

Failure Definition and Scoring Criteria (FDSC)

10 November 2011

Some of the terms used in this document to refer to the JLTV are different from than those used in the JLTV Scope of Work (SOW). Refer to the following table for the equivalent terminology:

Equivalent Terminology Definitions

Attachment 0038 FDSC Terminology	Scope of Work (SOW) Terminology
primary vehicle types	variants
4 seat Combat Tactical Vehicle (CTV)	4 seat variant (consisting of 2 base vehicle platforms: GP & CCWC)
2 seat Combat Support Vehicle (CSV)	2 seat variant (consisting of 1 base vehicle platform: UTL)
Mission Role Variant (MRV)	Mission Package Configuration (base vehicle platform + Mission Packages)

FAILURE DEFINITION AND SCORING CRITERIA (FDSC)

*For the
Joint Light Tactical Wheeled Vehicle (JLTV)*

Version 3.0

18 May, 2011



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1. Introduction.

1.1 Purpose.

The following Failure Definition and Scoring Criteria (FDSC) was developed to define what is considered to be degraded and unacceptable performance for the Joint Light Tactical Vehicle (JLTV) Family of Vehicles (FoV). Additionally, it outlines a specific process for categorizing all failure events (documented in Test Incident Reports (TIR)) that occur during operational and reliability testing. Failure categorizing and scoring is conducted during Reliability Growth Testing (RGT), Reliability Availability Maintainability (RAM) Testing, Limited User Test (LUT), Production Qualification Testing (PQT), and Multiservice Operational Testing and Evaluation (MOT&E) or other reliability testing. This FDSC applies to JLTV Engineering and Manufacturing Development (EMD) Phase and will be updated to incorporate lessons learned during reliability testing to support future acquisition phases.

1.2 System Description

The Joint Light Tactical Vehicle (JLTV) is a United States Marine Corps (USMC) and United States Army (USA) program to fulfill existing Light Ground Tactical Mobility capability gaps with a family of more survivable vehicles capable of transporting greater payloads. JLTV Mission Roles are divided into Force Application, Focused Logistics, and Battlespace Awareness functional concept categories. Each member of the JLTV FoV responds to one or more of these functional concepts. The JLTV family is based on two primary vehicle types: a four seat Combat Tactical Vehicle and a two seat Combat Support Vehicle. Refer to the current Capability Development Document (CDD) or Capability Production Document (CPD) for details on the different subconfigurations. The current acquisition plan is to develop a number of each Mission Role Variant (MRV) during the first increment and add the remaining in the second increment. Each MRV will be developed and test with a companion trailer as referenced in the Operational Mode Summary / Mission Profile (OMS/MP). The vehicle and trailers will be evaluated separately.

1.3 Reliability System Definition

The definitions within this document are for the purposes of evaluating the JLTV FoV reliability for compliance with their Mean Miles Between Operational Mission Failure (MMBOMF) thresholds. For evaluation purposes, the “system” is defined as the vehicle and trailer, each with their own reliability requirements.

The JLTV purchase description does not include Government Furnished Equipment (GFE) in reliability, i.e., weapon systems, communication equipment, etc. However, the requirement does include the mounting kit(s), interfaces, and power connections required for GFE installation and operation on the JLTV platforms.

1.4 Scope

This FDSC will be used by the scoring committee to score all TIR and establish an agreed upon data set that will be used by the evaluator to determine JLTV compliance with the reliability requirements stated in the Purchase Description (PD), CDD and CPD. The JLTV USMC/Army combat developers are responsible for providing the failure definitions; the

combat developers, along with the materiel developers and test communities perform the scoring. JLTV will be developed using a formal reliability growth process, the Reliability Growth Plan specifies the data elements required and sequencing of scoring conferences. FDSC changes after testing commences will be limited and will require agreement from all representatives from the principal commands listed in Table 1. If changes to the FDSC occur after start of scoring, all previously scored incidents will be scored according to the revised FDSC.

1.5. Scoring Conference:

The scoring conference objective is to review and classify all TIRs that occurred during reliability and operational testing. Scoring conferences will be scheduled on regular intervals during reliability testing to correspond with pre- and post-Corrective Action Period (CAP) evaluation in accordance with the JLTV Reliability Growth Plan. The conference chair reserves the right to call additional conferences to manage the quantity of TIRs.

Table 1 lists the commands that will participate in the joint scoring conferences. Each command organization will identify a representative who will have one vote.

Role	Command
Product Manager, Joint Light Tactical Vehicle	PM-JLTV
Marine Corps Combat Development & Integration	MC-CD&I
Army Sustainment Center of Excellence	SCoE
Marine Corps Operational Test and Evaluation Activity	MCOTEA
Army Test and Evaluation Command	ATEC

Table 1 - Scoring Conference Voting Members

The chairman of the scoring conference for EMD-DT, and PQT is the PM-JLTV and for Limited User-Test (LUT) and MOT&E the chair is AEC. The chairman for the respective testing is responsible for administrative activities, facilitating and ensures proper documentation of the meetings. The chairman will hold the tie breaking vote on all disputed issues.

The results of each scoring conference will be an agreed upon data set for all reliability availability and maintainability test data to include number of test miles, number of Operational Mission Failures (OMF), Essential Function Failures (EFFs) and Maintenance man-hours.

2. Mission Essential Functions (MEF).

2.1 MEFs for all JLTV Mission Role Variants:

See Appendix A for allowable degradation for the different MEF.

2.1.1 Mobility.

The capability to provide forward and rearward motion, day and night, over the varying terrains and environments specified in the OMS/MP. Included in this essential function is the capability to start, stop, and maneuver the vehicle. This function also includes the ability to move with sufficient speed and power to maintain minimum mean speeds on OMS/MP surfaces.

2.1.2 Command, Control, Communications, Computers and Intelligence (C4I).

The JLTV Vehicle must have the ability to host, integrate and provide power to C4I systems to communicate voice or data.

2.1.3 Force Protection.

The capability to provide essential protection to the crew and occupants from kinetic and explosive threats.

