Appendix 1

U.S. Army

SFAE-CSS-JC-JL
MS 640 BLDG 302 RM 113
6501 E 11 Mile Road
Warren, MI 48397-5000

INSTRUCTOR GUIDE

<u>Joint Light Tactical Vehicle (JLTVA1) Maintainer Course</u>

LESSON

01 Introduction and Safety

SECTION I. ADMINISTRATIVE DATA

All Courses Including This Lesson

Course Number	Version	Course Title
JLTVA1_MAINT_01	3.0	Introduction and Safety
JLTVA1_MAINT_02	3.0	Vehicle Familiarization
JLTVA1_MAINT_03	3.0	Electrical
JLTVA1_MAINT_04	3.0	Engine
JLTVA1_MAINT_05	3.0	Transmission
JLTVA1_MAINT_06	3.0	Drivetrain
JLTVA1_MAINT_07	3.0	Suspension, Hydraulics and Steering
JLTVA1_MAINT_08	3.0	Air Systems, Brakes and CTIS
JLTVA1_MAINT_09	3.0	End of Course

Task(s) Taught (*) or Supported

Task Number	Task Title
NATEF Shop and Personnel Safety 6	Identify safety tags
	Locate warnings/cautions in IETM
NATEF Shop and Personnel Safety 13	Demonstrate awareness of safety aspects of the JLTVA1

Reinforced Task(s)

Task Number	Task Title
N/A	

Academic Hours

The academic hours required to teach this lesson are as follows:

Academic	Resident Hours	Methods
1 hr 30 mins		Classroom Lecture
Total Hours:	1 hr 30 mins	

Test Lesson Number

Hours	Lesson Number Version	Lesson Title
1 hr 30 min	Test A	09_End of Course and Final Exam
1 hr 30 min	Test B	09_End of Course and Final Exam

Prerequisite Lesson(s)	**Hours** / **Lesson Number Version** / **Lesson Title**: N/A / N/A / N/A

Prerequisite Lesson(s)

Hours	Lesson Number Version	Lesson Title
N/A	N/A	N/A

Clearance Access

Security Level: Distribution C
Requirements: Distribution authorized to U.S. Government agencies and their contractors only.

Foreign Disclosure Restrictions

FD7. This product/publication has been reviewed by the product developers in coordination with the Oshkosh Corporation foreign disclosure authority. This product is NOT releasable to students from foreign countries.

References

Number	Title	Date
2320-01-653-6557	JLTVA1 GP IETM	April 2018
2320-01-653-6495	JLTVA1 HGC IETM	April 2018
2320-01-653-6516	JLTVA1 UTL IETM	April 2018
2320-01-653-6534	JLTVA1 CCWC IETM	April 2018

Student Study Assignments

None

Instructor Requirements

JLTVA1 Certified Instructor (3)

Additional Support Personnel Requirements

Name	Student Ratio	Qty	Man Hours
N/A			

Equipment Required for Instruction

The Laptop and JLTVA1 quantities are based on a 15-student headcount.

ID Name	Student Ratio	Instructor Ratio	Spt	Qty	Exp
Projector	1:15	1:1	No	1	Yes

Materials Required

Instructor Materials:
Instructor Guide
Power Point
FIK

Student Materials:
Student Guide

Classroom, Training Area, and Range Requirements

ID Name	Qty	Student Ratio	Setup Mins	Cleanup Mins
Classroom, 15 Student	1	1:15	30	30
Shop, Bays	3	1:5	30	30

Ammunition Requirements	<table><tr><td><u>DODIC Name</u></td><td><u>Qty</u></td><td><u>Student Ratio</u></td><td><u>Setup Mins</u></td><td><u>Cleanup Mins</u></td></tr><tr><td>N/A</td><td></td><td></td><td></td><td></td></tr></table>
Instructional Guidance / Conduct of Lesson	**NOTE:** Before presenting this lesson, instructors must thoroughly prepare by studying this lesson and identified reference material. All practical exercises must be practiced and prepared prior to the conduct of course.
Proponent Lesson Plan Approvals	<table><tr><td><u>Name</u></td><td><u>Rank</u></td><td><u>Position</u></td><td><u>Date</u></td></tr><tr><td>N/A</td><td></td><td></td><td></td></tr></table>

SECTION II.	INTRODUCTION
	Method of Instruction: Lecture Instructor to student ratio: 1:15 Time of Instruction: 5 min Instructional Strategy: Lecture & Group Discussion
Motivator	General Safety is the primary consideration when working with the JLTVA1. Observe all safety precautions and warnings at all times. This portion of the Maintainer Training program's intention is to remind students of general shop safety – safety specific to maintaining the JLTVA1 and to increase the students' familiarity with the training facilities. Failure to pay attention may result in decreased preparedness and inefficiencies in the event of an emergency or accident.
Terminal Learning Objective 1.	**NOTE:** Inform the students of the following Terminal Learning Objective requirements. Upon completion of this lesson, you will be able to: Action: Demonstrate safety throughout all required components of the JLTVA1 Maintenance Training Program Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, resource materials, classroom training and hands-on training Standards: Without injury or death to personnel or damage to vehicles and earn the course completion certificate by achieving 80% accuracy on a written test and 100% accuracy on hands on activity.
Safety Requirements	General Safety is the primary consideration when working with the JLTVA1. Observe all safety precautions and warnings at all times. Identify all safety requirements for the facility and working environments. This includes fire, natural disaster, and vehicle escape procedures. Report all hazards. If at any time, you detect a hazard, it is your responsibility to report the hazard to ensure corrections. If you detect a new or suspected hazard, particularly due to equipment installation, modification, or repair, it is your responsibility to report it through your chain-of-command. This will ensure that this hazard will be investigated, publicized, or corrected as required.
Risk Assessment Level	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	A Check on Learning will be conducted at the end of each lesson to ensure proper transfer of knowledge to students. Practical exercises will be conducted during each lesson. Students will need to complete each exercise with 100% accuracy (to include remedial training if

	necessary) before the Performance Evaluation Checklist is signed to ensure students can properly conduct maintenance procedures. The student will have a comprehensive test at the end of the course in which they will need to achieve an 80% score to pass.
Instructional Lead-In	The Joint Light Tactical Vehicle Maintainer course will familiarize US military personnel with the components of the JLTVA1 to perform maintenance without injury to personnel or damage to the vehicle. The JLTVA1 delivers new levels of agility to safely navigate rugged terrain and compressed urban areas. The JLTVA1 combines field-proven technologies, and an advanced crew protection system that provides MRAP-level protection and expeditionary levels of mobility in a light-duty profile. This vehicle training is focused on safety, characteristics, systems, and special tools involved to service the JLTVA1. The Joint Light Tactical Vehicle Maintainers course is targeted toward the US military personnel with a job requirement to maintain the JLTVA1.

SECTION III. **PRESENTATION**

1. TLO 1 – LSA 1

Learning Step/Activity:	Course Admin Data
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	40 mins
Media Type:	PPT

(Slide #2)

a. Introductions

1. Lead instructor

a) Lead instructor introduces self, giving a brief personal history.

b) Lead instructor provides experience with the vehicle and other JLTVA1 training events.

c) Lead instructor introduces all other supporting instructors, guests, and/or VIPs.

2. Supporting instructor

a) Supporting instructor introduces self, giving a brief personal history.

3. Student introductions

a) Each student introduces him/herself.

b) Determine student experience level by asking probing questions if needed.

(Slide #3)

b. Course Rules and Housekeeping

Instructor Note
Instructor to review/update the information below because locations and policies for each location may vary. Instructors shall adhere to all policies as well as students.

1. Daily schedule

a) Start time. The course begins at ________ every day and ends at approximately ___________.

b) Lunch: Lunch begins at ___________ and resumes at __________.

c) Breaks. During classroom instruction, we try to take a break for 10 minutes per hour of instruction. The break schedule works around teaching points to not interrupt the lesson/topic.

2. Classroom safety/rules

   a) Safety representatives will be ____. If an accident occurs, cease training and inform the instructor and safety rep ASAP what occurred. Apply first aid or help as capable. Safety first and safety always.

   b) Beverages and food will be allowed in the class and during hands-on activities according to the local SOP. It is a privilege to have these items, so you are responsible for the clean-up of all items at the end of a lesson/day. If they become a distraction, they will be dis-allowed.

   c) Classroom, vehicle bay area, vehicle, and garbage must be cleaned up every evening.

   d) The use of cell phones during class activities is disruptive and is not allowed. Limit calls and texting to official breaks and lunch hour. If you have an extenuating circumstance, please inform the instructor that you may receive a call and leave the classroom to hold the conversation.

   e) The smoking/vaping area is _________. Students may smoke on the breaks as given by the instructor. The local SOP dictates smokeless tobacco use.

Instructor Note
In the event, not all students are accounted for in an emergency, the instructor shall notify the emergency responders of the missing personnel.

3. Emergency procedures

   a) The muster area in case of fire is___________________________. Attendance/roll call will be taken by the instructor to ensure all students are present.

   b) The muster area in case of a tornado is ____________________. The instructor will take attendance/roll call to ensure all students are present.

   c) First Aid equipment location is ___________________________.

4. Restrooms

   a) The restrooms location is _____________. Try to use them on the breaks times, but in an emergency, you may quietly exit the classroom to use them. Please try to keep them clean during the course.

(Slide #4)

c. Course Overview

1. This is a 10 day/80-hour class and every minute counts.

2. The purpose of the course is to provide the knowledge and skills necessary for Maintainers to maintain the Joint Light Tactical Vehicle (JLTVA1).

3. Lesson focuses include:

   a) Safety

   b) Vehicle characteristics

   c) Theory of operation for each system

   d) Maintenance requirements

   e) Troubleshooting

   f) Special tools

4. Course completion requirements

   a) To successfully complete the course, you need to attend all lessons. The course does not allow for any missed time. Talk to the instructor and POC if you know of any time that you will not attend.

   b) This program is specifically designed for JLTVA1 Maintenance skills and knowledge. You must complete all hands-on activities with a score of 100% or all "Go's" on a Go/No Go rating scale.

   c) You must earn an 80% or greater on the final exam.

(Slide #5)

d. Training Program Lesson Breakdown

1. Day 1

   a) Introduction & Safety

   b) Vehicle Familiarization

2. Day 2

   a) Vehicle Familiarization cont.

   b) Electrical

3. Day 3

   a) Electrical cont.

4. Day 4
    a) Electrical cont.
    b) Engine
5. Day 5
    a) Engine cont.
    b) Transmission
6. Day 6
    a) Drivetrain
    b) Hydraulics/Steering/Suspension
7. Day 7-8
    a) Hydraulics/Steering/Suspension cont.
8. Day 9
    a) Hydraulics/Steering/Suspension cont.
    b) Air/Brakes/CTIS
9. Day 10
    a) Air/Brakes/CTIS
    b) Summary/Review
    c) Final Exam
    d) Course Wrap-Up

(Slide #6)

e. Today's Module Overview

1. Introduction and Safety – 2 hr
2. Vehicle Familiarization 12 hr 10 min (continue tomorrow)

Check on Learning

(Slide #7)

Q: What is the emergency procedure for a fire?
A: Everyone will meet at ______ muster point and attendance/roll call will be taken.

Q: What three items must you do to successfully complete this course?
A: Attend all lessons, pass all hands-on evaluations with 100% rate, and pass the comprehensive exam with an 80% or higher.

Summary

(Slide #8)

During this period of instruction, we covered introductions, training schedule, topics covered in this course, facilities, and emergencies. The next topic we'll cover are safety elements involved with servicing the JLTVA1.

Transition

Any questions before we move forward?

Enabling Learning Objective A.

(Slide #9)

Action:	Identify safety rules, decals, caution and warnings in/on the workspace or IETM
Conditions:	Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials
Standards:	Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test.

1.

ELO A – LSA 1 Learning Step/ Activity

Learning Step/Activity:	Safety
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	40 mins
Media Type:	PPT

(Slide #10)

a. Review Safety Training Objectives

1. At the start of class, we reviewed the Terminal Learning Objective for this module which is to safely complete all training elements. In order to do this, we have to learn about all pivotal safety information for JLTVA1 Maintenance. This next learning step helps you recall standard safety practices giving you a high-level overview of safety risks specific to maintaining a JLTVA1. Safety briefs will also occur throughout training immediately prior to the related maintenance task.

2. So, let's get into reviewing safety and identifying potential risks for maintaining the JLTVA1.

(Slide #11)

b. Safety Overview

1. We are going to cover 6 different safety aspects all from the perspective of JLTVA1 relevance and the shop/facilities provided for training.

a) General safety

b) Personal protective equipment (PPE)

c) Safety decals & data plates (on tools or on vehicle)

d) Warnings, cautions, and notes (inside the TM)

e) Electrical

f) High pressure systems (both hydraulics and gas)

(Slide #12)

c. General Safety

1. To prevent injury or death when working around the JLTVA1:

a) Adhere to warnings, cautions and notes

b) Observe general workshop safety

c) Wear PPE

d) Maintain 3 points of contact to avoid slips and falls

e) Be aware of your proximity to vehicle

f) Be aware of pinch points

g) Before working under vehicle, you must:

1) Support vehicle with safety stands or suspension lock-out braces

2) Chock tires

h) Use shop tools properly

1) Follow instructions for use and best practice

2) The JLTVA1 has special tools, such as lift kits, which may be new to you; so be sure to use the IETM to enable you to use the tools safely.

(Slide #13)

d. Personal Protective Equipment (PPE)

1. The following items must be used whenever and wherever applicable per policy:

a) Safety glasses

b) Hearing protection

c) Gloves

(Slide #14)

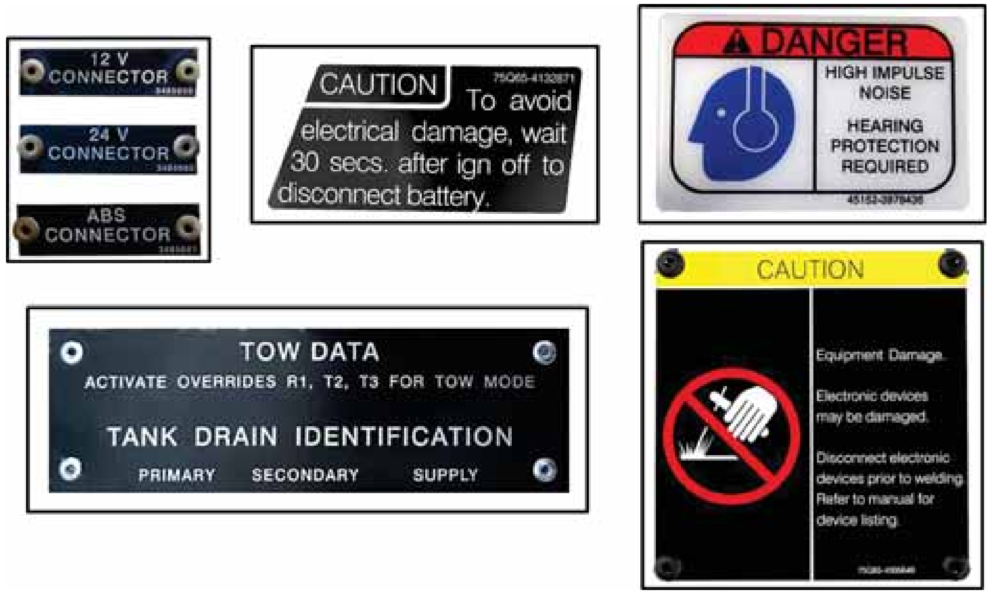

Figure 1.1 Sample Warning and Caution Tags on Equipment/Machinery

e. Safety Decals & Data Plates (Figure 1.1)

1. These are warning tags installed by the manufacturer of the item on which it is bolted/glued or attached. You will find safety decals/plates throughout the vehicle.

2. Internal decals and data plates

   a) 30 second caution

   b) High impulse noise warning

   c) Welding caution

3. External data plates

   a) 12-volt, 24 volt, ABS connectors

   b) Tow data

(Slide #15)

f. Warnings, Cautions, and Notes

1. These are three different levels of safety notices to maintainers from our technical publication experts.

2. You will find them inside the technical manual (TM) directly prior to the maintenance procedure or task step.

3. Do NOT skip through the Warnings, Cautions or Notes. The TM is updated regularly, and data may change.

4. Warnings are in red boxes and signify a potentially hazardous situation exists. If the recommended precautions are not taken, death or serious injury could occur.

5. Cautions are in yellow boxes and signify damage to the equipment may occur if the precautions are not followed.

6. Notes are in blue boxes and provide important, helpful information related to the task or vehicle component.

(Slide #16)

g. Electrical Safety

1. Electrical damage or injury are preventable in most cases. The best way to avoid risk of electrical shock or death is to get familiar with the vehicle electrical system, follow all the warnings, and adhere to safety precautions such as wearing PPE.

2. Electrical safety procedures

    a) Use battery disconnect switch to disconnect power from system

    b) Remove main battery negatives from system. There are two, primary and auxiliary batteries; disconnect both.

    c) Turn ignition power on for 10-15 seconds to discharge power from the system.

    d) Turn ignition power off.

3. Electrical safety notes

    a) Remove jewelry before starting any electrical services or inspections

    b) Take care when touching electrical components since conductors may ground through skin causing injury.

    c) Touch only conductors with multi-meter leads. Do not use your hands.

    d) Use grounding straps if necessary when handling sensitive electrical modules.

(Slide #17)

4. The JLTVA1 is equipped with multiple battery systems that provide electrical power throughout the entire vehicle located at the front and rear of the vehicle.

    a) Remove main negatives before troubleshooting

b) Do not touch conductors

c) Move wires and cables by their insulation

5. Electrical circuits run throughout JLTVA1 consisting of:

a) Modules

b) Conductors

c) Insulators

d) Semiconductors

e) Power sources

f) Electrical safety

1) Modules on JLTVA1 may supply power or ground to control circuit. Ensure power is removed from the module and the system is discharged before troubleshooting.

(Slide #18)

6. Wires

a) The conductor, copper core, carries current. It is protected by the insulation.

b) Do not touch copper core with bare hands

c) Use multi-meter leads for testing circuits

7. Semiconductors are controls for electrical circuits

a) Most common on JLTVA1 are diodes; allow for one-way flow of electricity

b) Incorrect insertion, testing, or overloading may cause diode to explode

(Slide #19)

h. High Pressure System Safety

1. Most cases of injury from high pressure systems are preventable.

2. Hydraulic safety may prevent burns, cuts, eye damage, and potential poisoning.

3. Pneumatic safety, for the high-pressure gas (nitrogen) system, may prevent various potential injuries from concentrated high-pressure blasts.

4. Safety Procedures

   a) Wear safety glasses and hearing protection when vehicle is running

   b) Wear gloves when working on hydraulic systems

   c) Locate safety decals and plates

   d) Use the TM-heed warnings

   e) Ensure suspension lock-out braces are installed

   f) Identify hose being removed- know your truck

   g) Bleed off pressure prior to removing any component

(Slide #20)

i. High Pressure Systems Risk

   1. **WARNING: THERE IS A RISK ASSOCIATED WITH MAINTAINING THE TAK-4i BECAUSE IT IS A PRESSURIZED SUSPENSION SYSTEM.**

   2. Risks from HPG System are:

      a) Hose Breaches or Leaks:

         1) When the HPG hoses/hard lines that go to the springs are compromised, rapid depressurization will occur, and the spring will collapse quickly.

         2) Do not over-torque fittings.

      b) Risks from HPG Maintenance include:

         1) Whip

         2) Nitrogen injected into bloodstream

         3) Crushing

(Slide #21)

j. Crushing Risk

   1. **WARNING: THERE IS A RISK OF BEING CRUSHED WHEN MAINTAINING THE JLTVA1 BECAUSE IT IS A PRESSURIZED SUSPENSION SYSTEM.**

      a) Worst case scenario: a catastrophic failure could cause the chassis to lower down into a decompressed position. Full decompression will leave:

         1) Five inches of clearance under the vehicle

2) **Zero clearance between wheel well and tire.**

b) Vehicle Safety Equipment

1) There are two types of safety equipment required when working underneath any part of the JLTVA1 (including inside wheel wells).

Figure 1.2 Suspension Jack Service Cart Kit (left) Suspension Lock-out Brace (right)

2) They are the Kit and Suspension Lock-out Braces. (Figure 1.2) You will learn how to use special tools in the lesson to which they are used.

Check on Learning

(Slide #22)

Q: What is the difference between decals/data plates and cautions and warnings?
A: The difference is where they are located. Decals and data plates are on the tools and on the vehicle and cautions and warnings are in the TM communicating risks associated with each maintenance task.

Q: What is the first thing you do when troubleshooting electrical system?
A: Turn off the power source

Q: Explain the risk associated with maintaining the TAK-4i as a pressurized suspension system.
A: Rapid depressurization occurs quickly collapsing the spring when HPG hoses/hard lines to springs are compromised.

Summary

(Slide #23)

In this lesson, we've covered:
- General Safety
- PPE
- Cautions, Warnings & Notes
- Decals & Placards
- Electrical Safety
- High Pressure System Safety
- Crushing Hazard

Transition

We've just finished the content for our first module, Introduction and Safety, one last step is to review everything we've talked about so far.

SECTION IV. SUMMARY

Method of Instruction:	Classroom
Instr Type (I: S Ratio)	1:15
Time of Instruction:	5 mins
Instructional Strategy	Lecture and Q&A

Check on Learning

(Slide #24)

Q: Name the two types of high-pressure systems you will encounter when working on the JLTVA1?
A: High pressure gas (Nitrogen) and hydraulic.

Q: Why should suspension safety be properly secured when working under the JLTVA1?
A: To avoid crushing hazards.

Summary

(Slide #25)

In this section, we covered introductions, training and training schedule, facilities, and emergency procedures. We also addressed general safety and JLTVA1 specific safety considerations.

APPENDIX A

01_JLTVA1_ARMY_ MAIN_Intro_PPT_V3.0.pptx

US Army

SFAE-CSS-JC-JL
MS 640 BLDG 302 RM 113
6501 E 11 Mile Road
Warren, MI 48397-5000

INSTRUCTOR GUIDE

<u>Joint Light Tactical Vehicle (JLTVA1) Maintainer Training</u>

LESSON

02 Vehicle Familiarization

SECTION I. **ADMINISTRATIVE DATA**

All Courses Including This Lesson

Course Number	Version	Course Title
JLTVA1_MAINT_01	3.0	Introduction and Safety
JLTVA1_MAINT_02	3.0	Vehicle Familiarization
JLTVA1_MAINT_03	3.0	Electrical
JLTVA1_MAINT_04	3.0	Engine
JLTVA1_MAINT_05	3.0	Transmission
JLTVA1_MAINT_06	3.0	Drivetrain
JLTVA1_MAINT_07	3.0	Suspension, Hydraulics and Steering
JLTVA1_MAINT_08	3.0	Air Systems, Brakes and CTIS
JLTVA1_MAINT_09	3.0	End of Course

Task(s) Taught (*) or Supported

Task Number	Task Title
I.A.1	Research applicable vehicle and service information, vehicle service history, service precautions, and technical service bulletins.
I.A.3	Verify operation of the instrument panel engine warning indicators.
V.E.1	Interface with vehicle’s on-board computer; perform diagnostic procedures using recommended electronic service tool(s) (including PC based software and/or data scan tools); determine needed action.
A_00_JGCXAAA	GENERAL ELECTRIC MAINTENANCE
AA10J_00_NGFAABI	REAR CHASSIS COMPONENTS DNO
AA10J_00_NGFAABK	ALL CHASSIS MVEC FUNCTIONS DNO
A91040Q_00_NGFAAAG	ALL INSTRUMENT PNL FUNC DNO
A91040Q_00_NGFAAAH	CHECK ENG IND DNI OR REMAINS ILL
A91040Q_00_NGFAAAI	ENG OIL LEVEL IND DNO OR REMAINS ILL
A91040Q_00_NGFAAAJ	FRONT AIR PRESS GAUGE DNO OR INAC
A91040Q_00_NGFAAAK	REAR AIR PRESS GAUGE DNO OR INAC
A91040Q_00_NGFAAAL	FUEL GAUGE DNO OR IS INAC
A91040Q_00_NGFAAAM	LOW VOLTAGE IND DNI
A91040Q_00_NGFAAAN	TRAILER ABS IND DNI OR REMAINS ILL

AA10J_00_NGFAABX	HORN, MAPLIGHT, INSTRUMENT PANEL DNO
551-Oper-0035	Driver smart display unit (DSDU) screen operation

Reinforced Task(s)

Task Number	Task Title
N/A	

Academic Hours

The academic hours required to teach this lesson are as follows:

Academic	Resident Hours	Methods
3 hr 15 min		ILT
9 hr 15 mins		PE
Total Hours:	12 hr 30 min	

Test Lesson Number

Hours	Lesson Number Version	Lesson Title
1 hr 30 min	Test A	09_End of Course and Final Exam
1 hr 30 min	Test B	09_End of Course and Final Exam

Prerequisite Lesson(s)

Hours	Lesson Number Version	Lesson Title
N/A	N/A	N/A

Clearance Access

Security Level: Distribution C
Requirements: Distribution authorized to U.S. Government agencies and their contractors only.

Foreign Disclosure Restrictions

FD7. This product/publication has been reviewed by the product developers in coordination with the Oshkosh Corporation foreign disclosure authority. This product is NOT releasable to students from foreign countries.

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2320-01-653-6495	JLTVA1 HGC IETM	April 2018
2320-01-653-6516	JLTVA1 UTL IETM	April 2018
2320-01-653-6534	JLTVA1 CCWC IETM	April 2018

Student Study Assignments

None

Instructor Requirements

JLTVA1 Certified Instructor (3)

Additional Support Personnel Requirements	**Name** / **Student Ratio** / **Qty** / **Man Hours** N/A

Additional Support Personnel Requirements

Name	Student Ratio	Qty	Man Hours
N/A			

Equipment Required for Instruction

Quantities are based on a 15-student class size.

ID Name	Student Ratio	Instructor Ratio	Spt	Qty	Exp
Projector	1:15	1:1	No	1	Yes
JLTVA1 w BII	1:5	1:1	No	3	Yes
MSD with EMS NG/IETM	1:5	1:1	No	3	Yes
GMTK	1:5	1:1	No	3	Yes
FIK	1:5	1:1	No	3	Yes
Special Tool – Jack Service Cart Kit JLTVA1	2:5	2:1	No	6	Yes

Materials Required

Instructor Materials:
Instructor Guide
FIK

Student Materials:
Student Guide
Job Aid for Maintainers (for DSDU log-in)

Classroom, Training Area, and Range Requirements

ID Name	Qty	Student Ratio	Setup Mins	Cleanup Mins
Classroom, 15 Student	1	1:15	30	30
Shop, 3 Bays	1	1:5	30	30

Ammunition Requirements

DODIC Name	Qty	Student Ratio	Setup Mins	Cleanup Mins
N/A				

Instructional Guidance / Conduct of Lesson

NOTE: Before presenting this lesson, instructors must thoroughly prepare by studying this Lesson and identified reference material

NOTE: MSDs must be loaded with IETM prior to starting the maintenance training program.

The instructor must install the suspension lock-out braces to ensure students are safe. The instructor will remove the braces prior to the Operate over various terrain (ELO F – LSA 1), where students are taught the lock out brace removal and installation procedure.

Proponent Lesson Plan Approvals

Name	Rank	Position	Date
N/A			

SECTION II. INTRODUCTION

Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of Instruction:	5 mins
Instructional Strategy	Lecture & Group Discussion

Motivator

It is important for the students to become very familiar with the exterior and interior systems and components of the JLTVA1. The JLTVA1 is capable of conducting various military operations such as maneuvering over varied terrain, from mountainous to open, desert to urban, during all weather conditions both day and night with limited and poor visibility. Failure to pay complete attention to this module will most likely result in declined comprehension and efficiency in subsequent modules, because this module's purpose is to educate on functionality and operation of all components, and capabilities of the vehicle as a whole and how to operate and understand the Driver Smart Display Unit and Interactive Electronic Technical Manual.

Terminal Learning Objective 2.

NOTE: Inform the students of the following Terminal Learning Objective requirements.

Upon completion of this lesson, you will be able to:

Action:	Maintain the JLTVA1's exterior and interior components and system functionality
Conditions:	Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials
Standards:	To fully mission capable, without injury or death to personnel, without damage to the equipment, to 80% accuracy on a written test and 100% accuracy of hands-on activity.

Safety Requirements

It is the responsibility of the student/warfighter to follow safety guidelines as well as local unit SOPs.

Risk Assessment Level

Low

Environmental Considerations

It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.

Evaluation

At the end of the course a written final exam will be administered of which each student/warfighter must earn an 80% or greater to pass this course. Throughout the lessons/modules practical exercises will be provided and graded using a "go/no go" criteria, of which all students/warfighters must earn all "go's" (100%).

Instructional Lead-In

(Slide #1)

The JLTVA1 delivers new levels of agility to safely traverse rugged terrain and compressed urban areas. This lesson will focus on becoming familiar with the characteristics and components of the JLTVA1.

SECTION III. **PRESENTATION**

(Slide #2)

Lesson overview:
The terminal Objective of vehicle familiarity is to: Maintain the vehicle's interior and exterior components and system functionality.

Course Purpose:
- JLTVA1 characteristics, capabilities and major systems
- Exterior vehicle familiarization
- Interior vehicle familiarization
- Operate all gauges, switches
- Understand the information and operation of Driver Smart Display Unit
- Familiarize with JLTVA1 Interactive Electronic Technical Manual

Enabling Learning Objective A.

Instructor Note
Inform the students of the following Enabling Learning Objective requirements.

(Slide #3)

Upon completion of this lesson, you will be able to:

Action:	Correlate the JLTVA1's exterior components with their location, purpose, function and maintenance requirements
Conditions:	Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials
Standards:	Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity.

1. **(Slide #4)**

ELO A – LSA 1

Learning Step/Activity:	JLTVA1 Characteristics, Capabilities, Performance and Major Components
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	15 mins
Media Type:	PPT

Our first learning step toward accomplishing the objective is to learn about the JLTVA1 characteristics such as variants and models.

(Slide #5)

a. Variants

1. The JLTVA1 is designed to be operational in all types of terrain. These vehicles operate in extreme conditions.

2. The baseline vehicle is available in two or four door variants, and is equipped with:

   a) Central Tire Inflation System (CTIS) enables the driver to control tire pressures and driveline lock settings for optimum mobility on various terrain conditions. The CTIS functionality also automatically monitors and maintains tire pressures and will automatically isolate a tire from the rest of the system if it detects a compromised tire.

   b) Transaxle

   c) Multi-operation setting High Pressure Gas (HPG) suspension system

3. The two and four-door variants are broken down into three base vehicles:

   a) General Purpose (GP)

   b) Close Combat Weapons Carrier (CCWC)

   c) Utility

4. There are four mission configurations of the JLTVA1. The mission configurations define the models.

(Slide #6)

Figure 2.1 General Purpose

   a) General Purpose (GP) (JLTVA1 – GP M1280) (Figure 2.1)

      1) A base platform vehicle for general utility, movement of troops, or small supply items

      2) Can provide general purpose logistical support, including administrative movement

3) Can be outfitted with multiple kits to support a variety of mission package configurations

4) Four-door configurations

Figure 2.2 Heavy Guns Carrier

b) Heavy Guns Carrier (HGC) (JLTVA1 – HGC M1278) (Figure 2.2)

1) Accommodates mounting crew served weapons (machine gun and grenade machine guns)

2) Four-door configurations

(Slide #7)

Figure 2.3 Close Combat Weapons Carrier

c) Close Combat Weapon Carrier (CCWC) (JLTVA1 – CCWC M1281) (Figure 2.3)

1) Base platform vehicle that has a closed combat weapons cargo bed

2) Accommodates the Tube-launched, optically-tracked, wire commanded data link, guided missile Improve Target Acquisition system (TOW – ITAS), and direct fire kinetic weapons

3) Four-door configurations

Figure 2.4 Utility

d) Utility (UTL) (JLTVA1-UTL M1279) (Figure 2.4)

1) Base platform vehicle that carries cargo on an open bed

2) As a prime mover, this vehicle has the capability to tow existing combat loads including 105 mm howitzers and Q-36 radars. Other towed loads typically moved by light tactical vehicles.

3) Can be outfitted with existing standard shelters required for maintenance, communications, etc.

4) Two-door configuration

Instructor Note

Some trucks have Contractor Furnished Equipment (CFE) kits attached to them. Show students Work Package (WP) 2 and briefly discuss.

Discuss the Operational, Tie Down Height, and Loading Height dimensions along with the Curb Weight and the Gross Vehicle Weight Rating of the JLTVA1 mission configurations.

(Slides #8-13) Inform students that the following slides have information important to them to use as a reference. Do NOT go through the information in great detail.

(Slide #8)

b. Dimensions, Heights, and Clearances

Figure 2.5 JLTVA1 Models

1. Operational dimensions (Figure 2.5)

    a) There are some differences in dimensions between the mission configurations of the JLTVA1. Reference the chart below.

Operational Dimensions

Vehicle	Length	Width	Height	Clearance	Wheel Base
GP M1280	211.3 in.	95.3 in.	128.5 in.	16.2 in.	130 in.
HGC M1278	211.3 in.	95.3 in.	128.5 in.	16.2 in.	130 in.
CCWC M1281	211.3 in.	95.3 in.	126.1 in.	16.2 in.	130 in.
UTL M1279	217.7 in.	95.3 in.	121.8 in.	16.2 in.	145 in.

(Slide #9)

2. Tie-down height

   a) There are some differences in height and clearance between JLTVA1 models. Reference the chart below to identify tie-down heights with lock out suspension braces.

Instructor Note
Explain to students that the chart below displays Tie-Down height measurements with lock out braces installed. Be sure to inform students that the clearance without lock out braces is much lower to the ground.

Tie-Down Height

Vehicle	Height	Clearance
GP M1280	86.5 in.	14.2 in.
HGC M1278	86.5 in.	14.2 in.
CCWC M1281	88.8 in.	14.2 in.
UTL M1279	88.7 in.	14.2 in.

(Slide #10)

3. Loading height

   a) There are some differences in height and clearance between JLTVA1 models. Reference the chart below to identify loading heights.

Loading Height

Vehicle	Height	Clearance
GP M1280	75.8 in.	3.8 in.
HGC M1278	75.8 in.	3.8 in.
CCWC M1281	75.8 in.	3.8 in.
UTL M1279	75.8 in.	3.6 in.

(Slide #11)

4. Curb weight

a) There are some differences in curb weight between the JLTVA1 variants. Reference the chart below to identify weights.

Curb Weight

Vehicle	Front Axle	Rear Axle	Total
GP M1280	7,189 lb.	6,241 lb.	13,430 lb.
HGC M1278	7,189 lb.	6,241 lb.	13,430 lb.
CCWC M1281	7,181 lb.	6,649 lb.	13,830 lb.
Utility M1279	7,624 lb.	5,996 lb.	13,620 lb.

(Slide #12)

5. Gross vehicle weight rating

a) Reference the chart below to identify gross vehicle weight.

Gross Vehicle Weight Rating

Vehicle	Front Axle	Rear Axle	Total
GP M1280	11,900 lb.	12,800 lb.	22,500 lb.
HGC M1278	11,900 lb.	12,800 lb.	22,500 lb.
CCWC M1281	11,900 lb.	12,800 lb.	22,500 lb.
Utility M1279	11,900 lb.	12,800 lb.	22,500 lb.

(Slide #13)

Instructor Note

Use the chart shown (Transmission Gear Ratios and Vehicle MPH) as a reference for students. Do not instruct using the details outlined on the chart.

c. Capabilities

1. Acceleration

a) The JLTVA1 can go from 0-30 mph in 7.4 seconds.

b) It can reach 0-50 in 18.3 seconds.

2. Range. The maximum range of the JLTVA1 is 300 miles at 35 mph at gross vehicle weight (GVW).

3. Top speed

a) Top speed of the JLTVA1 under normal conditions is 76 mph. The chart below lists the transmission/transaxle gear ratio.

Transmission Gear Ratios and Vehicle MPH

Gear	Ratio	MPH (km/h) with Transaxle in Low Range	MPH (km/h) with Transaxle in High Range
First	3.51:1	0.0 to 7.1 mph (0.0 to 11.4 km/h)	0.0 to 12.6 mph (0.0 to 20.3 km/h)
Second	1.90:1	7.1 to 15.7 mph (12.2 to 25.3 km/h)	12.6 to 28.0 mph (20.3 to 45.1 km/h)
Third	1.44:1	15.7 to 20.7 mph (25.3 to 33.3 km/h)	28.0 to 36.9 mph (45.1 to 59.4 km/h)
Fourth	1.00:1	20.7 to 29.8 mph (33.3 to 48.0 km/h)	36.9 to 53.1 mph (59.4 to 85.4 km/h)
Fifth	0.74:1	29.8 to 40.4 mph (48.0 to 65.0 km/h)	53.1 to 72.1 mph (85.4 to 116.0 km/h)
Sixth	0.64:1	40.4 to 47.4 mph (65.0 to 76.3 km/h)	72.1 to 76.0 mph (116.0 to 122.3 km/h)
Reverse	5.09:1	0.0 to 6.0 mph (0.0 to 9.7 km/h)	0.0 to 10.7 mph (0.0 to 17.2 km/h)

(Slide #14)

4. Payload

   a) The payload of the GP, HGC, and CCWC is 3,500 lbs. and 3,000 lbs. with the Gunners Protection Kit (GPK) installed.

   b) The payload of the UTL is 5,100 lbs.

(Slide #15)

Figure 2.6 Turn Radius Example

5. Turning radius (Figure 2.6)

   a) The Utility has a turning radius of 27 ft.

   b) The turning radius for the GP, CCWC and the HGC is 25 ft.

(Slide #16)

Figure 2.7 Clockwise from top left- side slope, 40% grade, 60% grade, and fording (shown with fording kit)

6. Performance

   a) The JLTVA1 is capable of lane changes at 53 mph.

   b) The JLTVA1 can negotiate a 40% side slope. It is capable of negotiating a 40% grade at 8 mph and a 60% grade at 6 mph. (Figure 2.7)

7. Fording depth

   a) 30” without kit

   b) 60” with kit

Check on Learning

(Slide #17-18)

Q: What are the differences between the JLTVA1 General Purpose and the JLTVA1 Utility?
A: The General-Purpose variant is a little taller, shorter and has four doors and less storage than the Utility. Whereas the Utility has 2 doors and a bed/cargo area behind the capsule.

Q: What is the maximum range of the JLTVA1 at 35 mph?
A: 300 miles (at GVW)

Q: What is the maximum fording depth the JLTVA1 is capable of without a kit?
A: Fording depth without a kit is 30 inches (60 inches with a kit).

Q: What is the top speed for the JLTVA1 in high range?
A: Maximum speed is 72-76 mph in top gear/high range.

Summary	**(Slide #19)** The JLTVA1 family of vehicles is ultimately comprised of four vehicle mission configurations (GP, HGC, CCWC, & UTL). Dimensions, heights, and clearances will vary between configurations, but all have a maximum GVWR of 22,500 lbs. The JLTVA1 has impressive performance capabilities. Being familiar with these capabilities will allow the warfighter to operate this vehicle safely within its design parameters.
Transition	Any questions? Let's do a little practical application to help reinforce what you've learned.
2.	**(Slide # 20)** ELO A – LSA 2 Learning Step/Activity: JLTVA1 Characteristics, Capabilities, Performance and Major Components Method of Instruction: Practical Exercise Instructor to student ratio: 1:5 Time of instruction: 10 min Media Type: None **(Slide #21)** See Appendix C: PE 2A-1 **Instructor Note** 1. Inform students to go to Appendix C and complete the Practical Exercise Sheet No. 2A-1 Solutions sheet. 2. Allow up to five minutes for students to complete worksheet. 3. Provide students with the correct answer from instructor's sheet: Practical Exercise Sheet No. 2A. 4. Students to correct their papers and record correct answers if needed. This group activity serves as the Check on Learning and Review for the Characteristics, Capabilities and Major Components learning step.
Check on Learning	None
Summary	None
Transition	The JLTVA1 has impressive performance capabilities. Being familiar with these capabilities will allow the warfighter to operate this vehicle safely within its design parameters. Our next learning step is to explore the exterior components and features, for that we'll use a video.

3. **(Slide #22)**

ELO A – LSA 3

Learning Step/Activity:	JLTVA1 Vehicle Familiarization Exterior
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	30 min
Media Type:	Video

Note

The following components were covered in the Exterior Vehicle Familiarization video. You may use the bullets below to take notes if you desire.

(Slide #23)

Instructor Note

Play the video: Exterior Vehicle Familiarization. Video has audio and is approximately 10 minutes long.

a. Front of JLTVA1

1. Tow eyes. They are used for towing the vehicle and tie down points.

2. Inter-vehicular connector

   a) The front of the vehicle is equipped with a 24 VDC (Volts Direct Current) inter-vehicular connector.

   b) Supplies power to the truck if towed.

3. NATO slave receptacle

   a) Used to jump-start the vehicle in the event of a dead battery.

   b) It is a 24 VDC system so ensure the vehicle you are jumping is also a 24 VDC system.

4. Glad hands

   a) The front glad hands supply air to the vehicle if towing and the air system is operational.

   b) The red is for emergency and the blue is for service.

5. Battery

   a) The battery supplies power for the vehicle to start.

   b) The access panel drops down the battery tray for servicing during its required intervals.

c) The two batteries are Optima sealed absorbed glass matte (AGM) supplying 25.6 VDC at 800 CCA (Cold Cranking Amps) when fully charged.

Figure 2.8 Cooling package

6. Cooling package. Located at front of truck (Figure 2.8) consists of:

   a) Transmission oil cooler (oil-to-air)

   b) AC condenser

   c) Air system cooler

   d) Charge air cooler

   e) Engine radiator

   f) Transmission cooler (air-to-water)

   g) Fuel cooler

   h) Hydraulic cooler

7. Hood

   a) Ultralight fiberglass hood with two rubber retaining straps for easy engine access.

   b) Hood is equipped with a hood prop to ensure hood does not blow down on operator if under the hood.

   c) Personnel should not stand on hood.

8. Lighting

    a) Headlights

    b) Marker lights

    c) Composite lights

    d) Blackout lights

9. Bumper

    a) No bumper on standard JLTVA1.

    b) If combat bumper is installed, it gives the vehicle the capability to push vehicles up to 6,000 lbs. out of the way.

Figure 2.9 Winch kit

10. Winch

    a) Rated for 18,000 lbs. (8,165 kg).

    b) Can be used as tow bar if kits are installed. (Figure 2.9)

    c) Kit options may limit bumper options on the vehicle.

b. Exterior Components Left

1. Air cleaner. The air filter for the engine is located on the left side of the truck.

2. Mirrors

    a) Electronically adjustable with control inside of the cab.

    b) Found on both sides of vehicle.

3. Doors

    a) The vehicle has carriage doors for front and rear protection.

    b) The JLTVA1 has tactical opening doors for easy egress and ingress.

c) Dependent upon individual strength, increased force may be required to open door. Use whatever means necessary to use (i.e. legs) to aid operations.

d) Always ensure the doors are combat locked whenever operating the vehicle.

e) Do not close both doors at the same time.

4. Ballistic windows. Windows are made of ballistic glass for crew protection.

5. Deice elements. Deice elements are only found in the windshield (not at side windows).

6. Step. There is a step to aid getting in/out of the vehicle safely.

7. Tires. The vehicle is equipped with 365/80 R20 Michelin XZL tires.

8. CTIS wheel valves

   a) These valves are a regulatory mechanism that manages inlet and outlet of air on all four tires.

   b) CTIS functionality is automatic as well as upon command. The JLTVA1 features a Communication Network controlled CTIS system controlling a Mechatronic Control Unit (MCU). (CTIS and MCU details provided later in training)

9. C4ISR vents

   a) These vents are found on the Utility variant.

   b) They are used to ensure clean air is brought into cool Command Control Computer Communication Intelligence Surveillance Reconnaissance (C4ISR) power distribution.

   c) The vents should be covered when fording.

   d) There are five vents found on the Utility variant located on both sides of the truck.

   e) Fans shut off in fording mode.

10. Stowage compartments

    a) The stowage compartments allow for securing:

       1) Basic issue items (BII)

       2) Components of end item (COEI)

c. Rear of JLTVA1

Figure 2.10 JLTVA1 rear lighting and camera

1. Cargo body
2. Tie-downs
   a) Used for holding down payload stored in cargo compartment.
   b) Do not use chain binders to secure loads.
3. Cargo cover
4. Tailgate
   a) Has two latches that must be opened to drop tailgate down.
   b) Removable on the Utility variant.
5. Rear lighting (Figure 2.10)
   a) Taillight
   b) Blackout light
   c) Reverse light
6. Rear camera (Figure 2.10)
   a) Assists with visibility behind the vehicle.
   b) Displays on the DSDU monitor.

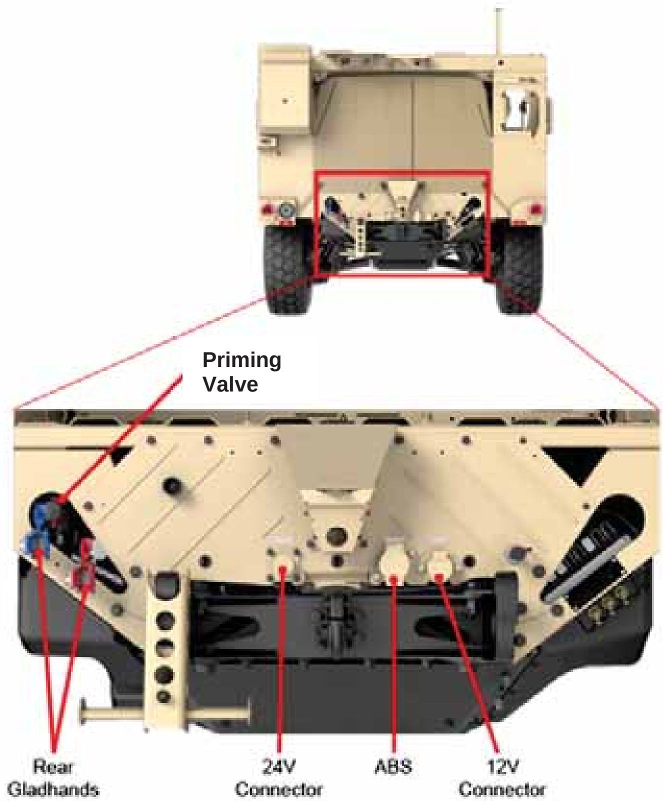


Figure 2.11 Rear components

7. Priming valve. Used to prime fuel system if the JLTVA1 runs out of fuel. (Figure 2.11)

8. Rear glad hands (Figure 2.11)

   a) The rear glad hands supply air to a towed JLTVA1 or trailer if the air system is operational.

   b) Blue is service.

   c) Red is emergency.

9. 24 VDC inter-vehicular connector

   a) 24-volt is used for towing a trailer but requires ABS connector.

10. Pintle hook. The pintle hook is used for towing a trailer or disabled vehicle.

11. ABS connector. Only when utilizing a 24V connector.

12. 12 VDC inter-vehicular connector

   a) 12-volt is used when connecting to the trailer.

   b) ABS connector is not required for 12 VDC connector.

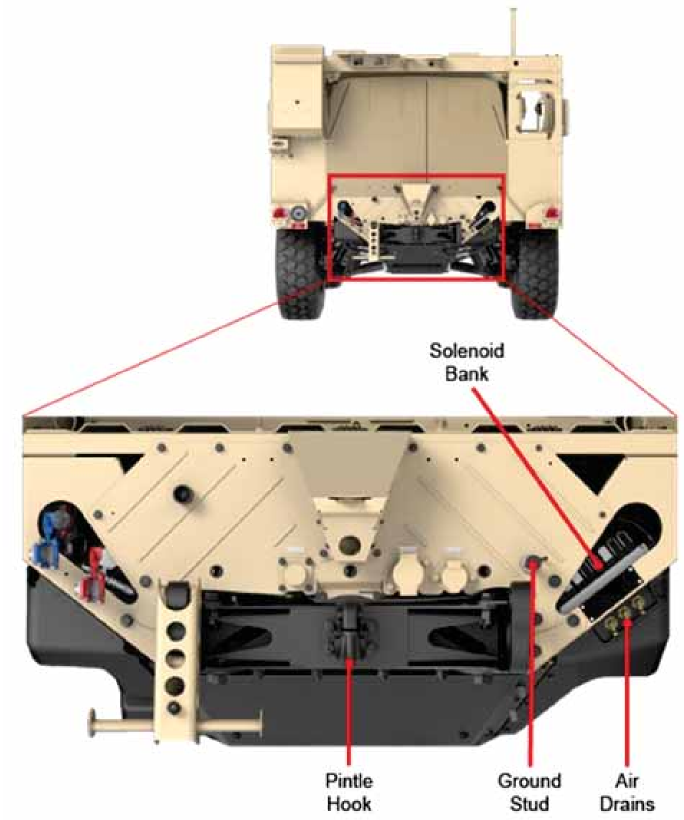


Figure 2.12 Rear components cont.

13. Grounding stud (Figure 2.12)

14. Solenoid bank

    a) Used to manually override different parts of the driveline.

    b) The only solenoids to be used for towing are the R1, T2 and T3.

15. Air drain

    a) Located on right side of truck, underneath solenoid bank.

    b) Used for draining air from air tanks once vehicle operations are complete.

d. Exterior Components Right

1. Fuel tank (35.5 gallons)

2. Stowage

Figure 2.13 Monocoque capsule

3. Capsule

    a) Monocoque (single shell) design for increased safety. (Figure 2.13)

    b) Welded nuts for armor plate mounting.

4. Exhaust. Do not operate engine in enclosed area without proper ventilation.

(Slide #24)

e. Major Components

Figure 2.14 A1 Engine

1. Engine (Figure 2.14)

    a) The engine in the JLTVA1 is the Banks 866T with turbo charged engine.

    b) The engine is a 6.6 liter with 340 HP at 3100 RPM. It produces 660 ft-lb of torque at 1600 RPM.

Figure 2.15 Transmission

2. Transmission (Figure 2.15)

   a) The transmission used in the JLTVA1 is an Allison 2500 Special Purpose (SP).

   b) This model of transmission is a 6-speed automatic.

   c) When the Central Tire Inflation System (CTIS) is not in highway (HWY) setting, the transmission is limited to fourth gear.

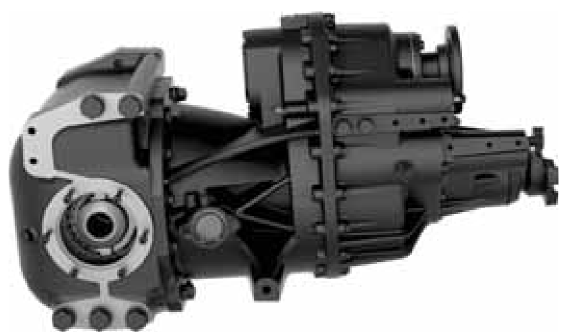


Figure 2.16 Transaxle

3. Transaxle (Figure 2.16)

   a) The transaxle receives power from the transmission and transfers it to the front and rear wheels. This provides all-wheel operation in both high and low ranges. The transaxle used in the JLTVA1 is an Oshkosh two-speed design.

      1) High reduction – 1.65

      2) Low reduction – 2.95

      3) Differential gear ratio – 2.2:1

      4) Power split – 50/50 split

(Slide #25)

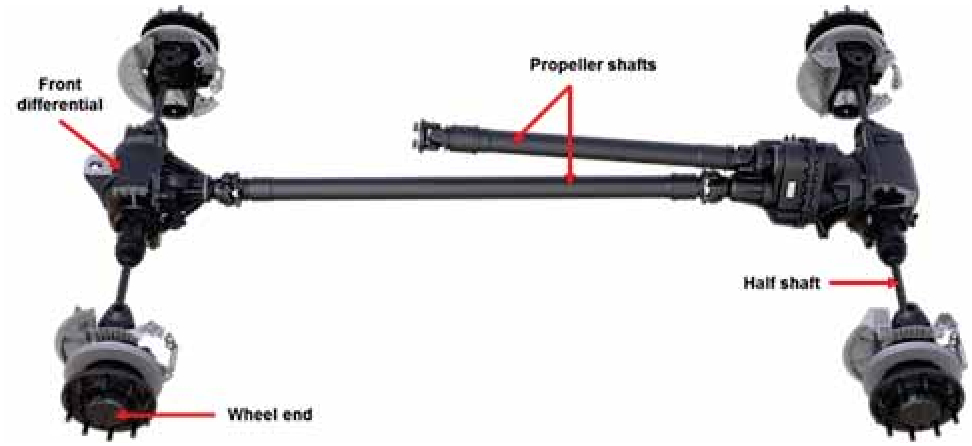


Figure 2.17 Shafts and axles

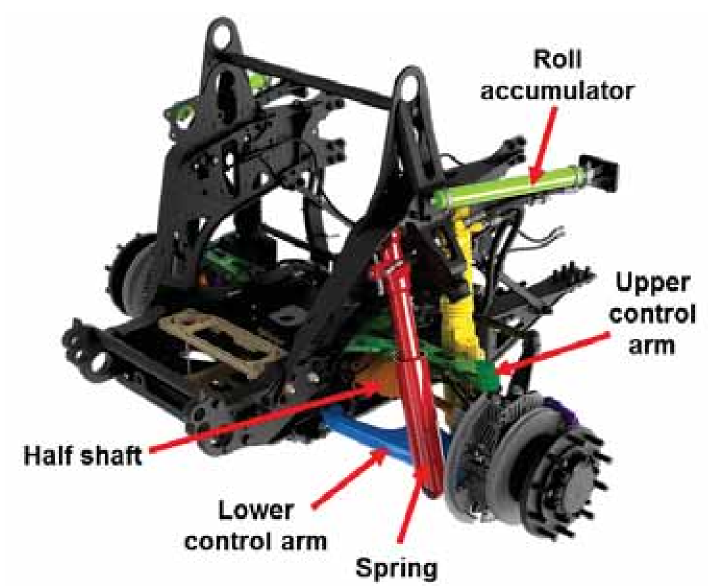
4. Propeller Shafts (Figure 2.17)

    a) The JLTVA1 has two drive axles. They are composite shafts with aluminum ends.

5. Half shafts and axles

    a) From the differential and transaxle, the vehicle uses half-shafts to account for angles produced by suspension movement.

(Slide #26)



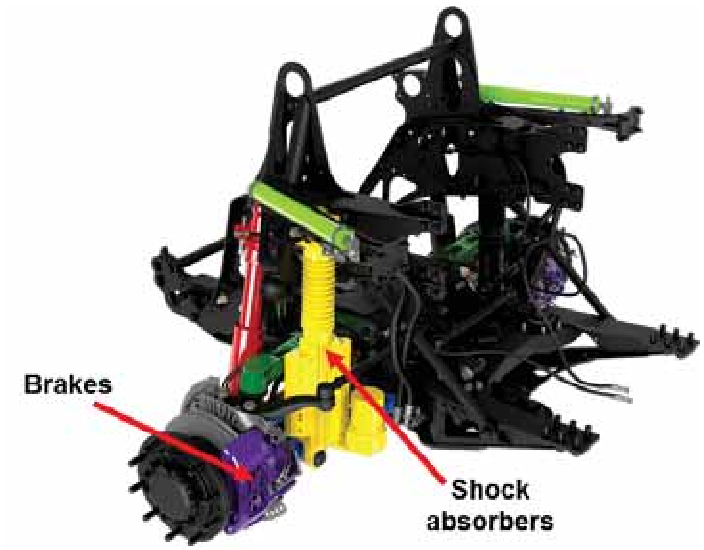


Figure 2.18 Suspension and Brake Components

6. High Pressure Gas Suspension

   a) The suspension used in the JLTVA1 is an Oshkosh TAK-4i Intelligent Suspension.

   b) The suspension is capable of 20 inches of total travel, 12 inches jounce and 8 inches rebound.

   c) The suspension system is designed to maximize traction, ride quality, and fuel efficiency.

   d) It will adjust pressure in the suspension to correspond to the suspension system setting selected by the operator.

   e) Components (Figure 2.18)

      1) Roll accumulator

      2) Half shaft

      3) Lower control arm

      4) Spring

      5) Upper control arm

      6) Shock absorbers

   f) The suspension system has six settings. The Driver Smart Display Unit (DSDU) is discussed later in this lesson.

      1) Fording Multiplexed (MUX) Switch panel

      2) Operational (DSDU)

3) Tie Down (DSDU)

4) Loading (DSDU)

5) Manual (Maintenance Mode only) (DSDU)

6) Suspension Aided Egress System (SAES) (DSDU) when parking brake is set, and vehicle is in neutral.

Warning

Do not exit vehicle when suspension is being adjusted. Severing, smashing, and crushing of body parts can occur if caught between door and cab. Remain in vehicle until suspension operation has concluded. Failure to comply may result in injury or death to personnel.

g) These settings may take up to 5 minutes to adjust; typically, the suspension adjustment is completed in less than 1 minute.

1) The engine RPM increase will slowly ramp up to approximately 1550 RPM if the transmission is in neutral and the parking brake is applied. If either the transmission is shifted out of neutral or the service brake is applied during an adjustment, the engine speed will return to normal idle speed. When adjustment selection is aborted, by either the abort selection in the DSDU or by releasing the brake or putting it in gear, the vehicle will be limited to 10 mph.

7. Brakes (Figure 2.18)

a) The vehicle is equipped with ABS (antilock braking system)

1) Service brakes use air over hydraulic with four independent disc brakes

2) Each service brake has its own hydraulic reservoir

b) The parking brake has its own reservoir and integrated heater

8. Center channel

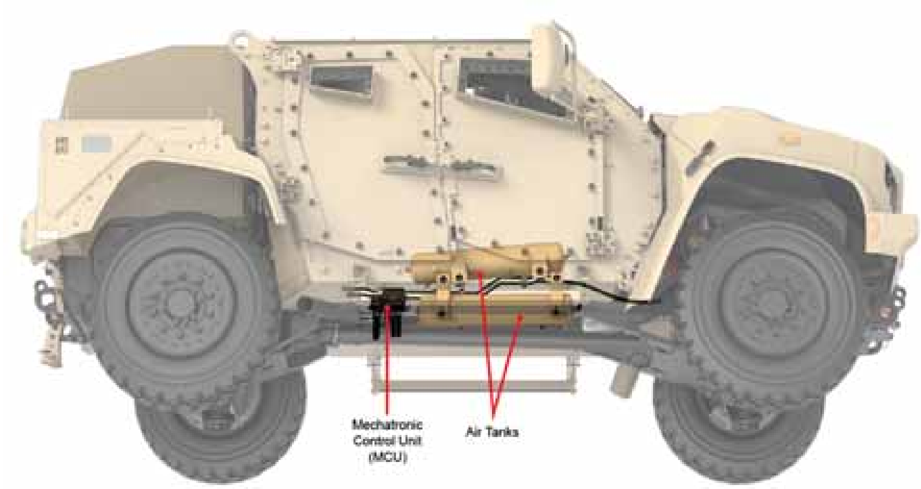


Figure 2.19 MCU and air tanks

a) Air tanks (Figure 2.19)

b) MCU (Figure 2.19)

1) Functions similar to pneumatic control unit (PCU) on other tactical vehicles.

2) Activates inflation/deflation of tires.

3) JLTVA1 unique in that the MCU can inflate/deflate each tire separately, instead of only front or back tires activated by a PCU.

4) Safeties are built into system to help prevent damage by running under inflated tires at speeds too fast for those conditions.

Check on Learning

(Slide #27)

Q: Where are the deice elements located on the JLTVA1?
A: In the windshield only.

Q: What is stored in the storage compartments?
A: BII/COEI

Q: Where are the auxiliary/C4ISR (Communication Package) batteries located?
A: At the rear of the vehicle on one of the sides depending on the variant.

Summary

(Slide #28)

You have been introduced to the exterior of the vehicle; the front, left, rear and right exterior components.

The JLTVA1 has many new features unique to the vehicle such as:
The Mechatronic Control Unit (MCU) is similar in function to the Pneumatic Control

	Unit (PCU) on other tactical vehicles. It activates inflation/deflation of tires. The capsule is a monocoque (single shell) design with welded nuts for adding armor plates. Ensure you are familiar with the exterior features of the vehicle, so you avoid injury to personnel or damage to the vehicle. The JLTVA1 is an impressive vehicle requiring each of the exterior components to be well maintained in order to be fully mission capable.
Transition	Any questions? If not, we're going to the next learning step which is to go identify the critical components and system on the truck.

4. **(Slide #29)**

ELO A – LSA 4

Learning Step/Activity:	Exterior Vehicle Familiarization Component ID
Method of Instruction:	Practical Exercise
Instructor to student ratio:	1:5
Time of instruction:	1 hr
Media Type:	None

(Slide #30)

See Appendix C: PE 2B-1

Students are to complete a worksheet to confirm ability to identify parts and answer instructor questions correctly.

> **Instructor Note**
> Go to classroom for Check on Learning, Summary and Interior Familiarization Video.

Check on Learning	None
Summary	None
Transition	Any Questions? Our next learning objective is to go inside the vehicle and get familiar with all the components, controls and electronic units. For this, we'll watch several short videos; again, feel free to jot down notes in your student guide as the videos are playing. Afterwards, we'll go back outside to the truck.

Enabling Learning Objective B.	**(Slide #31)**

Upon completion of this lesson, you will be able to:

Action:	Operate the JLTVA1 controls located within the capsule, including the DSDU
Conditions:	Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials
Standards:	Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity.

1. **(Slide #32)**

ELO B – LSA 1

Learning Step/Activity:	JLTVA1 Vehicle Familiarization Interior
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	30 mins
Media Type:	Video

(Slide #33)

Instructor Note
Play the video: Interior Vehicle Familiarization (Interior Controls & Indicators 1). Video has audio and is approximately 4 minutes and 16 seconds long.

Note
Controls of the JLTVA1 include analog switches, multiplex (MUX) switches, MUX panels, and DSDU (Driver's Smart Display Unit) Controls

Figure 2.20 Battery disconnect switch panel

(Slide #34)

a. Battery Disconnect Panel (Figure 2.20)

1. Vehicle battery disconnect switch

a) Located on bottom left side of the dash

b) Two-position switch

1) When in down position, batteries are disconnected from the vehicle

2) When in up position, battery power is supplied to the vehicle systems.

c) Green LED indicator

1) Located on the battery disconnect switch.

2) Solid light: The indicator will illuminate when power is supplied to the vehicle.

3) Flashing light: If low voltage is detected (below 24.2 VDC) on the JLTVA1, the green LED will flash for five minutes to indicate there is a low voltage condition.

2. Auxiliary battery switch

a) Two-position switch

b) When in the down position, the auxiliary batteries are disconnected.

3. Combiner switch

a) Three-position switch

1) Up position links auxiliary batteries to vehicle batteries

2) Down position is used to immediately disconnect auxiliary batteries from 24V vehicle batteries

3) Center position, its normal position, the combiner is in automatic mode which links auxiliary battery systems and vehicle battery systems together to charge when voltage is determined to be low on the auxiliary battery system

b. Ignition Switch Panel

Figure 2.21 Engine ignition switch and combat override switch

1. Ignition switch (Figure 2.21)

   a) Radial three-position switch: Off is the far-left position, the middle position requests power from electrical system, and the far-right position starts the vehicle

   b) Once the truck starts, the ignition switch will spring back to the ignition on position (middle position)

2. Combat override switch (Figure 2.21)

   a) For emergency or combat situations only.

   b) This switch will bypass all speed interlocks, system de-rates, and it ties batteries together for more amperage

   c) It also provides for an emergency bypass in the event of DSDU failure

   d) LED red light indicator illuminates steady red when the combat override switch has been turned on

Figure 2.22 Trailer air supply (left) and parking brake (right)

c. Parking Brake Panel (to the left of DSDU) (Figure 2.22)

1. Trailer air supply (red octagon) supplies air to out of the emergency (red) glad hand for air supply to a towed vehicle or trailer.

2. Parking brake switch (yellow square)

    a) Parking brake has a safety mechanism that must be released to release the parking brake (to ensure release is deliberate)

(Slide #35-36)

Instructor Note
Review content of previous video. Solicit questions as needed to ensure understanding. Play the video: Lighting and Systems MUX Panels (Interior Controls & Indicators 2). Video has audio and is approximately 5 minutes and 26 seconds long.

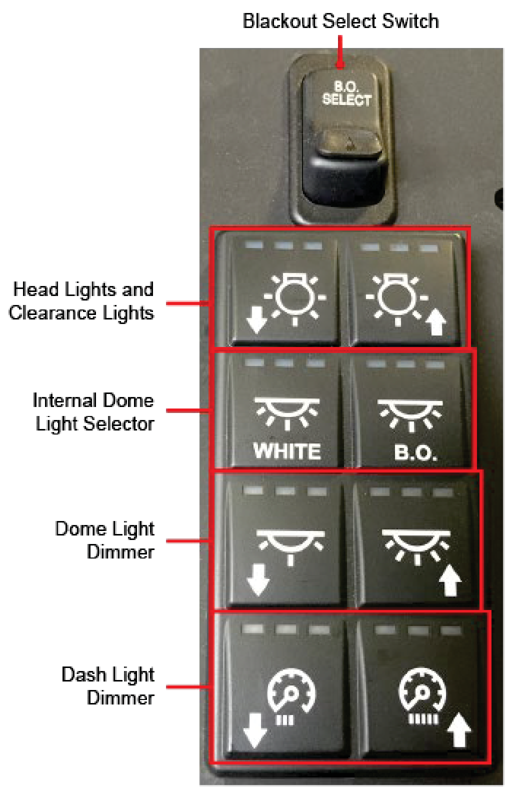


Figure 2.23 Lighting MUX panel

d. Lighting multiplexed switch panel (MUX) (Figure 2.23)

1. Located just above the battery disconnect switch panel is the lighting MUX panel.

2. Panel is the control for all lighting on the truck.

3. **Must hold one second to activate**. To turn these MUX switches on or off, the operator must deliberately push the button for it to activate. If the button is tapped for less than one second, the selection may not register to the system (designed to avoid inadvertent bumps or taps changing the lighting settings)

4. Dash dimmer switches

    a) Allows the Operator to adjust the backlighting on the dash.

    b) The left button decreases brightness, and the right button increases brightness.

5. Dome light dimmer

    a) Adjusts the brightness of the dome lights.

    b) The left button decreases brightness, and the right button increases brightness.

6. Internal dome light selector

    a) Select either the white light option (left) or blackout light option (right)

7. Headlights and clearance lights

    a) When the right switch is depressed, the clearance lights are turned on.

    b) When the switch is depressed a second time, the headlights turn on.

    c) The left switch will turn the lights off, headlights for the first depression, clearance lights with the second depression.

    d) These same switches are used for blackout service and drive lights when the blackout switch is activated

8. Black out select switch

    a) Located at top of lighting panel (left side of the dash)

    b) An analog switch that will turn off:

        1) Internal: all warning icons, gauge backgrounds, and LCD illumination on the dash

        2) External: all external lighting and sound.

Figure 2.24 Systems control multiplexed switch panel

e. Systems Control Multiplexed Switch Panel (Figure 2.24)

1. Fording mode switch

   a) Located on the top left side of the MUX panel

   b) This button raises the truck to fording position which allows the truck to ford water up to 30 inches without the fording kit or 60 inches with the fording kit

   c) This brings the truck differentials from approximately 16 inches from the ground to the bottom of the differential to about 22 inches

   d) Fording mode will limit maximum speed to 10 mph

   e) If the fording function is aborted for any reason, the truck will remain limited to 10 mph until it reaches operational height on its own

2. CTIS OFF switch

   a) Located next to the fording mode switch

   b) This switch will shut off the CTIS air system

   c) CTIS is off, but all the speed interlocks will still be in place, all the driveline locks will still be applied, the system will not adjust tire pressure.

   d) Use in cold environments or when there is extensive tire damage and the operator desires to protect the air system

3. Transaxle HI/LO

   a) Located just to the right of the CTIS off selection is the transaxle (T-axle) high/low selection

   b) Selection changes the ratio of the output of the transaxle

      1) Transaxle high will be used for normal operation

2) Transaxle low is used in any circumstance where additional torque is desired such as extreme muddy conditions, extreme up slopes or if the transmission defaults to too high of a gear

4. Axle locks: Lock up button/lock down button

   a) Located on the top and bottom half of the MUX panel on right hand side

   b) They are up and down arrows. The top button applies driveline locks; the bottom button removes the driveline locks

      1) The first time the up-selector button is pushed, the front and rear drive axles from the transaxle will lock together

      2) The second time the selector button is pushed the rear axles will lock side to side

      3) The third time the button is selected the front axles will lock side to side; this is considered full lock up

5. High idle

   a) Located just to the right of the engine exhaust brake switch

   b) High idle increases engine speed up to 1800 RPM

   c) This should be used whenever idling for more than 5 minutes or when operating in extreme cold conditions

6. Engine exhaust brake

   a) Located next to the deicer switch

   b) When selected, the engine exhaust brake will provide additional stopping power to assist in braking when necessary

7. Deicer

   a) Located on the bottom left side of the MUX panel

   b) The deice selection should only be used when there is physical ice on the windows

   c) Only works on the windshield

   d) Times out after 15 minutes of use

(Slide #37-38)

Instructor Note
Review content of previous video. Solicit questions as needed to ensure understanding. Play the video: Indicators and Gauges (Interior Controls & Indicators 3). Video has audio and is approximately 7 minutes and 31 seconds long.

Figure 2.25 Indicators on left side of dash

f. Indicators - Left Dash (Figure 2.25)

1. Left turn indicator: Blinks green when left turn is selected with the stalk. It also blinks with the right turn signal when the hazards are selected.

2. Wait to start: Illuminates steady amber while glow plugs are cycling.

3. Low voltage detection: Illuminates steady red when vehicle voltage drops below 24.2 VDC.

4. Engine fan disable indicator: Illuminates steady amber when engine fans are disabled.

5. Low oil level: Audible alarm will sound, and steady amber indicator illuminates when oil is low

6. High beam indicator: Illuminates steady blue when high beams are selected.

7. Driveline locks: Indicators illuminate steady green when driveline locks are applied. From left to right the lights are lock level 1 (inter-axle lockup), axle lock 2 (adds rear intra-axle lockup), axle lock 3 (adds front intra-axle lockup)

8. High idle: Illuminates steady green when high idle is selected.

9. Charging system indicator: Illuminates steady red when there is a charging system fault.

10. Low coolant indicator: Illuminates amber when coolant level is below safe operating level.

11. Combat override indicator: Illuminates steady red when the switch has been engaged.

Figure 2.26 Indicators on right side of dash

g. Indicators - Right Side of Dash (Figure 2.26)

1. Parking brake indictor: Illuminates steady red when parking brake is applied.

2. Range inhibit: Illuminates when transmission cannot be shifted.

3. Trailer ABS: Illuminates when trailer ABS has an ABS fault or is inoperable.

4. Tractor ABS: Illuminates steady amber when there is an ABS fault, or a loss of communication from the ABS controller. Will blink steady when in off road mode (CTIS settings other than highway).

5. Right turn indicator: Blinks green when right turns are selected on the stalk. This indicator will also flash green with the left turn indicator when hazards are selected.

6. CTIS over speed: Illuminates steady amber when the vehicle exceeds speeds programed in the CTIS controller.

7. CTIS fault: Illuminates steady amber when the CTIS has a fault.

8. Suspension error: Illuminates steady amber when there is a suspension error.

9. Brake failure indicator: Not used on this vehicle (looks like red exclamation point in a red circle)

10. Electronic Stability Control (ESC) Off: ESC Off indicator will illuminate steady amber when the ESC is disabled or when there is a system fault.

11. ESC Active (looks like swerving car): ESC Active indicator will flash amber when it is actively controlling the vehicle and will illuminate steady amber when the ESC is disabled or when there is a system fault.

12. Suspension active: Illuminates steady amber when the suspension is actively adjusting.

13. Suspension not level

    a) Illuminates when the suspension is outside its expected range.

    b) Select operational ride height from the ride height adjust screen on the DSDU to remedy this.

    c) This is not a fault as changing conditions may cause this light to illuminate.

Figure 2.27 Left gauge cluster of dash

h. Left Gauge Cluster for Engine Performance (Figure 2.27)

1. Tachometer for engine RPM (Section A of Figure 2.27)

2. Coolant temperature indicator: Illuminates amber when coolant is above critical range (approximately 240° F)

3. Coolant temperature gauge (Section B of Figure 2.27)

4. Check engine indicator: Amber indicator illuminates when an engine fault occurs.

5. Oil pressure gauge measures oil pressure and PSI.

6. Low oil pressure indicator: Red indicator illuminates when oil pressure is below 10-psi for 5 seconds at engine RPM above 400 (Section C of Figure 2.27)

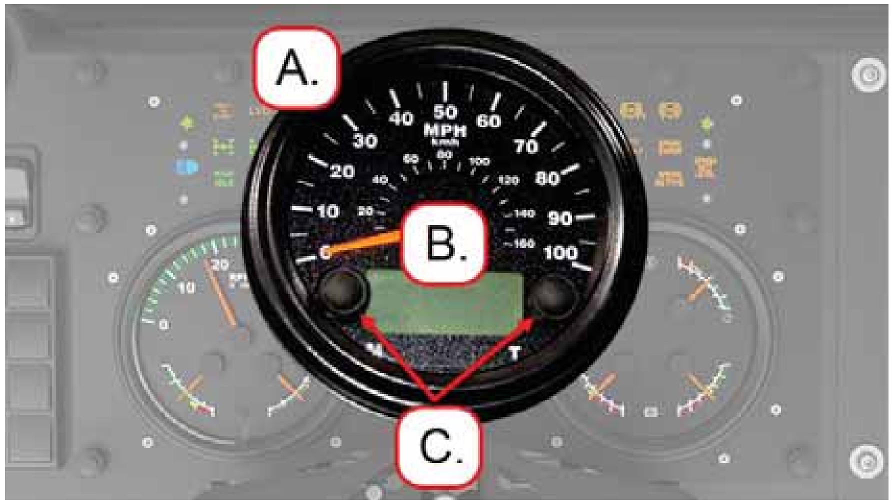


Figure 2.28 Center Gauge of Dash Cluster

i. Center Gauge Cluster (Figure 2.28)

1. Speedometer

   a) Located: Center gauge of three radial gauges in dash (Section A of Figure 2.28)

2. LCD screen (Section B of Figure 2.28)

3. LCD navigation buttons (Section C of Figure 2.28)

   a) M button on left of display

   b) T button on right of display

Figure 2.29 Right gauge cluster of dash

j. Right gauge cluster

1. Transmission indicator.

    a) Check transmission. Illuminates amber when transmission monitoring system indicates a fault.

    b) Icon is a dial (See Section A of Figure 2.29)

2. Transmission temperature gauge

3. Transmission temperature indicator. Illuminates amber when transmission temperature is above 325° F (See Section A of Figure 2.29)

4. Rear air pressure gauge /front air pressure gauge (See Section B of Figure 2.29)

5. Low air warning indicator: Illuminates red when air is below 70-psi (See Section B of Figure 2.29).

6. Low fuel indicator: Illuminates amber when fuel is at 1/8 tank (Section C of Figure 2.29)

7. Fuel level gauge (Section C of Figure 2.29)

(Slide #39-40)

Instructor Note

Review content of previous video. Solicit questions as needed to ensure understanding.

Play the video: Steering Column Controls, Mirror Controls, Transmission Shift Lever, HVAC, Driver Smart Display Unit (DSDU), Commander Smart Display Unit (CSDU), interior lights, AFES, and seats. Video has audio and is approximately 5 minutes and 10 seconds long.

Figure 2.30 Steering column

k. Steering Column (Figure 2.30)

1. Steering wheel

2. Horn

3. Stalk (high beams/turn signals/windshield wash)

Figure 2.31 Mirror adjustment controls

l. Mirror Adjustment Controls (Figure 2.31)

1. Joystick electronically controls the mirrors.

2. Turn the joystick to the side mirror you want to adjust (left or right) and then move the joystick up, down, left, right as needed for adjustment.

Figure 2.32 Transmission shift lever

m. Transmission Shift Lever (Figure 2.32)

1. The transmission shift lever is a stalk-style lever with a release button on the front of it.

2. It provides the operator with reverse, neutral, drive, 3rd, 2nd, and 1st. There is no diagnostic capability on the transmission shift selector.

Figure 2.33 HVAC controls

n. HVAC Controls (Figure 2.33)

1. The heating, ventilation, and air conditioning (HVAC) control panel is located just below the DSDU.

2. The controller has images for each function available.

3. On the left of the display is the fan speed control. The up arrow increases blower fan speed, the down lowers it.

4. To the right of the fan speed control is the auto fan selection. With this the operator can set the systems to the desired temperature.

5. Below the fan speed control is the power button, which turns the HVAC on and off.

6. In the middle of the display is the LED indicator. This reads temperature and selections as they are being completed by the operator.

7. Below the display is vent selection and the defog option.

8. To the right of the LED display is the A/C on button.

9. Just below that is the recirculation button.

10. To the far right of the unit are the temperature control buttons: the red up arrow increases cab temperature and the downward blue arrow decreases it.

Figure 2.34 DSDU (Showing default logon screen)

o. Driver Smart Display Unit (DSDU) (Figure 2.34)

1. The DSDU is a touch screen display unit that gives the operator capabilities to control CTIS, the suspension system, manage power distribution, monitor drive data, and check fluid and filter life among many other things.

