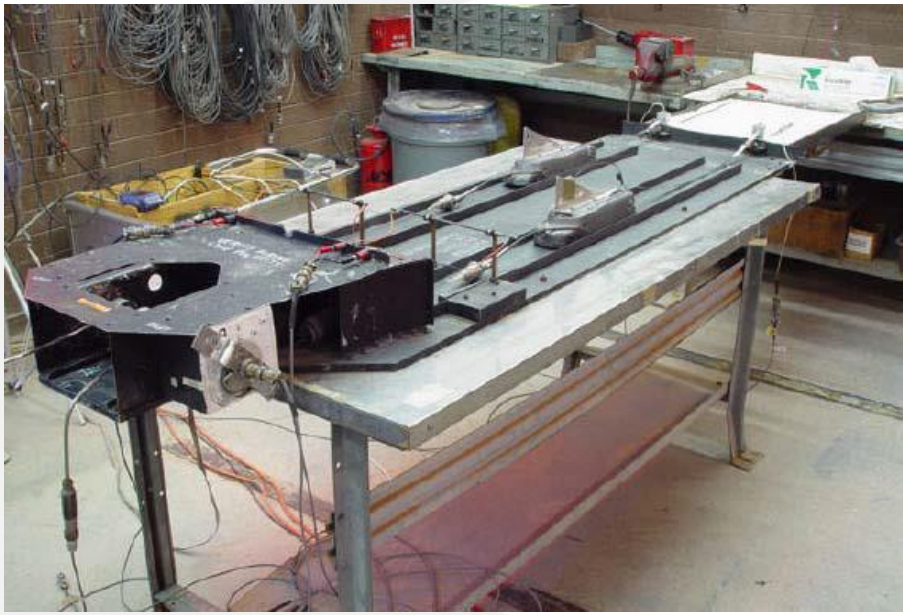
Successfully Fired

Recent Findings & Analysis

- DODICs MT30/31, MT13 (NACES USRMs & Impulse Cartridge – Nov 2017):
  - Conventional Ordnance Discrepancy Reports (CODRs) issued due to over-application of MIL-PRF-32033 / VV-L-800 general purpose lubricant at the 84-day inspections of O-rings and preventive maintenance of moving sub-system parts.
  - Engineering Investigation (EI) was conducted and subsequent emergency OA test plan was established to ensure system/end-items had not been compromised
  - All test scenarios concluded minimal impact to system and maintenance procedures were updated as preventative actions for the future.

Recent Findings & Analysis

- DODIC JM51 (U-2 Foot Retractor - March 2018):
  - Combined test stand validation due to recent refurbishment of fixture and OA at increased ages due to late delivery of assets.
  - Test stand validation was essential in follow-up propellant replacement program due to current propellant obsolescence.
  - Validation was completed and fixture was accepted as-is though several recommendations for improvement were noted for future use.
  - OA testing was completed and life determination was recommended for an increase.

