



Allowable Service Life Extension Determinations

Presented to:

2022 CAD/PAD Technical Exchange Workshop

Presented by:

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Assignment: Ordnance Assessment/Logistics Branch
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CAD/PAD Life

- Cartridge Actuated Devices (CAD) and Propellant Actuated Devices (PAD) begin their lives in manufacturing → Packaging
 - Complete manufacturing starts “shelf” life
 - Open package starts “install” life



CAD/PAD Evaluation

- CADs & PADs perform various functions in all critical military egress aircraft systems
 - CADs & PADs performance changes with time
 - The Ordnance Assessment (OA) Group assesses change using
 - OA/Quality Evaluation/Surveillance Test
 - Lot Acceptance Test
 - Qualification Test



Initial/Current CAD/PAD Life

- The latest ***approved*** Ordnance Evaluation Indian Head Technical Report determines current:
 - Allowed Shelf Life
 - Allowed Install Life and
 - Life limiting issues include:
 - Test Failure(s)
 - In-service Failure(s)
 - Out of specification with age and
 - Lack of long term data



Fleet Availability

- The fleet tries to schedule their deployment/maintenance cycles to accommodate unit replacement before they become overaged.
- Frequently, these deployment/maintenance cycles conflict with shelf/installed life predictions or stock availability. The choices are:
 - Deploy at risk,
 - Ground the aircraft, or
 - Deploy under a granted service life extension.



Request Service Life Extension

- The least risk to Aircrew Safety *and* Aircraft Availability is to operate under an approved Service Life Extension (SLE) request.
- SLE requests are submitted to the Virtual Fleet Support (VFS) SLE request module.
- VFS provides two types of data to evaluate SLEs:
 - Unit Identification and
 - Unit Shelf & Installed Age



VFS SLE Data

Unit Identification

- Assigned SLE Request No.
- Department Of Defense Identification Code (DODIC)
- Lot No.
- Part No.
- Part Serial No.
- Installed Aircraft Type
- Installed Aircraft Tail No. (BUNO)



VFS SLE Data

Unit Shelf & Installed Age

- Ordnance Evaluation Initial Life
- Latest Life Extension
- Current Life Requested Extension



Ordnance Evaluation Download

A VFS Feature allows SLE Download

- Ordnance Evaluator (OE) downloads VFS data into an Excel® spreadsheet
- OE sorts data by the earliest expiration date
 - Determines the highest priority + LMS requests
- OE filters data by assignment aircraft
- OE populates data in a separate spreadsheet with one or more DODIC(s) *New*



Ordnance Evaluation Spreadsheet

Excel window: (####) 202X-XX-XX SLE.xlsx - Excel
Archer, Harry L Jr. CIV USN NSW IHEODTD MD (USA) Share

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	SLE No	Squadron	Buser	Aircraft Type	Lot Number	Serial Number	Priority	Reason	Remarks	Shell/Install (Original)	Shell/Install (Current/Extended)	Current Expiration Date	Shell/Install (As of Today)	Shell/Install (Requested)	Requested Expiration Date	Order Status From One Year Ago to Today	Ordnance Evaluation Recommended	Recommended Expiration Date	Senior Engineer Concurrence Or Non-Concurrence	Comments
65																				
66																				
67																				

Sheet1

Excel window: (####) 202X-XX-XX SLE.xlsx - Excel

	A	B	C	D	E	F	G	H	I
1	SLE No	Squadron	Buser	Aircraft Type	Lot Number	Serial Number	Priority	Reason	Remarks
65									
66									
67									

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Ordnance Evaluation Spreadsheet

(####) 202X-XX-XX SLE.xlsx - Excel

Tell me what you want to do... Archer, Harry L Jr. CIV USN NSWC IHEODTD MD (USA) Share

J	K	L	M	N	O	P	Q	R	S	T
Shelf/Install (Original)	Shelf/Install (Current Extended)	Current Expiration Date	Shelf/Install (As of Today)	Shelf/Install (Requested)	Requested Expiration Date	Order Status From One Year Ago to Today	Ordnance Evaluation Recommended	Recommended Expiration Date	Senior Engineer Concurrence Or Non-Concurrence	Comments
The current Shelf/Installed life is ???m (Ref. Tech Report ???) ?? params						Stock: Qty ??? Condition and Purpose Code A	General Note -			

Units on Order
Status

Code A Stock

- Reference Unit Life Determination Technical Report Document
- VFS params give allowed extra shelf and installed life

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SLE Ordnance Evaluator's Role

- The **Ordnance Evaluator's** role is to recommend a service life and an install life that minimizes risk to the aircrew and aircraft.
- The Ordnance Evaluator's role isn't to maximize aircraft availability.