2. The DSDU has access to information, fault codes and diagnostic information specific for maintainers only. To access that information, you must log-on into the DSDU using maintainer credentials.

3. Primary home/menu screens can be found in the DSDU Quick Reference Guide.

p. USB Ports (for keyboard only – will not charge electronics)

1. Found in the middle of the cab, are a series of plugs or receptacles. There are 12-volt, 24-volt, and 120-volt connectors available to the operator

2. The connector with the grey cover is used for maintenance diagnostics.

3. Also found near the screens in the truck are locations to plug in the keyboard.

4. Treat USB ports like a government computer, do not plug personal devices into them.

Figure 2.35 Map lights

q. Map lights (Figure 2.35)

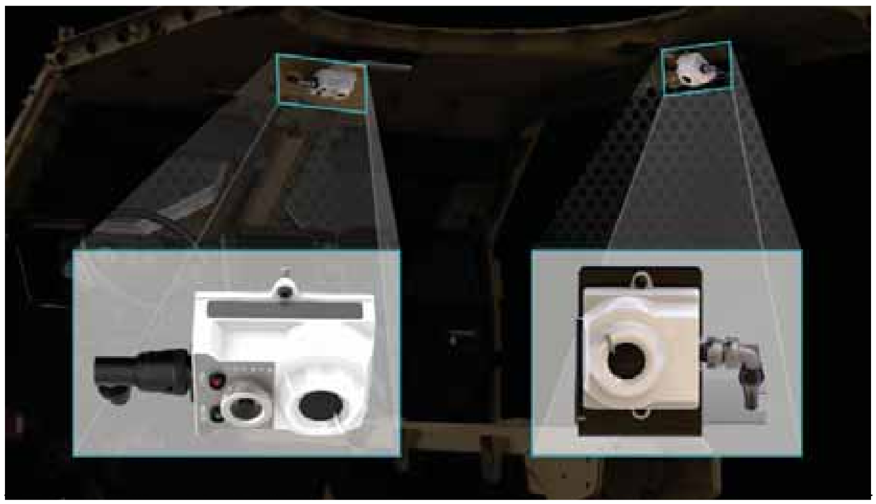


Figure 2.36 Automatic fire extinguishing system (AFES)

r. Automatic Fire Extinguishing System (AFES)

1. AFES has two optical sensors that monitor infrared (IR) and ultraviolet (UV) signatures within the capsule to determine fire suppression discharge

2. LED indicators: Monitor faults

3. Notify Field Maintenance if the AFES has been discharged

Figure 2.37 Commander’s Smart Display Unit

s. Commanders Smart Display Unit (CSDU) (Figure 2.37)

Figure 2.38 Seats and five-point harness/seatbelt

t. Five-Point Harness/Seatbelt (Figure 2.38)

1. The seats in the vehicle are equipped with five-point harnesses that adjust for height and length.

2. The seatbelt harness restraint is designed with quick release capability. The release is a rotational device that releases all the retaining straps at once.

u. Electronic Stability Control (ESC) Switch

1. The ESC switch is in front of the transmission gear shift.

2. ABS-based system that monitors vehicle pitch and roll as well as wheel speed. ESC can actuate an individual brake and reduce engine torque to correct yaw and roll instability.

Check on Learning	**(Slide #41)** **Q**: Where is the battery disconnect switch located, for powering the vehicle? **A**: On the dash, at the drivers left knee. **Q**: Where are the controls for all vehicle lighting functions? **A**: The lighting MUX panel **Q**: What is the function of the blackout switch? **A**: It disables normal exterior lighting and enables blackout lighting. **Q**: What is the function of the combat override switch? **A**: It disables all vehicle safety limitations and interlocks. **Q**: Where is the high idle switch, and what is the indicator it has been activated? **A**: The high idle button is just to the right of the engine exhaust brake, and an indicator illuminates steady green when high idle is selected.
Summary	**(Slide #42)** **Gauge clusters:** The left gauge cluster is the engine RPM, oil pressure, and engine temperature. In the middle is the speedometer with an LCD screen. The right is the fuel level, transmission temperature, front, and rear air tank pressures. There are colored bands to easily indicate safe operating levels, temperatures, and pressures. There are also LED's embedded in and around the gauges that will tell the operator when there is a fault, for example, over temperature, codes, or low pressures. **Battery disconnect:** The battery disconnect switch panel is on the bottom left-hand side of the dash. Depending on the package on the vehicle, there may be up to three switches available. Depending on the installed kit, the Combiner and Auxiliary battery switches may be available. **MUX panel:** MUX panels are unique as ***they do not work like a switch***. Upon pressing the button, **hold it down for approximately one second**. This is programmed into the MUX panel, so the operator does not accidentally turn on something they did not intend to when wearing gloves. **DSDU:** The Drivers Smart Display Unit is the communication to the Operator or Maintainer (depending on which role is logged into), communication from the J1939 – the brains of the vehicle.
Transition	Any questions? We're going to the next learning objective which focusses on operating the controls required to conduct maintenance and know your truck. Specifically, our objective is to, "safely operate the controls and indicators of the JLTVA1, gaining knowledge and familiarity about it so that you can pass the final exam and practical exercises.

2.	**(Slide #43)** ELO B – LSA 2 Learning Step/Activity: Interior Vehicle Familiarization Component ID Method of Instruction: Practical Exercise Instructor to student ratio: 1:5 Time of instruction: 60 min Media Type: None **(Slide #44)** See Appendix C: Practical Exercise Sheet JLTVA1 2C-1 **Instructor Note** Upon guiding each student through the Internal Vehicle Familiarization Checklist (PE) conduct the Check on Learning and Summary in the Bay/Outside as the next learning step is a hands-on the DSDU PE conducted on the truck.
Check on Learning	None
Summary	None
Transition	Are there any questions at all about the characteristics, capabilities, exterior or interior of the JLTVA1? Our next learning objective is to learn about the Driver Smart Display Unit (DSDU).
Enabling Learning Objective C.	**(Slide #45)** Upon completion of this lesson, you will be able to: Action: Operate the DSDU to maintenance screens required to service the JLTVA1 Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity.
1.	**(Slide #46)** ELO C – LSA 1 Learning Step/Activity: DSDU Overview Method of Instruction: Lecture Instructor to student ratio: 1:15 Time of instruction: 15 mins Media Type: None

Instructor Note

Use this slide to aid students with the transition across topics. The slide displays the topics (learning steps) that are included in this learning objective.

Instructor Note

Q&A interaction to help students understand the driver side display unit within the JLTVA1; helping students make an association to similar technology will aid increase training retention. Understanding and successfully using the DSDU is critical to maintain the JLTVA1.

Ask: How many of you either own a vehicle or have ridden in a vehicle that has a digital media screen in the center of the dash where the radio is traditionally located?

Answer: Almost all of you have encountered a media screen displaying information for the driver.

Ask: What type of information is available, or an option to be available on most citizen vehicles?

Answer: A lot of information is available!

- Just look at the music capabilities; Radio has at least three: AM, FM, and XM Digital Satellite radio.
- Eternal devices/Media: it lets you connect via Bluetooth to a cellular or mobile device or hard connect to the device with an auxiliary cord.
- GPS satellite Maps

- The display can show warnings too, right? Such as, “you cannot pair a mobile device while the vehicle is in motion.” Anybody seen that one?

Ask: How many of you have driven commercial trucks or emergency vehicles?

Ask: Can any of you tell me what additional technology is available in those types of vehicles?

Answer: Most commercial trucks and emergency vehicles have logistics monitoring software that records and has reports available regarding mileage, hours in use or in motion, speed, number of stops, braking, whether or not lights were in use, and several transmission outputs.

The DSDU in the JLTVA1 does all that and more.

(Slide #47)

a. Driver Smart Display Unit (DSDU) and Health Management System (HMS)

1. The Driver Smart Display Unit - DSDU is a human-to-machine interface which allows the operator and maintainer to interact with the vehicle for access to:

a) The ability to control certain vehicle functions, such as manual suspension leveling, suspension ride heights, CTIS settings, internal component pressure checks and more.

b) Health Management System Information - HMS is software that uses the DSDU to display health and status data on the following vehicle subsystems:

1) Engine

2) Transmission

3) ABS

4) Brake

5) Engine exhaust brake

6) CTIS

7) Instrument panel

8) Power generation and distribution management

c) Interactive diagnostics and first-level troubleshooting capabilities.

(Slide #48)

2. DSDU/HMS Sensor Strategy – It is important to understand the sensor strategy utilized for the HMS in the JLTVA1. The HMS strategy pertinent to maintainers is divided into three elements:

a) **Sensor Strategy** - Includes sensors that have been installed by Oshkosh Corporation for normal vehicle operation and/or diagnostic or prognostic purposes. There are two types of sensors:

1) Prognostic sensors - Predicts when a subsystem or component on the JLTVA1 will no longer perform its intended purpose; specifically filters, fluids and pumps. They are a preventative feature based off from engine hour and vehicle mile conversion calculations.

2) Diagnostic sensors – Relay fault notifications and also provide information regarding the current status of the vehicle's subsystem or component. Diagnostic sensors relay current state.

3) NOTE: Sensors which were pre-installed on systems, such as Commercial Off the Shelf (COTS), are NOT part of the JLTVA1 HMS sensor strategy; however, they still function and communicate as designed.

4) See Appendix D Table 1 for a list of the diagnostic and prognostic sensors designed into the JLTVA1 base vehicle.

b) **Fault Notification** – The DSDU displays faults to the operator and maintainer. Faults are broadcast from the J1939 Databus, stored in the DSDU and displayed on the gauge panel via indicator lights as well as displayed on the DSDU screen via symbols.

1) Faults are generated as a result of sensor communications from the vehicle subsystems which go through the diagnostics program integrated on the 3G Controller databus communication network.

2) NOTE: Fault alerts on the DSDU are interactive and guide the operator/maintainer to the appropriate screen.

3) Faults in the DSDU have two severity classifications: Warnings and Cautions (warnings are more severe and require immediate attention).

4) Faults on the dash are generally COTS but may also appear on the DSDU. See Appendix D Table 2 for list of JLTVA1 Dash Indicator Lights.

c) **Data Strategy** - Strategy for the collection and storage of fault, HMS, and Condition Based Maintenance (CBM) data only good for past 96 hours of operation, for the JLTVA1 vehicle control system.

1) This information is available via a report upon command.

2) See Appendix D Table 3 for a list of data elements available via the ABCD Export report.

(Slide #49)

b. Power-Up and Operate the DSDU

1. Starting UP DSDU - DSDU monitors ignition switch ON/OFF position. When ignition switch is initially turned on, DSDU will power up.

a) **Wait 60 seconds - DSDU is on a 60 second timer before it resets.**

b) If ignition switch is cycled off and back on before 60 seconds, then, it will not power up because it was interrupted, and resets for another 60 second cycle.

c) Hard Power Up - DSDU can be hard powered on by pressing PWR button for 3 seconds. Only use that method if absolutely necessary.

d) Hard Reboot - Battery disconnect switch and ignition switch need to be off until vehicle battery disconnect cycle is complete to perform a hard reset and restart of DSDU.

e) Automatic Power Off - Power will automatically shut off when vehicle senses voltage drop. If necessary, start engine (TM 9-2320-452-10) while navigating DSDU to prevent automatic power shut off.

NOTE: Remember to watch your battery voltage. The DSDU will power down if you are using it to retrieve information with the vehicle not operating.

(Slide #50)

2. Usability Interaction Options

   a) Keyboard is preferred method for data entry. If keyboard is not available, use virtual keyboard. Select Settings icon in lower left corner of log on screen. To connect the BII keyboard:

      1) Remove USB cap from USB port

      2) Retrieve keyboard from storage next to passenger seat

      3) Insert keyboard connector to USB port on DSDU (middle right side of DSDU)

      4) Press CTRL + ALT + DELETE keys on keyboard to open log on screen.

   b) Stylus is preferred method for on-screen selection of buttons. Use stylus attached to DSDU.

      1) It is a touchscreen; press selections with slight deliberate pressure (at least one second in duration to register selection). Some commands require the user to press and hold the selection until the command is complete.

   c) To access the touchscreen keyboard:

      1) Select Type without the keyboard (On-Screen Keyboard) check box on Ease of Access screen.

      2) Select OK on Ease of Access screen

Check on Learning

(Slide #51)

Q: What are the three key uses for the DSDU?
A:
(1) Check/Access information from vehicle systems (HMS information from sensors)
(2) Interactive diagnostics and first-level troubleshooting capabilities
(3) Control various system settings such as CTIS or suspension etc.

Q: You were informed of basics regarding the sensor strategy, what are the benefits to you as maintainers to know about that strategy?
A: The benefits of understanding the sensor strategy are:

- Knowing the JLTVA1 has technology to give fault notifications via the DSDU.
- It helps to understand system information displayed is dependent on the type of sensor (prognostic, Diagnostic or COTS)
- Understanding how fault codes are triggered (as a result of the HMS, diagnostics and communication to the databus network)

- Understanding there are two levels of fault codes: warnings and cautions and that warnings are more severe.

Summary **(Slide #52)**

The DSDU is a human-to-machine interface with multiple JLTVA1 systems.

It provides the ability to control certain vehicle functions and displays health status data on systems. The DSDU is integrated with the HMS which utilizes a sensor strategy to collect information and display it on the DSDU.

It displays faults to the operator and maintainer. Faults are broadcast from the J1939 Databus, stored in the DSDU and displayed on the gauge panel via indicator lights as well as displayed on the DSDU screen via symbols.

To use the DSDU you must turn on the ignition switch; Remember to wait 60 seconds and allow the systems to complete their start up processes.
The DSDU has touchscreen capabilities as well as a keyboard and stylus for data interaction.

Transition Now that we've covered the basics, high level functionality and purpose of the DSDU we will learn about the capability and information available to the Operator.

2. **(Slide #53)**

ELO C – LSA 2

Learning Step/Activity:	DSDU for Operator
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	10 mins
Media Type:	PPT

(Slide #54)

a. DSDU for Operator - Operator Role is the default setting when the DSDU powers up. The system was designed that way to enable the operator with immediate access to the system, so they can power up and use the truck as quickly as possible; maintainers must log off the Operator role to access maintainer information.

   1. Operators primarily use the main menu at the bottom of the DSDU display. That menu stays the same regardless of which role is logged in to use the DSDU

Figure 2.39 DSDU Home Screen

a) Home screen (Figure 2.39)

1) The home screen contains buttons used to check vehicle systems, access vehicle information (fluid levels, pressures, and temperatures), service screen (active codes), and powertrain selection (for monitoring the engine, transmission, and transaxle).

Figure 2.40 DSDU Drive Screen

b) Drive Screen (Figure 2.40)

1) The drive screen allows the operator to monitor vehicle drive information during operation.

2) Inclinometer - The INCLINOMETER button is available on the DRIVE screen. The inclinometer displays the vehicles pitch and roll angles.

3) It will also communicate to the driver when speed limiting is active or if there are any conditional faults.

Figure 2.41 DSDU CTIS Screen

c) CTIS screen (Figure 2.41)

1) Enables the driver to control tire pressures and driveline lock settings for optimum mobility from highway to soft soil conditions.

2) The DSDU provides a dedicated CTIS screen for adjusting the vehicle's load and terrain settings.

3) The DSDU gives commands to adjust wheel air pressures based on the Operator input for load selection and the terrain selection.

4) CTIS terrain selections available are:

(a) Highway

(b) Cross country

(c) Mud, sand and snow

(d) Emergency

Figure 2.42 DSDU Suspension Screen

d) Suspension screen (Figure 2.42)

1) The DSDU provides the commands and monitoring options for the suspension. The suspension screen displays the current suspension setting and a button to make ride height changes.

2) The “Ride Height Adjust” options available on the DSDU are:

(a) Operational - Normal ride height for the vehicle which provides the appropriate clearance for the vehicle at full operational speed. Interlocks are not applied in this suspension selection.

(b) Tie-down - Used to prepare the truck for transport on a flatbed or by rail. This lowers the suspension and limits the speed of the truck to 8-10 mph.

(c) Loading - Used for ship transport. Loading mode limits the vehicle speed to 8-10 mph. When the loading mode is selected, a prompt reminds to remove jounce bumpers and subsequent screens offer options to raise or lower the front or rear of the JLTVA1. There are four selections:

(1) Raise front suspension

(2) Lower front suspension

(3) Raise rear suspension

(4) Lower rear suspension

2. Primary Operator screens can be found in the DSDU Quick Reference Guide (flip card job aid).

Check on Learning	**(Slide #55)** **Q:** What are two vehicle system commands that are critical to changing settings for the JLTVA1 to navigate off road settings? **A:** CTIS and Suspension/Ride Height Adjustment **Q:** What are the four options available from the CTIS screen? **A:** Highway, Cross country, Mud, sand and snow and Emergency
Summary	**(Slide #56)** The DSDU default setting is for the Operator Role, upon powering up Operators are ready to roll. That's why maintainers must first log off the Operator role to access maintainer information. The DSDU display system status information to the Operator that is relevant to driving the JLTVA1 in various conditions or for other use such as loading or fording, operator level maintenance tasks, load shedding, power generation and position of the JLTVA1 with regards to terrain/slope. The DSDU also provides the Operator with making tactical vehicle command changes such as changing the pressure in the tires while on the move and changing the vehicle ride height. The most critical things you need to adhere to regarding using the DSDU are: • When starting the DSDU you must follow the proper sequence, be patient and wait 60 seconds without flipping the ignition switch on/off because you are disrupting the cycle and forcing the DSDU to cycle again every time you flip the switch. So, do it once, then just wait for it. • It will open for the Operator upon start-up. Use the keyboard, it's more likely to be accurate and keeps the DSDU display cleaner.
Transition	Next, we'll log off from the operator role and focus on information available to maintainers through the DSDU.
3.	**(Slide #57)** ELO C – LSA 3 Learning Step/Activity: DSDU for Maintainer Method of Instruction: Lecture Instructor to student ratio: 1:15 Time of instruction: 10 mins Media Type: PPT **(Slide #58)** a. DSDU for Maintainer 1. Logging into DSDU as Maintainer

a) Upon receiving power, the first screen the DSDU displays is the US Department of Defense Warning Screen. **Select Ok button to proceed to the next screen** (which is the Operators Home Screen).

b) The DSDU start-up defaults to the Operator's home screen. Select the **Log-Off button to continue** to the Maintainer Log-On Screen.

c) Maintainer Log-On Screen - **Enter** your **username** and **password**, then click the arrow button to submit your entries.

1) **WARNING**: Three incorrect attempts will lock the DSDU and require an Administrator from Oshkosh to unlock the system.

Figure 2.43 Warning Icon (Red) in Upper Left Corner

Figure 2.44 Caution Icon (Yellow) in Upper Right Corner

2. Retrieving Faults

a) The DSDU is used to alert the operator of faults (which comes from the J1939 Databus)

b) Fault notification can be found in the left and right upper corners of the Vehicle Interface Application screen header.

c) Faults are classified as a Warnings or Cautions.

1) Warnings appear as a red triangle icon in the upper left corner of the screen header. (Figure 2.43)

2) Cautions appear as a yellow triangle icon in the upper right corner of the screen header (Figure 2.44)

d) The operator or maintainer can acknowledge faults in either of two ways:

1) Select the Triangular Icon - The display will transition to the Active Codes screen displaying the faults. Once on the Active Codes Screen the triangular icons are no longer visible, and the faults are considered acknowledged.

2) Navigate to the Active Codes Screen using the buttons at the bottom of the display screen.

3. Active Service Codes

a) Understanding the Service Code - This screen provides four columns of information about each fault:

1) Lists the System ID for vehicle subsystem broadcasting the fault

2) The code number unique for each fault; active codes are a ”1” (one) and inactive codes are “0” (zero).

3) Two Severity classifications: Warnings and Cautions

b) Using the Service Code

1) Once on the Active Codes screen, the triangular icons will still be visible (use this in the event you do not want the codes to disappear).

2) If the provided online fault information is sufficient, the maintainer performs the necessary maintenance and restores vehicle operations.

3) Otherwise, the maintainer selects the fault

c) Clearing the Service Code

1) To acknowledge and clear off the fault indicator press/select the triangular icons.

(Slide #59)

4. Maintainer DSDU Screens

Figure 2.45 Main menu

a) Maintainer's Home Screen

1) Main Menu - The five buttons on the bottom of the home screen are constant buttons that are always there regardless of operator or maintainer access and regardless of how many layers deep into the system. (Figure 2.45)

(Slide #60)

Figure 2.46 Maintainer menu

2) Maintainer Menu (Figure 2.46) – The menu located in the center of the screen is specifically for maintainers. They are:

(Slide #61)

Figure 2.47 System checks

(a) SYSTEM CHECKS (Figure 2.47)

(Slide #62)

Figure 2.48 Vehicle info selection

(b) VEHICLE INFO (Figure 2.48)

(Slide #63)

Figure 2.49 Service selection

(c) SERVICE (Figure 2.49)

(Slide #64)

Figure 2.50 Powertrain selection

(d) POWERTRAIN SELECTION (Figure 2.50)

(Slide #65)

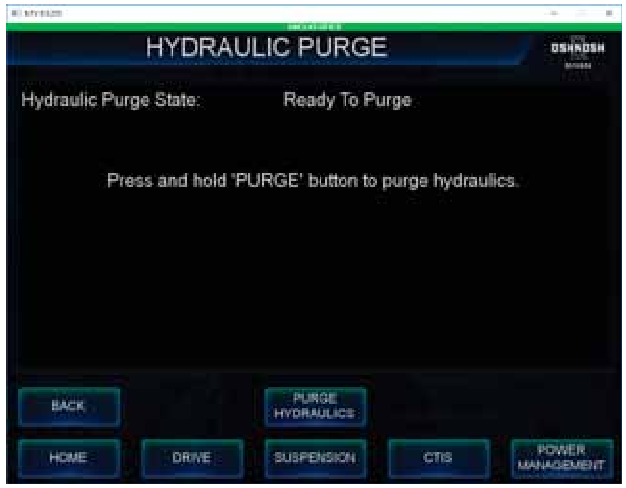


Figure 2.51 Hydraulic Purge

(e) HYDRAULIC PURGE (Figure 2.51)

(Slide #66)

Figure 2.52 Equipment Life

(f) EQUIPMENT LIFE (Figure 2.52)

(Slide #67)

Figure 2.53 Logging off

(g) LOGOFF - Logging Off - If you wish to return the DSDU to the Operator’s mode Select Log Off.

b) The screens displayed above are all subsequent menus resulting from the maintainer’s main menu.

1) Use of the subsequent menus are discussed within the context of each lesson.

2) Systems that use the DSDU will also contain job aid sheets in Appendix D to supplement training to provide more step-by-step guidance on how to use the DSDU for tasks.

(Slide #68)

Figure 2.54 Combat Override Switch

5. DSDU Failure- If the DSDU fails, the operator has the capability to command an emergency bypass by selecting the Combat Over-Ride Switch (Figure 2.54) This switch will bypass all speed interlocks, system de-rates, and it ties batteries together for more amperage.

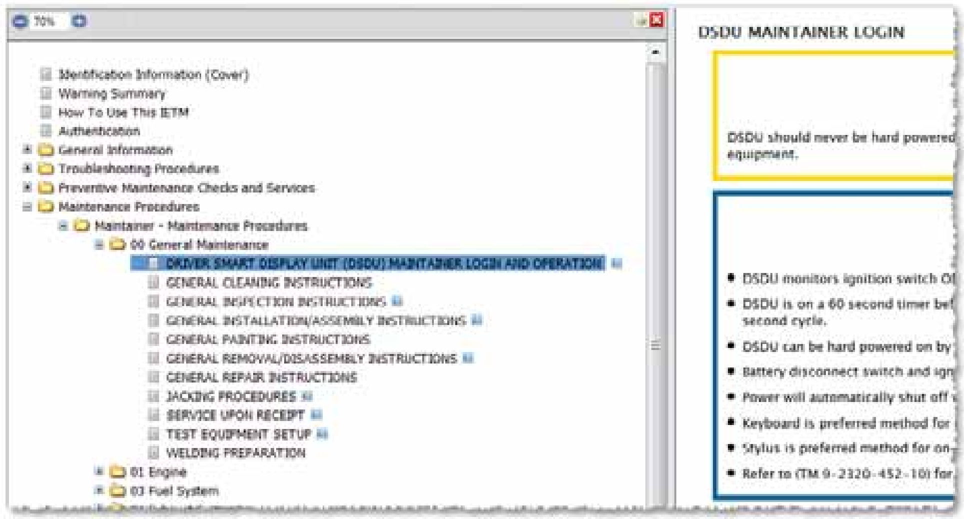


Figure 2.55 Image of IETM Path to DSDU Folder

For more information on the DSDU refer to the IETM: Maintenance Procedures Folder > Maintainer – Maintenance Procedures > 00 General Maintenance > Driver Smart Display Unit Maintainer Login and Operation. (Figure 2.55)

Check on Learning

(Slide #69)

Q: What are two ways to navigate to a fault code, which throws a warning?
A: One way is to touch/select the warning icon (red triangle) in the upper corner, the other way is to select the SERVICE button from the maintainer's menu, then select ACTIVE CODES.

Q: Is it possible to drive/operate the JLTVA1 if the DSDU fails and does not turn on?
A: Yes, it is possible; to drive the JLTVA1 without the DSDU the operator puts the vehicle into Combat Override.

Summary

(Slide #70)

Maintainer's Home Screen

- Main Menu - The five buttons on the bottom of the home screen are constant buttons that are always there regardless of operator or maintainer access and regardless of how many layers deep into the system.
- Maintainer Menu – The menu located in the center of the screen is specifically for maintainers. They are:
  - –SYSTEM CHECKS
  - –VEHICLE INFO
  - –SERVICE
  - –POWERTRAIN SELECTION
  - –HYDRAULIC PURGE
  - –EQUIPMENT LIFE
  - –LOGOFF
- Retrieving Faults - The DSDU is used to alert the operator of faults (which comes from the J1939 Databus)
  - –Faults are classified as a Warnings or Cautions

	–Warnings are red triangles in the upper left corner and are interactive icons –Cautions are yellow triangles in the upper right corner and are also interactive icons –Information on how to retrieve codes is available in Appendix D of Student Guide
Transition	Let's go to the truck for hands on application and practice logging in as a maintainer and navigating to a few maintenance screens.
4.	**(Slide #71)** ELO C – LSA 4 Learning Step/Activity: DSDU Navigation Method of Instruction: Practical Exercise Instructor to student ratio: 1:5 Time of instruction: 1 hour (10 min per student) Media Type: None **(Slide #72)** See Appendix C – PE 2D-1
Check on Learning	None
Summary	None
Transition	Are there any questions about the DSDU currently?
Enabling Learning Objective D.	**(Slide #73)** Upon completion of this lesson, you will be able to: Action: Navigate the IETM to maintenance screens required to service the JLTVA1 Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity.

1. **(Slide #74)**

ELO D – LSA 1

Learning Step/Activity:	EMS-NG
Method of Instruction:	Demonstration
Instructor to student ratio:	1:5
Time of instruction:	15 mins
Media Type:	IETM

(Slide #75)

Instructor Note

Use this slide to prepare learners for what they will learn within this objective; use it to aid with transitions across topics.
Inform them: There are two learning steps: The first one is an instructor led demonstration the second is a hands-on exercise.

Instructor Note

Demonstration: Log into EMS-NG and project the display for class viewing. Provide instruction from Instructor Guide either before or during the relevant section. Use Power Point or slideshow as required.

a. IETM

1. Provides all descriptive, operational, maintenance, troubleshooting, and parts information as prescribed for all applicable maintenance levels.

2. The IETM contains hyperlinks to allow maintainers quick access to maintenance tasks. Maintenance tasks are linked to the relevant figures in the Illustrated Parts Breakdown (IPB). Each maintenance task is associated with any precondition or follow-on maintenance tasks, any consumable supplies, or special tools required for the task. If a troubleshooting task requires the removal of parts, the IETM provides a hyperlink to the relevant maintenance task instructions.

b. IETM: Logging in via Laptop

1. The IETM is used to help maintainers find information on performing repairs, troubleshooting, and parts or service task items such as PMCS (Preventive Maintenance Check and Services). The IETM is viewed through EMS-NG.

2. The IETM is the primary resource for maintainers for both repair and troubleshooting tasks.

3. Accessing most recent version of EMS-NG via laptops

a) Periodic Updates: The IETM and EMS-NG must be periodically updated. Also, ensure the MSD and IETM meets the minimum requirements to operate the EMS-NG. There are multiple versions of EMS-NG that can be installed previous on an MSD but may not function properly with new features of the JLTVA1 IETM.

b) Log in Process: The IETM for the JLTVA1 can be found either on a laptop device, or on the maintainer screen of the Driver's Smart Display Unit (DSDU).

c) The laptop device will display an icon on the desktop called EMS-NG, followed by a version number such as 2.1.11. The text will be in black with a grey border. Follow the steps below to log into the IETM through a laptop device

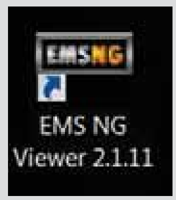


Figure 2.56 EMS NG icon

d) Double click on the icon to open the program. Click on the icon to access the application. (Figure 2.56)

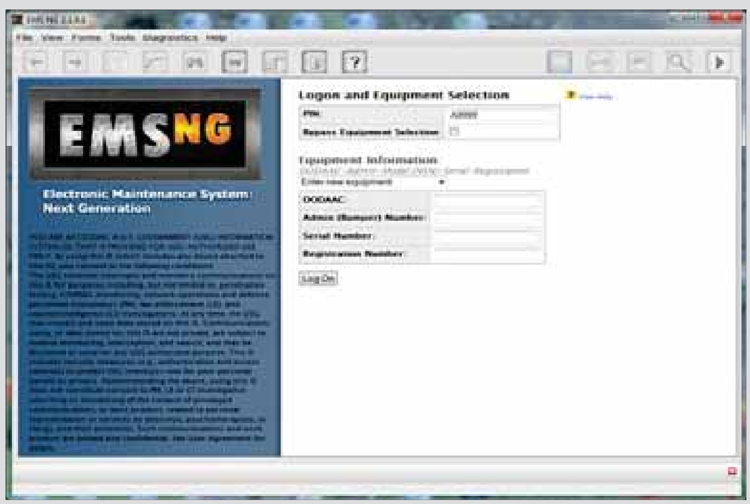


Figure 2.57 EMS-NG Opening Screen

e) After clicking on the EMS-NG icon, a box with a running bar underneath with the version will appear. It may take a few minutes for the program to open. (Figure 2.57)

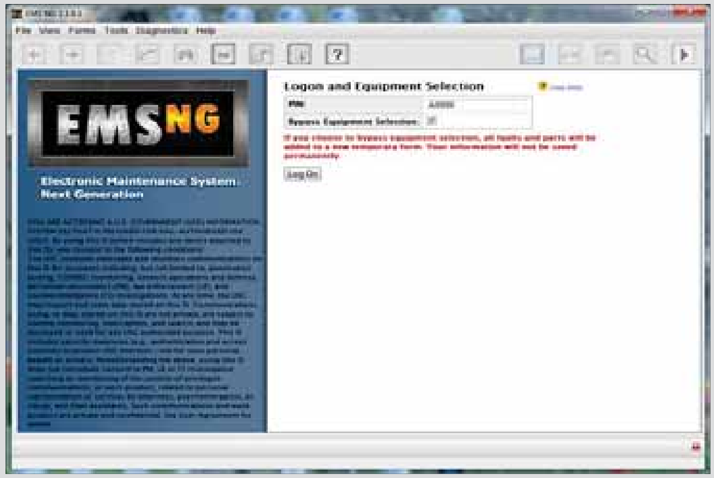


Figure 2.58 Logon Screen

f) When the program is open, a box marked “Bypass Equipment Selection” will appear at the top of the screen. Check this box and press the “log on” button. (Figure 2.58)

c. Review basic navigation of EMS-NG

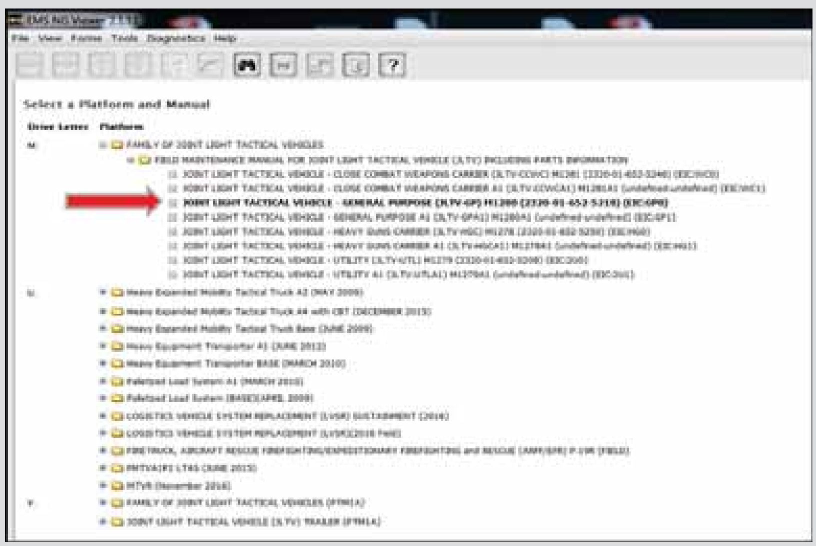


Figure 2.59 IETM Platform Selection Screen

1. Under the heading of “Select a Platform and Manual”, there is a list of files. (Figure 2.59)

   a) Click on the file name to expand the menu to see IETMs for all models.

   b) Select the JLTVA1 variant and configuration for the desired truck.

   c) Select the A1 variant and configuration

2. EMS-NG Maintenance Tracks

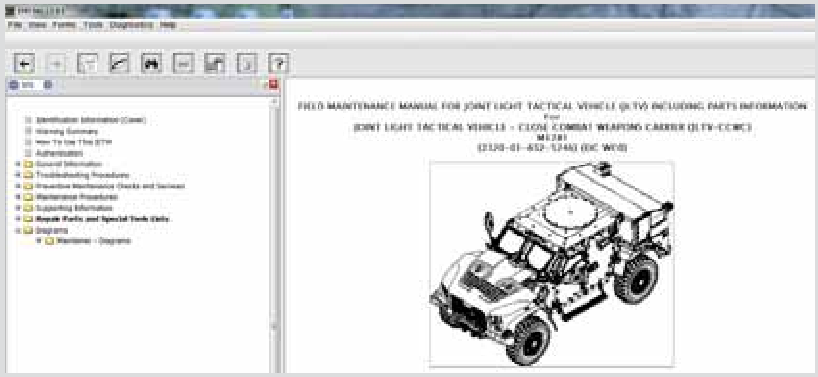


Figure 2.60 Front Cover of IETM for JLTVA1

a) Once the variant/configuration has been chosen, the screen will change, and a menu will appear on the left side of the window.

1) Use + or – signs to open or close folders

b) The menu will contain folders labeled General Information, Troubleshooting Procedures, PMCS, Maintenance Procedures, Supporting Information, RPSTL, and Diagrams. (Figure 2.60)

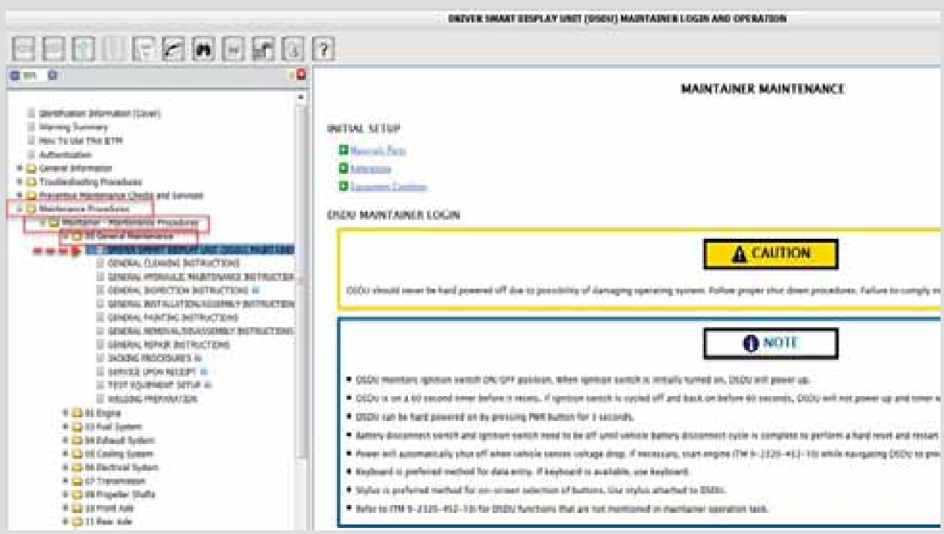


Figure 2.61 Maintenance Work Package Navigation

d. Navigation to Maintenance Work packages (Figure 2.61)

1. After you've selected the proper Platform and Manual section of the IETM and selected the correct configuration and variant of the JLTVA1 then:

a) Click on the plus symbol (+) to the left of the **Maintenance Procedures** Folder to open the folder

b) Open the **Maintainer-Maintenance Procedures** folder

c) Open the **General Maintenance** folder

d) Select the folder for the system you wish to service.

e) Continue to expand folders (clicking on + sign) until you find the task procedure (paper icon).

f) Select the maintenance task by clicking the paper icon next to it. The screen will change and instructions for performing the adjustment, repair or replacement will appear.

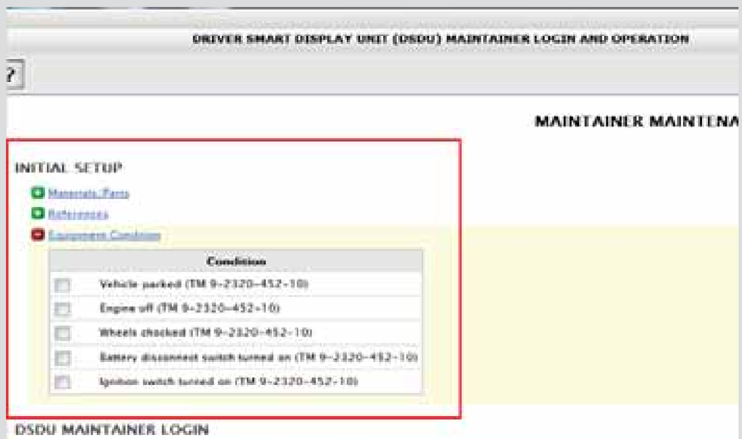


Figure 2.62 Initial Setup Information

2. Be sure to open the subfolders under the **INITIAL SETUP** (Figure 2.63) section as this is where you will find:

   a) List of tools or special tools required to conduct the maintenance

   b) Whether an assistant is required or not

   c) Materials and parts

   d) References

   e) Vehicle Pre-Conditions: the state the vehicle/systems must be in prior to maintenance

   f) Follow the instructions to perform the desired maintenance task. (Figure 2.62)

e. Navigation of JLTVA1 General Purpose Troubleshooting Tracks

1. Field Level Troubleshooting screens of the IETM gives the maintainer the ability to find the cause of faults or failures of components or systems on the JLTVA1. This is done by navigating through the list of system (i.e. engine, air) files and choosing the file that covers the fault or failure of the JLTVA1.

2. Navigating the Troubleshooting Procedures

    a) Scroll down and open the **Troubleshoot Procedures** folder

    b) Open the **Maintainer-Troubleshooting Procedures**

    c) Select the system pertaining to the issue; for our scenario, we'll use the **Engine** system.

    d) Select the symptom that best describes your issue (paper icon). In this case, we used **Engine Cranks but Fails to Start.**

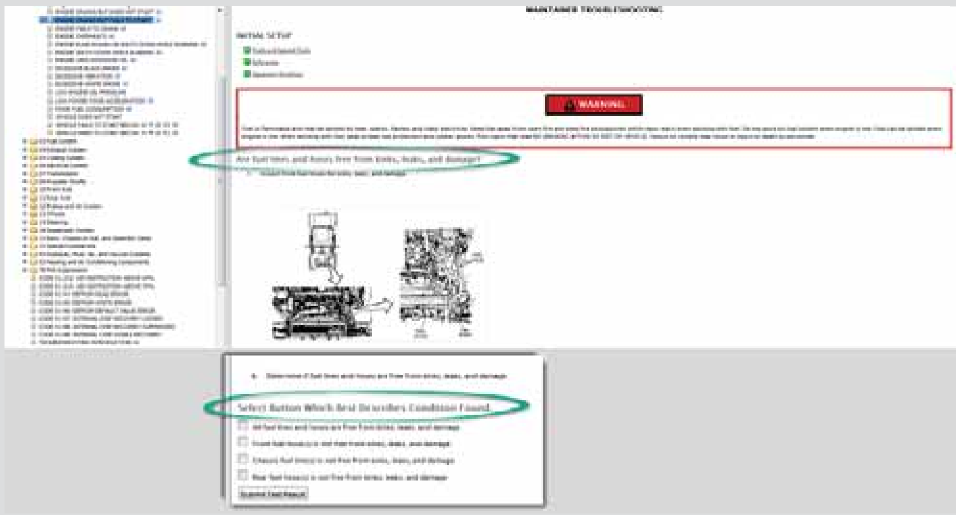


Figure 2.63 Troubleshooting Tracks begin with Q&A

3. Troubleshooting Procedures: These tracks will give step by step instructions on what to test, where to test and how to find the cause of a component/system failure.

    a) Questions and answers will guide the maintainer through the troubleshooting procedure.

    b) Always read the initial setup

    c) When you select a symptom, a series of questions will generate on the right side of the screen.

    d) Answer all the questions as accurately as you can, as you are providing input to the IETM to guide you to the best troubleshooting resolution. (Figure 2.63)

Figure 2.64 Q&A results push the user to relevant IETM locations

e) Once you enter all the criteria that track requests, the IETM will automatically take you to the section of the TM that contains the maintenance procedure that must be completed to resolve the issue. (Figure 2.64)

1) Recall we started on **Engine Cranks but Fails to Start** and the image now shows we are in **Fuel Filters** as a result of answering “Yes” to clogged fuel filter questions.

2) All tracks and troubleshooting procedures conclude with **END OF TASK**.

f) Be sure to review the INTIAL SETUP area to view tools, special tools, if an assistant is needed, and what state the vehicle/system should be prior to maintenance.

f. Introduce Enhanced Schematics

1. Schematics illustrate wiring, pneumatics, or hydraulics in each system. The Enhanced Schematics replace paper schematics and have navigational assistance.

g. Enhanced Schematic Navigation

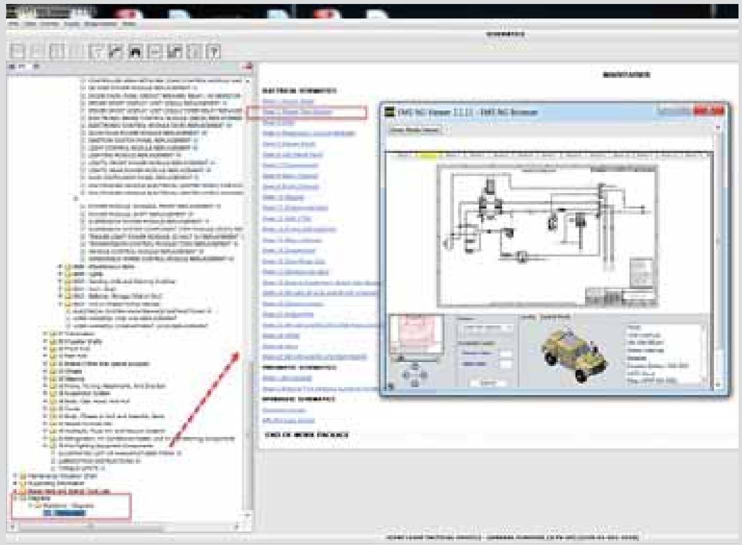


Figure 2.65 Navigating to Diagrams/Schematics

1. Navigating to Diagrams (Figure 2.65)

   a) From the menu on the left side of the screen, scroll down and open the **Diagrams**.

   b) Open the **Maintainer-Diagrams** folder.

   c) Open **Schematics** (paper icon) to generate the list of system schematics (opens on right side of screen).

   d) Select the system you are troubleshooting.

   e) The interactive schematic will appear in a separate pop-up window.

Instructor Note

Be sure to demonstrate how to use each type of interactive navigational assistance item listed below while projecting the display for class viewing.

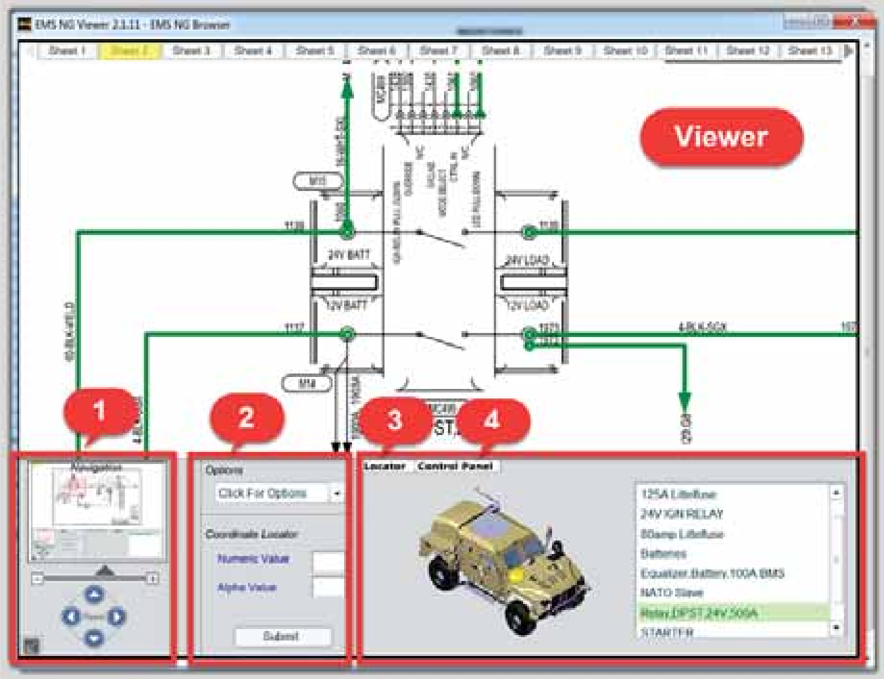


Figure 2.66 Interactive Schematic Navigational Assistance Options

h. Using the Enhanced Schematics (Figure 2.66) - There are several navigation assistance interactions available.

1. Schematic Navigation assistance for zooming/reading a schematic is in the lower left corner.

2. Coordinate Locator assistance is in the lower center area. This allows a person to enter a grid coordinates and the screen will zoom to that area.

3. Component Locator assistance is in the lower right corner. This provides some general guidance as to where the component is located on the vehicle.

4. Control Panel displays the distribution of the electrical power (pneumatic or hydraulic) for various circuits on the truck. The Control Panel is interactive and allows the user to turn on/off the circuit to trace the power. The circuit that is selected will be in green for all wires until you switch the control panel on or off. This will then highlight the power wires in the circuit red.

5. Regardless of which navigational assistance used the IETM will update the viewing area at the top of the window.

(Slide #76)

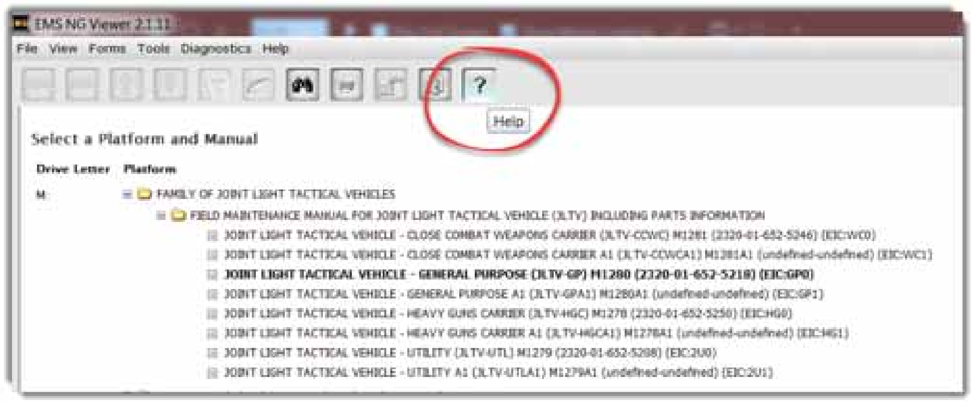


Figure 2.67 Help Icon

i. Navigational Assistance/Help Icon - For more information or to view tutorials, go to the Help icon (question mark icon) on the top menu bar. (Figure 2.67)

Check on Learning

(Slide #77)

Q: Name two places in the IETM that special tools needed to service the vehicle can only be located?
A: Special Tools are listed in the Special Tools folder in the menu, and they are also listed within each maintenance Work Package prior to the process steps.

Q: What are the four types of navigational assistance tools available within an enhanced schematic and how is that of value to you?
A:

1. Schematic navigational assistance
2. Coordinate Locator
3. Component Locator
4. Control Panel

Summary

(Slide #78)

Being efficient using the IETM is a critical tool to maintaining the JLTVA1. Spend time in the IETM navigating the various work package, troubleshooting tracks and reading and using the interactive schematics.

If you have questions later remember to view tutorials go to the Help icon on the top menu bar.

Transition

Using your technical manual is a critical skill, one that you will need to successfully complete all the rest of the JLTVA1 maintenance training modules.
So, let’s practice, I have a checklist of places for you to navigate within the IETM in the next activity.

2.	**(Slide #79)** ELO D – LSA 2 Learning Step/Activity: EMS-NG Navigation Method of Instruction: Practical Exercise Instructor to student ratio: 1:5 Time of instruction: 10 mins Media Type: None **(Slide #80)** See Appendix C: PE 2E-1 **Instructor Note** Due to the critical information available in the IETM (such as safety and vehicle preparation tasks), regardless of whether maintainers access it via a laptop or in the JLTVA1, it is important for you, the instructor, to ensure every student demonstrates his/her ability to navigate to maintainer support information. Walk around the class and initial the worksheet for students as they demonstrate navigation completion according to the worksheet.
Check on Learning	None
Summary	None
Transition	Questions? We will continue by operating on proved and improved roads.
Enabling Learning Objective E.	**(Slide #81)** Upon completion of this lesson, you will be able to: Action: Complete an Operation on proved and improved roads Conditions: Given the vehicle, equipment, tools, TM/IETM, PMCS Checklist from the OM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity.
1.	**(Slide #82)** ELO E– LSA 1 Learning Step/Activity: Before PMCS of Operation Road Test for Maintainers Method of Instruction: Lecture Instructor to student ratio: 1:15 Time of instruction: 15 min Media Type: PPT

(Slide #83)

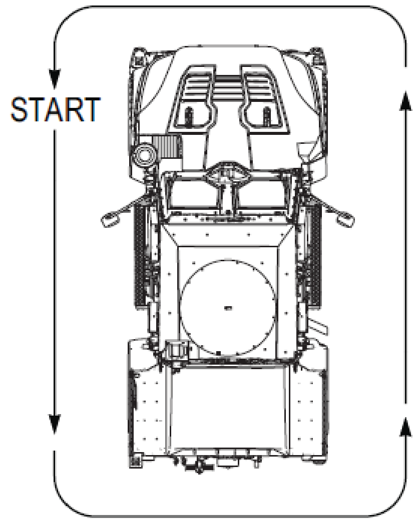


Figure 2.68 Vehicle Walk Around

a. Introduction to: Preventive Maintenance Checks and Services (PMCS).

1. The Operator Manual is the resource to utilize for this task as it lists the requirements.

2. Always Observe the warnings and cautions appearing in the PMCS table and do not ignore warning lights or buzzer sounds (audible indicators); check the appropriate system immediately.

3. Perform PMCS according to the manual or more frequently if operation is under severe conditions.

    a) Perform Before PMCS prior to using the JLTVA1

    b) Perform During PMCS while operating the JLTVA1

    c) Perform After PMCS immediately after operating the JLTVA1

    d) Conduct Monthly PMCS

4. Ensure JLTVA1 is on level ground.

5. Ensure combat lock is functioning properly.

6. Do not ignore a warning light or buzzer. This could indicate a failure in an important system and could lead to injury to personnel or damage to the equipment.

7. Checks and services are numbered in a logical order for moving around the equipment. (Figure 2.68) Start at driver’s side front corner (see image).

(Slide #84)

8. Have necessary tools and rags on hand to perform all checks.

9. Perform PMCS in prescribed order.

10. Follow general maintenance procedures:

    a) Cleanliness

        1) Clean prior to performing PMCS

        2) Dirt, oil, and debris may cover deficiencies

        3) Power wash only the exterior of the vehicle

    b) Lubrication. Lubricate vehicle after washing according to lubrication instructions.

    c) Nuts and screws

        1) Check for looseness, missing, bent or broken nuts and screws.

        2) Look for chipped paint, bare metal or rust around screw heads.

    d) Welds. Look for loose or chipped paint, rust or gaps where parts are welded together.

    e) Electric wires and connectors. Look for cracked or broken insulation, bare wires and loose or broken connectors.

    f) Fluid lines and fittings

        1) Look for wear, damage and leaks.

        2) Ensure clamps are tight.

        3) Fluids and stains on or around fittings and connectors can be signs of leaks.

11. Corrosion prevention and control (CPC)

    a) While performing PMCS, look for and always be aware of rust, peeling or blistering paint, and any damage that can cause corrosion.

    b) Inspect entire vehicle

    c) Appearance and color of corrosion is dependent on the metal/components involved.

METAL/COMPONENT	CORROSION APPLEARANCE
Steel	Powdery Reddish Brown
Aluminum	Powdery White
Brass	Green
Electrical Connectors	Green

12. Fluid Leakage

    a) Leakage categories:

        1) Class 1. Seepage of fluid not great enough to form drops.

        2) Class 2. Leakage of fluid great enough to form drops but not enough to cause drops to drip from item being checked/inspected.

        3) Class 3. Leakage of fluid great enough to form drops that fall from item being checked/inspected.

    b) It is important to know how fluid leakage affects the status of the JLTVA1.

Note

Any fuel leak shall render the JLTVA1 not mission capable.
Accumulation of condensation below air dryer is normal is and is not leak or deficiency.

Check on Learning

(Slide #85)

Q: What could occur if suspension lock-out braces are not installed before an operator crawls under the truck?
A: Vehicle may become unstable and crush personnel.

Q: What should the suspension be set to whenever you first start the JLTVA1?
A: Operational

Q: What must be engaged whenever the truck is in operation?
A: Combat locks

Summary

None

Transition

Now that we've reinforced the purpose for doing a PMCS and road test, we are going to go to the garage and finish the PMCS training on the JLTVA1 doing a guided activity completing the rest of the PMCS tasks.

Go to Appendix D and use the PMCS information there for the practical exercise. **Go to page 0146 (page number is in top right corner) of the Operator Manual PMCS information in the appendix.**

2.	**(Slide #86)** ELO E – LSA 2 Learning Step/Activity: Operation Road Test for Maintainer Method of Instruction: Practical Exercise Instructor to student ratio: 1:5 Time of instruction: 1 hour 30 min Media Type: Operator Manual – Appendix D **(Slide #87)** See Appendix C: PE 2F-1 When conducting the PE use the Ops Manual excerpt in Appendix D: Preventative Maintenance Checks and Services – Operators Manual
Check on Learning	None
Summary	None
Transition	None

3. ELO E – LSA 3

Learning Step/Activity:	After PMCS
Method of Instruction:	Demonstration
Instructor to student ratio:	1:5
Time of instruction:	15 mins
Media Type:	None

NOTE

Vehicle can become unstable while raising a single corner of vehicle. Suspension lock-out braces must be installed before crawling under vehicle. Failure to comply may result in injury or death to personnel.

a. After PMCS

1. Purpose: The purpose of this demonstration is to teach students the procedures for After PMCS.

2. Student role. Observe the demonstration. All students should position themselves for a clear view of the vehicle.

3. Instructor role. Locate and follow TM (Operator Manual) WP (Work Package) After PMCS. Demonstrate After PMCS procedures.

4. Safety brief. Primary Instructor will brief the students on safety procedures while working around the vehicle and in the bay. All students will be checked for proper equipment i.e. closed toe shoes, safety glasses, gloves and ear protection.

5. Supervision and guidance. The instructor(s) will lead the demonstration by showing students how to perform After PMCS.

6. Debrief. Ask students if there are any questions and probe the class to ensure understanding.

PERFORM AFTER PMCS	
1.	Clean vehicle.
2.	Park vehicle on level surface.
3.	Install suspension lock-out braces.
4.	Turn on engine.
5.	Raise and secure hood.
Active Faults	
1.	Check SERVICE SELECTION screen on DSDU for active codes and report active codes to Field Maintenance.
2.	Check FLUID LEVELS screen on DSDU for low hydraulic fluid, engine oil, coolant, front and rear axle oil, and fuel. If LOW, add appropriate fluid until level reads OK on screen or notify Field Maintenance as necessary.
3.	Check for illuminated fault indicators on main instrument panel
Windshield Wiper/Washer controls	
1.	Check windshield washer control and windshield wiper control for proper operation.
2.	Shut off engine.
Driver and Passenger Side, Mirrors, Doors, and Ballistic Glass	
1.	Check mirrors for improper operation and damage.
2.	Check front and rear doors, door latches, weldments, combat locks, and hinges for improper operation, binding, and damage.
3.	Check central region of front and rear door ballistic glass for delamination of inner layers, broken exterior glass exposing inner glass, excessive scratches which completely impair visibility, or large deep through thickness cracks.
4.	Only the M1279 has front door overlaps. Inspect for obvious damage and loose hardware.
Under Vehicle Checks	
1.	Inspect under vehicle for obvious damage and evidence of leaks.
2.	Inspect air lines, tubes and fittings for leaks.
3.	Inspect propeller shaft for damage.

Driver and Passenger Side Vehicle Checks	
1.	Inspect steps, step linkage, and fenders are present, intact, free of cracks and obvious damage, and all hardware is in place.
2.	Inspect steering components for obvious damage, looseness, and leaks.
3.	Inspect service and park brake hose protectors for excessive abrasion.
4.	Inspect whip collar for dislodgement or broken at the crimp.
5.	Inspect half shaft boots and ball joint boots for leaks, rips, tears, and obvious damage.
Suspension Inspections	
WARNING: Suspension lock-out braces must be installed prior to crawling under vehicle. Suspension may lower, crushing personnel. Failure to comply may result in injury or death to personnel.	
Install Suspension Lock-out Braces	
1.	Visually inspect four jounce bumpers to ensure jounce bumpers are not missing, cracked, or damaged.
2.	Set suspension to fording mode.
3.	Set fording mode to off position when suspension is high enough to install suspension lock-out braces.
4.	Install suspension lock-out brace on upper control arm with screw and wing nut.
5.	Repeat Step 4 for remaining suspension lock-out braces.
6.	Set suspension to tie down mode.
7.	Visually verify all four-suspension lock-out braces are seated against jounce bumpers.
Springs and Shocks	
1.	Inspect springs for leaks and obvious damage.
2.	Inspect shocks for leaks and obvious damage.
3.	Inspect shock absorber cap for cracks, tears, or if missing.
4.	Inspect spring cap for cracks, tears, or if missing.
Jounce Bumpers	
1.	Inspect jounce bumpers for gouges, cracks, or if missing.
Wheels/Tires	
1.	Inspect tires to ensure they are not low, flat, or have audible leaks.
2.	Inspect tires for cuts, gouges, cracks, bulging, leaks, or other damage.
3.	Inspect wheels for broken, cracked, or bent surfaces.
4.	Inspect wheel lug nuts and studs for looseness and obvious damage.
5.	Inspect wheel nuts and studs for looseness and obvious damage.

6.	Inspect Central Tire Inflation System (CTIS) valve for leaks.
Rear of Vehicle	
1.	Check fuel cap for looseness, cracks, and obvious damage
2.	Check rear glad-hand couplers for leaks, damage, or missing glad-hand covers.
Drain Air	
1.	Drain Air System
Cargo Cover	
1.	Perform inspection on M1278, M1279, and M1280 models only. Inspect cargo cover for tears, missing straps, and obvious damage.
Transaxle	
1.	Inspect transaxle for leaks and obvious damage.
Passenger Side Rear Brake Reservoirs	
1.	Inspect three brake reservoirs for obvious damage and leaks and park brake reservoir to ensure brake fluid between FILL and LOW lines. If brake fluid is below LOW line, add brake fluid as necessary.
Passenger Side Front Brake Reservoir	
1.	Inspect brake reservoir for obvious damage, leaks, and to ensure brake fluid is between FILL and LOW lines. If brake fluid is below LOW line, add brake fluid as necessary
Front of Vehicle	
1.	Inspect central region of driver and passenger windshield ballistic glass for delamination of inner layers, broken exterior glass exposing inner glass, excessive scratches which completely impair visibility, or large deep through thickness cracks.
2.	Inspect windshield wiper arms and blades for damage, cracks, tears, or if missing.
3.	Inspect front glad-hand couplers for leaks, damage, or missing glad-hand plugs.
Hood	
1.	Inspect hood for cracks and obvious damage.
2.	Check hood latches for improper operation and obvious damage.
Cooling System	
1.	Inspect radiator transmission oil cooler clamps, tubes, and hoses for leaks, cuts, loose hose clamps, debris, build up, and other obvious damage.
Engine Compartment	
1.	Inspect accessory drive belts for obvious damage.
2.	Inspect engine compartment for obvious damage.
3.	Inspect air compressor for leaks and obvious damage.

4.	Inspect fuel filter, fuel lines, and fuel hoses for leaks, looseness, and obvious damage.
Engine Oil	
1.	Remove dipstick from dipstick tube and check for milky colored oil and if oil has a fuel smell.
2.	Check oil level is between ADD and FULL marks. If level is below ADD, add oil to bring level between ADD and FULL marks
Driver Side Brake Reservoir	
1.	Inspect brake reservoir for obvious damage, leaks, and to ensure brake fluid between FILL and LOW lines. If brake fluid is below LOW line, add brake fluid as necessary.
Windshield Washer Reservoir	
1.	Inspect windshield washer reservoir for missing components, fluid level, leaks, and obvious damage.
Hydraulic Reservoir	
1.	Inspect hydraulic reservoir hoses, lines, and fittings for cracks, leaks, and obvious damage.
2.	Inspect hydraulic fill port for cracks, leaks, missing cap and obvious damage.
Front Differential	
1.	Inspect front differential or leaks and obvious damage.
2.	Close hood.
3.	Remove suspension lock-out braces.
Mandatory Replacement Parts No Mandatory replacement parts required for PMCS procedures.	

Note: If B-Kit armor and/or rocket Propelled Grenade (RPG) Netting are installed, see WP in the TM for PMCS procedures.

Enabling Learning Objective F

(Slide #88)

NOTE: Inform students of the following Enabling Learning Objective requirements.

Upon completion of this lesson, you will be able to:

Action:	Operate the JLTVA1 over various terrain obstacles
Conditions:	Given a classroom, Technical Manual, Performance Evaluation Checklist, maintenance bay, JLTVA1, and a road course
Standards:	Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity.

1. **(Slide #89)**

ELO F – LSA 1

Learning Step/Activity:	Operations over various terrain obstacles
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	15 min
Media Type:	PowerPoint (PPT)

(Slide #90)

NOTE: Adhere to Warnings, Cautions and Notes in the TM

a. Operating under mud, sand and snow conditions

1. Braking. Braking is reduced in mud, sand, and snow conditions. Ensure appropriate following distances are adhered to and safe driving practices are adhered to.

2. CTIS. CTIS is a tool the operator can use for mud, sand, and snow conditions. The operator should consider the CTIS settings before they enter conditions requiring lower tire pressures and axle locks. It takes time to adjust tire pressure. The technical manual has general guidance for different exercises for CTIS settings available on the JLTVA1.

a) Bump delays are built into system to help prevent damage by running under inflated tires at speeds too fast for those conditions.

1) Bump delays should not be used by an operator as a means to adjust tire pressure as it will log fault codes showing that the tire pressure was not adjusted correctly.

2) The following three scenarios are the conditions and times required to make an automatic adjustment to occur:

(a) If in cross country setting and Operator exceeds 45 mph for 120 seconds, CTIS will automatically adjust to highway.

(b) If in Mud, Sand, Snow setting, and Operator exceeds 20 mph for 60 seconds, CTIS will automatically adjust to cross country

(c) If in Emergency setting and Operator exceeds 10 mph for 30 seconds, CTIS will automatically adjust to Mud, Sand, and Snow

Instructor Note

The CTIS system takes about two minutes between each setting (i.e. highway to cross country, cross country to mud sand and snow, mud sand and snow to emergency). The total time it takes a JLTVA1 to go from highway to emergency is approximately seven minutes; from emergency to highway takes about nine minutes.

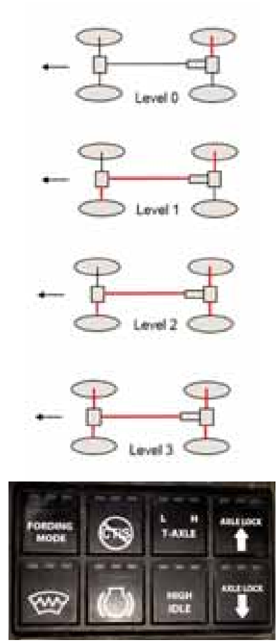


Figure 2.69 Axle lockups

3. Axle lockups (Figure 2.69)

   a) The axle lockup on the JLTVA1 is activated in one of two ways:

      1) CTIS Controller. The CTIS controller supplies driveline lock level 1 in cross country and driveline lock level 2 in mud, sand, and snow settings. If you need more lockups, the last lockup must be added manually.

      2) Manually. If you choose to maintain a higher tire pressure and still want to add driveline locks (which may be desirable for sharp rocks with a steep incline or decline), you can simply add driveline locks by pressing the axle lock button on the MUX panel. Pushing the axle lock up once will supply driveline lock level 1 (inter-axle lockup), pressing it again will give axle lock level 2 (adding rear intra-axle lockup), and pressing it a third time supplying axle lock 3 (front intra-axle lockup).

   b) Lock Level 0 Provides “Full Time All-Wheel Drive”. The primary drive wheel will be the right rear, and the secondary will be the driver side front. Power transfer between the two will be 68% Rear and 32% Front.

   c) Lock Level 1: Provides a 50/50 division of power between the front and rear axle. There will be two primary drive wheels, and they will be the passenger side rear, and the driver side front.

   d) Lock Level 2: Provides the same as lock level one, and applies a third drive wheel, which is the driver side rear. The driver side rear will be powered at the same rate as the passenger side rear, and the driver side front.

e) Lock level 3: Provides the same as lock level two, and applies the only other available drive wheel, which is the passenger side front. At this point, all wheels are being powered equally, and will rotate at the same rate.

(Slide #91)

Figure 2.70 Operating under mud, sand and snow conditions

b. Operating in extreme Soft Conditions or where the potential of a stuck vehicle is high. Maximum Tractive effort (Figure 2.70) Use emergency mode in extreme muddy conditions. Add lock level 3 as necessary. Remember not to over speed the truck for too long as this will kick the CTIS to the next highest setting. If additional torque is required, select transaxle low to increase output torque.

Instructor Note
The CTIS system applies the first driveline lock in cross country mode, the second in mud sand and snow, and no more after that. If you manually apply the third, and switch back to highway mode, the CTIS controller will remove all driveline locks as the terrain settings is placed back in HWY mode.

(Slide #92)

c. Operating under desert conditions

Figure 2.71 Dune face driving

1. Dune Face Driving. (Figure 2.71)

    a) Drive only on dune faces straight up or straight down. To drive across a dune or at an angle can cause the sand to collapse from below and unwanted sliding can occur.

    b) If driving across a dune is required and slipping occurs, it is ideal to direct the vehicle in a down slope direction.

2. Temperature Variation. Expansion and contraction due to constant temperature changes can cause the vehicle to leak fluids unexpectedly. It is recommended that operators check and top off fluids regularly.

3. Additional operating considerations

    a) When operating in sand, quick acceleration and braking can cause the vehicle to dig into the sand causing the truck to bury itself. It is wise to accelerate and decelerate slowly as this will prevent the truck from digging in the sand. Use high pressure air to clean cooling pack.

    b) When parking, it is advised that the truck is parked on hard ground. If hard ground is not available, park the truck on planks. If planks are not available, the operator should drive back and forth 3 feet or so to pack the sand, creating a solid area on which to park.

    c) Use high pressure air to clean cooling pack.

(Slide #93)

Figure 2.72 Operating under dusty conditions

d. Operating under dusty conditions (Figure 2.72)

1. Cleaning. The armored windows are cleaned with specific cleaners to remove dust and debris. There are two sides to transparent armor (windows), and they require different cleaning products.

    a) The strike side (known as the exterior), the safe side is known as the interior. The strike side (exterior) should be cleaned with standard window cleaning products like windshield washer fluid or mild detergent.

b) The safe side (known as the interior) should be cleaned with a 90% isopropyl alcohol solution and a lint free cloth. Do not use an ammonium-based cleaning product as this will damage the windshield.

2. Servicing. Monitor the air restriction gauge to ensure the engine air filter is not being restricted. The air filter should be cleaned weekly at a minimum in these conditions.

3. Whenever the vehicle is not in use, ensure that the glass is covered. Sand blowing on the glass can damage it. Park vehicles close together

4. Additional Maintenance Concerns. The operator should physically check the cabin air filter and the recirculation filter daily to ensure there is no restriction from a build-up of dust/debris.

(Slide #94)

Figure 2.73 Operating over forest and rocky terrain conditions

e. Operating over forest and rocky terrain (Figure 2.73)

1. Correct CTIS settings. Forest or rocky terrain can change quickly which may cause you to adjust CTIS settings often. The operator must be aware of sharp objects when operating though forests or sharp rocks. The side walls of the tires can get damaged easily.

2. Vehicle speed considerations. Drive to the terrain, lower speeds may be required to navigate though, over, around obstacles. Lower inflation in tires could result in puncturing of the sidewalls.

3. Maneuvering considerations. The operator should be considerate of maneuvering through low overhangs, narrow paths, over debris, approach and departure slopes, and throttle control. Do not throttle hard over rough terrain as this could damage equipment. Operator may need to slow vehicle to maneuver through these scenarios.

4. Transmission range selection. Adjust transmission range based on terrain. If going down a steep slope, place the transmission in first gear and gradually increase the speed of the JLTVA1. Avoid slopes greater than 40 percent to prevent getting mired in soft forest floors.

(Slide #95)

Figure 2.74 Fording heights

f. Operating under fording conditions (Figure 2.74)

1. Suspension rises to fording height when fording mode is selected.

2. Truck will be limited to 10 mph.

3. Engine fans, A/C compressor, CTIS, and 120 VAC outlets shut off once fording mode is achieved. The operator must take the vehicle out of fording mode to re-engage these components. Failure to do so may cause the engine to overheat.

4. If suspension adjustment has been aborted, the truck will still be limited in speed until it reaches Operational height.

5. Maximum fording height without fording kit is 30 inches (Figure 3.17).

    a) The 30-inch line on the vehicle falls to a point at the base of the cab.

6. Maximum fording height with kit is 60 inches.

    a) The 60-inch line on the vehicle falls to a point at the door levers, and the base of the air filter on the driver's side.

7. Operators must ensure that they take the vehicle out of fording mode immediately when not needed.

8. Operators must clean vehicle with clean, fresh water after fording through saltwater.

Check on Learning

(Slide #96)

Q: What is the maximum fording height without a fording kit?
A: 30 inches.

Q: Because forest or rocky terrain conditions can change quickly, what are some conditions the operator should be aware of?
A: Over hangs, debris and sharp objects, the tire side walls can be damaged easily.

Q: What speed is the vehicle limited to when the suspension is adjusted to fording mode?
A: 10 mph

Q: Why would an engine overheat when operating in fording mode?
A: Because the engine fan shuts off.

Q: What should an operator do when driving across a dune and slippage occurs?
A: Direct the vehicle in a down slope direction.

Transition

What questions do you have after going over driving in forest and rocky terrain? Next, we will learn about AFES Test Kit.

2.

(Slide #97)

ELO F – LSA 2

Learning Step/Activity:	Operate the Vehicle
Method of Instruction:	Practical Exercise
Instructor to student ratio:	1:5
Time of instruction:	2 hours 30 minutes
Media Type:	PowerPoint (PPT)

(Slide #98)

See Appendix C - PE 2G-1

3.

(Slide #99)

ELO F – LSA 3

Learning Step/Activity:	AFES Test Kit
Method of Instruction:	Demonstration
Instructor to student ratio:	1:5
Time of instruction:	30 mins
Media type:	None

(Slide #100)

a. AFES Test Kit

1. Purpose: This Demonstration will give you the opportunity to practice the skills required to provide maintenance to the JLTVA1 AFES under normal maintainer conditions.

2. A simulation means using the AFES test kit, following the task, discussing, and completing each step until task is complete. Students will not remove the installed components unless directed to do so.

AFES Testing Kit Use	Location
Locate correct WP in TM	
Follow Equipment Conditions	
Follow all warnings cautions and notes	
Tested AFES system functionality with fire simulator	
Returned AFES to operational condition	

Instructor Note

Within the Field-level Preventive Maintenance Checks and Services (PMCS) (Item 20), the Automatic Fire Extinguishing System (AFES) Test is conducted as a check every 3,000 miles or annually. Have the students select the link to the AFES Test work package and complete the steps to conduct the test.

Check on Learning

None

Summary

(Slide #101)

The AFES test kit is used to test and troubleshoot the AFES. The extinguisher simulator is used to test extinguisher cylinder functionality while the fire simulator tests the optical detectors. AFES must be tested in accordance with proper procedures to prevent accidental discharge.

The AFES system and its individual components can be tested safely and easily by using the appropriate test kit and following proper procedure. Always perform troubleshooting in accordance with the proper IETM procedure.

Transition

We have just gone over AFES Test Kit procedures with the JLTVA1. Do you have any questions before we move into lesson summary?

SECTION IV. **SUMMARY**

Method of Instruction:	Lecture
Instr Type (I:S Ratio)	1:15
Time of Instruction:	10 mins
Instructional Strategy	Discussion and Q/A

Check on Learning:

(Slide #102)

Q: Explain the process to find an accurate troubleshooting procedure.
A: Using the IETM, select a symptom and a series of questions. The IETM will automatically take you to the procedure to resolve the issue.

Q: What is the fording height clearance of the JLTVA1?
A: The JLTVA1 can ford 30 inches without a kit and 60 inches with the kit.

Q: The most unique characteristic of the JLTVA1 suspension is what?
A: That it is a high-pressure gas system.

Q: Where is the NATO slave receptacle?
A: It is in the front of the JLTVA1, directly left of center as you are facing the truck.

Summary

(Slide #103)

In this lesson, we covered:
- JLTVA1 characteristics and capabilities
- Major components
- Exterior components
- Interior components
- DSDU operation

The JLTVA1 can drive over various terrain. Due to its unique suspension system, it is necessary to know how to configure the vehicle for operation in normal driving conditions, on proved and improved roads, in emergency situations, in various climates and over various terrain order to complete the mission and avoid injury or death to personnel or damage to the vehicle.

Instructor Note
With appropriate time allocated, have students remove all fenders and splash guards to prepare for Lessons 3-8.

Appendix A

02_ JLTVA1_ ARMY_ MAIN_Fam_PPT_V3.0.pptx

Appendix C
JLTVA1 Practical Exercise Sheet No. 2A
Characteristics, Capabilities, Performance and Major Components Worksheet

Title	Characteristics, Capabilities, Performance and Major Components Worksheet
Lesson Number/ Title	02 Vehicle Familiarization
Introduction	We will now complete a worksheet to reinforce a few key elements of the JLTVA1's characteristics, capabilities and major components.
Motivator	It is imperative to maintaining the JTLVA1 to be familiar with all the truck's exterior components, systems and their purpose or function.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Enabling Learning Objective A	Action: Correlate the JLTVA1's exterior components with their location, purpose, function and maintenance requirements Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity.
Risk Assessment Level	Low
Environmental Considerations	N/A
Evaluation	Practical Exercise worksheet
Instructional Lead-In	This Practical Exercise will give you the opportunity to practice the skills required to provide maintenance to the JLTVA1 under normal maintainer conditions.
Resource Requirements	**Instructor Materials:** Instructor Guide **Student Materials:** Student guides Pens/Pencils
Special Instructions	Below are the instructions for how to prepare for the practical exercise.

Preparation	Instructor Notes
TM Reference:	N/A
Time Required for Prep:	N/A
Symptom/Purpose:	Familiarization with system and component location for troubleshooting

Prepare Area for PE:	1-2 ladders for viewing and prevent climbing on vehicle
Configure Vehicle for PE:	N/A
Instructor Preparation:	• Ensure instructors have located and understand the purpose all components before conducting component location. • Review the basic information below as required.
Safety	Instructors will monitor the exercise and ensure students are properly adhering to safety guidelines while working on the vehicle.

Procedures

a. Inform the students to fill out their name, date, and locations at the top of the solution sheet.

b. Inform students this is an open book exercise; they may use the student guide to search for answers. Wait for students to finish and answer any questions they may have.

c. Inform students they will have approximately 5 minutes to complete the practical exercise.

d. Inform students that as they complete the exercise, they should have an instructor mark the worksheet.

e. Ask if there are any questions.

f. Students may begin.