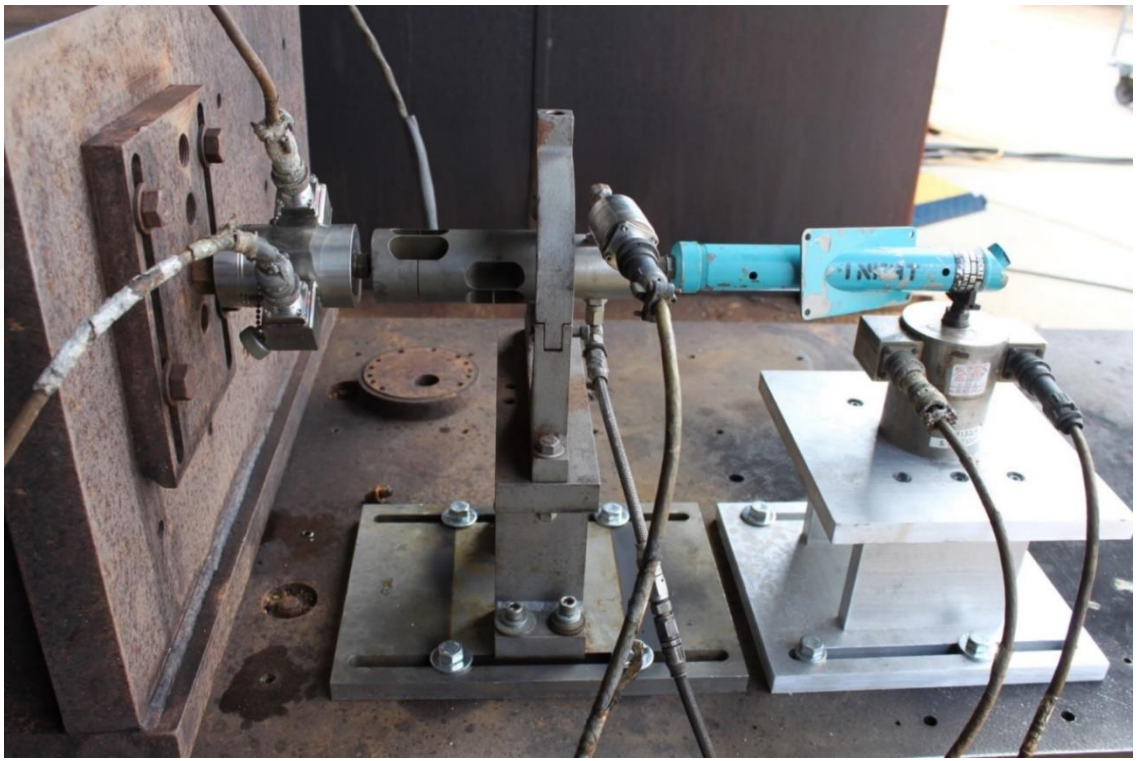


Recent Findings & Analysis

- DODIC MD72 (A-4 MK 16 ROCAT - Dec 2017):
  - OA testing was completed in order to validate performance at increased ages in order to allow temporary service life extensions (SLEs) to mitigate late delivery of alternative designs.
  - Test assets were provided from FMS partner to ensure installs were aging similar to US installs.

Recent Findings & Analysis

- DODICs MU75/76 (MK90/82 Man/Seat Separation Rocket Motor - March 2018):
  - OA testing was completed in order to validate performance at increased ages in order to allow temporary service life extensions (SLEs) to mitigate late delivery of alternative designs.



Recent Work – Ballistic Firings

#	DODIC	Nomenclature	Test Date	Current Life
1	XW36	Catapult Ctg. Mk 205 Mod 1/2	7/24/17	96/-
2	MT30, MT31	Mk 123/124 Mod 0 Rocket Motor	10/12/17	204/-
3	M514	MARK 44 MOD 0 Impulse Cartridge	7/24/17	A: 204/84
4	XW57	Impulse Cartridge	5/3/17	159/96
5	M397	Impulse Cartridge Set	7/6/17	162/72
6	MJ21	CCU-92/A Impulse Cartridge	10/11/17	various
7	MF21	Mk 79 Mod 1/2 Rocket Motor	8/17/17	156/156
8	MT28	Mk 121 Mod 0 Rocket Motor	10/5/17	84/84
9	MD92	GYRO SPIN-UP GAS GENERATOR	7/18/17	84/84
10	M492, MG01	MK18 Cartridge Actuated Cutter & THU-	6/13/17	108/36
11	MD87	HARNESS RELEASE CTG	2/28/18	96/96
12	MF64	S-3B A/C Initiator (JAU-22/B)	5/9/17	108/12
13	M500	M21 Cutter	6/28/17	312/72
14	M758	JAU-8/A EJECTION INITIATOR	6/15/17	132/132
15	MD99	Trajectory Divergency Rocket Motor	10/23/17	240/228,
16	M179	Fire Extinguisher Cartridge	6/6/17	204/96
17	M182	Fire Extinguisher Cartridge	1/18/18	216/72
18	M720	Cartridge Actuated Initiator	8/2/17	various
19	MF72	Initiator, Propellant Act. JAU-27 /A	6/19/17	192/120
20	M934	Mark 17 Mod 0 Ignition Element	9/6/17	84/12
21	XW58	Impulse Cartridge	6/15/17	192/96
22	MC60	INITIATOR, DELAY 0.4 SEC	6/22/17	120/96
23	CWDR	MXU-792A/A Thermal Battery	10/11/17	120/96
24	MC50	0.3-Second Delay Initiator	3/23/18	60/24