SLE LMS's Role

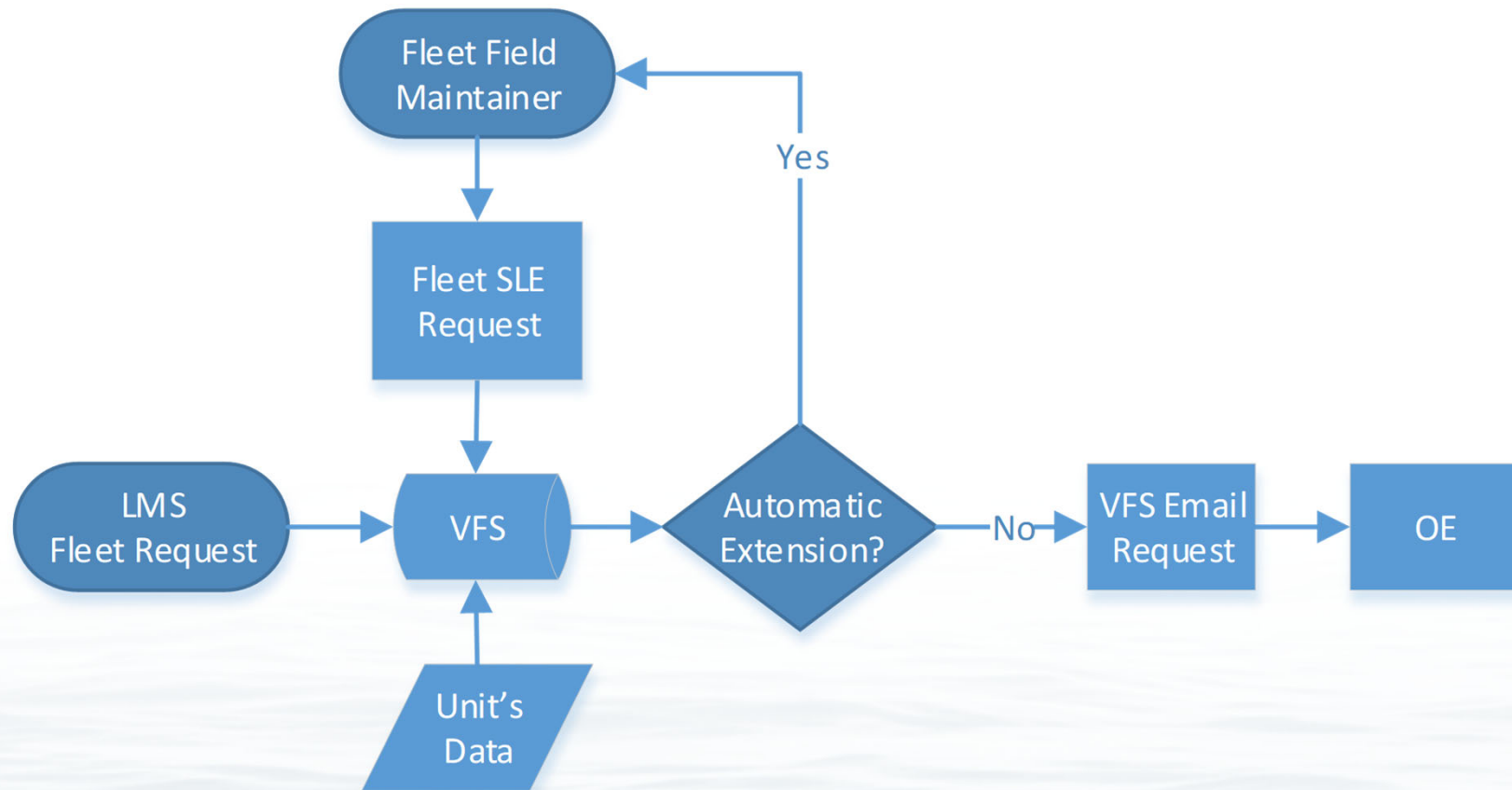
- The Logistics Management Specialist (LMS)'s role is to maximize aircraft availability by managing CAD/PADs supplied to aircrafts as need if available.
- The LMS's role isn't to evaluate a service life's affect on aircrew or aircraft safety.