2.1.4 Carry.

Deliver personnel to the objective in fighting condition, while towing loads and/or carrying standard military cargo up to its rated payload capacity across the OMS/MP. Provide ability to ingress/egress, host fire suppression and environment control.

2.1.5 Lethality.

The JLTV system must be able to employ the key weapon systems assigned to the vehicle. JLTV must be able to host, integrate and provide power to the weapon systems.

2.2 Additional configuration-specific MEFs for the JLTV variants:

2.2.1 Power generation.

Provide hotel (automotive performance), on-board, and exportable electrical power for specific equipment.

2.2.2 Trailer variants.

2.2.2.1 Mobility.

The capability to provide forward and rearward motion over the varying terrain specified in the OMS/MP. Included in this essential function is the capability to tow, brake, and maneuver the trailer. A failure of the trailer will not be scored against the vehicle.

2.2.2.2 Carry

The trailer must be capable of carrying a secured payload up to its rated capacity without causing the loss or degradation of the JLTV Mobility MEF.

3. Classification.

3.1 Failure Definition (FD).

A failure is an event, or inoperable state, in which an item or part of an item does not perform as specified. For the purpose of this FD, all reliability or operational test events are categorized as No-Test or Non-Failure, Operational Mission Failure (OMF), Essential Function Failure (EFF), Non-essential Function Failure (N-EFF), Dependent Event (DE), or Crew Correctable Maintenance Action (CCMA).

It should be noted that regardless of the classification all recorded test incident reports (TIRs) will be addressed by the contractor for corrective action and categorized by reliability growth failure mode type (A, BC, BD) and presented at the Corrective Action Review Board (CARB). A-modes are failure modes that, when experienced in test, will not receive corrective action; whereas, BC and BD Modes are uncovered during test and corrected. BD Modes require more design change and are delayed until the next corrective action period. BC Modes have minor design influence, more focused on quality issues that can be implemented with minimal design change during the next testing opportunity.

3.1.1 No-Test or Non-Failure.

No-Test events are incidents that occur outside of reliability testing (performance, & special tests) and are not directly related to a reliability MEF failure. Incidents scored as No-Test are not used in the RAM evaluation. Scheduled maintenance actions, routine checks and services, and prognostics generated maintenance events related to the reliability testing are Non-Failures. Non-failure incidents are used in the RAM evaluation. After identifying No-Test or Non-RAM select the appropriate category to reflect the incident from section 4.1.1.

3.1.2 Operational Mission Failure (OMF).

An OMF is an event that results in the loss of a Mission Essential Function (MEF) that reduces its utility to the point that it is deemed ineffective in its role on the battlefield or that causes immediate removal from service in an operational environment. The level of degradation that constitutes the loss of a MEF is addressed in the Relationship/Scoring Matrices found in Appendix A. Incidents that occur as a result of a failure and pose a credible risk to personal injury related to a Category I (catastrophic) or II (critical) hazard as defined in section 5.2 may be classified as OMF after thorough consideration of the operational impact. It should be noted that all safety and environmental related incidents regardless of the classification are unacceptable and corrective action will be addressed with the safety or environmental community.

3.1.3 Essential Function Failure (EFF).

An EFF is an event that results in significant degradation of a MEF, yet the vehicle is still partially mission capable. The Relationship/Scoring Matrices found in Appendix A address the EFFs that result in a partial mission capable status under wartime conditions or reduce its utility in certain operations on the battlefield. An Essential Function Failure also includes those events that create a personal injury but do not meet the OMF classification.

3.1.4 Non-Essential Function Failure (N-EFF).

A Non-Essential Function Failure is an event that does not result in the operationally significant degradation or loss of an essential function, has an obvious indication of a malfunction or abnormal equipment condition, maintenance/corrective action is required to remedy the failure, and/or could be deferred to the next maintenance period allowing follow-on missions before repair.

3.1.5 Dependent Events (DE).

An event that is caused by, or is directly attributable to, another primary incident or event. To be classified as a dependent event, analysis of the failure event must positively confirm that it occurred as the direct result of a specified primary event. Dependent events can occur as a series of repetitive incidents that are attributable to a single identified “primary” event. The “primary” event is scored either as an OMF or EFF and all associated events are scored DE. The chargeability of an event scored DE will be the same as the chargeability assigned for the “primary” event.

3.1.6 Crew Correctable Maintenance Action (CCMA).

The first three malfunctions which the vehicle crew is able to correct in less than 30 minutes through the execution of prescribed maintenance/repair procedures using authorized tools, repair parts, and spares carried on-board the vehicle (BII) will be classified as Crew Correctable Maintenance Actions (CCMAs). CCMAs are incidents that are Field Repairable or Rapidly Recoverable that would otherwise be scored as an OMF or EFF if the repair or recovery could not restore the incident to operational condition within the 30 minutes allowance with the exception to the sub-systems time and frequency identified in Table 2 below. Incidents exceeding frequency constraints will be scored on their own merit.

SUB-SYSTEM	MAX TIME ALLOWED	FREQUENCY
Vehicle Mounted Sensors	2 minutes	Once / RAM Mission Profile
Primary Weapon	20 seconds	Twice / RAM Mission Profile
Crew Stations (monitors)	3 minutes	Twice / RAM Mission Profile
Vehicle fault codes / warning	5 minutes reset	Twice / RAM Mission Profile
Vehicle configuration	5 minutes reset	Once / RAM Mission Profile
C4I (radios)	5 minutes reset/reconnect	Once / RAM Mission Profile
Vehicle Computer Systems	5 minutes	Twice / RAM Mission Profile
Ventilation/Heat/Cool	5 minutes	Once / RAM Mission Profile
Start (slave start)	5 minutes (30 minutes*)	Once / RAM Mission Profile

Table 2 - Crew Correctable Action Time Limits

Note: The 30 minute CCMA will more closely replicate the operator manual and other identified crew correctable maintenance actions identified by engineering during design.