Recent Work – Ballistic Firings

#	NALC/ DODIC	Nomenclature	Test Date	Current Life
25	WB55	Initiator	3/23/18	48//24
26	MC48	Internal/ External S-3 handle initiator	5/31/17	96/24
27	MU12	TOW SEVERANCE REL ASSY	9/5/17	84/60
28	MU21, MT52	CTG, WORK TABLE THRUSTER	6/19/17	120/72
29	JM47, JM48, JM49	CUTTER RISER LINE LOWER	5/9/17	60/36
30	ZY46, ZY47, ME52-54	Line Assembly	8/7/17	252/192
31	MT92	Impulse Cartridge for B-1B Seat Retraction	6/12/17	108/84
32	MT10	Output Initiator of B-1B Seat Retraction	6/12/17	108/84
33	MT93	IMPULSE CTG, PIN PULLER	5/9/17	120/96
34	MD89, MT76	Drogue Gun Ctg	5/9/17	132/132
35	JM36	CUTTER ASSY	2/20/18	144/144
36	MF69	Initiator	1/31/18	108/36
37	SR67/68	B-1B LCAs	3/15/18	144/96
38	SQ03	Impact Initiator	12/5/17	156/75
39	SQ04	Front Mount Cutter	12/5/17	156/75
40	JN25	Power Module	10/30/17	120/96
41	KY90	Cabin Decompressor Sensor	12/5/17	108/72
42	SR75	Ambient Pressure Delay Initiator	11/27/17	60/36
43	JM33, JM34, JM41	EEDs, Canopy Thruster Rocket	2/20/18	84/60
44	MU84, MU87	F15 - 2.0 and 1.5 SEC DELAY INIT	4/17/18	72/48
45	JM51	U-2 Foot Retractor	2/27/18	72/36
46	DWEA	DUAL-BRIDGEWIRE BOOSTER CARTRIDGE	9/12/17	108/36
47	SR76/77/78	Delay Initiators	11/27/17	156/75
48	MT57, MT58, MT65	.33, .40, & 1.0 sec Delay Initiators	4/17/18	96/72