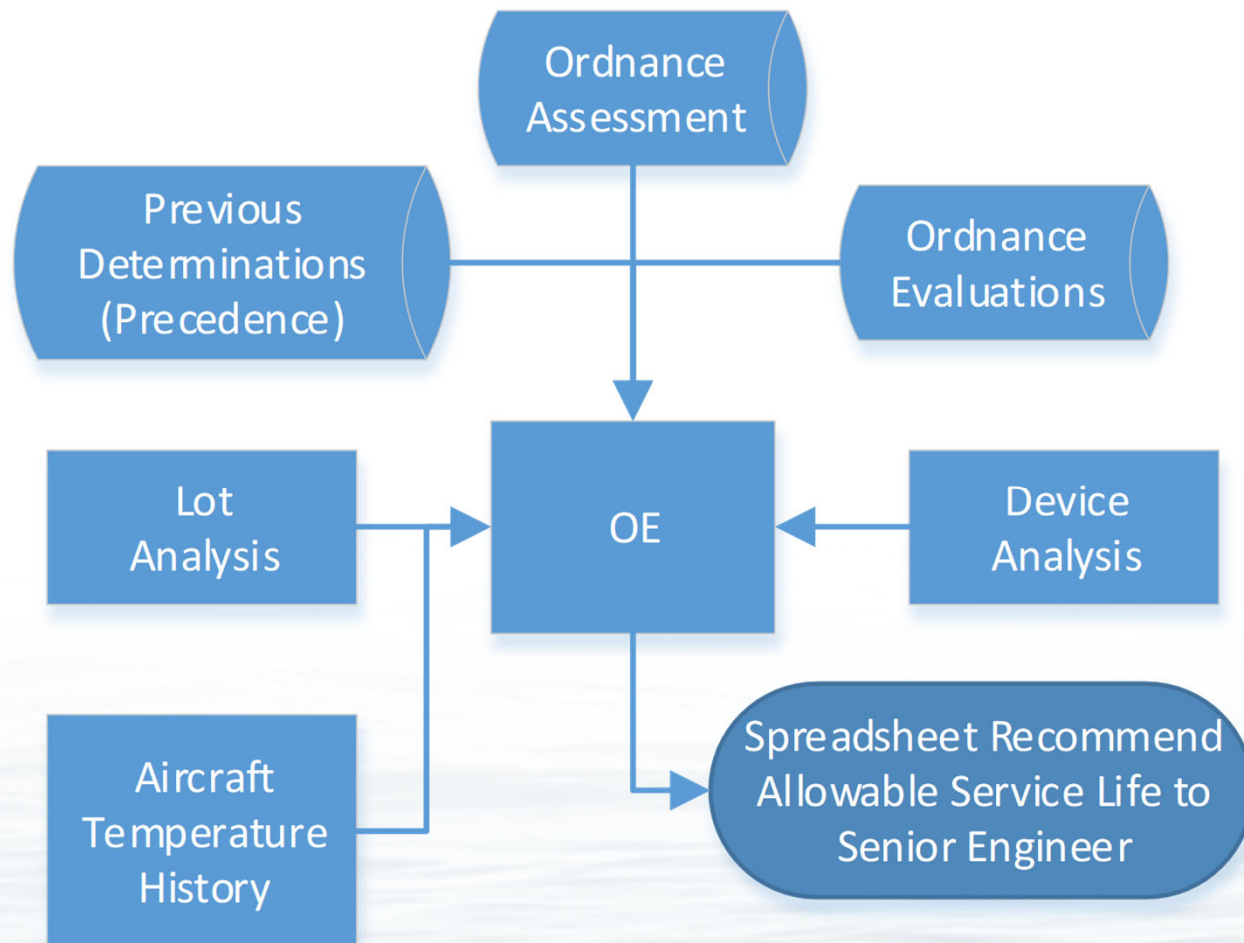
SLE Senior Engineer's Role

- The **Senior Engineer's** role is to concur or not concur with the Ordnance Evaluator's recommended allowable service life and install life
- If non-concurrence, the **Senior Engineer's** recommends a service life and install life that minimizes risk to the aircrew, aircraft and aircraft availability to the Ordnance Evaluator.
- The Program Office ultimately dictates what service life and install life the **Senior Engineer** may allow.

