

Materials & Advanced Manufacturing (M&AM)

GVSETS

GROUND VEHICLE SYSTEMS ENGINEERING & TECHNOLOGY SYMPOSIUM
& ADVANCED PLANNING BRIEFING FOR INDUSTRY



NDIA
Michigan

Corrosion Surveys of Army Ground Assets to Identify Leading Issues and Opportunities for Corrosion Prevention

J. Peter Ault, P.E. and John Repp, P.E.- Elzly Technology Corporation

Dr. Thomas Sanders and Scott Porter – TARDEC MECC

Timothy Pike – TACOM ILSC



- Army Regulation (AR) 750-59 specifies policy for corrosion prevention and control of Army Materiel
 - “Corrosion Prevention and Control for Army Materiel”
- Paragraph 3-6 specifies the requirement for Command Corrosion Prevention and Control Surveys
 - Identify trends in corrosion of Army Materiel
 - Survey equipment on a 4-year basis
 - Include photographs/video to augment reports
 - Evaluate CPC program implementation
 - In-brief and out-brief of findings
 - Report of findings within 45 days to AMC G-4





- Integrated Logistics Support Command (ILSC)* opted for a statistical sampling of ground assets
 - Army ground equipment estimated at up to 500,000 individual end items, making surveying all assets impractical/not cost-effective
- ILSC engaged the Tank Automotive Research Development and Engineering Center (TARDEC) to execute survey requirements
- TARDEC contracted with Elzly Technology Corporation (Elzly) to develop and execute the survey process with the following goals
 - Capture corrosion data using existing inspection methods
 - Collect photographs tied to vehicles and parts inspected
 - Provide corrosion trend analysis within 45 days on survey trips

**ILSC is the Corrosion Prevention and Control (CPC) Program Manager for Army ground equipment*



Materials & Advanced Manufacturing (M&AM)