Recent Work – Life Evaluations

#	DODIC	Nomenclature	Old Life	Life Recommendation
1	BY81	VAR - FLU 9B/P INFLATOR	108/108	132/132
2	M783	EA-6B Multi-Use Impulse Cartridge	264/126	288/144
3	M647	Impulse Cartridge	240/108	252/111
4	ZY56	Drogue Severance Assy	120/120, 102/102	No Change
5	MT97	NACES Impulse Cartridge	144/96	No Change
6	XW48	Impulse Cartridge	124/75	No Change
7	JL96	CATAPULT, RKT CKU-7A/A	132/-	144/-
8	JL54	IMP CTG CCU-152/A 4.0 Sec Time	108/60	132/60
9	SR95, WB19	DFIRS Explosive D	144/120	156/126
10	SQ85	Exp Bolt Electric Squib	132/30	144/30
11	MD72	Mk 16 ROCAT	156/-	No Change
12	SS49	GGU-15A/A Dry Bay Fire Extingisher	120/96	132/96
13	JL53, DWFI, DWFH	ATU-136/A MECHANICAL ACTUATOR	132/72	144/72
14	M699	INITIATOR, M28	192/192	204/204
15	M363	MK124 Mod 0 Impulse Cartridge	198/12	No Change
16	MD58	CCU-123/E Impulse Cartridge	indefinite/-	No Change
17	XW51	CARTRIDGE, IMPULSE	202/126	No Change
18	MT20	CCU-125/A FIRE EXTINGUISHER	Army: 216/96	Army: 228/96
19	4W69	Parachute Release PCU-48 /B	144/36	156/36
20	WB05	DET CORD ASSY	180/60	No Change
21	UY68, XW53	SELECTOR, EJECT SEQUENCE	156/84, 108/72	156/84, 108/72
22	WB06	DET CORD ASSY	120/60	No Change
23	M571	Impulse Cartridge	96/48	108/54
24	MC47	Internal S-3 handle initiator	156/72	192/72
25	MG67	Mk 113 Mod 0/1 Rocket Motor	96/-	No Change

Recent Work – Life Evaluations

#	DODIC	Nomenclature	Old Life	Life Recommendation
26	JN06	INITATOR	96/48	No Change
27	WB24	CCU-145/A Impulse Cartridge	66/12	78/12 and 60/12
28	MT88	NACES Impulse Cartridge	168/96	180/108
29	MD99	ACES II - DIVERG RKT MTR	219/219, 108/108	No Change
30	MD33, MD36, SS45,	Window Cutting Assembly	216/96	216/102
31	SP86	ACES II - DIVERG RKT MTR	168/144, 108/108	No Change
32	WB62	Cartridge Actuated Cutter (CAC)	72/60	84/60
33	MH61, MJ98	ONE-WAY TRANSFER INITIATOR	MH61: 144/108, MJ98: 216/148	MH61: 144/108, MJ98: 216/148
34	JL62	IMP CTG CCU-154/A Powered Inertial	84/48	No Change
35	MT06	JAU-59/A MECHANICALLY ACTUATED	156/72	144/60
36	M161	Impulse Cartridge MK23 MOD 0	204/30	216/30
37	JL63	IMP CTG CCU-155/A Head Box	108/72	120/72
38	MG05	Initiator, Pressure Act	156/84	No Change
39	JN16	IMP CTG CCU-155/A Head Box	72/48	84/48
40	MS01	GENERATOR, GAS	132/84	180/120
41	SS34, SS35	UWARS CTG	Navy: 120/72, AF: 120/108	Navy: 132/72, AF: 132/108
42	SS66	FIRE EXT CTG	108/60	120/60
43	M865	THRUSTER, M1A2	216/216	228/216
44	MS94-97	AH-64 AD Window Cutting	168/96	No Change
45	M232	Fire Extinguisher Cartridge	192/72	No Change
46	M190	Impulse Cartridge	258/12, 144/12	No Change
47	JL57	.17 Second Delay Cartridge	84/48	**60/24**
48	WB34, WB35, WB36,	CV-22 CANOPY SEVERANCE STAR	120/72	144/72
49	NY16	B1B - ROCKET MOTOR, BOTTOM	108/84	No Change
50	SP81, SP82, SP83	C-17 ARM-FIRE INIT, EXTERNAL	84/72 72/72	108/72