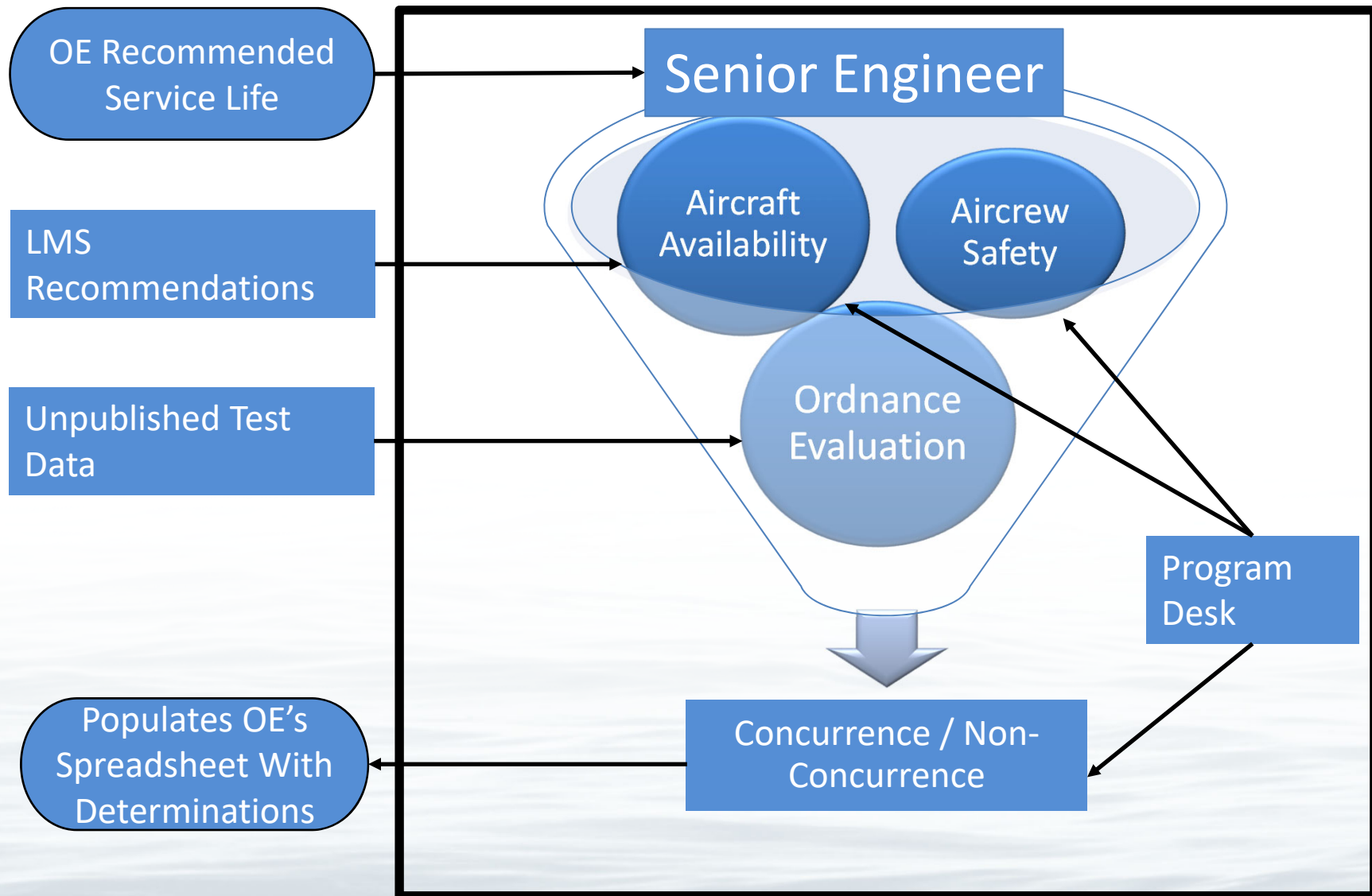
Ordnance Evaluator's SLE Recommendation



Ordnance Evaluator's SLE Recommendation



SLE Determination Data Flow



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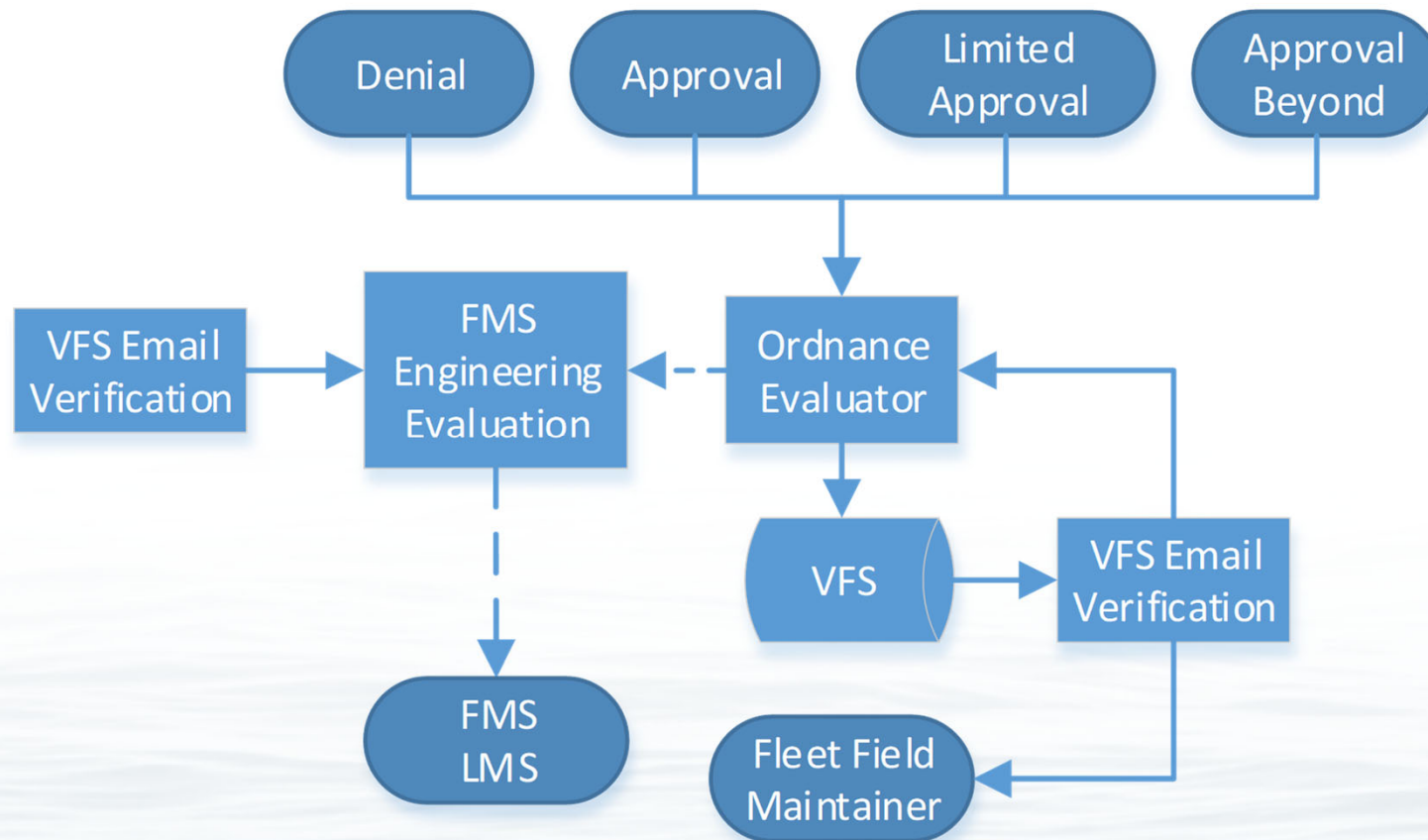