GVSETS GROUND VEHICLE SYSTEMS ENGINEERING & TECHNOLOGY SYMPOSIUM
& ADVANCED PLANNING BRIEFING FOR INDUSTRY



NDIA
Michigan

Current Status

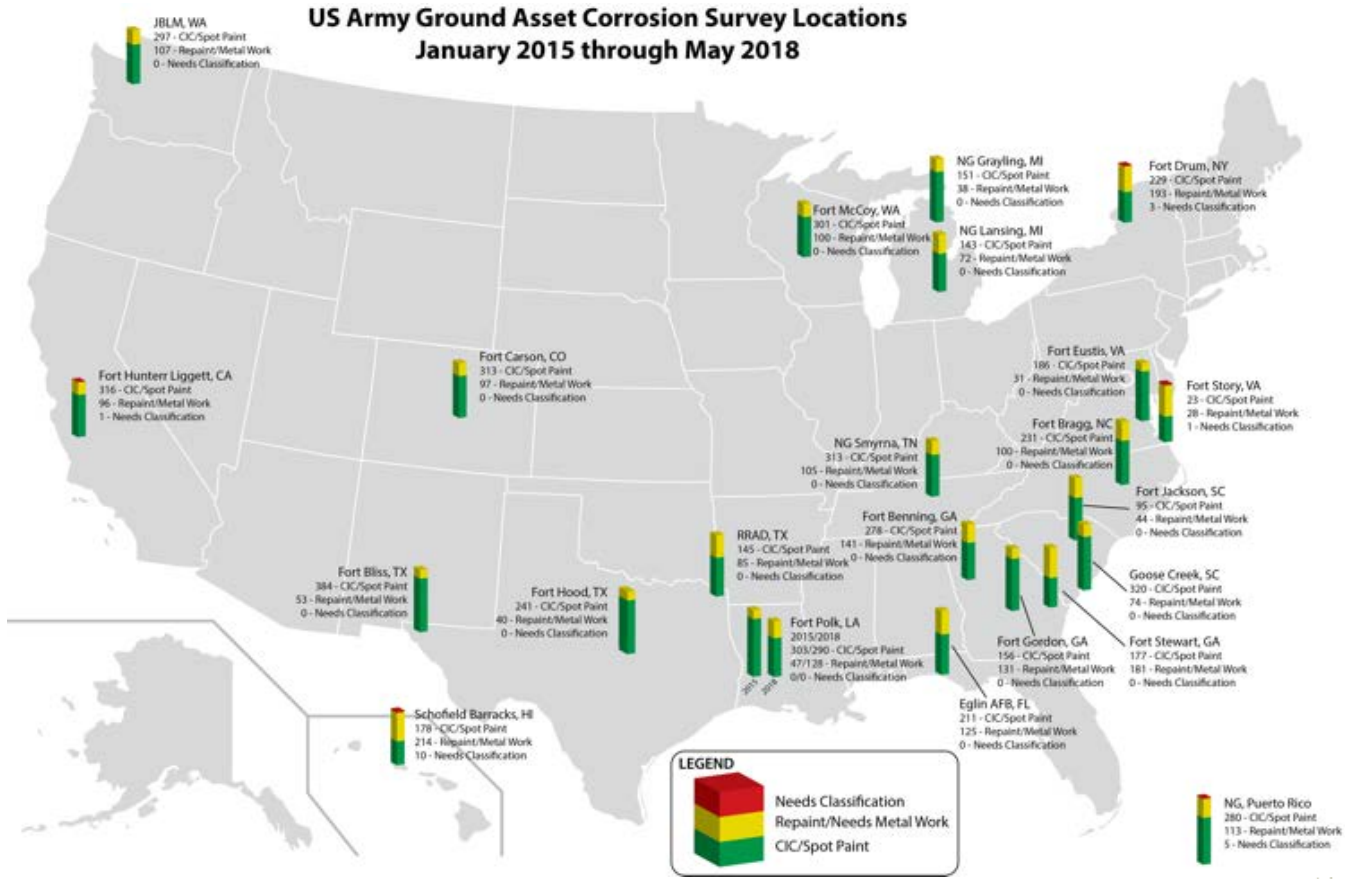


- Surveys conducted at 24 installations
- 8,200+ assets surveyed
- 121,000+ parts observed to have corrosion/coating issues
- 180,000+ photos captured of corrosion/coating observations
- Running list of corrosion opportunities for improvement of Army materiel
 - Preventive Maintenance Checks and Services (PMCS) items
 - Repaint/repair options to improve corrosion resistance
 - Alternative materials for use in current and future systems



Survey Locations

Materials & Advanced Manufacturing (M&AM)



Corrosion Prevention Opportunities



Category	Issue	Chip-Resistant Coatings	Galvanized Shackles	Galvanized Wire Mesh	Encapsulating Lug Nuts	Improved Fastener Coatings	Improved Overcoating Procedures	CIC/CARC Spot Painting	LRC Maintenance	Engineering Change of GPK	Addition of Drain Holes	Priming Before Assembly	Engineering Change of Vent Cap	Running Light Gasket/Sealant
Common Parts	Connection Points	X	X				X	X				X		
	Wheels & Lugs				X	X	X	X						
	Brackets						X		X	X		X		
	Fasteners					X		X						
	Latches							X						
	Hydraulic & Air Lines & Connections							X						
General Parts	Suspension							X						
	Bumper	X					X	X	X					
	Frame								X					
	Body Panels						X	X	X					
	Cargo Bed Frame							X	X					
	Mirrors							X						
	Steps	X						X						



Materials & Advanced Manufacturing (M&AM)