(*) The Slave Start time includes maneuvering a second vehicle into position and starting the vehicle, all of which must occur within 30 minutes; after the cables are attached the vehicle must start within 5 minutes. TIR should reflect the entire process, including crew time from second vehicle.

Additions/changes will be made when specific subsystem design time/frequency constraints are identified/clarified through modeling, simulation, and design reviews. The time

allowance is for an individual/discrete event or incident. The frequency defines how often a CCMA can occur during the execution of a RAM Test mission profile.

4. Scoring Criteria.

The following scoring process will be utilized during evaluation of individual test incidents (a test incident is generally described in a Test Incident Report (TIR)). The scoring criteria are structured in a multiple-choice format thereby permitting the classification of test incidents into proper categories. Figure 1 graphically portrays the scoring process. Failure incidents are further amplified with examples provided in the Relationship/Scoring Matrices found in Appendix A.

4.1 Select the appropriate category below and proceed as directed.

1. Incident is a No Test or Non-Failure. Proceed to paragraph 4.1.1.
2. Incident is a Failure. Proceed to paragraph 4.1.2

4.1.1 No Test / Non-Failure.

Score the incident as one of the following, a No Test or Non-Failure, identify the associated chargeability, and then proceed to the next incident.

1. No Test - TIR Field 41 "FD/SC Step#/Event:"

Category for No Test – TIR Field 42 "FD/SC Class:"

- | | |
|---------------------------------|---------------------------|
| A. Non-RAM Test Oriented Event. | B. Equipment Modification |
| C. Test Directed Abuse. | D. Test Peculiar Event |
| E. Pre-Test Inspection | F. Design Deficiency. |

2. Non-Failure - TIR Field 41 "FD/SC Step#/Event:"

Category for Non-Failure – TIR Field 42 "FD/SC Class:"

- | | |
|------------------------------|----------------------------------|
| A. On Condition Maintenance. | B. Scheduled Maintenance. |
| C. PMCS. | D. Routine Operating Procedures. |

4.1.2 Failure - TIR Field 41 "FD/SC Step#/Event:"

Score the incident as one of the following TIR Field 42 "FD/SC Class:" categories and proceed to paragraph 5.1.

- 3. Crew Correctable Maintenance Action (CCMA).**
- 4. Operational Mission Failure (OMF).**
- 5. Essential Function Failure (EFF).**
- 6. Dependent Event (DE).**
- 7. Non-essential Function Failure (N-EFF).**

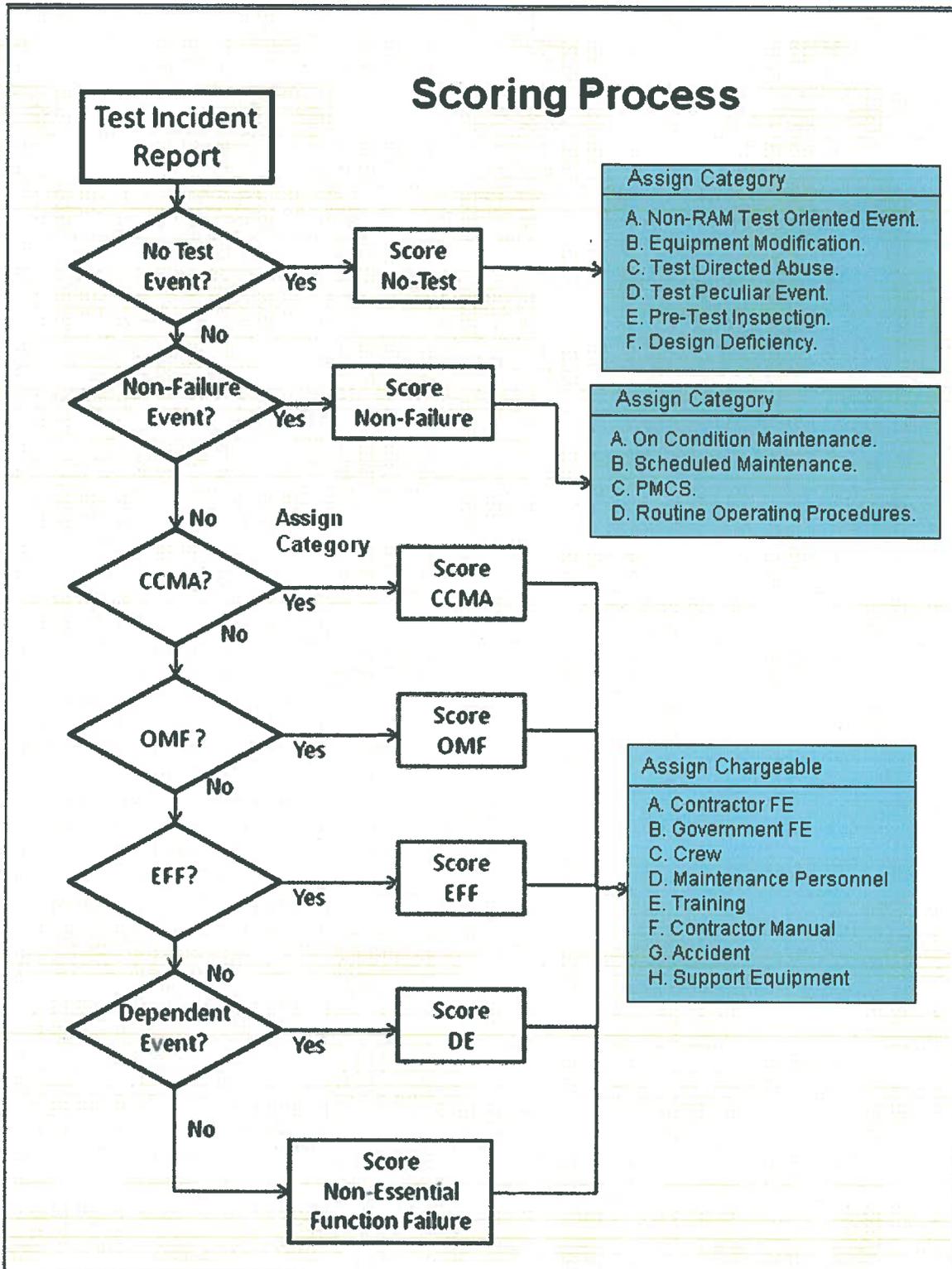


Figure 1 Scoring Process Flow Chart

5. Chargeability and Hazard.

Only Failure have chargeability assigned in TIR Field 43 "Chargeability:" No-Test and Non-Failures TIR Field 43 "Chargeability:" is identified as "NA"