SLE Request Limited Approval

- Limits Shelf Life and/or Install Life
 - Shelf life limits are based on unit deterioration/uncertainty in storage and in an aircraft
 - Install Life limits are based on unit deterioration/uncertainty in an aircraft

SLE Spreadsheet Determinations

SLE Request Bottom Line





Same DODIC \neq Same Life

- The same DODIC may have difference extension lives
 - Some devices have stabilizer depleted by heat influenced by its aircraft ambient temperature history
 - DODICs produced with performance near or far from its limits have life determinations based how long it takes to exceed those limits.
 - Some producer make units with better aging performance than others.

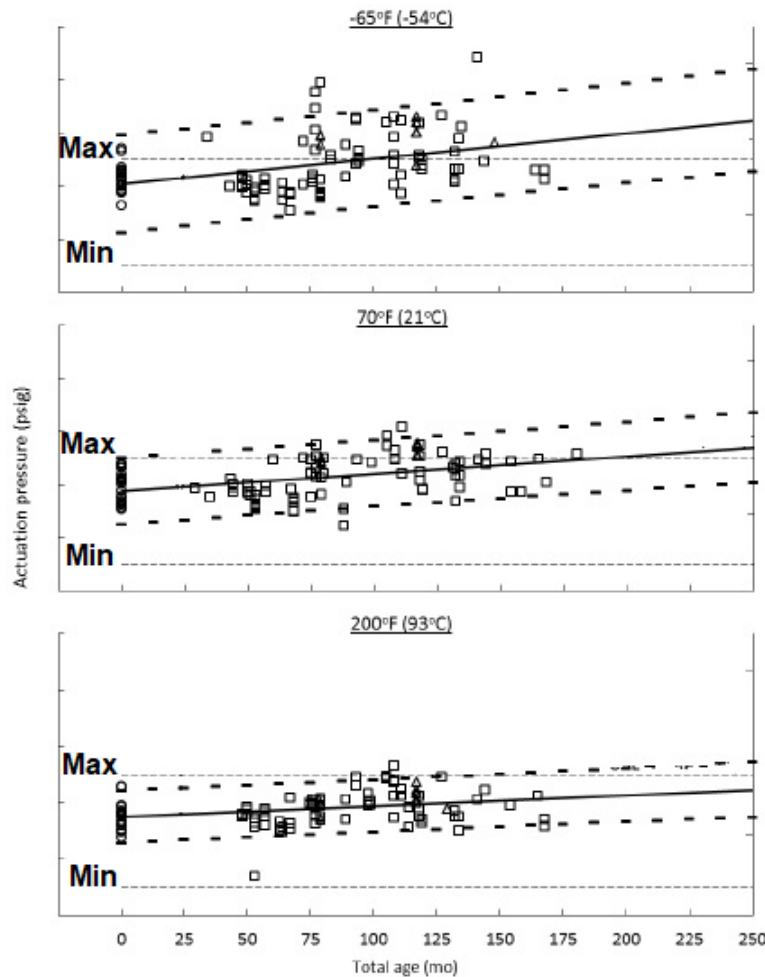


SLE Determination Tools

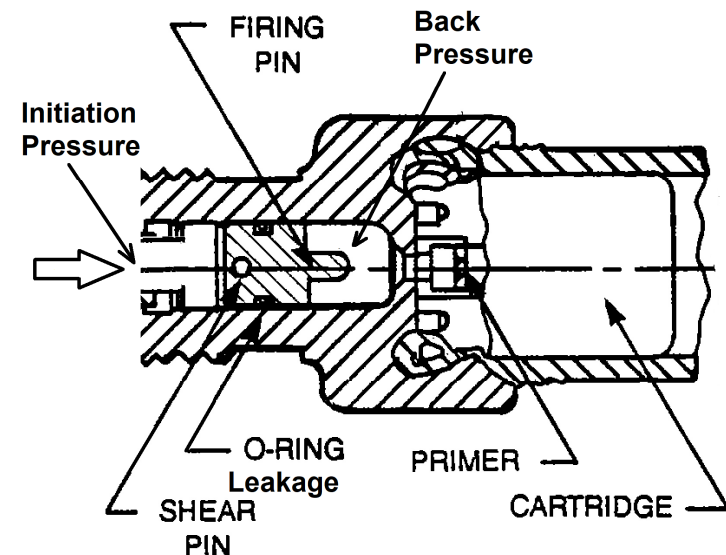
- Ordnance Assessment
 - Unit's test performance changes with time
 - Linear trends with tolerance bands
 - Where there is a 90% confidence that 99% of the inventory population will perform within those bands.
 - Projection of curves
- Device analysis
- Rates of aging *New*
- Precedence