GVSETS

GROUND VEHICLE SYSTEMS ENGINEERING & TECHNOLOGY SYMPOSIUM
& ADVANCED PLANNING BRIEFING FOR INDUSTRY



NDIA
Michigan

Development and Execution

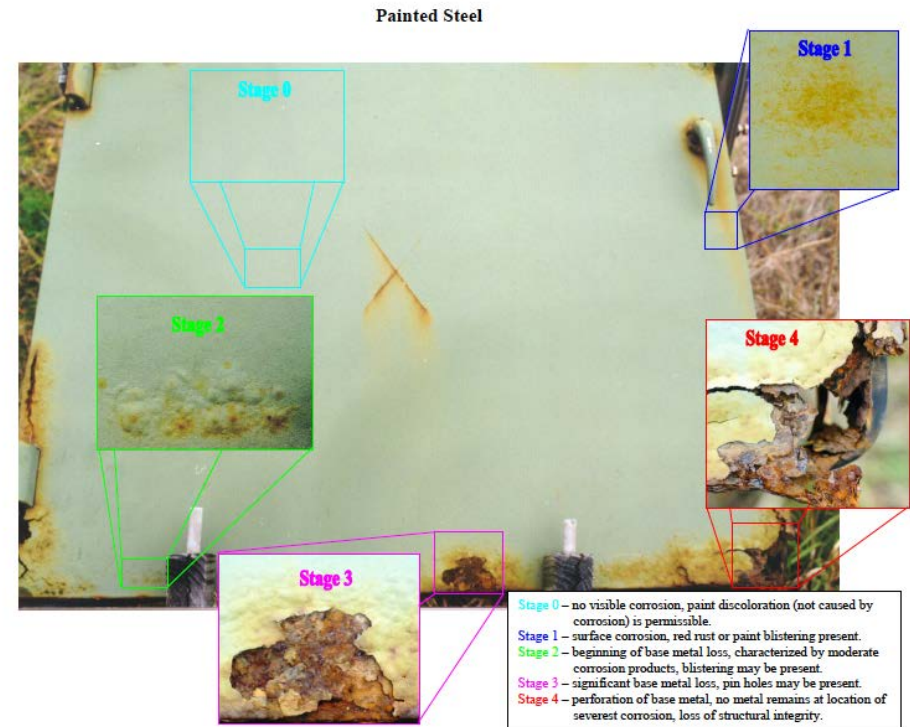


- Collection of asset identification/usage information
 - Bumper and Serial Numbers
 - NSN
 - Miles/hours
 - Rebuild date/location
 - Installation and unit
 - Surveyor
- Collection of corrosion data
 - Linked to parts/areas/assets
 - Severity (stage) of corrosion
 - Coating issues
 - Maintenance recommendations for correction
 - Photos for review/reporting linked to part and asset type
- Summary and reporting of data





- Severity by stage
 - Stage 1 corrosion initiation
 - Stage 4 perforation (metal loss) due to corrosion
- Corrosion type
 - General corrosion
 - Galvanic corrosion
 - Crevice corrosion
 - Pitting corrosion
- Coating damage
 - Mechanical damage
 - Coating delamination
 - Needs repainting
 - Faded





- Tool requirements
 - Perform survey at asset without need to move/operate
 - Collect asset identification and corrosion data rapidly
 - Include capture of photographs that are linked to the parts, asset, and location
 - Rapid reporting for out-brief and 45-day AMC report
- Tool features
 - Utilized tablet (Apple iPad™) for data collection
 - Developed tool using COTS database software for data collection
 - Developed and programmed analysis methods for rapid collection and summarizing of data – no data transcription, photo re-naming, etc.
 - Created dashboards for units/installations







Survey Tool Interface (Left Screen):

Location: FT EUSTIS, VA | BMA 93

Vehicle Information:

PdM Type: CSH4T | Divest: 5

1U3TC92167BN0329 | Reg/USA

11/3/07 | 5

4940010259856 | No NSN

Rebuilt? ☐ Yes ☒ No

PaintColor: ☐ Tan ☐ Green ☐ Camo

Miles: | Hours: | AMonda:

Change Cat Code of Previous Vehicle

Retake Photo

DataPlate

Notes

Survey Tool Interface (Right Screen):

Vehicle ID: 1U3TC92167BN03293 | Passenger Side

Category Code: 4

Structurally unsound due to:

- ☐ Standing Water
- ☐ CARC over CARC
- ☐ Needs Cleaning
- ☐ Mold or Mildew
- ☐ Armored Windows

Actions:

- ☒ CANNOT INSPECT
- ☐ No Issues
- ☐ Inspect Parts
- ☐ Next Area
- ☐ Rate Vehicle

Retake Photo

Notes



Survey Tool

Materials & Advanced Manufacturing (M&AM)



Survey Tool Interface (Left Panel):

Parts Inspected: Part Name Not Present

Common Parts General Parts

1U3TC92167BN03293

Passenger Side

Stage 1 Stage 2

Stage 3 Stage 4

100

Total for Stages 1 to 4 100 %

Part Notes

BODY PANELS

CORROSION TYPE

General ☒ Galvanic ☐

Crevice ☐ Pitting ☐

PAINT ISSUES

Delamination ☐ Need Repaint ☐

Mechanical Damage ☐ Fading ☐

CONDITION

Other Issues ☐ Needs Cleaning ☐

Take Photo

Review Photos

Inspect Next Part

Return to Area

Survey Tool Interface (Right Panel):

Passenger Side

BODY PANELS

Return to Parts

Take Photo

Selfie Photo

Mold

Standing Water

Clouded Windows

CARC over CARC

Notes





Reporting



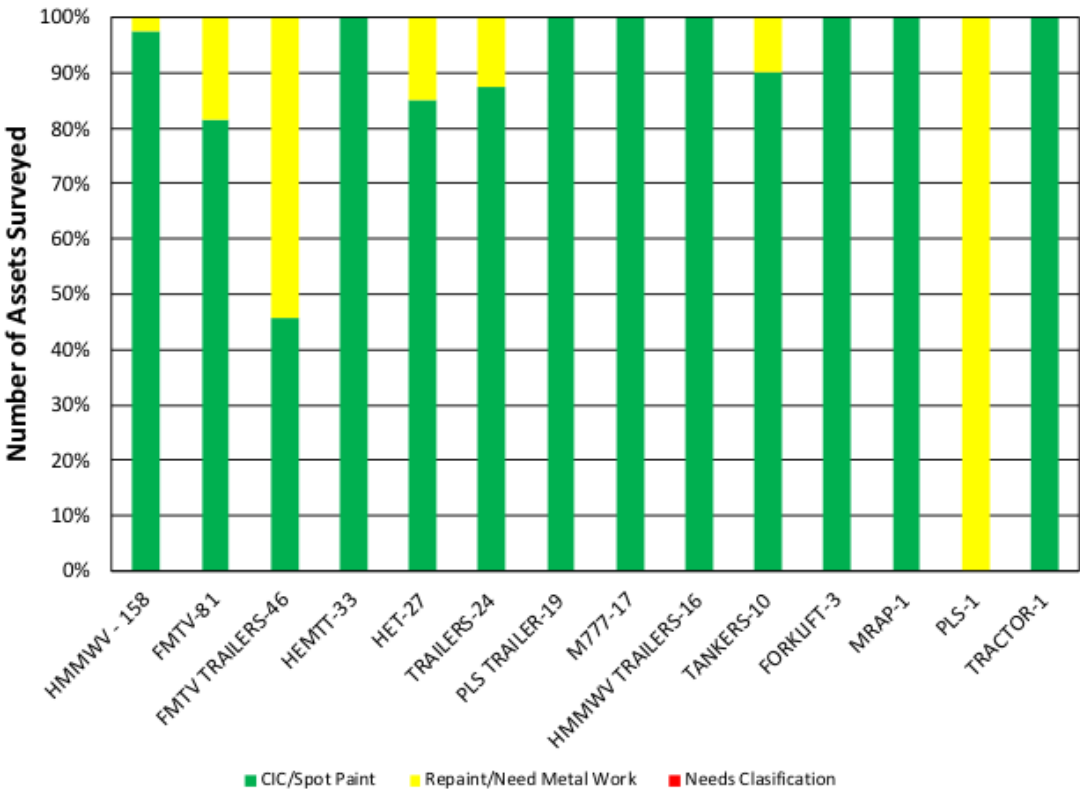


- Installation-specific data is provided within 45 days of each survey
 - Summary of observations
 - Installation-specific opportunities
 - Running list of opportunities
 - Relative ranking
- Annual reporting providing showing overall trends in corrosion within the Army
 - Summary of all observations to date
 - Updated list of opportunities with supporting implementation information
 - Summary of corrosion engagements with units, installations, and PMs/PdMs