<table>
<tr><th>Go/No Go Questions</th><th>Answer Key</th></tr>
<tr><td colspan="2">What is the loading clearance of all the JLTVA1 variants?
<table>
<tr><th>Vehicle</th><th>Height</th><th>Clearance</th></tr>
<tr><td>GP M1280</td><td>75.8 in.</td><td>3.8 in.</td></tr>
<tr><td>HGC M1278</td><td>75.8 in.</td><td>3.8 in.</td></tr>
<tr><td>CCWC M1281</td><td>75.8 in.</td><td>3.8 in.</td></tr>
<tr><td>UTL M1279</td><td>75.8 in.</td><td>3.6 in.</td></tr>
</table></td></tr>
<tr><td>1. What is the top speed for the JLTVA1 in top gear/high range?</td><td>Top speed of the JLTVA1 under normal conditions is 76 mph.</td></tr>
<tr><td>2. How long does it take the JLTVA1 to go from 0 to 30 mph?</td><td>The JLTVA1 can go from 0-30 mph in 7.4 seconds.</td></tr>
<tr><td>3. How long does it take the JLTVA1 to go from 0 to 50 mph?</td><td>It can reach 0-50 in 18.3 seconds.</td></tr>
</table>

4. What is the make model of the engine on the JLTVA1?	The engine in the JLTVA1 is the Banks 866T 6.6L with turbo charged engine.

g. Mark worksheets accordingly.

1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

2. Once the Practical Exercise is complete, the Lead Instructor must sign each student’s Solution Sheet.

Feedback Requirements

Provide coaching and correct answers as needed.

APPENDIX C
JLTVA1 Practical Exercise Solutions Sheet No. 2A-1
Characteristics, Capabilities, Performance and Major Components

Name____

Date____

Training Location_______________________________________

You may use your student guide for the answers.

1. What is the loading clearance of all the JLTVA1 variants?

Vehicle	Height	Clearance
GP M1280		
HGC M1278		
CCWC M1281		
UTL M1279		

2. What is the top speed for the JLTVA1 in top gear/high range?

3. How long does it take the JLTVA1 to go from 0 to 30 mph?

4. How long does it take the JLTVA1 to go from 0 to 50 mph?

Signature____

Appendix C
JLTVA1 Practical Exercise Sheet No. 2B
Exterior Vehicle Familiarization Component Identification

Title	Exterior Vehicle Familiarization Component Identification
Lesson Number/ Title	02 Vehicle Familiarization
Introduction	We will now perform a P.E. on JLTVA1 familiarization.
Motivator	It is imperative to maintaining the JTLVA1 to be familiar with all the truck's exterior components, systems and their purpose or function.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Enabling Learning Objective A	Action: Correlate the JLTVA1's exterior components with their location, purpose, function and maintenance requirements Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity.
Risk Assessment Level	Low
Environmental Considerations	N/A
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	This Practical Exercise will give you the opportunity to practice the skills required to provide maintenance to the JLTVA1 under normal maintainer conditions.
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide **Student Materials:** Student guides Pens/Pencils
Special Instructions	Below are the instructions for how to prepare for the practical exercise.

Preparation	Instructor Notes
TM Reference:	N/A
Time Required to Induce Fault:	N/A

Symptom/Purpose:	Gain familiarity with external vehicle features, components per maintainer needs
Prepare Area for PE:	Ladder for viewing
Configure Vehicle for PE:	N/A

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises.

d. Inform students they will have approximately 30 minutes to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five.

h. Ask if there are any questions.

i. Students will conduct a walkaround of the truck and identify for the instructor the following components:

Component/System	Location and Purpose
Instructor Note:	Instructors will monitor the exercise and ensure students are properly adhering to safety guidelines while working on the vehicle.
Chassis Batteries	Location: Under Front bumper in battery box Purpose: Power Generation for all systems
NATO Connector	Location: Center front of Vehicle Purpose:
Glad-hands (Red and Blue)	Location: Both on front and rear of vehicle. Purpose: Use front gland hands for towing and rear to conduct towing of another vehicle. Red is Emergency Air Blue is Service Air
Front Intravehicular Cable Connector	Location: Center front of Vehicle Purpose:
Blackout drive light	Location: Under driver side head lamp Purpose:

Mirrors	Location: each side of truck, attached to front doors Purpose: Visibility – REMOTE adjustments (no hands)
CTIS Wheel Valves	Location: on each wheel; under CTIS guards Purpose:
Jounce Bumper	Inside each wheel well. Looks like a black spool or mushroom. Purpose is to prevent metal-to-metal contact
Hard Stop Plate	Inside each wheel well; it is the flat portion of upper control arm to support the suspension lockout braces.
Shock Absorber (for Suspension)	Inside each wheel well. It is covered by a flexible accordion-like sheath.
HPG Spring (for Suspension)	Inside each wheel well; it is a vertical, black, tube-like component.
Air intake and filter	Location: Just ahead of driver side door Purpose: port and cleaner for air intake to engine
Rear stowage locations	Location: each side of JLTVA1 – rear corner panels of truck; exact location depends on variant. Purpose:
BII - specifically Suspension Lock-out Braces	Stored inside rear storage compartment. There are four lock-out braces required to secure the suspension during maintenance procedures; braces stay with the truck.
Location on truck where Suspension Lock-out Braces are installed	1. Suspension lock-out braces are to be inserted while JLTVA1 in FORDING height (Figure 1.2) 2. Install all four-suspension lock-out braces on hard stop plate of each axle. 3. Lower vehicle onto braces by selecting OPERATIONAL ride height, then TIE DOWN mode. Vehicle will continue to lower until it is lowered all the way onto the braces and cannot go any lower.  BII: Suspension Lock-out Brace

Auxiliary Batteries	Rear of truck; exact location varies by JLTVA1 variant. Point out auxiliary batteries on the training vehicle.
Fuel Priming Pump (if present on training vehicle variant)	Location: Rear of truck, left of center. May be present on JLTVA1, if not retrofitted.
Auxiliary Batteries	Location: Rear of truck; exact location varies by JLTVA1 variant. Point out auxiliary batteries on the training vehicle. Purpose: provide power for C4ISR
12 VDC Connector	Location: Rear of truck; Left of Pintle Purpose: 12 volts is used when connecting to the trailer, ABS connector is not required
24 VDC Connector	Location: Rear of truck; Left of Pintle Purpose: 24 volts is used for towing a trailer, but requires the ABS connector
ABS connector	Location: Rear of truck; Between Pintle and 12V Purpose:
Grounding Stud	Location: Rear of truck; right of 12V Purpose:
Air solenoids	Location: Rear of truck; right of center Purpose:
Air Drains	Location: Purpose:
Brake Fluid Reservoirs (3)	Location: 3 Rear Passenger side, under the wheel well, Both rear brakes and Parking Brake Purpose: Store brake fluid
Tie Downs	Location: Located throughout the cargo box area of the vehicle Purpose: Use ratchet straps for tie down truck when loading truck
*Exhaust	Location: Passenger side of truck. Surfaces from beneath truck between front and rear passenger doors Purpose: pipe engine exhaust out of system May also relay: Exhaust is an indicator of Fording Kit and Variant type
Doors (Design, Alignment Grooves, Opening/Closing info)	Location: Both sides of crew capsule. Purpose: The edges of each door include features that interlock with the sidewall B-pillar to keep the doors from becoming misaligned, helping to prevent jams. In the unlikely event the doors are jammed by an extreme event, a pull ring is provided.
Mechatronics Control Unit for CTIS	Location: Passenger side; Under center area of truck

	Purpose: MCU carries out the orders (from the 3G controller) by opening and closing solenoids to control air in/out of each wheel.
Hood Latches and Hood Brace	Location: One on each side; two-man task to open/lift hood. Purpose: Hood is fiberglass to reduce weight of truck; hood brace is on the passenger side of hood and attaches near the cooling pack.
12/24 VDC Chassis mVEC	Location: Inside the engine compartment, passenger side. Also referred to as Chassis MVEC Purpose: MVECs contain the circuit breakers and provide 12 and 24-volts DC for the Engine and exterior of the JLTVA1
Brake Reservoirs (2)	Location: One on each side of the engine compartment Purpose: Store brake fluid
Towing Ball Valve	Location: Purpose: Engine compartment, Driver side, must be turned to the tow position, prior to towing the vehicle

j. Mark Go/No Go Sheets accordingly.

1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

2. Once the Practical Exercise is complete, the Lead Instructor must sign each student's Solution Sheet.

Feedback Requirements

Provide coaching and feedback to students to ensure comprehension.

APPENDIX C
JLTVA1 Practical Exercise Solution Sheet No. 2B-1
Exterior Vehicle Familiarization: Component Location

Name____

Date____

Training Location__________________________________

Component Location-Exterior	**Go**	**NO GO**	**Initials**
Accessory Bumper and/or Combat Bumper			
Chassis Batteries & Drop Tray			
NATO Connector			
Glad-hands (Red and Blue)			
Front Intravehicular Cable Connector			
Blackout Drive Light			
Mirrors			
CTIS Wheel Valves			
Jounce Bumper			
Hard Stop Plate			
Shock Absorber (for Suspension)			
HPG Spring (for Suspension)			
Air Intake and filter			
Rear stowage locations			
BII - specifically Suspension Lock-out Braces			
Location where Suspension Lock-out Braces are installed			
Auxiliary Batteries			
Fuel Priming Pump (if present on training vehicle variant)			
12 VDC Connector			
24 VDC Connector			

ABS Connector			
Grounding Stud			
Air Solenoids			
Air Drains			
Brake Fluid Reservoirs (3)			
Tie Downs (use ratchet straps for tie down)			
Exhaust (Point out Fording Kit Exhaust if present on any truck)			
Doors (Design, Alignment Grooves, Opening/Closing info)			
Mechatronics Control Unit for CTIS			
Hood Latches and Hood Brace			
12/24 VDC Chassis mVEC			
Brake Reservoirs (2)			
Towing Ball Valve			

Signature____

Appendix C
JLTVA1 Practical Exercise Sheet No. 2C
Vehicle Familiarization of Interior Controls

Title	Vehicle Familiarization of Interior Controls
Lesson Number/ Title	02 Vehicle Familiarization
Introduction	We will now perform a P.E. on JLTVA1 familiarization.
Motivator	It is important for the students to become very familiar with the interior systems and components of the JLTVA1 to properly service the truck.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Enabling Learning Objective B	Action: Operate the JLTVA1 controls located within the capsule, including the DSDU Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity.
Risk Assessment Level	Low
Environmental Considerations	N/A
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	This Practical Exercise will give you the opportunity to practice the skills required to provide maintenance to the JLTVA1 under normal maintainer conditions.
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide **Student Materials:** Student guides Pens/Pencils
Special Instructions	Students will move into the truck and identify the following components:

Component	Location/Function
Instructor note:	The following components should be identified and described by students – Use the content from the lesson as the answer key as it provides images and explanations.
Battery switch panel	**Use content from the lesson as the answer key as it provides images and explanations.**
Lighting MUX panel	
Steering wheel adjustment lever	
Transmission shift selector	
Mirror controls	
Vehicle control MUX panel	
Blackout switch	
Ignition switch	
Combat override switch	
Drivers Smart Display Unit (DSDU)	
Commanders Smart Display Unit (if applicable) (CSDU)	
AFES Optical Sensor	
AFES Bottle	
AFES controller	
HVAC controller	
120 VAC outlet	

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises.

d. Inform students they will have approximately one hour to complete the practical exercises.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five.

h. Ask if there are any questions.

i. Students may begin.

j. Mark Go/No Go Sheets accordingly.

1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

2. Once the Practical Exercise is complete, the Lead Instructor must sign each student's Solution Sheet.

Feedback Requirements

Answer questions and provide feedback as needed.

APPENDIX C
JLTVA1 Practical Exercise Solution Sheet No. 2C-1
Vehicle Familiarization of Interior Controls

Name____

Date____

Training Location____

Vehicle Familiarization of Interior Controls	**Go**	**No Go**	**Initials**
Battery Switch Panel			
Lighting MUX Panel			
Steering Wheel Adjustment Lever			
Transmission shift selector			
Mirror Controls			
Vehicle Control MUX Panel			
Blackout Switch			
Ignition Switch			
Combat Override Switch			
DSDU			
CSDU (if applicable)			
AFES Bottle and Discharge			
AFES Controller			
HVAC Controller			
120 VAC Outlet			

Instructor Signature____

Appendix C
JLTVA1 Practical Exercise Sheet No. 2D
DSDU Navigation

Title	DSDU Navigation
Lesson Number/ Title	02 Vehicle Familiarization
Introduction	We will now perform a P.E. on JLTVA1 familiarization.
Motivator	It is important for the students to become very familiar with the interior systems and components of the JLTVA1. The JLTVA1 is capable of conducting various military operations for which the control panel is the DSDU. Navigating the DSDU is essential for providing maintenance and troubleshooting for maintainers.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Enabling Learning Objective B	Action: Operate the JLTVA1 controls located within the capsule, including the DSDU Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity.
Risk Assessment Level	Low
Environmental Considerations	Vent to outside if vehicle running in enclosed training area.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	This Practical Exercise will give you the opportunity to practice the skills required to provide maintenance to the JLTVA1 under normal maintainer conditions.
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide **Student Materials:** Student guides Pens/Pencils

Special Instructions	Three workstations (JLTVA1s) and Rotate students through Operator seat to navigate DSU: • Students are to work in small groups and take turns operating the DSDU. • Five students need to rotate into Operator's seat. Instructor in front passenger seat and two students in rear passenger area; other two rotate into rear seating as operator exits so they can observe the operator. • Three JLTVA1s/Three instructors. Instructors stay in front right passenger seat to facilitate activity and provide answers, coaching etc. • Time: Approximately 10 minutes per student

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises.

d. Inform students they will have approximately **30 minutes** to complete the practical exercises.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five.

h. Ask if there are any questions.

i. Students may begin.

DSDU Screen	Location/Maintainer Info
Instructor note:	The following components should be identified and described by students
Conduct proper start-up sequence	Wait 60 seconds before pushing any buttons.
HOME	First button of main menu (bottom of screen). Will bring you back to the main menu.
DRIVE	Provides: Current gear, fuel percent, engine oil and air PSI. battery voltage, engine and transmission temps and CTIS terrain setting. INCLINOMETER Button: shows pitch/role of vehicle chassis
SUSPENSION	Five suspension specific buttons available above the DSDU Main Menu (bottom of screen/menu stays the same for both

	Operators and Maintainers) Five Buttons are: • HPG TEST • SENSOR ADDRESSING • SENSORS • CALIBRATION RIDE HEIGHT ADJUST
CTIS	CTIS Settings Operational Ride Height Setting
POWERMANAGMENT	Drive Train/Axle Lock Screen
Log Off as Operator	Select LOGOFF from upper menu (Operator's Menu)
Connect Keyboard	Keyboard is stored in the passenger sitting area near left knee
Log-In as Maintainer	**Username:** **Password:** Only have three tries otherwise have to involve administration and wait for access to be unlocked.
Maintainer Main Menu	Positioned in the upper/center of the screen. Displays approximately 8 menu options (depending on the vehicle variant and DSDU version installed on the truck) Maintainer Menu Buttons: • SYSTEM CHECKS • VEHICLE INFO • SERVICE • POWERTRAIN SELECTION • HYDRAULIC PURGE • EQUIPMENT LIFE • IETM • LOGOFF Each menu option will branch again; providing additional menus or information screens.
SYSTEM CHECKS	Provides status (good or bad) of engine, suspension, chassis, power generator, fuel level, engine oil level, coolant level, air pressure
VEHICLE INFO	Opens to a sub menu of buttons: Fluid Levels, Fluid Pressures, Fluid Temps and Preventative Maintenance
SERVICE	Opens to a sub menu of buttons: Active Codes, Data Entry (not used) Service Code History, Vehicle Configuration, ABCD Export and Unit Selection (not used)

POWERTRAIN SELECTION	Opens to a sub menu of buttons: Engine Status, Axle Status and Transmission Status
HYDRAULIC PURGE	Opens immediately to hydraulic purge command
EQUIPMENT LIFE	Opens to display information (% of life remaining) in air, fuel engine and hydraulic filters and/or pump % life; depending on the JLTVA1 variant and version of DSDU downloaded to the JLTVA1. RESET button is available to reset %life calculations for the filters/pumps listed when the filter/pump was replaced with a new component.

j. Mark Go/No Go Sheets accordingly.

1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

2. Once the Practical Exercise is complete, the Lead Instructor must sign each student’s Solution Sheet.

Feedback Requirements

Answer questions and provide feedback as needed.

APPENDIX C
JLTVA1 Practical Exercise Solution Sheet No. 2D-1
DSDU Navigation

Name____

Date____

Training Location____

DSDU Navigation	**Go**	**No Go**	**Initials**
Conduct proper start-up sequence			
Find INCLINOMETER			
Change Ride Height Setting: (if set low then raise JTLV /if high then lower the JLTVA1)			
Change CTIS setting to: (if in Operational set to Mud/Sand/Snow, if in Mud/Sand/Snow set to Operational)			
Log Off as Operator			
Connect Keyboard			
Log-In as Maintainer			
Maintainer Main Menu:			
SYSTEM CHECKS			
VEHICLE INFO – go to: FLUID LEVEL screens and Go to: PREVENATIVE MAINTENANCE SCREENS Then select: HOME			
Go to Active Codes Screen			
POWERTRAIN SELECTION: Select all menu options and get familiar with information on each of the three screens			
HYDRAULIC PURGE – Go to the slide and return to HOME			
EQUIPMENT LIFE – Explain purpose of feature and maintainer responsibility			
LOGOFF			
VEHICLE INFO: Explain purpose of this feature			

Instructor Signature: ____

Appendix C
JLTVA1 Practical Exercise Sheet No. 2E
IETM Navigation on Laptop

Title	IETM Navigation on Laptop
Lesson Number/ Title	02 Vehicle Familiarization
Introduction	You observed a demonstration/tour of the IETM sections that are most critical to you as maintainers. This exercise is an opportunity for practice and to demonstrate you are capable of navigating to information critical to **safely** maintaining the JLTVA1.
Motivator	Ability to use the IETM successfully to support the mission by maintaining the vehicle to fully operationally as efficiently as possible.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Learning Enabling Objective D	Action: Navigate EMS-NG on laptop to locate maintenance/troubleshooting tracks and special tools required to provide maintenance to JLTVA1 Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity.
Risk Assessment Level	Low
Environmental Considerations	N/A
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	This exercise is to be completed in small groups with all participants engaging equally to complete the navigation checklist (take turns navigating).
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide with Appendix C: Worksheet Instructions **Student Materials:** Student Guide with Appendix C: Worksheet Go/No Go Laptop with EMS-NG to access IETM Pens/Pencils

Special Instructions

Below are the instructions for how to prepare for the practical exercise.

Preparation	Instructor Notes
TM Reference:	N/A
Time Required for Prep:	N/A
Symptom/Purpose:	Familiarization with information available in the IETM as well as the layout/where to find the information maintainers require.
Prepare Area for PE:	Laptops for students to practice navigation.
Configure Vehicle for PE:	N/A
Instructor Preparation:	Be familiar with the IETM and the student exercises prior to conducting the PE.
Safety	N/A

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises.

d. Inform students they will have approximately 10 minutes to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Ask if there are any questions.

h. Students may begin.

Component	Location/Function
Instructor note:	Instructors will monitor the exercise and ensure students are working independently. Exploring and the number of click to success is not significant, the end
	Instructor to conduct a walkaround. Students should wait for the instructor (and/or assistants) to confirm they have successfully navigated to the required screens or item indicated during the navigation exercise.

	Students should also verbalize the purpose and usefulness for maintainers of each navigational checkpoint.
EMS-NG Log-In	Icon on desktop
Select JLTVA1 General Purpose Variant	There are hyperlinks on the opening page of the IETM (after logging in) for each variant of JLTVA1. Be sure to select the correct variant manual.
Open Maintenance Work Packages –	Be sure students have opened the correct folder/location.
Purpose/When this information is valuable	These maintenance folders are organized by system and provide critical safety information, special tools, general tools and the sequence of steps required to conduct maintenance. The Maintenance Work Packages (WP) may contain links to other sections of the IETM – be sure to follow/use them.
Open Diagrams Navigate to Enhanced Schematics	Be sure students have opened the correct folder/location
Purpose/When this information is valuable	All electrical schematics are located in this folder; schematics are critical for troubleshooting the power continuity for all major systems. There is also component locator assistance.
Open Troubleshooting Folder	Be sure students have opened the correct folder/location
Purpose/When this information is valuable	The troubleshooting tracks **use question and answer diagnostic technique**; answers to the questions determine where the IETM will direct you to resolve the problem

i. Mark Go/No Go Sheets accordingly.

1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

2. Once the Practical Exercise is complete, the Lead Instructor must sign each student’s Solution Sheet.

Feedback Requirements

Provide students with feedback to ensure comprehension.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 2E-1
IETM Navigation on Laptop

Name____

Date____

Training Location____

IETM Navigation on Laptop	**Go**	**NO GO**	**Initials**
EMS-NG Log-In			
JLTVA1 General Purpose Variant selection			
Identified Purpose/When this information is valuable			
Opened Maintenance Work Packages – Engine Folder			
Identified Purpose/When this information is valuable			
Opened Diagrams Navigate to Enhanced Schematics			
Identified Purpose/When this information is valuable			
Opened Troubleshooting Folder			
Identified Purpose/When this information is valuable			

Signature____

Appendix C
JLTVA1 Practical Exercise Sheet No. 2F
Operation Road Test for Maintainers

Title	Operation Road Test for Maintainers
Lesson Number/ Title	02 Vehicle Familiarization
Introduction	We will now operate the JLTVA1 and complete a road test.
Motivator	The skill and knowledge of operating a JLTVA1 is important to successfully maintain the JLTVA1 to fully operational condition. Maintainers must drive, use, and validate performance on vehicles after conducting service work to ensure any and all issues have been resolved.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Enabling Learning Objective E	Action: Complete an Operation on proved and improved roads Conditions: Given the vehicle, equipment, tools, TM/IETM, PMCS Checklist from the OM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity.
Risk Assessment Level	Low
Environmental Considerations	N/A
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	This Practical Exercise will give you the opportunity to practice the skills required to provide maintenance to the JLTVA1 under normal maintainer conditions.
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide **Student Materials:** Student guides Pens/Pencils
Special Instructions	Below are the instructions for how to prepare for the practical exercise.

Preparation	Instructor Notes
Reference:	Operator Manual: 0045, 0145, 0047, 0055, 946
Time Required to Induce Fault:	N/A
Symptom/Purpose:	Gain familiarity with operating the vehicle to gain understanding of normal operating behaviors/conditions as a baseline for conducting post maintenance vehicle testing.
Prepare Area for PE:	Facilitator must be prepared with the driving range plans. Access to driving range for each student to conduct During PMCS Tests for 40 min (each).
Configure Vehicle for PE:	Vehicle is in Operational condition to go on the road.

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises.

d. Inform students they will have approximately **4 hours** to complete the practical exercises.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five.

h. Ask if there are any questions.

i. Students may begin.

j. Students should conduct the Operation Road Test for Maintainers; below are key steps the instructor may use to assist with the Go/No Go rubric.

Step	Student Action
Instructor Note:	All students will complete the before and after checks as a group Time: 15 pre and 15 min post check
	Drive time is 40 minutes per student.
	Due to the 4-person seat capacity the

	students will take turns and rotate through the vehicle for During PMCS training.
1. Before PMCS	Perform Before PMCS. OM WP 0145
2. Prepare for driving	Have students prepare for driving.
3. During PMCS	Perform During PMCS.
4. Operate vehicle systems	Perform road test to verifying vehicle systems are operational.
5. After PMCS	Perform After PMCS

k. Mark Go/No Go Sheets accordingly.

1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

2. Once the Practical Exercise is complete, the Lead Instructor must sign each student's Solution Sheet.

Feedback Requirements

Provide feedback to students real-time to ensure comprehension.

Appendix C
JLTVA1 Practical Exercise Sheet No. 2F-1
Operation Road Test for Maintainers

Name____

Date____

Training Location________________________________

***Use the PMCS excerpt from Operators Manual (in Appendix D) for this PE.**

Operation Road Test for Maintainers	**GO**	**NO GO**	**INTIALS**
Start JLTVA1			
Perform Before PMCS			
Start Engine			
Follow the correct starting procedure depending upon the temperature; Cold Conditions (32°F to -25°F; 0°C to -31.6°C). Extreme Cold Conditions (-26°F to -40°F; -32.2°c to - 40°C)			
Turn on Battery Disconnect			
Turn Ignition Switch to the ON Position			
NOTE: If temperature is between 32 and -25 degrees			
IF Below 32 Degrees, Disable CTIS Allow 5 miles minimum of drive time to warm up seals			
Apply Service Brake			
Check Voltage Level on LCD			
When WAIT TO START ENGINE light goes out, Turn Ignition Switch to Run			
Release Service Brake			
Adjust Seat (WP0046)			
Adjust Side Mirrors (WP0052)			
Fasten and Adjust Seatbelts (WP0049)			
Adjust Steering Wheel (WP0018)			
Lock Combat Locks (WP0029)			
Turn ON HVAC as Required (WP 0042)			

Turn on Lights (WP0029)			
Set CTIS Controller to Appropriate Setting			
Set Transaxle Setting (WP0061)			
Set Service Brake			
Lift Parking Brake Safety Lever and Push it in to Release Parking Brake			
Accelerate/Brake/Steer as Required			
PERFORM DURING PMCS			
Monitor Air System			
Monitor Gauges			
Monitor Engine			
Monitor Transmission			
Monitor Brakes			
Monitor Steering			
Monitor Accelerator Pedal			
Monitor HVAC System			
Monitor Powertrain			
Operate Vehicle Systems			
Adjust CTIS setting according to terrain			
Adjust Suspension to TIE DOWN, SAES, Operational			
Fording			
Adjust Transaxle Gear Range			
Perform After PMCS			
Parked vehicle on level ground			
Install Suspension Lockout Braces			
Ensure Equipment Conditions are completed			
Perform After PMCS in prescribed order			

Signature____

Appendix C
JLTVA1 Practical Exercise Sheet No. 2G
Operating the JLTVA1 in Various Terrain

Title	Operating the JLTVA1 in Various Terrain
Lesson Number/ Title	02 Vehicle Familiarization
Introduction	The purpose of this practical exercise is for learners to apply skills learned about operating with the JLTVA1 over various terrain and practice self-recovery of the vehicle.
Motivator	In this lesson, the student will gain the knowledge and skills necessary to configure and operate the vehicle over various terrain and perform self-recovery procedures. Injury to personnel or damage to the vehicle may result if the proper procedures are not followed.
Enabling Learning Objective F	Action: Operate the JLTVA1 over various terrain obstacles Conditions: Given a classroom, Technical Manual, Performance Evaluation Checklist, maintenance bay, JLTVA1, and a road course Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity.
Safety Requirements	It is the responsibility of all Soldiers to follow all U.S. Army safety guidelines as well as local unit SOPs.
Risk Assessment	Low
Environmental Consideration	It is everyone's responsibility to adhere to local and state regulations and unit SOP to protect the environment from damage.
Evaluation	Practical Exercise Go/No Go Sheet
Instructional Lead-In	In this Practical Exercise, students will configure the JLTVA1 for fording, perform self-recovery procedures, and configure and operate the vehicle in various terrain.
Resource Requirements	**Instructor Materials:** Instructor Guide, Technical Manual, maintenance bay, JLTVA1 General Purpose 2320-01-652-5218 **Student Materials:** Student Guide, Technical Manual
Special Instructions	Instructor Note: Remember to give students a 10-minute break every hour during the practical exercise
Procedures	**Instructor Note**: Students will be broken up into groups of five. Each student will be issued a Performance Evaluation Checklist. The student must locate, identify, or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

NOTE: Begin all drivers are hard ball surfaces. Then, as time and various terrains, vary the driving conditions for students.

a. Instruct students to turn to Appendix C for Practical Exercise.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical Manual (TM) to ford water obstacles, perform self-recovery procedure, and properly configure and operate the JLTVA1 over various terrain.

d. Inform students they will have approximately 2 hrs. 30 mins to complete the practical exercise.

e. Inform students that as they complete the exercises, have instructor mark the GO/NO GO sheet.

f. Ask if there are any questions.

g. Students may begin. Mark Go/No Go Sheets accordingly.

   1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

   2. Once the Practical Exercise is complete, the Lead Instructor must sign each student's Solution Sheet.

h. When everyone is finished collect Practical Exercise sheet.

Feedback Requirements

Provide feedback to ensure student learning.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 2G-1
Operating the JLTVA1 in Various Terrains

Name____

Date____

Training Location____

Operating the JLTVA1 in Various Terrains	**GO**	**NO GO**	**Initials**
Disconnected shelter power from 120 VAC/28 VAC outlets.			
For Utility variant only- Installed electronic box filter covers			
If equipped with fording kit, removed mats, installed plugs and tightened			
Stopped vehicle at edge of water obstacle.			
Set transmission range selector to N (neutral) and engaged parking brake			
Selected CTIS button to MUD/SAND/SNOW			
Pressed FORDING MODE button two times within three seconds to enable fording mode.			
Turned off HVAC unit			
Released parking brake after suspension reached fording height.			
Set CTIS to appropriate setting			

Signature____

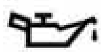
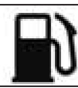
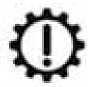
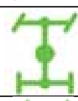
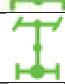
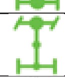
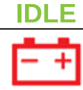
Appendix D
Table 1: JLTVA1 Sensor List

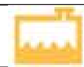
The table provided below is a list of only the diagnostic and prognostic sensors designed into the JLTVA1 base vehicle to address JLTVA1 diagnostic and prognostic requirements, military and commercial design standards, and Oshkosh Corporation design practices. Not included in the table are sensors which are pre-installed on a COTS vehicle component.

Sensor	Subsystem	Purpose	Justification/ Analysis
Rear Air PSI Transducer	Brakes	Senses low rear air reservoir pressure	FMVSS 571.121, PDFOV-2877 & 2885 Gauges and Indicators
Front Air PSI Transducer	Brakes	Senses low front air reservoir pressure	FMVSS 571.121, PDFOV-2877 & 2885: Gauges and Indicators
Engine Oil Level	Engine	Senses engine crankcase oil level	PDFOV-2877 Gauges and Indicators PDFOV-2978: PMCS
Hydraulic System Temperature	Hydraulic	Senses high hydraulic system temperature	Hydraulic system provides pressurized oil for suspension operation, and power steering
Hydraulic Level Switch	Hydraulic	Senses low hydraulic reservoir level	Hydraulic system provides pressurized oil for suspension operation, and power steering PDFOV-2978: PMCS
Hydraulic Pressure	Hydraulic	Senses low hydraulic system pressure	Hydraulic system provides pressurized oil for suspension operation. steering
Air Restriction	Engine	Senses restriction of engine intake air through the air filter.	PDFOV-2978: PMCS PDFOV-2877: Gauges and Indicators
Water in Fuel	Engine	Senses water within the fuel/water separator	Bowl is not clear. A switch is needed to detect the presence of water.
Coolant Level	Engine	Senses low engine coolant level	PDFOV-2978: PMCS
Front Axle Oil Level	Powertrain	Senses low front differential oil level	PDFOV-2978: PMCS Without sensor, underbody armor would need to be removed to check oil level.
Rear Axle Oil Level	Powertrain	Senses low rear differential oil level	PDFOV-2978: PMCS Without sensor, underbody armor would need to be removed to check oil level.
Left Front Spring Press	Suspension	Monitors spring pressure at left front corner	Required for adjustable height suspension operation
Right Front Spring Press	Suspension	Monitors spring pressure at right front corner	Required for adjustable height suspension operation
Left Rear Spring Press	Suspension	Monitors spring pressure at left rear corner	Required for adjustable height suspension operation
Left Rear	Suspension	Monitors accumulator	Required for adjustable height

Sensor	Subsystem	Purpose	Justification/ Analysis
Accumulator Press		pressure at left rear corner	suspension operation
High Press Sensor	Suspension	Monitors pressure in nitrogen reservoir	Required for adjustable height suspension operation
Right Rear Spring Press	Suspension	Monitors spring pressure at right rear corner	Required for adjustable height suspension operation
Right Rear Accumulator Press	Suspension	Monitors accumulator pressure at right rear corner	Required for adjustable height suspension operation
Park Brake Heater Temperature	Park Brake	Monitors park brake temperature	Ensures Park brake remains in its operating temperature

Appendix D
Table 2: JLTVA1 Dash Indicator Light List

Description	Symbol/Text	Location	Illumination	Alarm Type	Symbol/Text Color
Check Engine		Left Gauge	Continuous	None	Amber
Oil Pressure		Left Gauge	Continuous	Continuous	Red
Coolant Temp		Left Gauge	Continuous	Continuous	Amber
Low Fuel		Right Gauge	Continuous	0.5s on / 0.5s off	Amber
Trans Temp		Right Gauge	Continuous	Continuous	Red
Front or Rear Air Press		Right Gauge	Continuous	0.5s on / 0.5s off	Amber
Check Trans		Right Gauge	Continuous	0.5s on / 0.5s off	Amber
Wait to Start	**WAIT TO START**	Left Indicator Bank	Continuous	N/A	Amber
Low Voltage	LVD	Left Indicator Bank	Continuous	N/A	Red
Engine Fan Disable		Left Indicator Bank	Continuous	N/A	Amber
Left Turn		Left Indicator Bank	Flash	N/A	Green
Combat Override	**COMBAT OVRD**	Left Indicator Bank	Continuous	N/A	Red
Inter Axle Diff Lock		Left Indicator Bank	Continuous	N/A	Green
Rear Axle Diff Lock		Left Indicator Bank	Continuous	N/A	Green
Front Axle Diff Lock		Left Indicator Bank	Continuous	N/A	Green
High Beam		Left Indicator Bank	Continuous	N/A	Blue
Engine Oil Level	**LOW OIL LEVEL**	Left Indicator Bank	Continuous	Continuous	Amber
High Idle	**HIGH IDLE**	Left Indicator Bank	Continuous	N/A	Green
Charging System		Left Indicator Bank	Continuous	N/A	Red

Low Coolant Level		Left Indicator Bank	Continuous	N/A	Amber
Shift Range Inhibit	RANGE INHIBIT	Right Indicator Bank	Continuous	N/A	Amber
Trailer ABS		Right Indicator Bank	Continuous	N/A	Amber
Tractor ABS		Right Indicator Bank	Continuous/Flas h	N/A	Amber
Park Brake		Right Indicator Bank	Continuous	N/A	Red
Right Turn		Right Indicator Bank	Continuous	N/A	Green
CITS Overspeed	CTIS OVER SPEED	Right Indicator Bank	Continuous	N/A	Amber
CTIS Fault	CTIS FAULT	Right Indicator Bank	Continuous	N/A	Amber
Suspension Error	SPNSN ERROR	Right Indicator Bank	Continuous	N/A	Amber
Suspension Not Level	SPNSN NOT LEVEL	Right Indicator Bank	Continuous	N/A	Amber

Appendix D
Table 3: JLTVA1 Health Management System and Condition Based Maintenance Data List

The Data Table is the list of HMS and CBM data that is stored in the DSDU. This includes Faults, Conditioned Based Maintenance Data, as well as vehicle configuration and service data entered manually by users and maintainers.

Category	Types	Stored Format	Export Format	Sample Rate
Fault (Warning/ Caution/Alert)	ABS (Antilock Brake System)	Human Readable Text	ABCD	On Occurrence
Fault (Warning/ Caution/Alert)	Engine	Human Readable Text	ABCD	On Occurrence
Fault (Warning/ Caution/Alert)	Transmission	Human Readable Text	ABCD	On Occurrence
Fault (Warning/ Caution/Alert)	Chassis	Human Readable Text	ABCD	On Occurrence
Fault (Warning/ Caution/Alert)	Hydraulic	Human Readable Text	ABCD	On Occurrence
Fault (Warning/ Caution/Alert)	BMS (Battery Mgmt. Sys)	Human Readable Text	ABCD	On Occurrence
Fault (Warning/ Caution/Alert)	Axle	Human Readable Text	ABCD	On Occurrence
Fault (Warning/ Caution/Alert)	Silent Watch BMS	Human Readable Text	ABCD	On Occurrence
Fault (Warning/ Caution/Alert)	Lighting	Human Readable Text	ABCD	On Occurrence
Fault (Warning/ Caution/Alert)	HVAC	Human Readable Text	ABCD	On Occurrence
Fault (Warning/ Caution/Alert)	CTIS	Human Readable Text	ABCD	On Occurrence
Fault (Warning/ Caution/Alert)	24v mVEC	Human Readable Text	ABCD	On Occurrence
Fault (Warning/ Caution/Alert)	12v mVEC	Human Readable Text	ABCD	On Occurrence
Fault (Warning/ Caution/Alert)	Suspension	Human Readable Text	ABCD	On Occurrence
CBM	Vehicle Speed	Human Readable Text	ABCD	100 MS
CBM	Engine Speed	Human Readable Text	ABCD	30 MS
CBM	Odometer	Human Readable Text	ABCD	100 MS
CBM	Trans Gear	Human Readable Text	ABCD	100 MS

Category	Types	Stored Format	Export Format	Sample Rate
CBM	Service Brake	Human Readable Text	ABCD	100 MS
CBM	Engine Hours	Human Readable Text	ABCD	1 minute
CBM	Throttle Position	Human Readable Text	ABCD	30 MS
CBM	Intake Manifold Temp	Human Readable Text	ABCD	500 MS
Manual Entry	Vehicle Configuration Data	Human Readable Text	N/A	N/A
Manual Entry	Service Data/ Notes	Human Readable Text	N/A	N/A

Appendix D

GLOSSARY

CBM	Conditioned Based Maintenance
COTS	Commercial off the shelf
DSDU	Driver’s Smart Display Unit
FMEA	Failure Modes and Effects Analysis
HMS	Health Management System
JLTVA1	Joint Light Tactical Vehicle
L-ATV	Light Combat Tactical All-Terrain Vehicle (Oshkosh brand name for the JLTVA1 vehicle)
VIA	Vehicle Interface Application

Appendix D
DSDU for Maintainers – Retrieving Transmission Active Codes

To retrieve active service codes for troubleshooting the transmission, follow the steps below:
1. **Select SERVICE** to navigate to the active codes button.

2. **Select ACTIVE CODES** to access the list of active codes.

3. The image below is a sample display of the ACTIVE SERVICE CODES screen. Any codes that are occurring (active) will display on this screen. Select the BACK button to go to previous slide, or HOME to return to DSDU for Maintainers HOME screen.

Appendix D
Preventative Maintenance Checks and Services (PMCS)
Maintenance Instructions

This PMCS information is from Operations Manual dated 7-12-18

CHAPTER 4

PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS) MAINTENANCE INSTRUCTIONS

US Army
SFAE-CSS-JC-JL
MS 640 BLDG 302 RM 113
6501 E 11 Mile Road
Warren, MI 48397-5000

INSTRUCTOR GUIDE

Joint Light Tactical Vehicle (JLTVA1) Maintainer Course

LESSON

03 Electrical

SECTION I. ADMINISTRATIVE DATA

All Courses Including This Lesson

Course Number	Version	Course Title
JLTVA1_MAINT_01	3.0	Introduction and Safety
JLTVA1_MAINT_02	3.0	Vehicle Familiarization
JLTVA1_MAINT_03	3.0	Electrical
JLTVA1_MAINT_04	3.0	Engine
JLTVA1_MAINT_05	3.0	Transmission
JLTVA1_MAINT_06	3.0	Drivetrain
JLTVA1_MAINT_07	3.0	Suspension, Hydraulics and Steering
JLTVA1_MAINT_08	3.0	Air Systems, Brakes and CTIS
JLTVA1_MAINT_09	3.0	End of Course

Task(s) Taught (*) or Supported

Task Number	Task Title
V.A.1	*Interpret electrical circuits using wiring diagrams
VII.C.1.2	*Inspect battery hold downs, connections, cables and cable routing; service as necessary
V.G.18	*Identify causes of databus communication problems; determine needed action
VII.C.2.1	*Inspect Alternator Mountings, Cable, Wiring and Wiring Routing; Determine Needed Action
V.E.1	*Interface with vehicle's on-board computer; perform diagnostic procedures using recommended electronic service tool(s) (including PC based software and/or data scan tools); determine needed action.
VII.C.B.6	*Check Operation of All Accessories (GFE)
V.A.6	*Locate Shorts Grounds and Opens in Electrical Circuits: • Power Distribution • Starting Circuit • J1939 • Charging Circuit • Lighting Circuit
AA118_00_NGFAAAC	*Troubleshoot Engine Fails to Crank
AA10406_00_NGFAAA	*Troubleshoot 24 VDC Does Not Operate Open at wire 1061
AA10406_00_NGFAAA	*Troubleshoot 24 VDC Does not operate Inspect Battery Disconnect

AA10J_00_NGFAADC	*Troubleshoot Code 15-22 NO J1939 COMM with ALTERNATOR
AA10J_00_NGFAACO	*Troubleshoot Code 15-08 NO COMM-PM FRONT-ENG
A510A06_00_NGFAAAD	*Troubleshoot Headlight Low Beams Do Not Operate
AA118_00_NGFAAAE	*Troubleshoot Rear Lighting Does Not Operate
	*Troubleshoot C4ISR

Reinforced Task(s)

Task Number	Task Title
N/A	

Academic Hours

The academic hours required to teach this lesson are as follows:

Academic	Resident Hours	Methods
4 hrs. 30 mins		ILT
10 hrs. 30 mins		PE
Total Hours:	15 hrs.	

Test Lesson Number

Hours	Lesson Number Version	Lesson Title
1 hr 30 min	Test A	09_End of Course and Final Exam
1 hr 30 min	Test B	09_End of Course and Final Exam

Prerequisite Lesson(s)

Hours	Lesson Number Version	Lesson Title
N/A	N/A	N/A

Clearance Access

Security Level: Distribution C
Requirements: Distribution authorized to U.S. Government agencies and their contractors only.

Foreign Disclosure Restrictions

FD7. This product/publication has been reviewed by the product developers in coordination with the Oshkosh Corporation foreign disclosure authority. This product is NOT releasable to students from foreign countries.

References

Number	Title	Date
2320-01-653-6557	JLTVA1 GP IETM	April 2018
2320-01-653-6495	JLTVA1 HGC IETM	April 2018
2320-01-653-6516	JLTVA1 UTL IETM	April 2018
2320-01-653-6534	JLTVA1 CCWC IETM	April 2018

Student Study Assignments	None
Instructor Requirements	JLTVA1 Certified Instructor (3)

Additional Support Personnel Requirements

Name	Student Ratio	Qty	Man Hours
N/A			

Equipment Required for Instruction

ID Name	Student Ratio	Instructor Ratio	Spt	Qty	Exp
Laptop	1:1	1:1	No	15	Yes
Projector	1:15	1:1	No	1	Yes
JLTVA1	1:5	1:1	No	3	Yes
MSD with EMS NG/IETM	1:5	1:1	No	1/JLTV A1	Yes
FRS/SATS Trailer	1:5	1:1	No	1/JLTV A1	Yes
BII	1:5	1:1	No	1/JLTV A1	Yes
FIK	1:5	1:1	No	1/JLTV A1	Yes

Materials Required

Instructor Materials:
Instructor Guide

Student Materials:
Student Guide

Classroom, Training Area, and Range Requirements

ID Name	Qty	Student Ratio	Setup Mins	Cleanup Mins
Classroom, 15 Student	1	1:15	30	30
Shop, 3 Bays	1	1:5	30	30

Ammunition Requirements

DODIC Name	Qty	Student Ratio	Setup Mins	Cleanup Mins
N/A				

Instructional Guidance / Conduct of Lesson

NOTE: Before presenting this lesson, instructors must thoroughly prepare by studying this Lesson and identified reference material

Proponent Lesson Plan Approvals

Name	Rank	Position	Date
N/A			

SECTION II.	INTRODUCTION
	Method of Instruction: Lecture Instructor to student ratio: 1:15 Time of Instruction: 15 mins Instructional Strategy: Lecture & Group Discussion
Motivator	Working on vehicles electrical systems today is vastly advanced from working on electrical systems of the past; it requires a deeper understanding of the technology that goes into the modern, more sophisticated electric wiring and computer interfaces. This increased sophistication requires the students to know the truck, understand the system of operation and know how to read the schematics available in the IETM; failure to understand all the above has an increased risk of injury or death to personnel and/or damage to the vehicle.
Terminal Learning Objective 3.	**NOTE:** Inform the students of the following Terminal Learning Objective requirements. Upon completion of this lesson, you will be able to: Action: Maintain the JLTVA1's electrical systems Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity.
Safety Requirements	Remove all jewelry Disconnect the battery if applicable It is the responsibility of the student/warfighter to follow safety guidelines as well as local unit SOPs.
Risk Assessment Level	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	A Check on Learning will be conducted at the end of each lesson to help reinforce and monitor the proper transfer of knowledge to students At the end of the course a written final exam will be administered of which each student/warfighter must earn an 80% or greater to pass this course. Throughout the lessons/modules practical exercises are conducted. Students will need to complete each exercise with 100% accuracy (to include remedial training if necessary) before the Performance Evaluation Checklist is signed, to ensure students can properly conduct maintenance procedures. PE's are graded using a "go/no go" criteria, of which all students/warfighters must earn all "go's" (100%).

Instructional Lead-In	**(Slide #1)** The electrical system of this vehicle uses a combination of traditional analog circuits, but also includes multiple communication networks. These networks connect the various electrical systems and displays this information on the DSDU interface. Understanding the circuits, how they work, and their purpose is essential to troubleshoot and maintain the JLTVA1.

SECTION III.	PRESENTATION

Enabling Learning Objective A.

(Slide #1 cont.)

Upon the completion of this JLTVA1 Electrical Maintenance Module, you will be able to perform proper inspections, testing, maintenance and troubleshooting of the JLTVA1 vehicle family.

The knowledge and skill from this training is critical to ensuring the JLTVA1 is serviced and maintained to fully mission capable.

(Slide #2)

Lesson Overview:
The Electrical Lesson is 15 hrs. long. Time is split between classroom and hands-on. The daily time split is displayed on the screen for your reference.

The focus of training will be on JLTVA1 specifics; this course is not a review of basic electrical. We will cover the following topics in the order below:

- Power Distribution
- Starting/Charging
- J1939 Electrical Theory of Operations
- Auxiliary Electrical
- Maintenance
- Troubleshooting Fault Codes

We will always lead with classroom discussion of the Theory of Operation and schematic trace, then we will move to the shop to do hands on training to experience live system testing and troubleshooting for each subsystem of the JLTVA1.

(Slide #3)

To prepare you for accomplishing the primary goal of maintaining the electrical system for the JLTVA1, there are several enabling learning steps we must accomplish. We'll review each learning objective prior to launching into the topic.

Upon completion of this lesson, you will be able to:

Action:	Troubleshoot the 24 VDC electrical system of the JLTVA1 including power distribution, charging, and starting electrical systems/sub-systems
Conditions:	Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials
Standards:	Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity.

1. **(Slide #4)**

ELO A – LSA 1

Learning Step/Activity:	JLTVA1 Electrical System Overview
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	10 mins
Media Type:	PowerPoint

(Slide #5)

a. Structured Overview of JLTVA1 Electrical System

1. Systems

a) Battery/Power Supply

b) Ignition Power

c) Starting

d) Charging

e) J1939 Databus

f) Lights

g) C4ISR (Tactical Vehicle Communication Suite)

(Slide #6)

2. The JLTVA1 electrical system can be divided into two separate sub-systems; one for the vehicle itself called the Vetronics (vehicle-electronics), and another for C4ISR equipment. This lesson will focus primarily on the vehicle electrical system; however, providing and controlling power to the C4ISR system and interaction between the two systems will also be presented. The vehicle electrical system uses multiple J1939 Databus networks and electronic control modules to control and operate most vehicle components. This is common across all JLTVA1 platforms. Dash mounted controls and the DSDU allow the operator or maintainer to interact with these systems.

3. The electrical system performs the electrical power storage, protection, distribution, and generation functions required to support JLTVA1 mission profile requirements. These electrical functions provide the power sources, controls, and linkages required for vehicle automotive operation, operation of on-board electrical/electronic components, and C4ISR equipment.

(Slide #7)

4. Electrical System Breakdown

   a) JLTVA1 Analog Circuits-Like other tactical vehicles the JLTVA1 contains a basic analog style electrical system that distributes battery power throughout the truck for use on normal automotive systems. This electrical system is broke down into the following circuits:

      1) Battery/power supply circuit takes the stored power of the battery and sends that power through the battery cables to distribution points on the vehicle.

      2) Ignition power supply circuit takes the battery supply circuit power and activates the next circuit when the operator would turn the ignition on. This is a requirement of most electronic control units (ECUs) to have a main battery power, and then ignition power to "wake up" the computers.

         (a) The battery and ignition supply circuits power the electrical requirements and distribution points for the automotive systems on the JLTVA1. For some, the JLTVA1 uses a multiplexed vehicle electrical center (mVEC). An mVEC is commonly used on other tactical wheeled vehicles but may be referred to as a fuse or relay box. The difference with a traditional fuse/relay box and the JLTVA1 mVEC is electronic monitoring of the circuit breaker state (Good, faulted, or missing).

      3) Starting system circuit allows the operator to start the engine on the vehicle after battery and ignition power distribution occurs.

      4) Charging system circuit replenishes the battery after the engine starts then provides the electrical power used during vehicle operations.

      5) J1939 JLTVA1 Databus/Controller Area Network (CAN) Systems- Used to transmit information, requests and commands in a computer to computer message as opposed to analog wiring. This increases the efficiency of the vehicle, reduces wiring, and allows for on-board diagnostics as the physical wiring can be used for multiple purposes instead of dedicated wires for each input or output. Each network shares/uses the same information structure but would be specific to the system and components of the system.

         (a) Communication on a J1939 network is either information/status or request and command messages

(b) Information messages are simply just shared for all computers connected to that network to know about such as oil pressure or engine RPM. When the engine shares the RPM, the DSDU and dash will get the message and update the gauge/screen accordingly.

(c) Requests/Commands are processed by a main controller and either allowed or not. The decision to allow the request or not is based on the program and processing that occurs inside the main controller. This logic is often referred to as the programing of the computer or main controller.

(d) The JLTVA1 has four J1939 Databus networks of the vehicle and one additional network for the C4ISR systems. Each network will be constructed so the correct computers communicate on the same network. The controller will direct the information flow if required from one network to another as the controller is connected to each network. The J1939 networks on the JLTVA1 are:

(1) Engine network- Shares engine related information and controls such as ABS, Transmission, CTIS.

(2) Chassis network- Connects all the chassis ECUs.

(3) Sensor network- Used to gather information on various systems.

(4) Suspension network- Used to control the suspension ride heights.

(5) C4ISR Network- Follows the same principles as covered for J1939 but is dedicated to the equipment required to complete the various missions, minus the truck systems.

Instructor Note

This learning step begins with guided Q&A for encouraging student interaction, peer commentary, and primarily to trigger recall of prior knowledge in the students before escalating into the complex electrical data.

Trigger Prior Recall of Electricity Basics

Q: What are the three primary requirements for electrical circuits?
A: Power, Ground and Signal.

Q: Who can tell me (at a high level) the difference between DC circuits and AC circuits?
A: DC (direct current) circuit – electric charge flows in one direction only. AC (alternating current) circuit – electric charge periodically changes direction

Q: By show of hands who has experience working with databuses/communication networks?

Check on Learning

(Slide #8)

Q: What are the two separate sub-systems of the JLTVA1 electrical system?
A: One for the vehicle itself called the Vetronics (vehicle-electronics), and another for C4ISR equipment.

Q: What is the function of each of the 5 databus networks of the J1939?
A: Engine network- Shares engine related information and controls such as ABS, Transmission, CTIS.
Chassis network- Connects all the chassis ECUs
Sensor network- Used to gather information on various systems.
Suspension network- Used to control the suspension ride heights.
C4ISR Network- Follows the same principles as covered for J1939 but is dedicated to the equipment required to complete the various missions, minus the truck systems.

Summary

(Slide #9)

Now that you understand there are two types of subsystems utilized to power the major systems of the JLTVA1 we will start looking at each of the primary circuits in detail.

Transition

Any questions before we cover power distribution?

2.

(Slide #10)

ELO A – LSA 2

Learning Step/Activity:	Power Distribution
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	45 mins
Media Type:	PowerPoint, EMS-NG Diagrams

(Slide #11)

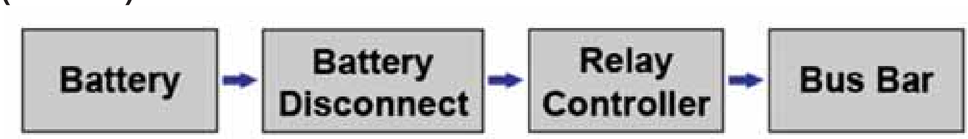


Figure 3.1 Battery/power circuit diagram

a. Battery/Power Supply Circuit (Figure 3.1)

1. Overview

a) The first circuit is the battery/power supply circuit. This circuit is used on the JLTVA1 to supply power for all the automotive systems needed to start and drive the JLTVA1.

b) The battery supply is like other tactical vehicles using an absorbed glass-matte style battery for electrical power storage and a battery disconnect to isolate the batteries from the rest of the electrical system. This disconnect prevents unwanted drain on the battery when the vehicle is not in use.

c) After the power is passed through the master disconnect, it is sent to a bus bar that is used to distribute the electrical power to all the circuits/components that require battery power.

(Slide #12)

b. Components and Location

Figure 3.2 Optima Red Top batteries

1. Primary vehicle batteries (Figure 3.2) are Optima Red Top maintenance-free, sealed, wound spiral cell.

   a) Batteries are located behind the front mounted NATO slave connector below the engine compartment in the battery tray. The batteries are accessed by dropping the front of the tray down.

   b) The batteries' open circuit voltage is 12.6 VDC. Each battery provides a nominal voltage of 12 volts at 800CCA (1000 A above 32 °F).

   c) Reserve capacity of the batteries is 110 minutes (25-amp discharge at 80 degrees to 10.5 VDC cutoff).

   d) The Red Top batteries weigh 38.8 lbs.

   e) Connected in series, the batteries supply 24 VDC to the automotive systems on the JLTVA1.

(Slide #13)

Figure 3.3 Battery disconnect switch

2. Master battery disconnect switch (Figure 3.3)

   a) The battery disconnect switch, a common rocker style, is located on the bottom, far left side of the dash. Turning the switch on sends a signal to the relay controller to close or allow power to pass through to the bus bar.

   b) The power is supplied to the battery disconnect switch (S6) from the battery, to the M15 power stud and then through fuse 10 for circuit protection.

   c) Once the battery disconnect switch is turned on, 24 VDC passes though the switch, back to the relay controller MC499, pin 6 to activate the relays. The relays close or latch and battery power is now supplied to the truck.

   d) The JLTVA1 incorporates a low voltage detection system. If the battery power drops too low, the LVD light comes on the dash and the LED incorporated into the battery disconnect switch begins to flash. This is a warning that battery supply is dropping.

(Slide #14)

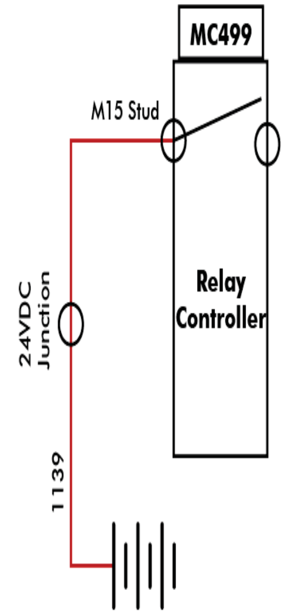


Figure 3.4 Relay control wiring

Figure 3.5 Relay controller

3. Relay Controller (Figure 3.4 and 3.5)

   a) The battery disconnect relay controller is a 24v, 500-amp relay controller. The relay controller has 2 independent relays within it and is in the engine compartment, near the alternator on the passenger side. The relay controller is a hermetically sealed relay that has 4 studs and one connector.

      1) The two relays inside the controller are for distribution of battery power supplied to the relay. Each relay has a stud where battery power supply gets to the relay and another stud that once activated would send power out of relay for vehicle use.

      2) One of the relays is 24VDC from both batteries, and the other is 12VDC supplied from the battery equalizer. Both 12 and 24 VDC are required on the JLTVA1.

3) Once the power is supplied though the relay it is distributed to the bus bar after the relay has been activated.

4) The connector contains the wiring that controls the latch/close, unlatch/open features.

(Slide #15)

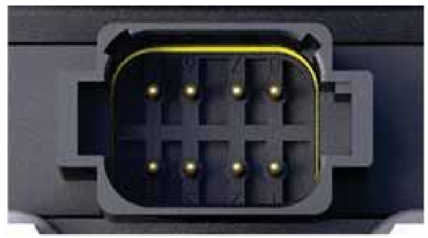


Figure 3.6 Eight pin Deutsch connector

b) The relay controller connector is an eight pin Deutsch connector. The inputs and outputs are

1) Pin location 1 is for the low current output. The low current output is used to latch the relays to the on position when the ignition switch is active.

2) Pin location 2 is used for combat-override input. This override input is received from the combat override switch. This keeps the relay controller latched to the on position always. It will over-ride the function of the battery disconnect switch.

3) Pin location 3 is the low voltage calibration output. This is not currently used on the JLTVA1.

4) Pin 4 is the relay controller ground. The internal processing unit of the relay controller uses the ground to complete the electrical circuits.

5) Pin 5 is the mode input. The mode of the relay controller is determined if there is a wire for ground or if there is power. The available modes relate to the duration it takes to shut off the battery disconnect. The battery disconnect has a 30 second timer integrated to the relay controller.

6) Pin 6 is the relay controller activation input. The input is the common return from the battery disconnect switch. The switch is used to turn on and off the batteries.

7) Pin 7 is for timing calibration. Timing calibration verifies timing of the low voltage signal output. It does not have a wire in place.

8) Pin 8 is the LED pull down output. It turns on the LED on the battery disconnect switch.

(Slide #16)

Figure 3.7 24V Bus bar

4. 24V Bus bar (Figure 3.7)

    a) The 24V Bus bar is a 9-position bus bar that is located behind the Alternator in the engine compartment. The bus bar has at least 7 connections to it.

    b) Wire 1139 supplies battery power to the bus bar from the relay controller.

    c) Wire 1274 (6 cables)

        1) 2 cables attach to the alternator for system charging.

        2) 1 cable attaches to the cab mVEC stud.

        3) 1 cable supplies power to the Starter relay.

        4) 1 cable supplies power to the ignition relay.

        5) 1 cable supplies 24 VDC for the battery equalizer.

(Slide #17)

Instructor Note
The mVEC has a communication network used to display faults. Students only need to be aware this capability is there right now. Further discussions on communication networks will provide detail for how the systems work, and how to troubleshoot it.

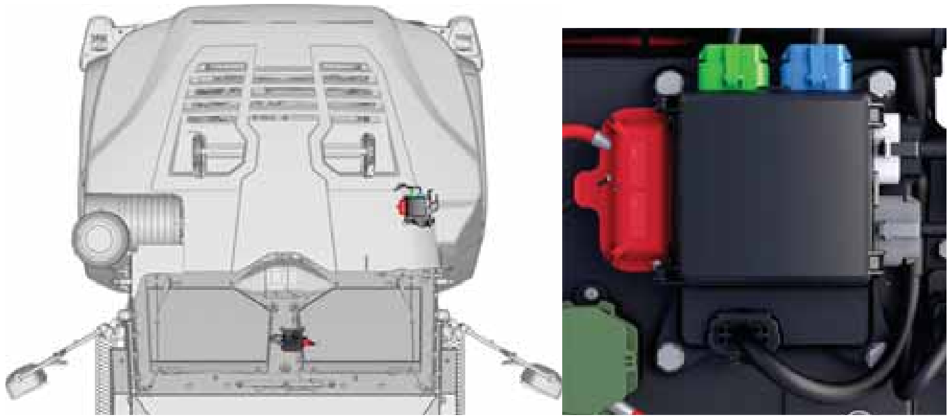


Figure 3.8 Multiplex vehicle electrical center (mVEC)

5. Multiplex Vehicle Electrical Center (mVEC) (Figure 3.8)

   a) There are 2 mVEC on the JLTVA1. One is in the cab and the other is in the engine compartment.

   b) The Cab mVEC is in the dash, behind the DSDU. It contains fuses and relays for power distribution. The cab mVEC is only 24 VDC.

   c) The engine compartment mVEC is on the right side of the engine compartment. It provides power to the 12 and 24 VDC systems outside of the cab.

   d) The mVEC is a multiplex vehicle electrical center. This is a fuse and relay box like other tactical wheeled vehicles, but this one is integrated into a communication network and displays the status of circuit breakers on the DSDU as either good, faulted, or missing. Each circuit breaker is an input to the mVEC module. The module broadcasts the status of the circuit breakers via the J1939 communication network.

Note

With the implementation of ECP OSKW8402R2, the 12/24 VDC mVEC replaced each circuit breaker with a fuse. This update may be present in the vehicle. Refer to Appendix D, page 1 for the conversation table.

(Slide #18)

Figure 3.9 12 pin Packard connector

e) The mVEC has 2 power studs to provide battery power and one 12-pin Packard connector. It is rated at 200A total throughout the module. Individual circuit breakers can be rated up to 30A. Below lists the inputs and outputs used by the 12-pin connector. (Figure 3.9)

1) Pin 1 battery power used to power the mVEC.

2) Pin 2 is the network address ground. This is one of the ways the mVEC module identifies itself on the J1939 Databus network. (used on the engine mVEC). The cab mVEC uses mode zero-no wire in place.

3) Pin 3 is chassis ground to power the mVEC unit.

4) Pin 4 is another address ground. (not used).

5) Pin 5 is J1939 shield ground.

6) Pin 6 is CAN+ (high).

7) Pin 7 is ignition ground (not used).

8) Pin 8 is ignition power for the mVEC unit.

9) Pin 9 is another address ground. (not used).

10) Pin 10 is another address ground. (used on the engine mVEC).

11) Pin 11 is a high side output and not used.

12) Pin 12 is CAN- (low).

> **Note**
>
> There are four output connectors on each mVEC. On the 12/24V Chassis mVEC, they are MC301, MC302, MC303, and MC304. In the 24V Cab mVEC, they are MC401, MC402, MC403, and MC404. To identify the connector and pin location for each circuit in the schematics, there is an alphanumeric code before each circuit name. For example, in the Chassis mVEC, wire 1200 is described as “G 2 ABS 15A”. This gives the name of the circuit and the amperage rating of the circuit breaker, but also the connector and pin location. In this case, wire 1200 is located in pin G of connector MC302. This method is used to identify all output circuits in both mVECs.

(Slide #19)

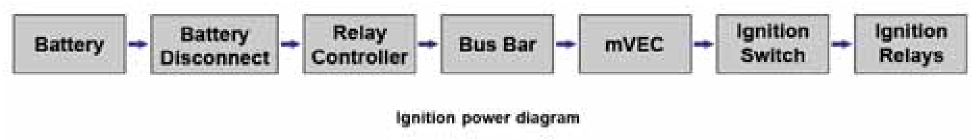


Figure 3.10 Ignition power diagram

c. Ignition Power Circuit Overview (Figure 3.10)

1. Ignition power is power supplied to components upon activation of the ignition switch. This will distribute power to the other circuits on the JLTVA1 that need power to prepare the vehicle for starting and operation.

2. Power flows from bus bar to mVEC to Ignition Switch to Ignition Relays to mVEC.

(Slide #20)

d. Ignition Components

1. Ignition Switch (Figure 3.11)

   a) The ignition switch is the three-position rotary switch that provides power to the ignition and starting circuit. It is in the cab next to the driver’s right knee.

Figure 3.11 Ignition switch panel

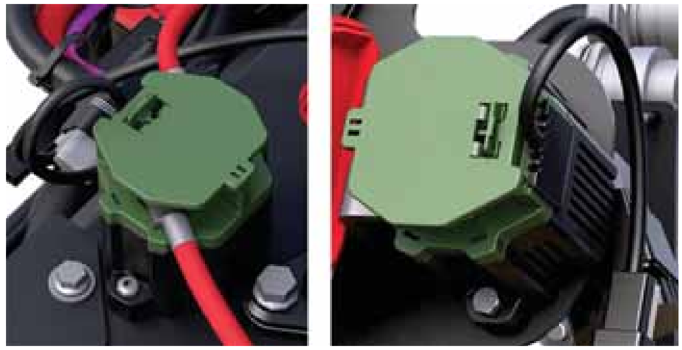


Figure 3.12 Ignition relays

2. Ignition Relays (Figure 3.12)

   a) Two 24 VDC relays (coils energized by 24 VDC); one relay is located behind the dash near the Cab mVEC that passes 24 VDC, and the other is in the engine compartment that passes 12 VDC.

   b) Single pull/single throw

   c) Normally in open position.

   d) When ignition is in “on” position, wire 1075 supplies 24V to the ignition relays at MC507 and MC111 position 2.

   e) The ground is supplied from MC499 position 1 wire 1438 at the relay controller.

(Slide #21)

Instructor Note
The line drawing will reappear throughout the rest of this module to provide a visual of the power distribution flow throughout the systems. Use this map is to help reference the power distribution path from: **Battery Power to Ignition Circuit.** Refer students to the IETM.

e. Ignition Power Distribution Circuit

1. Battery Power to Ignition Circuit (Figure 3.13)

   a) Once the battery disconnect relay is energized, the relay controller supplies 24 VDC to the 24 VDC Bus bar.

   b) Next, the bus bar distributes 24 VDC to the cab mVEC and out to CB21 (10A). Then, CB21 supplies 24 VDC to SP50 which powers the accelerometer and pin 1 of the ignition switch.

   c) When the ignition switch is rotated to the first position, 24 VDC leaves S1 at pins 4 and 5 which splice together at SP1.

   d) Next, the 24 VDC supplies the ignition relays which receive a hold down signal from pin 1 at MC499 at the relay controller.

e) The relay controller supplies ignition power for the 24 VDC ignition power and the 12 VDC ignition power

f) This then wakes up all Electronic Control Units (ECUs) on the truck to begin system operation.

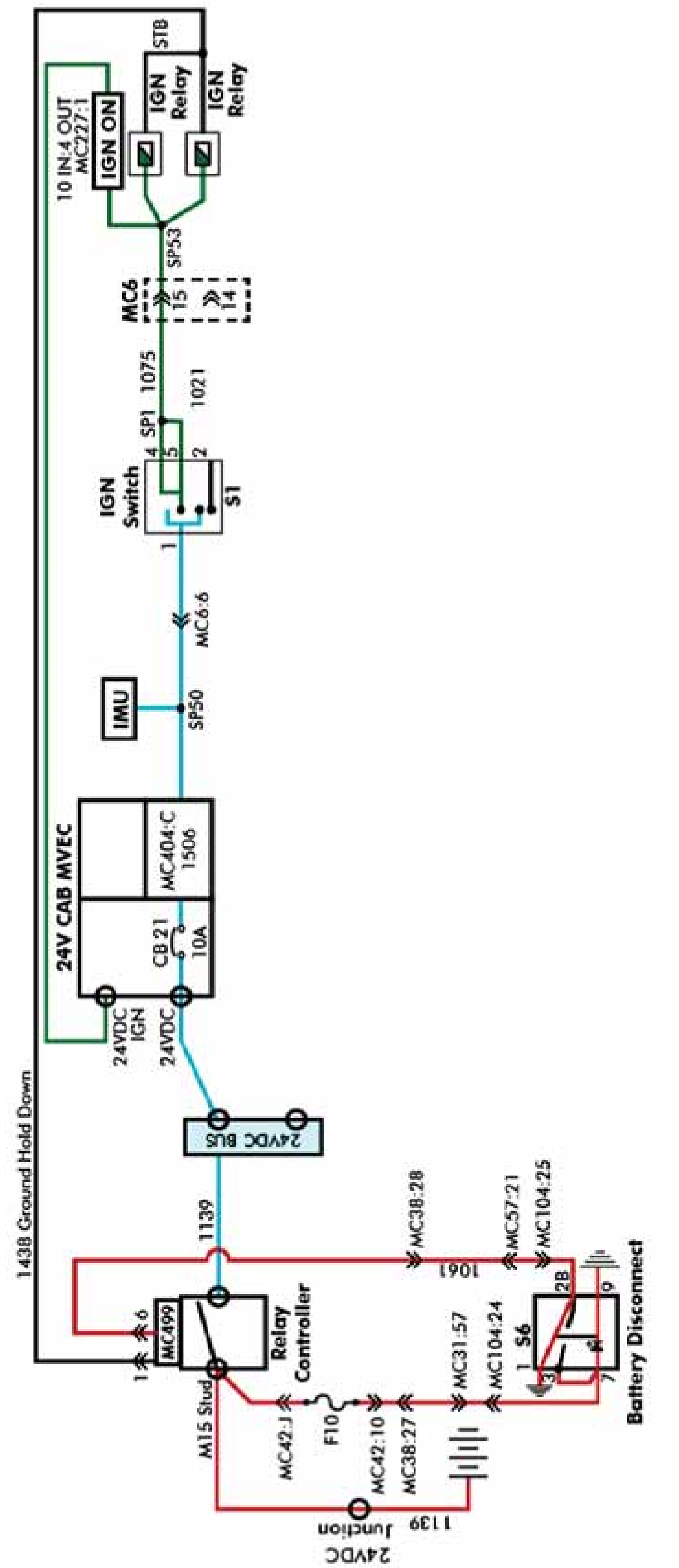


Figure 3.13 Battery/power circuit diagram

(Slide #22)

Figure 3.14 DSDU

f. Maintenance of the battery and ignition power circuits.

1. Electrical maintenance consists of inspection for damage or corrosion and correct function of components.

2. The power distribution/electrical circuits can be inspected or checked on the DSDU by looking at the mVEC circuit breaker status screen. This shows the user whether the circuit breaker is OK, Faulted, or Unknown. OK means the circuit breaker is closed and there is no problem with the circuit. Faulted means the circuit breaker tripped, popped, or has been removed. This indicates a possible short to ground in the circuit. Unknown means the circuit breaker has not been addressed. (Figure 3.14)

Check on Learning

(Slide #23)

Q: Which Pin of the Relay controller is the activation input for the relay controller to turn the batteries on and off?
A: Pin 6.

Q: There are two mVEC on the JLTVA1. Differentiate the location and function of each.
A: The Cab mVEC is behind the DSDU and is 24 VDC. The Cab mVEC distributes power to 24-volt systems only. The engine compartment mVEC is located inside the engine compartment on the far-right side (passenger side). This mVEC is 12-24 VDC. It distributes power to 12 and 24-volt systems outside the cab such as the ignition.

Summary

(Slide #24)

Power distribution begins with the batteries.

The JLTVA1 uses Optima Red Top batteries.

Once the battery disconnect relay is energized, 24 VDC is supplied from the relay controller to the 24 VDC bus bar.

	The bus bar then distributes the 24 VDC to the cab mVEC and out to CB21 (10A). Next, the CB21 supplies 24 VDC out to SP50 that powers the accelerometer and pin 1 – the ignition switch. When the ignition switch is rotated to the first position, 24 VDC leaves S1 at pins 4 and 5 which are spliced together at SP1. Next, the 24 VDC supplies the ignition relays which receive their hold down signal from pin1 at MC499 at the relay controller. The relay controller then supplies ignition power for the 24 VDC ignition power and 12 VDC ignition power. Finally, all ECUs wake up on the truck and begin system operation.
Transition	What questions do you have at this point? Now that you understand the Theory of Operation and schematics for power distribution, the next learning step provides the opportunity to apply what you learned and get familiar with the power distribution systems in place on the JLTVA1.
3.	**(Slide #25)** ELO A – LSA 3 Learning Step/Activity: 12 & 24 VDC Does Not Operate #1 Method of Instruction: Practical Exercise Instructor to student ratio: 1:5 Time of instruction: 60 mins Media Type: None **(Slide #26)** See Appendix C: PE 3A-1
Check on Learning	None
Summary	None
Transition	Any questions before we begin the next Practical Exercise?
4.	ELO A – LSA 4 Learning Step/Activity: 12 & 24 VDC Does Not Operate #2 Method of Instruction: Practical Exercise Instructor to student ratio: 1:5 Time of instruction: 30 mins Media Type: None See Appendix C: PE No. 3B-1
Check on Learning	None

Summary	None
Transition	Any questions before we continue to the next Practical Exercise?
5.	ELO A – LSA 5 Learning Step/Activity: Vehicle Batteries Overheating Method of Instruction: Practical Exercise Instructor to student ratio: 1:5 Time of instruction: 45 mins Media Type: None See Appendix C: PE 3C-1
Check on Learning	None
Summary	None
Transition	Any questions before we go back to the classroom?

6.

(Slide #27)

ELO A – LSA 6

Learning Step/Activity: Starting System
Method of Instruction: Lecture
Instructor to student ratio: 1:15
Time of instruction: 30 mins
Media Type: PPT

(Slide #28)

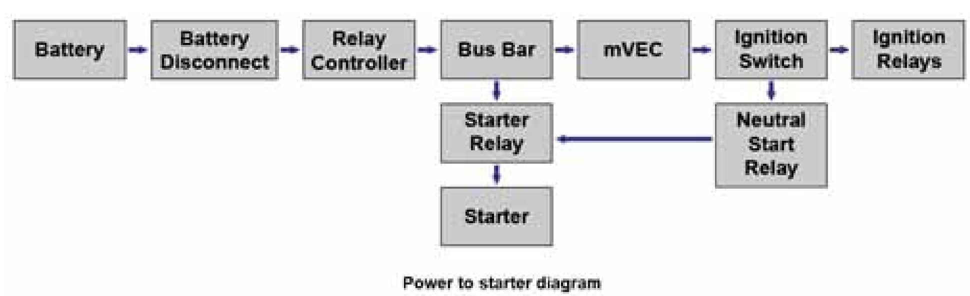


Figure 3.15 Power to starter diagram

a. Overview-Starting System Circuit (Figure 3.15)

1. Power is supplied from the batteries through the relay controller to the bus bar.

2. The bus bar supplies 24 VDC on wire 1274 to terminal 30 on the K6 starter relay.

3. When the transmission is in neutral, the TCM provides a 24 VDC neutral signal on wire 1041 to terminal 86 on the K3 neutral start relay. This energizes the coil of K3 causing the switch contacts to close.

4. When the ignition switch is turned to the ‘start’ position, power flows down wire 1021, through the switch contacts of K3 neutral start relay, and out wire 1021a to terminal 86 on the K6 starter relay. This energizes the coil of K6 causing the switch contacts to close. 24 VDC from wire 1274 then flows through the switch contacts of K6 relay and to the starter on wire 1436 to start the vehicle.

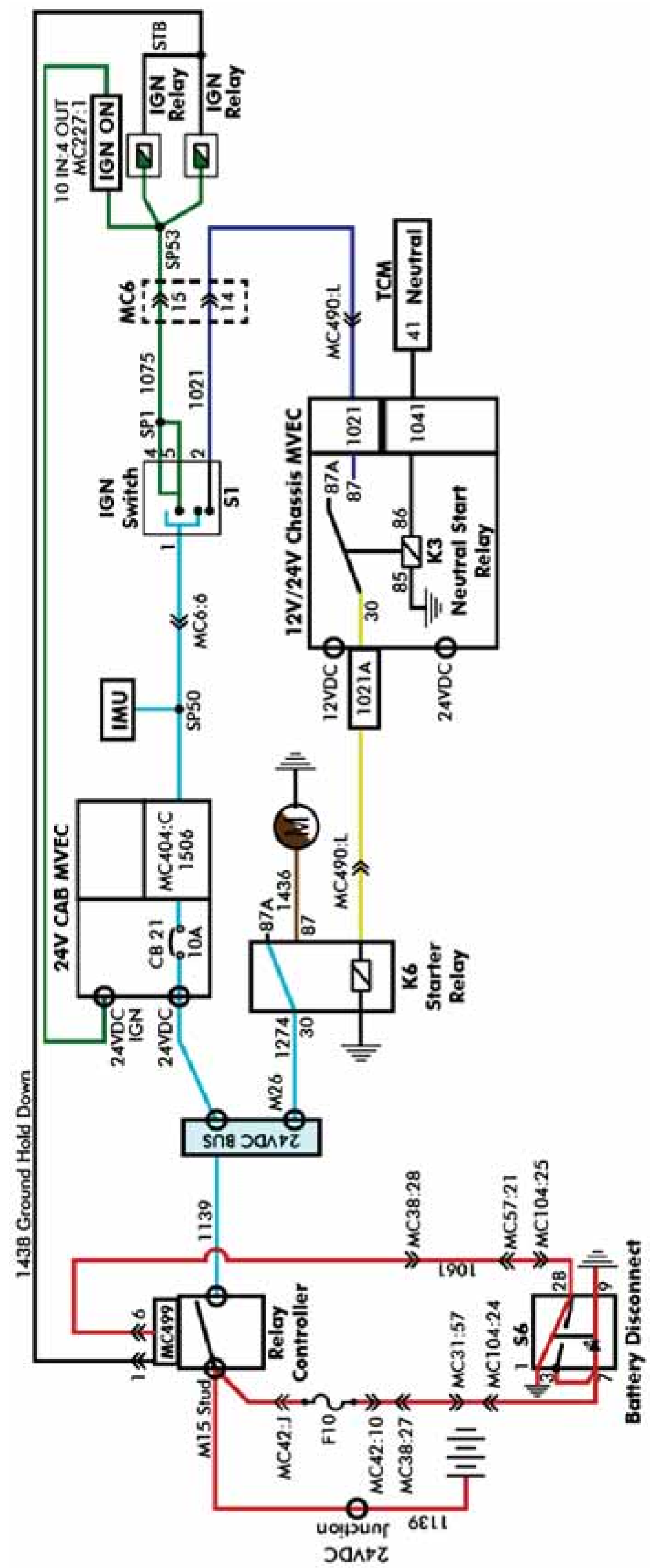


Figure 3.16 Power circuit diagram

(Slide #29)

b. Components & Locations

Figure 3.17 Ignition switch panel

1. Engine Start Switch (Figure 3.17)

   a) Three-position rotary switch provides power to the ignition and starting circuit.

   b) The switch is in the cab next to the driver's right knee. The switch makes contact between pins 1 and 6 (internally tied together) and 2 providing the start voltage to the K3 neutral start relay when rotated to the far-right position.