SLE Determination Tools

Project of Curves



Device Analysis

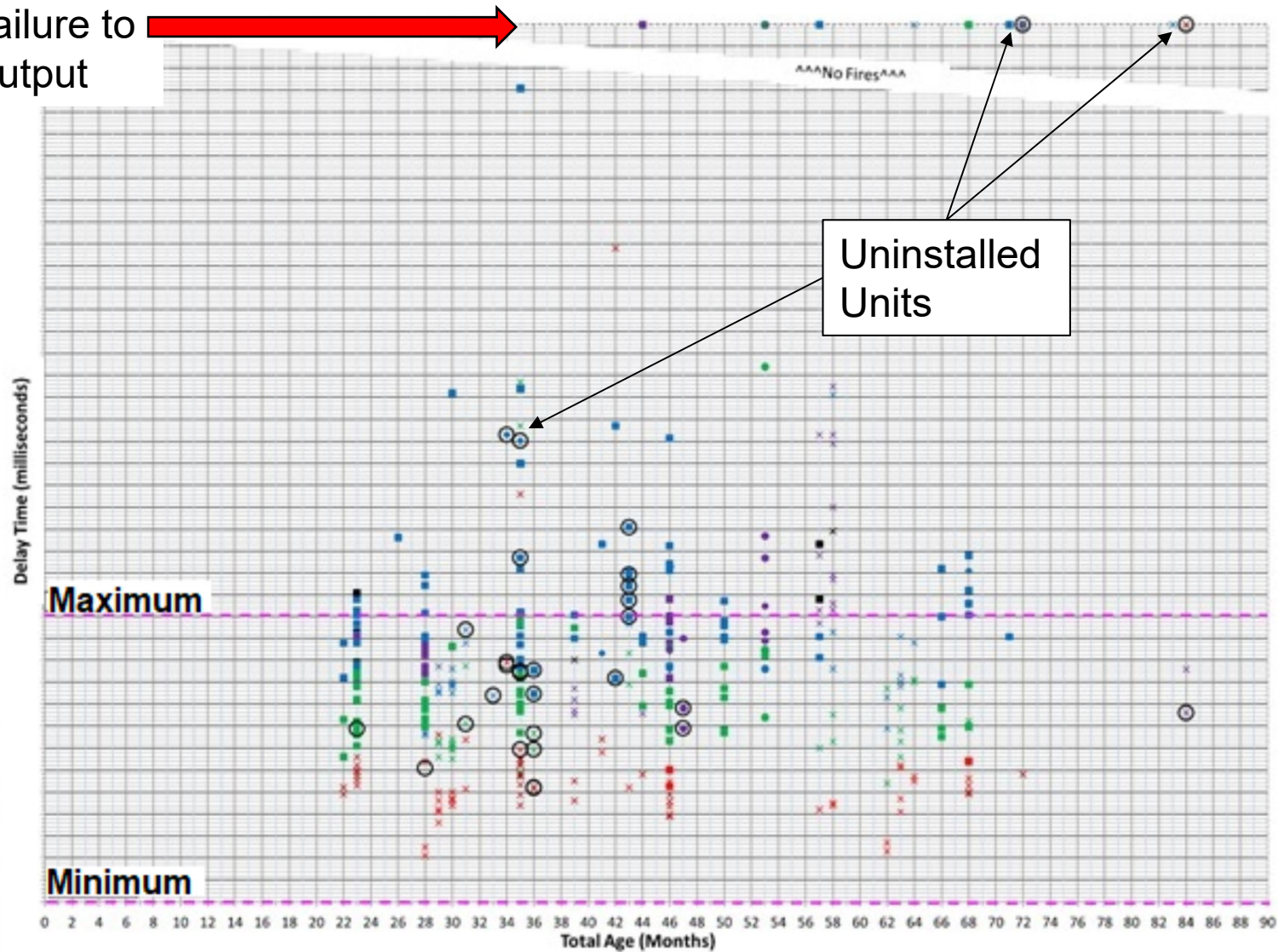


- Shear Pin Force = Initiation force – Back Pressure force
- Back Pressure force increases with increased O-ring leakage
- Aged Nitrile O-rings tend to shrink
- O-ring on shear pin hole may damage O-ring → leakage