Maintenance Methods to Correct Observed Corrosion



7



Installation-specific Opportunities for Out-brief

Materials & Advanced Manufacturing (M&AM)



Near-term Opportunities



- Items/areas for additional operator/user maintenance
 - Opportunity for use of CARC aerosol products for touch-up and registration marking
 - CARC aerosols include epoxy primer and polyurethane (CARC) topcoat
 - Washing/cleaning of undercarriages and other areas

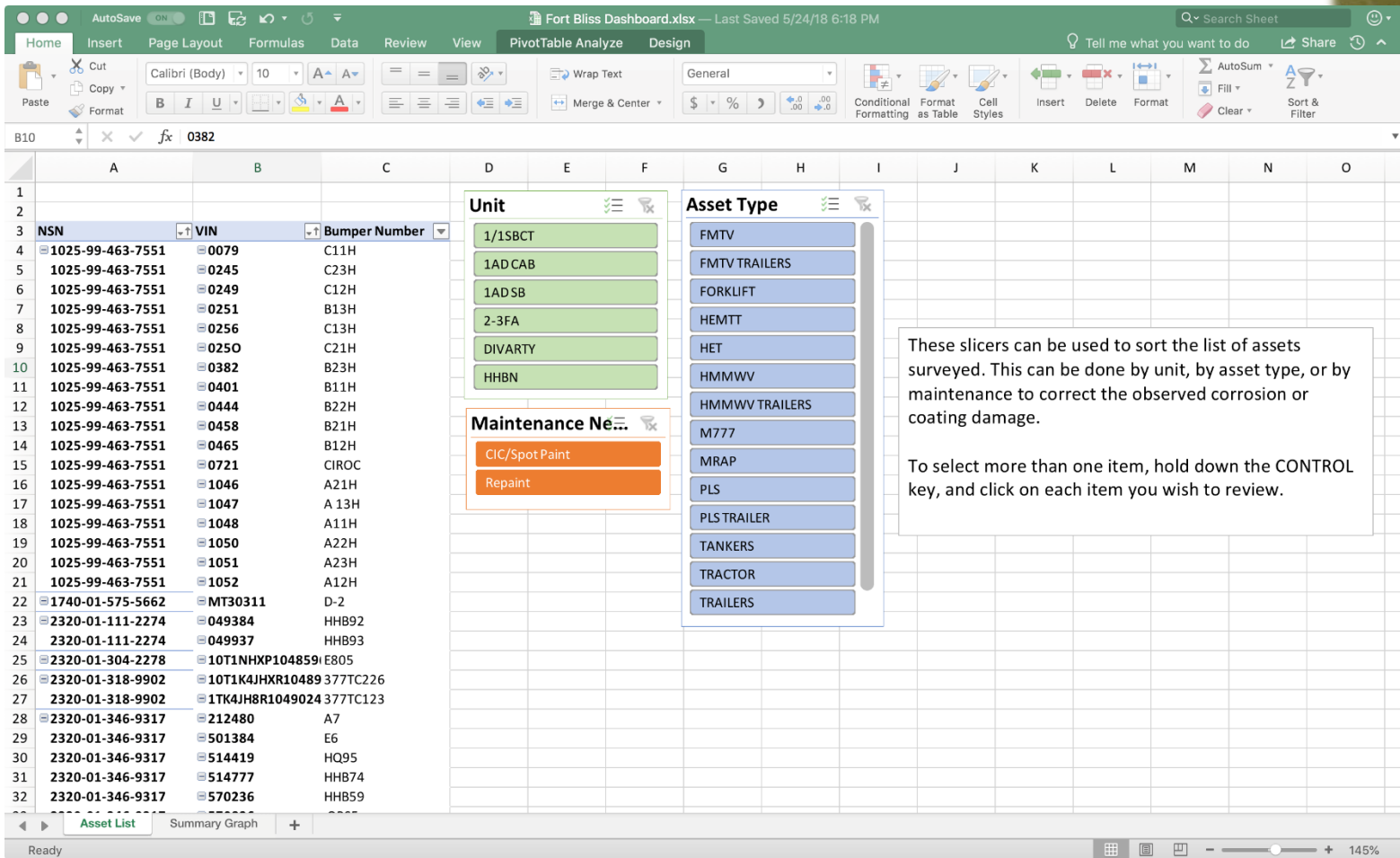


12



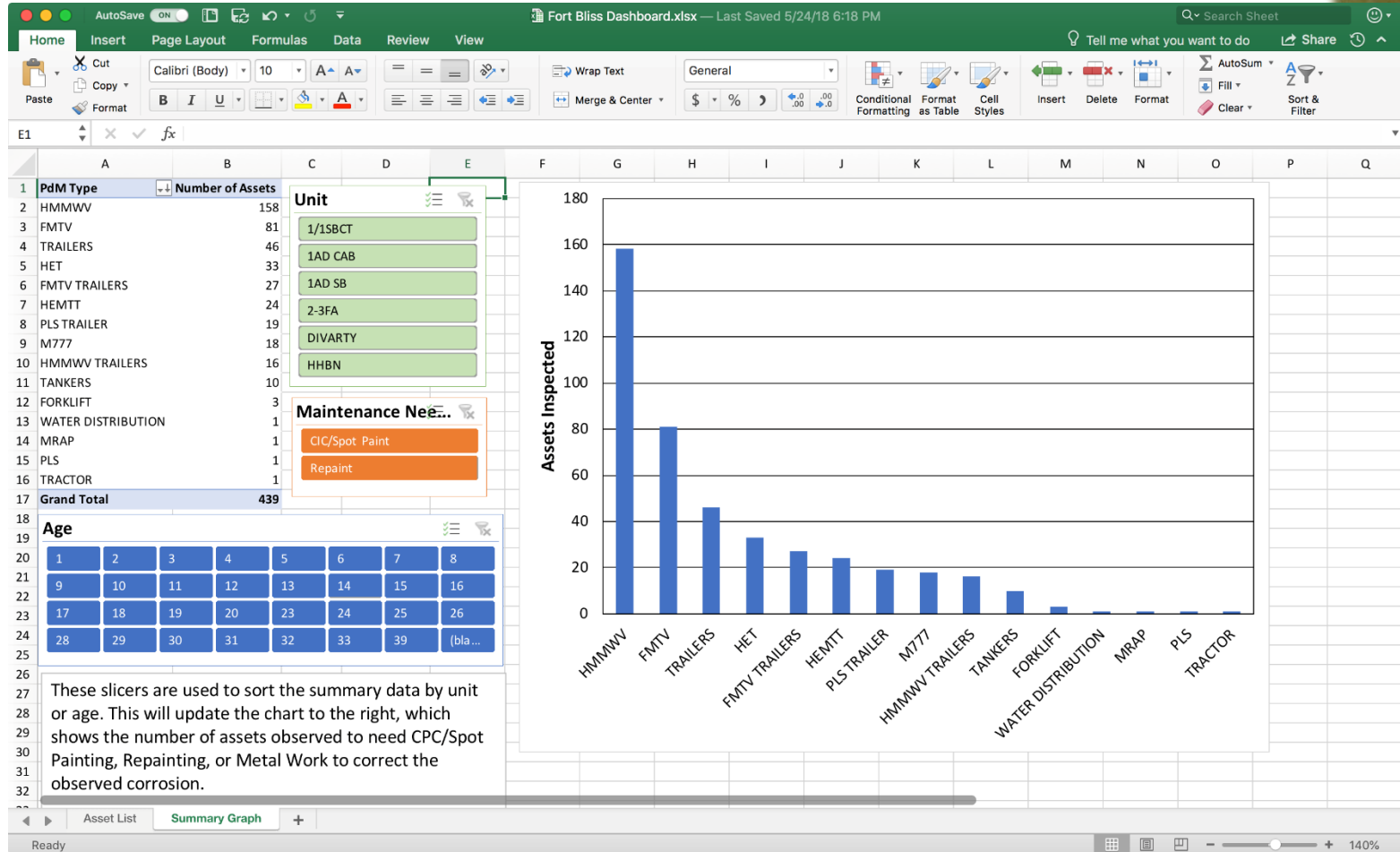
Microsoft Excel™ based Dashboards

Materials & Advanced Manufacturing (M&AM)