Figure 3.18 K3 and K6 relays

2. Neutral Start Relay (Figure 3.18)

   a) Supplies power to activate the K6 starter relay that supplies power to the starter

   b) The K3 neutral start relay is in the Chassis mVEC and is a 24 VDC relay.

3. Starter Relay

   a) The K6 Starter Relay provides power to the starter. It is located on the outside of the front right upper subframe just below the lifting eye.

b) It is a 24 VDC relay.

Figure 3.19 Starter and solenoid

4. Starter motor and solenoid (Figure 3.19)

   a) The starter is a Delco Remy 24 VDC, 11 tooth, 3.9 kw starter. It weighs about 19 lbs. and incorporates a soft start system for smooth operation when energized.

   b) It is a brushed design with planetary reduction for additional torque. It rotates in a right-hand direction.

(Slide #30)

c. Maintenance

1. Periodic checks of the starter are critical to good health of any starting system.

2. When the starter is engaged, ensure it engages smoothly with no unusual noise.

3. Inspect wiring to solenoids and relays to ensure there is no corrosion or damage to the system that could become a larger problem in the future.

Check on Learning

(Slide #31)

Q: Explain the power flow from when the ignition switch is in the 'start' position to when the starter starts the vehicle.
A: Power flows through the K3 relay to the starter relay. The bus bar supplies 24 VDC to energize the starter relay. The starter then starts the vehicle.

Summary

(Slide #32)

The Engine Start Switch is a three-position rotary switch which connects the power from the battery to the ignition and starting circuit. It is in the cab next to the driver's right knee.

Engaging the switch supplies ignition power for the 24 VDC ignition power and 12 VDC ignition power. This wakes up all ECUs (electronic control units) on the truck and begin system operation.

Transition	Any questions before we head out to the truck?

7. **(Slide #33)**

ELO A – LSA 7

Learning Step/Activity:	Engine Fails to Crank
Method of Instruction:	Practical Exercise
Instructor to student ratio:	1:5
Time of instruction:	45 mins
Media Type:	None

(Slide #34)

See Appendix C: PE 3D-1

Check on Learning	None
Summary	None
Transition	What questions do you have at this point? We will now return to the classroom to discuss the Charging Subsystem.

8. **(Slide #35)**

ELO A – LSA 8

Learning Step/Activity:	Charging
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	20 mins
Media Type:	PPT

(Slide #36)

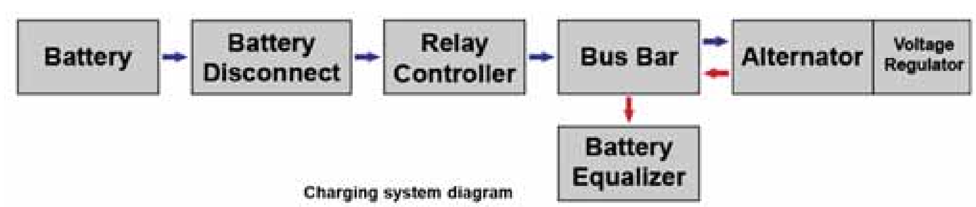


Figure 3.20 Charging system diagram

a. Overview- Charging System Circuit (Figure 3.20)

1. The charging system on the JLTVA1 recharges the batteries after starting and maintains all the electrical loads during vehicle operations.

2. The engine drives the alternator via a drive belt system.

3. The alternator senses the electrical load or depletion by monitoring the system voltage. As the voltage goes down, the alternator increases its output. As the system voltage increases, the alternator decreases its output.

(Slide #37)

b. Components and Location

Figure 3.21 Alternator

1. Alternator (Figure 3.21)

   a) The alternator in the JLTVA1 is a Neihoff model N1618-1 alternator.

   b) The alternator is controlled internally to produce 28 VDC (650 Amps peak output) to the JLTVA1 9 position bus bar to power the vehicle systems and charge the batteries.

   c) All the current transmitting components are non-moving which extends the life of the alternator.

Figure 3.22 DSDU

2. Voltage regulator

   a) The voltage regulator is a Neihoff voltage regulator model N3274.

      1) The voltage regulator communicates on J1939. Connector (MC 181) on the voltage regulator contains CAN+ (pin 1), CAN – (pin 2) and ignition sense signaling (pin 10).

2) After the engine is running, the voltage regulator monitors shaft rotation. Once the shaft rotation reaches an appropriate speed, the regulator begins to provide a field activation current to start charging the system.

3) The soft start to charging the alternator can take up to 10 seconds before charging occurs at the full electrical load.

4) The set points to begin charging are 28 VDC +-.2 volts and 14.0 VDC +-.2 VDC at 75 Degrees F. The alternator output is temperature compensated.

5) The voltage regulator is equipped with over voltage protection in the event charging brings the voltage too high. The voltage regulator opens the field signal to the alternator if charging is higher than 32 VDC on the 28 VDC system OR 16 VDC on a 14 VDC side for 2 seconds.

   (a) If this happens, the voltage regulator only reenergizes the field once the system voltage reaches 11 VDC on the 14 VDC system OR 22 VDC on the 28 VDC system.

Instructor Note
At the time of publication there is another connector on the voltage regulator which contains Neihoff proprietary control wiring.

(Slide #38)

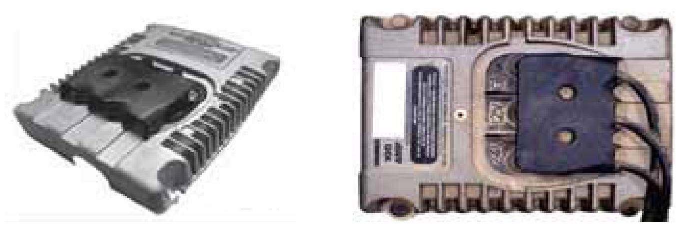


Figure 3.23 Battery Equalizer

3. Battery Equalizer (Figure 3.23)

   a) The battery equalizer provides 12-14 VDC current to the 12-volt circuits when the engine runs. It is at the right rear of the engine compartment below the relay controller.

   b) The equalizer receives 28 VDC on wire 1274 from the alternator via the 24 VDC bus bar.

   c) It converts the 28 VDC input to 14 VDC output to operate the 12-14 VDC system during vehicle operation (engine running).

   d) 14 VDC power flows from the battery equalizer, out wire 1973, through a 125A fuse, to the 12V Load stud on the relay controller and on to the 12/14 VDC system.

(Slide #39)

c. Charging System Power Distribution

   1. Schematic

   2. Maintenance/Troubleshooting

      a) Signs/indicators

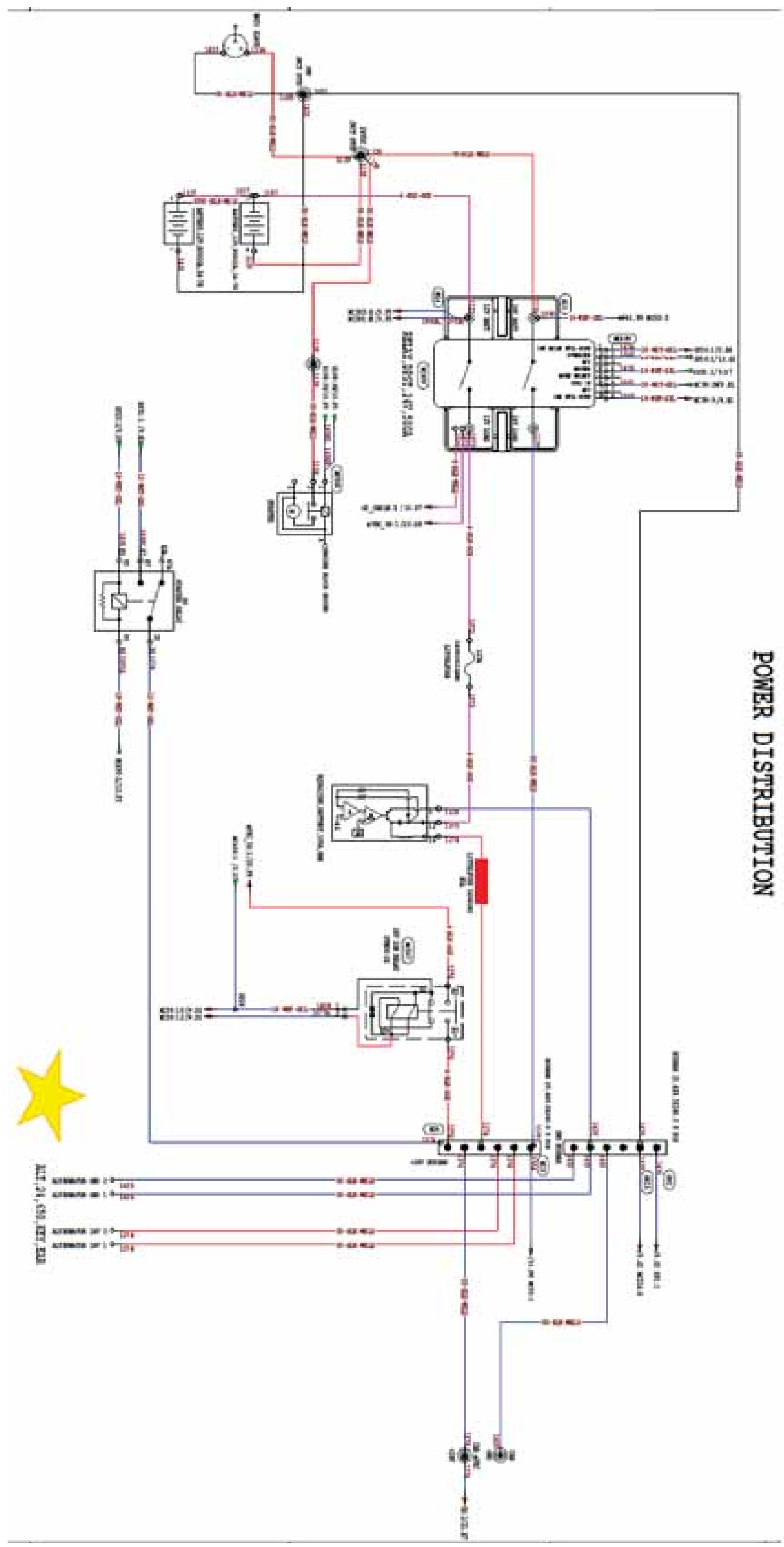


Figure 3.24 Power distribution diagram

Check on Learning	**(Slide #40)** **Q:** What is the maximum amperage output of the alternator at 28 VDC? **A:** 650A **Q:** During a soft start of charging, how long can it take to ramp up to full alternator output? **A:** It can take up to ten seconds at full electrical load for full output to be achieved. **Q:** At what voltages will the voltage regulator disable the charging system to protect from overvoltage? **A:** 32 VDC on the 28 VDC system and 16 VDC on the 14 VDC system.
Summary	**(Slide #41)** The charging system consists of a 650-amp alternator that outputs 28 VDC. The voltage regulator communicates on the databus and controls when the alternator begins charging as well as the charging system output. It disables the charging system if an overcharge condition occurs. The battery equalizer receives 28 VDC from the alternator and provides output to power the 14 VDC system while the engine is running.
Transition	What questions do you have before we go out to the truck?
9.	**(Slide #42)** ELO A – LSA 9 Learning Step/Activity: Troubleshoot Alternator Method of Instruction: Practical Exercise Instructor to student ratio: 1:5 Time of instruction: 1 hr Media Type: None **(Slide #43)** See Appendix C: PE 3E-1
Check on Learning	None
Summary	None
Transition	What questions do you have about the troubleshooting exercise? Now that we know about power distribution, the starting system, and the charging system, we can move on to the J1939 Databus system.

Enabling Learning Objective B.

(Slide #44)

Upon completion of this lesson, you will be able to:

Action:	Troubleshoot the JLTVA1's J1939 Databus systems/sub-systems
Conditions:	Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials
Standards:	Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity.

1.

(Slide #45)

ELO B – LSA 1

Learning Step/Activity:	J1939 Databus
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	1 hr
Media Type:	PPT and Video

(Slide #46)

Instructor Note
Play J1939 Databus Video [running time 8 minutes]

a. Overview- Controller Area Network (CAN) Networks (Video)

1. The J1939 is a communication network which allows messages to pass through or involve many components on one controlled area network or CAN system.

2. A black network cable – the backbone - contains a twisted pair of insulated wires (Yellow/Green) for transmitting messages between ECUs and 1 non-insulated 'shield' wire for preventing electromagnetic interference.

3. ECUs are connected to the backbone at each splitter – called node - and Deutsch connectors used as diagnostic tools to the network.

4. Terminating resistors are used for allowing messages to travel between ECUs. Each terminating resistor creates one circuit for communication. Since the network has 2 resistors, messages may travel between ECUs and increases the overall message capacity of the network.

(Slide #47)

b. J1939 Overview (Figure 3.25)

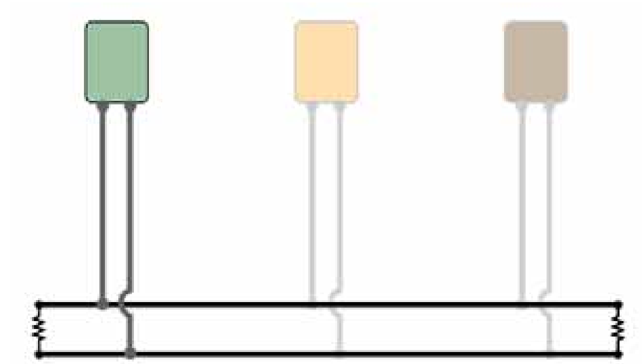


Figure 3.25 J1939 introduction

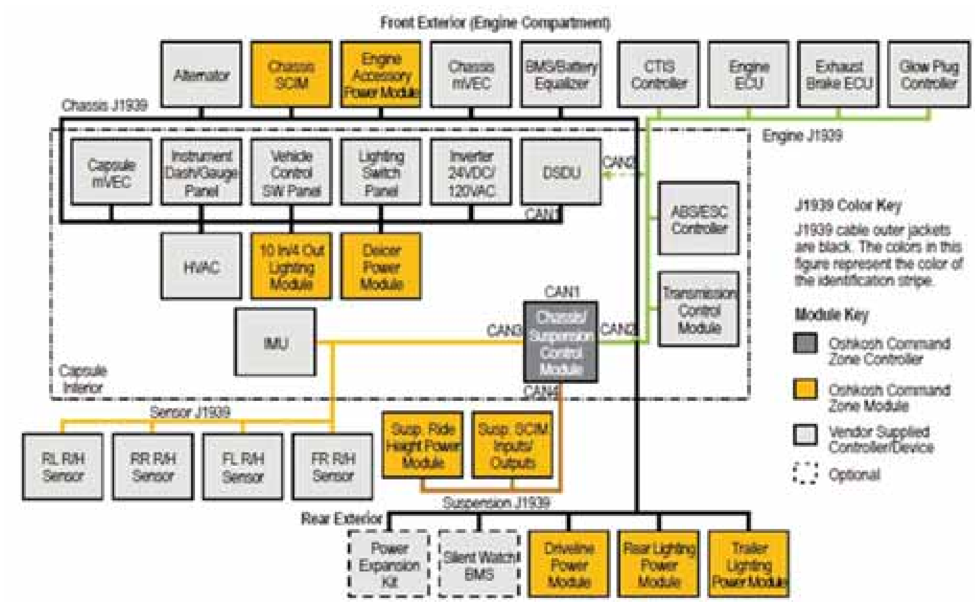


Figure 3.26 J1939 diagram

1. Overview

   a) A J1939 network allows for computers to communicate with one another. Each computer or module on the network has a specific address. When messages are sent out on the databus, the module sending the message includes who the message is from and the address of who the message is intended. J1939 is a specific CAN network with detailed specifications for wiring architecture, messaging protocol, and performance requirements. (Figure 3.25-26)

   b) There are three main types of messages on the databuses.

      1) Information – Messages report status and data that other computers may use.

      2) Requests – Messages require the main computer to ensure all requirements are met before allowing a request to process and turn into a command message.

3) Commands – Messages are actionable items by the computer/module they are addressed to do. For example, turn on the headlights.

c) There are three types of computers on a J1939 network

1) Input devices/sensors – These components capture and report information on the network such as pressures, statuses, positions, etc.

2) Controllers/Processing Devices – There is usually one of these per network that contains the vehicle programming and logic. This programming allows the module to process information or requests and make decisions on activation of other systems/components sent out as commands.

3) Output devices – The modules receive the commands sent to them via the processor or controller and carry out the action.

2. There are numerous databuses on the truck. All the buses report through the Databus Communication Network Controller. Below are the databuses on for the JLTVA1.

a) Chassis Bus

b) Suspension Bus

c) Engine Bus

d) Sensor Bus

e) C4ISR Bus

(Slide #48)

3. Components

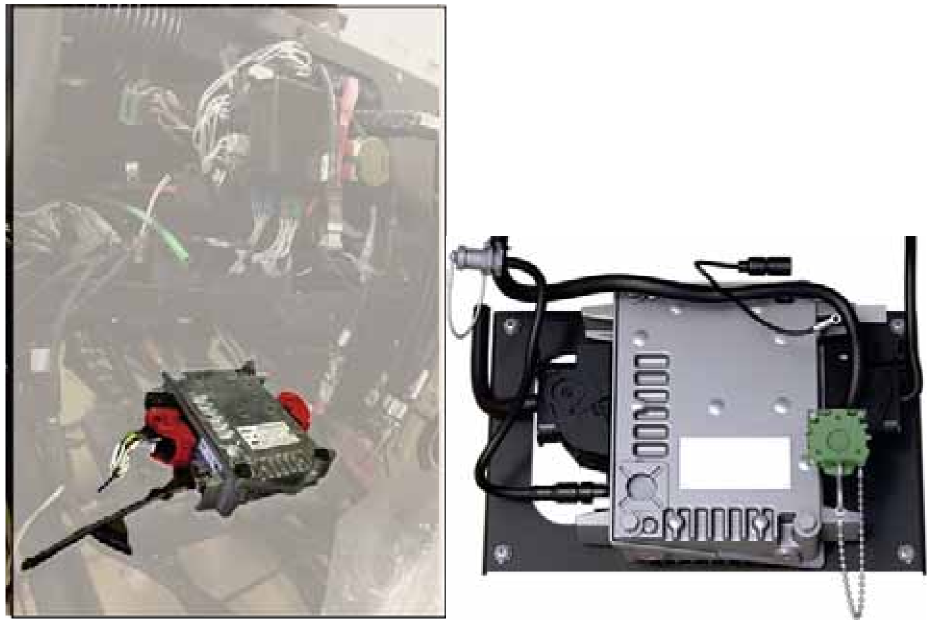


Figure 3.27 Databus Communication Network Controller

a) Network Controller (Figure 3.27)

1) The 3G controller is the main bus chassis computer for the JLTVA1 platform and contains the programming logic for all the system’s functions to work. All system requests must go through the 3G controller.

2) Theory of Operation of Databus Communication Network.

(a) The 3G controller processes information, requests and commands. If one of the switch modules sends a request out on the network, the switch lights up indicating the message was sent.

(b) This request is sent down the databus to the 3G controller which reviews the request and ensures the criteria is met to grant the request. The JLTVA1 3G controller allows operation of the component and a command message is sent to the output action. The controller does not complete the action directly.

(c) If the required criteria are not met, the request will not be granted by the system.

(Slide #49)

Figure 3.28 Power Module Example

b) Power Modules (Figure 3.28)

1) The power module is an output device that when activated outputs battery power. The power module replaces the need for more fuses and relays. The power module acts like a relay by sending power to the component when the criteria is met. There is circuit protection internal to the power module which reduces the need for circuit breakers.

(a) Power modules have a splice point that supplies power to the power module inputs (8 total). Inside the power module a transistor receives the request from the J1939 then passes the input power to the output power for the component.

2) The power module receives a command from the 3G controller to activate an output. The output is battery power that was supplied to the module.

3) There are **six output only power modules** found on the JLTVA1: Deicer power module, front chassis power module, rear chassis power module, rear light power module, suspension power module, and the 12V trailer power module. The following locations are the power modules on the JLTVA1 (Figure 3.29)

(Slide #50)

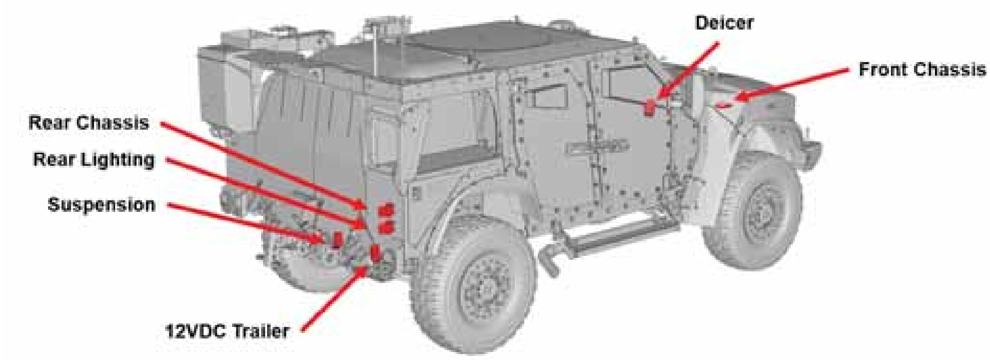


Figure 3.29 Power module locations

(a) Deicer - For all JLTVA1 models, the deicer power module is located inside the cab, on the right side of the truck behind the CSDU (if installed) or the CSDU panel.

(b) Front Chassis - For all JLTVA1 models, the front chassis power module is located on the right side of the truck below 12/24VDC mVEC.

(c) Rear Light - For all JLTVA1 models, the rear chassis lighting power module is located on the right side of the truck, mounted on the outboard side of the bracket that houses the tractor protection valve.

(d) Rear Chassis - For all JLTVA1 models, the rear chassis power module is mounted to the right rear of the truck, near the brake reservoirs.

(e) 12V Trailer - For all JLTVA1 models, the 12 VDC trailer power module is located behind the splash panel on the right rear of the truck.

(f) Suspension - For all JLTVA1 models, the suspension power module is located on the left rear side of the truck under the splash guards on the bracket just behind the cross-plumbing bleed ports.

(Slide #51)

Figure 3.30 Lighting switch module

Figure 3.31 Systems control switch module

c) Multiplex (MUX) Control Panels

1) There are two MUX panels used on the JLTVA1; one on the left side of the dash for lighting, and one in the center dash area for vehicle systems. (Figure 3.30-31)

2) The MUX panels work as computer modules. Even though there are eight buttons on each MUX panel, the connector on the back of the panel only has four wires; a power wire, a ground wire, and two databus wires.

(a) When a button is pressed, the MUX panel sends a request message over the databus for the function that the button is programmed to control.

(b) The 3G Controller processes the request message which in turn sends a databus command message to whichever module directly powers the component being controlled.

(c) Since they are electronic components, it may take a couple of seconds after ignition ON for the panels to begin to function (startup time). Also, the buttons require a deliberate press to operate (press, hold, release within about one second); a “quick hit” to one of the buttons will likely not produce an output.

3) The buttons are very durable and rated for a 1,000,000 press-cycle life.

(Slide #52)

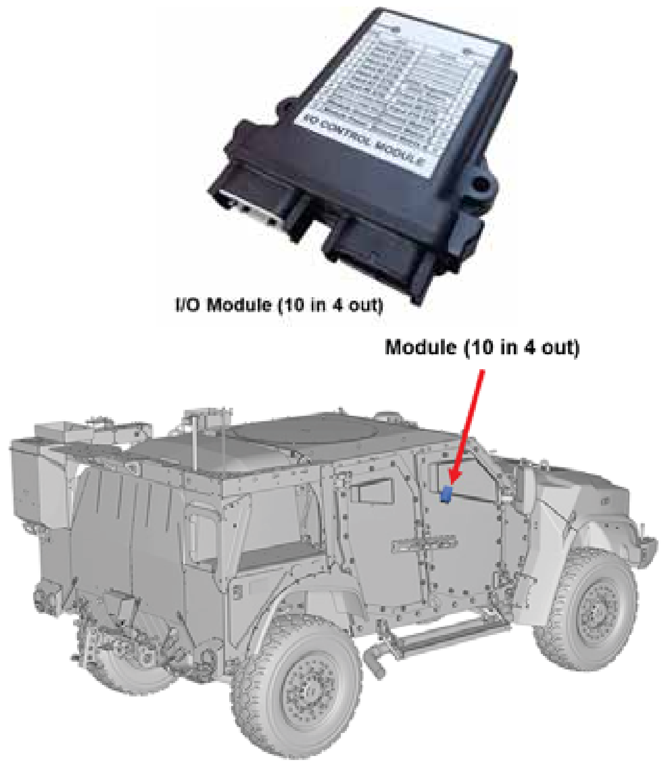


Figure 3.32 Input/output modules

d) Input/output modules (Figure 3.32)

1) There are two different types of I/O modules used on the JLTVA1 (10 in 4 out module and Software Configurable Input Module (SCIM)).

2) The 10 in 4 out module is found behind the panel on the commander side of the vehicle on the left side (the power module is on the right) receives inputs and produces some outputs. Pins 1-12 on MC227 are all inputs with pins 9 and 10 being CAN- and CAN+ respectively. Pin 11 is ground and 12 is power. MC 228 pins 1-4 are 2.5A outputs, pin 5 and 6 are 5 VDC reference voltage and ground. Pins 8 and 9 are switch to battery (STB) inputs. Pins 10-12 are the Hardware Identity (HID) pins with only 10 and 12 used. Pin 7 is not used.

(Slide #53)

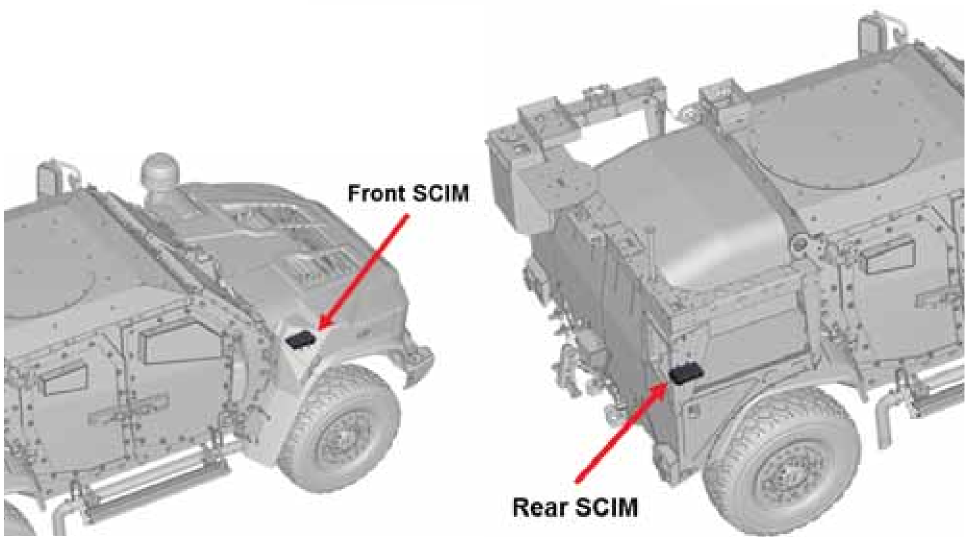


Figure 3.33 Front (left) and rear (right) SCIM

e) The SCIM is a module that is configured for its use within the vehicle. It has the option, based on the programming, to produce and receive a broad range of data including grounds, power (PWM, reference voltages, etc.) and frequencies. There are 2 SCIM's found on the JLTVA1. The first is on the front, in the engine compartment, just below the mVEC. The second is on the rear of the vehicle near the brake fluid reservoirs.

1) The rear SCIM has connectors MC173, 174, and 175 connected to it. The rear SCIM processes the data from the suspension system and relays that data to the 3G controller for processing.

2) The front SCIM has connectors 245, 246, 247 connected to it. This module monitors some lighting inputs and chassis engine control elements. The SCIM, on the diagram, is split on two pages: sheet 9 (3G) and 13 (H5). (Figure 3.33)

(Slide #54)

Terminating Resistor

Terminating Resistor	Located
Engine R8 : Green	Behind the CSDU
Engine: Engine ECM at pins 44 (CAN-) and 57 (CAN+)	
Chassis R5: Black	Rear of the truck by the rear brake actuator
Chassis R6: Black	Center of the truck near the alternator
Sensor R3: Yellow	Rear of the capsule near left rear suspension spring
Sensor R9: Yellow	Behind the CSDU
Suspension R1: Orange	Rear of the truck near the glad hands
Suspension R7: Orange	Behind the CSDU
GFE P03-P4 : No Color	In the GFE cabinet
GFE W10-P7: No Color	Behind the 120 V outlet inside the cab

Figure 3.34 J1939 Network – terminating resistor

f) Terminating Resistors (Figure 3.33) on the J1939 network remove transient voltage from the communication network. Every message sent on the databus creates a voltage. This voltage needs to be removed from the system, or it will overload the system. The terminating resistors keep the message amount or bandwidth within an acceptable range. If the terminating resistors are not present, the databus would be full of messages and no computer communication could happen resulting in a comm loss.

1) The two terminating resistors are on the truck for each databus. There are 10 terminating resistors on the JLTVA1.

2) The central location for the terminating resisters is behind the CSDU when a CSDU is present. Each terminating resistor is a 120-ohm resistor. The bus has 60 ohms of resistance when checked on a completed circuit. Each of the resistors has a color associated with it EXCEPT the C4ISR Bus. Below is the key of colors:

(a) Green – Engine The terminating resistors for the Engine Bus (Green Network) are the R8 and the Engine ECU at pins 44 (CAN-) and 57 (CAN+). The R8 resistor is behind the CSDU, if equipped.

(b) Black – Chassis. The terminating resistors for the Chassis Bus (Black Network) are the R5 and R6 resistors. The R5 is at the rear of the truck by the rear brake actuator. The R6 resistor is at the center of the truck, near the alternator.

(c) Yellow – Sensor. The terminating resistors for the Sensor Bus (Yellow Network) are the R3 and R9 resistors. The R3 is near the rear of the capsule, close to the left-rear suspension spring. The R9 is behind the CSDU.

(d) Orange – Suspension. The terminating resistors for the Suspension Bus (Orange Network) are the R1 and R7. The R1 is at the rear of the truck, near the glad hands. The R7 is behind the CSDU.

(e) No Color – C4ISR. The terminating resistors for the C4ISR Bus have no specific coloring to identify it. One of the terminating resisters is at P03-P4 in the C4ISR cabinet. The other resistor is the W10-P7, behind the 120V outlet inside the cab.

(Slide #55)

Instructor Note
Use the following schematics as reference. Refer students to the IETM. The different CAN Bus networks are not color coded in the IETM schematics as they are on the truck. To properly identify each network in the schematics, there is a two-letter prefix before “J1939” on each wire. The prefixes are: “CB” for the Chassis CAN Bus “EN” for the Engine CAN Bus “SP” for the Suspension CAN Bus “SN” for the Sensor CAN Bus For example, the CAN HI wire for the Engine CAN Bus is identified as “ENJ1939+”. There is no identifying prefix for the C4ISR CAN Bus. It is simply identified as “J1939”.

c. Databus CAN Networks

1. Chassis CAN (Figure 3.35) ID Color: Black

a) The Chassis CAN Bus is the primary databus network on the JLTVA1 and provides communication for vehicle power and control systems. These types of systems include power generation and distribution (Alternator, Battery Management System, Chassis mVEC, Cab mVEC), operational controls and indicators (Instrument Panel, Lighting MUX Panel, Vehicle Systems MUX Panel), and chassis system or end component control (Front Chassis Power Module, Front SCIM, 10 In 4 Out Module, HVAC Controller, Deice Module, Inverter, Rear Chassis Power Module, Rear Lighting Module, 12V Trailer Lighting Module, and the Silent Watch kit, if equipped). There is a connection to the DSDU to provide the operator or maintainer with system information (charging system status, circuit protection, hydraulic system temperature and pressure, or driveline lock status, for example) and user interface capability (such as load shedding scheduling). The Chassis CAN Bus connects to the 3G Controller to provide command and control functions and to allow interfacing with the other vehicle CANs. It also has a connection to the 9-pin Diagnostic Connector to provide diagnostic capability of these systems using external test equipment (MSD, etc.)

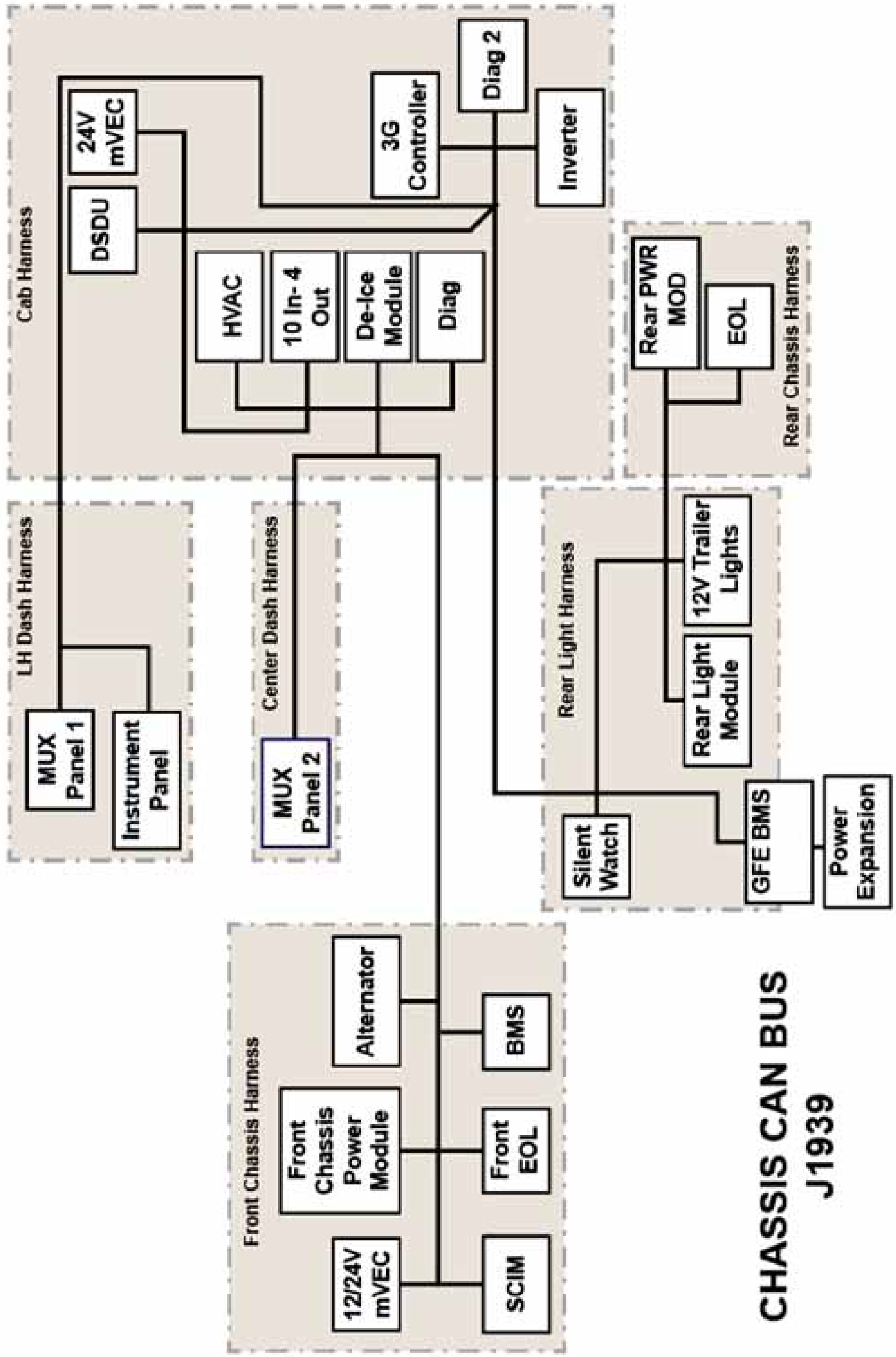


Figure 3.35 Chassis CAN Bus diagram

(Slide #56)

2. Engine CAN (Figure 3.36) ID Color: Green

   a) The Engine CAN Bus provides communication for the major vehicle operational systems (ECM, TCM, ABS, CTIS, and Turbo Controller). There is a connection to the DSDU to provide the operator or maintainer with system information (engine and transmission operational parameters, for example) and user interface capability (such as CTIS control). The Engine CAN Bus connects to the 3G Controller to provide command and control functions and to allow interfacing with the other vehicle CANs. It also has a connection to the 9-pin Diagnostic Connector to provide diagnostic capability of these systems using external test equipment (MSD, etc.).

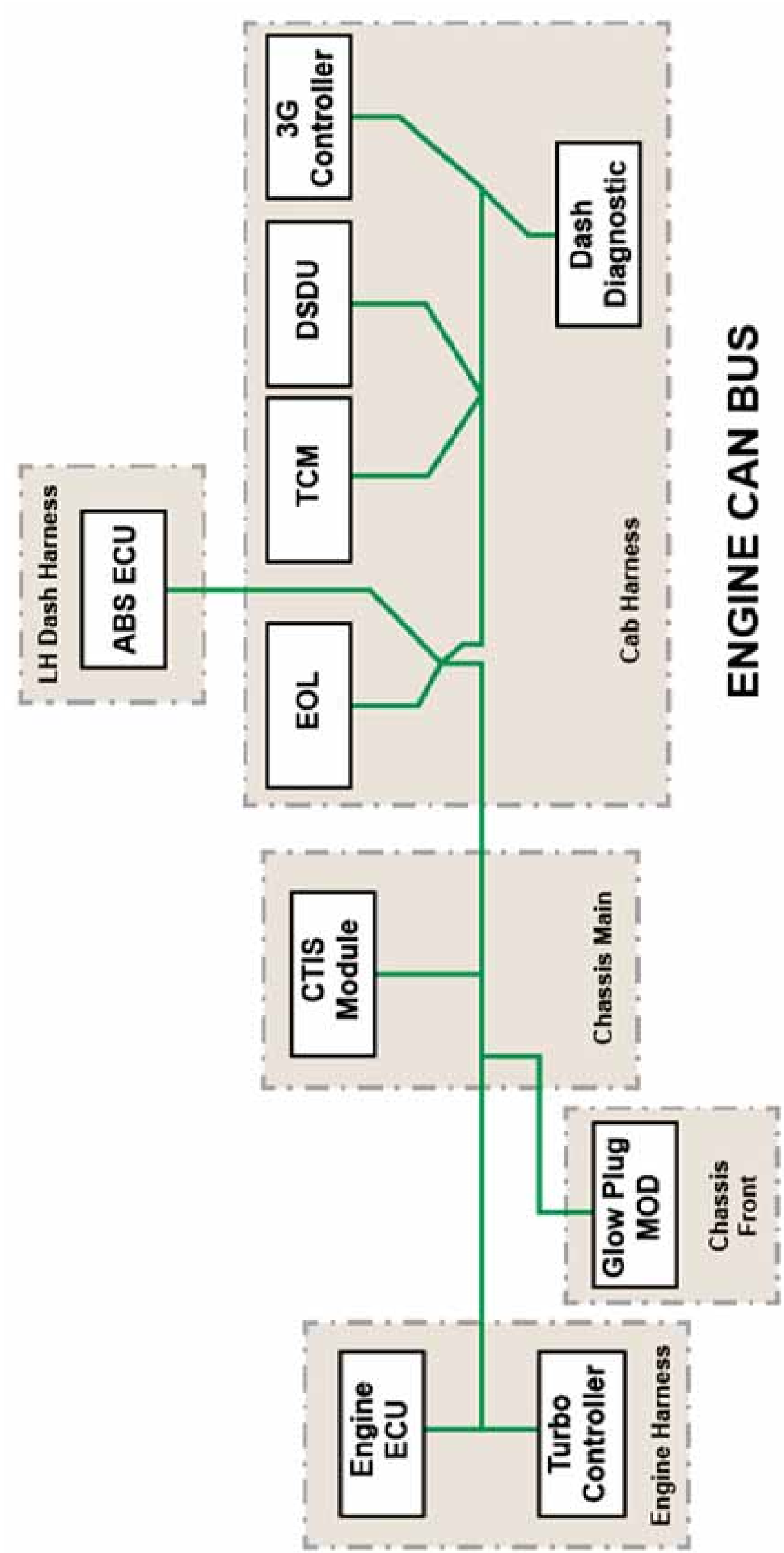


Figure 3.36 Engine CAN diagram

(Slide #57)

3. Suspension CAN (Figure 3.37) ID Color: Orange

    a) The Suspension CAN Bus provides communication for control of the TAK-4i ride height adjustable suspension system (3G Controller, Suspension SCIM and Suspension Power Module). This CAN has no direct connection to the DSDU, so system information (HPG spring or reservoir pressure, for example), user interface capability (such as ride height adjustment requests), and any potential diagnostic capability using external test equipment (MSD, etc.) are provided via the 3G Controller over the Chassis CAN Bus.

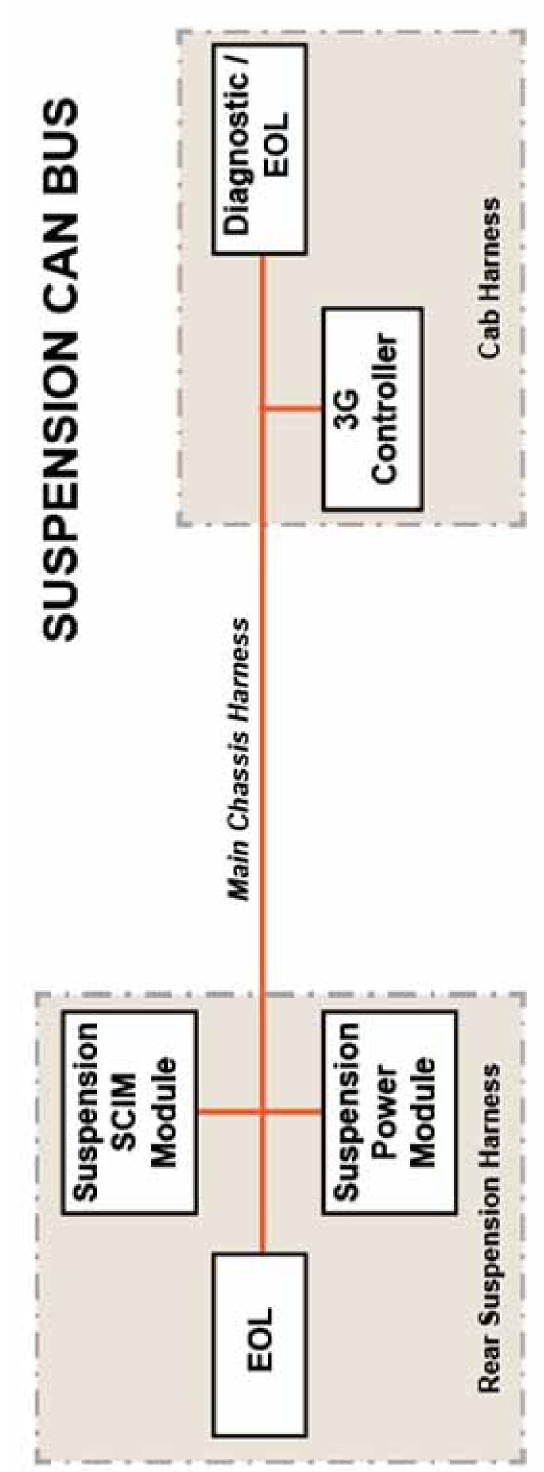


Figure 3.37 Suspension CAN diagram

(Slide #58)

4. Sensor CAN (Figure 3.38) ID Color: Yellow

   a) The Sensor CAN Bus provides communication for the CAN-based sensors on the vehicle (HPG spring ride height sensors and the IMU). These sensors will report their data to the 3G Controller which will utilize that data primarily for suspension operation. This CAN has no direct connection to the DSDU, so system information (HPG spring heights or inclinometer display, for example) and user interface capability (such as sensor addressing or IMU calibration) are provided via the 3G Controller over the Chassis CAN Bus.

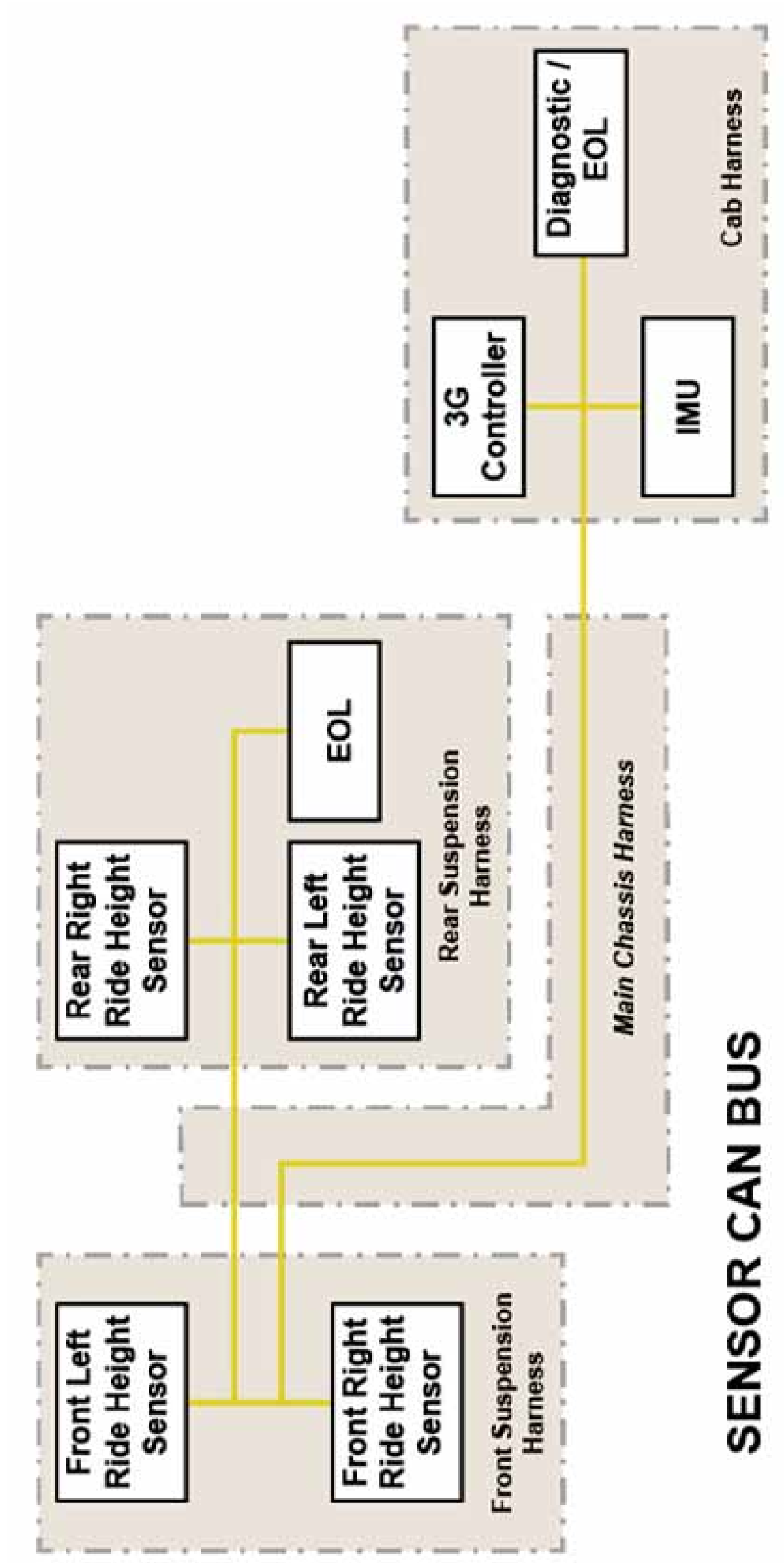


Figure 3.38 Sensor CAN diagram

(Slide #59)

Figure 3.39 C4ISR

5. C4ISR (Figure 3.39) ID Color: N/A (Black Cable)

   a) This provides communication for Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) equipment such as CROW systems, turrets, CBRN, radios, antennas, secure comms, weapon systems, and duke systems. This allows C4ISR secure and non-secure integration to the JLTVA1 via J1939.

(Slide #60)

d. Maintenance and Troubleshooting

1. General Maintenance – there is none.

2. Troubleshooting

   a) General Guideline is that the J1939 network needs to have 60 ohms to be a complete circuit. Each terminating resistor is 120 ohms and when put in parallel this equals 60 ohms. Common faults in a J1939 network are:

      1) Loose or open connection at a "Y" or node connector. This is the most common issue as the vibration and conditions the vehicle operate in can cause these connectors to come loose. This could create either 120 ohms or infinite resistance depending on the location of the fault.

      2) Open circuit in the CAN high or low wire. Both wires need to be intact to have a complete circuit. This can happen if a J1939 cable is pinched between two objects during operations or maintenance of the vehicle. This could create either 120 ohms or infinite resistance depending on where the fault is.

      3) Shorts between CAN high and low and/or ground or shield wire. Shorts can occur if the wire is chaffing on another object or harness creating an unwanted circuit path. This could create a circuit resistance of near 0 ohms.

b) Use the appropriate system to retrieve fault codes. If there is an issue with the J1939, a fault code generates and is available on the DSDU.

1) A communication fault with one module will most likely be from the connector at the backbone to the specific module with the comm loss.

2) Make sure not to overlook power and ground wires for this module. A module that does not power up will cause the same symptom and be reported as the same comm loss fault.

3) If there is a comm loss fault, the DSDU will show, “no comm fault”, Procedures from the IETM for the system at fault should be followed.

4) If there are multiple comm loss faults the most likely issue is a problem in the backbone from the ECUs reporting the fault. By looking at a schematic of the system one could identify the ECUs that are communicating and the ones that are not. The fault will most likely be in between these locations.

Check on Learning

(Slide #61)

Q: You have determined that there is a fault with the J1939 Databus. What could be some of the potential areas of concern?
A: Improper termination (resistance values), pulled or misaligned pins, zip ties too tight, open backbone or node lines, short to ground or shield.

Q: How many power modules are found on the JLTVA1
A: Six

Q: How many total terminating resistors are found on the JLTVA1?
A: Ten

Q: What are the five databus networks on the JLTVA1?
A: Chassis, Engine, Suspension, Sensor, and C4ISR.

Q: Which databus network has one terminating resistor inside an ECU?
A: The Engine databus has one terminating resistor inside the ECU.

Summary

(Slide #62)

The JLTVA1 uses the J1939 Databus as the communication network interacting with all the critical systems. There are five critical networks. Four of the five are color coded and communicate through the 3G controller: chassis, engine, suspension, sensor databuses.

The fifth critical databus is the C4ISR. Remember, the C4ISR is the only databus that is not color coded and is isolated from the 3G Controller.

Transition

What questions do you have? Next, we will go to the truck to identify each of the J1939 Databuses and the primary components.

2. **(Slide #63)**

ELO B – LSA 2

Learning Step/Activity:	J1939 Databus Component ID
Method of Instruction:	Demonstration
Instructor to student ratio:	1:5
Time of instruction:	20 mins
Media Type:	None

(Slide #64)

DEMONSTRATION J1939 DATABUS Components on JLTVA1. (20 MIN)
The purpose of this demonstration is to show the students the location of the J1939 components found on the JLTVA1.

STUDENT ROLE: Observe the demonstration and record locations in SG. All students should position themselves for a clear view of the components.

INSTRUCTOR ROLE: The instructor should provide component location and functionality. Ensure students understand how each component relates to the J1939 Databus and how each network supports its corresponding system.

TIME: Approximately 20 minutes

Safety Brief: Primary Instructor will brief the students on safety procedures while working around the vehicle and in the bay. All students will be checked for proper equipment i.e. closed toe shoes, safety glasses, gloves and ear protection.

Equipment Needed for Training:

Ladder or elevated platform (if applicable)

Supervision and Guidance: Have the students follow along with the demonstration and ask questions as they come up. Starting at the left side of the truck, walk around the vehicle while pointing out and explaining operation of each component.

Chassis Can

Component	Location
Instrument Panel	Center dash behind steering wheel
MUX Panel 1 Lighting	Left side of dash
MUX Panel 2 Systems	Right side of dash (left of DSDU)
DSDU	Center dash (display)
24 MVEC	Behind DSDU
HVAC	Below DSDU
10 IN 4 OUT	Behind CSDU on left side

Deicer	Behind CSDU on right side
Diagnostic Connector	Right of shift lever
3G Module	Beneath shift lever housing
Diagnostic 2	Left side of shift lever housing
Invertor	Under right rear seat (DC to AC)
12/24 MVEC	Right side of engine compartment
SCIM	Bottom module beneath relay controller in right side engine compartment
Front Chassis Power Module	Top module beneath relay controller in right side engine compartment
Alternator	Right side engine top rear of engine compartment
Battery Management System	Beneath the 12/24V MVEC
Front EOL/Terminating Resistor	Center ENG comp near alternator (sometimes lays a little closer to the wet tank)
Silent Watch	KIT: Roof or rear if equipped
Power Expansion	Kit: rear compartment if equipped.
Rear Lighting Module	Lower module vertically mounted behind rear brake reservoirs
12 V Trailer	Lowest module mounted behind rear brake reservoirs (lowest, close to control arms)
Rear Power Module	Upper module vertically mounted behind rear brake reservoirs
EOL/Terminating Resistor	Rear of truck by brake actuator (R5) (Black)

Engine Can

Component	Location
Engine ECU	Left side engine compartment under intake
Exhaust Brake Controller	Part of the engine ECU
Glow Plug Power Module	Left side center engine compartment on engine bracket (labeled Banks Glow Plug Module)
Mechatronic Controller	Under vehicle next to driveshaft (incorporates CTIS PCU and ECU)
EOL/Terminating Resistor	Behind CSDU (R8) (Green) & internal to engine ECM

ABS ECU	Behind driver side dash mounted to bulkhead (says Bendex)
TCM	Behind DSDU on left side
DSDU	Dash Center
3G Module	Beneath shift lever housing
Dash Diagnostic	Right side of shift lever housing

Suspension Can

Component	Location
SCIM	Horizontally mounted module behind rear brake reservoirs
EOL/Terminating Resistor	Rear of truck by glad-hands (Red)(R1)
Suspension Power Module	Rear of truck on left side in sub frame
3G Module	Beneath shift lever housing
Diagnostic EOL / Terminating Resistor	Behind CSDU (Red)(R7)

Sensor Can

Component	Location
Front Left Ride Height	FL top spring
Front Right Ride Height	FR top spring
Rear Right Ride Height	RR top spring
Rear Left Ride Height	LR top spring
EOL/Terminating Resistor	Rear of capsule near left rear spring (yellow)(R3)
3G Module	Beneath shift lever housing
IMU	On tunnel center of capsule below radio racks
Diagnostic EOL / Terminating Resistor	Behind CSDU (yellow)(R9)

Instructor Note
Transition immediately into the troubleshooting practical exercise.

Check on Learning None

Summary None

Transition None

3.	ELO B – LSA 3 Learning Step/Activity: J1939 Databus Comm Failure Method of Instruction: Practical Exercise Instructor to student ratio: 1:5 Time of instruction: 40 mins Media Type: None See Appendix C: PE 3F-1
Check on Learning	None
Summary	None
Transition	None
4.	ELO B – LSA 4 Learning Step/Activity: J1939 Communication Failures – Engine, Transmission, Suspension Method of Instruction: Practical Exercise Instructor to student ratio: 1:5 Time of instruction: 2 hr Media Type: None See Appendix C: PE No. 3G-1, 3H-1, 3I-1
Check on Learning	None
Summary	None
Transition	None
5.	**(Slide #65)** ELO B – LSA 5 Learning Step/Activity: Lighting System Method of Instruction: Lecture Instructor to student ratio: 1:15 Time of instruction: 20 mins Media Type: PPT

(Slide #66)

a. Overview

1. Theory of Operation for Lighting System

a) The lighting system on the JLTVA1 is J1939 dependent. This network is a diverse system that works with a combination of inputs and outputs to control different light systems.

b) The lights found on the JLTVA1 are dome lights, map lights, clearance/marker lights, reverse lights, blackout, headlights and taillights.

c) A module controls each light system. A power output from the SCIM controls the headlights, taillights, blackout lights, and clearance lights.

d) All the JLTVA1 lights use LED lights which are higher in reliability and use less power than a standard incandescent light.

(Slide #67)

b. Components & Locations of Light Systems

Figure 3.40 Low beams

Figure 3.41 High beams

1. Headlights

a) The headlights on the JLTVA1 are 12-24 VDC LED lights powered by the 24 VDC system on this vehicle with a high and low beam.

1) The low beams draw 1.0A at 28 VDC. (Figure 3.40)

2) The high beams draw 1.5 A at 28 VDC. (Figure3.41)

b) When the lighting MUX panel receives the headlight input from the operator, a request message is sent on the chassis J1939 Databus to the 3G controller.

c) The 3G controller then sends a command to the SCIM to turn on the lights.

d) The headlights receive power from the SCIM pin 10 (wire 1006) for low beams and pin 8 and 11 (spliced at SP3 on wire 1007) for high beams.

(Slide #68)

Figure 3.42 Rear composite light

2. Taillights

   a) The taillights are a composite design with integrated blackout lights for both blackout stop and blackout taillights. (Figure 3.42)

   b) The light modules are a 12-24V design. This is a standard military taillight.

   c) The taillights are on output from pin 5 wire 1012A from the SCIM via the D4 lighting diode pack.

   d) A request is sent out to the network from the lighting MUX panel on the J1939 network to the 3G controller.

   e) The 3G controller then receives the message and sends it out to the SCIM to produce an output to turn on the lights.

   f) When the clearance lights are on, only three of the LEDs come on at the main rear taillight.

(Slide #69)

Figure 3.43 Turn signal off

Figure 3.44 Turn signal on

3. Turn Signal Lights/Blinker (Figure 3.43-44)

Turn Signal Lights/Blinker	Function
Blinker Module (Steering Column)	• Pin G provides IGN power to MC96 (wire 1519) • Pin D provides the ground to MC 96 (wire 1435)
Left Blinker	• Pin K (wire 1010) activates 24V signal to pin 7 of MC227 at the 10 in 4 out Module.
Right Blinker	• Pin A (wire 1011) activates 24V signal to pin 8 of MC227 at the 10 in 4 out Module.
10 in 4 out Module	• Once it receives the 24V signal on either pin, it then sends signal utilizing the J1939 CAN network (Pin 9 and Pin 10 on MC227) to the 3G controller.
3G Controller	• The 3G controller sends a command to the SCIM providing power output to left or right turn signal
SCIM	• Sends power to the signal lights which splice to front and rear through the chassis harness and allow both front and rear lights to blink simultaneously.

(Slide #70)

Figure 3.45 Brake light

4. Brake Lights (Figure 3.45)

   a) If the truck has ignition power, the brake lights turn on when the brake is pressed.

   b) The 10 in 4 out module pin 6 wire 1005A receives the brake switch input. Once the signal is received, the 10 in 4 out module sends a network signal to the 3G controller.

   c) The 3G controller then sends out the command to the rear lighting module.

   d) The rear lighting power module pins 8 (left) and 10 (right) control the stop lights.

(Slide #71)

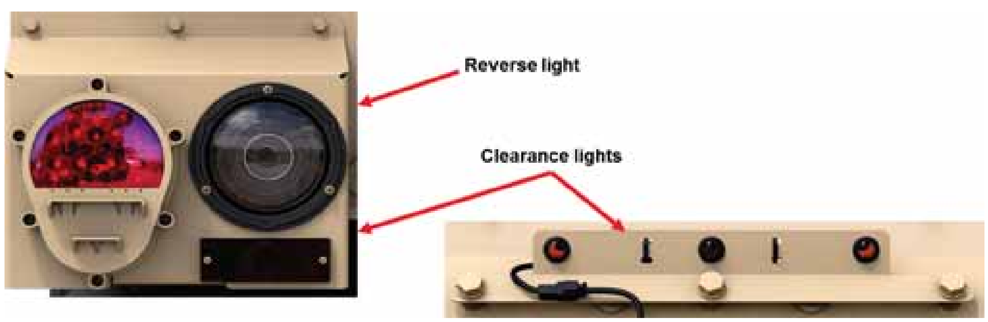


Figure 3.46 Reverse and clearance lights

5. Reverse lights (Figure 3.46)

   a) The reverse warning light is an output from the rear light power module, through the D3 diode pack, and out to the reverse light. The TCM broadcasts a reverse signal to the J1939 network.

   b) The reverse signal is received at the 3G controller which sends out a command to the rear lighting power module to turn on the reverse light.

6. Clearance lights (Figure 3.46)

   a) The clearance lights are tied to the taillight module and work the same as the taillights.

(Slide #72)

Figure 3.47 Front blackout lights

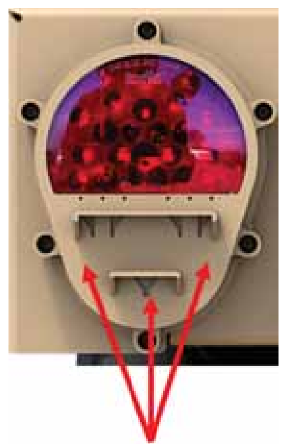


Figure 3.48 Rear blackout lights

7. Blackout lights (Figure 3.47-48)

   a) The CB14 supplies 24V to the blackout light switch. When the blackout light switch is in the normal position, 24V feeds through the switch to the instrument panel that turns on the backlighting. Using technical terms – Pin 4 of MC 227 (10in 4out module is for Databus Communication Network request processing) and out to the 24V (Cab mVEC) mVEC.

   b) Once power enters the mVEC, it supplies power to the map light (CB23), the horn relay, and the spare B.O. circuit breaker 10A. When the switch is on blackout position, power is taken away from the instrument panel (removing the backlighting), the map lights and horn (mVEC), and the input to the 10 in 4 out module.

   c) Once this signal is removed from the 10 in 4 out module, the output sends out to the rear lighting power module to the rear composite lights from pins 1 and 5 of MC454. This then turns on the blackout taillights and the blackout stop (when the brake is pressed).

(Slide #73)

Figure 3.49 Dome and front map lights


Figure 3.50 Rear map lights

8. Map lights (Figure 3.49-50)

   a) The map lights receive power from CB23 in the cab mVEC when the blackout switch is in the “normal operation” mode.

   b) This power feeds to the switches, so when they are turned on, power is fed to the LEDs to turn on the lights.

9. Dome lights (Figure 3.50)

   a) When the dome light select switch is pressed, the request is sent on the J1939 network to the 3G controller for processing.

   b) If normal lighting mode is active (input received at the 10 in 4 out module pin 4), both the cyan and white lights can be used in the vehicle.

   c) When blackout mode is active (no input to pin 4), only the cyan lights can be used in the vehicle.

   d) When the 3G computer processes this, it sends a J1939 message to the 10 in 4 out module to provide either color (cyan-pin 2 MC228 or white-pin 1 MC228) output to the dome lights.

c. Schematics

1. The description of input and output required for each light style was discussed above. For more please refer to schematics or IETM.

(Slide #74)

d. Maintenance and Troubleshooting

1. Maintenance

a) Periodic checks are critical to maintaining functionality of electrical systems.

1) Inspect wiring to solenoids and relays to ensure there is no corrosion or damage to the system that could become a larger problem in the future.

2) Inspect wires for breakage and proper connection to components.

3) Use the DSDU to check for system information.

Symptoms	Probable Causes
Headlights don't illuminate	Wire backed out of a connector
Rear Flashers don't work	Diode Pack 5 shorted
White dome light doesn't work	Black Outs are applied

Figure 3.65 Lighting system symptoms and probable cause of issue

2. Troubleshooting (Figure 3.65)

Check on Learning

(Slide #75)

Q: Which two modules are involved in almost all JLTVA1 lighting functions?
A: The 10 in 4 out module and the 3G controller.

Q: Which module provides the reverse light message to the 3G controller?
A: The TCM

Q: Where are your front lights controlled?
A: The request is sent from the MUX then the controller, the work is done by the SCIM

Q: To understand lighting to power distribution: Which mVEC distributes power to the blackout lights when it is switched to the normal position?
A: The Blackout lights use 24 VDC and are within the cab, so the power is distributed from the Cab mVEC.

Summary	**(Slide #76)** LED lighting is used throughout the JLTVA1 and is controlled electronically via the chassis CAN Bus. The different lighting controls will send various messages on the bus depending on what lighting function is requested.
Transition	I want to take a break to answer your questions. Once I have answered all your questions, let’s apply what we learned by a practice troubleshoot on a light.
6.	**(Slide #77)** ELO B – LSA 6 Learning Step/Activity: Headlights Inoperable Method of Instruction: Practical Exercise Instructor to student ratio: 1:5 Time of instruction: 30 mins Media Type: None **(Slide #78)** See Appendix C: PE 3J-1
Check on Learning	None
Summary	None
Transition	Any questions before we move to the next exercise?
7.	ELO B – LSA 7 Learning Step/Activity: Driver Side Stop/Turn Lights DNO Method of Instruction: Practical Exercise Instructor to student ratio: 1:5 Time of instruction: 30 mins Media Type: None See Appendix C: PE 3K-1
Check on Learning	None
Summary	None
Transition	Any questions? Excellent job, we have one last learning objective to cover, it just so happens this last one is custom for your truck; this last objective is to help you understand the power supply and circuits for C4ISR auxiliary equipment.

Enabling Learning Objective C.	**(Slide #79)** Upon completion of this lesson, you will be able to: Action: Correlate the JLTVA1's Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) electrical systems/sub-systems and their location, purpose, function and maintenance requirements. Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity.
1.	**(Slide #80)** ELO C – LSA 1 Learning Step/Activity: C4ISR Method of Instruction: Lecture Instructor to student ratio: 1:15 Time of instruction: 30 mins Media Type: PPT **(Slide #81)** a. Overview Government Furnished Equipment (C4ISR) 1. There are literally hundreds of configurations available as custom additions to a base model JLTVA1. 2. Some of the more consistent government vehicle equipment include the options below, to name a few. a) CROW System b) Turrets c) CBRN d) Radios e) Antenna f) Secure Comms g) Weapon System h) DUKE

3. All C4ISR equipment and systems are powered with an auxiliary battery system that is separate of the vehicle batteries. The vehicle alternator charges both sets of batteries independently as the batteries require charging.

(Slide #82)

b. Auxiliary Power Components

Figure 3.51 Auxiliary components locations (Utility, above, and General Purpose)

1. Components (Figure 3.51)

   a) The auxiliary system has several components including batteries, combiner relay, terminating resistors and Solid-State Power Controls (SSPC).

(Slide #83)

Figure 3.52 Auxiliary batteries

2. Auxiliary Batteries (Figure 3.52)

   a) The Auxiliary power system performs the electrical power generation, storage, protection and distribution functions required to support Auxiliary system components.

   b) The auxiliary batteries are Optima yellow top batteries. These are 12 VDC, 750 CCA deep-cycle batteries. The batteries have a reserve capacity of 25A for 120 minutes and rated at 55-amp hours.

   c) The batteries connect in series (resulting in a 24 VDC supply voltage), in the cargo area of the JLTVA1. Exact location is dependent on vehicle variant and configuration.

   d) The auxiliary battery switch activates with 24 VDC from the D1 diode.

   e) Once the switch is activated, the system receives power from the C4ISR batteries.

      1) The Auxiliary Battery switch should not be turned on unless the CSDU is powered up and Core Services is active. Core Services in the CSDU controls power supplied to any installed C4ISR systems. The auxiliary power system will not power up or shut down properly if not done IAW proper procedure through Core Services.

(Slide #84)

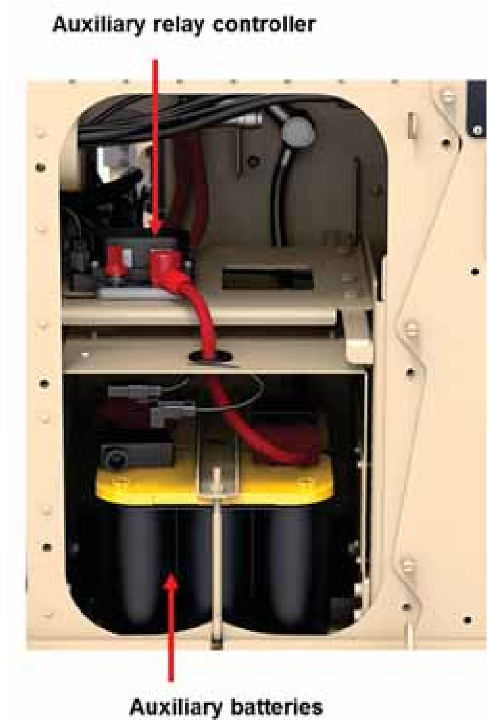


Figure 3.53 Combiner Relay

3. Combiner Relay (Figure 3.53)

   a) The auxiliary battery relay is a 24V, 500-amp GIGAVAC relay controller very similar to the vehicle main battery disconnect. The relay controller is in the rear of the vehicle near the auxiliary batteries. Again, location is dependent on the vehicle variant and configuration.

   b) When the aux battery switch is turned on, a signal is sent to the aux relay controller pin 3 to close only the C4ISR side of the disconnect contact providing power to the Solid-State Power Controller-SSPC #1 and #2 modules. The SSPC modules connect to the CSDU for control via the C4ISR Databus.

   c) The combiner relay works with both the combiner circuit and auxiliary power circuit. When the combiner input is received at pin 1 of the relay controller, the other contact closes to allow C4ISR 24 VDC supply to connect out to the Chassis electrical system for emergency starting.

(Slide #85)

Figure 3.54 C4ISR terminating resistor

Terminating Resistor	Located
Engine R8 : Green	Behind the CSDU
Engine: Engine ECM at pins 44 (CAN-) and 57 (CAN+)	
Chassis R5: Black	Rear of the truck by the rear brake actuator
Chassis R6: Black	Center of the truck near the alternator
Sensor R3: Yellow	Rear of the capsule near left rear suspension spring
Sensor R9: Yellow	Behind the CSDU
Suspension R1: Orange	Rear of the truck near the glad hands
Suspension R7: Orange	Behind the CSDU
C4ISR P03-P4 : No Color	In the C4ISR cabinet
C4ISR W10-P7: No Color	Behind the 120 V outlet inside the cab

Figure 3.55 Terminating resistor

4. Terminating Resistors (Figure 3.54-55)

   a) As with all databuses, there are two terminating resistors for the Auxiliary Databus. The terminating resistors are behind the dash, and in the C4ISR cabinet.

   b) When a request is sent from the CSDU, the appropriate Solid-State Power Controller (SSPC) receives the signal from the C4ISR J1939 Databus to activate the component.

(Slide #86)

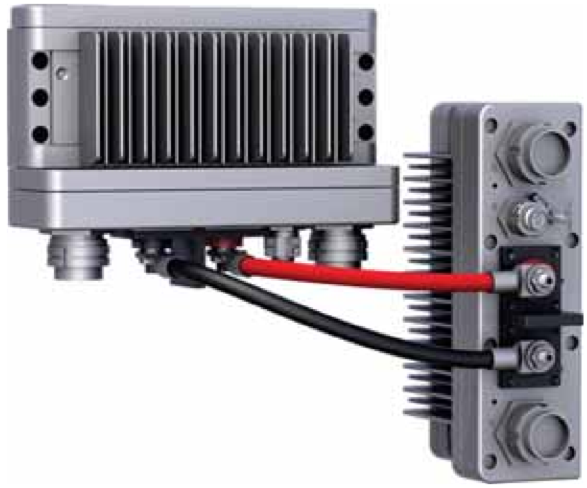


Figure 3.56 Solid state power control (SSPC)

5. Solid State Power Controllers (SSPC) (Figure 3.56)

    a) The SSPC units are in different locations based on the mission configuration of the truck.

    b) Supply power comes from the 1141 wire off the auxiliary battery relay controller to the J3 connector of the SSPC unit. Grounds come from the J2 connector to the C4ISR battery ground.

    c) There are two:

        1) SSPC 1: Unsecured

        2) SSPC 2: Secured

(Slide #87)

Instructor Note
Show Auxiliary Circuit drawing and discuss bullets below.

c. Auxiliary Power Circuits (Figure 3.57)

1. Auxiliary Battery Power Distribution Circuit

    a) The Auxiliary power system performs the electrical power generation, storage, protection and distribution functions required to support Auxiliary system components.

    b) When the auxiliary battery switch activates, 24-volts supply the relay controller pin1 closing only the C4ISRS side contact. This provides power to the SSPC #1 and #2 modules. This power comes from the C4ISR battery, passes thru fuse F028, DO1 diode, and finally to the aux battery switch.

2. Both modules are J1939 connected to the CSDU for control. The terminating resistors are behind the dash in the C4ISR cabinet. When a request is sent out from the CSDU, the appropriate SSPC receives the signal from the J1939 Databus and provides the power output required to turn on the component.

(Slide #88)

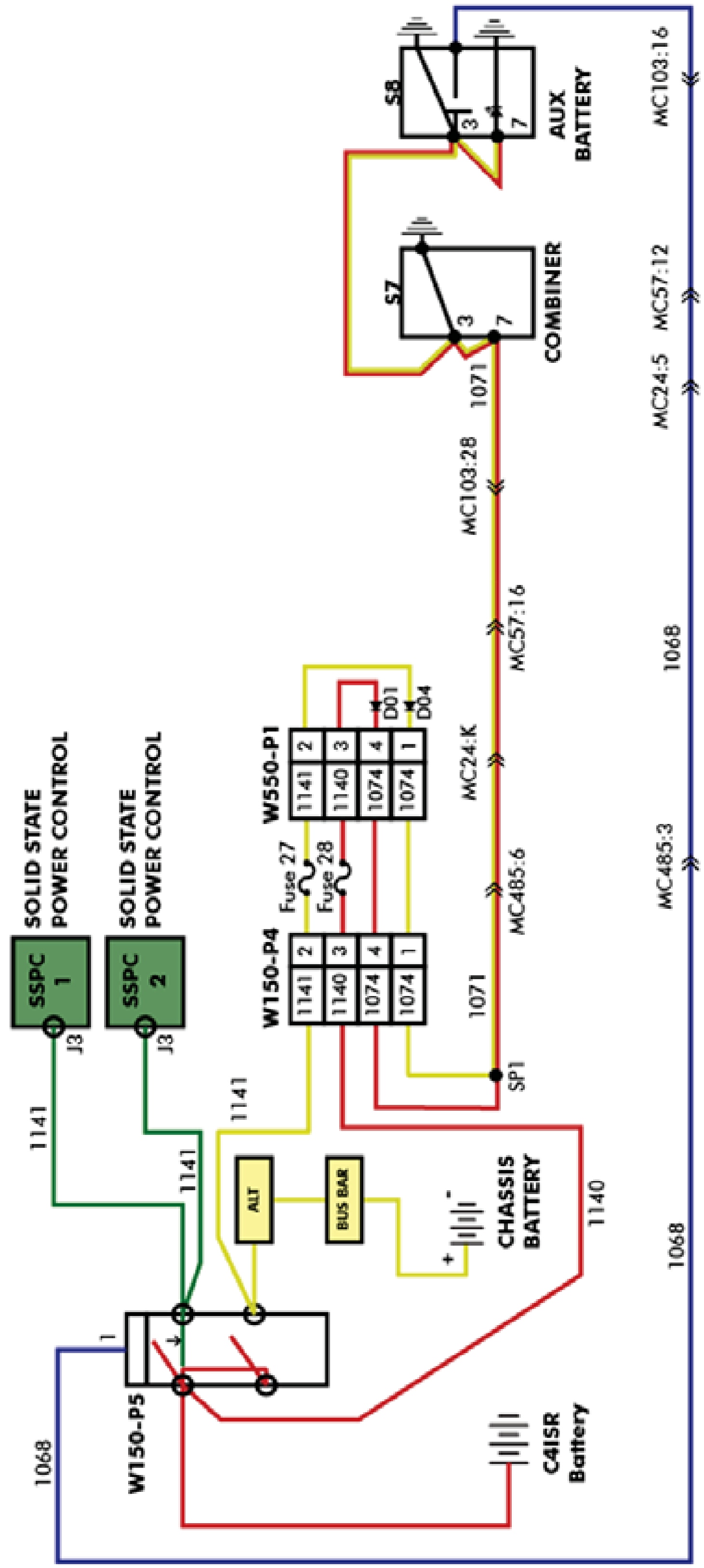


Figure 3.57 Auxiliary power circuit diagram

(Slide #89)

Figure 3.58 Combiner switch

3. Combiner Circuit

    a) Overview

        1) The Combiner Circuit is primarily for emergency starting of vehicle.