Recent Work – Life Evaluations

#	DODIC	Nomenclature	Old Life	Life Recommendation
51	JM35	F-22 CANOPY REMOVER, RKT	96/72	108/72
52	MT64, SQ34	B1B - SMDC/GAS TYPE 1 INITIATOR	Various	No Change
53	SR74	B-2 MANUAL PULL INITIATOR N00174-	72/48	No Change
54	MT58, MT65	F-16 0.33 and 0.4 Second Time	Various	No Change
55	WB40, WB41, WB44,	C-17 FEDS PANEL	72/48	No Change
56	SR67, SR68	B1B - LINEAR CHARGE ASSY	144/96	156/96
57	SY14	B1B - MODE SELECTOR	120/84	No Change
58	JN25	ACES II - POWER MODULE	120/120	132/96
59	M948	AERIAL REFUELING RECEPTACLE CTG	144/120	No Change
60	ME80/81, MT33/34	Canopy Jettison Rocket Motor	132/120, 144/132	156/-
61	JM39	F-22 THERMAL BATTERY	108/96	No Change
62	MU21	B1B - WORKTABLE THRUST CTG	120/72	No Change
63	ME34	F-16 MANUALLY ACTUATED	180/156, 108/108	No Change
64	ME35	GAS ACTUATED DETONATION	168/168, 84/84	No Change
65	MF69	T38 - INITIATOR (1007-4) F-5F, T-38	144/132	180/132
66	MU97, MU98, MU99	B1B-AND GATE	120/96	No Change
67	MG47	T38 - 1.0 SEC TIME DELAY INITIATOR	60/36	72/48, 72/60
68	MU90, MU29, MU23	CARTRIDGE,DELAY	Various	No Change
69	MT75, MT19, MU88,	AFT HATCH REMOVER INPUT CTG	84/66	No Change
70	MU96	KIT DEPLOYMENT ACTUATOR	144/96	No Change
71	MT85	CCU-109/A Impulse Cartridge	240/90	No Change
72	XW36	Catapult Ctg. Mk 205 Mod 1/2	96/-	108/-
73	WB55	Initiator	48/24	No Change
74	MD68, MD69	Mk 100/101 Mod 0 Rocket Motor	216/-	No Change
75	MT89	NACES Impulse Cartridge	192/96	No Change

Recent Work – Life Evaluations

#	DODIC	Nomenclature	Old Life	Life Recommendation
76	XW78	Initiator	180/114	192/126
77	M690	INITIATOR, M3A2	246/198	No Change
78	MW19	Parachute Release Imp. Ctg.	150/85	No Change
79	M689	INITIATOR, M53	AF: 248/216	264/148
80	JL71	CCU-148/B Impulse Cartridge	96/24	No Change
81	M264	M55 Electric Ignition Element	96/12	No Change
82	M365	Impulse Cartridge MK 1 MOD 3	144/18	No Change
83	XW49	Shoulder Harness Reel Imp Ctg	158/96	No Change
84	FW98	Inflation Device FLU-8 B/PA	168/-	No Change
85	MT16	NACES Initiator	168/108	No Change
86	MT69	Fire Extinguisher Cartridge	156/84	No Change
87	M012	Impulse Cartridge Mk 19 Mod 0	192/42	No Change
88	M783	Multi-Use Impulse Cartridge	264/126	No Change
89	M703	INIT, M31 (NON-SEAT ITEM)	168/168	No Change
90	MJ15, MJ92	Fire Extinguisher Cartridge	various	No Change
91	MU84, MU87	F15 - 2.0 and 1.5 SEC DELAY INI	72/48	No Change
92	JM81	EED, Catapult	120/84	132/84
93	UY01, UY02, UY03	Bottom Bailout Handle, Type 4	126/72	No Change
94	MG08, MU10	CUTTER ANTENNA, SMALL	132/84	144/84