5.1. Chargeability:

Identify the cause of all Failures from the following list then proceed to paragraph 5.2

- A. Contractor Furnished Equipment (Contractor)-CR
- B. Government Furnished Equipment (Government)
- C. Crew
- D. Maintenance Personnel
- E. Training
- F. Contractor Technical/Operator's Manuals -CR
- G. Accident
- H. Support Equipment

CR-Contractor Responsible failures are used in the reliability calculation during the EMD phase to assess contractors responsible MMBOMF.

For additional description of the above chargeability causes see Appendix B.

All maintenance time associated with Non-Failures and Failures is considered chargeable maintenance time. Recorded chargeable maintenance time for corrective maintenance consists of fault isolation, repair/replace, through successful verification that the incident was corrected. For scheduled, on-condition, and PMCS, maintenance time consists of all time associated with the task. The maintenance time will reflect clock hours as well as man-hours, whether crew chief/operator (CCMA) or mechanic performed action.

5.2. Hazard Severity/Probability.

Hazard Severity is used to evaluate an incident's impact on personnel safety, equipment condition, and the environment. Probability level is used to evaluate an incidents probability of reoccurring. The hazard severity and probability are identified in TIR Field 36 "Special Requirement Data". Hazard/Mishap severity categories are designed to provide a qualitative measure of potential hazards and mishaps resulting from personnel error, environmental conditions, design inadequacies, procedural deficiencies, and system, subsystem or component failures or malfunctions. Extracted from Appendix 1, paragraph A.4.4.3.2.1 and A.4.4.3.2.2 of Military Standard (MIL-STD) 882D, 10 February 2000. Hazard/Mishap and probability category codes will be assigned to TIRs in accordance with the criteria provided in the table extracts.

6. Test Data Collection.

Accurate collection of certain data and information is critical to successful evaluation of a system's RAM performance. Information of this nature may be used by scoring personnel to make a final determination regarding categorization of reliability failures. Accurate daily record of the vehicle usage data (miles driven during RAM testing "RAM Mission Miles" by course) are as critical as the scoring of a TIR. Data collectors will record maintenance and supply demands for individual TIRs, daily mission log of course mileage, and daily operations log of time. The data collected will be used in the assessment of the following sustainability metrics Maintenance Ratio (MR), Mean Time To Repair (MTTR), Mean Miles Between Operational Mission Failure (MMBOMF), Reliability Growth, and Operational Availability for each Mission Role Variant.

The following vehicle and trailer configurations will be document within specific field on all TIRs, Mission Log, and Operational Log entries.

Vehicle Payload	Vehicle Armor	Trailer Payload	Electrical Load	RAM Phase	RAM Balanced Missions
Curb Weight	Base	No Trailer	No Load	EMD	MSN 1
ECC Weight	A Kit	Empty	5 KW	EMD RAM 0	MSN 2
1/2 Payload	B Kit	1/2 Loaded	10 KW	EMD RAM 1	MSN 3
Gross Weight		Fully Loaded	15 KW	EMD RAM 2	MSN 4
			20 KW	EMD RAM 3	MSN 5
			30 KW	LRIP PQT RAM 0	MSN 6
			40 KW	LRIP PQT RAM 1	MSN 7
				LRIP PQT RAM 2	MSN 8
				MOT&E	MSN 9

Table 3 - Configuration Matrix

The above fields and the associated information will identify each TIR to a specific configuration as well as allow the miles by terrain and engine hours to be tabulated electronically for all the possible test configurations.

Mission Log will replicate the Driver's Log with the following entries:

1. Create a record for recording vehicle mileage by test course and access road.
2. Create a record when TIRs are initiated and a field for the TIR number,
3. Identify a field and record fuel added,
4. Create a record to accumulate Engine Standby and Silent Watch time and associated load banks.

The field "Mission Log Test" needs to be identify as "RAM" and the field "Mission Log Sub-Test needs to be one of the following:

- A. END & REL OPERATIONS (*)
- B. MAINTENANCE SCH/UNSCH (*)
- C. SILENT WATCH (engine off Essential Equipment power on)
- D. STANDBY (engine on supplying exportable power)
- E. On-Course Inspection (*)
- F. Incident Issue
- G. Engineering Modification (*),(^)

H. Pre/Post Operational inspection at Maintenance facility (*)

I. Other special situations as identified (*)

(*) Indicate TIR Field 48 "Test Environment" available selections.

(^) TIRs that record actions conducted during the Corrective Action Periods (CAPs) scheduled during the Reliability Growth Testing (RGT) should be identified "Engineering Modification".