        2) The combiner switch takes power from the Yellow Top batteries (rear of truck) and transfers it to the Red Top batteries (at the front of the truck). (Figure 3.58)

        3) The auxiliary batteries provide 24 VDC out to the Chassis electrical system for emergency starting.

        4) The combiner relay works with both the Combiner circuit and the auxiliary power circuit.

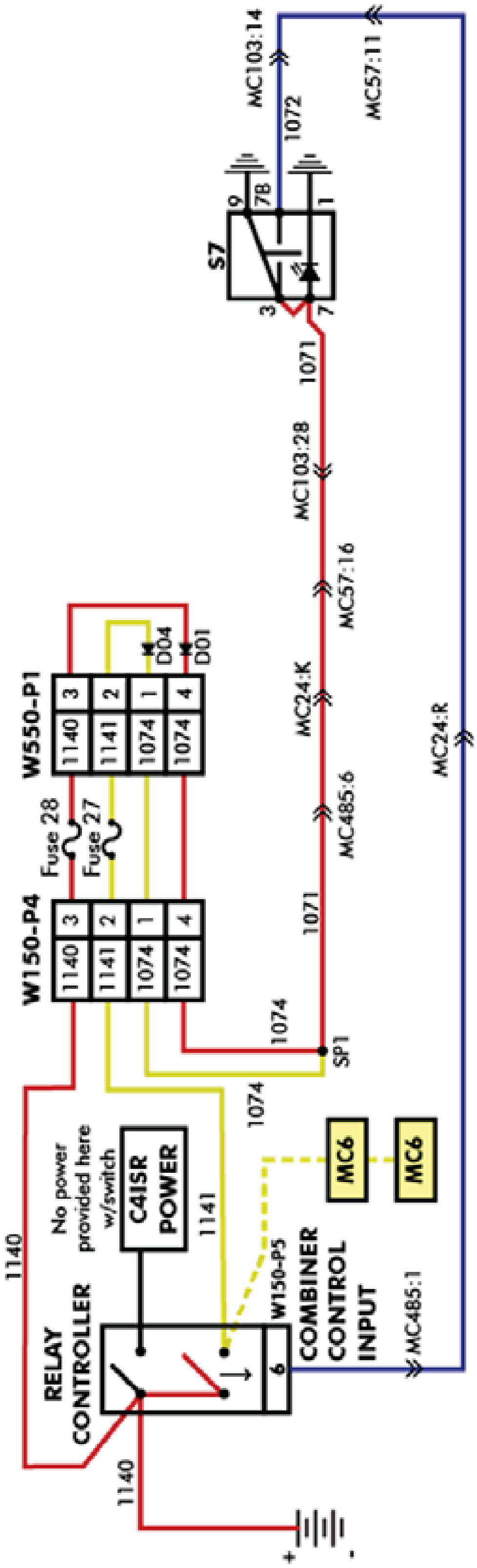
(Slide #90)

    b) Combiner Schematic Walk Through (Figure 3.59)

        1) The auxiliary batteries provide power through fuse F027, thru D04 diode to SP1, then to the Combiner switch (S7).

        2) Once the combiner switch is activated, 24 VDC supplies wire 1072 out to the auxiliary battery relay controller pin 6.

        3) When the relay controller sees the voltage signal pin 6, it will switch only one side of the relay controller to supply C4ISR battery power to the chassis power circuit.



3.59 Combiner schematic diagram

(Slide #91)

d. Combat Override (Figure 3.60)

1. Combat Override Functionality
2. Disables Low Voltage Disconnect.
3. Disables Neutral Safety interlock for starting.
4. Disables engine de-rate due to Engine Oil, Fuel, or Coolant Temperature.
5. Disables Suspension related speed limitations.
6. Disables CTIS related transmission gear limitation.
7. Disables all load shedding (re-enables all shed loads).
8. Override suspension hydraulic faults that inhibit operation.
9. High hydraulic oil temp during pumping.
10. 10-minute pumping time-out.
11. Low hydraulic oil level combined with low hydraulic oil pressure (both must occur for suspension to error out).
12. Used to adjust CTIS settings when DSDU is not operational.
13. Used to adjust suspension ride height when DSDU is not operational (To Operational only).
14. Enables Low Pressure Fuel Pump @ full pressure (JLTVA1).

(Slide #92)

Instructor Note
Reference Combat Override Electrical Schematic

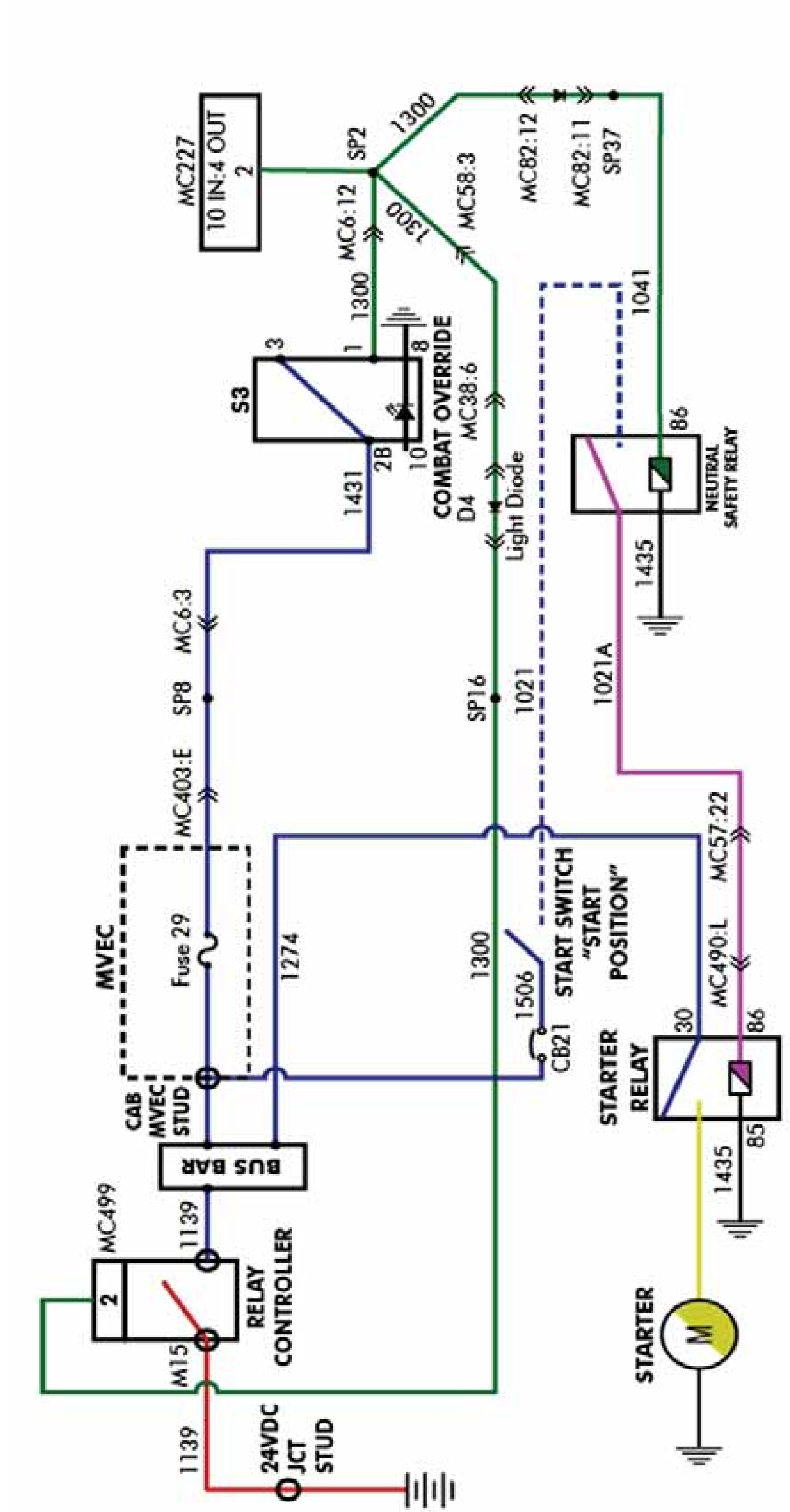


Figure 3.60 Combat override circuit

Check on Learning	**(Slide #93)** **Q:** What is the difference between the two Solid State Power Controllers (SSPCs)? **A:** One is designated to power unsecured systems; the other is designated to power secured systems. **Q:** Explain why the two sets of contacts in the Rear Relay Controller are independently controlled. **A:** One contact provides 24 VDC to Solid State Power Controls 1&2 when the AUX Switch (S8) is closed, the other contact allows the alternator to charge the batteries when the Combiner Switch (S7) is closed. **Q:** Which components will receive a voltage signal when the Combat Override switch is engaged? **A:** The Relay Controller in the front of the truck, the K3 relay, and the 10 in 4 out module.
Summary	**(Slide #94)** The C4ISR system powers both secured and unsecured government-furnished auxiliary and mission-use equipment. The auxiliary batteries power the components or systems and controlled by the two Solid State Power Controllers (SSPC) through the CSDU. If necessary, the combine function is available to link the auxiliary batteries to the chassis batteries. The Combat Override switch serves as a bypass to all safety limitation and interlocks on the vehicle. It can also be used for limited control of CTIS and suspension functions in the event of a DSDU failure. Only use this option when necessary.
Transition	This was a lot of information. Before we go out to the truck to find the networks and troubleshoot an induced fault, what questions do you have for me?
2.	**(Slide #95)** ELO C- LSA 2 Learning Step/Activity: C4ISR Component ID and Troubleshoot Method of Instruction: Demonstration Instructor to student ratio: 1:5 Time of instruction: 1 hr Media Type: None **(Slide #96)** See Appendix C: PE 3L-1
Check on Learning	None
Summary	None

Transition	That concludes the content we needed to cover for the JLTVA1 electrical systems. Let's do a quick review of the last 15 or so hours of content to help reinforce key points for the final exam. Any questions before we move onto the chapter summary?

SECTION IV. **SUMMARY**

Method of Instruction:	Lecture
Instructor to student ratio	1:15
Time of Instruction:	15 mins
Instructional Strategy	Lecture and Q&A

Check on Learning

(Slide #97)

Q: Which batteries feed power to the Combiner switch?
A: The Combiner switch can receive power from either pair of batteries.

Q: What is the purpose of the 3G controller?
A: It is the central bus main computer for the JLTVA1 platform. It acts as a hub for all vehicle databus networks and allows interaction of major systems and components.

Q: When checking Pins C and D of the Diagnostic Port for resistance, you see a reading of 0.2 ohms. What does this reading indicate?
A: That the J1939 Databus has a short in it, causing a loss of communications to that network.

Summary

(Slide #99)

We first learned about the JLTVA1's power distribution circuit. The power starts with the batteries. Remember, the JLTVA1 uses Optima Red Top batteries. The battery disconnection switch is on the dash, near the driver's left knee.

Then, we covered the starting system. The Engine Start Switch is a three-position rotary switch that connects the power from the battery to the ignition and starting circuit. It is in the cab next to the driver's right knee.

The JLTVA1 CAN Network is a J1939 Databus communication network that allows interaction between all major vehicle systems.
There are five networks on the vehicles. Four are color coded and communicate through 3G controller. They are the chassis, engine, suspension, and sensor databuses.

The fifth databus is the C4ISR. The C4ISR is the only databus that is not color coded and is isolated from the 3G controller.

Both the charging and lighting systems are straightforward and comparable to other systems you've worked with previously.
As we learned from all the electrical PEs, a failure anywhere in the circuit, including an open circuit in wires, will interrupt the voltage signals failing the component to energize or activate. The DSDU helps to identify the symptom. Use the schematics to locate the network involved and use the IETM's troubleshooting track to isolate the root cause of the failure.

Lastly, the C4ISR circuit is used to power both secured and unsecured government-furnished auxiliary and mission-use equipment. The auxiliary batteries are in the rear of the vehicle and are Optima Yellow Tops. We also covered operation of the Combiner and Combat Override circuits which are only to be used in emergency situations.

It is critical for maintainers to understand that the J1939 Databus connect all primary mechanical and electrical systems and displays the communication on the DSDU interface. You may use the enhanced schematics in the IETM to assist with the location of the primary electric components in addition to the troubleshooting packages regarding electrical systems.

Appendix A

03_JLTVA1_ ARMY_ MAIN_Elec_PPT_V3.0.pptx

Appendix C
JLTVA1 Practical Exercise Sheet No. 3A
Power Distribution Troubleshooting #1

Title	Power Distribution System Troubleshooting (FIK #3-2: 12- and 24-VOLT Circuits Do Not Operate #1)
Lesson Number / Title	03 Electrical
Introduction	We will now perform a P.E. on the JLTVA1 applicable to the Electrical Systems.
Motivator	The electrical system provides power to all systems on the JLTVA1; therefore, it is critical to be very familiar with power distribution and ignition components, circuits and the connections required to start the truck.
Enabling Learning Objective A	Action: Troubleshoot the 24 VDC electrical system of the JLTVA1 including power distribution, charging, and starting electrical systems/sub-systems Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test or 100% accuracy on hands on activity.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Risk Assessment	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	One of the primary functions of the chassis electrical system is to provide power for the 12 and 24V systems found on the JLTVA1. This exercise provides the opportunity to troubleshoot an issue in the power distribution system.
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide JLTVA1 FIK PE Instruction Job Aid **Student Materials:** MSD with EMS NG/IETM DVOM Student guides Pens/Pencils

Special Instructions	Instructor Note: Instructor will need to prep the vehicle for the troubleshooting task by inserting **FIK WP: FIK #3-1: 12- and 24-VOLT Circuits Do Not Operate** using the FIK PE Instructions Job Aid. Prep and/or time to Install FIK is: 2 minutes. Assistant Trainers must install the fault while the primary instructor is training. Facilitation Tip: Simulate the exercises as appropriate; means using the Interactive Electronic Technical Manual (IETM), following the task, discussing, and completing each step until task is complete. Students will not remove the installed components.
Procedures	a. Instructor distributes the Practical Exercise worksheet to the students. b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have. c. Inform students they will be using the vehicle and the IETM to complete the exercises. d. Inform students they will have 1 hour to complete the practical exercise. e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet. f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so. g. Students will be broken up into groups of no more than five. h. Ask if there are any questions. i. Students may begin. j. Mark Go/No Go Sheets accordingly. 1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished. 2. Once the Practical Exercise is complete, the Lead Instructor must sign each student's Solution Sheet. k. When everyone is finished collect solution sheet.
Feedback Requirements	Provide feedback to ensure student learning.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 3A-1
Power Distribution Troubleshooting #1

Name____

Date____

Training Location____

Power Distribution Troubleshooting #1	**Go**	**NO GO**	**Initials**
Verified the Fault			
Located proper troubleshooting fault in the IETM			
Followed all warning cautions and notes			
Correctly followed troubleshooting track in IETM			
Correctly repaired fault (per IETM)			
Verified fault was corrected			

Instructor Signature ____

Appendix C
JLTVA1 Practical Exercise Sheet No. 3B
Power Distribution Troubleshooting #2

Title	Power Distribution System Troubleshooting (FIK #3-2: 12 and 24V Circuits Do Not Operate #2)
Lesson Number / Title	03 Electrical
Introduction	We will now perform a P.E. on the JLTVA1 applicable to the Electrical Systems.
Motivator	The electrical system provides power to all systems on the JLTVA1; therefore, it is critical to be very familiar with power distribution and ignition components, circuities and the connections required to start the truck.
Enabling Learning Objective A	Action: Troubleshoot the 24 VDC electrical system of the JLTVA1 including power distribution, charging, and starting electrical systems/sub-systems Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test or 100% accuracy on hands on activity.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Risk Assessment	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	As there are many potential causes for failure in the power distribution and ignition circuit, we are going to troubleshoot another scenario of a fault within that circuit.
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide JLTVA1 FIK PE Instruction Job Aid **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils
Special Instructions	Instructor Note: Instructor will need to prep the vehicle for the troubleshooting task by inserting **FIK WP: FIK #3-2: 12 and 24V Circuits Do Not Operate** using the FIK PE Instructions Job Aid.

Prep and/or time to Install FIK is: 2 minutes.

Assistant Trainers: If possible, it would be acceptable to have an assistant instructor install the fault while the primary instructor is training.

Facilitation Tip: Simulate the exercises as appropriate; means using the Interactive Engaging Technical Manual (IETM), following the task, discussing, and completing each step until task is complete. Students will not remove the installed components.

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and the IETM to complete the exercises.

d. Inform students they will have approximately 30 minutes to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five.

h. Ask if there are any questions.

i. Students may begin.

j. Mark Go/No Go Sheets accordingly.

   1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

   2. Once the Practical Exercise is complete, the Lead Instructor must sign each student's Solution Sheet.

k. When everyone is finished collect solution sheet.

Feedback Requirements

Provide feedback to ensure student learning.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 3B-1
Power Distribution Troubleshooting #2

Name____

Date____

Training Location____

Power Distribution Troubleshooting #2	**Go**	**NO GO**	**Initials**
Verified the Fault			
Located proper troubleshooting fault in the IETM			
Followed all warning cautions and notes			
Correctly followed troubleshooting track in IETM			
Correctly repaired fault (per IETM)			
Verified fault was corrected			

Instructor Signature ____

Appendix C
JLTVA1 Practical Exercise Sheet No. 3C
Vehicle Batteries Overheating

Title	Vehicle Batteries Overheating
Lesson Number / Title	03 Electrical
Introduction	We will now perform a P.E. on the JLTVA1 applicable to the Electrical Systems.
Motivator	In this practical exercise, you will be able to use the information and tools provided to aid in identifying the fault, troubleshoot to trace and correct the fault
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Enabling Learning Objective A	Action: Troubleshoot the 24 VDC electrical system of the JLTVA1 including power distribution, charging, and starting electrical systems/sub-systems Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 70% accuracy on a written test or 100% accuracy on hands on activity.
Risk Assessment Level	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	This Practical Exercise will give you the opportunity to practice the skills required to provide maintenance to the JLTVA. (Vehicle Batteries Overheating)
Resource Requirements	**Instructor Materials: (paper resources & IETM)** EMS NG with IETM Instructor Guide **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils
Special Instructions	The fields below are PE development requirements for successfully providing instruction to others on how to complete the task in alignment with the IETM. Complete all applicable fields with information from the IETM as well as the instructions, steps and time required to complete the PE.

PE Requirement	Instructor Notes
TM Reference:	
Time Required to Prep for PE:	15 minutes
Number of Instructors for PE:	1
Prepare Area for PE:	A. Clear any obstructions in front of vehicle
Configure Vehicle for PE:	1. Remove or Lower Skid Plate and then lower battery tray, remove battery temperature sensor from D/S of batteries and disconnect temperature sensor from Harness, Install the 20k oms resister fault plug, Verify DSDU indicates battery temperature extremely High
The symptom of this fault is:	Battery overheating
The following fault codes will be associated with this fault:	Code 6-4
Standard Default PE Instructions:	Associate Instructors will prep the vehicle and induce faults while the primary instructor leads the classroom training. All instructors will monitor the exercise and ensure students are properly adhering to safety guidelines while working on the vehicle. Instructors will assist students on finding work packages associated with the tasks they are trying to do. Provide feedback to students to ensure comprehension.
Definition of Simulation for PE:	For Oshkosh PEs simulation means using the IETM to guide a work package or troubleshooting track and completing each step until the IETM becomes incorrect or the task needs to be stopped for another reason. Instructors will inform students of which steps will not be followed (or parts that will

	not be removed) and instead the instructor will verbalize the steps that would occur normally and explain why we cannot do that at this time (aka simulate the steps) then continue the PE.

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises.

d. Inform students they will have approximately 30 minutes to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five.

h. Ask if there are any questions.

i. Students may begin. Below are key steps the instructor may use to assist with coaching and completing the Go/No Go rubric.

**Steps below are to aid with coaching and conducting the PE. When creating a PE be sure to list key decision-making steps as well as insights that are not in the IETM. Delete this line of instruction once PE is a working draft and not a template.

Step (List the key steps)	Student Action (or Expected Values) or Instructor Note
1. 1. Remove/Lower Skid Plate and then lower battery tray (IF Needed), Remove battery temperature sensor from D/S of batteries and disconnect temperature sensor from Harness, Install the 20k oms resister fault plug, to induce fault	

2. Fault will display DSDU code 6-4	Students will turn on vehicle to ignition on and notice warnings and cautions displayed on DSDU
3. Instructor will aid in directing the students to check gauges, and go to the Power Generation Screen, use load shedding application on the DSDU. Code 6-4 will be active	At this time displayed codes found in the IETM will direct the students through troubleshooting track to find the fault
4.	Identify and repair fault
5. Verify Fault has been corrected	

j. Mark Go/No Go Sheets accordingly.

1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

2. Once the Practical Exercise is complete, the Lead Instructor must sign each student's Solution Sheet.

Feedback Requirements

Debrief the Activity: Provide tips and insights into potential "go wrongs" and reasons/rational for things that occurred during the PE.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 3C-1
Vehicle Batteries Overheating

Name____

Date____

Training Location____

Vehicle Batteries Overheating	**Go**	**NO GO**	**Initials**
1. Verified the Fault			
2. Located proper troubleshooting fault in the IETM			
3. Followed all warning cautions and notes			
4. Correctly followed troubleshooting track in TM			
5. Correctly repaired fault (per TM)			
6. Verified fault was corrected			

Signature____

Appendix C
JLTVA1 Practical Exercise Sheet No. 3D
Starting System Troubleshooting

Title	Starting System Troubleshooting (FIK #3-3: Engine Fails to Crank (K6 Relay))
Lesson Number / Title	03 Electrical
Introduction	We will now perform a P.E. on the JLTVA1 applicable to the Electrical Systems.
Motivator	The electrical system provides many functions for your JLTVA1. One of the primary functions of the chassis electrical system is to provide power for the starting system. This section will cover troubleshooting of the starting system.
Enabling Learning Objective A	Action: Troubleshoot the 24 VDC electrical system of the JLTVA1 including power distribution, charging, and starting electrical systems/sub-systems Conditions: Given the vehicle, equipment, tools, IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test or 100% accuracy on hands on activity.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Risk Assessment	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	Let's explore the electrical system on the JLTVA1
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide JLTVA1 FIK PE Instruction Job Aid **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils
Special Instructions	Instructor Note: Instructor will need to prep the vehicle for the troubleshooting task by inserting **FIK #3-3: Engine Fails to Crank** using the FIK PE Instructions Job Aid. Prep and/or time to Install FIK is: 2 minutes.

Assistant Trainers: If possible, it would be acceptable to have an assistant instructor install the fault while the primary instructor is training.

Facilitation Tip: Simulate the exercises as appropriate; means using the Interactive Engaging Technical Manual (IETM), following the task, discussing, and completing each step until task is complete. Students will not remove the installed components.

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises.

d. Inform students they will have approximately 45 minutes to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five.

h. Ask if there are any questions.

i. Students may begin.

j. Mark Go/No Go sheets accordingly.

1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

2. Once the Practical Exercise is complete, the Lead Instructor must sign each student's Solution Sheet.

k. When everyone is finished collect solution sheet.

Feedback Requirements

Provide feedback to ensure student learning.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 3D-1
Troubleshoot Starting System

Name____

Date____

Training Location_______________________________________

Troubleshoot Starting System	**Go**	**NO GO**	**Initials**
Verified the Fault			
Located proper troubleshooting fault in the IETM			
Followed all warning cautions and notes			
Correctly followed troubleshooting track in TM			
Correctly repaired fault (per TM)			
Verified fault was corrected			

Instructor Signature ____

Appendix C
JLTVA1 Practical Exercise Sheet No. 3E
Charging System Troubleshooting

Title	Charging System Troubleshooting (FIK #3-4: CODE 06-17 and Code 15-22 Alternator Faulted No J1939 Com with Alt)
Lesson Number / Title	03 Electrical
Introduction	We will now perform a P.E. on the JLTVA1 applicable to the Electrical Systems.
Motivator	The electrical system provides many functions for your JLTVA1. One of the primary functions of the chassis electrical system is to provide power for the 12 and 24V systems found on the JLTVA1. This section will cover troubleshooting of the charging system.
Enabling Learning Objective A	Action: Troubleshoot the 24 VDC electrical system of the JLTVA1 including power distribution, charging, and starting electrical systems/sub-systems Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test or 100% accuracy on hands on activity.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Risk Assessment	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	Let's explore the electrical system on the JLTVA1
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide JLTVA1 FIK PE Instruction Job Aid **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils

Special Instructions	Instructor Note: Instructor will need to prep the vehicle for the troubleshooting task by inserting **FIK #3-4: CODE 06-17 and Code 15-22 Alternator Faulted No J1939 Com with Alt** using the FIK PE Instructions Job Aid. Assistant Trainers: If possible, it would be acceptable to have an assistant instructor install the fault while the primary instructor is training. Facilitation Tip: Simulate the exercises as appropriate; means using the Interactive Engaging Technical Manual (IETM), following the task, discussing, and completing each step until task is complete. Students will not remove the installed components.
Procedures	a. Instructor distributes the Practical Exercise worksheet to the students. b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have. c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises. d. Inform students they will have approximately 30 minutes to complete the practical exercise. e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet. f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so. g. Students will be broken up into groups of no more than five. h. Ask if there are any questions. i. Mark Go/No Go Sheets accordingly 1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished. 2. Once the Practical Exercise is complete, the Lead Instructor must sign each student’s Solution Sheet. j. When everyone is finished collect solution sheet.
Feedback Requirements	Provide feedback to students to ensure learning

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 3E-1
Troubleshoot Charging System

Name____

Date____

Training Location____

Troubleshoot Charging System	**Go**	**NO GO**	**Initials**
Verified the Fault			
Located proper troubleshooting fault in the IETM			
Followed all warning cautions and notes			
Correctly followed troubleshooting track in TM			
Correctly repaired fault (per TM)			
Verified fault was corrected			

Instructor Signature ____

Appendix C
JLTVA1 Practical Exercise Sheet No. 3F
J1939 Databus Troubleshooting

Title	J1939 Databus Troubleshooting (FIK #3-5: J1939 Databus Communication Failure)
Lesson Number / Title	03 Electrical
Introduction	We will now perform a P.E. on the JLTVA1 applicable to the Electrical Systems.
Motivator	The electrical system provides many functions for your JLTVA1. One of the functions of the CAN network is to provide communication for the vehicle systems found on the JLTVA1. This section will cover troubleshooting of the J1939 system.
Enabling Learning Objective B	Action: Troubleshoot the JLTVA1's J1939 Databus systems/sub-systems Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test or 100% accuracy on hands on activity.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Risk Assessment	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	Let's explore the electrical system on the JLTVA1
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide JLTVA1 FIK PE Instruction Job Aid **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils
Special Instructions	Instructor Note: Instructor will need to prep the vehicle for the troubleshooting task by inserting **FIK #3-5: J1939 Databus Communication Failure** using the FIK PE Instructions Job Aid.

Assistant Trainers: If possible, it would be acceptable to have an assistant instructor install the fault while the primary instructor is training.

Facilitation Tip: Simulate the exercises as appropriate; means using the Interactive Engaging Technical Manual (IETM), following the task, discussing, and completing each step until task is complete. Students will not remove the installed components.

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises.

d. Inform students they will have approximately 40 minutes to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five.

h. Ask if there are any questions.

i. Mark Go/No Go Sheets accordingly.

   1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

   2. Once the Practical Exercise is complete, the Lead Instructor must sign each student’s Solution Sheet.

j. When everyone is finished collect solution sheet.

Feedback Requirements

Provide feedback to students to ensure learning.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 3F-1
J1939 Databus Troubleshooting

Name____

Date____

Training Location____

Troubleshoot J1939 Databus Communication Network	Go	NO GO	Initials
Verified the Fault			
Located proper troubleshooting fault in the IETM			
Followed all warning cautions and notes			
Correctly followed troubleshooting track in TM			
Correctly repaired fault (per TM)			
Verified fault was corrected			

Instructor Signature ____

Appendix C
JLTVA1 Practical Exercise Sheet No. 3G
Electrical Comm Failure

Title	Electrical Comm Failure
Lesson Number / Title	03 Electrical
Introduction	The following faults are induced on each truck. You will rotate through each truck as a group to resolve each fault.
Motivator	In this practical exercise, you will be able to use the information and tools provided to aid in identifying the fault, troubleshoot to trace and correct the fault
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Enabling Learning Objective B	Action: Troubleshoot the JLTVA1's J1939 Databus systems/sub-systems Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test or 100% accuracy on hands on activity.
Risk Assessment Level	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Resource Requirements	**Instructor Materials: (paper resources & IETM)** EMS NG with IETM Instructor Guide **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils
Special Instructions	The fields below are PE development requirements for successfully providing instruction to others on how to complete the task in alignment with the IETM. Complete all applicable fields with information from the IETM as well as the instructions, steps and time required to complete the PE.

PE Requirement	Instructor Notes
TM Reference:	
Time Required to Prep for PE:	5 minutes
Number of Instructors for PE:	1
Prepare Area for PE:	B. 1.Disconnect MC214(Black connector) on DS of engine. remove yellow Can+ wire connector. C.
Configure Vehicle for PE:	
The symptom of this fault is:	Engine Comms Lost
The following fault codes will be associated with this fault:	ABS 11-70, SUSP 14-8, DENG 2-9, CHASIS 15-18,
Standard Default PE Instructions:	Associate Instructors will prep the vehicle and induce faults while the primary instructor leads the classroom training. All instructors will monitor the exercise and ensure students are properly adhering to safety guidelines while working on the vehicle. Instructors will assist students on finding work packages associated with the tasks they are trying to do. Provide feedback to students to ensure comprehension.
Definition of Simulation for PE:	For Oshkosh PEs simulation means using the IETM to guide a work package or troubleshooting track and completing each step until the IETM becomes incorrect or the task needs to be stopped for another reason. Instructors will inform students of which steps will not be followed (or parts that will not be removed) and instead the instructor will verbalize the steps that would occur normally and explain why we cannot do that at this time (aka simulate the steps) then continue the PE. Instructors ensure students utilize fine tipped multi-meter leads, or manufactured pin leads, to ensure Engine ECU harness is not damaged.

Procedures	a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises.

d. Inform students they will have approximately **40 minutes** to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five.

h. Ask if there are any questions.

i. Students may begin. Below are key steps the instructor may use to assist with coaching and completing the Go/No Go rubric.

Step (List the key steps)	Student Action (or Expected Values) or Instructor Note
6. Disconnect MC214(Black connector) on DS of engine. Remove yellow Can+ wire from connector	
7. Fault will display (5) codes on DSDU, Lower left gauge sweeps, and ABS and Suspension Error indicator lights are shown	Students will turn on vehicle to ignition on and notice warnings and cautions displayed
8.	identify codes on the DSDU to start troubleshooting track
9. Instructor will aid in directing the students in the right path going over previously covered material in section to find (MC214)	At this time displayed codes found in the IETM will direct the students through troubleshooting track to find the fault
10.	Identify and repair fault
11. Verify Fault has been corrected	

j. Mark Go/No Go Sheets accordingly.

	1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished. 2. Once the Practical Exercise is complete, the Lead Instructor must sign each student's Solution Sheet.
Feedback Requirements	Debrief the Activity: Provide tips and insights into potential "go wrongs" and reasons/rational for things that occurred during the PE.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 3G-1
Suspension Communication Lost

Name____

Date____

Training Location____

Suspension Communication Lost	Go	NO GO	Initials
1. Verified the Fault			
2. Located proper troubleshooting fault in the IETM			
3. Followed all warning cautions and notes			
4. Correctly followed troubleshooting track in TM			
5. Correctly repaired fault (per TM)			
6. Verified fault was corrected			

Signature____

Appendix C
JLTVA1 Practical Exercise Sheet No. 3H
Transmission Comm Fault

Title	Transmission Comm Fault
Lesson Number / Title	03 Electrical
Introduction	The following faults are induced on each truck. You will rotate through each truck as a group to resolve each fault.
Motivator	In this practical exercise, you will be able to use the information and tools provided to aid in identifying the fault, troubleshoot to trace and correct the fault
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Enabling Learning Objective B	Action: Troubleshoot the JLTVA1's J1939 Databus systems/sub-systems Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test or 100% accuracy on hands on activity.
Risk Assessment Level	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Resource Requirements	**Instructor Materials: (paper resources & IETM)** EMS NG with IETM Instructor Guide **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils
Special Instructions	The fields below are PE development requirements for successfully providing instruction to others on how to complete the task in alignment with the IETM. Complete all applicable fields with information from the IETM as well as the instructions, steps and time required to complete the PE.

PE Requirement	Instructor Notes
TM Reference:	
Time Required to Prep for PE:	5 minutes
Number of Instructors for PE:	1
Prepare Area for PE:	D.
Configure Vehicle for PE:	1.Inside the Cab Remove (4) locking pins from J1939 data port bracket, remove Engine Hi/Lo Can wires and install jumper, reinstall data port
The symptom of this fault is:	Engine Comms Lost
The following fault codes will be associated with this fault:	ABS 11-70, SUSP 14-8, DENG 2-9, CHASIS 15-18,
Standard Default PE Instructions:	Associate Instructors will prep the vehicle and induce faults while the primary instructor leads the classroom training. All instructors will monitor the exercise and ensure students are properly adhering to safety guidelines while working on the vehicle. Instructors will assist students on finding work packages associated with the tasks they are trying to do. Provide feedback to students to ensure comprehension.
Definition of Simulation for PE:	For Oshkosh PEs simulation means using the IETM to guide a work package or troubleshooting track and completing each step until the IETM becomes incorrect or the task needs to be stopped for another reason. Instructors will inform students of which steps will not be followed (or parts that will not be removed) and instead the instructor will verbalize the steps that would occur normally and explain why we cannot do that at this time (aka simulate the steps) then continue the PE.

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises.

d. Inform students they will have approximately **40 minutes** to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five.

h. Ask if there are any questions.

i. Students may begin. Below are key steps the instructor may use to assist with coaching and completing the Go/No Go rubric.

Step (List the key steps)	Student Action (or Expected Values) or Instructor Note
12. Inside the Cab Remove (4) locking pins from J1939 data port bracket, remove Engine Hi/Lo Can wires and install jumper, reinstall data port	
13. Fault will display (Multiple) codes on DSDU, Lower left gauge sweeps and ABS and Suspension Error indicator light on	Students will turn on vehicle to ignition on and notice warnings and cautions displayed Note: Inform the students to focus on the transmission communication loss troubleshooting track
14.	identify codes on the DSDU to start troubleshooting track
15. Instructor will aid in directing the students in the right path going over previously covered material in section to find (Diagnostic Port is shorted)	At this time displayed codes found in the IETM will direct the students through troubleshooting track to find the fault, but will not be able to due to the IETM not giving a troubleshooting track for J1939 Diagnostic port
16.	Identify and repair fault
17. Verify Fault has been corrected	

j. Mark Go/No Go Sheets accordingly.

1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

	2. Once the Practical Exercise is complete, the Lead Instructor must sign each student's Solution Sheet.
Feedback Requirements	Debrief the Activity: Provide tips and insights into potential "go wrongs" and reasons/rational for things that occurred during the PE.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 3H-1
Transmission Comm Fault

Name____

Date____

Training Location____

Transmission Comm Fault	**Go**	**NO GO**	**Initials**
1. Verified the Fault			
2. Located proper troubleshooting fault in the IETM			
3. Followed all warning cautions and notes			
4. Correctly followed troubleshooting track in TM			
5. Correctly repaired fault (per TM)			
6. Verified fault was corrected			

Signature____

Appendix C
JLTVA1 Practical Exercise Sheet No. 3I
Suspension Comm Failure

Title	Suspension Comm Failure
Lesson Number / Title	03 Electrical
Introduction	The following faults are induced on each truck. You will rotate through each truck as a group to resolve each fault.
Motivator	In this practical exercise, you will be able to use the information and tools provided to aid in identifying the fault, troubleshoot to trace and correct the fault
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Enabling Learning Objective B	Action: Troubleshoot the JLTVA1's J1939 Databus systems/sub-systems Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test or 100% accuracy on hands on activity.
Risk Assessment Level	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Special Instructions	The fields below are PE development requirements for successfully providing instruction to others on how to complete the task in alignment with the IETM. Complete all applicable fields with information from the IETM as well as the instructions, steps and time required to complete the PE.

PE Requirement	Instructor Notes
TM Reference:	
Time Required to Prep for PE:	10 minutes
Number of Instructors for PE:	1
Prepare Area for PE:	E. At the right rear of vehicle locate suspension SCIM (Right Connector MC174) Disconnect and remove Pin 5, wire 1701

Configure Vehicle for PE:	
The symptom of this fault is:	No Comms to Suspension SCIM
The following fault codes will be associated with this fault:	SUSP 14- 11
Standard Default PE Instructions:	Associate Instructors will prep the vehicle and induce faults while the primary instructor leads the classroom training. All instructors will monitor the exercise and ensure students are properly adhering to safety guidelines while working on the vehicle. Instructors will assist students on finding work packages associated with the tasks they are trying to do. Provide feedback to students to ensure comprehension.
Definition of Simulation for PE:	For Oshkosh PEs simulation means using the IETM to guide a work package or troubleshooting track and completing each step until the IETM becomes incorrect or the task needs to be stopped for another reason. Instructors will inform students of which steps will not be followed (or parts that will not be removed) and instead the instructor will verbalize the steps that would occur normally and explain why we cannot do that at this time (aka simulate the steps) then continue the PE.

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises.

d. Inform students they will have approximately 40 minutes to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five.

h. Ask if there are any questions.

i. Students may begin. Below are key steps the instructor may use to assist with coaching and completing the Go/No Go rubric.

**Steps below are to aid with coaching and conducting the PE. When creating a PE be sure to list key decision-making steps as well as insights that are not in the IETM. Delete this line of instruction once PE is a working draft and not a template.

Step (List the key steps)	**Student Action (or Expected Values) or Instructor Note**
1. At right rear of vehicle to the left of the brake reservoir, is the Suspension SCIM, disconnect the right connector (MC174) and remove wire 1701, pin 5	
2. Fault will display (1) codes on DSDU, code 14-11	Students will turn on the vehicle to see if there are codes on the DSDU
3.	identify codes on the DSDU to start troubleshooting track
4. Instructor will observe and aid if troubleshooting is close to allotted time	At this time displayed codes will direct student to check connector MC174
5.	Identify and repair fault
6. Verify Fault has been corrected	

j. Mark Go/No Go Sheets accordingly.

1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

2. Once the Practical Exercise is complete, the Lead Instructor must sign each student's Solution Sheet.

Feedback Requirements

Debrief the Activity: Provide tips and insights into potential "go wrongs" and reasons/rational for things that occurred during the PE.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 3I-1
Suspension Comm Fault

Name____

Date____

Training Location____

Suspension Comm Fault	**Go**	**NO GO**	**Initials**
1. Verified the Fault			
2. Located proper troubleshooting fault in the IETM			
3. Followed all warning cautions and notes			
4. Correctly followed troubleshooting track in TM			
5. Correctly repaired fault (per TM)			
6. Verified fault was corrected			

Signature____

Appendix C
JLTVA1 Practical Exercise Sheet No. 3J
Headlight Troubleshooting

Title	Headlight Troubleshooting (FIK #3-6: Low Beam Headlights Do Not Operate)
Lesson Number / Title	03 Electrical
Introduction	We will now perform a P.E. on the JLTVA1 applicable to the Electrical Systems.
Motivator	The electrical system provides many functions for your JLTVA1. One of the primary functions of the chassis electrical system is to provide power for the lighting system. This section will cover troubleshooting of the headlight system.
Enabling Learning Objective B	Action: Troubleshoot the JLTVA1's J1939 Databus systems/sub-systems Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test or 100% accuracy on hands on activity.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Risk Assessment	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	Let's explore the electrical system on the JLTVA1
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide JLTVA1 FIK PE Instruction Job Aid **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils
Special Instructions	Instructor Note: Instructor will need to prep the vehicle for the troubleshooting task by inserting **FIK #3-6: Low Beam Headlights Do Not Operate** using the FIK PE Instructions Job Aid. Assistant Trainers: If possible, it would be acceptable to have an assistant instructor install the fault while the primary instructor is training.

Facilitation Tip: Simulate the exercises as appropriate; means using the Interactive Engaging Technical Manual (IETM), following the task, discussing, and completing each step until task is complete. Students will not remove the installed components.

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises.

d. Inform students they will have approximately 30 minutes to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five.

h. Ask if there are any questions.

i. Mark Go/No Go Sheets accordingly.

   1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

   2. Once the Practical Exercise is complete, the Lead Instructor must sign each student's Solution Sheet.

j. When everyone is finished collect solution sheet.

Feedback Requirements

Provide feedback to ensure student learning.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 3J-1
Headlight Troubleshooting

Name____

Date____

Training Location____

Headlight Troubleshooting	**Go**	**NO GO**	**Initials**
Verified the Fault			
Located proper troubleshooting fault in the IETM			
Followed all warning cautions and notes			
Correctly followed troubleshooting track in TM			
Correctly repaired fault (per TM)			
Verified fault was corrected			

Instructor Signature ____

Appendix C
JLTVA1 Practical Exercise Sheet No. 3K
Stop/Turn Light Troubleshooting

Title	Stop/Turn Light Troubleshooting (FIK #3-7: Driver Side Stop/Turn Light Does Not Illuminate)
Lesson Number / Title	03 Electrical
Introduction	We will now perform a P.E. on the JLTVA1 applicable to the Electrical Systems.
Motivator	The electrical system provides many functions for your JLTVA1. One of the primary functions of the chassis electrical system is to provide power for the lighting system.
Enabling Learning Objective B	Action: Troubleshoot the JLTVA1's J1939 Databus systems/sub-systems Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test or 100% accuracy on hands on activity.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Risk Assessment	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	Let's explore the electrical system on the JLTVA1
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide JLTVA1 FIK PE Instruction Job Aid **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils
Special Instructions	Instructor Note: Instructor will need to prep the vehicle for the troubleshooting task by inserting (**FIK #3-7: Driver Side Stop/Turn Light Does Not Illuminate)** using the FIK PE Instructions Job Aid. Assistant Trainers: If possible, it would be acceptable to have an assistant instructor install the fault while the primary instructor is training.

Facilitation Tip: Simulate the exercises as appropriate; means using the Interactive Engaging Technical Manual (IETM), following the task, discussing, and completing each step until task is complete. Students will not remove the installed components.

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises.

d. Inform students they will have approximately **1 hour 30 minutes** to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five

h. Ask if there are any questions.

k. Mark Go/No Go Sheets accordingly.

1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

2. Once the Practical Exercise is complete, the Lead Instructor must sign each student’s Solution Sheet.

l. When everyone is finished collect solution sheet.

Feedback Requirements

Provide feedback to ensure student learning.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 3K-1
Stop/Turn Light Troubleshooting

Name____

Date____

Training Location____

Stop/Turn Light Troubleshooting	**Go**	**NO GO**	**Initials**
Verified the Fault			
Located proper troubleshooting fault in the IETM			
Followed all warning cautions and notes			
Correctly followed troubleshooting track in TM			
Correctly repaired fault (per TM)			
Verified fault was corrected			

Instructor Signature ____

Appendix C
JLTVA1 Practical Exercise Sheet No. 3L
C4ISR Component ID and Troubleshooting

Title	C4ISR Component ID and Troubleshooting
Lesson Number / Title	03 Electrical
Introduction	To start this exercise, you will do component identification of the electrical components that power C4ISR equipment. Immediately following component ID, you will troubleshoot an induced fault of the C4SIR equipment.
Motivator	The auxiliary electrical system of the JLTVA1 allows operators the capability to communicate on the battlefield. Without a functional auxiliary power distribution system, the JLTVA1 is not capable of controlling integrated systems effectively. This electrical system is critical to understanding not because it makes the truck run, but because it powers all customized command, control, communications and intelligence equipment on the JLTVA1.
Enabling Learning Objective C	Action: Troubleshoot Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) electrical systems/sub-systems Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test or 100% accuracy on hands on activity.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Risk Assessment	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	Let's explore the electrical system on the JLTVA1
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils

Special Instructions

Part	Description
	Conduct Component ID first (guided PE help students locate and recognize components as needed)
Wire # 1068	Wire that will be disconnected to induce fault in system.
Technical Manual Reference	IETM folder path is below: ➢ **Maintainer- Diagrams** ➢ Electrical Schematics; Sheets 6, 3, 8, 14 ➢ Kit Schematics; Sheet 5
Time to insert	10 minutes
Symptom	This fault simulates an open Aux Load Control circuit between the Auxiliary Battery Switch and the Rear Relay Controller. When the Auxiliary Battery Switch is turned on, the trigger signal will not reach the Rear Relay Controller and Auxiliary Battery power will not be provided to SSPC1 and SSPC2.
Install	1. Disconnect MCC103 located behind the left dash (note: there are two connectors there, MC103 and MC104, be sure to use MC103) 2. Using the Deutsch pin removal tools from the FIK, remove wire 1068 from pin 16. 3. Resolution of the fault is easy; disconnect M103, reinsert wire 1068 into pin 16 slot, and reconnect MC103. Instructor must ensure the wire is installed properly.
Instructor Note:	Instructor Note: The instructor should demonstrate the components locations before testing the students. The instructor should give information discussed during the walk around to help jog the student's memory before giving a location. Students should have no more than 10 minutes to complete this task. There is no troubleshooting track to follow in the IETM. Therefore, **schematics must be used.** Use the following steps to guide the students through the troubleshooting process: 1. Verify the fault; No C4ISR power. 2. Ensure auxiliary batteries are connected. 3. Turn the Aux Battery switch ON and check for voltage out of the Rear Relay Controller to SSPC1 and SSPC2. There should be no voltage present. 4. Disconnect connector W150-P5 from the Rear Relay Controller and check for voltage at pin 1. This is wire 1068 from the Aux Battery switch. There should be no voltage present. Reconnect W150-P5. 5. Locate and disconnect connector W150-P3/MC485. This is a grey 12-way Deutsch connector in the C4ISR cabinet. On the MC485 side, check for voltage at pin

	3, wire 1068. There should be no voltage present. Reconnect W150-P3/MC485. 6. Locate and disconnect MC24. This is a round silver Deutsch connector under the capsule to the left of the transaxle. On the side coming from the front of the truck, check for voltage at pin S, wire 1068. There should be no voltage present. Reconnect MC24. 7. Locate and disconnect MC57. This has been found during previous PEs. On the bulkhead side, check for voltage at pin 12, wire 1068. There should be no voltage present. Reconnect MC57. 8. Locate and disconnect MC103 Its location was described in the fault insertion instructions above. Show the students the terminal push-out/simulated open circuit on wire 1068 at pin 16 To verify the voltage signal from the Aux Battery switch, check for voltage at pin 16 n the harness side on the connector. 24 volts should be present. Turn off the Aux Battery switch, reinsert the terminal, and reconnect MC103 DO NOT turn the Aux Battery switch on to verify operation; the CSDU and Core Services must be up and running before turning the Auxiliary Batteries on to properly power and control the SSPCs, and there is no authorization in this training course to operate the CSDU.

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises.

d. Inform students they will have approximately 30 minutes to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five.

h. Ask if there are any questions. Students may begin.

i. Mark Go/No Go Sheets accordingly.

   1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

2. Once the Practical Exercise is complete, the Lead Instructor must sign each student's Solution Sheet.

m. Below are C4ISR Components, their locations and functionality the instructor may use to assist with the Go/No Go rubric.

C4ISR Component	Component Location/Function
Auxiliary Batteries	In the C4ISR cabinet (variant dependent)
Relay Controller	In the C4ISR cabinet (variant dependent)
CSDU Fuse	Inline in the wiring harness behind the CSDU
D1 Diode	In the C4ISR cabinet (variant dependent)
SSPC 1	In the C4ISR cabinet (variant dependent)
SSPC 2	In the C4ISR cabinet (variant dependent)
C4ISR Terminating Resistors	In the C4ISR cabinet (variant dependent) and in the dash near the 120V outlets

j. Score students' solutions sheets and sign on the instructor signature line.

Feedback

Provide feedback to ensure student learning.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 3L-1
C4ISR Component ID and Troubleshooting

Name____

Date____

Training Location_____________________________________

C4ISR Component ID and Troubleshooting	**Go**	**NO GO**	**Initials**
Located the auxiliary batteries			
Located the relay controller (Combiner Relay)			
Located the CSDU fuse			
Located the D1 Diode			
Located SSPC 1			
Located SSPC 2			
Located terminating resistors			

Instructor Signature ____

Troubleshoot C4ISR Electrical System	**Go**	**NO GO**	**Initials**
Verified the Fault			
Located proper troubleshooting fault in the IETM			
Followed all warning cautions and notes			
Correctly followed troubleshooting track in TM			
Correctly repaired fault (per TM)			
Verified fault was corrected			

Instructor Signature ____

Appendix D
JLTVA1 12/24 VDC mVEC Circuit Breaker to Fuse

JLTVA1 12/24 VDC mVEC Circuit Breaker to Fuse Chart			
DSDU	**Current**	**Description**	**Rating**
CB01	F16	AIR DRYER	15 AMP
CB02	F17	TRAILER ABS	15AMP
CB03	F18	ENGIEN ECY IGN	10 AMP
CB04	F19	AIR COMPRESSOR	10 AMP
CB05	F20	SUSP MODULE POWER	15 AMP
CB06	F21	ENGINE ACC POWER	15 AMP
CB07	F22	12V ENGINE ECU SUPPLY	10 AMP
CB08	F23	12V ENGINE ECU	30 AMP
CB09	F24	SUSP SOL POWER	15 AMP
CB10	F25	RR CHASS POWER	20 AMP
CB11	F26	FRONT VEHICLE LIGHTING	15 AMP
CB12	F27	mVEC PWR	10 AMP
CB13	F28	12V ENGINE ECU	20 AMP
CB14	F29	ACTV AIR CLEANER	15 AMP
CB16	F30	12V LIGHTING	15 AMP
CB17	F31	24V ACCESSORY OUTLET	10 AMP
CB18	F32	FRONT SNSR PWR	15 AMP
CB19	F33	SPARE 24V IGN	15 AMP
CB20	F34	CTIS	20 AMP
CB21	F35	ABS	15 AMP
CB22	F36	REAR VEHICLE LIGHTING	15 AMP
F1	F1	12V ACCESSORY OUTLET	10 AMP
F2	F2	12V ACCESSORY OUTLET	10 AMP
F15	F15	12V ENGINE ECU	10 AMP

US Army
SFAE-CSS-JC-JL
MS 640 BLDG 302 RM 113
6501 E 11 Mile Road
Warren, MI 48397-5000

INSTRUCTOR GUIDE

Joint Light Tactical Vehicle (JLTVA1) Maintainer Course

LESSON

04 Engine

SECTION I. ADMINISTRATIVE DATA

All Courses Including This Lesson

Course Number	Version	Course Title
JLTVA1_MAINT_01	3.0	Introduction and Safety
JLTVA1_MAINT_02	3.0	Vehicle Familiarization
JLTVA1_MAINT_03	3.0	Electrical
JLTVA1_MAINT_04	3.0	Engine
JLTVA1_MAINT_05	3.0	Transmission
JLTVA1_MAINT_06	3.0	Drivetrain
JLTVA1_MAINT_07	3.0	Suspension, Hydraulics and Steering
JLTVA1_MAINT_08	3.0	Air Systems, Brakes and CTIS
JLTVA1_MAINT_09	3.0	End of Course

Task(s) Taught (*) or Supported

Task Number	Task Title
I.G.4	*Locate and Use Relevant Service Information (to include diagnostic procedures, flow charts and wiring diagrams)
I.G.2.1	*Inspect and Test Power and Ground Circuits and Connections; Measure and Interpret Voltage, Voltage Drop, Amperage, and Resistance Readings using a Digital Multimeter; determine needed action
I.A.5	*Check Engine No Cranking, Cranks but Fails to Start, Hard Starting, and Starts but Does Not Continue to run Problems; Determine needed action
A8M_00_NGFAAAA	*Engine Cranks but Does Not Start

Reinforced Task(s)

Task Number	Task Title
N/A	

Academic Hours

The academic hours required to teach this lesson are as follows:

Academic	Resident Hours	Methods
3 hr 05 min		ILT
2 hr 20 min		PE
Total Hours:	5 hr 25 min	

Test Lesson Number

Hours	Lesson Number Version	Lesson Title
1 hr 30 min	Test A	09_End of Course and Final Exam
1 hr 30 min	Test B	09_End of Course and Final Exam

Prerequisite Lesson(s)

Hours	Lesson Number Version	Lesson Title
N/A	N/A	N/A

Clearance Access

Security Level: Distribution C
Requirements: Distribution authorized to U.S. Government agencies and their contractors only.

Foreign Disclosure Restrictions

FD7. This product/publication has been reviewed by the product developers in coordination with the Oshkosh Corporation foreign disclosure authority. This product is NOT releasable to students from foreign countries.

References

Number	Title	Date
2320-01-653-6557	JLTVA1 GP IETM	April 2018
2320-01-653-6495	JLTVA1 HGC IETM	April 2018
2320-01-653-6516	JLTVA1 UTL IETM	April 2018
2320-01-653-6534	JLTVA1 CCWC IETM	April 2018

Student Study Assignments

None

Instructor Requirements

JLTVA1 Certified Instructor (3)

Additional Support Personnel Requirements

Name	Student Ratio	Qty	Man Hours
N/A			

Equipment Required for Instruction

Quantities are based on a 15-student class size.

ID Name	Student Ratio	Instructor Ratio	Spt	Qty	Exp
Projector	1:15	1:1	No	1	Yes
JLTVA1 w BII	1:5	1:1	No	3	Yes
MSD with EMS NG/IETM	1:5	1:1	No	3	Yes
GMTK	1:5	1:1	No	3	Yes
FIK	1:5	1:1	No	3	Yes

Special Tool – Jack Service Cart Kit JLTVA1	2:5	2:1	No	6	Yes

Materials Required

Instructor Materials:
Instructor Guide
FIK

Student Materials:
Student Guide

Classroom, Training Area, and Range Requirements

ID Name	Qty	Student Ratio	Setup Mins	Cleanup Mins
Classroom, 15 Student	1	1:15	30	30
Shop, 3 Bays	1	1:5	30	30

Ammunition Requirements

DODIC Name	Qty	Student Ratio	Setup Mins	Cleanup Mins
N/A				

Instructional Guidance / Conduct of Lesson

NOTE: Before presenting this lesson, instructors must thoroughly prepare by studying this Lesson and identified reference material

Proponent Lesson Plan Approvals

Name	Rank	Position	Date
N/A			

SECTION II. INTRODUCTION

Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of Instruction:	5 min
Instructional Strategy	Lecture and Group Discussion

Motivator

We just finished learning about the electrical system, one could state the electrical system of a vehicle is equivalent to one's brain because the brain, spinal cord and nerves are similar to sensors, connectors and the Controller Area Network (CAN). Using that same analogy, the engine would equate to the heart of the vehicle; it is critical to starting, movement and operation. Failure to understand and become efficient maintaining the JLTVA1 engine may result in dead lining a powerful tactical vehicle.

Terminal Learning Objective 4.

NOTE: Inform the students of the following Terminal Learning Objective requirements.

Upon completion of this lesson, you will be able to:

Action:	Maintain the JLTVA1's engine system, subsystems, and components
Conditions:	Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials
Standards:	Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity.

Safety Requirements

It is the responsibility of the student/warfighter to follow safety guidelines as well as local unit SOPs.

Risk Assessment Level

Low – Electrical. Follow general shop safety to avoid risk.

Low – Crushing. JLTVA1 should already be properly secured on lifting kits to avoid potential incidents from working around wheel ends.

Environmental Considerations

It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.

AR200-1 delineates the responsibilities to integrate environmental requirements and verify all training procedures, materials, and doctrine, including sound environmental practices and considerations are followed.

Evaluation

A Check on Learning will be conducted at the end of each lesson to help reinforce and monitor the proper transfer of knowledge to students

At the end of the course a written final exam will be administered of which each student/warfighter must earn an 80% or greater to pass this course.

Throughout the lessons/modules practical exercises are conducted. Students will need to complete each exercise with 100% accuracy (to include remedial training if necessary) before the Performance Evaluation Checklist is signed, to ensure students can properly conduct maintenance procedures. PE’s are graded using a “go/no go” criteria, of which all students/warfighters must earn all “go’s” (100%).

Instructional Lead-In

(Slide #1 – Cover slide)

The goal for your training is to prepare you to maintain the JLTVA1 to fully operational condition so it can conduct various military operations which may require maneuvering over varied terrain, from mountainous to open, desert to urban, during all weather conditions both day and night with limited and poor visibility.

The engine is an exciting part of any training, because it’s the powerhouse of the machine. The JLTVA1 uses a powerful engine to enable it to be the tactical vehicle warfighters need for combat. As maintainers, it’s critical you understand how to service and maintain this engine.

(Slide #2)

Instructor Note
Explain the Module Overview as displayed on screen. This module is 5 hours long: 1.5 of it is classroom the rest is for hands-on training. Then transition to introducing the first learning objective.

SECTION III. **PRESENTATION**

Enabling Learning Objective A.

(Slide #3)

Upon completion of this lesson, you will be able to:

Action:	Correlate the JLTVA1's engine system/subsystem and components with their location, purpose, function and maintenance requirements
Conditions:	Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials
Standards:	Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity.

1.

(Slide #4)

ELO A – LSA 1

Learning Step/Activity:	Engine Characteristics Capabilities Overview
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	10 min
Media Type:	PPT

(Slide #5)

a. Engine Overview - JLTVA1 engine is based on a powerful, reliable, and efficient Banks 866T 6.6L turbocharged V8 diesel engine that has been derated to the JLTVA1 requirements.

Figure 4.1 Banks 866T Engine

1. The Banks 866T (Figure 4.1) production engine was de-rated by 15% from 397 hp to 340 hp to provide enhanced reliability, durability and the power required to accelerate from 0 to 50 mph in less than 20 seconds. Also, the package can maintain more than 50 mph on a 5% grade while not overstressing the engine.

2. The JLTVA1 engine employs 4 overhead valves per cylinder, with high-pressure common-rail direct injection at 26,000 psi and solenoid-actuated precision-spray fuel injectors. The block is cast of high strength nodular iron with high-heat-transfer aluminum-alloy cylinder heads, with a compression ratio of 16.8:1 to reduce peak cylinder pressures. The Variable Geometry Turbocharger (VGT) selected for the JLTVA1 is aerodynamically more efficient than standard turbochargers and provides better fuel economy and quicker response, practically eliminating the turbo lag present on some diesel engines.

3. The JLTVA1 engine is calibrated to optimize the air/fuel ratio, boost pressures, injection shot size, and injection timing for maximum fuel efficiency at idle and across the entire power spectrum, providing a high-power density in a compact, lightweight, and reliable engine.

(Slide #6)

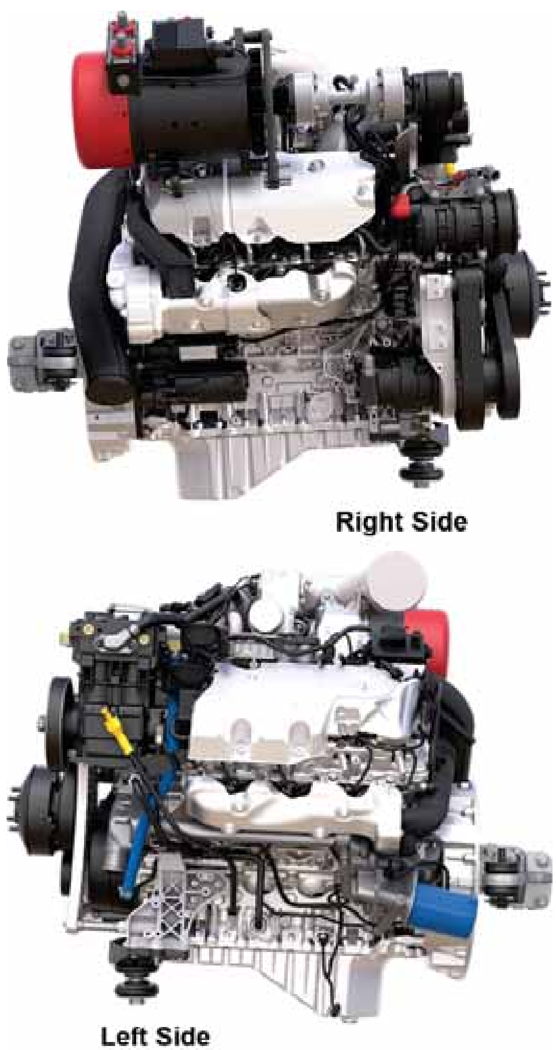


Figure 4.2 JLTVA1 Banks 866T Engine (left and right sides)

b. JLTVA1 Engine Specifications (Figure 4.2)

1. 6.6 Liter
2. 340 HP at 3100 RPM
3. 660 ft-lb torque at 1600 RPM
4. Variable geometry turbocharger (VGT)
5. Fuel cooler integrated into cooling pack
6. Currently accepts all diesel fuels available in the military
    a) DF-1
    b) DF-2
    c) JP-8, or alternate fuels as prescribed
7. 15W-40 engine oil
8. Engine firing order: 1-2-7-8-4-5-6-3
9. Fuel system is a high-pressure common rail (HPCR) fuel system

(Slide #7)

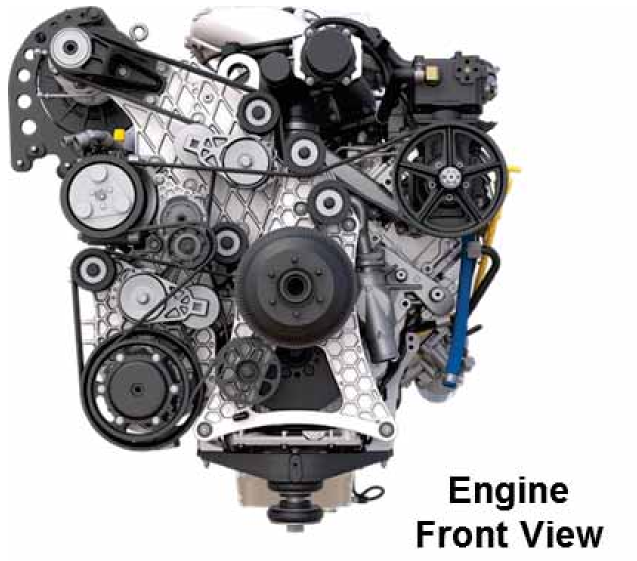


Figure 4.3 Three Belt Accessory Drive System

c. Engine Accessory Drive System

1. The Front Engine Accessory Drive (FEAD) provides power to the engine subsystem components, including alternator, hydraulic pump, cooling fan, air compressor, and HVAC compressor. The engine coolant pump is not driven by the FEAD, but directly by the engine. The FEAD is configured as a three-belt system. This design reduces belt loading for improved reliability.

2. A three-belt system is used to extend the life of the accessory drive belts. The belts are named-from the rearmost belt on the truck (the belt closest to the engine block) the primary belt, secondary belt, and the tertiary belt. Each belt has no more than three functions. (Figure 4.3)

   a) The primary belt (rear belt) has a tensioner, is driven off the crank pulley, and drives the alternator.

   b) The secondary belt (middle belt) also has a tensioner, is also driven off the crank pulley, and drives the hydraulic pump.

   c) The tertiary belt (front belt) has a tensioner, is driven off the hydraulic pump drive-through pulley, drives the air compressor, AC compressor, and engine fan drive.

3. Engine fan drive - The engine fan drive is pneumatically released, and spring applied. This is standard for fan clutches because they must default to on if the air system fails.

Check on Learning

(Slide #8)

Q: What type and size engine does the JLTVA1 have?
A: Banks 866T 6.6L

Q: What are the accessory drives on the engine?
A: It has three belts.

Q: Which belt runs the engine cooling fan?
A: The tertiary belt.

Summary

(Slide #9)

Let’s go over the bigger points of emphasis we covered during the engine overview.

- The engine specifications for the Banks 866T engine are:
  - 6.6 Liter
  - 340 HP at 3100 RPM
  - 660 ft-lb torque at 1600 RPM
  - Variable Geometry Turbocharger (VGT)
  - Fuel cooler integrated into cooling pack
  - Currently accepts all diesel fuels available in the military
    - DF-1, DF-2, JP-8, or alternate fuels as prescribed
  - 15W-40 engine oil
  - Engine firing order: 1-2-7-8-4-5-6-3
  - Fuel system is a High-Pressure Common Rail (HPCR) fuel system
- Uses a three-belt system - The primary belt drives the alternator; the secondary belt drives the hydraulic pump; and the tertiary belt drives the engine fan, HVAC compressor, and air compressor.

Transition

Now that you are familiar with the Banks 866T engine specifics, we are going to learn about the subsystems that make the performance possible and provide you with what you need to know to maintain those subsystems. Each of the subsystems are their own learning step; we are starting with the engine’s electrical system.

2. **(Slide #10)**

ELO A – LSA 2

Learning Step/Activity:	Engine Subsystem – Electrical
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	1 hr
Media Type:	PPT

(Slide #11)

Figure 4.4 ECM

a. Theory of Operation of Engine Electrical System

1. The Banks 866T theory of operation is the same as all other engines, the performance parameters are made possible by the tuned, calibrated operation of the following systems. To understand the enhancements, we'll start with the electrical components.

2. The electrical control system consists of the engine control module (Banks ECM), sensors, and actuators. Each part of the system is monitored and controlled by the ECM. (Figure 4.4)

(Slide #12)

Figure 4.5 ECM located under air intake tube

Figure 4.6 Banks ECM

b. Engine Electrical System Components

1. Engine Control Module (ECM)

a) ECM overview - The Banks ECM operates on programmed parameters that allow for the horsepower and torque curves required to meet the performance specifications of the JLTVA1. It is located under the air intake tube. (Figure 4.5)

1) It also has software modifications to eliminate the emissions parameters and systems (exhaust gas recirculation and aftertreatment) that are required on the base engine.

2) Engine exhaust brake control is incorporated into the ECM and the 3G controller on the JLTVA1. (Figure 4.6)

3) The ECM communicates via the J1939 Databus to display information on the DSDU, including

(a) Engine status (operating parameters)

(b) Oil, coolant, and fuel levels

(c) Oil, coolant, and fuel temperatures

(d) Oil pressure

(e) Intake air filter restriction

(f) Active fault codes

(Slide #13)

Figure 4.7 Banks controller connector

b) Power inputs (Figure 4.7)

> **Note**
> With the implementation of ECP OSKW8402R2, the 12/24 VDC mVEC replaced each circuit breaker with a fuse. This update may be present in the vehicle. Refer to Appendix D, page 1 for the conversation table.

1) Ignition power

(a) When the chassis ignition relay is energized by the ignition switch, it provides 24 VDC over wire 1274 into the chassis mVEC. In the mVEC, this voltage will energize K2 relay. 12 VDC is provided over wire 1973 from the relay controller into the chassis mVEC. This voltage is available at the switch side of K2. When K2 relay is energized, 12 VDC power flows from K2, through F18 (10A), exits the mVEC from MC301 pin G on wire 1902, and continues to the ECM at C2 pin 21.

(b) The 12 VDC power on wire 1902 branches off at SP11 and is used also to power the pressure transducer for the air filter restriction indicator (Filter Minder).

2) Battery power

(a) 12 VDC battery supply power comes from the M14 stud on the relay controller over wire 1903A. This 12 VDC power flows into the chassis mVEC at MC303 pin G, through F22 (10A), exits the mVEC from MC489 pin D on wire 1903, and continues into the ECM at C1 pin 77.

3) Main relay power

(a) 12 VDC battery power is supplied from the M14 stud on the relay controller over wire 1900A into the chassis mVEC at MC301 pin E, through F23 (30A), and is made available to both the coil and switch sides of K1 relay.

(b) When the ECM receives ignition power (as described above), it electronically supplies the necessary ground (on C2 pin 19 at the ECM, over wire 1901, to MC301 pin H at the chassis mVEC) to energize K1 relay.

(c) Here it splits power at SP3 which powers the ECM at pins 1, 3, and 5 of the C2 connector at the Banks controller. When K1 energizes, it provides 12 VDC power through two circuit breakers; power through F28 (20A) exits the mVEC at MC301 pin C on wire 107A3 and continues to the ECM at C1 pin 76. Power through CB15 (10A) exits the mVEC at MC301 pin D on wire 1900, splits in two at SP21, takes two redundant paths through MC213 (pins 1 and 8), splices back together at SP8, splits again into three paths at SP3, and continues into the ECM at C1 pins 1, 3, and 5.

4) Grounds (Figure 4.7)

(a) The grounds for the ECM are found at pins 2, 4, and 6 of the C2 connector at the Banks controller. The ECM grounds through C2 pins 2, 4, and 6. These are all wire 1435. They splice to each other at SP2, and splice with other 1435 ground wires at SP1 and SP26 before terminating at the GR1 battery ground post.

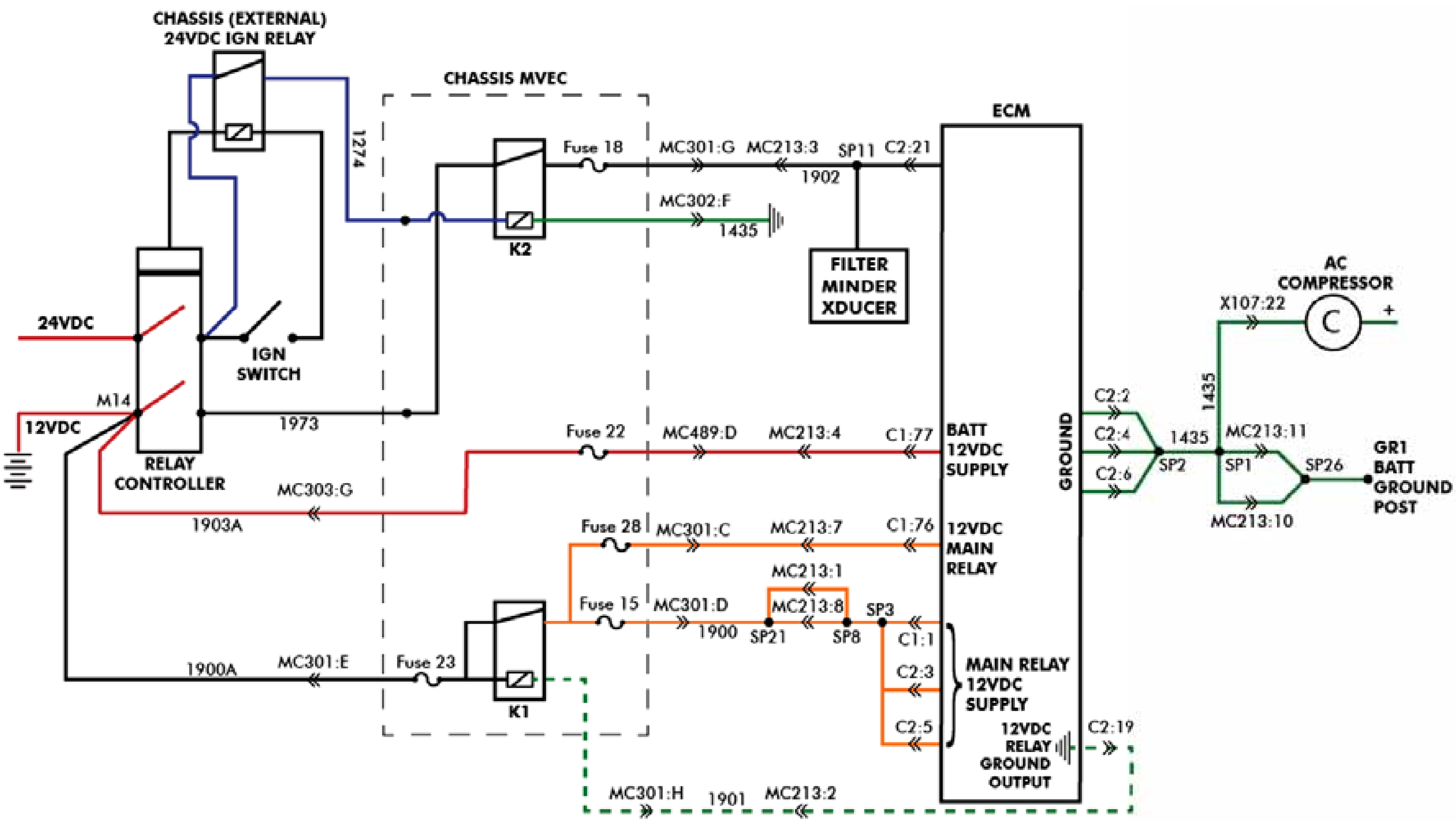
5) All power and ground circuits to-and-from the ECM pass through MC213.

(Slide #14)

Instructor Note:
Pull up the engine electrical schematic in the IETM (path listed below) Direct students to go to Appendix D to view the Engine Electrical Schematic and follow the circuits as you walk through the schematic to explain the flow and primary component interfacing.

6) Electrical schematic for engine; To view the JLTVA1 engine schematic use the IETM and go to: **Diagram** > Maintainer - Diagram >Schematics> Sheet 11 (Engine Interface)

7) See Figure 4.8 – Diagram of Engine Electrical System.



Engine Electrical System
Figure 4.8

(Slide #15)

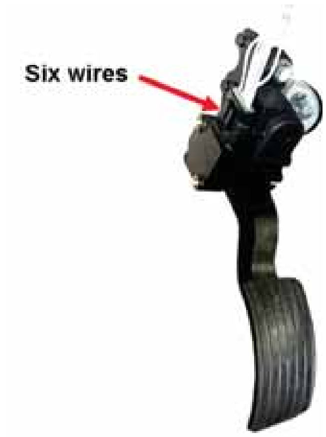


Figure 4.9 Accelerator pedal

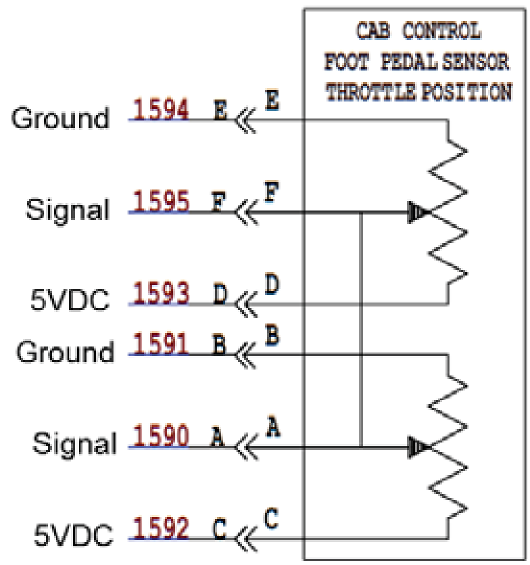


Figure 4.10 Cab control foot pedal sensor

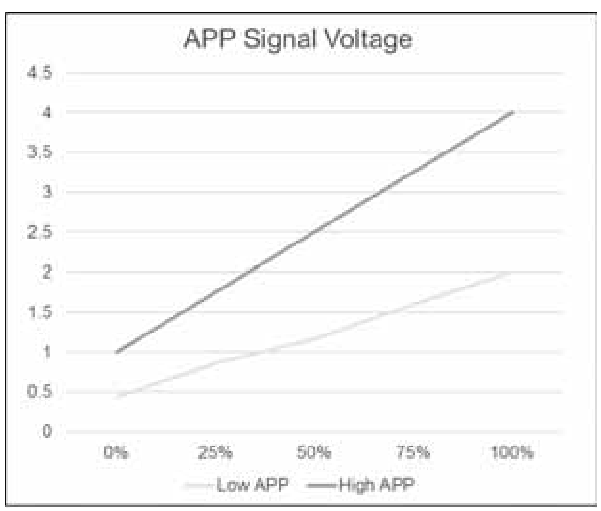


Figure 4.11 APP signal voltage

1. Accelerator pedal sensor

    a) The accelerator pedal sensor is a six-wire sensor (Figure 4.11)

    b) There are two variable resistors found in the accelerator pedal sensor.

        1) These are two separate sensors that supply a variable voltage for throttle position verification to the ECM.