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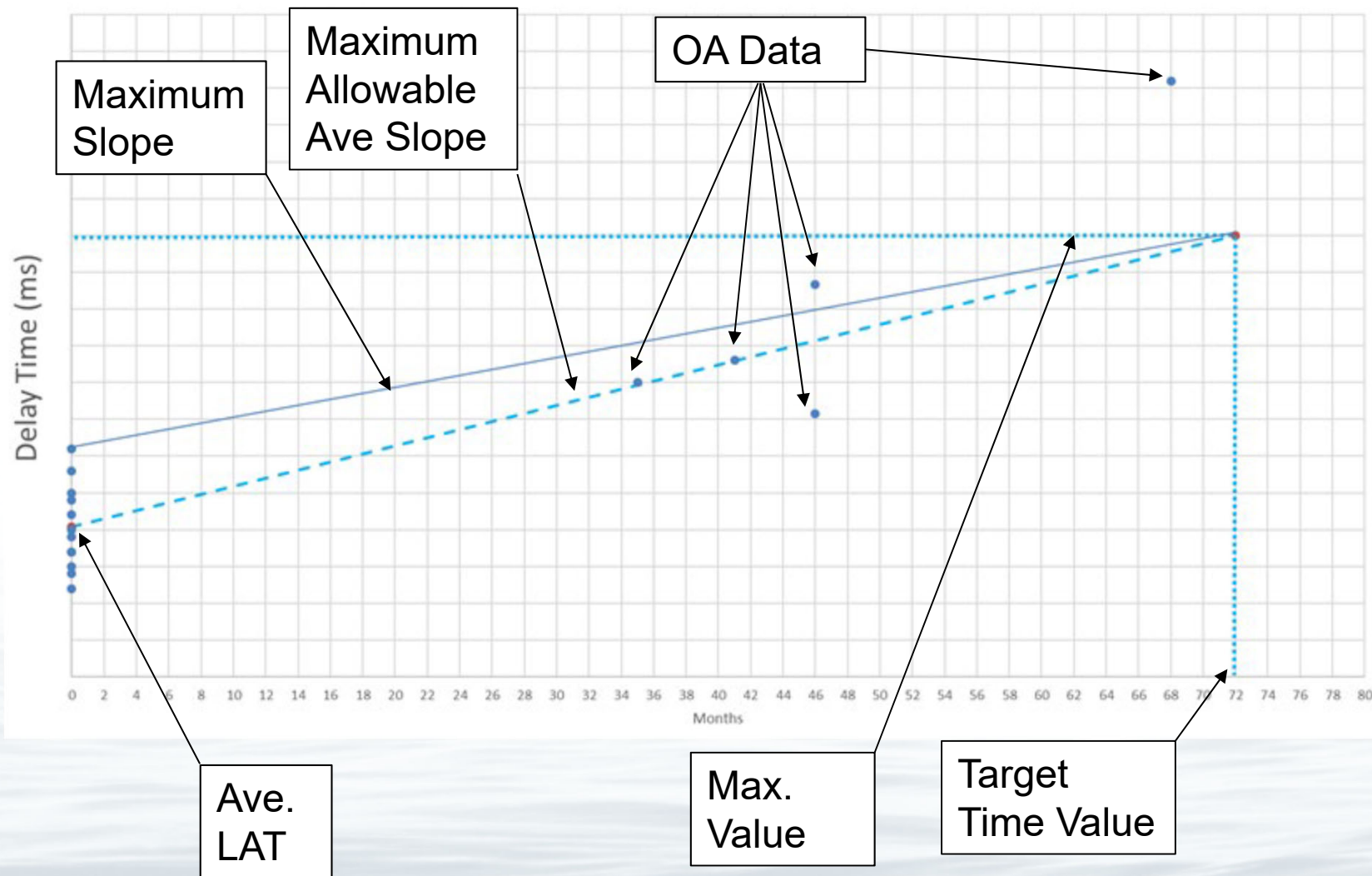
An Uninstalled DODIC Can Fail

Failure to
Output



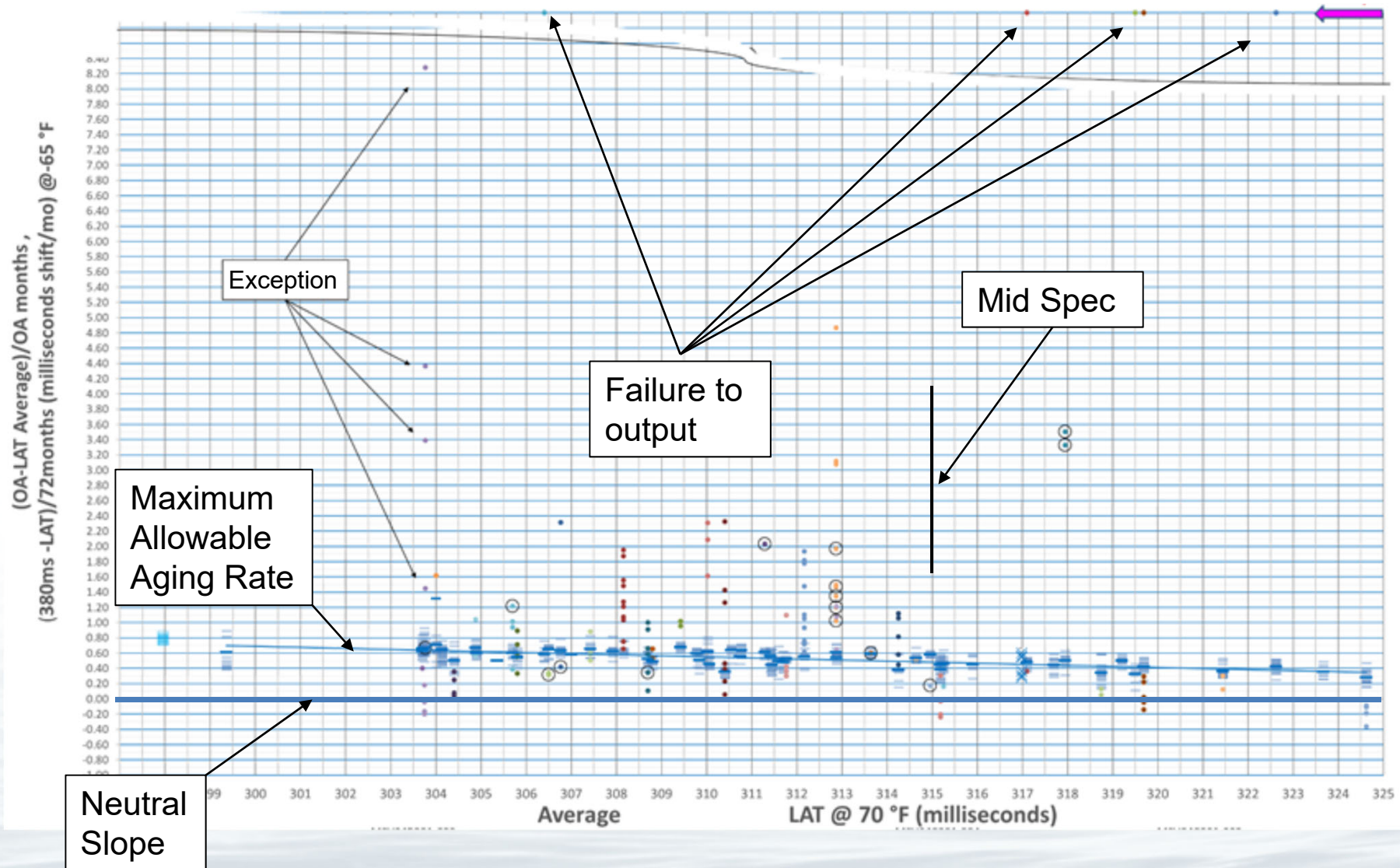
Distribution Statement A (22-110). Approved for public release. Distribution is unlimited.