TIR Field 46 "Categories:" should be the key field identifying RAM relates TIRs as follows:

- | | |
|-------------------------|--|
| A. INSPECTION | TIRs incurred during inspections before and after testing |
| B. RAM | TIRs incurred during actual Reliability Growth Testing (RGT) |
| C. CAP | TIRs incurred during the Corrective Action Periods (CAP) |
| D. LUT | TIRs incurred during the actual Limited User Test (LUT) |
| E. Special Test | TIRs incurred during other types of Non RAM tests such as: |
| a. PERFORMANCE | |
| b. HUMAN FACTORS | |
| c. PHYSICAL | |
| d. Others as Identified | |

The following list depicts the minimal data and information that should be collected:

- Test procedure being run.
- Vehicle identification including modifications reference.
- Test environment where incident occurred (ex. RAM cross country test).
- Test stage and effect of incident (ex. Test stop during cross country stage)
- Vehicle Miles –RAM mission miles daily and total.
- Vehicle Engine Hours –RAM mission hours daily and total.
- Operational time bucket, following test site Time Classification Model.
- Crew Chief/Operator PMCS (field level actions).
- Maintenance mechanic wrench turning time (remove/replace and/or repair time for on-system repairs).
- Maintenance clock-hours excluding logistic delays.
- Diagnostic time.
- Repair confirmation time.
- Military Occupational Specialty (MOS).
- Spare parts or Line Replaceable Units/Modules (LRU/LRM) used.
- Repair materials used.
- Petroleum, Oil, and Lubrication (POL) quantity used.
- Daily Usage rates, e.g., hours of operation, distance traveled, rounds fired, part usage, number of cycles operated, etc.
- Environmental conditions to include such as wet, muddy, sandy, temperature and humidity at time of incident (if feasible).
- Type of incident - Physics/subjective cause of failure.

Appendix A

JLTV Relationship/ Scoring Matrix

The tables below provide examples of failure caused degradation levels that would be scored OMF or EFF for each Mission Essential Function described in paragraph 2. Lesser levels of failure caused degradation not listed below are scored as Non-Essential Function Failures (N-EFF).

	INCIDENT DESCRIPTION (FUNCTIONAL DEGRADATION) RELATIVE TO THE JLTV MISSION ESSENTIAL FUNCTION (MEF) INDICATED	INCIDENT CLASSIFICATION	
		OMF	EFF
A.1	Mobility		
A.1.1	Move		
A.1.1.1	Vehicle unable to adequately move in reverse	X	
A.1.1.2	Vehicle unable to adequately traverse cross-country terrain during mission operations over OMSMP		X
A.1.1.3	Vehicle unable to adequately sustain 15 MPH forward speeds on improved or 10 MPH on unimproved surfaces during mission operations over OMSMP	X	
A.1.2	Engine		
A.1.2.1	Vehicle engine will not start under own power and is unable to be slave started	X	
A.1.2.2	Vehicle engine unable to start under own power but can be slave started		X
A.1.2.3	Vehicle loses power during fording operations (“drowns out”)		
A.1.2.3.1	Crew able to correct problem and restart engine past time limit		X
A.1.2.3.2	Crew unable to correct problem and requires organizational level support	X	
A.1.2.4	Accelerator (throttle) linkage binding and fails to return to “engine idle” position without driver assistance (potential safety issue)		X
A.1.3	Vehicle On/Off Board Power		
A.1.3.1	Inability to provide in excess of 5 KW DC onboard power all variants		X
A.1.3.2	Inability to provide in excess of 5 KW AC off board power on Utility C MRV		X
A.1.3.3	Loss of all Vehicle hotel (automotive performance) power resulting in vehicle shutdown while on course and unable to be slave started	X	
A.1.4	Fluid/Pneumatic		
A.1.4.1	Class I for automotive drive train fluids only (grease scored on its own merit)		X
A.1.4.2	Class II for automotive drive train fluids only		X
A.1.4.3	Class III for automotive drive train fluids and other onboard fluids		
A.1.4.3.1	Class III with leakage insufficient to cause a failure to complete mission		X
A.1.4.3.2	Class III with sufficient leakage rate to prevent completion of mission	X	
A.1.5	Engine Cooling		
A.1.5.1	Total loss of engine cooling capability	X	
A.1.5.2	Cooling capability significantly degraded but can still operate without damaging system		X

	INCIDENT DESCRIPTION (FUNCTIONAL DEGRADATION) RELATIVE TO THE JLTV MISSION ESSENTIAL FUNCTION (MEF) INDICATED	INCIDENT CLASSIFICATION	
		OMF	EFF
A.1.6	Quick Disconnect:		
A.1.6.1	QD separates and is reconnected without impacting mission success		X
A.1.6.2	QD separates and cannot be reconnected reestablishing fluid flow thus preventing completion of mission	X	
A.1.7	Suspension		
A.1.7.1	Vehicle ride height failures, where fitted with adjustable ride height:		
A.1.7.1.1	Vehicle fails to maintain or achieve proper ride height yet maintains sufficient mobility ground clearance (including transport height)		X
A.1.7.1.2	Vehicle power or ride height switch are cycled to reset proper ride height (coordinate with Table 2 - Crew Correctable Action Time Limits)		X
A.1.7.1.3	Vehicle ride height adjusts to setting where operation across the OMS/MP is not possible, or vehicle loses mobility function and cannot be restored without organizational level support	X	
A.1.8	Drive train		
A.1.8.1	Vehicle acceleration obviously degraded during mission operations (but vehicle can still attain and sustain speeds of at least 15 MPH on improved and 10 MPH on unimproved surfaces)		X
A.1.8.2	Deterioration of dynamic wear parts identified by PCMS or non-scheduled inspection because of smell, noise, or sight., (NEFF depending on functional impact)		X
A.1.8.3	Deterioration of elastomeric designed to contain fluid for dynamic components (NEFF depending on functional impact)		X
A.1.8.4	Self recovery winch (or snatch block, if equipped) inoperable		X
A.1.8.5	Vehicle unable to tow "like" vehicle		X
A.1.8.6	Vehicle requires towing from test course to maintenance facility	X	
A.1.8.7	Vehicle Hardware (nuts, bolts, screws)		
A.1.8.7.1	Bolt tightening of critical load bearing or major drive train components		X
A.1.8.7.2	Loss of load bearing components or more than 3/4 of securing hardware.	X	
A.1.9	Tires		
A.1.9.1	One or More run-flats tires fail to allow vehicle to move at 15 MPH forward speeds on improved or 10 MPH on unimproved surfaces during mission operations over OMSMP for a minimum of 20 miles	X	
A.1.9.2	One/two tires punctured but vehicle has traveled to the objective utilizing CTIS or run-flats with no critical adverse impact on mission operations		X
A.1.9.3	Tire failure that can be replaced with spare tire and resume operation within 30 minute CCMA time limit		X
A.1.10	Steering		
A.1.10.1	Steering erratic / difficult (but controllable) wandering in either direction		X