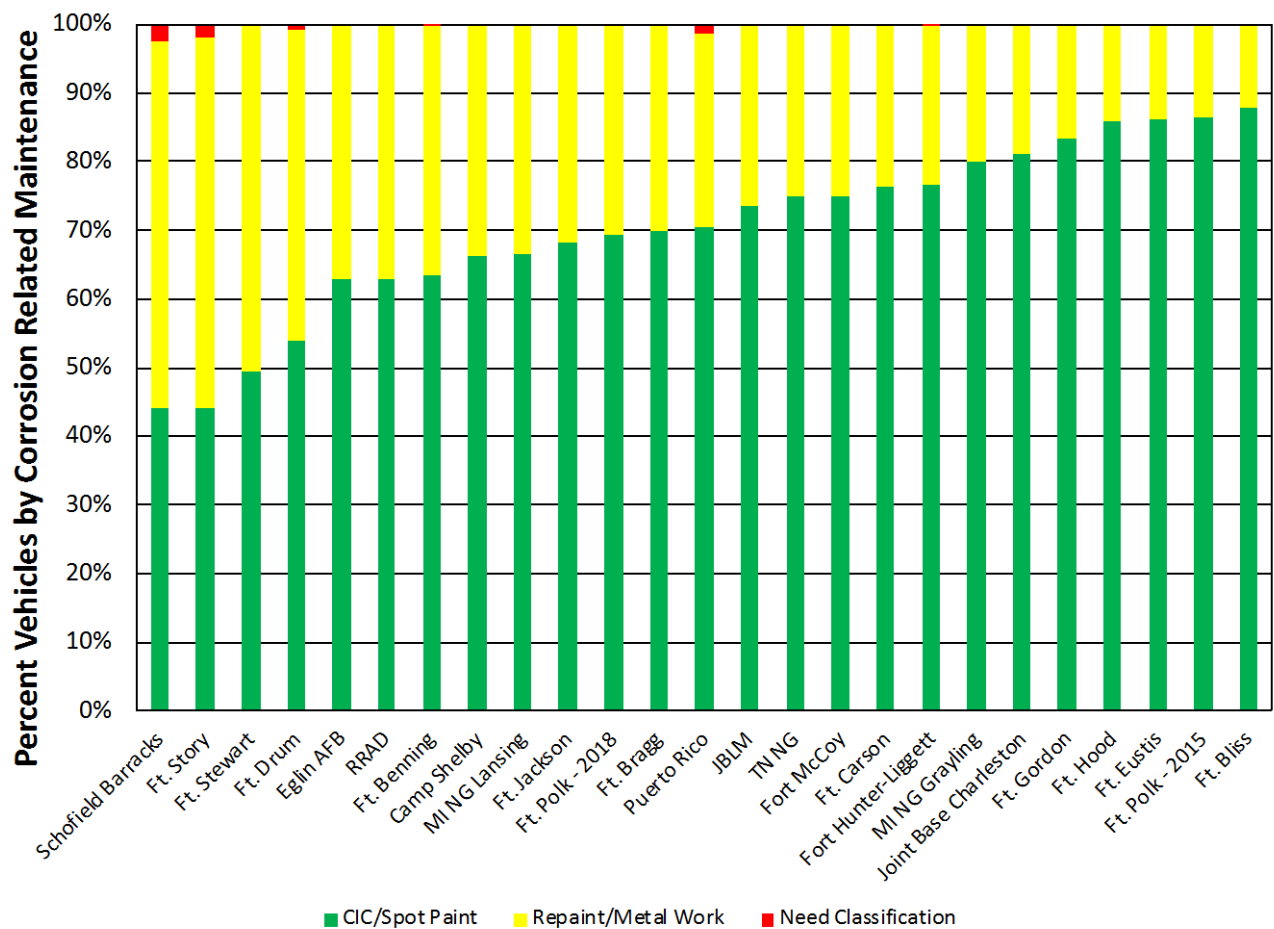


Microsoft Excel™ based Dashboards

Materials & Advanced Manufacturing (M&AM)



Installation Ranking by Corrosion Maintenance



Assets by ISO Corrosion Code



ISO Code	Location	Assets Surveyed	Assets by ISO Code
C2	MI NG LANSING & GRAYLING	404	2,205
	FT HUNTER-LIGGETT, CA	413	
	FT MCCOY, WI	401	
	FT CARSON, CO	410	
	FT JACKSON, SC	139	
	FT BLISS, TX	438	
C3	FT BENNING, GA	383	4,129
	FT BRAGG, NC	331	
	FT DRUM, NY	425	
	FT HOOD, TX	312	
	FT POLK, LA (2015)	394	
	FT STEWART, GA	358	
	RRAD, TX	230	
	ARNG SMYRNA, TN	418	
	JOINT BASE LEWIS MCCHORD, WA	404	
	FORT POLK, LA (2018)	418	
	FORT GORDON, GA	187	
	FORT EUSTIS, VA	217	
	FORT STORY, VA	52	

ISO Code	Location	Assets Surveyed	Assets by ISO Code
C4	SCHOFIELD BARRACKS, HI	402	796
	JOINT BASE CHARLESTON, SC	394	
C5	EGLIN AFB, FL	342	740
	PUERTO RICO	398	
UNK*	CAMP SHELBY, MS	419	419

ISO Corrosivity Classification determined in accordance with ISO 9223, “Corrosion of metals and alloys — Corrosivity of atmospheres — Classification, determination and estimation,” where C1 is the least corrosive, and CX being most corrosive; to date surveys have only been performed in locations rated a C2 through a C5.





Part Name	Times in Top 10
Body Panels	24 out of 24
Bumper	23 out of 24
Suspension	23 out of 24
Exhaust	21 out of 24
Frame	21 out of 24
Drivetrain	20 out of 24
Mirrors	19 out of 24
Steps	18 out of 24
Door Frame	13 out of 24

More frequent observations → opportunities to reduce corrosion across multiple locations





- IN FY17, TARDEC began briefing PMs and PdMs on survey results for their assets
 - Identified leading issues for their systems
 - Included potential methods for correction/mitigation of issues
- TARDEC is leveraging the survey data for development of expert systems to evaluate asset corrosion
 - Data has been provided to the Accelerated Corrosion Expert System (ACES) project for identification of corrosion issues during asset design
- Potential use for Condition Based Maintenance (CBM) and other modeling efforts
 - Identify optimum insertion point for corrosion repair methods





- The Army CPC Program surveys are being performed per AR 750-59
- The data collected is being used to identify leading issues across the Army and for specific platforms.
- TARDEC is engaging the PdMs for various platforms to identify opportunities to reduce corrosion on their assets.
- There exists a large dataset on Army ground vehicles that can be used to:
 - Identify corrosion trends,
 - Support training efforts for corrosion prevention and control,
 - Support maintenance and research investments, and
 - Support research projects in general
- Opportunity to understand corrosion progression over time as sites are revisited
 - Efficacy of local CPC methods
 - Refine maintenance recommendations