What's the Difference?



Distribution Statement A (2011) Approved for public release; distribution is unlimited.

OA Rates of Aging



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Rates of Aging Spreadsheet *New*

xlbx - Excel																												Archer, Harry L Jr. CIV USN NSWC IHEODTD MD (USA)		Share
File Home Insert Page Layout Formulas Data Review View Developer Acrobat Tell me what you want to do...																														
D3																														
	A	B	C	D	E	F	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC						
										CUI																				
1	SLE No	Squadron	Busser	Aircraft Type	Lot Number	Serial Number	Current Expiration Date	Shell/Install (As of Today)	Shell/Install (Requested)	Requested Expiration Date	Order Status From One Year Ago to Today	Ave. Delay (ms) Time LAT at 70 F	Worse case aging rate @ -65 F ms/month Figure XX	Total Age Request	Ave. Delay (ms) Time LAT at -65 F	Worse case estimated delay time at requested Total age (ms): requested shelf time x (Age rate @ -65 F) + Ave LAT @ -65 F	Worse case estimated allowable total age in months: (Max ms - (Ave. LAT @ -65 F)) / Age rate @ -65 F	Maximum Delay Time (ms) Allowed	E22 Recommended	E22 Recommended Expiration Date	E22CEI2PFSUPOB Decision: (Concur with E22 Recommendation) or (Don't Concur with E22 Recommendation and see E22CEI2PFSUPOB Comment Decision)	E22CEI2PFSUPOB Comments								

	Ave. Delay (ms) Time LAT at 70 F	Worse case aging rate @ -65 F ms/month Figure XX	Total Age Request	Ave. Delay (ms) Time LAT at -65 F	Worse case estimated delay time at requested Total age (ms): requested shelf time x (Age rate @ -65 F) + Ave LAT @ -65 F	Worse case estimated allowable total age in months: (Max ms - (Ave. LAT @ -65 F)) / Age rate @ -65 F	Maximum Delay Time (ms) Allowed
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Calculated worse case
service life based on
aging rate

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SLE Data Uncertainty

- Test results may falsely indicate less life due to excessive bending/damage during uninstalling, packaging or testing:
 - Mild Detonating Cord Sets (MDCS)
 - Thin Layer Explosive lines (TLX)
 - Mild Detonating Cords (MDC)
 - Flexible Linear Shape Charges (FLSC)
- Excessive bending may cause charge separation or excessive compression and large variations in propagation velocities.



SLE Data Uncertainty

- Ballistic ordnance assessment testing may show successful testing; however, false positives may happen because
 - Long out of conditioning times bring the unit closer to ambient
 - Some uninsulated units reach ambient temperature quickly out of conditioning
 - Fixture can bring a unit to its temperature
 - An inadequately cleaned closed bomb volume decreases with each test
 - Inadequate or unmeasured stabilizer

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SLE Data Uncertainty

- Qualification may not simulate aging
 - Current temperature extreme cycling may not adequately simulate long term aging
 - Real aging requires multiple cycles that simulate day and night exposures
 - In storage and
 - In its appropriate aircraft

Conclusions

Predicting allowable service life accurately requires:

1. A well understood installed/storage environment and its impact on performance
2. Representative unit ballistic testing performance
3. Measuring chemical/mechanical changes that correlate well with performance
4. An accurate performance analysis of trend data with sufficient data at the requested age



Acknowledgements

- Ordnance Assessment/Logistics Branch