	INCIDENT DESCRIPTION (FUNCTIONAL DEGRADATION) RELATIVE TO THE JLTV MISSION ESSENTIAL FUNCTION (MEF) INDICATED	INCIDENT CLASSIFICATION	
		OMF	EFF
A.1.10.2	Steering binding/excessive “play” in steering linkage degrading steering capability, yet remains operationally adequate		X
A.1.10.3	Steering column assembly bent resulting in steering difficulty		X
A.1.10.4	Steering failure of assisted (power) steering pump or associated drive belt (incident constitutes an EFF if residual steering capability is operationally adequate and safely controllable (if not, an OMF will be the result))		X
A.1.10.5	Steering equipment damage resulting in operationally significant increase in turn radius		X
A.1.10.6	Steering capability lost (critical component in steering linkage fractured/unserviceable)	X	
A.1.11	Braking		
A.1.11.1	Vehicle braking system (service brakes) not serviceable (i.e., are inoperative or severely degraded, preventing repeatable stopping)	X	
A.1.11.2	Minor brake system leak not affecting brake function (may qualify as an NEFF but due to impending safety concerns, would likely require prompt corrective maintenance, thus would constitute an EFF)		X
A.1.11.3	Antilock braking system inoperable / not serviceable (incident constitutes an EFF if system reverts to manually controlled braking capability)		X
A.1.11.4	Parking brake inoperable (OMF if transmission cannot hold vehicle stationary)		X
A.1.12	Vehicle lighting		
A.1.12.1	Vehicle headlights inoperable		X
A.1.12.2	External blackout lights inoperable		X
A.1.12.3	Running or braking lights inoperable		X
A.1.13	Instruments Gauges, Indications, and Aids		
A.1.13.1	Vehicle gauges or indicators inoperable/malfunctioning i.e., speedometer, voltmeter, fuel gauge, engine oil pressure gauge, coolant temperature gauge, air restriction gauge, and transmission temperature warning device (as equipped)		X
A.1.13.2	Driver’s vision enhancer inoperable or severely degraded (driver can use night vision device as an alternative)		X
A.1.13.3	Vehicle windshield wipers inoperable (serious issue during in theater rainy season)		X
A.1.14	Vehicle electronic Alerts / Warning Displays:		
A.1.14.1	Repeated warning with not identified fault are Nuisance Warning		X
A.1.14.2	Warning that self clear after a power reset or vehicle restart		X
A.1.14.3	Warning that cannot be duplicated (self resetting)		X
A.1.14.4	Warning that are identified within the maintenance facility and resolved		X
A.1.14.5	Warning that are identified within the maintenance facility and deferred		X

	INCIDENT DESCRIPTION (FUNCTIONAL DEGRADATION) RELATIVE TO THE JLTV MISSION ESSENTIAL FUNCTION (MEF) INDICATED	INCIDENT CLASSIFICATION	
		OMF	EFF
A.1.14.6	Warning requires organizational level support to use a maintenance support device within the maintenance facility		X
A.1.14.7	Warning require organizational level support to use a maintenance support device out on the course to clear fault in order to complete the mission	X	
A.1.14.8	Warning that require FSR intervention to clear without a identified fault are scored on their own merit		
A.1.14.9	FSR intervention due to a true Warning are scored on their own merit		
A.2	Command, Control, Communications, Computers and Intelligence (C4I).		
A.2.1	Vehicle Communication		
A.2.1.1	Functional loss of ability to transmit/receive on secure net		X
A.2.1.2	Functional loss of digital data transmission/reception capability (where voice receive/transmit capability remains functional/ operational)		X
A.2.1.3	All on-board vehicle radios inoperable (e.g., radio power harness failure)	X	
A.2.1.4	Inability to transmit or receive on all on-board radios (e.g., signal harness failure)	X	
A.2.2	On-board Vehicle Position i.e., defense advanced global positioning system (GPS) receiver (DAGR)) inoperable or substantially degraded		
A.2.2.1	Vehicle position/location updates/fixes unable to be obtained		X
A.2.2.2	Confirmed malfunctions resulting in obviously errant/erroneous position/location data (data from accompanying vehicle or maps and ground references can be used as the alternative)		X
A.2.3	Computing		
A.2.3.1	Any unreadable or degraded display screen imagery		X
A.2.3.2	Failure of onboard computer elements that have direct adverse impact on mission operations	X	
A.3	Force Protection.		
A.3.1	Armor		
A.3.1.1	Protective ballistic provisions integral to vehicle chassis/hull/body compromised		
A.3.1.1.1	Integral structural crack present at critical juncture (e.g., a stress crack along a weld in the hull)		X
A.3.1.1.2	Bolt-on armor (as applicable) not securely/properly affixed; critical quantity of bolts (or bolts in a critical location) are excessively loose (and cannot be retightened by the crew) or broken / sheared off		X
A.3.1.1.3	Failure of transparent armor resulting in driver inability to negotiating the terrain during mission operations over OMSMP	X	
A.3.1.2	Protective ballistic provisions for mounted weapon system gunner compromised		