FY18 Planned OAs

#	DODIC	Nomenclature
1	JN28, JN29	Secondary Impulse Ctg (T-6 and T-38)
2	JN26	Primary Impulse Ctg (T-6 and T-38)
3	A965, MD73, MG62	M839 25.4-Millimeter Decoy Cartridge, M796 Impulse Cartridge, BBU-35/B Impulse Cartridge
4	BY81	FLU-9 Inflation Device
5	JL57	.17 Second Delay Cartridge
6	SR95, WB19	DFIRS Explosive D
7	SU58	Mild Det Cord (MDC) Set
8	WB15/16	Initiator/Cartridge
9	WB54	Delay Initiator
10	XW48	Impulse Cartridge
11	XW53	Explosive Sequence Control
12	XW56	Cartridge Set
13	MT23	Fire Extinguisher Cartridge
14	XW78	Initiator
15	MG39/40	Canopy Overhead/Periphery MDC Assy
16	MT97	NACES Impulse Cartridge
17	XW51	Impulse Cartridge
18	FW98	Inflation Device FLU-8 B/PA
19	JL63, JN16	Parachute Impulse Cartridge
20	JL64	Impulse Cartridge
21	JL65	CCU-157/A Impulse Cartridge
22	MD68 MD69	Mk 100/101 Mod 0 Rocket Motor
23	MT16	NACES Initiator
24	MT88	NACES Impulse Cartridge
25	MT89	NACES Impulse Cartridge
26	MT98	NACES Impulse Cartridge
27	Various	Det Cord Assy (TLX)
28	MJ98, MH61	Initiator
29	MS91, MS92	AH-64A/D SERVICE-RETURNED FLEXIBLE CONFINED DETONATING CORDS [FCDC]
30	MT06	JAU-59/A MECHANICALLY ACTUATED INITIATOR
31	MD66	Impulse Cartridge (Bomb Ejection)
32	MT95	CCU-107/B Impulse Cartridge
33	WB51	Fire Extinguisher Cartridge
34	XW52	Initiator
35	XW70	S &A Detonator
36	M690	M3A2 Initiator
37	JM60	CKU-5 Rocket Catapult
38	M710	M26 Initiator
39	ZY56	Drogue Severance Assy
40	JL42-44	Fire Extinguisher Cartridge
41	JL62	PIRD Cartridge
42	M700	M27 Initiator
43	M647	Impulse Cartridge
44	MT91, XW50	Impulse Cartridge
45	JL54	ADU Cartridge
46	JL55	Drogue Gun Imp. Ctg.
47	MW19	Parachute Release Imp. Ctg.
48	M597	Initiator JAU-14 /A
49	MT13	NACES Impulse Cartridge
50	MW97	MK 235 MOD 0 Impulse Cartridge
51	MT86	CANOPY REMOVER CTG
52	JM37, JM34	Canopy Thruster Assy w/ctg
53	JN13, JN14	Underseat Rocket Motor, Front & Underseat Rocket Motor, Aft
54	MU15-19, MU79/80, MJ93	B-1B Time Delays
55	WB34-39	Canopy Severance Assemblies
56	MU97-99	AND Gates Type 1
57	MT64, SQ34	SMDC to Gas Initiator
58	ME35	INITIATOR ALT
59	JM58	INITIATOR DUAL GAS FIRED
60	JM59	INITIATOR DUAL MECH FIRED
61	JM56	INITIATOR 1.0 SEC DELAY GAS FIRED
62	M948	AERIAL REFUELING RECEPTACLE CTG
63	MU90, MU89 MU29, MU23	CARTRIDGE,DELAY
64	SP81-83	ARM-FIRE INIT, EXTERNAL
65	JM35	Canopy Remover Rocket
66	JM55	INITIATOR ANEROID ACTUATOR
67	SR74	Manual Pull Initiator
68	JN40	PYROTECHNIC ARMING UNIT (PAU)
69	JM57	INITIATOR 0.3 SEC DUAL GAS FIRED
70	JM39	F-22 Thermal Battery
71	JL03, WA98, WA99, WB01, WB02, WB03, WB04	JAU-73/A Initiator

Summary

- Ordnance Assessment ensures the safety, quality and reliability of CADs and PADs
- Quality of test depends on the quality of the samples
- Sample install history (VFS) is essential analyzing degradation of assets
- Usable FMS tests samples are needed in order to ensure similar aging characteristics to US installs.

Ordnance Assessment
ensures the safety of our Warfighters!