        2) Both sensing elements operate on a 5-volt reference. (Figure 4. 10 and 4.11)

(Slide #16)

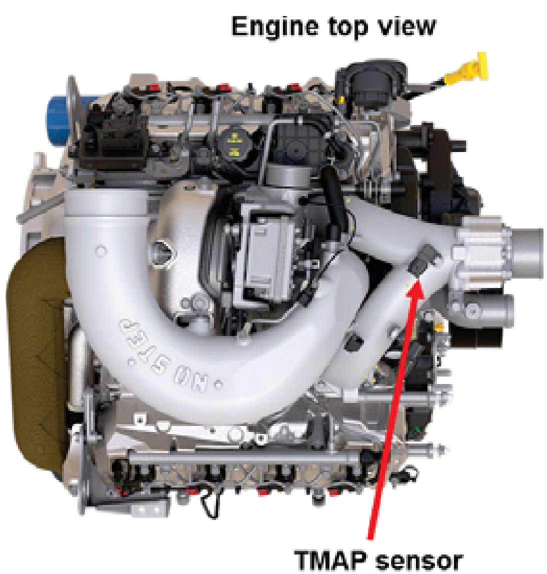


Figure 4.12 TMAP sensor

2. Temperature & manifold absolute pressure (TMAP) sensor

    a) The TMAP sensor is located in the top of the air intake bridge, just forward of the turbo inlet tube. It is used by the ECM to monitor intake air temperature and manifold pressure. (Figure 4.12)

        1) Four-wire sensor

            (a) 5 VDC reference (pin 2)

            (b) Signal 1 (pressure signal, pin 4)

            (c) Signal 2 (temperature signal, pin 1)

            (d) Ground (pin 3)

(Slide #17)

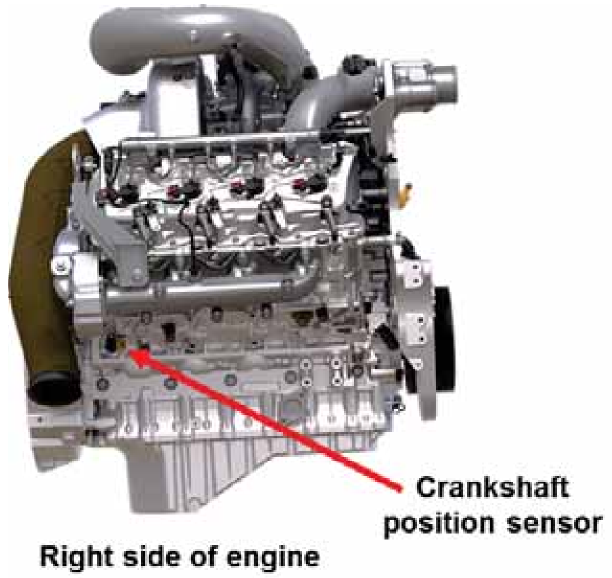


Figure 4.13 Crankshaft sensor position on A1

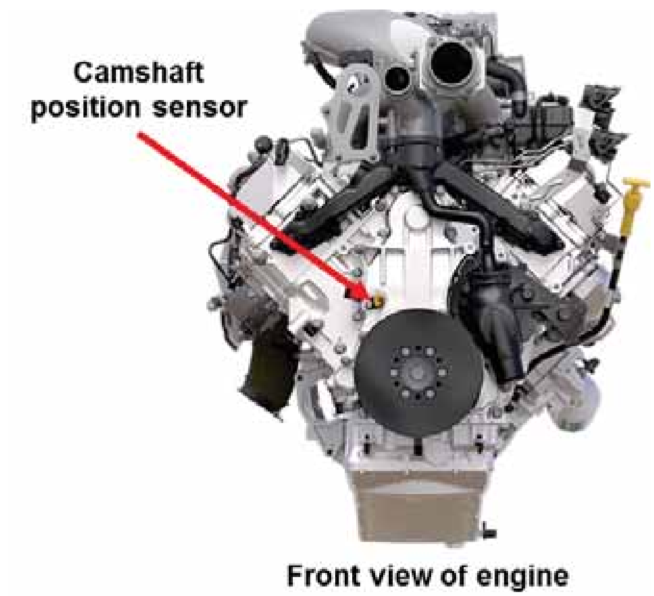


Figure 4.14 Camshaft sensor position on A1

3. Crankshaft/camshaft position sensors (Figure 4.13 and 4.14)

   a) Tell the ECM the position of the crankshaft and camshaft.

   b) These sensors have three wires that send information back to the ECM.

      1) 5 VDC reference (pin 1)

      2) Ground (pin 2)

3) Signal (pin 3)

c) If one of these sensors goes down, the truck will not start. If the truck is already running, it will continue to run.

(Slide #18)

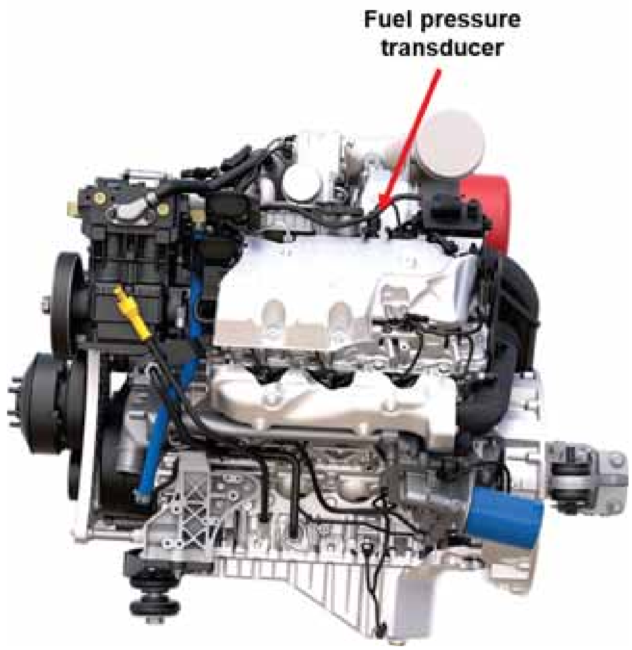


Figure 4.15 Pressure Sensor

4. Pressure sensors

a) The fuel pressure transducer is found in the fuel supply line, downstream of the fuel filter and just to the rear of the oil fill cap on the top left side of the engine. This monitors fuel supply pressure from the low-pressure fuel pump. Wiring for this sensor passes through connectors X107 and MC210. (Figure 4.15)

1) Signal (pin A) to Front Chassis SCIM

2) Ground (pin B) to 10 in, 4 out module

3) 5 VDC reference (pin C) from 10 in, 4 out module

(Slide #19)

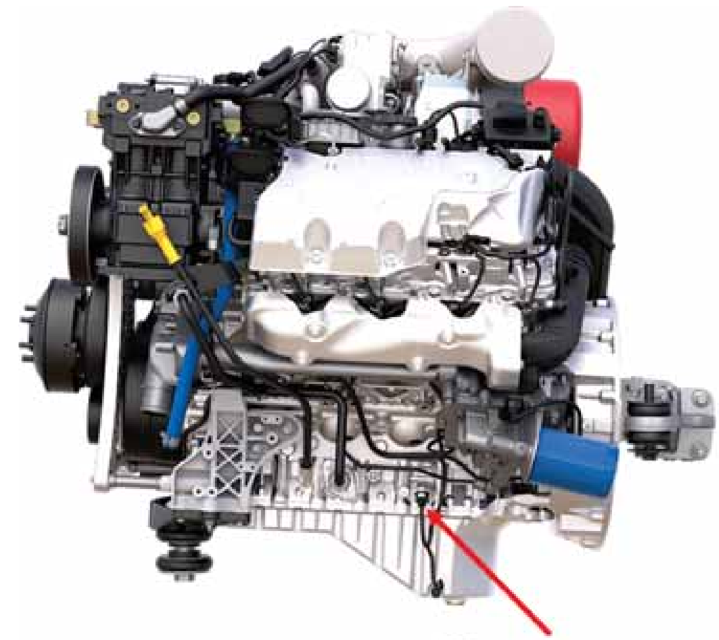


Figure 4.16 Fuel pressure sensor and oil pressure sensor

b) The oil pressure sensor is located in the side of the cylinder block near the oil filter base. It is used by the ECM to monitor engine oil pressure. The ECM will broadcast this over the J1939 network to tell other systems and the operator what the oil pressure is for the engine. Wiring for this sensor passes through connector X108. (Figure 4.16)

1) Signal (pin 1)

2) Ground (pin 2)

3) 5 VDC reference (pin 3)

(Slide #20)

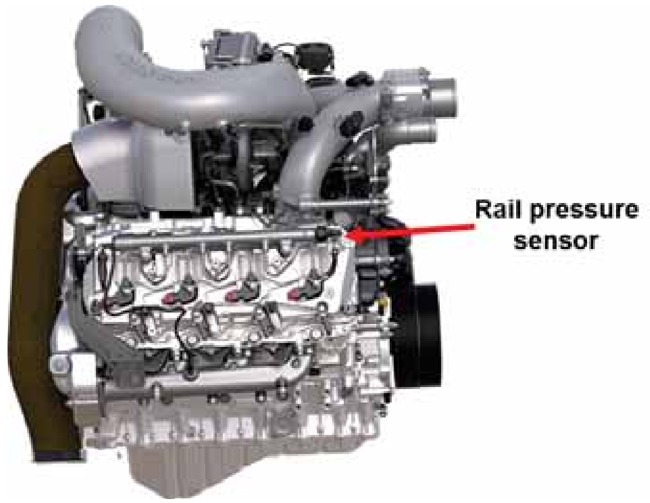


Figure 4.17 Rail pressure sensor

c) The rail pressure sensor is located on the front end of the right (passenger side) fuel rail. It is used by the ECM to monitor fuel rail pressure. It is a four-wire sensor and wiring for this sensor passes through connector X108. The wire from pin 2 of the sensor goes to X108, pin 21, but is not used and continues no further (Figure 4.17).

1) 5 VDC reference (pin 1)

2) Ground (pin 3)

3) Signal (pin 4)

(Slide #21)

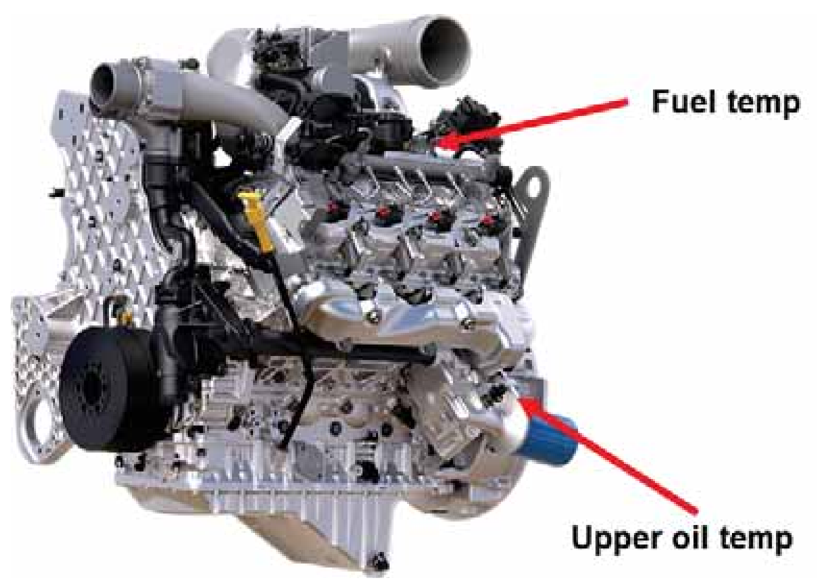


Figure 4. 18 Fuel and Oil Temperature Sensors

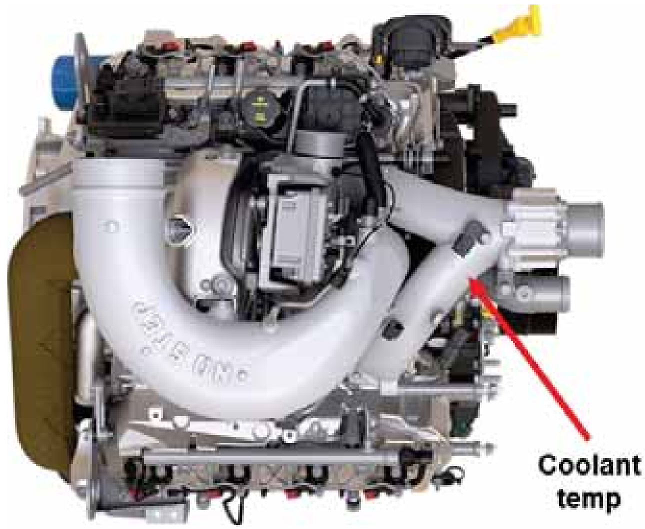


Figure 4.19 Coolant Temperature Sensor

5. Temperature sensors

   a) Temperature sensors are all two wire sensors (5 VDC reference and ground) that change resistance as temperature changes.

   b) The fuel temperature sensor is located in the fuel return line, just to the rear of the fuel pressure transducer on the top left side of the engine. (Figure 4.18)

      1) Signal (pin 1)

      2) Ground (pin 2)

   c) The upper oil temperature sensor is located in the oil cooler in the oil filter housing. (Figure 4.18)

      1) Signal (pin 1)

      2) Ground (pin 2)

   d) The coolant temperature sensor is located on the top front center of the engine, next to the thermostat housing and below the air intake bridge. (Figure 4.19)

      1) Signal (pin 2)

      2) Ground (pin 1)

   e) These sensors are negative temperature coefficient. This means that as temperature goes up, resistance goes down in the circuit.

      1) As resistance drops current flow increases. This reduces the voltage. As resistance increases current flow is reduced and a potential difference is formed. This potential difference is increased voltage.

(a) A voltage high fault is an open (or high resistance) circuit.

(b) A voltage low fault is a shorted (damaged) sensor.

f) There are three temperature sensors installed on the engine that are not utilized.

1) The air temperature sensor is located just off the turbocharger outlet with a pigtail going to a two-pin connector. Wiring from this sensor goes to connector X108 and continues no further.

2) The lower oil temperature sensor is located at the lower left rear corner of the oil sump. Wiring from this sensor goes to connector X108 and continues no further.

Note
On newer engines, the lower oil temperature sensor may not be installed, or there may not even be an installation location in the oil pan.

3) The gas exhaust temperature sensor is located in the right (passenger side) exhaust manifold. Wiring from this sensor goes to connector X107 and continues no further.

(Slide #22)

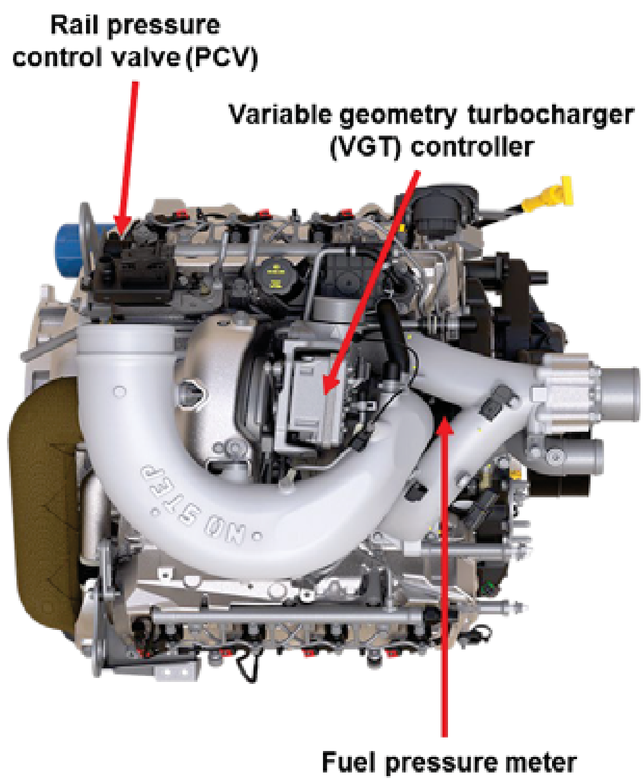


Figure 4.20 Actuators - VGT controller and fuel pressure meter

6. Actuators

   a) The variable geometry turbocharger (VGT) controller (Figure 4.20) is mounted to the turbocharger.

      1) The VGT controls the variable vanes within the turbo.

      2) It communicates via J1939 Databus and is powered by 12 VDC ignition. Information regarding turbo vane position and engine exhaust brake operation is provided to the VGT controller by the ECM and the 3G controller.

   b) The fuel pressure meter (Figure 4.20) is a solenoid located on the top side of the fuel metering unit (FMU) which houses the high-pressure fuel pump.

      1) It is controlled by the ECM to tailor the pressure supplied by the low-pressure fuel pump based on engine requirements.

      2) The PWM duty cycle is typically between 5-95% (ground controlled).

      3) The valve is normally open.

      4) As the PWM signal is increased, the valve closes which feeds fuel to the control piston, thereby increasing fuel rail pressure.

      5) This same concept is applied in the inverse, as the PWM signal is decreased, the valve opens again, and pressure is again reduced in the downstream circuit.

   c) The rail pressure control valve (PCV) is located on the rear end of the left (driver side) fuel rail. The ECM controls the current supplied to the valve to maintain optimum rail pressure under varying conditions. The valve is normally open; full applied current closes the valve. (Figure 4.20)

(Slide #23)

7. Injectors (Figure 4.21)

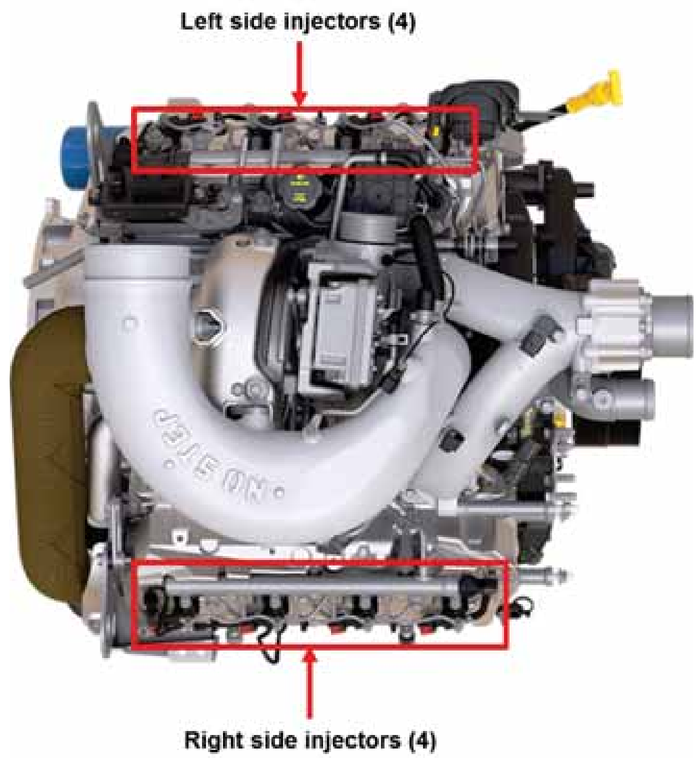


Figure 4.21 Injectors

a) The injectors are energized at about 93 VDC and 15A. When energized, the injection cycle begins:

   1) At low RPM the engine uses split injection

   2) At higher RPM it only uses the primary injection

b) The amperage is reduced to 12A and lifts the pilot needle to supply fuel down to the plunger which then overcomes the needle spring and delivers fuel to the chamber (Figure 4.21).

Check on Learning

(Slide #24)

Q: What are the three types of power required for the ECM?
A: Main relay power, ignition power, and battery power.

Q: What is the reference voltage for all the engine sensors?
A: 5 VDC

Q: Is the rail pressure control valve normally open or normally closed?
A: Normally open.

Summary

(Slide #25)

The engine of the JLTVA1 is a Banks 866T 6.6L engine, the electrical system for this engine requires the coordination of several control modules, controllers, power modules, sensors and actuators. Below are function-critical electrical components we covered:

- The Banks engine control module (ECM) has been programmed with modifications to allow for the horsepower and torque curves required to provide the performance needed for the JLTVA1.
- The chassis mVEC is in the engine compartment and supplies battery, ignition, and main relay power to the ECM.
- Accelerator pedal has a sensor, the APP, for operator fuel requests to the ECM.
- The manifold has the TMAP sensor that supplies the data the ECM uses to determine optimal fuel supply for air induced into the intake.
- The crankshaft and camshaft have sensors as well, to communicate on/off commands.
- Pressure sensors for the fuel and oil are monitored for the injection cycles and pressure regulation.
- There are several temperature sensors that monitor the air, oil, coolant and fuel.
- Three actuators control fuel pressure and injection.

Transition If there are no questions about the electrical controls used by the engine, we're going to move on to other subsystems that support the engine. Out next learning step is to discuss the lubrication system.

3. **(Slide #26)**

ELO A – LSA 3

Learning Step/Activity:	Engine Subsystem - Lubrication
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	5 min
Media Type:	PPT

(Slide #27)

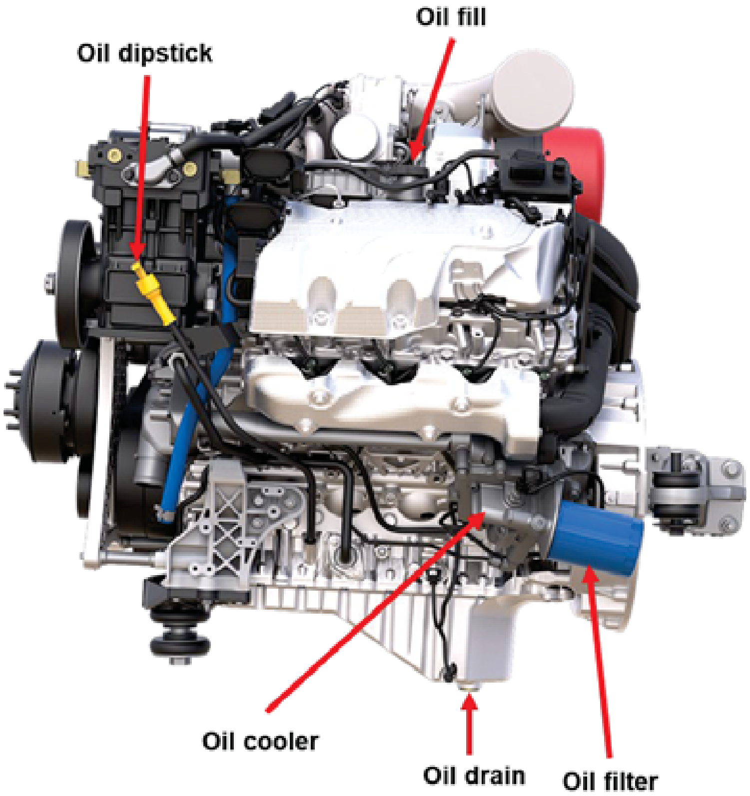


Figure 4.22 Lubrication Components

a. Engine Lubrication System Components (Figure 4.22)

1. Oil fill: Top left side of the engine, black cap.
2. Dipstick: Yellow stick, left front of engine below air compressor.
3. Oil cooler: On the oil filter housing.
4. Oil filter: The oil filter is located on the bottom of the engine on the left side of the truck.
5. Oil drain: On the oil pan; lowest point on the engine.

(Slide #28)

Figure 4.23 Oil Filter

b. Lubrication System

1. Typical oil pressure in the lubrication system is between 22 and 33-psi, depending on engine RPM. If oil pressure is too low, a relief may be stuck open, if it is too high, there may be a restricted pathway.

   a) Integrated bypass valves in oil filter housing

   b) Oil pressure sensor mounted in cylinder block

   c) Replace oil filter annually or every 6,000 miles (Figure 4.23)

Check on Learning

(Slide #29)

Q: What is the typical oil pressure range when hot?
A: 22-33-psi

Q: Name one reason why oil pressure may be too low?
A: A relief valve may be stuck open.

Q: What's a reason the oil pressure may be too high?
A: A restricted pathway.

Summary

(Slide #30)

Lubrication is a concise maintenance task; there are not a lot of levels of complexity:

- Engine oil filter is a spin on type. Replacement interval of the filter is every 6000 miles or annually.
- Oil cooler is part of the oil filter housing
- Typical system pressure is between 22-33-psi.
- Maintenance
  - Engine oil is 15W-40
  - Replace engine oil and filter annually or every 6000 miles

Transition

Questions?
The next learning step is about the engine's fuel system.

4. **(Slide #31)**

ELO A – LSA 4

Learning Step/Activity:	Engine Subsystem – Fuel System
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	15 min
Media Type:	PPT

(Slide #32)

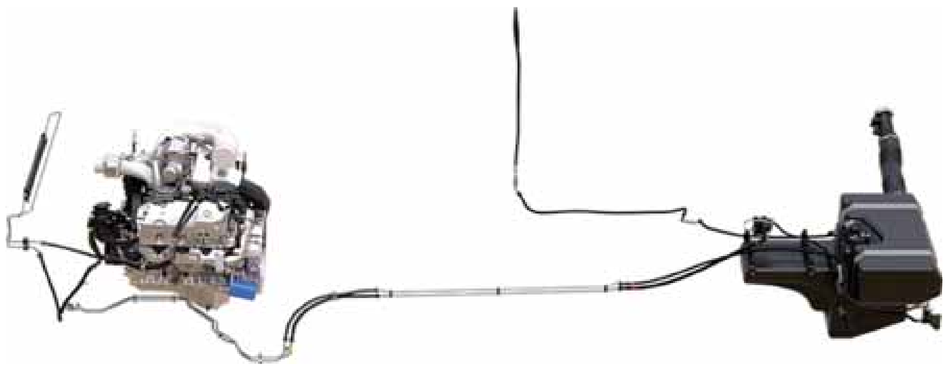


Figure 4.24 Engine to fuel tank

a. Theory of Operation of Engine Fuel System (Figure 4.24)

1. The Banks 866T engine is a modified version of the stock GM Duramax 6.6L engine. It has been modified for durability, longevity, and to run effectively on multiple available battlefield fuels. This engine uses Bosch solenoid-actuated precision-spray fuel injectors.

2. Intense calibration work was done to optimize the air/fuel ratio, boost pressures, injection pressures, injection shot size, and injection timing for maximum fuel efficiency and power while using multiple fuels.

3. The fuel system found on the JLTVA1 is a high-pressure common rail (HPCR) system. This means that maintainers must use caution when testing the fuel system. The system cannot simply be opened to check for fuel. The DSDU will provide codes to identify when fuel pressure is out of range.

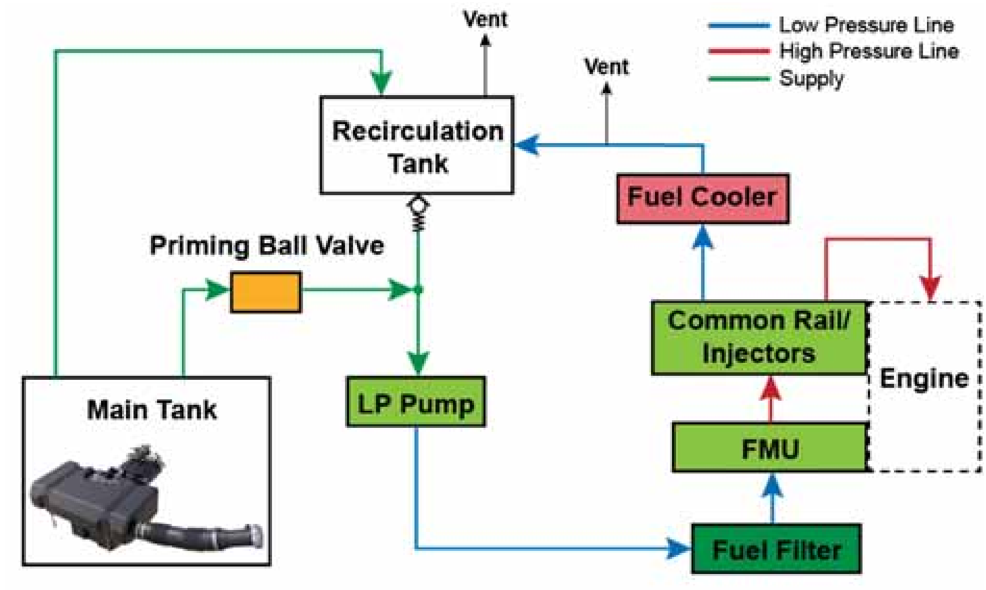


Figure 4.25 Fuel System Diagram

(Slide #33)

4. Engine Fuel Circuit (Figure 4.25)

   a) Fuel leaves the tank and passes through the priming valve.

   b) From the priming valve, it passes through the recirculation tank.

   c) After it leaves the recirculation tank, it is sent to the engine by the low-pressure fuel pump.

   d) After it leaves the low-pressure fuel pump, it passes through the fuel filter.

   e) After the filter, it goes into the fuel metering unit and the high-pressure fuel pump which pressurizes fuel to the engine fuel rails and, ultimately, to the injectors.

      1) The rail PCV controls fuel rail pressure.

   f) Unused fuel from the injectors and the FMU is sent through the fuel cooler and returned to the recirculation tank.

   g) The unused fuel from the engine gets fed back to the recirculation tank for further use.

(Slide #34)

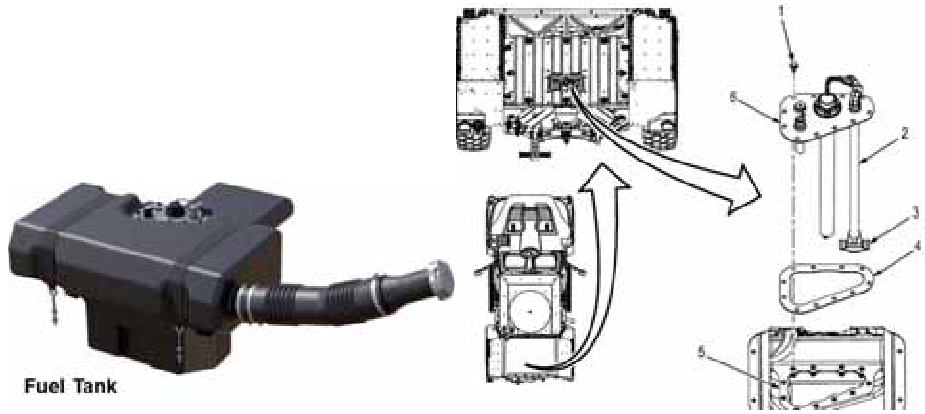


Figure 4.26 Fuel tank (isolated on left) in system (right)

b. Fuel System Components

1. Fuel tank (Figure 4.26)

a) The fuel tank is located at the rear of the truck.

b) This tank has an integrated level sensor, a filter sock, and a fill port.

1) Filter sock must be serviced biennially or every 12,000 miles

c) The fill port is located in the right-side rear compartment.

d) There is a drain port on the bottom of the fuel tank.

e) The level sensor is part of the pickup assembly installed in the top of the fuel tank, but it extends down to the bottom of the tank

(Slide #35)

Figure 4.27 Recirculation tank

2. Recirculation tank (Figure 4.27)

   a) The recirculation tank is used to allow for the JLTVA1 to continue mission for up to .6 miles if the fuel system has been damaged.

   b) It also is the return location for the unused fuel that has been returned from the engine.

(Slide #36)

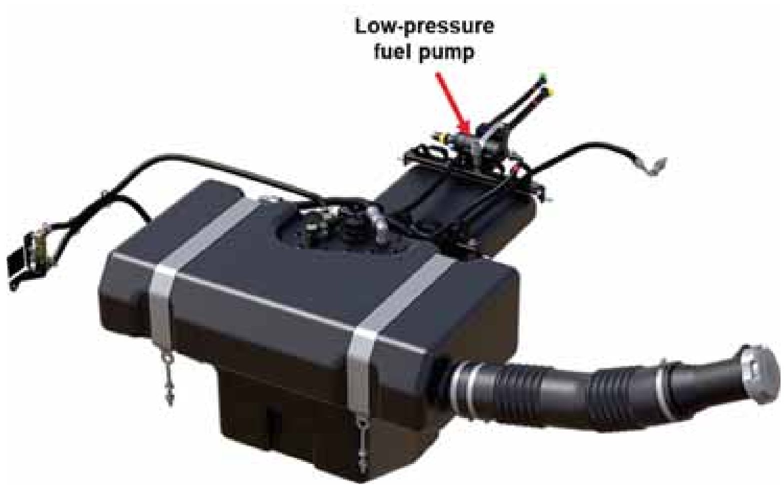


Figure 4.28 Low-pressure fuel pump (located above fuel tank)

3. Low-pressure fuel pump

   a) The low-pressure fuel pump is located under the rear cargo deck, mounted to the rear roll accumulator.

   b) It supplies fuel under pressure to the fuel metering unit (FMU) on the engine.

   c) It is controlled by the 3G controller and powered by the rear chassis power module.

      1) Will be powered by the Combat Override switch when the switch is activated. Pump will run at its maximum output of 80-psi.

(Slide #37)

Figure 4.29 JLTVA1 Fuel filter

4. Fuel filter assembly (Figure 4.29)

   a) The fuel filter on the JLTVA1 is a fuel water separator/filter system. It contains a cartridge-type filter element.

   b) There is a sensor in the filter that tells the operator when there is water in the fuel. There is also a water drain valve on the bottom of the filter assembly. It is operated by a smaller hex drive recessed in the larger hex on the bottom of the filter assembly.

      1) The valve can only be operated with a socket because the recessed location prevents access with a wrench. Maintainers should exercise caution when opening the valve to prevent obstructing the flow of water and fuel with the socket and ratchet.

   c) The filter should be serviced biennially or 12,000 miles – whichever comes first. Although there is a hex drive on the bottom of the filter housing, the internal filter element is currently unavailable. Service requires replacement of the complete filter assembly.

(Slide #38)

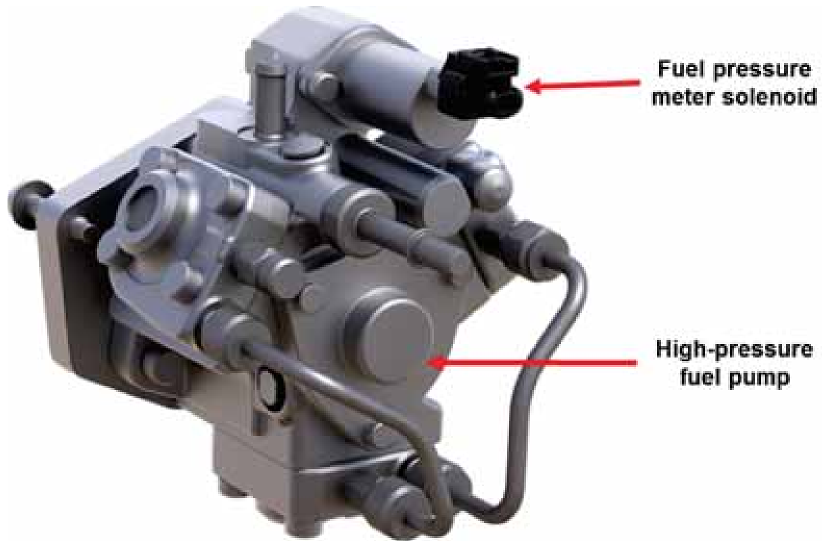


Figure 4.30 Fuel metering unit

5. Fuel metering unit (FMU)

    a) The FMU is located at the top front center of the engine below the air intake bridge. It houses the fuel pressure meter solenoid and the high-pressure fuel pump.

    b) The FMU receives fuel from the low-pressure fuel pump.

    c) The fuel pressure meter solenoid controls the fuel supplied to the high-pressure pump.

    d) The cam driven high pressure fuel pump then supplies highly pressurized fuel (26,000-psi maximum) to the fuel rails.

(Slide #39)

Figure 4.31 Fuel injectors (multiple on left/isolated on right)

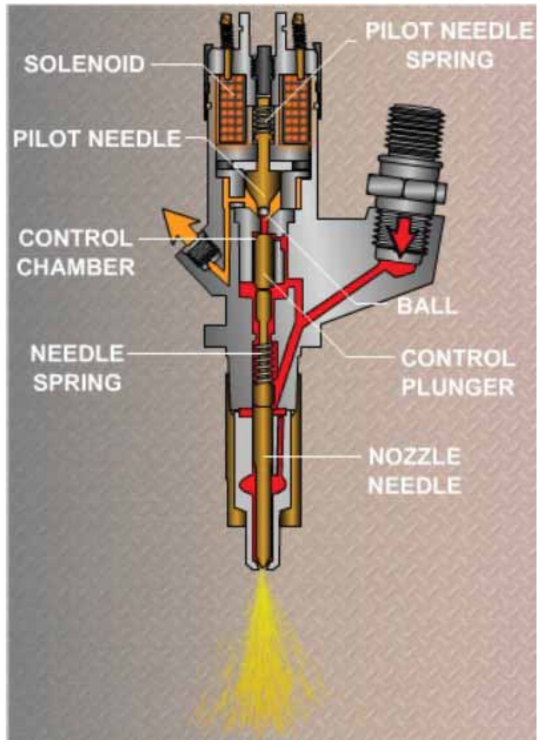


Figure 4.32 Fuel injector (internal diagram/flow)

6. Fuel injectors (Figure 4.31)

   a) The injectors are solenoid operated and are electronically controlled by the ECM.

   b) At low engine RPM, the injectors are operated on a split injection strategy.

      1) The first phase is a small pre-injection. This shoots a small quantity of fuel into the combustion chamber to start the flame front. (Figure 4.32)

      2) Once combustion has begun, the main fuel charge is injected.

      3) This strategy provides for more efficient and complete combustion at low engine speeds and loads.

   c) During high RPM operation, the injectors fire on a single shot strategy. Because compression and cylinder temperatures are higher, the split injection strategy is not necessary.

(**Slide #40)**

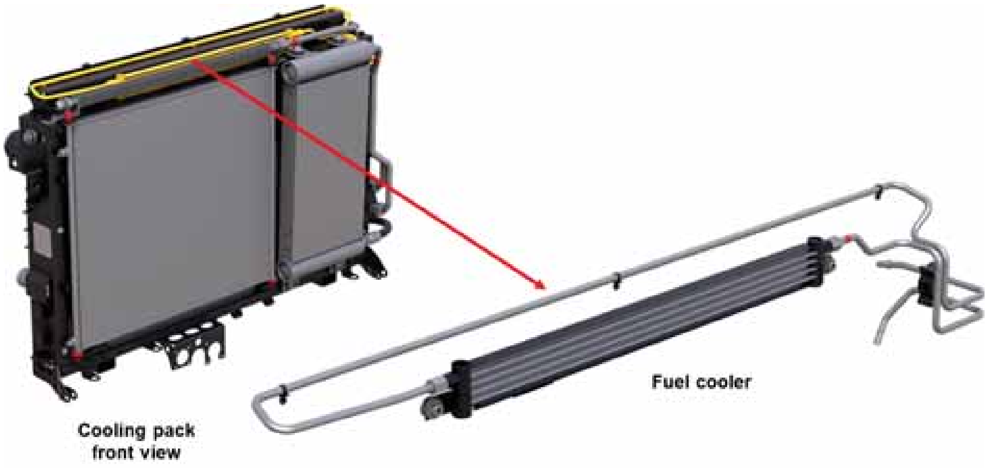


Figure 4.33 Fuel cooler

7. Fuel cooler

   a) The fuel cooler cools fuel on the return side of the fuel system. It is mounted on the top front side of the cooling pack. (Figure 4.32)

   b) It provides for cooling of the return fuel after being pressurized and heated in the fuel rails and injectors.

      1) Pressure-temperature relationship; when pressure goes up, temperature goes up. The fuel is heated by virtue of it being highly pressurized. The fuel cooler is downstream of the high-pressure side of the system to remove that heat buildup.

(Slide #41)

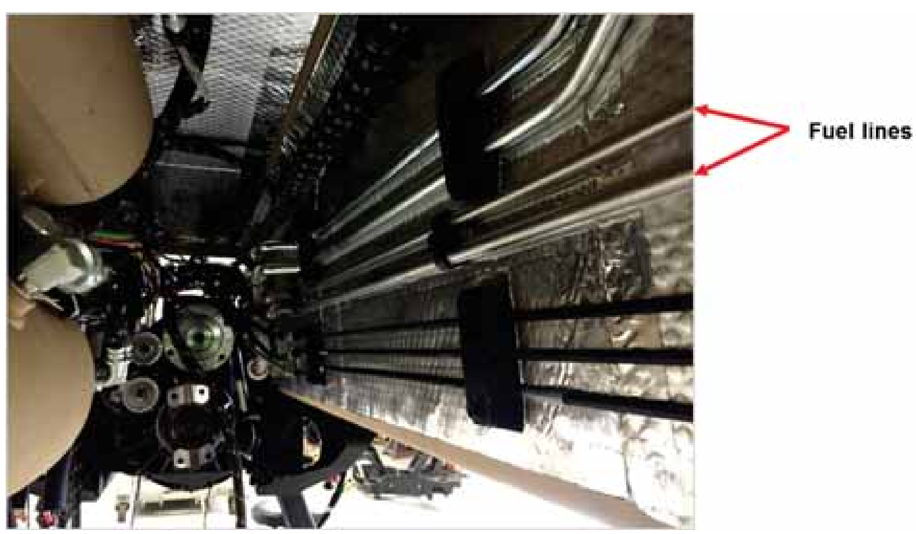


Figure 4.34 Fuel lines (located within center tunnel)

8. Fuel return

   a) The fuel lines that supply and return fuel to the engine from the tank pass through the center tunnel. (Figure 4.34)

   b) This center tunnel is normally open; however, there is a B-kit that can be used for underbody protection. If this is in place, the center tunnel will not be accessible.

Check on Learning

(Slide #42)

Q: True or false; the low-pressure fuel pump is located in the fuel tank?
A: False. The low-pressure pump is located under the cargo deck.

Q: What provides the operator with an indication that there is water in the fuel?
A: The sensor in the fuel filter assembly.

Summary

(Slide #43)

Putting it all together and recapping the highlights:
The fuel system found on the JLTVA1 is a HPCR system. This means that maintainers must take care when testing the fuel system. The system cannot simply be opened up to check for fuel. The fuel system requires checking pressure with gauges.

The rail PCV controls fuel rail pressure. Unused fuel from the injectors and the FMU is sent through the fuel cooler and returned to the recirculation tank. The unused fuel from the engine gets fed back to the recirculation tank for further use.

Transition

We've covered the lubrication system and the fuel systems for the engine, next up is the cooling system.

5.

(Slide #44)

ELO A – LSA 5

Learning Step/Activity:	Engine Subsystem – Cooling
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	15 min
Media Type:	PPT

(Slide #45)

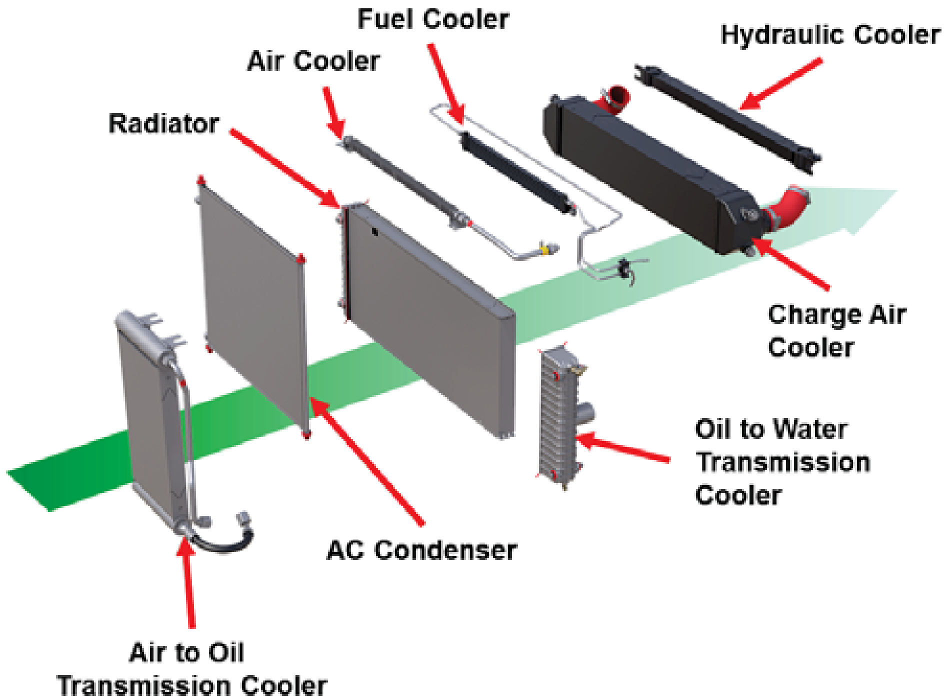


Figure 4.35 JLTVA1 Cooling Package

a. Theory of Operation of Engine Cooling System (Figure 4.35)

1. The JLTVA1's cooling package is comprised as a modular stack of high-efficiency cores. Aluminum construction is used to reduce weight and provide optimal cooling for the seven vehicle subsystems. Aluminum heat exchangers are utilized, rather than copper-brass for purposes of weight reduction, corrosion resistance, and longer life expectancy.

   a) Each cooler is sized to meet operating temperature requirements, with fin spacing optimized for airflow and resistance to debris/obstruction.

   b) A 27 in. (690 mm) diameter suction fan, with a 1:1 ratio, enclosed within a nonmetallic shroud, directs the air through the cooling package and across the engine to meet required heat rejection rates for each subsystem. Coolant temperatures are continuously monitored to determine fan engagement, spinning the fan only when needed, to maximize fuel economy. The system is designed for high performance whether at highway speeds, or stationary/idle.

   c) A direct-drive coolant pump circulates up to 71 GPM through the engine and radiator to maintain optimum engine operating temperatures.

   d) A thermostat coolant bridge provides for rapid engine warm-up time, and a surge tank ensures constant flow of coolant into the system.

e) An engine water-to-oil cooler, integrated into the engine block, provides optimum engine oil temperature. This engine-block-integrated design protects the cooler from damage, reducing risk of oil leaks.

(Slide #46)

Figure 4.36

Thermostat	State of Operation
Primary at 180°	Closed but starts to open
Secondary below 185°	Closed but starts to open
Primary at 203°	Fully open
Secondary at 212°	Fully open
Turbo bypass valve at 140°	Closed but starts to open

Figure 4.37 Cooling system thermostat operation

2. The cooling system on the Banks 866T has two thermostats; a primary and a secondary. (Figure 4.36) The opening/closing triggers are as follows: (Figure 4.37)

   a) The thermostats, when cold, are closed and allow flow only to the engine block and water jackets until the temperature reaches about 180° F.

   b) At 180° F, the primary thermostat opens allowing limited flow to the radiator in the cooling pack.

   c) At 185° F, the secondary thermostat begins to open. This allows coolant to flow to the radiator and the turbocharger.

   d) The turbo bypass valve, which controls coolant flow to the turbocharger, is also thermostatically controlled and opens at about 140° F.

   e) At 203° F, the primary thermostat is fully open.

   f) At 212° F, the secondary is fully open.

3. The coolant temperature sensor is mounted in the thermostat housing.

(Slide #47)

b. Cooling System Components

Figure 4.38 JLTVA1 cooling packs

1. Cooling pack assembly (Figure 4.38)

   a) The cooling pack is comprised of multiple coolers designed to cool multiple systems. The fan is controlled by the front chassis power module from MC231 pin 7 whenever criteria is met for the fans to come on (engine temperature, transmission temperature, AC condenser fans, etc.)

   b) The cooling pack assembly is integrated with various cooling systems to maintain all the temperatures for each system on the vehicle. Some manage temperature for coolant, oils, and air.

(Slide #48)

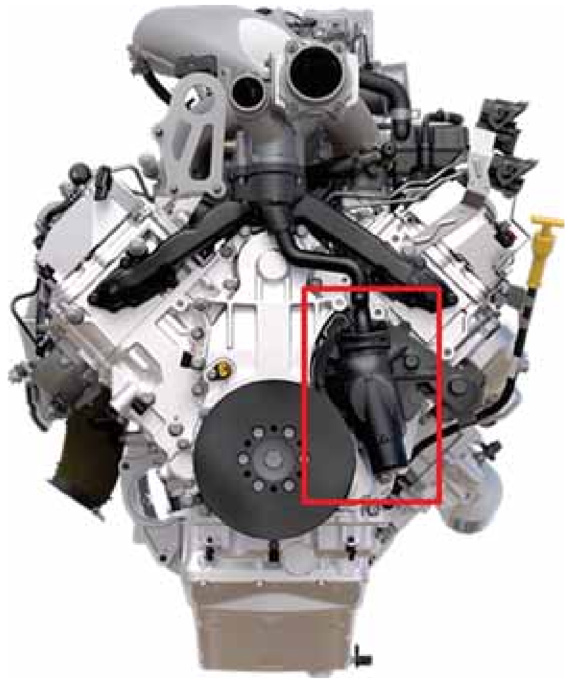


Figure 4.39 Engine coolant pump

2. Coolant pump (Figure 4.39)

   a) The coolant pump is a gear driven centrifugal non-positive displacement pump that sends coolant throughout the system to maintain engine temperature.

   b) The coolant pump is located on the front left of the engine.

(Slide #49)

Figure 4.40 Coolant surge tank

3. Surge tank (Figure 4.40)

    a) The surge tank is in the engine compartment on the left side of the truck. There is an integral sight glass to visually check the coolant level. There is also a coolant level sensor found on the tank.

    b) 20 lb. pressure cap

    c) Sight glass measurement: Coolant is visible in the sight glass

    d) Coolant level sensor. This is the sensor that sends data to the computer system to tell it the coolant level is low.

    e) Specified surge tank coolant volume is 12 pints.

4. Coolant mixture

    a) The coolant mixture is a 50/50 mix of ethylene glycol.

    b) In colder climates, the ratio can be increased to 60/40

Check on Learning

(Slide #50)

Q: At what temperature does the secondary thermostat begin to open?
A: 185° F.

Q: Where is the coolant temperature sensor located?
A: In the thermostat housing.

Summary **(Slide #51)**

Thermostat	State of Operation
Primary at 180°	Closed but starts to open
Secondary below 185°	Closed but starts to open
Primary at 203°	Fully open
Secondary at 212°	Fully open
Turbo bypass valve at 140°	Closed but starts to open

Figure 4.42 Thermostat operating conditions

The cooling process revolves around the primary and secondary thermostats, which are located near the coolant. As we discussed previously the thermostat triggers are reflected in this chart (See Figure 4.42)

The cooling system has several components which work together including:

- Thermostats
- Coolant
- Surge tank
- Coolant pump
- Cooling pack assembly (radiator)

Transition Are there any questions about the cooling system for the JLTVA1 engine? The next engine subsystem is the air intake and exhaust system.

---

6. **(Slide #52)**

ELO A – LSA 6

Learning Step/Activity:	Engine Subsystem – Air Intake/Exhaust
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	15 min
Media Type:	PPT

(Slide #53)

Instructor Note
Use the real-world photo of the engine to walk through the air flow and air intake/exhaust flow using bullets on screen.

a. Air Intake and Exhaust Overview

Figure 4.42 Engine Air Intake

Figure 4.43 Engine Exhaust (shown with Fording Kit)

1. The JLTVA1's air intake is designed to minimize airflow restriction, maximize fuel economy, and meet the airflow requirements of the engine. (Figure 4.42)

    a) The intake air filter element ensures high performance capability in dusty conditions.

    b) To minimize maintenance time, the filter element has a service life greater than 20 hr. under extreme dust conditions and can be serviced without tools.

c) The air intake is positioned above the 60 in. (152 cm) fording line to minimize fording preparation time and reduce debris ingestion.

d) Both the air cleaner assembly and the air pre-cleaner are industry standard equipment.

2. The exhaust system is constructed of stainless steel for long life. It is designed to minimize restriction, reducing backpressure, and improving fuel economy. (Figure 4.43)

   a) Prior to fording the JLTVA1 must be equipped with an exhaust fording kit; the fording exhaust kit provides a 60-inch fording depth.

(Slide #54)

b. Air Intake and Exhaust Theory of Operation (Figure 4.44)

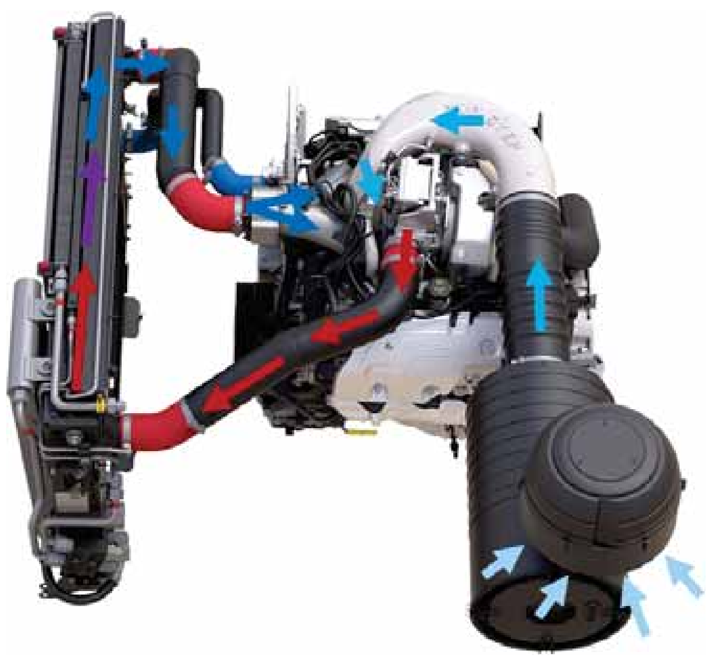


Figure 4.44 Air Intake Flow

1. Air is pulled in through the air cleaner found on the right side of the vehicle.

2. Air passes through the turbocharger into the charge air cooler (CAC).

3. Air is cooled in the CAC where it then feeds into the intake manifold. As fuel is burned, exhaust gasses are expelled out of the exhaust manifold.

4. Exhaust gasses spin the turbo charger to increase air intake.

   a) The exhaust gasses are then expelled out the exhaust pipe on the right side of the truck.

   b) Fording kit on JLTVA1: the exhaust is extended to above the passenger's rear door and dispelled out the snorkel.

(Slide #55)

c. Air Intake and Exhaust System Components

Figure 4.45 Air filter

1. Air filter

    a) The air filter is a complete filter element.

    b) Do not clean the filter with compressed air as this may damage the filter element or force dust through the element into the intake.

    c) There is no need to remove the filter during inspections unless there is evidence of mud or water contamination.

    d) Critical Alignment: When installing pre-filter, the slit must be facing the crew capsule. (Figure 4.45)

    e) Typically, air filters are changed annually; however, currently, there are no published intervals for this service. Therefore, the air filter should be changed as required based on condition.

(Slide #56)

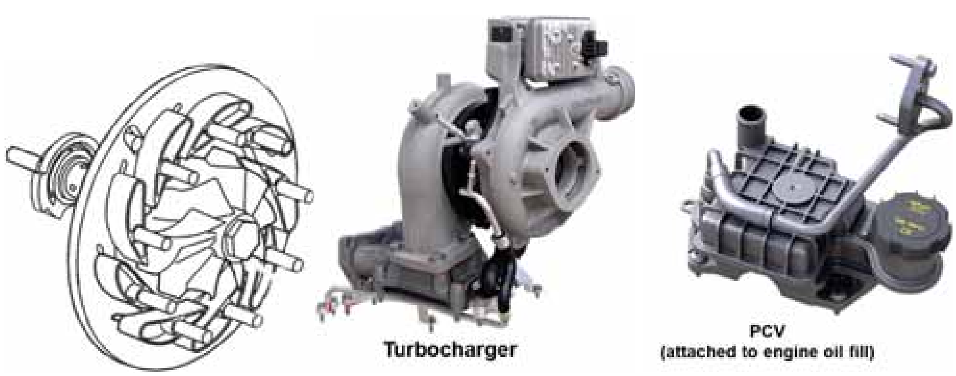


Figure 4.46 VGT diagram (left), turbocharger (center), PCV (right)

2. Turbocharger (Figure 4.46)

a) The Variable Geometry Turbocharger (VGT) designed to be aerodynamically efficient to provide better fuel economy and quicker response, practically eliminating turbo lag.

1) The turbocharger is an exhaust gas driven variable geometry turbocharger.

2) The VGT, when combined with an electronic speed regulating system, provides engine exhaust braking.

b) The position of the turbocharger is controlled by the integrated VGT controller.

c) Coolant enters the turbocharger through the turbo bypass valve at about 140° F.

d) Lubrication oil is fed from the main oil gallery.

e) The positive crankcase ventilation (PCV) system feeds crankcase pressure gasses into the intake of the turbocharger.

f) It is abnormal to see excessive oil coming out of the turbocharger; however, a little bit is normal due the nature of the PCV system.

(Slide #57)

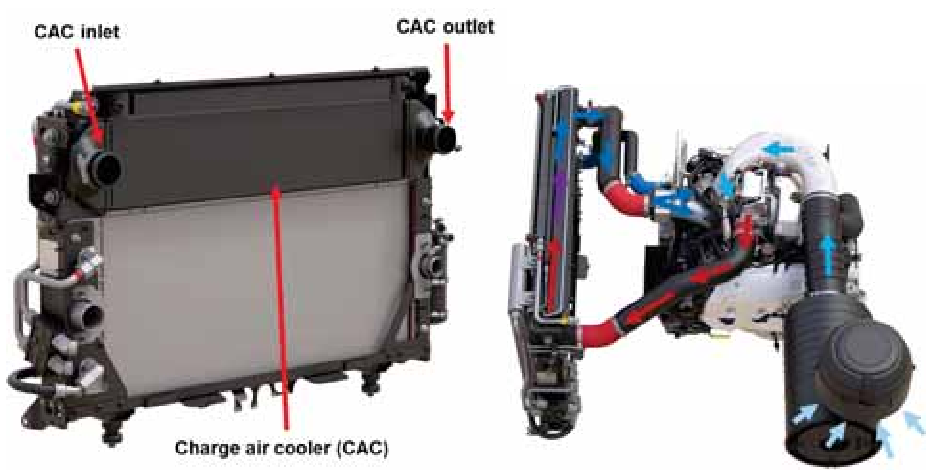


Figure 4.47 Charge air cooler (left) and two intake valves (right)

3. Charge air cooler (CAC)

a) The charge air cooler takes high pressure, high temperature intake air and cools it to a temperature that best meets the needs of the engine's volumetric efficiency requirements. (Figure 4.47)

4. Intake

a) There are two intake valves per cylinder on the Banks 866T engine.

(Slide #59)

Figure 4.48 JLTVA1 standard exhaust piping

Figure 4.49 JLTVA1 fording kit exhaust

5. Exhaust piping

   a) There are two exhaust valves per cylinder on the Banks 866T engine.

   b) The exhaust piping comes off the rear of the engine from the exhaust manifold. This then passes out the piping and is expelled out the right rear side of the truck.

   c) Be aware that if there is a fording kit, the exhaust is extended to above the passenger’s rear door and dispelled out the snorkel.

(Slide #59)

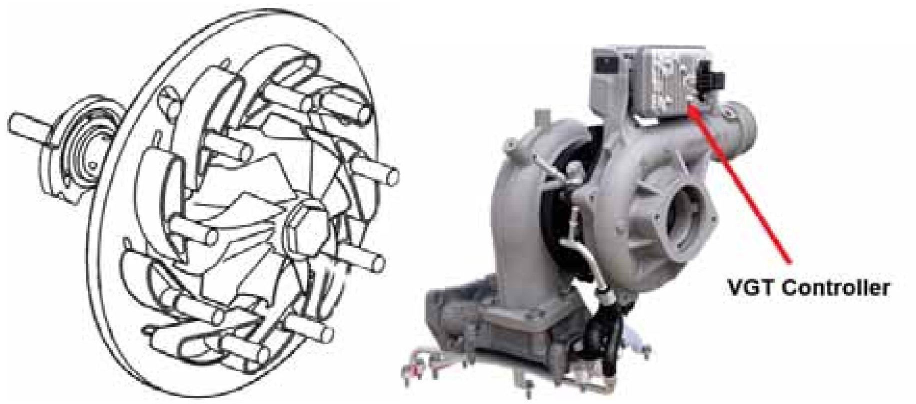


Figure 4.50 VGT internal

6. Engine exhaust brake

   a) The engine exhaust brake is the variable geometry turbocharger (Figure 4.50). It is actuated by the integrated VGT controller which receives activation commands and information from the ECM and the 3G controller over the J1939 Databus.

   b) The operator will request engine exhaust brake use by pushing the Engine exhaust Brake button on the Vehicle Systems MUX panel. The MUX panel sends a request message over the databus to the 3G controller which then sends an engine exhaust brake command message to the ECM.

   c) When the ECM sees a closed throttle signal from the APP sensor, and the engine speed is above the programmed lower cutoff threshold, it will communicate over the databus to the VGT controller to shift the turbo vanes to the engine exhaust brake position.

Check on Learning

(Slide #60)

Q: How many valves per cylinder does the Banks engine have?
A: Two intake, two exhaust

Q: How frequently should the air filter be changed?
A: Annually or when dictated by the air filter condition.

Q: What is used to control the position of the turbocharger vanes?
A: The integrated VGT controller.

Summary

(Slide #61)

As a recap, air is pulled in through the air cleaner found on the left side of the vehicle. Air passes through the turbocharger into the charge air cooler (CAC). Air is cooled in the CAC where it then feeds into the intake manifold.
As fuel is burned exhaust gasses are expelled out of the exhaust manifold. Exhaust gasses spin the turbocharger to increase air intake. The exhaust gasses are then expelled out the exhaust pipe on the right side of the truck.

Transition	If there aren't any questions about the air intake and exhaust system let's go outside and meet your JLTVA1 engine. I'm going to do a demonstration of component identification to increase your familiarity with all thing's engine.

7. **(Slide #62)**

ELO A – LSA 7

Learning Step/Activity:	Engine Component ID
Method of Instruction:	Practical Exercise
Instructor to student ratio:	1:5 (Break into 3 small groups on 3 trucks)
Time of instruction:	30 min
Media Type:	None

(Slide #63)

See Appendix C: PE 4A-1

Instructor Note

Conduct the Check on Learning and Summary in the shop/bay; do not go into the classroom. Use the truck for the check on learning to reinforce and or as a tool to provide corrective explanations.

Check on Learning	None
Summary	None
Transition	Let's go back in the classroom to talk about engine maintenance.

8. **(Slide #64)**

ELO A – LSA 8

Learning Step/Activity:	Engine Maintenance Requirements
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	15 min
Media Type:	PPT

(Slide #65)

a. Always refer to the IETM for maintenance schedules.

b. Accessory Drive – Belt Maintenance

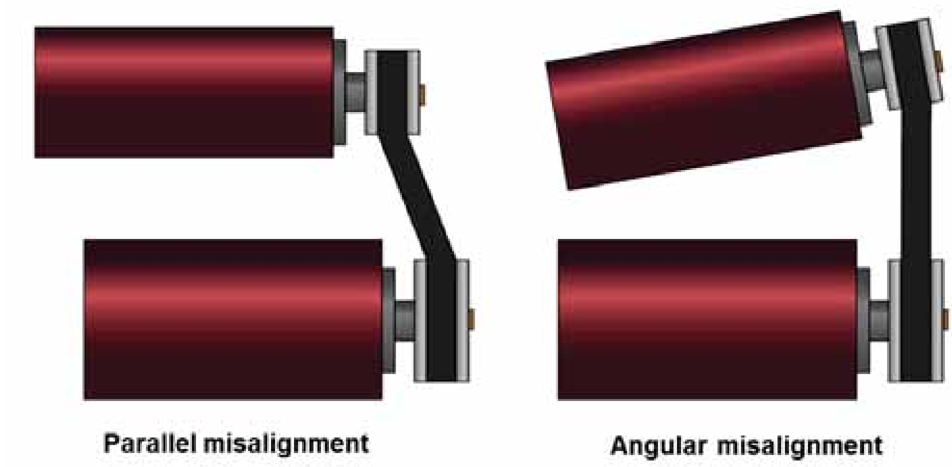


Figure 4.51 Banks 866T belt alignment

1. These belts should be inspected every 3,000 miles or annually, whichever comes first.

2. Inspect belts for:

   a) Parallel and angular misalignment (Figure 4.51)

   b) Worn or cracked belts

      1) 1/8” or 50% depth

      2) Fraying longer than two inches

   c) Cleanliness and serviceability of the pullies

   d) Appropriate tension

3. Reference your IETM to identify the appropriate tension and procedure for measuring belt tension.

(Slide #66)

c. Electrical System Maintenance

   1. There is no common maintenance that is done to the electrical system of the truck except for regular inspection of connectors and wire harnesses to make sure there is no damage to the electrical components.

d. Lubrication System Maintenance

6,000/Annual	Lubrication	1. Drain engine oil. 2. Replace engine oil filter. 3. Fill engine oil.

Figure 4.52 From IETM PMCS – Engine lubrication tasks

1. Annually or every 6,000 miles draining the engine oil, replace the filter, refill the engine oil. (Figure 4.52) The oil cooler is part of the oil filter housing and the typical system pressure is between 22-33-psi. Engine oil is 15W-40.

(Slide #67)

e. Fuel System Maintenance

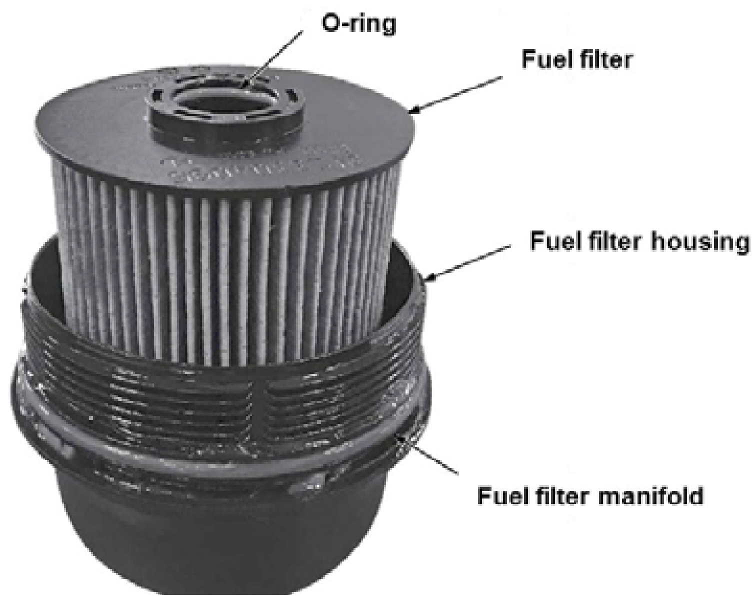


Figure 4.53 Fuel Filter Assembly

Figure 4.54 DSDU Equipment life screen for fuel filter

1. Common fuel system maintenance includes priming the fuel system, fuel filter changes (both the filter screen and the fuel water separator), and injector replacement if necessary. (Figure 4.53)

2. Use the PREVENTATIVE MAINTENANCE screen in the DSDU to monitor the fuel filter life span. (Figure 4.54) New components start at 100% and decrease according to internal calculations based on sensors. The lower the percentage the less time the component has left to its life span.

(Slide #68)

f. Cooling System Maintenance

1. Inspect the Cooling Fan and Belts

2. Draining the Cooling System: If the cooling system needs to be drained, it should be drained from the petcock at the bottom left side of the cooling pack.

3. The coolant should be checked regularly with a refractometer or test strips to ensure an appropriate level of protection is maintained. Pressure check the cooling system regularly.

4. Inspect the system cold and hot to ensure there are no leaks both at operating temperature and at ambient air temperature.

(Slide #69)

g. Air Intake/Exhaust System Maintenance

Figure 4.55 Air Intake/Exhaust System and DSDU

1. Air filter maintenance should be conducted every year at a minimum.

    a) Monitor the air restriction indicator in the DSDU and use that as a guideline for filter services. (Figure 4.55)

    b) Replace the filter, **do not use compressed air as an attempt to clean filter**

2. Use the DSDU to update the health maintenance information when you replace a filter, to reset the equipment life tracker.

    a) This function is accessed via the DSDU Maintainer Login, in the Equipment Life screen.

3. The PREVENTATIVE MAINTENANCE (Figure 4.56) and ENGINE STATUS screens (Figure 4.57 are used primarily by operators, but maintainers may use it for reference when doing their services. The following two DSDU slides provide insight into the condition of each system.

(Slide #70)

Figure 4.56 DSDU preventative maintenance information screen

Figure 4.57 DSDU engine maintenance information screen

(Slide #71)

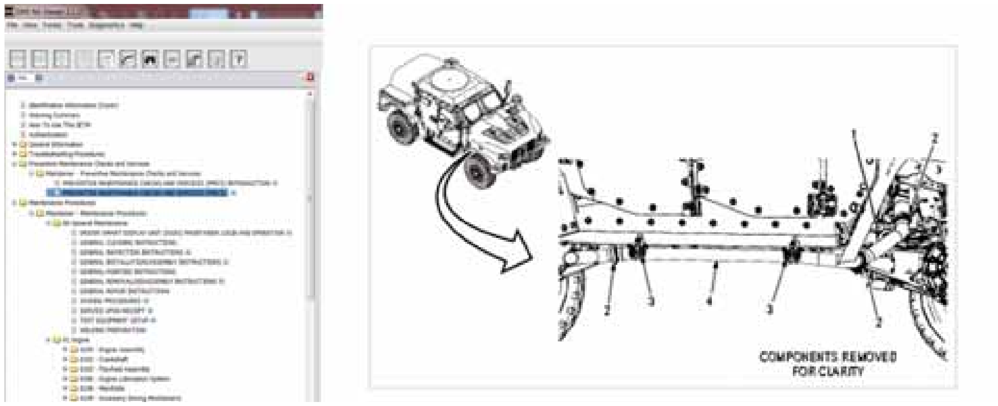


Figure 4.58 See IETM for Exhaust Maintenance Schedule

1. Exhaust Inspections

   a) Verify airline bundle is not in contact with the engine exhaust downpipe. Note any deficiencies and continue.

   b) Inspect exhaust system clamps and isolators for looseness, corrosion, and damage. Note any deficiencies and continue.

   c) Inspect exhaust system piping and mounting for looseness, cracks, corrosion, and damage.

   d) Follow the PMCS schedule in the IETM (Figure 4.58)

Check on Learning

(Slide #72)

Q: What is the frequency for changing the fuel filter?
A: Every 2 years or 12,000 miles.

Q: How frequently should the air filter be maintained?
A: Annually or when dictated by the air restriction indicator.

Q: When inspecting the exhaust system what are the main things you are evaluating?
A: Inspect clamps and mountings for looseness; they should be in place and firm. There shouldn't be corrosion or rust on anything throughout the system. Components should be in place and intact; no holes or cracks in the components or piping.

Summary

(Slide #73)

Proper maintenance is critical for any engine and regular maintenance can help ensure that your JLTVA1 engine, and engine supported systems, run as efficiently as possible.

While diesel engines have very large capacity oiling systems that allow them to run much longer between changes than their gas counterparts, don't take that for granted. Follow the lubrication schedule. The frequency for JLTVA1 oil changes is every 6000 miles or once a year; whichever occurs first. Use the recommended oil because engines and the injectors are very sensitive to oil contamination.

Conducting the inspections (and/or replacements) of components and fluids at the recommended intervals provides the opportunity to address issues before they progress into major engine troubles.

Remember to use the DSDU to access maintenance information and to update the equipment life records onboard the JLTVA1 computer system when you replace a filter.

Transition

Now that you know about the engine's normal performance capabilities and some routine maintenance, we are going to learn what signs and indicators to watch for that indicate engine problems.

Enabling Learning Objective B.

(Slide #74)

Instructor Note

Read the learning objective below then advance to explaining the demonstration.

Stay with the truck: After the demonstration, you will conduct the Q&A and Summary for the demo on engine components, then immediately transition into the instructions for the next two PEs.

Upon completion of this lesson, you will be able to:

Action:	Troubleshoot the JLTVA1 engine
Conditions:	Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials
Standards:	Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity.

1.

(Slide #75)

ELO B – LSA 1

Learning Step/Activity:	Engine Troubleshooting
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	15 min
Media Type:	None

(Slide #76)

a. Indicators/Symptoms and Potential Causes - Each engine subsystem is listed below with charts of indicators and symptoms each system may display along with potential causes.

1. ECU Troubleshooting Symptoms and Potential Causes:

Indicators/Symptom	Potential Cause
Vehicle cranks/does not start	Faulty ECU (uncommon) • No battery power • No ground • No ignition sense
Check engine light & code: bad internal battery	Internal ECU battery died (lasts 15 years)
Output/input faults	Faulty wiring Faulty drivers
No communication from ECU	Faulty connection to J1939 Faulty power and/or ground

Figure 4.59 Indicators/Symptoms and Causes of ECU Problems

(Slide #78)

2. Sensor troubleshooting Symptoms and Potential Causes:

Indicators/Symptom	Potential Cause
Sensor Voltage Open or High	Open wire (break in harness) Disconnected sensor
Sensor Voltage Low	Short to ground on signal wire Faulty sensor
Erratic/Abnormal Voltage	Loose connector/wiring Faulty sensor
Engine Running Rough/No Gauge display	Faulty wiring Faulty sensor Faulty ECU

Figure 4.60 Symptoms/Indicators and Possible Causes of Sensor Problems

(Slide #78)

3. Fuel System Troubleshooting Guideline:

   a) Pressure Testing

   b) Solenoid Testing

   c) Injector Testing

   d) Symptoms and Potential Causes:

Indicator/Symptom	Potential Cause
Engine Cranks/Does Not Start	ECU not firing injectors Fuel not getting to injectors
Engine Runs Rough	Contaminated fuel/poor quality fuel Air in fuel Faulty wiring to injector Faulty injector

Figure 4.61 Indicators/Symptoms and Potential Causes of Fuel System Problems

(Slide #79)

4. Lubrication System Troubleshooting Symptoms and Potential Causes:

Indicator/Symptom	Potential Cause
Metal Contaminants in Oil	Bearing failure (due to lack of lubrication) Engine component failure (due to lack of lubrication)
Coolant Contaminants in Oil	Cracked liner Faulty head gasket Damaged air compressor Injector sleeve
Fuel Contaminants in Oil	Leaking injector Long periods of low idle

Figure 4.62 Indicators/Symptoms and Potential Causes of Lubrication System

(Slide #80)

5. Cooling System indicators and corresponding causes are below:

Indicator/Symptom	Potential Cause
Engine Overheats	Low/No coolant (leaks) Degraded coolant (degrades over time) Clogged lines or clogged radiator Radiator cap not holding pressure

Figure 4.63 Indicators/Symptoms and Potential Causes of Cooling System

(Slide #81)

6. Intake & Exhaust Troubleshooting

Indicators/Symptom	Potential Cause
Excessive smoke and color (Black, white or blue)	**Exhaust: Excessive smoke color** Black smoke: • Excessive fuel (rich) • Boost problem - dirty air filter

	• Leaking charge air cooler White smoke: • Excessive air (lean) • Cold cylinder • Coolant leak into combustion chamber Blue smoke: • Burning oil
Loss of power	**Intake**: A leak in any component **Intake/Combustion:** Loss of Compression **Exhaust:** Manifold crack
Excessive noise	**Exhaust**: A leak anywhere prior to the muffler

Figure 4.64 Intake/Exhaust Indicators and Potential Causes

> **Note**
> With the implementation of ECP OSKW4039, it is important to search the IETM using the fault code instead of the description as it may not match in the IETM. Use the resource on Appendix D, page 2 to assist in verifying the code displayed.

Check on Learning

(Slide #82)

Q: What are two potential causes for why the JLTVA1 engine cranks but does not start?
A: Fuel may not be getting to the injectors, or the ECU is not sending the message to fire the injectors.

Q: If metal fragments are found in the oil, what are the two most likely causes?
A: There is a bearing failure (from lack of lubrication) or there's an engine component failure causing components to grind on each other (also from a lack of lubrication).

Q: Black smoke is an indicator, name the three potential causes for black smoke we discussed.
A: Excessive fuel in system (fuel rich), a dirty filter/boost problem, or a leaking charge air cooler.

Summary

(Slide #83)

Proper engine troubleshooting is aided by familiarity with the various engine subsystems. In this section, we saw some possible problems within each subsystem and the various possible causes.

Transition

Now that you are familiar with the system routine maintenance requirements and troubleshooting guidelines, it's time for you to do a practical exercise.

2. **(Slide #84)**

ELO B – LSA 2

Learning Step/Activity:	Troubleshoot Engine Cranks but Does Not Start 4B1
Method of Instruction:	Practical Exercise
Instructor to student ratio:	1:5
Time of instruction:	30 min
Media Type:	None

Instructor Note

The next three PEs are to be set up as a rotation; each JLTVA1 is induced with an individual fault and the students rotate from truck-to-truck experiencing each of the three faults. Each JLTVA1 station has a PE sheet and Go/No Go Sheet.

Complete the Summary by the truck. Use the truck as needed to answer question or reteach if a student does not answer questions correctly. Next slide in presentation is a transition slide leading into the module wrap-up: check on learning and summary.

(Slide #85)

See Appendix C: PE4B-1

3. ELO B – LSA 3

Learning Step/Activity:	Engine Troubleshooting - Engine Cranks will not start (MC213)
Method of Instruction:	Practical Exercise
Instructor to student ratio:	1:5
Time of instruction:	30 min
Media Type:	None

Note

Note this PE is one of three exercises to be conducted using a three-truck rotation (three PE stations – students rotate through PEs).

Station: JLTVA1 #2: See Appendix C: PE 4B-2

4. ELO B – LSA 4

Learning Step/Activity:	Engine Troubleshooting - Engine Cranks will not start resistor (4B3)
Method of Instruction:	Practical Exercise
Instructor to student ratio:	1:5
Time of instruction:	30 min
Media Type:	None

	Note Note this PE is one of three exercises to be conducted using a three-truck rotation (three PE stations – students rotate through PEs). **Station: JLTVA1 #3:** See Appendix C: PE 4B-3
Check on Learning	None
Summary	None
Transition	This concludes our application exercises for the engine, we will return to the classroom and complete the summary and check on learning for the entire lesson.

SECTION IV. SUMMARY

Method of Instruction:	Lecture
Instructor to student ratio	1:15
Time of Instruction:	10 min
Instructional Strategy	Lecture and Q&A

Check on Learning

(Slide #86)

Q: How much torque does the JLTVA1 engine produce?
A: 660 lb./ft at 1600 rpm.