	INCIDENT DESCRIPTION (FUNCTIONAL DEGRADATION) RELATIVE TO THE JLTV MISSION ESSENTIAL FUNCTION (MEF) INDICATED	INCIDENT CLASSIFICATION	
		OMF	EFF
A.3.1.2.1	Critical segments of armor not retained in proper protective position (and cannot be reattached by the crew); e.g., bolts securing one or more armor segments of armor have vibrated loose, or armor has cracked around bolt holes		X
A.3.2	Countermeasures		
A.3.2.1	Smoke Grenade Launchers or other bolt on systems degraded/inoperative (incident constitutes an EFF, as the crew can relocate vehicle within the protective envelope of an accompanying vehicle having a functional systems)		X
A.3.3	Door / Vehicle Egress		
A.3.3.1	Functional loss of capability to unlock/open any hatch or door on the vehicle		X
A.3.3.2	Functional loss of capability to secure any hatch or door using latching device		X
A.3.3.3	Doors latch inhibits safe operation and delays personnel egress		X
A.3.3.4	Inability to open 2 or more doors due to functional loss of door latch	X	
A.3.3.5	Inability to secure multiple doors with combat lock or door latch	X	
A.3.3.6	Inability to open vehicle door using combat lock	X	
A.3.3.7	Mechanical assist for Door(s) damaged or degraded, as applicable; probably EFF if substantial force is required to open the door (time delay issue associated with personnel egress)		X
A.3.4	Hood		
A.3.4.3	Hood latches release and inhibit operation requiring hood to be strapped down		X
A.3.5	Hatch		
A.3.5.1	Roof hatch fail to securely Seal/latch/lock in the open or closed position (personnel safety issue)		X
A.3.5.2	Roof hatch fail to open due to damaged or degraded, probably EFF if substantial force is required to open the hatch (time delay issue associated with weapon firing)		X
A.4	Carry.		
A.4.1	HVAC		
A.4.1.1	Vehicle compartment air conditioning (cooling) inoperable or degraded to an operationally critical level (because of a malfunction, equipment damage, or equipment wear)		X
A.4.1.2	Vehicle compartment heating inoperable or significantly degraded		X
A.4.2	Fire Suppression		
A.4.2.1	Crew/Troop Compartment:		
A.4.2.1.1	Functional loss of fire extinguishing/suppression capability internal to vehicle cab/troop compartment		X

	INCIDENT DESCRIPTION (FUNCTIONAL DEGRADATION) RELATIVE TO THE JLTV MISSION ESSENTIAL FUNCTION (MEF) INDICATED	INCIDENT CLASSIFICATION	
		OMF	EFF
A.4.2.1.2	Automated and manual capabilities inoperable or degraded to an operationally unacceptable level, on vehicles equipped w/both		X
A.4.2.1.3	Automated capability inoperable or degraded to an operationally unacceptable level on vehicles equipped w/only an automated suppression system (e.g., system unable to provide fire suppression at "at least" 2 ingress/egress points located on different sides of vehicle (top/back/left side/right side)		X
A.4.2.1.4	Manual capability inoperable on vehicles not equipped w/an automated suppression system (e.g., any hand-held fire extinguisher not fully charged / fully functional)		X
A.4.2.1.5	Inadvertent discharge of crew/troop compartment fire bottles (safety issue)		X
A.4.2.2	Engine Compartment: (No Threshold/Objective Requirement)		
A.4.2.2.1	Engine compartment fire suppression system inoperable/degraded (for vehicles so equipped)		X
A.4.3	Crew Seats		
A.4.3.1	Functional loss/damage of essential seat installation hardware resulting in inadequate driver seating support		X
A.4.3.2	Seat adjustment provisions not functional (as applicable), rendering driver unable to adequately reach/access accelerator/braking/steering control mechanisms		X
A.5	Lethality.		
A.5.1	Mechanical failure/damage/malfunction of gun mount assembly (or traverse and elevation mechanism) resulting in reduced capability to position the weapon		
A.5.1.1	Unable to elevate, depress, and traverse weapon over ranges of motion necessary and adequate for the conduct of mission operations	X	
A.5.1.2	Range of motion is significantly reduced, but operationally adequate		X
A.5.1.3	Weapon unable to be held in the commanded/selected/desired position (e.g., ring mount traverse lock damaged, traverse and elevation mechanism functioning inadequately)		X
A.5.1.4	Mechanical failure/damage resulting in the inability to mount and secure weapon to vehicle	X	
A.5.1.5	Mechanical failure/equipment damage causing inability to dismount weapon		X
A.6	JLTV Trailer		
A.6.1	Trailer / Towability by vehicle:		
A.6.1.1	Inability of trailer to manage air/hydraulics		X
A.6.1.2	Inability of trailer to manage electrical power		X
A.6.1.3	Inability of trailer to secure payload		X
A.6.1.4	Inability of trailer to apply parking / service brakes	X	

	INCIDENT DESCRIPTION (FUNCTIONAL DEGRADATION) RELATIVE TO THE JLTV MISSION ESSENTIAL FUNCTION (MEF) INDICATED	INCIDENT CLASSIFICATION	
		OMF	EFF
A.6.1.5	Inability of trailer to disengage parking / service brakes	X	
A.6.1.6	Inability of trailer to clear terrain obstacles	X	

Appendix B

Reliability Descriptions and TIR Guidelines

B.1. FD/SC Descriptions:

1. Failure: are incident associated with a system anomalies that require action to understand and correct. The severity of the failure and the operational impact along with the time to diagnose, correct, and verify are used in the reliability and sustainment matrixes.
2. Non-Failures: are incidents that address action associated with maintenance actions and the time accumulated is used in the sustainability matrixes.
3. No-Test: are incidents associated anomalies outside the RAM tests or are outside the test parameters and are not included in the RAM assessment.

B.2. Non-Failure Descriptions:

1. ROUTINE OP PROC: are action taken by the crew during normal operation, the time associated with this action is not used in either the crew or maintainer sustainment matrix.
2. PMCS: are performed by crew and time is used in the crew sustainment matrix.
3. On-Condition Maintenance: is performed by mechanics and the time is used in the maintainer sustainment matrix.
4. Scheduled Maintenance: is performed by mechanics on pre determined intervals and the time is used in the maintainer sustainment matrix.