Q: What is the maximum regulated fuel pressure?
A: 26,000 psi

Q: Ignition power is supplied to the ECM via which relay?
A: K2 relay

Summary

(Slide #87)

Today, we learned about the JLTVA1's Banks 866T, 6.6L engine functionality and subsystems.

- **Engine electrical:** Requires the coordination of several control modules, controllers, power modules, sensors and actuators.
- **Engine lubrication:** Uses a gear driven oil pump which is driven off crankshaft and integrated pressure relief valve. Uses 15W-40 oil and changed annually or every 6000 miles
- **Engine fueling:** The fuel system found on the JLTVA1 is a HPCR system. This means that maintainers must take care when testing the fuel system. The system cannot simply be opened-up to check for fuel. The fuel system requires checking pressure with gauges or a scan device.
- **Engine cooling:** The cooling process revolves around the primary and secondary thermostats, which are located near the coolant
- **Engine air intake/exhaust:** Air is pulled in through the air cleaner found on the left side of the vehicle, then passes through the turbocharger into the charge air cooler (CAC). It is cooled in the CAC then feeds into the intake manifold. After use the exhaust exits at the vents and is piped out of the system on the passenger side.

As the engine is essentially the heart of the vehicle, be sure to take good care of it by adhering to the maintenance service schedules, use the equipment life information in the DSDU and conduct routine visual inspections.

Appendix A

04_JLTVA1_ ARMY_ MAIN_Engine_PPT_V3.0.pptx

Appendix C
JLTVA1 Practical Exercise Sheet No. 4A
Engine Component Identification

Title	Engine Component Identification
Lesson Number/ Title	04 Engine
Introduction	In the classroom, you saw photos, graphics and the schematic, and received a good introduction to how this engine works, now you can see it on the truck. Although this may be your first time seeing a JLTVA1 engine, you should be able to complete this component identification activity; however, this is a guided practical exercise. I am here to assist you if you can't find the engine component or subsystem or explain a functionality of the system.
Motivator	Maintain the JLTVA1 Engine system to keep the vehicle mission ready.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Enabling Learning Objective A	Action: Correlate the JLTVA1's engine system/subsystem and components with their location, purpose, function and maintenance requirements. Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity.
Risk Assessment Level	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	This practical exercise will give you the opportunity to practice the skills required to provide maintenance to the JLTVA1 Engine under normal maintainer conditions.
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils

Special Instructions

Below are the instructions for how to prepare for the practical exercise.

Preparation	Instructor Notes
TM Reference:	N/A
Time Required for Prep:	N/A
Symptom/Purpose:	Familiarization with system and component location for troubleshooting
Prepare Area for PE:	1-2 ladders for viewing and prevent climbing on vehicle
Configure Vehicle for PE:	N/A
Instructor Preparation:	• Ensure instructors have located and understand the purpose all components before conducting component location. • Review the basic information below as required.
Safety	Instructors will monitor the exercise and ensure students are properly adhering to safety guidelines while working on the vehicle.

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical Manual (TM) to complete the exercises.

d. Inform students they will have approximately 1 hour to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the Go/No Go sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five.

h. Ask if there are any questions.

i. Students may begin.

j. Mark Go/No Go Sheets accordingly.

1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

2. Once the Practical Exercise is complete, the Lead Instructor must sign each student's Solution Sheet.

Component	Location/Function
Instructor note:	Instructor/student ratio is 1:5 if you use three trucks and have associate instructors conduct demonstrations simultaneously as lead instructor.
Instructor note:	The following components should be identified and described by students
Engine Control Module	Upper left rear of engine bay; controls engine functions
Variable Geometry Turbocharger (VGT) and controller	Top center rear of engine (controller mounted to upper left of turbo assembly); provides forced combustion air to engine and engine exhaust brake function
Gas exhaust temperature sensor (unused)	Lower rear of right exhaust manifold; unused
Air temperature sensor (unused)	Outlet of turbocharger; unused
Temperature & Manifold Absolute Pressure (TMAP) sensor	Top front center of engine, in air intake bridge; provides intake air temperature and intake manifold pressure signals to the ECM
Thermostat housing	Top front center of engine, below the air intake bridge; houses the thermostats
Coolant temperature sensor	Top front center of engine, below the air intake bridge, to the left of the thermostat housing; provides coolant temperature signal to the ECM
Glow plug module	Upper left rear of engine bay, near the ECM; controls glow plug operation as required
Injectors	In the top of each valve cover, four on the left, four on the right; inject fuel into the engine
Primary belt	Front of engine, innermost; drives alternator
Secondary belt	Front of engine, middle; drives hydraulic pump
Tertiary belt	Front of engine, outermost; drives air compressor, AC compressor, and engine fan
Camshaft position sensor	Front right of engine; provides camshaft speed and position signal to ECM
Crankshaft position sensor	Right side rear of engine block; provides crankshaft speed and position signal to ECM

Fuel rail pressure sensor	Front of right fuel rail; provides fuel rai pressure signal to ECM
Fuel metering unit/fuel pressure meter solenoid	Top front center of engine in valley below air intake bridge; provides high pressure fuel to fuel rails and injectors
Rail Pressure Control Valve (PCV)	Rear of left fuel rail; used to fine tune rail pressure for optimum performance
Fuel temperature sensor	Top left of engine, just rear of fuel pressure transducer; provides return fuel temperature signal to ECM
Fuel pressure transducer	Top left of engine, just rear of oil fill cap; provides low-pressure supply fuel pressure signal to ECM
Fuel filter	Upper left front of engine bay; filters and removes moisture from supply fuel
Fuel cooler	Top of cooling pack; cools return fuel
Oil filter	Left side lower rear of engine block; filters engine lube oil
Upper oil temperature sensor	Left side rear of engine, in oil filter housing; provides oil temperature signal to ECM
Lower oil temperature sensor (unused)	Left side lower corner of oil pan; unused (may not be installed)
Oil pressure sensor	Left side rear of engine block, just forward of oil filter housing; provides oil pressure signal to ECM
Oil level sensor	Left side rear of engine block, just above oil pan; provides oil level signal to ECM
Low pressure fuel pump	Under center of rear cargo bed; provides low-pressure fuel from the fuel tank to the engine
Fuel priming pump/vents	Left rear of truck; allows for priming of fuel system
Recirculation tank	Above upper left front corner of fuel tank; provides recirculation fuel volume and reserve fuel capacity
Fuel tank	Center rear of vehicle; contains fuel for use
Fuel fill port	Inside right rear stowage compartment; allows fuel to be added to tank

Feedback Requirements

Conduct the Check on Learning and Summary in the shop/bay; do not go into the classroom. Use the truck for the check on learning to reinforce and or as a tool to provide corrective explanations.

Provide students with feedback to ensure comprehension.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 4A-1
Engine Component Identification

Name____

Date____

Training Location____

Engine Component Identification	**Go**	**No Go**	**Initials**
Engine Control Module			
Variable Geometry Turbocharger (VGT) and controller			
Gas exhaust temperature sensor (unused)			
Air temperature sensor (unused)			
Temperature & Manifold Absolute Pressure (TMAP) sensor			
Thermostat housing			
Coolant temperature sensor			
Glow plug module			
Injectors			
Primary belt			
Secondary belt			
Tertiary belt			
Camshaft position sensor			
Crankshaft position sensor			
Fuel rail pressure sensor			
Fuel metering unit/fuel pressure meter solenoid			
Rail Pressure Control Valve (PCV)			
Fuel temperature sensor			
Fuel pressure transducer			
Fuel filter			

Fuel cooler			
Oil filter			
Upper oil temperature sensor			
Lower oil temperature sensor (unused)			
Oil pressure sensor			
Oil level sensor			
Low pressure fuel pump			
Fuel priming pump/vents			
Recirculation tank			
Fuel tank			
Fuel fill port			

Instructor Signature____

Appendix C
JLTVA1 Practical Exercise Sheet No. 4B1
Engine System Troubleshooting – Engine Cranks but Does Not Start

Title	Engine System Troubleshooting (FIK WP 04-1 Engine Cranks but Does Not Start)
Lesson Number/ Title	04 Engine
Introduction	We will now perform a P.E. on the JLTVA1 applicable to the Engine Systems. There are 3 P.E.s that you will rotate through each addressing an Engine troubleshooting fault.
Motivator	The JLTVA1 system can get a warfighter out of almost any scenario. The torque provided to the wheels keeps the vehicle moving when needed. If the engine is not running, no torque is being applied to the wheels and you are not moving. Being able to keep the engine running keeps you in the fight.
Enabling Learning Objective B	Action: Troubleshoot the JLTVA1 engine Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity.
Safety Requirements	It is the responsibility of the Soldier to follow all U.S. Army safety guidelines as well as local unit SOPs.
Risk Assessment	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	Let's explore the engine system on the JLTVA1
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide JLTVA1 FIK PE Instruction Job Aid **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils
Special Instructions	**Go to the FIK PE Instructions Job Aid for instructions on how to prepare and conduct this PE. Use the FIK WP 04-1 Engine Cranks but Does Not Start.**

Instructor Note: Instructor will need to prep the vehicle for the troubleshooting task. If possible, it would be acceptable to have an assistant instructor install the fault while the primary instructor is training.

Simulated means using EMS NG, following the task, discussing, and completing each step until task is complete. Students will not remove the installed components.

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises.

d. Inform students they will have approximately 30 minutes to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five.

h. Ask if there are any questions.

i. Students may begin.

j. Mark Go/No Go Sheets accordingly.

   1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

   2. Once the Practical Exercise is complete, the Lead Instructor must sign each student's Solution Sheet.

k. When everyone is finished collect solution sheet.

Feedback Requirements

Provide feedback to ensure student learning.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 4B1-1
Engine System Troubleshooting – Engine Cranks but Does Not Start

Name____

Date____

Training Location____

Troubleshoot Fault – Engine Cranks but Does Not Start Fault	Go	NO GO	Initials
1. Verify the Fault			
2. Locate Proper Troubleshooting fault in the IETM			
3. Follow all warning cautions and notes			
4. Troubleshooting Track in TM			
5. Repair the Fault/Issue			
6. Verify fault is resolved			

Signature____

Appendix C
JLTVA1 Practical Exercise Sheet No. 4B2
Engine Troubleshooting - Engine Cranks will not start (MC213)

Title	Engine System Troubleshooting - Engine Cranks will not start (MC213)
Lesson Number/ Title	04 Engine
Introduction	We will now perform a P.E. on the JLTVA1 applicable to the Engine Systems. There are 3 P.E.s that you will rotate through each addressing an Engine troubleshooting fault.
Motivator	The JLTVA1 system can get a warfighter out of almost any scenario. The torque provided to the wheels keeps the vehicle moving when needed. If the engine is not running, no torque is being applied to the wheels and you are not moving. Being able to keep the engine running keeps you in the fight.
Enabling Learning Objective B	Action: Troubleshoot the JLTVA1 engine Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Risk Assessment Level	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	This Practical Exercise will give you the opportunity to practice the skills required to provide maintenance to the JLTVA1. (Engine Cranks, fails to start)
Resource Requirements	**Instructor Materials: (paper resources & IETM)** EMS NG with IETM Instructor Guide **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils

Special Instructions

The fields below are PE development requirements for successfully providing instruction to others on how to complete the task in alignment with the IETM. Complete all applicable fields with information from the IETM as well as the instructions, steps and time required to complete the PE.

PE Requirement	Instructor Notes
TM Reference:	
Time Required to Prep for PE:	5 minutes
Number of Instructors for PE:	1
Prepare Area for PE:	A. Disconnect MC213(Grey connector) on DS of engine. remove wire 1902, pin 3 from connector.
Configure Vehicle for PE:	
The symptom of this fault is:	Cranks no start
The following fault codes will be associated with this fault:	DENG 1-216, ABS 11-70, SUSP 14-8, DENG 2-9, CHASIS 15-18, CHASIS 15-1
Standard Default PE Instructions:	Associate Instructors will prep the vehicle and induce faults while the primary instructor leads the classroom training. All instructors will monitor the exercise and ensure students are properly adhering to safety guidelines while working on the vehicle. Instructors will assist students on finding work packages associated with the tasks they are trying to do. Provide feedback to students to ensure comprehension.
Definition of Simulation for PE:	For Oshkosh PEs simulation means using the IETM to guide a work package or troubleshooting track and completing each step until the IETM becomes incorrect or the task needs to be stopped for another reason. Instructors will inform students of which steps will not be followed (or parts that will not be removed) and instead the instructor will verbalize the steps that would occur normally and explain why we cannot do

	that at this time (aka simulate the steps) then continue the PE.

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises.

d. Inform students they will have approximately 30 minutes to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five.

h. Ask if there are any questions.

i. Students may begin. Below are key steps the instructor may use to assist with coaching and completing the Go/No Go rubric.

Steps	Student Action (or Expected Values) or Instructor Note
1. Disconnect MC213(Grey connector) on DS of engine. remove wire 1902, pin 3 from connector	
2. Fault will display (7) codes on DSDU, Lower left gauge sweeps, and ABS and Suspension Error indicator lights are shown	Students will attempt to start vehicle
3. Engine will crank but no start	Identify codes on the DSDU to start troubleshooting track
4. Instructor will aid in directing the students in the right path going over previously covered material in section to find (MC213)	At this time displayed codes will direct student to replace wiring harness,
5.	Identify and repair fault
6. Verify Fault has been corrected	

j. Mark Go/No Go Sheets accordingly.

	1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished. 2. Once the Practical Exercise is complete, the Lead Instructor must sign each student's Solution Sheet.
Feedback Requirements	Debrief the Activity: Provide tips and insights into potential "go wrongs" and reasons/rational for things that occurred during the PE.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 4B2-1
Engine Troubleshooting - Engine Cranks will not start

Name____

Date____

Training Location____

Engine Cranks but will not start – 2	**Go**	**NO GO**	**Initials**
1. Verified the Fault			
2. Located proper troubleshooting fault in the IETM			
3. Followed all warning cautions and notes			
4. Correctly followed troubleshooting track in TM			
5. Correctly repaired fault (per TM)			
6. Verified fault was corrected			

Signature____

Appendix C
JLTVA1 Practical Exercise Sheet No. 4B3
Engine cranks will not start

Title	Engine Cranks will not start
Lesson Number/ Title	04 Engine
Introduction	We will now perform a P.E. on the JLTVA1 applicable to the Engine Systems. There are 3 P.E.s that you will rotate through each addressing an Engine troubleshooting fault.
Motivator	The JLTVA1 system can get a warfighter out of almost any scenario. The torque provided to the wheels keeps the vehicle moving when needed. If the engine is not running, no torque is being applied to the wheels and you are not moving. Being able to keep the engine running keeps you in the fight.
Enabling Learning Objective B	Action: Troubleshoot the JLTVA1 engine Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Risk Assessment Level	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	This Practical Exercise will give you the opportunity to practice the skills required to provide maintenance to the JLTVA1. (Engine Cranks, fails to start)
Resource Requirements	**Instructor Materials: (paper resources & IETM)** EMS NG with IETM Instructor Guide **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils

Special Instructions

The fields below are PE development requirements for successfully providing instruction to others on how to complete the task in alignment with the IETM. Complete all applicable fields with information from the IETM as well as the instructions, steps and time required to complete the PE.

PE Requirement	Instructor Notes
TM Reference:	
Time Required to Prep for PE:	5 minutes
Number of Instructors for PE:	1
Prepare Area for PE:	B. Behind CSCU on Engine Databus (R8) with green tape. Replace terminating resister with a (shorted terminating resister.
Configure Vehicle for PE:	
The symptom of this fault is:	Cranks no start
The following fault codes will be associated with this fault:	SUSP 14-8, DENG 2-9, CHASIS 15-18, CHASIS 15-1, CHASIS 15-2, CHASIS 15-4, CHASIS 15-9
Standard Default PE Instructions:	Associate Instructors will prep the vehicle and induce faults while the primary instructor leads the classroom training. All instructors will monitor the exercise and ensure students are properly adhering to safety guidelines while working on the vehicle. Instructors will assist students on finding work packages associated with the tasks they are trying to do. Provide feedback to students to ensure comprehension.
Definition of Simulation for PE:	For Oshkosh PEs simulation means using the IETM to guide a work package or troubleshooting track and completing each step until the IETM becomes incorrect or the task needs to be stopped for another reason. Instructors will inform students of which steps will not be followed (or parts that will not be removed) and instead the instructor will verbalize the steps that would occur normally and explain why we cannot do

	that at this time (aka simulate the steps) then continue the PE.

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises.

d. Inform students they will have approximately 30 minutes to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five.

h. Ask if there are any questions.

i. Students may begin. Below are key steps the instructor may use to assist with coaching and completing the Go/No Go rubric.

Step (List the key steps)	Student Action (or Expected Values) or Instructor Note
1. Replace terminating resister (R8) Behind CSCU in cab with shorted resister	
2. Fault will display (10) codes on DSDU, Alarm sounds, Engine gauge sweeps, ABS Comms lost, in right gauge of dash trans temp and warning light will be on	Students will attempt to start vehicle
3. Engine will crank but no start	Identify codes on the DSDU to start troubleshooting track
4. Instructor will aid in directing the students in the right path going over previously covered material in section to find (Engine Databus (R8))	At this time displayed codes will direct student to replace wiring harnesses, and power modules
5.	Identify and repair fault
6. Verify Fault has been corrected	

j. Mark Go/No Go Sheets accordingly.

	1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished. 2. Once the Practical Exercise is complete, the Lead Instructor must sign each student's Solution Sheet.
Feedback Requirements	Debrief the Activity: Provide tips and insights into potential "go wrongs" and reasons/rational for things that occurred during the PE.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 4B3-1
Engine Troubleshooting - Engine Cranks will not start

Name____

Date____

Training Location____

Engine Cranks but will not start-3	**Go**	**NO GO**	**Initials**
1. Verified the Fault			
2. Located proper troubleshooting fault in the IETM			
3. Followed all warning cautions and notes			
4. Correctly followed troubleshooting track in TM			
5. Correctly repaired fault (per TM)			
6. Verified fault was corrected			

Signature____

Appendix D
JLTVA1 12/24 VDC mVEC Circuit Breaker to Fuse

JLTVA1 12/24 VDC mVEC Circuit Breaker to Fuse Chart			
DSDU	**Current**	**Description**	**Rating**
CB01	F16	AIR DRYER	15 AMP
CB02	F17	TRAILER ABS	15AMP
CB03	F18	ENGIEN ECY IGN	10 AMP
CB04	F19	AIR COMPRESSOR	10 AMP
CB05	F20	SUSP MODULE POWER	15 AMP
CB06	F21	ENGINE ACC POWER	15 AMP
CB07	F22	12V ENGINE ECU SUPPLY	10 AMP
CB08	F23	12V ENGINE ECU	30 AMP
CB09	F24	SUSP SOL POWER	15 AMP
CB10	F25	RR CHASS POWER	20 AMP
CB11	F26	FRONT VEHICLE LIGHTING	15 AMP
CB12	F27	mVEC PWR	10 AMP
CB13	F28	12V ENGINE ECU	20 AMP
CB14	F29	ACTV AIR CLEANER	15 AMP
CB16	F30	12V LIGHTING	15 AMP
CB17	F31	24V ACCESSORY OUTLET	10 AMP
CB18	F32	FRONT SNSR PWR	15 AMP
CB19	F33	SPARE 24V IGN	15 AMP
CB20	F34	CTIS	20 AMP
CB21	F35	ABS	15 AMP
CB22	F36	REAR VEHICLE LIGHTING	15 AMP
F1	F1	12V ACCESSORY OUTLET	10 AMP
F2	F2	12V ACCESSORY OUTLET	10 AMP
F15	F15	12V ENGINE ECU	10 AMP

Appendix D
Fault Codes Reference

FAULT CODES - BANKS AUTOMIND EDC L5P								
J1939 DM1							Application SW Ver: 502_E_34	Changes
SPN	FMI	MIL LAMP	TRQ LIM	SHUT OFF	VISIBLE ON OBDTESTER	VISIBLE ON DM1	System Description	Verbose Description
636	3	x		x	x	x	Error path of crankshaft failure	No crankshaft signal
636	4	x		x	x	x	Error path of crankshaft failure	Wrong crankhaft signal
520434	3				x	x	Dfp for messages SRAST	timeout for SRAST, when active
520434	31				x	x	Dfp for messages SRAST	timeout for SRAST, when inactive
520295	5	x		x	x	x	Faultpath bank1-specific warnings -> stop engine	Open load
520297	5	x		x	x	x	Faultpath bank2-specific warnings -> stop engine	Open load
520299	5	x		x	x	x	Faultpath bank3-specific warnings -> stop engine	Open load
520301	5	x		x	x	x	Faultpath bank4-specific warnings -> stop engine	Open load
18	1	x		x	x	x	Failure path for minimum rail pressure	Rail pressure too low
520422	31	x		x	x	x	error path of pressure control valve PWM-powerstage	open load of pressure control valve output
520422	2	x		x	x	x	error path of pressure control valve PWM-powerstage	excess temperature of pressure control valve powerstage
520423	3	x		x	x	x	error path of pressure control valve PWM-powerstage	short circuit to battery of pressure control valve output
520424	4	x	x		x	x	error path of pressure control valve PWM-powerstage	short circuit to ground of pressure control valve output
520421	4	x	x		x	x	fault path for short circuit to ground in the HighSide switch	Short Circuit Ground
5313		x		x	x	x	Error path of rail pressure -> stop engine	Sensor raw signal (voltage) above upper limit
5313		x		x	x	x	Error path of rail pressure -> stop engine	Sensor raw signal (voltage) below lower limit
520353		x		x	x	x	Error path RPS offset monitoring -> stop engine	Rail Pressure Sensor raw value is above maximum offset
520353		x		x	x	x	Error path RPS offset monitoring -> stop engine	Rail Pressure Sensor raw value is below minimum offset

FAULT CODES - BANKS AUTOMIND EDC LML								
J1939 DM1							Application SW Ver: 502_E_34	Changes
SPN	FMI	MIL LAMP	TRQ LIM	SHUT OFF	VISIBLE ON OBDTESTER	VISIBLE ON DM1	System Description	Verbose Description
636	3	x		x	x	x	Error path of crankshaft failure	No crankshaft signal
636	4	x		x	x	x	Error path of crankshaft failure	Wrong crankhaft signal
520295	5	x		x	x	x	Faultpath bank1-specific warnings -> stop engine	Open load
520297	5	x		x	x	x	Faultpath bank2-specific warnings -> stop engine	Open load
520299	5	x		x	x	x	Faultpath bank3-specific warnings -> stop engine	Open load
520301	5	x		x	x	x	Faultpath bank4-specific warnings -> stop engine	Open load
18	1	x		x	x	x	Failure path for minimum rail pressure	Rail pressure too low
5313		x		x	x	x	Error path of rail pressure -> stop engine	Sensor raw signal (voltage) above upper limit
5313		x		x	x	x	Error path of rail pressure -> stop engine	Sensor raw signal (voltage) below lower limit
520353		x		x	x	x	Error path RPS offset monitoring -> stop engine	Rail Pressure Sensor raw value is above maximum offset
520353		x		x	x	x	Error path RPS offset monitoring -> stop engine	Rail Pressure Sensor raw value is below minimum offset

US Army
SFAE-CSS-JC-JL
MS 640 BLDG 302 RM 113
6501 E 11 Mile Road
Warren, MI 48397-5000

INSTRUCTOR GUIDE

Joint Light Tactical Vehicle (JLTVA1) Maintainer Course

LESSON

05 Transmission

SECTION I. ADMINISTRATIVE DATA

All Courses Including This Lesson

Course Number	Version	Course Title
JLTVA1_MAINT_01	3.0	Introduction and Safety
JLTVA1_MAINT_02	3.0	Vehicle Familiarization
JLTVA1_MAINT_03	3.0	Electrical
JLTVA1_MAINT_04	3.0	Engine
JLTVA1_MAINT_05	3.0	Transmission
JLTVA1_MAINT_06	3.0	Drivetrain
JLTVA1_MAINT_07	3.0	Suspension, Hydraulics and Steering
JLTVA1_MAINT_08	3.0	Air Systems, Brakes and CTIS
JLTVA1_MAINT_09	3.0	End of Course

Task(s) Taught (*) or Supported

Task Number	Task Title
II.B.17	* Inspect and Test Operation of Automatic Transmission Electronic shift controls, shift solenoids, shift motors, indicators, speed and range sensors, CU/TCU, Neutral/In-Gear and Reverse switches and wiring harnesses
II.B.17	*Inspect and Test Operation of Automatic Transmission Electronic shift controls, shift solenoids, shift motors, indicators, speed and range sensors, CU/TCU, Neutral/In-Gear and Reverse switches and wiring harnesses
II.B.16	*Use appropriate electronic service tool(s) and procedures to diagnose automatic transmission problems; check, record, and clear diagnostic codes, interpret digital multimeter (DMM) readings; determine needed action

Reinforced Task(s)

Task Number	Task Title
N/A	*Component Identification
N/A	*Transmission Sensor/Solenoid Testing
N/A	*Troubleshoot Transmission without a Code
A70000L_00_NGFAAAW	*Troubleshoot Fault Code 3-23_Trans Range Circuit Perform
A70000L_00_NGFAAAX	* Troubleshoot Fault Code 3-24_Trans Range Circuit High Input
A70000L_00_NGFAABE	* Troubleshoot Fault Code 3-31_ Output

Shaft Speed Sen Circuit

Academic Hours	The academic hours required to teach this lesson are as follows:

Academic	Resident Hours	Methods
1 hour 30 mins		ILT
2 hr 20 mins		PE
Total Hours:	3 hrs. 50 mins	

Test Lesson Number

Hours	Lesson Number Version	Lesson Title
1 hr 30 min	Test A	09_End of Course and Final Exam
1 hr 30 min	Test B	09_End of Course and Final Exam

Prerequisite Lesson(s)

Hours	Lesson Number Version	Lesson Title
N/A	N/A	N/A

Clearance Access

Security Level: Unclassified
Requirements: There are no clearance or access requirements for the lesson.

Foreign Disclosure Restrictions

FD7. This product/publication has been reviewed by the product developers in coordination with the Oshkosh Corporation foreign disclosure authority. This product is NOT releasable to students from foreign countries.

References

Number	Title	Date
2320-01-653-6557	JLTVA1 GP IETM	April 2018
2320-01-653-6495	JLTVA1 HGC IETM	April 2018
2320-01-653-6516	JLTVA1 UTL IETM	April 2018
2320-01-653-6534	JLTVA1 CCWC IETM	April 2018

Student Study Assignments

None

Instructor Requirements

JLTVA1 Certified Instructor (3)

Additional Support Personnel Requirements

Name	Student Ratio	Qty	Man Hours
N/A			

Equipment Required for Instruction

ID Name	Student Ratio	Instructor Ratio	Spt	Qty	Exp

Laptop	1:1	1:1	No	15	Yes
Projector	1:15	1:1	No	1	Yes
JLTVA1	1:5	1:1	No	1	Yes
MSD with EMS NG/IETM	1:5	1:1	No	1/JLTV A1	Yes
FRS/SATS Trailer	1:5	1:1	No	1/JLTV A1	Yes
BII	1:5	1:1	No	1/JLTV A1	Yes
FIK	1:5	1:1	No	1/JLTV A1	Yes

Materials Required

Instructor Materials:
Instructor Guide

Student Materials:
Student Guide

Classroom, Training Area, and Range Requirements

ID Name	Qty	Student Ratio	Setup Mins	Cleanup Mins
Classroom, 15 Student	1	1:15	30	30
Shop, 3 Bays	1	1:5	30	30

Ammunition Requirements

DODIC Name	Qty	Student Ratio	Setup Mins	Cleanup Mins
N/A				

Instructional Guidance / Conduct of Lesson

NOTE: Before presenting this lesson, instructors must thoroughly prepare by studying this Lesson and identified reference material

Proponent Lesson Plan Approvals

Name	Rank	Position	Date
N/A			

SECTION II.	INTRODUCTION
	Method of Instruction: Lecture Instructor to student ratio: 1:15 Time of Instruction: 5 min Instructional Strategy Lecture
Motivator	Maintaining the transmission is critical towards maintaining the JLTVA1's ability to maneuver over varied terrain, from mountainous to open, desert to fording. The Allison transmission may be new to some students, so it is imperative everybody pay attention and is able to successfully pass the hands-on assessments. The XMSN is wired to the J1939 Databus and does have electrical components, failure to follow safety and best practices may result in injury to personnel or damage to vehicle.
Terminal Learning Objective 5.	Upon completion of this lesson, you will be able to: Action: Maintain the JLTVA1's transmission system Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity.
Risk Assessment Level	Low – Electrical. Follow general shop safety to avoid risk. Low – Crushing. JLTVA1 should already be properly secured on lifting kits to avoid potential incidents from working around wheel ends.
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	A Check on Learning will be conducted at the end of each lesson to help reinforce and monitor the proper transfer of knowledge to students At the end of the course a written final exam will be administered of which each student/warfighter must earn an 80% or greater to pass this course. Throughout the lessons/modules practical exercises are conducted. Students will need to complete each exercise with 100% accuracy (to include remedial training if necessary) before the Performance Evaluation Checklist is signed, to ensure students can properly conduct maintenance procedures. PE's are graded using a "go/no go" criteria, of which all students/warfighters must earn all "go's" (100%).
Instructional Lead-In	**(Slide #2)** You've seen the JLTVA1 General Purpose truck, learned about the electrical system then the engine and starting systems; next we'll learn about the transmission. As mechanics, you all know the transmission is a mechanical component designed to transmit power from a vehicle's engine to the drive axle making it possible for the vehicle to move.

SECTION III. **PRESENTATION**

Enabling Learning Objective A.

(Slide #3)

Note: Review Module Objectives (ELOs)

Upon completion of this lesson, you will be able to:

Action:	Correlate the JLTVA1's transmission system/subsystem and components with their location, purpose, function and maintenance requirements
Conditions:	Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials
Standards:	Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity.

1.

(Slide #4)

ELO A – LSA 1

Learning Step/Activity:	Transmission Overview
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	10 mins
Media Type:	PPT

(Slide #5)

a. Transmission Overview

Figure 5.1 Allison 2500 SP transmission

1. The JLTVA1 uses an Allison 2500 SP six-speed electronically controlled transmission. (Figure 5.1)

   a) The transmission provides power and controls the speed of the wheels by providing torque conversions from the engine flywheel. Then it transmits power to the drivetrain through composite propeller shafts to a rear transaxle with a power split to the front differential.

b) The transmission comes equipped with diagnostics that monitor overall transmission health. The diagnostics and maintenance are available via transmission integration with the databus network and DSDU.

(Slide #6)

b. Theory of Operation

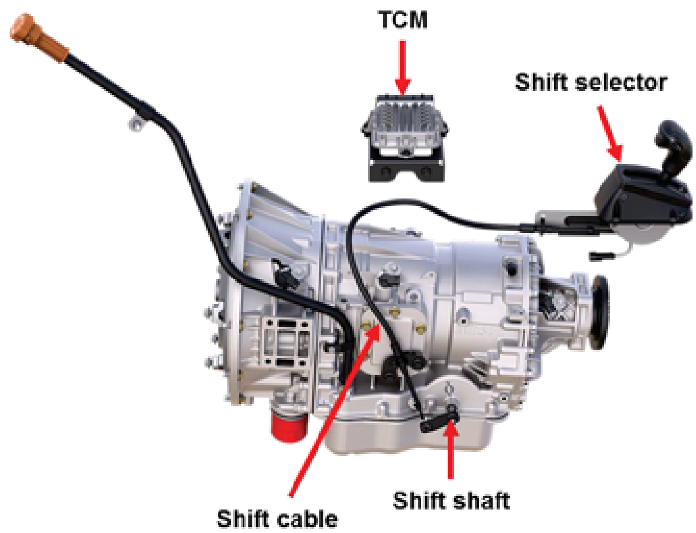


Figure 5.2 Transmission components

1. The vehicle operator makes gear range selections through the mechanical shift selector. (Figure 5.2)

   a) When the shift selector lever position is changed, the shift cable acts on the shift shaft on the left side of the transmission.

   b) The shift shaft is connected to the Manual Selector Valve inside the transmission.

   c) The Manual Selector Valve is a three-position valve that directs fluid flow inside the transmission in the Reverse, Neutral, and Drive shift selector positions.

   d) Hydraulic pressure to the rotating clutches is exhausted in the Reverse and Neutral positions, so that forward gear range selection is inhibited. This functions as a manual override in Neutral for any forward motion regardless of electronic control.

   e) The Internal Mode Switch (IMS) inside the transmission is also actuated by the shift shaft. It is a six-position switch that serves to communicate shift selector lever position to the TCM.

(Slide #7)

c. Performance and Transmission Specifics

Gear	Ratio
1st	3.51:1
2nd	1.90:1
3rd	1.44:1
4th	1.00:1
5th	0.74:1
6th	0.64:1
Reverse	5.09:1

Figure 5.3 Allison 2500 SP 6-Speed Gear Ratio

Figure 5.4 – Transmission Cross Section

1. The 2500SP is rated for a maximum input power of 340 hp and a maximum input torque of 700 lb.-ft. The unit is a wide-ratio transmission with six forward speeds and one reverse. This wide-ratio approach, compared to close-ratio, provides for both rapid acceleration and maximum speed. (Figures 5.3 and 5.4)

2. The system has two overdrive gears to enhance fuel economy at high speed, low load conditions.

3. The torque converter is a severe-duty unit designed to handle extreme conditions.

4. Governed Speed

    a) It's maximum governed engine speed rating under full load conditions is 3800 rpm.

5. Gear Ratios: First-Sixth and Reverse

(Slide #8)

    a) Gears 1 and 2: When in the first and second gear ranges (and not in converter lockup), the transmission uses the full torque from the engine and multiplies it with the 1.73 ratio torque converter.

1) When the overall lower drive train ratios are factored in, the driveline provides capability to smoothly negotiate steep grades and pull heavy loads.

2) The torque converter also provides a dampening effect that reduces shock and strain on all driveline components which extends the life of downstream driveline components.

b) Gears 3 through 6: In gears three through six, the transmission switches to full torque converter lock-up power transfer to improve efficiency and lower torque converter heat generation.

1) This design along with the low range of the lower drive train allows the lower transmission gear ratios to provide optimal performance at slower speeds. The higher gears deliver cruising capability to 76 mph (120 kph).

2) The transmission's shift schedule is developed to allow for proper gear selection during faster speeds over most off-road terrain (faster off-road speeds are results of the TAK-4i suspension on this vehicle).

Check on Learning

(Slide #9)

Q: What is the benefit of a wide-ratio design in the Allison 2500SP?
A: A wide-ratio design provides both rapid acceleration and maximum speed.

Q: What is the max governed engine speed rating (under full load conditions) of the 2500SP?
A: The maximum governed engine speed rating under full load conditions is 3800 rpm.

Q: Explain the driving capability differences between Gears 1 and 2 and Gears 3 through 6.
A: In gears 1 & 2 the torque converter clutch is unlocked and the torque converter acts as a fluid coupling. This provides both additional torque multiplication to negotiate steep grades and pull heavy loads, and a dampening effect to the drive train, reducing shock and strain which extends the life of downstream driveline components.
In gears 3-6 the torque converter clutch switches to full lock-up and the torque converter becomes a solid coupling between the engine and transmission, which allows cruising capability up to 76 mph on pavement and allows faster speeds over most off-road terrain.

Summary

(Slide #10)

In addition to the basics we just reviewed, you should remember:
The JLTVA1 uses Allison's 2500SP (Special Purpose) transmission which features:
Wide ratio 6-speed automatic
Maximum governed speed is 3800 rpm

Transition

Are there any questions?
Next, you'll learn about the internal components and how they function within the transmission.

2. **(Slide #11)**

ELO A – LSA 2

Learning Step/Activity:	Transmission Components
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	15 mins
Media Type:	PPT

(Slide #12)

Instructor Note
This slide is an introduction to the components only, do not go into detail. The overview queues the learner what we are going to discuss.

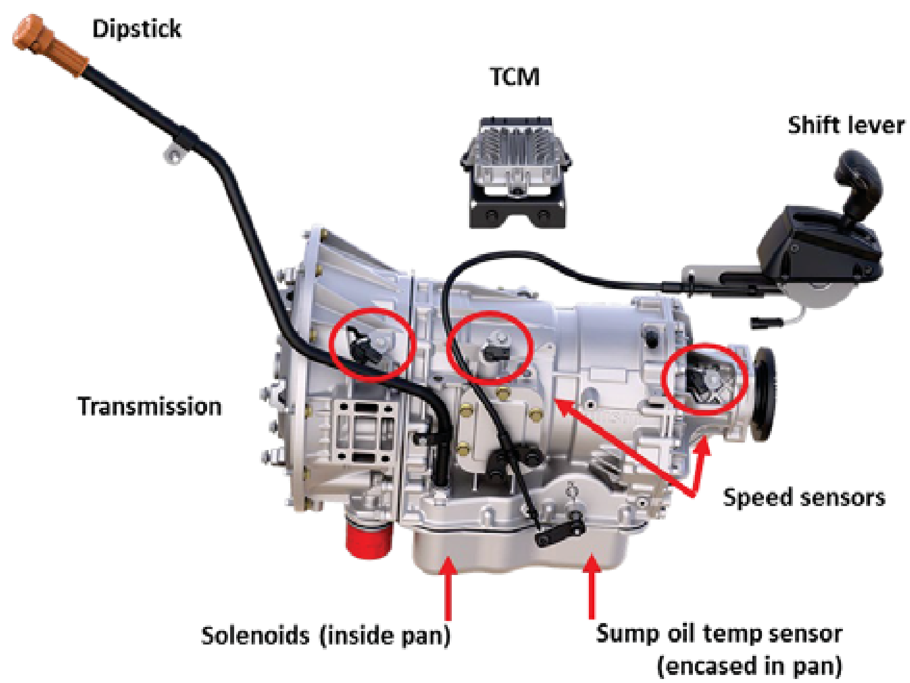


Figure 5.5 Transmission components

a. Assembly Component Overview (Figure 5.5) - The transmission system consists of five basic components.

1. Transmission Shift Selector
2. Transmission Control Module (TCM)
3. Wiring harness
4. Sensors and Solenoid Valves
5. Transmission Coolers - Cooling Pack

(Slide #13)

Figure 5.6 Transmission shift selector

6. Transmission Shift Selector (Figure 5.6)

   a) The Transmission Shift Selector is a mechanical lever mounted in the center console that allows the operator to select the desired transmission gear range.

   b) It is a lever-type selector that can be positioned to any one of six positions; Reverse (R), Neutral (N), Drive (D), Third (3), Second (2), and First (1). Positioning the shift selector lever in D provides use of all six forward gear ranges.

   c) Transmission Lever positions:

      1) Reverse (R)

      2) Neutral (N)

      3) Drive (D)

      4) Third (3)

      5) Second (2)

      6) First (1)

(Slide #14)

   d) Selector/Shaft/Cable

1) A shift cable connects the shift selector lever to the shift selector shaft on the left side of the transmission. Moving the shift selector lever causes the shift selector shaft to rotate. This is the only input the shift selector lever has to the transmission. It is a mechanical lever only. When the shift selector lever is positioned in 3, 2, or 1, the highest available gear range is third, second, or first, respectively.

2) Two-Pin Connector (Figure 5.6) - The two-pin connector on the shift selector assembly is for backlighting only. There is no electrical output from the shift selector lever.

3) Off-Road Terrain Settings are Governed - It is important to note that if the Central Tire Inflation System (CTIS) is in any terrain setting other than Highway, the forward speeds are limited. The highest available gear is fourth gear. The theory behind this function is that if a setting other than Highway is selected, the vehicle is likely in an off-road situation and will not be reaching speeds that need two overdrive gears.

(Slide #15)

Figure 5.7 Transmission control module

7. Transmission Control Module (TCM) (Figure 5.7)

   a) TCM Location - The Transmission Control Module, or TCM, is located inside the crew capsule, behind the left side of the dash, near the parking brake and trailer air supply valves. It has an all-aluminum housing.

   b) TCM Function - The TCM provides all electronic signals and control for the transmission and dictates transmission operation.
   The TCM is a fifth-generation control from Allison. The fifth generation offers better shift stabilization, improved grade braking and the opportunity for enhanced fuel economy calibrations.

   c) TCM Operation - The TCM supplies power and ground to the shift solenoids in the transmission for gear range requirements. The TCM monitors the three speed sensors and uses the input to determine when to shift up or down. It constantly learns and adapts the shift parameters to reduce shifting harshness based on vehicle load and driving patterns.

(Slide #16)

Figure 5.8 Rear view of transmission control module

d) TCM Power (Figure 5.8)

1) Battery power - A 24 VDC unswitched battery power is supplied to the TCM over wire 1054 into pins 10 and 70 in the TCM connector MC12. This power is sourced from CB1 in the 24V mVEC.

2) Ignition power - Switched ignition power is supplied over wire 1075 into pin 63 from CB22 in the 24V mVEC.

(a) If the TCM does not have ignition or battery power, it cannot provide a neutral position to the K3 relay. Power would fail to transfer to TCM if CB2 or CB22 are tripped.

(b) However, activation of the Combat Override switch energizes K3 directly (bypassing the TCM) which allows the engine to crank.

3) Ground -Module ground is supplied over wire 1435 from pins 9 and 69

(Slide #17)

8. Wiring Harness (Figure 5.9)

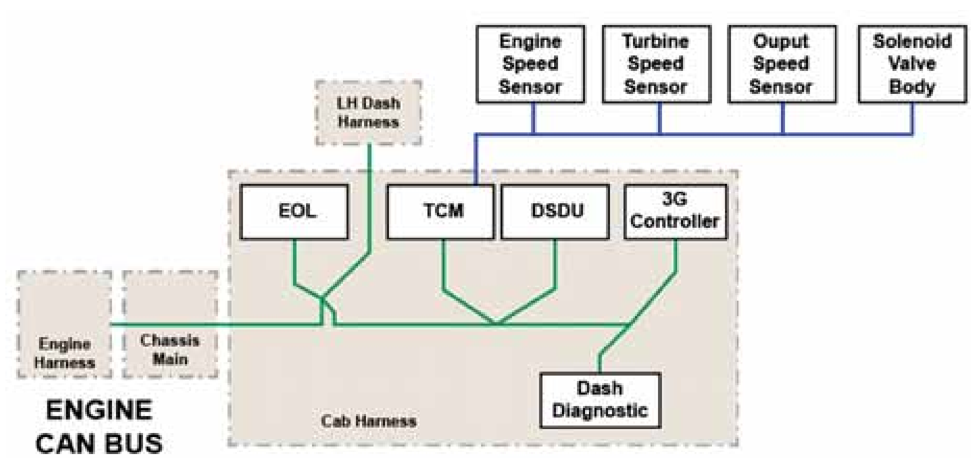


Figure 5.9 Wiring harness

a) The TCM communicates over the Engine network of the J1939 or CAN2 Databus.

b) The wiring harness serves to connect the TCM to the three speed sensors and the solenoid valve body within the transmission.

c) Transmission faults are broadcast on the J1939 Databus, and available to the operator and maintainer on the DSDU

(Slide #18)

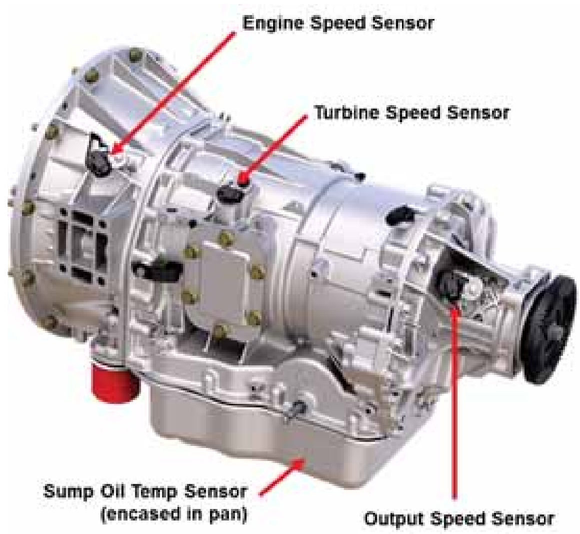


Figure 5.10 Speed sensors

9. Sensors (Figure 5.10) - Sensors are within the transmission to provide feedback to the TCM regarding transmission operating conditions. This allows the TCM to control the internal transmission hydraulic functions.

   a) Speed Sensors - The 2500SP uses three speed sensors and one oil temperature sensor. The TCM uses the sensors to determine the operating status of the transmission including the differences in speeds between various internal transmission components. If any of the sensors fail or send an irregular signal to the TCM, a fault indicator illuminates on the dash and a fault code is generated. All three sensors are electrically tested from outside the transmission.

   b) Engine speed sensor

      1) Location - The engine speed sensor is on the upper left of the torque converter housing.

      2) Function - It provides an engine speed reading to the TCM. This is the torque converter pump speed also since the torque converter housing is bolted to the engine flexplate.

(Slide #19)

   c) Turbine speed sensor

1) Location - The turbine speed sensor is located on the upper left center of the transmission housing. It provides a rotating clutch housing speed reading to the TCM.

2) Function – It provides rotating clutch housing speed (torque converter turbine speed) signal to the TCM. Since the rotating clutch housing is driven by the torque converter turbine, this is also the turbine speed. The TCM will use both sensors to determine torque converter lock up. When the torque converter clutch is engaged, both speed readings should be equal.

d) Output speed sensor

1) Location - The output speed sensor is located on the upper left of the tail housing.

2) Function - It provides an output shaft speed reading to the TCM. The TCM uses this sensor, with the turbine speed sensor, to verify gear range engagement by comparing the two speeds.

(a) In first, second and third gears, the output speed is less than the turbine speed.

(b) In fourth gear, which has a ratio of 1:1, they will be equal.

(c) In fifth and sixth gears, the output speed is greater than the turbine speed.

e) Sump Oil Temperature Sensor

1) Location - The sump oil temperature sensor is located internally in the transmission, in the pressure switch manifold.

2) Function - It allows the TCM to monitor transmission fluid temperature and provide over-temperature warnings as needed.

(Slide #20)

Figure 5.11 Solenoids

10. The TCM uses the solenoid valves, located internal to the transmission, to control internal fluid flow and transmission operation. The 2500SP uses the following solenoid valves (Figure 5.11):

    a) Pressure Control Solenoids (PCS1, PCS2)

    b) Shift Solenoids (SS1, SS2, SS3) - The 2500SP uses several Pressure Control Solenoids (PCS1 and PCS2) and Shift Solenoids (SS1, SS2, and SS3) to control shift operation and performance.

    c) Torque Converter Clutch solenoid (TCC) - The Torque Converter Clutch (TCC) solenoid controls engagement and disengagement of the torque converter lockup clutch.

    d) Modulated Main pressure solenoid (MAIN MOD) - The MAIN MOD pressure solenoid controls main line circuit pressure throughout the transmission.

(Slide #21)

    e) Location - Transmission solenoids are located inside the assembly, on the valve body (encased in the pan beneath transmission). (Figure 5.11)

	C1	C2	C3	C4	C5	C6
R			X		X	
N					X	
1	X				X	
2	X			X		
3	X		X			
4	X	X				
5		X	X			
6		X		X		

Figure 5.12 Clutch engagement chart

f) Function – The TCM uses solenoids to control internal fluid flow and transmission operation. Using solenoids to actuate internal valves allows the TCM to control internal fluid pressure (reduction of pump pressure down to line pressure) and to direct the fluid pressure to apply the various clutches (C1 – C5) that engage the gears and transmit power through the transmission, and to engage the torque converter lockup clutch.

1) Example – As shown in the chart above, C2 clutch uses 4th through 6th gears. A failure of the components that control C2, either electrically with the solenoid or wiring or in the internal transmission hydraulic circuit, will affect all three gear ranges. A fault code displayed in the DSDU indicates an electrical failure in the solenoid circuit. (Figure 5.12)

(Slide #22)

Figure 5.13 Transmission cooling package location

11. Transmission Fluid Coolers – Cooling Pack

    a) Location – The transmission fluid coolers are within the JLTVA1 Cooling Pack Assembly at the front of the vehicle. (Figure 5.13)

(Slide #23)

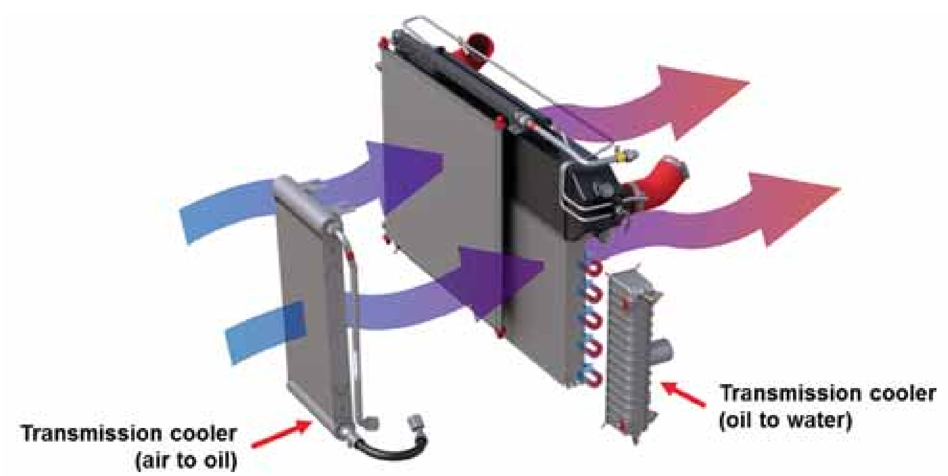


Figure 5.14 Transmission cooling package assembly

    b) Function - A combination of oil-to-water and air-to-oil coolers maintains the transmission at the optimum operating temperatures. A thermal bypass circuit allows transmission fluid to bypass the coolers to improve warm-up time and prevents overcooling during arctic conditions.

1) The transmission fluid flows first through the seven-plate oil-to-water cooler – integrated inside the engine radiator end tank. (Figure 5.14)

2) The fluid then flows through the air-to-oil cooler – located on the front of the cooling package. (Figure 5.14)

3) This series approach to transmission cooling maintains the proper transmission fluid temperatures even under severe conditions.

Check on Learning

(Slide #24)

Q: What is the benefit of positioning the shift selector lever in D?
A: Provides use of all six forward gear ranges.

Q: The operator returns the vehicle stating it would not reach 5th gear. You observe that the CTIS is set to Cross Country. Explain to the operator why this occurred.
A: Since the CTIS was in a setting other than highway, the TCM electronically limited the transmission to 4th gear as the highest gear available. Since 5th and 6th are both overdrive gears, they are only available in the Highway CTIS setting.

Summary

(Slide #25)

Assembly Components consist of:
Transmission Shift Selector (Mechanical lever – not a shift pad)
Transmission Control Module (TCM) – Gen V
J1939 Wiring harness (Connects the TCM to sensors/solenoids)
Sensors and Solenoids
Transmission Fluid Coolers

The vehicle operator makes gear range selections through the mechanical shift selector. When the shift selector lever position changes, the shift cable acts on the shift shaft on the left side of the transmission. The shift shaft actuates the Manual Selector Valve and the IMS inside the transmission. The IMS communicates the shift selector lever position to the TCM.

The TCM supplies power and ground to the shift solenoids in the transmission for gear range requirements. The TCM monitors the three speed sensors and uses the input to determine when to shift up or shift down. Sensors are incorporated into the transmission to provide feedback to the TCM regarding transmission operating conditions.

Solenoids actuate internal valves allowing the TCM to control internal fluid pressure (reduction of pump pressure down to line pressure) and to direct that fluid pressure to apply the various clutches that engage the gears and transmit power through the transmission, and to engage the torque converter lockup clutch.

The transmission has many moving parts that require cooling, the cooling system has a series of transmission coolers that maintain proper fluid temperatures. Remember, diagnostic and maintenance information is available via transmission integration with the databus network and DSDU.

Transition

Any questions before we move on to component ID?

3.	**(Slide #26)** ELO A – LSA 3 Learning Step/Activity: Transmission Component ID Method of Instruction: Practical Exercise Instructor to student ratio: 1:5 Time of instruction: 30 mins Media Type: None **(Slide #27)** See Appendix C: PE 5A-1
Check on Learning	None
Summary	None
Transition	Are there any questions? Now it is your turn. The next exercise is for you to identify the components and verbalize each components purpose or function.
4.	**(Slide #28)** ELO A – LSA 4 Learning Step/Activity: Maintenance Overview Method of Instruction: Lecture Instructor to student ratio: 1:15 Time of instruction: 10 mins Media Type: PPT

(Slide #29)

a. Overview - Maintenance

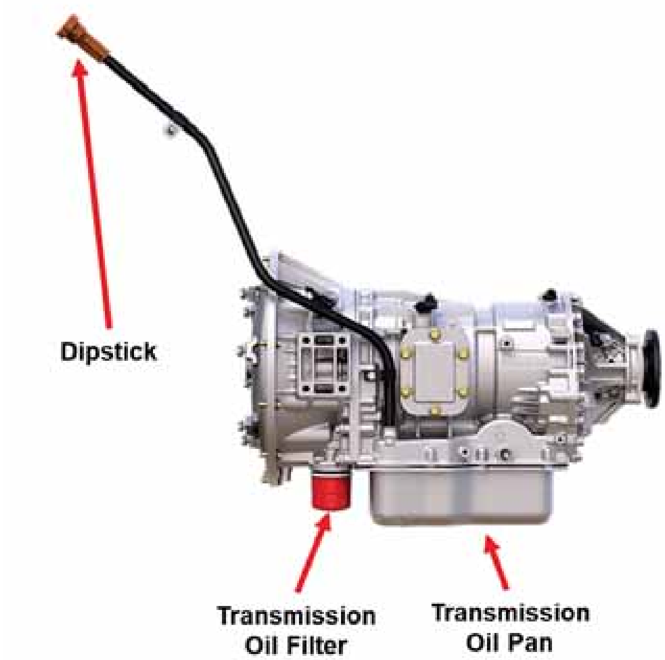


Figure 5.15 Dipstick, Oil Filter and Oil Pan

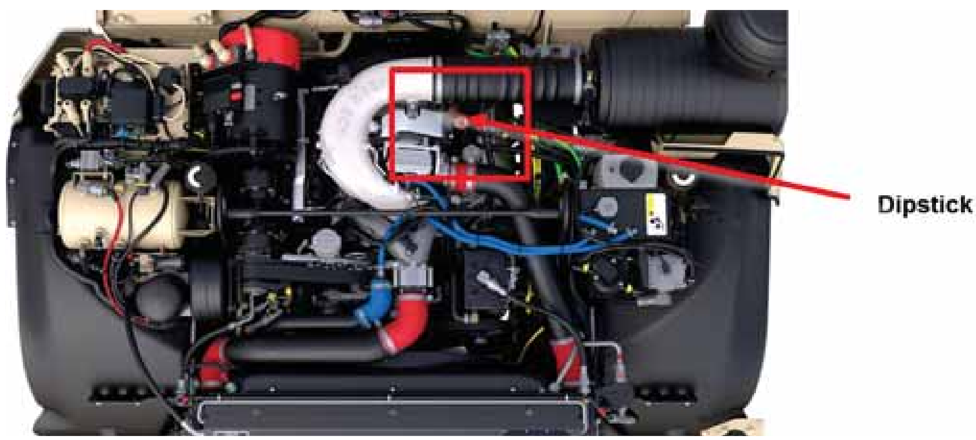


Figure 5.16 Transmission Dipstick location within engine compartment

1. Scheduled/Routine Maintenance

    a) Requirements for the 2500SP consist primarily of oil and filter changes. Fluid and filter service should always be performed in accordance with the interval schedule specified in the IETM.

        1) Oil Filter - The 2500SP uses a single spin-on external oil filter - located on the bottom left front of the transmission. (Figure 5.15)

2) Oil Changes - The specified oil is TES-295; 10 qt. capacity. Do not use any other fluid or mix with any other fluid. Always fill to the indicated level on the dipstick to prevent overfilling of the transmission if residual fluid is present. (Figure 5.16)

(Slide #30)

2. DSDU for Transmission Health Maintenance

Figure 5.17 Transmission Status Screen of DSDU (Maintainer Role)

a) Diagnostics Sensors - The sensors and solenoids of the JLTVA1 are diagnostic sensors which allows the JLTVA1 operator or maintainer to view the status of the vehicle's subsystem or component.

1) Transmission status and fluid temperature can be monitored through the DSDU. These parameters help give a general indication of transmission health. (Figure 5.17)

2) See Appendix D: DSDU for Maintainers – Transmission Status Job Aid Sheets for instructions on how to access Transmission information in the DSDU.

b) Prognostic Sensors - There are no prognostic sensors (oil level, filter life, etc.) for health maintenance. Therefore, no indication of oil level or filter condition can be determined using the DSDU.

c) Note: Although the DSDU provides some information, it is still important to utilize the dipstick to determine if the transmission oil level is within the proper operating range. Always service the transmission filter in accordance with the correct maintenance schedule.

Check on Learning	**(Slide #31)** **Q:** Where do you find the interval schedule for fluid and filter service on the truck? **A:** In the IETM **Q:** What are the benefits of using the DSDU as a Health Maintenance source? **A:** The DSDU provides interactive diagnostics and first-level troubleshooting capabilities from within the crew capsule.
Summary	**(Slide #32)** Requirements for the 2500SP consist primarily of oil and filter changes. Fluid and filter service should always be performed in accordance with the interval schedule specified in the IETM. Diagnostics Sensors - The sensors and solenoids of the JLTVA1 are diagnostic sensors which allows the JLTVA1 operator or maintainer to view the status of the vehicle's subsystem or component.
Transition	Do you have any questions? Now that you are introduced to general capabilities, general assembly and maintenance we are going to transition into troubleshooting and testing the transmission.
Enabling Learning Objective B.	**(Slide #33)** Upon completion of this lesson, you will be able to: Action: Troubleshoot Guidelines Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test.
1.	**(Slide #34)** ELO B – LSA 1 Learning Step/Activity: Troubleshooting Guidelines Method of Instruction: Lecture Instructor to student ratio: 1:15 Time of instruction: 30 mins Media Type: PPT **(Slide #35)** a. Symptoms and Indicators of Transmission Problems 1. There are two indicators of transmission problems; poor performance and/or fault codes and warnings from the databus.

2. Poor performance or failure to perform are indicators of transmission problems. Symptoms of poor performance or failure to perform are below.

   a) Leaks/Low Fluid Level - The automatic transmission is a hydraulic system, so any other hydraulic system fluid level is critical. If your transmission fluid is low, inspect the system for leaks.

   b) Hard Shifts or Slipping - Internal leaks or line pressure that is either too low or too high can cause hard shifts or transmission slipping.

   c) Engine fails to crank – A loss of power to the TCM may result in a no crank condition. A loss of TCM power will result in a No Neutral signal being provided. Without the neutral signal, the engine will not crank.

(Slide #36)

3. Warnings and Fault codes

Figure 5.18 Active Service Code Screen

   a) Fault codes in DSDU (Figure 5.18)

      1) If the Check Transmission light is illuminated, a fault code generates in the DSDU and requires proper analysis.

Figure 5.19 Range Inhibit Indicator

b) Range Inhibit Light illuminated (Figure 5.19)

1) The purpose of the indicator is to alert the operator that transmission operation is inhibited and that range shifts being requested by the operator may not occur. When certain operating conditions are detected by the TCM, the controls command the transmission to lock in the range currently in use. If the torque converter clutch applies when the condition is detected, the clutch will disengage concurrently with the activation of the Range Inhibit Light.

2) However, if the Range Inhibit Light remains illuminated, transmission troubleshooting should be performed. This means the TCM is seeing something that causes it to inhibit normal operation of the transmission.

(Slide #37)

b. Assess the Issue

1. One of the first issue indicators are fault codes. Resolving an issue that generated a fault code is a multistep process, part of which may require system testing.

2. Identify the Fault

a) When performing fault code analysis, the first step is always to identify the fault and verify a fault occurred. Fault indicators include the Check Transmission light in the right gauge cluster as well as the fault indicator in the DSDU.

3. Retrieving Codes

a) There are two ways to retrieve active fault codes from the JLTVA1.

1) Use the DSDU to access the code.

2) Use external electronic test equipment (MSD) to retrieve both active and stored fault codes for more complete analysis.

4. Resolve the Fault

a) Use the IETM and follow the appropriate IETM troubleshooting work package.

1) Use the Schematics

2) Verify issue is resolved on the ACTIA dash and DSDU

(Slide #38)

c. Inspect & Test Transmission System

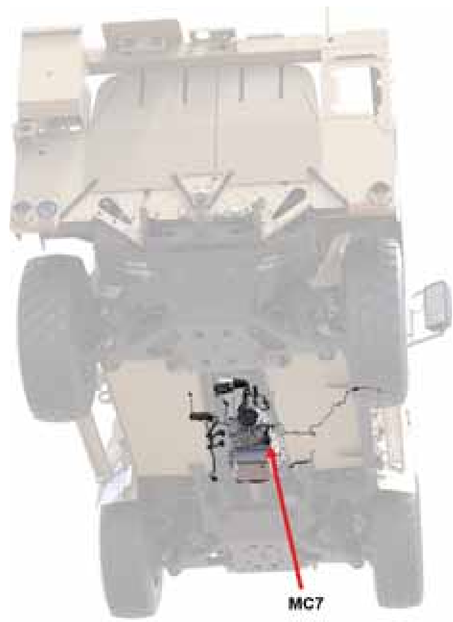


Figure 5.20 MC7 location

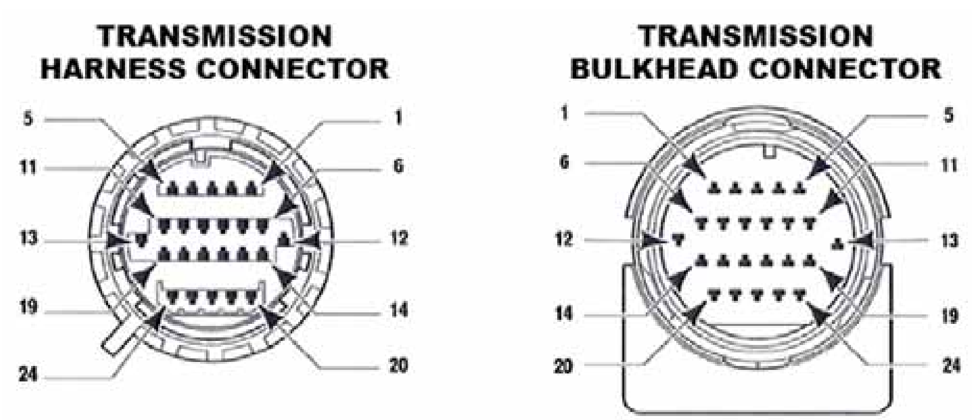


Figure 5.21 Transmission connectors

1. All internal transmission electrical components can be tested from outside the transmission. This can be done to verify if the potential failure is inside or outside the transmission itself.

   a) Locate MC7 on the lower right rear of the transmission and disconnect it. (Figure 5.20)

   b) Pin 1 of MC7 is at the top left, then continue to read the pins from left to right. (Figure 5.21)

(Slide #39)

   c) Use the schematics to determine the correct pin locations for testing the components listed below.

   d) Expected value ranges for the following solenoids and sensors:

      1) Pressure Control Solenoid (PCS1): 4-8 ohms

      2) Torque Convertor Clutch Solenoid (TCC): 4-8 ohms

      3) Main Modulation Solenoid (Main Mod): 4-8 ohms

      4) PCS2 4-8 ohms

      5) Shift Solenoid 1 (SS1): 20-30 ohms

      6) Shift Solenoid 2 (SS2): 20-30 ohms

      7) Shift Solenoid 3 (SS3): 20-30 ohms

      8) Sump Temperature Sensor: 2,340-2,600 Ω at 77 °F

(Slide #40)

2. If the components to test are difficult to access (such as the engine or turbine speed sensors), or if MC7 is obstructed (B-kit installed, etc.), transmission electrical components can also be tested from the bulkhead connector at the front of the crew capsule.

   a) Locate MC 68 on the Cab/Engine bulkhead pass-through and disconnect it.

      1) Use the schematics to determine the correct pin locations for testing the components listed below.

      2) Reference the pins for the speed sensors and the Internal Mode Switch (IMS). Use the chart to determine the correct reading for each IMS position; the expected reading is OL if the indicated position is shown as “Open” or “OFF”, whereas the expected reading will be continuity (<5 ohms) if the indicated position is shown as “Closed” or “ON”.

3) Since the signals through the IMS change as shift selector position changes, test all five IMS switch channels in both Neutral and Drive to see the differences between the positions.

4) When testing the IMS switch channels, the return path for all will be the Signal Return, wire 158. For example, to test the position of IMS switch A, use the pins for switch A and Signal Return.

5) Expected Value Ranges: For all three speed sensors, the expected value range is 2000-3000 ohms.

Check on Learning

(Slide #41)

Q: What equipment can be used to access fault codes in the TCM?
A: The DSDU or external electronic test equipment (MSD).

Q: What does the Range Inhibit light indicate?
A: It indicates that, under certain operating conditions, the requested shifts may not occur.

Q: Scenario: The Range Inhibit light in a JLTVA1 is illuminated. Technician A states that means the TCM is seeing something that causes it to inhibit normal operation of the transmission and troubleshooting should be performed. Technician B states that means the TCM is delaying a shift and it is normal. Who is correct?
A: Technician A.

Summary

(Slide #42)

If a transmission fault occurs, the operator must use appropriate judgement and monitor operating conditions to determine if it is viable to continue the mission. Troubleshooting an Allison transmission is very similar to troubleshooting many other electronic or hydraulic systems. Loss of power to the TCM will cause a No Crank condition.

Transition

Now that we have reviewed the troubleshooting indicators and the ways to retrieve fault codes, we will move out to the truck for a practical exercise.

2.

(Slide #43)

ELO B – LSA 2

Learning Step/Activity:	Troubleshoot Induced Fault Code 3-23 and 3-24
Method of Instruction:	Practical Exercise
Instructor to student ratio:	1:5
Time of instruction:	30 min
Media Type:	None

(Slide #44)

See Appendix C: PE 5B-1

Check on Learning	None
Summary	None
Transition	None
3.	**(Slide #45)**

ELO B – LSA 3

Learning Step/Activity:	Troubleshoot No Crank without a Code
Method of Instruction:	Practical Exercise
Instructor to student ratio:	1:5
Time of instruction:	30 mins
Media Type:	None

Instructor Note

The next three PEs are to be set up as a rotation; each JLTVA1 is induced with an individual fault and the students rotate from truck-to-truck experiencing each of the three faults. Each JLTVA1 station has a PE sheet and Go/No Go Sheet.

Complete the Summary by the truck. Use the truck as needed to answer question or reteach if a student does not answer questions correctly.

Next slide in presentation is a transition slide leading into the module wrap-up: check on learning and summary.

(Slide #46)

Station: JLTVA1 #1: See Appendix C: PE 5C-1

4.

ELO B – LSA 4

Learning Step/Activity:	Troubleshoot Induced Fault Code 3-31
Method of Instruction:	Practical Exercise
Instructor to student ratio:	1:5
Time of instruction:	20 min
Media Type:	None

Note

Note this PE is one of three exercises to be conducted using a three-truck rotation (three PE stations – students rotate through PEs).

Station: JLTVA1 #2: See Appendix C: PE 5D-1

Check on Learning	None
Summary	None
Transition	Are there any questions on the content covered in this module?

SECTION IV. **SUMMARY**

Method of Instruction:	Lecture
Instructor to student ratio	1:15
Time of Instruction:	5 mins
Instructional Strategy	Lecture and Q&A

Check on Learning

(Slide #47)

Q: When troubleshooting the transmission, how is being able to test all internal transmission electrical components from outside it beneficial?
A: It allows the maintainer to electrically verify everything inside the transmission and to determine if the issue is internal or external in the harness.

Q: A JLTVA1 fails to crank under normal conditions but will crank and start with the Combat Override switch activated (as per the Troubleshooting Track). Technician A states that a faulty turbine speed sensor could cause this condition, and it should be tested from MC68. Technician B states that CB22 in the Cab mVEC should be checked, since it provides ignition power to the TCM. Who is correct?
A: Technician B. If CB22 is tripped, the TCM will not “wake up” and it will not provide the neutral signal to energize the K3 Neutral Start relay. When the Combat Override switch is activated, the switch energizes K3 directly (bypassing the TCM), which allows the engine to crank. The TCM will not be monitoring the turbine speed sensor until the engine is running and the sensor is providing a signal.

Summary

(Slide #48)

In conclusion to this module we’ll do a comprehensive high-level review.

The JLTVA1 uses an Allison’s 2500SP (Special Purpose) transmission which features:
- Wide ratio 6-speed automatic
- Generation V electronic control
- Maximum governed speed is 3800 rpm

The transmission is paired with a torque converter and has six forward and one reverse gear as well a neutral setting. This engine/transmission combination provides power to the wheels through composite drive shafts to a rear transaxle, with a power split to the front differential.

The transmission provides speed and torque conversions from the engine flywheel and transmits power to the transaxle.

The transmission components consist of:
- Transmission Shift Selector (Mechanical lever – not a shift pad)
- Transmission Control Module (TCM)
- Wiring harness (Connects the TCM to sensors/solenoids)
- Sensors and Solenoid Valves
- Transmission Coolers - Cooling Pack
- Hydraulic Circuit

The transmission comes equipped with diagnostics that monitor fluid level and overall transmission health. The diagnostics and maintenance are available via transmission integration with the databus network and DSDU.
Follow the IETM PMCS for regularly scheduled maintenance

Appendix A

05_JLTVA1_ARMY_ MAIN_Trans_PPT_V3.0.pptx

Appendix C
JLTVA1 Practical Exercise Sheet No. 5A
Transmission Component ID

Title	Transmission Component ID
Lesson Number/ Title	05 Transmission
Introduction	We will now perform a P.E. on the JLTVA1 transmission
Motivator	The JLTVA1 is a capable vehicle with extreme torque at the wheels. The transmission is the start of torque multiplication. Without the transmission, you aren't moving. In this PA you will learn the critical components of the transmission and where they are located.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Enabling Learning Objective B	Action: Troubleshoot the transmission system Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test or 100% accuracy on hands on activity.
Risk Assessment Level	Low – Electrical. Follow general shop safety to avoid risk. Low – Crushing. JLTVA1 should already be properly secured on lifting kits to avoid potential incidents from working around wheel ends.
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	Now that you are familiar with the transmission, and we've walked through the schematics together, this upcoming practical exercise will give you the opportunity to go hands-on and practice the skills required to provide maintenance to the JLTVA1 transmission under normal maintainer conditions.
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils

Special Instructions

Below are the instructions for how to prepare for the practical exercise.

Preparation	Instructor Notes
TM Reference:	N/A
Time Required for Prep:	0 minutes (JLTVA1 prepped prior to class conduct)
Symptom/Purpose:	N/A
Prepare Area for PE:	insert
Configure Vehicle for PE:	Belly armor removed (if B-Kit installed) Cowl armor removed (if B-Kit installed) JLVT on Jack Stands or Suspension Lock-out Braces Installed Splash Guards removed Drop Battery Tray
Instructor Preparation:	• Ensure instructors have located and understand the purpose all components before conducting component location. • Review the basic information below as required.

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises.

d. Inform students they will have approximately 15 minutes to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five.

h. Ask if there are any questions.

i. **Point out the following components on the transmission and explain the components function.** Students may begin. Below are components and their function which the instructor may use to assist with the Go/No Go rubric.

Component	Location/Function
Instructor note:	
Transmission Input Sensor	Transmission input sensor: Monitors engine input speed for transmission processing (this is most visible from the engine compartment).
Transmission Turbine Sensor	Transmission turbine sensor: Monitors rotating clutch turbine for speed in relation to input and output speed (this is most visible from under the truck….it is not accessible).
Transmission Output Sensor	Transmission output sensor: Monitors output speed of the transmission (This is visible from under the truck).
MC 7 Transmission Connector	MC7 Transmission connector: Connection that allows for signaling from the TCM to the transmission for gear shifting and management (this is visible from under the truck).
MC 68 Bulkhead Connector	MC 68 Bulkhead pass-through: Provides a pass-through from the armored cab to the transmission connector and speed sensors (this is in the engine compartment bulkhead pass-through on the right side of the truck (left-hand side as you are looking to the rear of the truck from the top of the engine bay) it has 18-gauge (smaller) wires).
Transmission Control Module	Transmission Control Module (TCM): Primary transmission communication and processing component. Primary computer for the transmission receiving inputs-making decisions-and creating outputs for transmission control and J1939 communications (the gauge cluster should be removed to see the TCM, it is in the center console, sort of behind the DSDU on the right-hand side as you look into the center console cavity).
Shift Selector	Shift selector: Gear selecting mechanism that moves a spool valve inside the transmission to control hydraulic flow through the transmission for gear selection (inside cab).
Shift Selector Shaft	Selector shaft on transmission: Location that linkage from shift selector moves shaft to move internal spool valve (left side of the transmission housing).

Breather	Allows for transmission to vent to atmosphere to prevent over pressurization (on the top of the transmission; there is a fitting and a line that feeds up to the bulkhead passthrough).

j. Mark Go/No Go Sheets accordingly.

1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

2. Once the Practical Exercise is complete, the Lead Instructor must sign each student's Solution Sheet.

Feedback Provide feedback to students to ensure comprehension.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 5A-1
Transmission Component ID

Name____

Date____

Training Location____

Transmission Component ID	**Go**	**NO GO**	**Initials**
Transmission Input Sensor			
Transmission Turbine Sensor			
Transmission Output Sensor			
MC7 Transmission Connector			
MC 68 Bulkhead Connector			
Transmission Control Module			
Shift Selector			
Shift Selector Shaft			
Breather			

Signature____

Appendix C
JLTVA1 Practical Exercise Sheet No. 5B
Troubleshoot Induced Fault Code 3-23 and 3-24

Title	Troubleshoot Induced Fault Code 3-23 and 3-24
Lesson Number/ Title	05 Transmission
Introduction	We will now perform a P.E. on troubleshooting the JLTVA1.
Motivator	The transmission is a critical system for movement and operational control of the vehicle, this exercise provides the opportunity to practice resolving a troubleshooting scenario.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Enabling Learning Objective B	Action: Troubleshoot the transmission system Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test.
Risk Assessment Level	Low – Electrical. Follow general shop safety to avoid risk. Low – Crushing. JLTVA1 should already be properly secured on lifting kits to avoid potential incidents from working around wheel ends.
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	Now that you are familiar with the transmission, and we've walked through the schematics together, this upcoming practical exercise will give you the opportunity to go hands-on and practice the skills required to provide maintenance to the JLTVA1 transmission under normal maintainer conditions.
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide Wire removal tool (red) PN # D04112402005 **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils
Special Instructions	**Note this PE is one of three exercises to be conducted using a three-truck rotation (three PE stations – students rotate through PEs).**

Station: JLTVA1 #1
Below are the instructions for how to prepare for the practical exercise.

Preparation	Instructor Notes
TM Reference:	**Troubleshooting Procedures**>07 Transmission >Transmission Codes Troubleshooting>Code 3-23 & 3-24 Transmission Range Sensor Circuit
Time Required for Prep:	5 min
Symptom/Purpose:	The induced fault will cause the engine not to crank, **however, the fault codes will not immediately appear.** ***To get the faults to appear, the students must begin troubleshooting Engine Fails to Crank.*** During this track they will be directed to attempt to start the engine with Combat Override engaged. Once the engine starts, it will cause the audible alarm to sound, and the check transmission light to illuminate. The codes that will display on the DSDU is code 3-23 (Transmission Range Sensor Circuit-Performance) and code 3-24 (Transmission Range Sensor Circuit-High Input).
Prepare Area for PE:	• The instructor or assistant instructor will need to install this fault while class is being conducted. This will allow for faults to be installed in all three assets. • When students are done troubleshooting, have them rotate through each truck for a breadth of experience.
Configure Vehicle for PE:	Fault Installation: Remove wire from position 18 of the MC 68 bulkhead connector. Belly armor removed (if B-Kit installed) Cowl armor removed (if B-Kit installed) JLVT on Jack Stands or Suspension Lock-out Braces Installed Splash Guards removed Drop Battery Tray

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises.

d. Inform students they will have approximately 30 minutes to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five.

h. Ask if there are any questions.

i. Below are key steps the instructor may use to assist with the Go/No Go Students may begin. Below are key steps the instructor may use to assist with the Go/No Go rubric.

Step	Correct/Expected Value
Find correct TM Work Package or Troubleshooting Track	**Troubleshooting Procedures**>07 Transmission >Transmission Codes Troubleshooting>Code 3-23 & 3-24 Transmission Range Sensor Circuit
Ensure Equipment Conditions are Met	Vehicle Prep conditions conducted prior to PE cover this.
Coaching:	Instructors will assist students on finding work packages associated with the tasks they are trying to do.
Monitor for Safety:	Instructors will monitor the exercise and ensure students are properly adhering to safety guidelines while working on the vehicle.
Follow Troubleshooting Track in IETM	Locate Disconnected Sensor, which is the Internal Mode Sensor (IMS) Open at MC 68 Repair Harness

j. Mark Go/No Go Sheets accordingly.