B.3. Failure Description:

1. Crew Correctable Maintenance Actions (CCMAs). Malfunctions which the vehicle crew is able to correct in less than 30 minutes through the execution of prescribed maintenance/repair procedures using authorized tools, repair parts, and spares carried on-board the vehicle will be classified as Crew Correctable Maintenance Actions (CCMAs). At the discretion of RAM Scoring Committee members (based on input from test personnel and/or Subject Matter Experts), frequently recurring failures, more than what is identified in Table 2, of a particular type or an excessively high frequency of failures in general that cumulatively consume an excessive amount of mission time, more than 30 minutes, for execution of crew level corrective maintenance may result in a higher level of failure classification (even an OMF) being assigned in the event that the adverse overall cumulative impact of the failures on operations is great enough.
2. Dependent Event (DE): If a failure directly attributable or simultaneous to another failure occurs, then the data of the secondary failure should be added to the TIR for the primary TIR. This would shift all chargeable maintenance to the primary originating TIR. The secondary failure can be scored as a Dependent Event (DE). The maintenance time will be the sum of the maintenance time for all related incidents.
3. Non-Essential Function Failures (NEFF): Failures that do not result in the loss or operationally significant degradation of a MEF will be scored as Non-Essential Function Failures (NEFFs). The incident is an actual malfunction for which maintenance can be deferred to the next scheduled maintenance opportunity or deferred to end of test.
4. Essential Function Failure (EFF): Failures or equipment damage that causes significant degradation of a MEF, but do not preclude the function from being performed in a degraded

state to the extent needed to complete the ongoing mission will be scored as Essential Function Failures (EFFs). An incident that causes the vehicle to require corrective action before the next mission could begin (commensurate with the criteria provided in the FD/SC Appendix A - JLTV RELATIONSHIP/ SCORING MATRIX is indicative of an EFF. When an EFF occurs, the vehicle is still capable of completing the mission that is currently underway because of no effect on the mission essential functions but must be repaired prior to the start of the next mission.

5. Operational Mission Failure (OMF): Incidents that render the vehicle incapable of performing a MEF to the extent required for successful completion of the ongoing mission will be classified as Operational Mission Failures (OMFs), which are subject to being assessed against the Mean Miles between Operational Mission Failure (MMBOMF) reliability requirements.

B.4. Failure Chargeability Descriptions:

1. Contractor Furnished Equipment (Contractor). A chargeability category provided to capture vehicle failure events and maintenance actions that are attributable to malfunctioning vehicle hardware or characteristics of the system's software, firmware, or BIT that is not performing its intended function. Incidents attributable to the contractor designed, bought, modified, or subcontracted and integrated into the system will be charged to CFE. This includes all contractor modified GFE.
2. Government Furnished Equipment (Government). A chargeability category provided to capture vehicle failure events and maintenance actions attributable to malfunctioning associated with equipment procured and furnished by the government to the contractor for integration and installation.
3. Operator/Crew - A chargeability category provided to identify all vehicle failure events and corrective maintenance actions induced by improper crew actions that were not rooted in CFE design problems, deficiencies or errors in technical documentation, training deficiencies, or issues with crew level support equipment.
4. Maintenance Personnel - A chargeability category used to identify all vehicle malfunctions attributed to maintenance personnel errors (e.g., malfunctions caused by dedicated maintenance personnel not adhering to, or properly executing, the established repair procedures) that were not rooted in CFE design problems, deficiencies or errors in training or maintenance manuals, or issues with the prescribed support equipment. Malfunctions stemming from improper crew - level maintenance would be charged to Operator/Crew Error.
5. Training - A chargeability category used to identify those vehicle failure events and corrective maintenance actions that can be directly attributed to deficiencies, inadequacies, or errors in operator or maintainer training due to omitted or incorrect training procedures, or inappropriate training material such as information above the general level of understanding of the target audience.
6. Contractor Technical/Operator's Manuals - A chargeability category used to identify all vehicle failure events and corrective maintenance actions that were attributable to misleading, incorrect, or nonexistent information in the Technical Manuals (operator and maintenance manuals). Poorly written, inadequate, or incomplete instructional materials may

cause crew or maintainer error; in such cases, the incident should be charged to Technical Manual.

7. Accidents - A chargeability category provided specifically for those vehicle failure events and corrective maintenance actions that were the result of an accident (e.g., an incident attributable to an unexpected occurrence by the vehicle crew, mounted personnel, or maintainer that is not clearly an act of negligence or error). Accidents attributed to system CFE design problems, issues with support equipment, deficiencies or errors in training or technical documentation (e.g., inadequate warnings in the documentation), and crew or maintainer error would not be charged to the "Accidents" category, but rather, the category depicting the appropriate root cause for the accident.
8. Support Equipment - A chargeability category for incidents attributable to malfunctions of any support equipment or tools (on-vehicle, within the vehicle - equipped unit, or utilized by maintainers), as well as the lack of one or more tools to complete required operator or maintainer tasks. This includes any Test, Measurement, and Diagnostic Equipment (TMDE), special tools, and related equipment deemed necessary to support the vehicle from the total "system" perspective. This category serves to verify and amplify the need for any additional support equipment or changes to existing support equipment required for the vehicle.

B.5. TIR Guide:

1. TIR written with deferred maintenance need to say why it is bring deferred
2. TIR written with no actions taken need to state if the incident is resolved
3. TIR written that identify cosmetic wear and tear need to state if there is a failure or potential failure in the making
4. TIR written that identify performance limits need to state the impact on testing
5. TIRs need to be written that identify crew discomfort or limitations
6. TIR need to state where incident occurred, if it was found in the maintenance facility during repair of another TIR or for scheduled maintenance
7. TIR needs to be written identifying start of each balanced mission cycle
8. TIR need to state if the incident identified during pre (before PMCS), at halt (during PMCS), or post (after PMCS), inspection and whether they were on the test course or in the maintenance facility
9. TIR need to state if the incident identified during daily on-course limited visual inspection
10. TIR involving flat tire need to clarify whether vehicle was able to sustain required speeds on and off road so that CTIS and run-flat performance can be assessed.
11. TIR involving door latching inability to close need to discuss whether the battle lock is operable to secure the door.
12. TIR involving Equipment Mod should include a CARB or FACAR reference number in the short title.
13. Generate Informational TIRs to identify completion of a balanced RAM cycle with mileage and dates, CAP periods, and test phases.