1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

2. Once the Practical Exercise is complete, the Lead Instructor must sign each student's Solution Sheet.

Feedback Requirements

Provide feedback to students to ensure comprehension.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 5B-1
Troubleshoot Code 3-23 and 3-24

Name____

Date____

Training Location___________________________________

Station: JLTVA1 #1

Troubleshoot Code 3-23 and 3-24	**Go**	**NO GO**	**Initials**
1. Verified the Fault			
2. Located proper troubleshooting fault in the IETM			
3. Followed all warning cautions and notes			
4. Correctly followed troubleshooting track in TM			
5. Correctly repaired fault (per TM)			
6. Verified fault was corrected			

Signature____

Appendix C
JLTVA1 Practical Exercise Sheet No. 5C
Troubleshoot No Crank Without a Code

Title	Troubleshoot No Crank Without a Code
Lesson Number/ Title	05 Transmission
Introduction	We will now perform a P.E. on troubleshooting the JLTVA1.
Motivator	This troubleshooting exercise enables you to perform a repair on the JLTVA1 when the engine fails to crank with no code present.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Enabling Learning Objective B	Action: Troubleshoot the transmission system Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test.
Risk Assessment Level	Low – Electrical. Follow general shop safety to avoid risk. Low – Crushing. JLTVA1 should already be properly secured on lifting kits to avoid potential incidents from working around wheel ends.
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	Now that you are familiar with the transmission, and we've walked through the schematics together, this upcoming practical exercise will give you the opportunity to go hands-on and practice the skills required to provide maintenance to the JLTVA1 transmission under normal maintainer conditions.
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide Wire removal tool (red) PN # D04112402005 **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils
Special Instructions	**Note this PE is one of three exercises to be conducted using a three-truck rotation (three PE stations – students rotate through PEs).** **Station: JLTVA1 #2**

Below are the instructions for how to prepare for the practical exercise.

Preparation	Instructor Notes
TM Reference:	**Troubleshooting Procedures**>01 Engine>Engine Fails to Crank
Time Required to Induce Fault:	1 – 5 minutes
Symptom/Purpose:	Engine will not crank with no code present
Prepare Area for PE:	• The instructor or assistant instructor will need to install this fault while class is being conducted. **This will allow for faults to be installed in all three assets**. • When students are done troubleshooting, have them rotate through each truck for a breadth of experience.
Configure Vehicle for PE:	Fault Installation: Option 1: No Crank -remove the shift cable from the transmission shift shaft and manually place the transmission in reverse. Option 2: The instructor may simply position the shift selector lever to R. This will remove Neutral signal and the engine will not be allowed to crank. When cranking is attempted, the Range Inhibit light will also illuminate. Vehicle Prep: Belly armor removed (if B-Kit installed) Cowl armor removed (if B-Kit installed) JLVT on Jack Stands or Suspension Lock-out Braces Installed Splash Guards removed Drop Battery Tray

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises.

d. Inform students they will have approximately 15 minutes to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five.

h. Ask if there are any questions.

i. Students may begin. Below are key steps the instructor may use to assist with the Go/No Go rubric.

Step	Correct/Expected Value
Find correct TM Work Package or Troubleshooting Track	**Troubleshooting Procedures**>01 Engine>Engine Fails to Crank
Coaching:	Instructors will assist students on finding work packages associated with the tasks they are trying to do.
Monitor for Safety:	Instructors will monitor the exercise and ensure students are properly adhering to safety guidelines while working on the vehicle.
Follow Troubleshooting Track in IETM	Fault induced Option 1: If JLTVA1 is in reverse the student should discover this during step three of troubleshooting track. Fault Induced Option 2: If JLTVA1 cable was disconnected then student will discover the issue at step four of troubleshooting track.

j. Mark Go/No Go Sheets accordingly.

1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

2. Once the Practical Exercise is complete, the Lead Instructor must sign each student’s Solution Sheet.

Feedback Provide feedback to students to ensure comprehension.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 5C-1
Troubleshoot No Crank Without a Code

Name____

Date____

Training Location____

Troubleshoot No Crank Without a Code	**Go**	**NO GO**	**Initials**
1. Verified the Fault			
2. Located proper troubleshooting fault in the IETM			
3. Followed all warning cautions and notes			
4. Correctly followed troubleshooting track in TM			
5. Correctly repaired fault (per TM)			
6. Verified fault was corrected			

Signature____

Appendix C
JLTVA1 Practical Exercise Sheet No. 5D
Troubleshoot Induced Fault Code 3-31

Title	Troubleshoot Induced Fault Code 3-31
Lesson Number/ Title	05 Transmission
Introduction	We will now perform a P.E. on troubleshooting the JLTVA1.
Motivator	It is important you are able to assess a system without the assistance of the DSDU codes. The following exercise gives you that opportunity.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Enabling Learning Objective B	Action: Troubleshoot the transmission system Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test.
Risk Assessment Level	Low – Electrical. Follow general shop safety to avoid risk. Low – Crushing. JLTVA1 should already be properly secured on lifting kits to avoid potential incidents from working around wheel ends.
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	Now that you are familiar with the transmission, and we've walked through the schematics together, this upcoming practical exercise will give you the opportunity to go hands-on and practice the skills required to provide maintenance to the JLTVA1 transmission under normal maintainer conditions.
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils

Special Instructions

Note this PE is one of three exercises to be conducted using a three-truck rotation (three PE stations – students rotate through PEs).

Station: JLTVA1 #3

Below are the instructions for how to prepare for the practical exercise.

Preparation	Instructor Notes
TM Reference:	**Troubleshooting Procedures**>07>Transmission Code Troubleshooting>Code 03-31 Output Shaft Speed Sensor Circuit
Time Required for Prep:	10 min
Symptom/Purpose:	• This will set the above fault code as well as turn on the Check Transmission light and sound the audible alarm. • Fault code 3-31 Output SpdSnsCir;
Prepare Area for PE:	• The instructor or assistant instructor will need to install this fault while class is being conducted. This will allow for faults to be installed in all three assets. • When students are done troubleshooting, have them rotate through each truck for a breadth of experience.
Configure Vehicle for PE:	Fault Installation: • Remove connector MC74 from the output speed sensor and, with the engine running, shift into either D or R. • Assistant Instructor must prep JLTVA1 to allow access to the TCM by moving the DSDU off to the side without disconnecting the electronic wiring (follow IETM). Tight area close to MVEC. Vehicle Prep: Belly armor removed (if B-Kit installed) Cowl armor removed (if B-Kit installed) JLVT on Jack Stands or Suspension Lock-out Braces Installed Splash Guards removed Drop Battery Tray

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises.

d. Inform students they will have approximately 20 minutes to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five.

h. Ask if there are any questions.

i. Below are key steps the instructor may use to assist with the Go/No Go Students may begin. Below are key steps the instructor may use to assist with the Go/No Go rubric.

Step	Correct/Expected Value
Find correct TM Work Package or Troubleshooting Track	**Troubleshooting Procedures**>07>Transmission Code Troubleshooting>Code 03-31 Output Shaft Speed Sensor Circuit
Note:	It will be a challenge getting to the TCM Instructor to provide coaching on how to properly
Step 1	Verify fault code in IETM
Step 2	Tell student transmission troubleshooting start procedures have been performed. Continue troubleshooting with that step considered completed.
Step 3	The task in the IETM will direct student to check for resistance from the TCM connector through the sensor. Note: With this fault installed there will not be resistance; the meter will display OL. Instructor should direct the student to answer “NO, there is no resistance” o the troubleshooting track question to prevent damage to the TCM connector. From this step forward, the students can work without assistance.

Coaching:	Instructors will assist students on finding work packages associated with the tasks they are trying to do.
Monitor for Safety:	Instructors will monitor the exercise and ensure students are properly adhering to safety guidelines while working on the vehicle.

j. Mark Go/No Go Sheets accordingly.

1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

2. Once the Practical Exercise is complete, the Lead Instructor must sign each student’s Solution Sheet.

k. When everyone is finished collect solution sheet.

Feedback Provide feedback to students to ensure comprehension.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 5D-1
Troubleshoot Induced Fault Code 3-31

Name____

Date____

Training Location____

Station: JLTVA1 #3

Troubleshoot Induced Fault Code 3-31	**Go**	**NO GO**	**Initials**
1. Verified the Fault			
2. Located proper troubleshooting fault in the IETM			
3. Followed all warning cautions and notes			
4. Correctly followed troubleshooting track in TM			
5. Correctly repaired fault (per TM)			
6. Verified fault was corrected			

Signature____

Appendix D
DSDU for Maintainers – Transmission Status Job Aid Sheets

To check the current status of Transmission diagnostic information, follow the steps below:

1. **Select POWERTRAIN SELECTION** to navigate to more options.

2. Select TRANSMISSION STATUS

3. The screen below relays the current status of transmission diagnostics.
   Select BACK to return to the prior screen or HOME to return to Maintainers HOME screen.

US Army
SFAE-CSS-JC-JL
MS 640 BLDG 302 RM 113
6501 E 11 Mile Road
Warren, MI 48397-5000

INSTRUCTOR GUIDE

Joint Light Tactical Vehicle (JLTVA1) Maintainer Course

LESSON

06 Drivetrain

SECTION I. ADMINISTRATIVE DATA

All Courses Including This Lesson

Course Number	Version	Course Title
JLTVA1_MAINT_01	3.0	Introduction and Safety
JLTVA1_MAINT_02	3.0	Vehicle Familiarization
JLTVA1_MAINT_03	3.0	Electrical
JLTVA1_MAINT_04	3.0	Engine
JLTVA1_MAINT_05	3.0	Transmission
JLTVA1_MAINT_06	3.0	Drivetrain
JLTVA1_MAINT_07	3.0	Suspension, Hydraulics and Steering
JLTVA1_MAINT_08	3.0	Air Systems, Brakes and CTIS
JLTVA1_MAINT_09	3.0	End of Course

Task(s) Taught (*) or Supported

Task Number	Task Title
III.C.1	Describe the operational characteristics of an electronically controlled manual transmission/transaxle.
III.E.2	Check and Adjust Differential Housing Fluid Level
II.D.6	Inspect and replace components of locking differential case assembly.
III.D.2	Inspect, service, and replace shafts, yokes, boots, and universal/CV joints.
III.D.1	*Wheel End Inspection
N/A	Drivetrain Sensor Testing
A650A0S_00_NGFAABC	*107-29_GEARBOX UNKNOWN
A650A0S_00_NGFAABD	*107-30_GEARBOX SHIFT NOT COMPLETED

Reinforced Task(s)

Task Number	Task Title
N/A	

Academic Hours

The academic hours required to teach this lesson are as follows:

Academic	Resident Hours	Methods
1 hr 10 min		ILT
3 hr 10 min		PE
Total Hours:	4 hr 20 min	

Test Lesson Number	**Hours**	**Lesson Number Version**	**Lesson Title**
	1 hr 30 min	Test A	09_End of Course and Final Exam
	1 hr 30 min	Test B	09_End of Course and Final Exam

Prerequisite Lesson(s)	**Hours**	**Lesson Number Version**	**Lesson Title**
	N/A	N/A	N/A

Clearance Access

Security Level: Unclassified
Requirements: There are no clearance or access requirements for the lesson.

Foreign Disclosure Restrictions

FD7. This product/publication has been reviewed by the product developers in coordination with the Oshkosh Corporation foreign disclosure authority. This product is NOT releasable to students from foreign countries.

References	**Number**	**Title**	**Date**
	2320-01-653-6557	JLTVA1 GP IETM	April 2018
	2320-01-653-6495	JLTVA1 HGC IETM	April 2018
	2320-01-653-6516	JLTVA1 UTL IETM	April 2018
	2320-01-653-6534	JLTVA1 CCWC IETM	April 2018

Student Study Assignments

None

Instructor Requirements

JLTVA1 Certified Instructor (3)

Additional Support Personnel Requirements	**Name**	**Student Ratio**	**Qty**	**Man Hours**
	N/A			

Equipment Required for Instruction

Quantities are based on a 15-student class size.

ID Name	Student Ratio	Instructor Ratio	Spt	Qty	Exp
Projector	1:15	1:1	No	1	Yes
JLTVA1 w BII	1:5	1:1	No	3	Yes
MSD with EMS NG/IETM	1:5	1:1	No	3	Yes
GMTK	1:5	1:1	No	3	Yes
FIK	1:5	1:1	No	3	Yes
Special Tool – Jack Service Cart Kit JLTVA1	2:5	2:1	No	6	Yes

Materials Required	**Instructor Materials:** Instructor Guide FIK **Student Materials:** Student Guide

Classroom, Training Area, and Range Requirements

ID Name	Qty	Student Ratio	Setup Mins	Cleanup Mins
Classroom, 15 Student	1	1:15	30	30
Shop, 3 Bays	1	1:5	30	30

Ammunition Requirements

DODIC Name	Qty	Student Ratio	Setup Mins	Cleanup Mins
N/A				

Instructional Guidance / Conduct of Lesson

NOTE: Before presenting this lesson, instructors must thoroughly prepare by studying this Lesson and identified reference material

Proponent Lesson Plan Approvals

Name	Rank	Position	Date
N/A			

SECTION II.	**INTRODUCTION**
	Method of Instruction: Lecture Instructor to student ratio: 1:15 Time of Instruction: 5 min Instructional Strategy: Lecture & Group Discussion
Motivator	Failure to understand the new technology presented in this Drivetrain module could result to damage to the vehicle.
Terminal Learning Objective 6.	**NOTE:** Inform the students of the following Terminal Learning Objective requirements. Upon completion of this lesson, you will be able to: Action: Maintain the JLTVA1's drivetrain system, subsystems and components Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity.
Safety Requirements	It is the responsibility of the student/warfighter to follow safety guidelines as well as local unit SOPs.
Risk Assessment Level	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	A Check on Learning will be conducted at the end of each lesson to help reinforce and monitor the proper transfer of knowledge to students. At the end of the course a written final exam will be administered of which each student/warfighter must earn an 80% or greater to pass this course. Throughout the lessons/modules practical exercises are conducted. Students will need to complete each exercise with 100% accuracy (to include remedial training if necessary) before the Performance Evaluation Checklist is signed, to ensure students can properly conduct maintenance procedures. PE's are graded using a "go/no go" criteria, of which all students/warfighters must earn all "go's" (100%).
Instructional Lead-In	The transmission captures the power of the engine and through the gears provides the potential to move the vehicle through various speeds, however, it needs the drivetrain to transfer power from the output of the transmission to the wheels to put the vehicle in motion.

SECTION III.	**PRESENTATION**

Enabling Learning Objective A.

(Slide #3)

NOTE: Inform the students of the following Enabling Learning Objective requirements.

Upon completion of this lesson, you will be able to:

Action:	Correlate the JLTVA1's drivetrain system/subsystem and components with their location, purpose, function and maintenance requirements
Conditions:	Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials
Standards:	Without injury or death to personnel and reaching the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activities.

1.

(Slide #4)

ELO A – LSA 1

Learning Step/Activity:	Drivetrain Theory of Operation
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	5 min
Media Type:	PPT

(Slide #5)

a. Drivetrain Overview

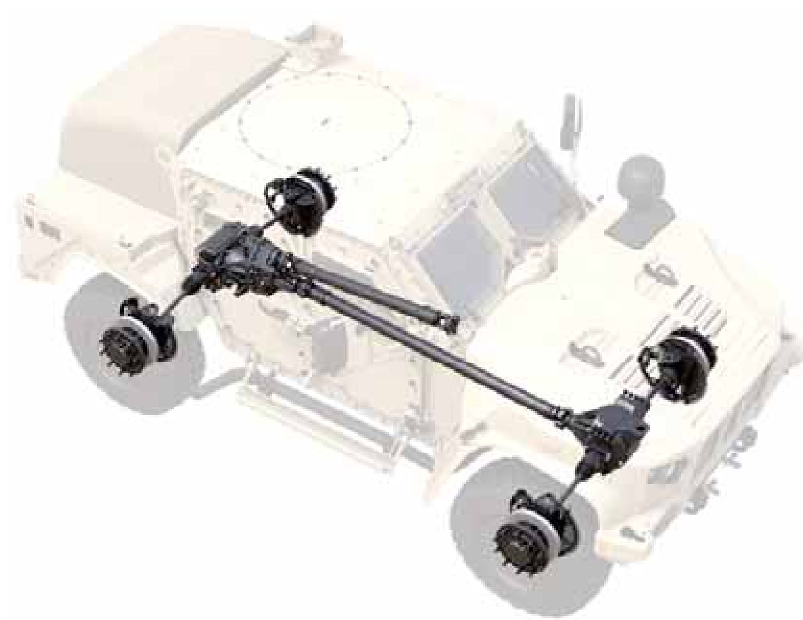


Figure 6.1 JLTVA1 drivetrain

1. The JLTVA1 Power and Drivetrain systems were designed to perform while delivering reliability and exceptional power-to-weight ratios across any type of setting encountered. The high power-to-weight ratio is possible due to the unique drivetrain of the JLTVA1. (Figure 6.1)

Instructor Note
Play video “JLTVA1 climbing”

Instructor Note

Q& A Interaction to trigger students’ prior knowledge of drivetrains.

Ask the students the questions below to prompt a discussion discussing traditional drivetrain assemblies; this will help learning occur when discussing the differences of the JLTVA1 drivetrain.

Q: Who can describe a straight axle you would see in a traditional drivetrain on an everyday pickup truck?
A: Traditional drivetrains have straight axles connected to the wheel assemblies, across the vehicle from side-to-side. They are rigid and much of the force is transferred to the chassis when operating over rough terrain.

Q: Who has heard the term Multi-link Suspension or Independent Link Suspension used on civilian vehicles and what do you suppose the terms mean?
A: On these types of suspensions, the wheel assembly works independently of the opposite wheel on the same axle allowing the axle to navigate different types of terrain without compromising the stability of the vehicle. On the JLTVA1 this type of suspension is referred to as TAK4i.

Q: What do you think needs to be changed within the drivetrain from a traditional axle to a TAK4i axle?
A: The JLTVA1’s drivetrain uses half shafts and transaxles to support and integrate with the suspension system. This allows the wheel assembly to flex up and down independently. The JLTVA1 drivetrain is comprised of several systems/components including transaxles, front and rear differentials and the wheel end assemblies.

Q: What do you think is the motivation NOT to use a traditional drivetrain on the JLTVA1?
A: A straight axle is rigid and is not conducive to the independent four-wheel suspension system. The TAK4i allows us to navigate in extreme conditions under heavy loads while maintaining stability of the JLTVA1 as well as dampen the shocks to the chassis. If a traditional straight axle were used, off-road capability would be extremely limited due to the shocks the chassis would absorb rather than the suspension.

(Slide #6)

Figure 6.2 JLTVA1 Drivetrain

2. Drivetrain Theory of Operation: the transaxles, differentials and wheel end assemblies work together in the following way (Figure 6.2):

    a) The transmission has a propeller shaft that transfers power to the transaxle.

    b) The transaxle is a unitized housing that combines both the transfer case and the rear differential into a single unit.

    c) The transaxle has a propeller shaft that transfers power to the front differential.

    d) The purpose of the front and rear differential is to transfer power from the transfer case, that is integrated into the transaxle, out to the hubs via the half shafts.

    e) The differentials are what allows the wheels on either side of the vehicle to turn at different speeds without binding.

    f) The half shafts drive the wheel end assemblies and provide an attachment point for the wheels.

    g) The wheels themselves are integrated into the vehicle's control center using technology enabling operator commanded tire pressure adjustments to accommodate terrain changes, as well as provide automated tire pressure checks and adjustments.

Check on Learning

(Slide #7)

Q: What two major drivetrain components are integrated into the transaxle?
A: The transfer case and the rear differential.

Q: What is the function of the half shafts?
A: Transfers power from the differential to the wheel assembly and allows independent movement of the suspension on each axle.

Q: Why is it important that differentials keep the wheels from binding at different speeds?
A: If you were making a turn and your left and right wheels were locked to the same speed, it would be difficult to make the turn, reduce turning radius, as well as cause increased tire wear.

Summary **(Slide #8)**

The JLTVA1 drivetrain is comprised of several systems/components including transaxles, front and rear differentials and the wheel end assemblies. Each component is essential in putting the JLTVA1 into motion.

Transition Any questions before we move forward?

2. **(Slide #9)**

ELO A – LSA 2

Learning Step/Activity:	Drivetrain Components
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	20 min
Media Type:	PPT

(Slide #10)

a. Components of the Drivetrain Assembly

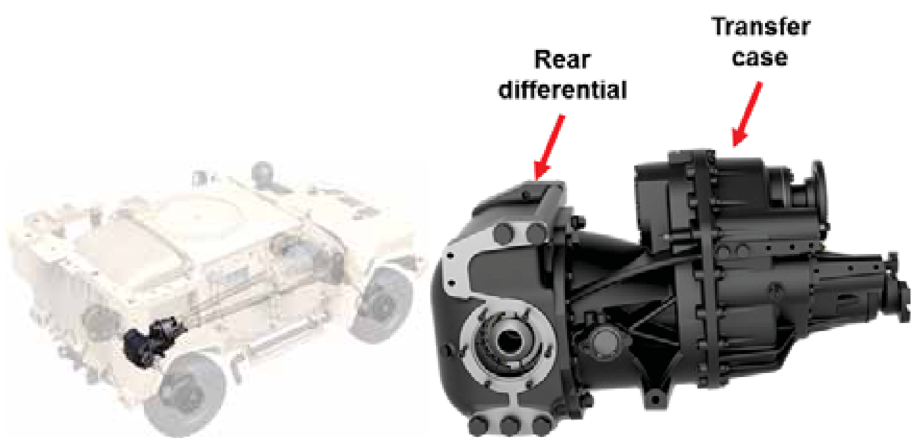


Figure 6.3 Transaxle components

1. Transaxle - The transaxle is a new component used on JLTVA1. The traditional transfer case and differential have been combined into one unit called the transaxle. (Figure 6.3)

   a) The purpose of the transaxle's transfer case is to deliver power from the transmission to the front and rear differentials.

   b) Input power from the transmission via the propeller shaft is input to the top front, top yoke.

   c) Output is directly to the rear differential internal to the transaxle.

   d) The lower front yoke transfers power to the front differential via the propeller shaft.

(Slide #11)

Figure 6.4 Transaxle

e) Benefits of a Transaxle configuration –

1) Reduces rotating mass – There is no propeller shaft between the transfer case and rear differential. This reduces overall drivetrain mass as well as rotating mass since a separate propeller shaft between the transfer case and the rear differential is no longer required.

2) Improved propeller shaft angles - The position of the transaxle at the rear of the vehicle improves the propeller shaft angles which results in less drivetrain vibration and smoother operation

3) Improved front/rear weight distribution - The rear mounting location of the transaxle improved the vehicle’s front/rear weight distribution.

4) Improved blast performance and safety - Possibly the most important benefit is in improved blast performance and safety. This is due to eliminating major assemblies (such as a stand-alone transfer case) directly under the crew capsule.

5) Full-time, All-Wheel Drive - The Transfer case section is a two-speed gear drive configuration that incorporates a planetary power divider differential. The case can send power to both the front and rear differentials, but it will allow for variable power delivery based upon differing axle and wheel speeds. This provides full-time, all-wheel drive.

(Slide #12)

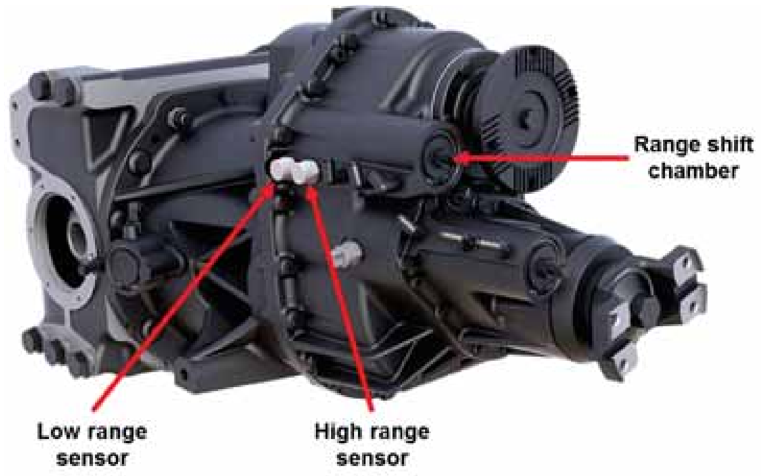


Figure 6.5 Transaxle components

f) Transaxle Components (Figure 6.5) – The transaxle is comprised of the range shift chamber and drivetrain lock.

1) Range shift chamber

(a) The transaxle range shift chamber is integrated into the transaxle front housing.

(b) This allows shifting of transaxle between high and low ranges

(1) High range has a gear ratio of 1.65:1

(2) Low range has a gear ratio of 2.95:1.

(c) The shift chamber is air actuated, electronically controlled. When the operator presses the range selection button on the vehicle systems MUX panel, a switch request signal is sent to the rear chassis power module. The rear chassis power module then energizes the appropriate solenoid to shift valves in the rear air valve bank to control application of air to the range shift chamber.

(Slide #13)

2) High & Low Range Shift Sensors

(a) The Range Shift Sensors determine the shift position. They are on the right side of the range shift chamber.

(b) The range shift sensors are two wire sensors with a switch that is either open or closed depending on which range is selected.

(c) The Rear Chassis Power module provides 24 VDC battery power to each sensor on wire 1500. When the switch is closed by air pressure, the 24 VDC supplied to the sensor passes through the sensor (wire 1555 for High Range, wire 1557 for Low Range) and is input into the SCIM (I/O module).

(d) The SCIM turns the 24 VDC input from the switch into a J1939 message which allows the operator to see the range selected by turning the lights on the MUX panel solid for the range selected.

(e) If the lights on the MUX panel flash, it is attempting to make the shift.

(Slide #14)

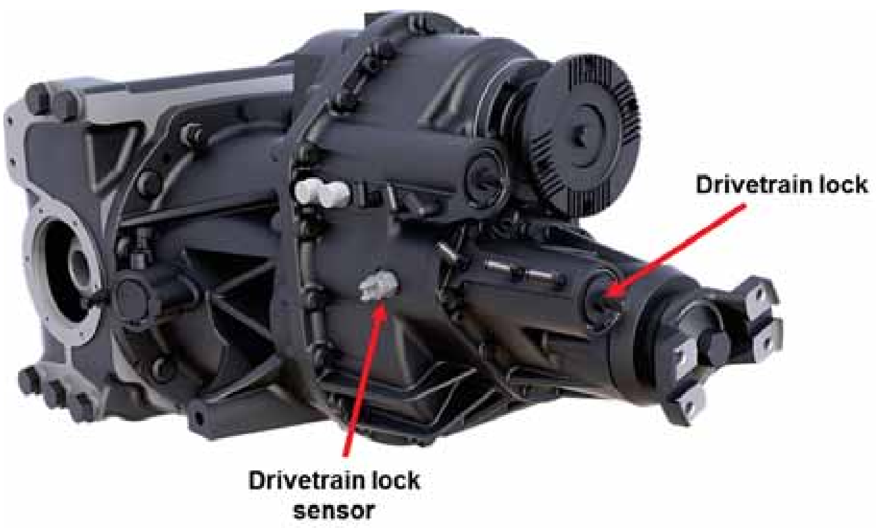


Figure 6.6 Drivetrain lock and sensor

3) Drivetrain Lock (Figure 6.6)

(a) Solidly locked front-to-rear - The drivetrain can be locked solidly from front-to-rear thus applying equal power to both differentials. It is interchangeably referred to as the longitudinal drivetrain lock, interaxle lock, or lock level one. It is important to note that engaging this lock will not allow differences in rotational speed between the front and rear differentials.

(b) The transaxle drivetrain lock chamber is integrated into the transaxle front housing and has a drivetrain lock sensor on the right side of the chamber. The drivetrain lock sensor determines whether the lock engages or disengages.

(c) The drivetrain lock is air actuated but electronically controlled. The method of control is the same as for the range shift described previously.

(d) Once power exits the transaxle, there are several components required to continue the transfer of power to the hubs. They are propeller shafts, front and rear differentials and half shafts.

(Slide #15)

Figure 6.7 Propeller shaft

2. Propeller shafts - The propeller shafts are lightweight units constructed of carbon fiber composite with aluminum end caps (Figure 6.7).

   a) There are two shafts used on JLTVA1; one between transmission and transaxle and one between transaxle and front differential.

   b) The propeller shaft (sometimes referred to as a prop shaft) transmits rotational power from the transmission to the transaxle, and the transaxle to the front differential.

   c) When a drivetrain is unusually noisy or has excessive vibrations, inspect the propeller shafts for the following:

      1) Faulty universal joints

      2) Faulty yokes

      3) Damaged propeller shafts

(Slide #16)

3. Differentials

Figure 6.8 Differentials

   a) Differential Overview - The purpose of the differentials is to receive input power from the transfer case integrated within the transaxle and redirect it to turn the wheels. The differentials also allow the wheels on either side of the vehicle to turn at different speeds without binding. (Figure 6.8)

1) The front and rear differentials are responsible for taking the longitudinal rotation of the drivetrain and redirecting it 90° left and right to drive the wheels.

2) The front differential is constructed as an independent structural aluminum housing. The rear differential is incorporated into the transaxle.

3) Gear ratio in both differentials is 2.23:1

(Slide #17)

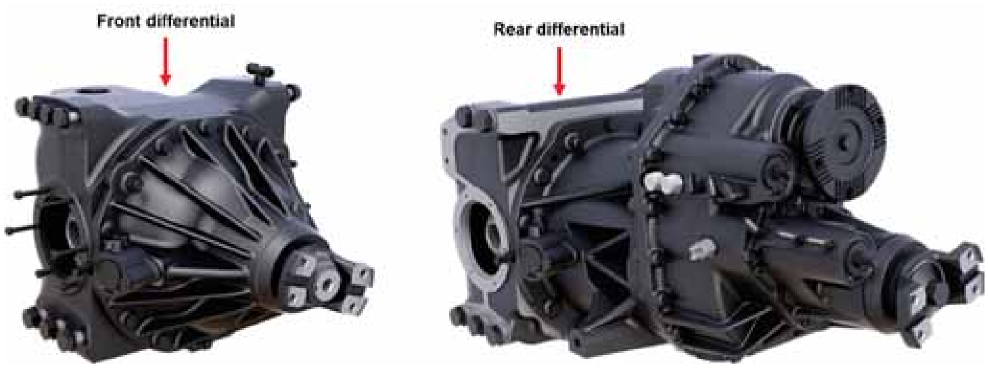


Figure 6.9 Front (left) and Rear (right) Differentials

b) Differential Components - Front and rear differentials (Figure 6.9)

1) Longitude power is input into the differential.

2) Power is diverted 90° using a ring gear and pinion.

3) The differential has a splined hub to drive the half shafts providing power to the wheel hubs.

(Slide #18)

Figure 6.10 Lock up chambers

4) Lock up chambers

(a) Referred to as either the front or rear side-to-side lock, intra-axle lock, or lock level two (for the rear differential) or three (for the front differential).

(b) They allow each differential to be solidly locked, sending power to both wheels.

(c) There are removable lockup chambers, externally mounted to the side of each differential housing. (Figure 6.10)

(d) The chamber for the front differential is on the left side of the differential housing.

(e) The chamber for the rear differential is on the right side of the differential housing.

(f) Both chambers are air actuated, but electronically controlled. The method of control is the same as the transaxle drivetrain lock described previously.

(g) It is important to note that engaging either of these locks will not allow differences in rotational speed between the left and right wheels.

(h) If a differential fails to engage, inspect the following:

(1) Air supply to lock up chambers

(2) Air supply to air control manifold

(3) Electrical input to air control manifold solenoids

(Slide #19)

Figure 6.11 Axle oil level sensors

5) Axle oil level sensors (Figure 6.11)

   (a) Each differential has an oil level sensor for monitoring differential oil levels and displaying them on the DSDU.

   (b) They are Wheatstone Bridge (Resistance Bridge) type optical sensors and are on the left side of each differential.

   (c) The sensor uses two series-parallel circuit arrangements with a common power and ground with a zero-voltage difference when both parallel branches balance.

      (1) It produces a voltage drop that can be read on the signal wire by the SCIM (I/O module) when the resistance between the two series, parallel circuits within the sensor are not balanced.

      (2) When the resistance becomes too high or low, the signal wire to the SCIM communicates this to the operator via the DSDU.

      (3) The front and rear oil level sensors are both wire sensors that share 5VDC power (wire 1599) and ground (wire 1598).

      (4) The third wire in the connector is the signal wire (front differential wire 1562, rear differential wire 1560).

(Slide #20)

Figure 6.12 Half Shaft

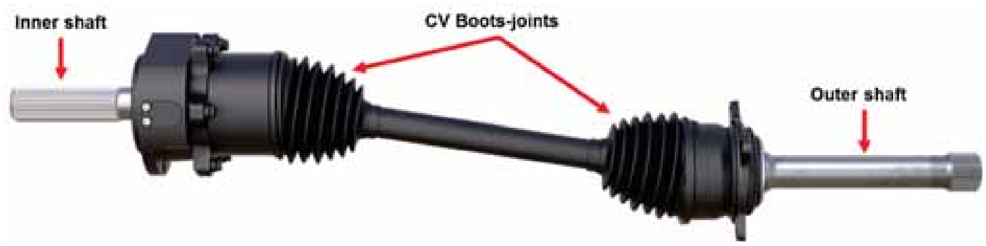


Figure 6.13 Outer Shaft

4. Half shaft (Figure 6.12)

   a) Half Shaft Overview - The half shafts send power from the differentials out to the hubs.

   b) The half shafts are assemblies that comprise of three components: an inner shaft, Constant Velocity (CV) joints and an outer shaft (Figure 6.13). There are four half shafts on each JLTVA1.

(Slide #21)

   c) Haft Shaft Components

      1) Inner shaft - The inner shaft is a stub shaft that splines into the differential connecting the differential to the half shaft. The inner shaft is bolted to the Constant Velocity (CV) joint which is bolted to the inner stub shaft flange.

      2) CV Joint - The CV (Constant Velocity) joints are also referred to as “CV Boots’”. Its purpose is to enable full wheel travel and suspension articulation. They avoid binding due to extreme joint angles per the design.

         (a) There are two per shaft - one on each end (an inner joint and an outer joint).

         (b) They are lubricated with grease and sealed by flexible rubber boots.

(c) It is important to inspect the boots for wear or damage, such as cuts or tears, and to not damage them during removal or installation of the half shaft.

3) Outer shaft - The outer shaft is a critical component of the half shaft as it connects the stub shaft to wheel end.

(a) Consists of inner and outer CV joints, main shaft and wheel end stub shaft.

(Slide #22)

Figure 6.14 Hub/Wheel End

5. Hub/Wheel End Assembly (Figure 6.14)

a) The half shafts drive the hubs, or wheel end housings, and provide an attachment point for the wheels. Each hub consists primarily of an aluminum housing and cover.

b) Two tapered roller wheel bearings support the hub on the spindle.

1) The inner wheel bearing is lubricated with grease and uses an inner grease seal.

2) The outer wheel bearing is oil lubricated using the wheel end oil.

3) The preload for both bearings is torque specific for the axle nut.

4) Failed or failing bearings can cause uneven tread wear on a single tire.

(Slide #23)

Figure 6.15 Hub

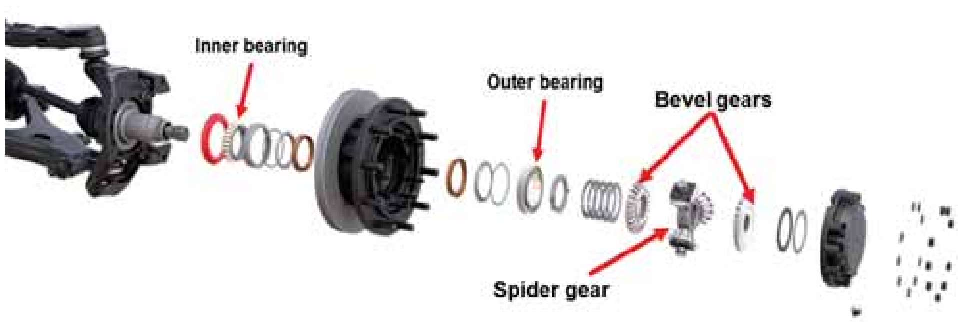


Figure 6.16 Bevel Gear Reduction

c) Each hub also contains a bevel gear reduction wheel end. This is an additional gear reduction drive in each hub. (Figure 6.15 and 16)

1) It uses inner and outer bevel gears with a spider gear assembly in between these two gears. The rotation of the outer bevel gear causes the three spider gears to rotate across the face of the stationary inner bevel gear.

2) Gears splined to spindle - Inner bevel gear splined to spindle. The outer bevel gear splined to half shaft which causes the three spider gears to rotate.

3) Power is transferred to the hub via the “Y” of the spider gear assembly.

4) The gear ratio of the wheel ends is 2.00:1.

5) Wheel end gear backlash is set by using a pack of shims positioned between the inner bevel gear and the axle nut.

(Slide #24)

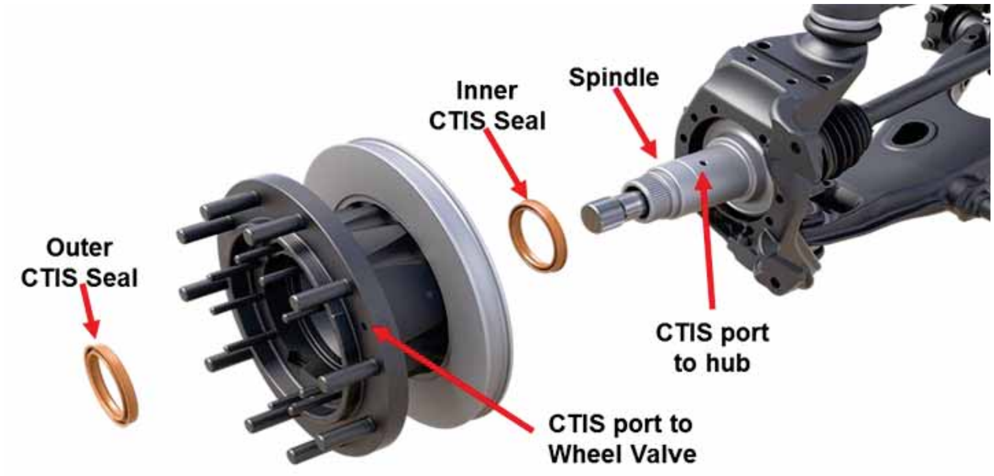


Figure 6.17 Central Tire Inflation System

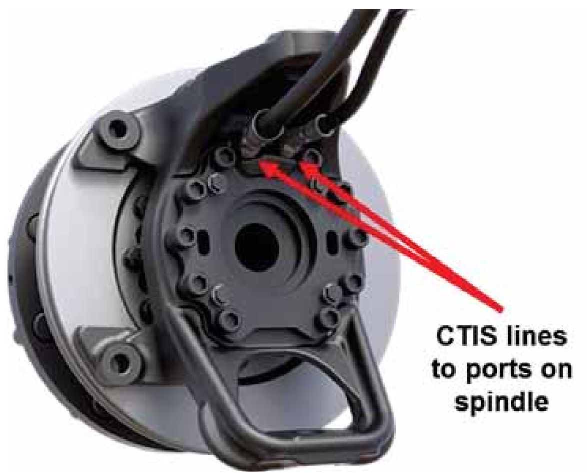


Figure 6.18 CTIS lines

d) Each hub also houses a pair of Central Tire Inflation System (CTIS) hub seals. (Figure 6.17 and 6.18)

   1) These seals allow compressed air to travel between the CTIS air passages in the spindle and out to the hub where it can then go into the tire.

   2) A specified spindle sleeve must be used when removing or installing the hub to prevent the machined portions of the spindle from damaging either the inner grease seal or the CTIS seals.

   3) It is important to exercise these seals regularly by adjusting tire pressure settings. This will help prevent flat spots on the seals from remaining in one position too long causing the seals to fail.

Check on Learning

(Slide #25)

Q: In your own words, describe the purpose of the lock-up chambers?
A: They are interchangeably referred to as either the front or rear side-to-side lock, intra-axle lock, or lock level two (for the rear differential) or three (for the front differential). They allow each differential to be solidly locked, sending power to both wheels.

Q: What is the purpose of a Constant Velocity (CV) Joint?
A: The CV (Constant Velocity) joints are also referred to as “CV Boots’” their purpose is to enable full wheel travel and suspension articulation. They are designed to avoid binding due to extreme joint angles.

Q: There are two air-actuated shift chambers on the transfer case section of the transaxle; which of the two chambers is the Range Shift Chamber?
A: The upper, or higher, of the two chambers is the Range Shift Chamber.

(Slide #26)

Q: How many volts power the axle oil level sensors on wire 1599?
A: 5 VDC

Q: What is the wheel end gear ratio and what does the ratio mean?
A: 2.00:1, it means for every two revolutions input into the wheel end, it is reduced to one revolution output. This means the input spins faster than the output.

Summary

(Slide #27)

Figure 6.11 JLTVA1 Drivetrain

The transaxle is a unitized housing that combines both the transfer case and the rear differential into a single unit. The transfer case portion is a two-speed unit with high and low ranges and an integrated drivetrain lock. It uses sensors to confirm engagement of these features. The rear differential portion incorporates a side-to-side lock as well as an oil level sensor.

The two propeller shafts transfer power from the transmission to the transaxle and the transaxle to the front differential. The differentials each incorporate a side-to-side lock as well as an oil level sensor. The half shafts transfer power from the differentials to the hubs to turn the wheels. They each have two constant velocity (CV) joints that provide for wheel movement and articulation without binding. (Figure 6.11)

The hubs, or wheel end housings, are driven by the half shafts and provide an attachment point for the wheels. Each hub consists primarily of an aluminum housing and cover. Each hub also contains a bevel gear reduction wheel end which provides an additional gear reduction in each hub. The hubs also house CTIS air seals to provide for the transfer of air from the chassis out to the tires.

Transition Are there any questions about the components or functionality of the JLTVA1 drivetrain before we segue into learning system maintenance requirements?

3. **(Slide #28)**

ELO A – LSA 3

Learning Step/Activity:	Use of Lift Kits
Method of Instruction:	Practical Exercise
Instructor to student ratio:	1:5
Time of Instruction:	45 min
Media Type:	N/A

(Slide #29)

Special Tool Required for Lifting JLTVA1

a. When working underneath any part of the JLTVA1 (including inside wheel wells) you must use one of the two safety precautions, this activity uses the JLTVA1 Lift Kit.

b. Lifting the JLTVA1 (Figure 6.12)

Figure 6.19 JLTVA1 lift kit

1. The vehicle should be raised to FORDING position
2. Place the jacks under the support stands.
3. Raise the vehicle as high as necessary.
4. Caution: The front and/or rear left and right sides must be raised at the same time to prevent the vehicle from tipping.
5. Lower the JLTVA1 onto the support stands.

(Slide #30)

See Appendix C: PE 6A-1

4.

ELO A – LSA 4

Learning Step/Activity: Drivetrain Component Identification
Method of Instruction: Guided Practical Exercise
Instructor to student ratio: 1:5
Time of Instruction: 15 min
Media Type: N/A

See Appendix C: PE 6B – 1

Check on Learning

None

Summary

None

Transition

Are there any questions?

Now that you are familiar with the drivetrain components and their locations, we are going to drivetrain maintenance**.**

5.

(Slide #31)

ELO A – LSA 5

Learning Step/Activity: Drivetrain Maintenance
Method of Instruction: Lecture
Instructor to student ratio: 1:15
Time of instruction: 15 min
Media Type: PPT

(Slide #32)

a. Maintenance and Lubrication - For any drivetrain maintenance the suspension should be lowered onto the suspension lockout braces included within the JLTVA1 BII Kit. Always follow the technical manual and complete all vehicle preconditions prior to starting a task. Periodic maintenance of propeller shafts IAW the manual, requires removal of the belly armor.

(Slide #33)

Figure 6.20 Drain Plug (left) Fill Plug (right)

1. Differential and Transaxle – Maintenance and Lubrication

    a) Maintenance – Follow the maintenance schedule for timing of when to drain and fill the differentials and Transaxle. There is an indicator on the DSDU that will notify the Operator when the lube level is low.

        1) The drain plug is a magnetic O-ring boss centrally located on the bottom of the differential on both the front and rear axle. (Figure 6.20)

        2) Visually check the drain plug for metal particles that indicate differential or transaxle damage.

        3) The use of O-ring boss plugs removes the need to use sealants. Ensure the O-ring is not damaged before reinstallation.

        4) The fill plug is on the right side about halfway up the differential housing. (Figure 6.20)

        5) The differential and transaxle properly fill when oil is level with the bottom of the fill plug port.

        6) Maintenance procedures for differentials is the same for front and rear.

    b) Lubrication

        1) Lubrication for the front differential and rear transaxle assembly is specified as 80W-90 gear oil.

        2) The capacity of the front differential is 8.8 quarts.

        3) As stated previously, the rear differential shares its oil with the transfer case within the transaxle assembly.

        4) The capacity for the rear differential (Transaxle assembly) is 11.5 quarts.

(Slide #34)

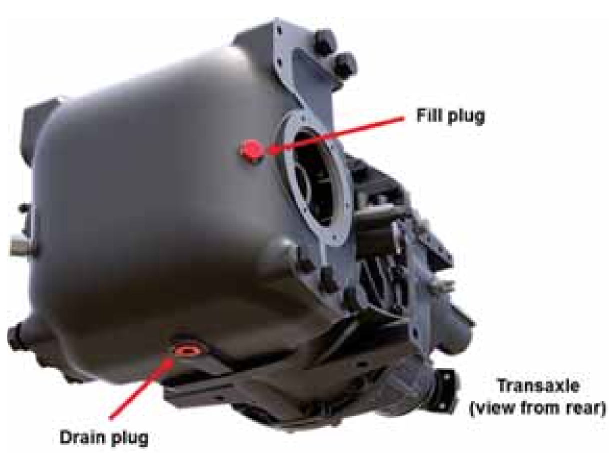


Figure 6.21 Transaxle Assembly

2. Transaxle Maintenance

   a) As stated previously, the rear differential is integrated into transaxle; therefore, oil is shared with the transfer case within the transaxle assembly. (Figure 6.21)

   b) Single drain plug on bottom of the rear differential section drains the entire transaxle.

   c) The fill plug is on the right side which can be accessed via the wheel well.

(Slide #35)

Figure 6.22 Drain Plug

3. Front Differential Maintenance (Figure 6.22)

   a) Remove a single drain plug on the bottom of the differential housing to drain the front differential lubricating oil.

   b) The fill plug is on the left side and is accessible via the wheel well.

(Slide #36)

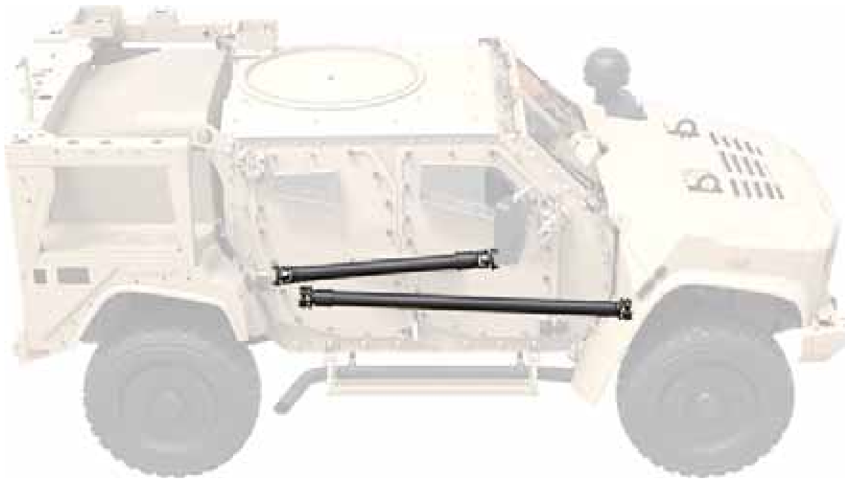


Figure 6.23 Lubrication Points

Figure 6.24 Upper Prop Shaft Grease

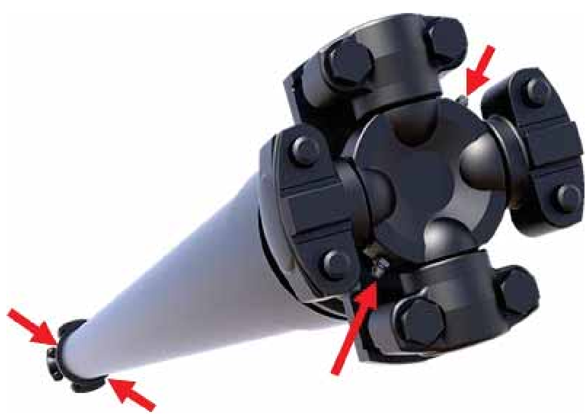


Figure 6.25 Lower Prop Shaft Grease Location

3. Half Shaft Maintenance and Lubrication

   a) Shaft Maintenance – Inspect CV boots for wear or damage, such as cuts or tears, or damage caused during removal or installation of the half shaft.

b) Lubricate prop shafts during periodic maintenance.

1) Lubrication Points - There are multiple locations on the prop shafts requiring grease to function properly (Figure 6.23-6.25).

2) The grease fittings are on the propeller shaft U-joints. The U-Joint locations dictate the locations of the grease fittings. Standard fittings are used to maintain a level of familiarity for the maintainer.

3) Wipe off the fitting prior to greasing. This avoids contamination from dirt.

(Slide #37)

4. Wheel End Maintenance

Figure 6.26 Wheel End Plug

Figure 6.27 Bottom position (left) Upward position (right)

a) Wheel End Drain and Fill - There are no covers or guards in place that require removal to access the wheel end plug. (Figure 6.26)

1) The fill and drain plug are on the outboard end of the wheel drive for ease of access for draining and filling.

2) To drain the wheel end, the wheel must be rotated, so the plug is at the bottom position. (Figure 6.26)

3) To check and fill the wheel, the wheel must be rotated upward to the check and fill positions. (Figure 6.27)

4) When servicing the wheel end hub, refill with 6.8 oz of fluid; when replacing the component, refill with 8.5 oz of fluid.

Check on Learning

(Slide #38)

Q: Why is it important to wipe of grease fittings prior to greasing?
A: To avoid contamination.

Q: What type of oil is used in the transaxle and differential, and why are the capacities different?
A: 80W-90 Gear Oil, they are different because the rear differential is integrated into transaxle; therefore, oil is shared with the transfer case within the transaxle assembly. The front differential is a standalone assembly.

Q: Why is it important to check the magnetic drain plug for metal particles?
A: It’s a good indication of damage internally to the differential of transaxle gears.

Summary

(Slide #39)

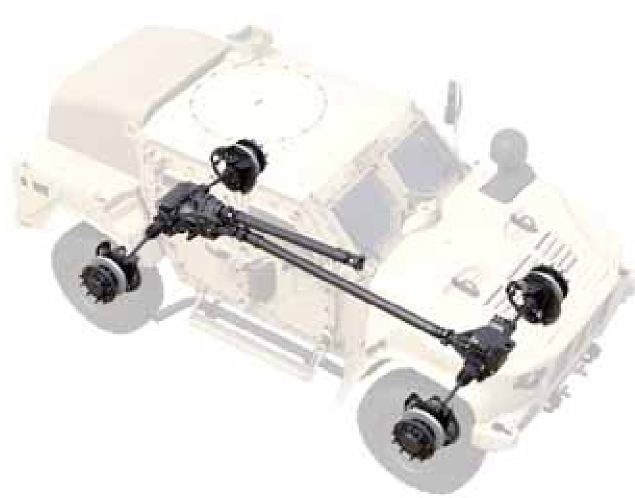


Figure 6.28 CTIS

The hubs, or wheel end housings, are driven by the half shafts and provide an attachment point for the wheels. Each hub consists primarily of an aluminum housing and cover. Each hub also contains a bevel gear reduction wheel end which provides an additional gear reduction in each hub. The hubs also house CTIS air seals to provide for the transfer of air from the chassis out to the tires. (Figure 6.28)

Transition

Are there any questions?

Now that you are familiar with the drivetrain maintenance requirements, we are going to inspect the wheel end**.**

6.

(Slide #40)

ELO A – LSA 6

Learning Step/Activity:	Wheel End Inspection
Method of Instruction:	Practical Exercise
Instructor to student ratio:	1:5
Time of instruction:	1 hour
Media Type:	N/A

(Slide #41)

See Appendix C: PE 6C - 1

Check on Learning

None

Summary

None

Transition

Are there any questions?

The next learning step is to go hands on and troubleshoot.

Enabling Learning Objective B.

(Slide #42)

Upon completion of this lesson, you will be able to:
Troubleshoot an induced fault of the drivetrain, electric system or components. We are going to start in the classroom and learn about typical maintenance and troubleshooting the drivetrain. Then of course we'll go to the truck for hands-on training.

Action:	Troubleshoot the drivetrain system
Conditions:	Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials
Standards:	Without injury or death to personnel and reaching the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activities.

1.

(Slide #43)

ELO B – LSA 1

Learning Step/Activity:	Diagnostics and Troubleshooting
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	10 mins
Media Type:	PPT

(Slide #44)

a. Diagnostics and Troubleshooting

   1. High/low range and drivetrain lock sensors

a) Sensors are essentially component activated momentary switches

1) Sensors should have continuity with range or lock disengaged

2) Sensors should read open with range or lock engaged

Instructor Note
Use the IETM and display the Schematic to the class to verbalize tracing the schematics of sheet 8 and sheet 9 to identify the lock sensors and their path when in neutral and when open.

2. Drivetrain Schematics

a) From the Diagram folder inside the IETM, use sheet 8 and 9 of the electrical schematics to view that lock sensors are three wire sensors which have 5 VDC power, common ground, and a signal wire.

b) In this schematic, the switch is drawn in its neutral state. The switch will open signaling the SCIM a lock has been applied. All the range and lock sensors function the same way.

3. Low differential oil indication

a) Only visible when checking fluid levels in DSDU

4. Tips

a) Use caution when installing the hub to prevent damage to the CTIS seals.

b) The propeller shafts have aluminum end caps on them. Release the parking brake prior to removal or installation of the shafts

(Slide #45)

5. Inspect Components/Systems as preventative measure with the corresponding issue or symptoms:

a) Propeller shafts

1) Bends

2) Cracks

3) Grooves

b) CV Joints

1) Looseness

2) Lateral play

3) Rubber boots in place and free of damage

c) Transaxle and front differential

1) Fluid leaks

2) Contamination

3) Gear noise

4) Missing or loose hardware

d) Half shafts

1) Looseness or binding in the CV joints

2) Cut or torn CV joints

3) Missing or broken mounting hardware

(Slide #46)

Instructor Note
Use the scenario below as an exercise to help advance the students thought process from components and symptoms toward holistic system functionality and thinking at a higher level. The goal is to prompt problem-solving thought process prior to the hands-on activity. Present the scenario and prompt students to verbalize the symptoms/indicators, potential probable cause of the symptoms or system failure as well as potential resolutions.

b. Scenario

1. The operator of a JLTVA1 brings a GP in to be looked at with a complaint of excessive noise and vibration within the truck at higher speeds. The operator states the truck was working great all day while off roading through all sorts of boulders and rocky terrain, but when the GP was brought back onto the hard ball at higher speeds, the operator noticed it was unusually noisy and had excessive vibrations. What would you troubleshoot first on this truck based on this complaint?

2. **Solution** – When a driveline is unusually noisy or has excessive vibrations at higher speeds, a few things should be inspected during troubleshooting. Some of these items include propeller shafts, half shafts, yokes, universal joints, and wheel hubs. Typically damage on these components are more apparent at higher speeds due to the increase of rotational force. When these components become unbalanced from damage, it will send the noise and vibrations throughout the chassis at higher speeds and decrease noise and vibrations at lower speeds.

Check on Learning

(Slide #47)

Q: The front differential will not engage. What are some possible causes for this?
A: A faulty air supply to the actuator, a failed front differential lock or differential, failed rear air control manifold, failed solenoid on the rear air control manifold.

Q: When testing the low range sensor with low range engaged, what is the expected multimeter reading and why?
A: OL (out of limits) or open circuit, the sensor is a switch that opens with no air pressure. When low range is selected, air is applied to the low side chamber of the actuator opening the switch.

Summary

(Slide #48)

In this section, we've covered:

- High/low range and drivetrain lock sensors
- Low differential oil indication
- Tips
- Inspection and testing

Transition

What questions do you have at this point?
At this time, we will complete the next Practical Exercise.

2.

(Slide #49)

ELO B – LSA 2

Learning Step/Activity:	Open Circuit on Rear Axle Differential
Method of Instruction:	Practical Exercise
Instructor to student ratio:	1:5
Time of instruction:	30 min
Media Type:	None

(Slide #50)

See Appendix C: PE 6D-1

3.

ELO B – LSA 3

Learning Step/Activity:	Troubleshoot Inter Axle Differential
Method of Instruction:	Practical Exercise
Instructor to student ratio:	1:5
Time of instruction:	15 min
Media Type:	None

See Appendix C: PE 6E-1

Check on Learning

None

Summary

None

Transition Any questions? Everybody get their go/no go worksheet signed?

Let’s head back into class and finish this module with a comprehensive review.

SECTION IV. **SUMMARY**

Method of Instruction:	Lecture
Instructor to student ratio	1:15
Time of Instruction:	5 mins
Instructional Strategy	Lecture and Q&A

Check on Learning

(Slide #51-52)

Q: When draining the oil from front differential, large chunks of metal are found on the drain plug, what could this be an indicator of?
A: Oftentimes, this is an indicator of gear failure within the differential ring gear and pinion gear and would warrant further inspection of the differential.

Q: What is the purpose of a propeller shaft and what would be a sign of a damaged propeller shaft?
A: A propeller shaft (sometimes referred to as a drive shaft) transmits rotational power from the transmission to the transaxle and the transaxle to the front differential. Symptoms of a damaged propeller shaft would be excessive noise and vibrations at higher speeds throughout the drivetrain.

Q: On the Transaxle, there is a Range Shift Chamber and a Drivetrain Lock Chamber. How are the two chambers different?
A: The Range shift chamber changes the output speed of the transfer case located internal to the transaxle to high and low ranges. The Drivetrain lock chamber when engaged provides a 50/50 torque split between the front and rear axles.

Q: What should be checked if the center LED on the high/low MUX panel is illuminated?
A: Check the position of R1, T2, and T3 solenoids for towing mode engagement.

Summary

(Slide #53)

We've learned the drivetrain of the JLTVA1 is unique and comprised of several systems/components including transaxles, front and rear differentials, wheel end assemblies.

- The purpose of the differentials is to transfer power from the drivetrain out to the hubs. The differentials also allow the wheels on either side of the vehicle to turn at different speeds without binding.
- The two propeller shafts transfer power from the transmission to the transaxle and the transaxle transfers power to the front differential.
- The transaxle is a unitized housing that combines both the transfer case and the rear differential into a single unit. The transfer case portion is a two-speed unit with high and low ranges and an integrated drivetrain lock. It uses sensors to confirm engagement of these features.

We practiced troubleshooting skills when we did practical exercises on the differentials. The critical lesson is to remember that the momentary switches that SHOULD have continuity when the respective range or lockup is NOT engaged and should NOT have continuity (open) when the range or lockup is ENGAGED.

Appendix A

06_JLTVA1_ARMY_ MAIN_Drivetrain_PPT_V3.0.pptx

Appendix C
JLTVA1 Practical Exercise Sheet No. 6A
Use of JLTVA1 Lift Kit

Title	Use of JLTVA1 Lift Kit
Lesson Number/ Title	06 Drivetrain
Introduction	We will now learn how to use the JLTVA1 Lift Kit, a special tool made for lifting and suspending the JLTVA1 enabling maintainers to safely service the truck.
Motivator	Properly using the lifting kit is critical to safety of personnel and for preventing damage to the vehicle.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Enabling Learning Objective A	Action: Correlate the JLTVA1's drivetrain system/subsystem and components with their location, purpose, function and maintenance requirements Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity.
Risk Assessment Level	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	This Practical Exercise will allow students to explore the drivetrain of the JLTVA1.
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils
Special Instructions	Instructor Note: Associate Instructors will need to prepare the work environment by getting the lifting kits ready for the guided PE. Below are the instructions for how to prepare for the practical exercise.

Preparation	Instructor Notes
TM Reference:	
Time Required for Prep:	15 minutes to get the lift kits set up for demo
Symptom/Purpose:	N/A
Prepare Area for PE:	Students to have PPE
Configure Vehicle for PE:	Vehicle Prep: Belly armor removed (if B-Kit installed) Cowl armor removed (if B-Kit installed) JLTVA1 on Jack Stands or Suspension Lock-out Braces Installed Splash Guards removed Drop Battery Tray
This is a guided practical exercise.	1. The first part of the PE is a demo/instruction to the lift kit and components. 2. After the first truck is properly secured on the lifts, then the students can break into groups to raise the other JLTVA1s. 3. Instructors will monitor the exercise and ensure students are properly adhering to safety guidelines while working on the vehicle. Instructors will assist students with the tasks they are trying to do and provide immediate feedback, guidance or direction real time.

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises.

d. Inform students they will have approximately **45 minutes** to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. Demonstration:

DEMONSTRATION: Use of Lifting Equipment
The purpose of this demonstration is to train students on the special equipment required to complete suspension maintenance.

LOCATION: The demonstration is to occur in the shop. Instructor/student ratio is 1:6.

STUDENT ROLE: Observe the demonstration. All students should position themselves for a clear view of the components. Ask appropriate questions as they arise with respect to the topic.

INSTRUCTOR ROLES:

1. Associate Instructor to prepare demonstration equipment for the lead instructor. Prep time is 15 minutes.

2. Bring the students out and show students the equipment while providing an explanation, or demonstration, of how each component works and where on the truck to attach the component.

a. **Safety Brief:** Primary Instructor will brief the students on safety procedures regarding pressurized systems. All students will be checked for proper equipment i.e. closed toe shoes, safety glasses, gloves and ear protection (if applicable).

b. **Equipment Needed for Training:**

1. Bay Space to allow space for all special tools needed to raise the vehicle.

2. Air Jack Stand (4)

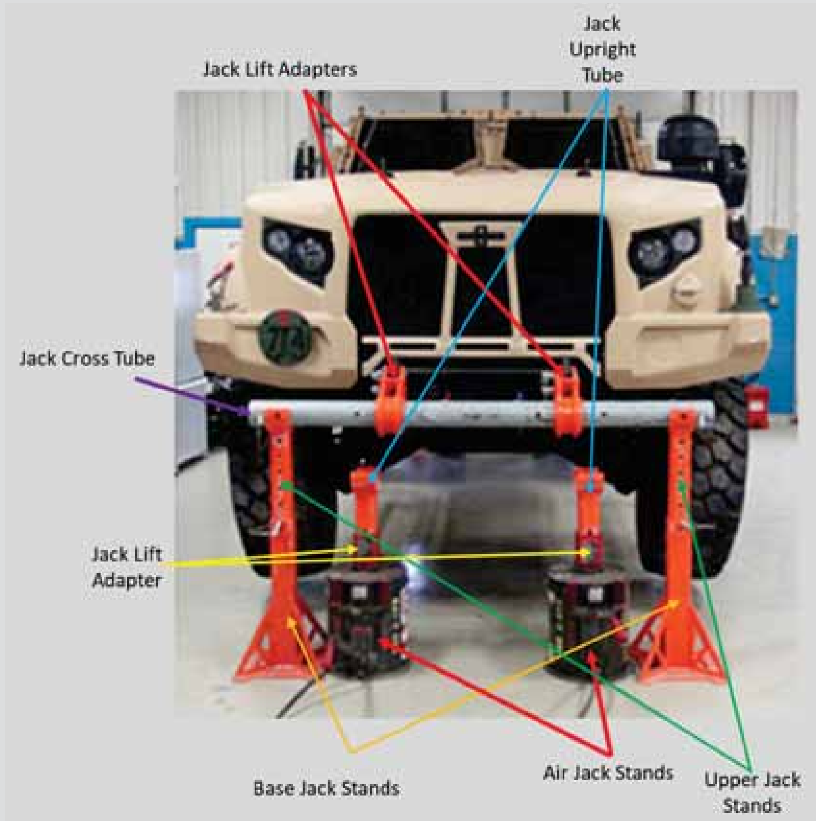
   - Jack Lift Adapter (4)

3. Jack Service Cart

   - Jack Tube Pin Assembly (16)
   - Clevis Pin (4)
   - Quick Release Pin (4)
   - Base Jack Stand (4)
   - Upper Jack Stand (4)
   - Jack Cross Tube (2)
   - Jack Upright Tube (4)

c. **Supervision and Guidance**: Have the students follow along with the demonstration and ask questions as they come up.

d. **Conduct Demonstration**: The instructor should provide the following information to the students:



1. Install two jack lift adapters on crossmember with four clevis pins and quick release pins.

2. With the aid of an assistant and a lifting device, insert jack cross tube through two jack lift adapters.

3. Center jack cross tube on two jack lift adapters.

4. Install two jack tube pins on jack cross tube with two locking pins.

5. Install two jack upright tubes on air jack stands with jack tube pins and locking pins.

6. Position two jack upright tubes and air jack stands under jack cross tube.

7. Install two jack upright tubes on jack cross tube with two jack tube pins and locking pins.

8. With the aid of an assistant, evenly raise two air jack stands to maximum height.

9. Install two upper jack stands on base jack stands with jack tube pins and locking pins

10. Position two upper jack stands, and base jack stands under jack cross tube, inboard of two outside holes.

11. With the aid of an assistant, evenly lower two air jack stands until jack cross tube rests on two upper jack stands and base jack stands.

12. Remove two locking pins and jack tube pins from jack cross tube and two jack upright tubes.

13. Completely lower two air jack stands.

14. Remove two locking pins, jack tube pins, and jack upright tubes from air jack stands

15. Install two adapters and jack upright tubes on air jack stands) with jack tube pins and locking pins.

16. With the aid of an assistant, evenly raise two air jack stands until jack cross tube is clear of two upper jack stands.

17. Set two upper jack stands on base jack stands to desired height with jack tube pins and locking pins.

    Instructor Note: Usually only need five holes showing and go into the sixth hole on the upper jack stands.

18. Position two upper jack stands, and base jack stands under jack cross tube.

19. With the aid of an assistant, evenly lower two air jack stands until jack cross tube rests on two upper jack stands and base jack stands.

20. Install two jack tube pins and locking pins on jack cross tube.

21. Completely lower two air jack stands.

22. Remove two locking pins, jack tube pins, jack upright tubes), and adapters from air jack stands, and properly store all components.

    Q: Are there any questions on how to properly lift the JLTVA1?

g. Students will be broken up into groups of no more than five.

h. Ask if there are any questions.

i. Students may begin.

j. Mark Go/No Go Sheets accordingly.

   1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

	2. Once the Practical Exercise is complete, the Lead Instructor must sign each student's Solution Sheet.
Feedback Requirements	Provide feedback to students to ensure comprehension.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 6A-1
Use of Lift Kit

Name____

Date____

Training Location____

Use of Lift Kit	**Go**	**NO GO**	**Initials**
Install two jack lift adapters on crossmember with four clevis pins and quick release pins.			
With the aid of an assistant and a lifting device, insert jack cross tube through two jack lift adapters.			
Center jack cross tube on two jack lift adapters.			
Install two jack tube pins on jack cross tube with two locking pins.			
Install two jack upright tubes on air jack stands with jack tube pins and locking pins.			
Position two jack upright tubes and air jack stands under jack cross tube.			
Install two jack upright tubes on jack cross tube with two jack tube pins and locking pins.			
With the aid of an assistant, evenly raise two air jack stands to maximum height.			
Install two upper jack stands on base jack stands with jack tube pins and locking pins			
Position two upper jack stands, and base jack stands under jack cross tube, inboard of two outside holes.			
With the aid of an assistant, evenly lower two air jack stands until jack cross tube rests on two upper jack stands and base jack stands.			
Remove two locking pins and jack tube pins from jack cross tube and two jack upright tubes.			
Completely lower two air jack stands.			
Remove two locking pins, jack tube pins, and jack upright tubes from air jack stands			

Install two adapters and jack upright tubes on air jack stands) with jack tube pins and locking pins.			
With the aid of an assistant, evenly raise two air jack stands until jack cross tube is clear of two upper jack stands.			
Set two upper jack stands on base jack stands to desired height with jack tube pins and locking pins.			
Note: Usually only need five holes showing and go into the sixth hole on the upper jack stands.			
Position two upper jack stands, and base jack stands under jack cross tube.			
With the aid of an assistant, evenly lower two air jack stands until jack cross tube rests on two upper jack stands and base jack stands.			
Install two jack tube pins and locking pins on jack cross tube.			
Completely lower two air jack stands.			
Remove two locking pins, jack tube pins, (jack upright tubes), and adapters from air jack stands, and properly store all components.			

Instructor Signature ____

Appendix C
JLTVA1 Practical Exercise Sheet No. 6B
Drivetrain Component ID

Title	Drivetrain Component ID
Lesson Number/ Title	06 Drivetrain
Introduction	We will now perform a P.E. on the JLTVA1 drivetrain.
Motivator	Proper component identification is a prerequisite to providing maintenance to the JLTVA1.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Enabling Learning Objective A	Action: Correlate the JLTVA1's drivetrain system/subsystem and components with their location, purpose, function and maintenance requirements Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity.
Risk Assessment Level	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	This Practical Exercise will allow students to explore the drivetrain of the JLTVA1.
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils
Special Instructions	Instructor Note: Instructor will need to prep the vehicle for the troubleshooting task. Instructors will monitor the exercise and ensure students are properly adhering to safety guidelines while working on the vehicle. Instructors will assist students on finding work packages associated with the tasks they are trying to do. Provide feedback to students to ensure comprehension.

Below are the instructions for how to prepare for the practical exercise.

Preparation	Instructor Notes
TM Reference:	N/A
Time Required for Prep:	N/A if Vehicle Prepped
Symptom/Purpose:	N/A
Prepare Area for PE:	N/A
Configure Vehicle for PE:	Vehicle Prep: Belly armor removed (if B-Kit installed) Cowl armor removed (if B-Kit installed) JLVT on Jack Stands or Suspension Lock-out Braces Installed Splash Guards removed Drop Battery Tray

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises.

d. Inform students they will have approximately 15 minutes to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five.

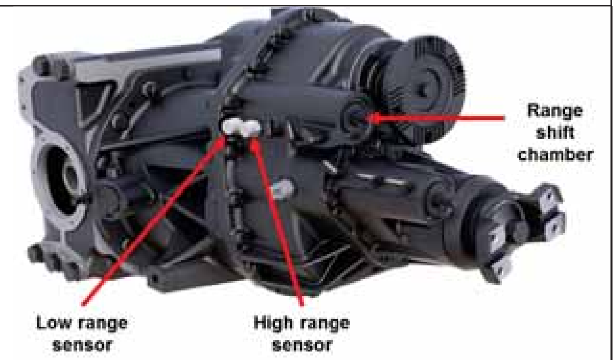
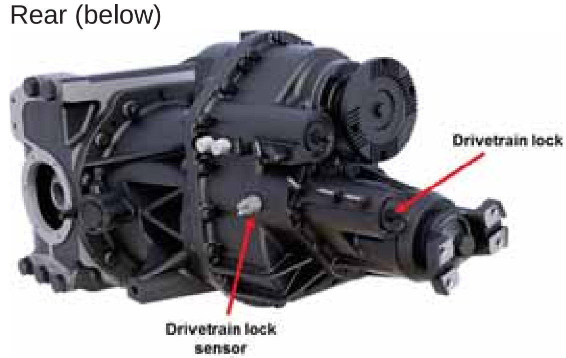
h. Ask if there are any questions.

i. Students may begin.

j. Mark Go/No Go Sheets accordingly.

1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

2. Once the Practical Exercise is complete, the Lead Instructor must sign each student's Solution Sheet.

Component:	Location/Function:
Transaxle	Rear of truck; connects propeller shafts to half shaft
Front Differential	Front center of truck under engine
Air solenoid bank	Right Rear of truck (by tow solenoids)
Range shift chamber Drivetrain lock chamber High and low range sensors	
Front intra-axle lock chambers And Rear intra-axle lock chambers	Front differential intra-axle lock chamber: Incorporated into the front differential (similar in location to rear transaxle location). Rear (below) 
Front and rear differential oil level sensors	Located in the transaxle and differential

k. When everyone is finished collect solution sheet.

Feedback Requirements

Provide feedback to ensure student learning.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 6B-1
Drivetrain Component ID

Name____

Date____

Training Location____

Drivetrain Component ID	**Go**	**NO GO**	**Initials**
Located the transaxle			
Located the air solenoid bank			
Located the range shift chamber			
Located the drivetrain lock chamber			
Located the high and low range sensors			
Located the Front differential			
Located the front and rear intra-axle locks			
Located the front and rear differential oil level sensors			
Identified CV Shaft Components			
Inspected CV Boot			
Identified Wheel/Hub Components			

Instructor Signature____

Appendix C
JLTVA1 Practical Exercise Sheet No. 6C
Wheel End Inspection

Title	Wheel End Inspection
Lesson Number/ Title	06 Drivetrain
Introduction	We will now perform a P.E. on the JLTVA1 drivetrain.
Motivator	Wheel end inspections are part of the vehicle's annual service.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Enabling Learning Objective A	Action: Correlate the JLTVA1's drivetrain system/subsystem and components with their location, purpose, function and maintenance requirements Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity.
Risk Assessment Level	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	This Practical Exercise will allow students to inspect and adjust a wheel end on a JLTVA1
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils
Special Instructions	Below are the instructions for how to prepare for the practical exercise.

Preparation	Instructor Notes
TM Reference:	**Preventative Maintenance Checks and Services>** PMSCS> Item 23 6000/Annual >Number 1 for Front Or ➢ Number 2 for Rear
Time Required to Induce Fault:	N/A
Symptom/Purpose:	6000/Annual Service
Prepare Area for PE:	
Configure Vehicle for PE:	• Number of students in class will determine how many wheel ends need to be inspected per a 5 student: 1 instructor ration. • JLTVA1s should be **in specification**, so there should be no need to remove the calipers. • If the calipers are removed, the service and park brake bleed procedure will need to be completed. Vehicle Prep: • Belly armor removed (if B-Kit installed) • Cowl armor removed (if B-Kit installed) • JLVT on Jack Stands or Suspension Lock-out Braces Installed • Splash Guards removed • Drop Battery Tray

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises.

d. Inform students they will have approximately 60 minutes to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five.

h. Ask if there are any questions.

i. Students may begin. Below are key steps the instructor may use to assist with the Go/No Go rubric.

Step	Instructor Notes
IETM Work Package:	**Preventative Maintenance Checks and Services>** PMSCS> Item 23 6000/Annual >Number 1 for Front Or >Number 2 for Rear
Remove Wheel & Tire	Must remove front right wheel assembly as prep for the next lesson's PE
Remove Brake Pads	
Identify Piston Bracket & Ensure it stays in place during pad removal	
Install and Zero Dial Indicator	
Take Accurate Reading from Dial Indicator	
Remove Dial Indicator	
Install Brake Pads	
	Wheel stays off as prep for next lesson PE.

j. Mark Go/No Go Sheets accordingly.

1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

2. Once the Practical Exercise is complete, the Lead Instructor must sign each student's Solution Sheet.

k. When everyone is finished collect solution sheet.

Feedback Requirements

Provide immediate feedback and coaching to assist students through the exercise.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 6C-1
Wheel End Inspection

Name____

Date____

Training Location____

Wheel End Inspection	**Go**	**NO GO**	**Initials**
Locate Correct Work Package for wheel End Inspection			
Remove Wheel & Tire			
Remove Brake Pads			
Identify Piston Bracket & Ensure it stays in place during pad removal			
Install and Zero Dial Indicator			
Take Accurate Reading from Dial Indicator			
Remove Dial Indicator			
Install Brake Pads			

Instructor Signature____

Appendix C
JLTVA1 Practical Exercise Sheet No. 6D
Open Circuit on Rear Axle Diff

Title	Open Circuit on Rear Axle Diff (FIK WP 6-1 Rear Differential Will Not Engage)
Lesson Number/ Title	06 Drivetrain
Introduction	We will now perform a P.E. on the JLTVA1 applicable to the CTIS.
Motivator	As a maintainer, it is important you know how to troubleshoot drivetrain failures and resolve electrical or mechanical malfunctions.
Enabling Learning Objective B	**NOTE:** The instructor should inform the students of the following Terminal Learning Objective covered by this practical exercise. At the completion of this lesson, you [the student] will: Action: Troubleshoot the drivetrain system Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity
Safety Requirements	It is the responsibility of the Soldier to follow all U.S. Army safety guidelines as well as local unit SOPs.
Risk Assessment	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	Let’s explore the electrical system on the JLTVA1
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide JLTVA1 FIK PE Instruction Job Aid **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils

Special Instructions	Instructor Note: Instructor will need to prep the vehicle for the troubleshooting task by inserting **FIK: WP 6-1 Rear Differential Will Not Engage** using the FIK PE Instructions Job Aid, “JLTVA1 FIK Validated Faults_IG” Assistant Trainers: If possible, it would be acceptable to have an assistant instructor install the fault while the primary instructor is training. Facilitation Tip: Simulate the exercises as appropriate; means using the Interactive Engaging Technical Manual (IETM), following the task, discussing, and completing each step until task is complete. Students will not remove the installed components.
Procedures	a. Instructor distributes the Practical Exercise worksheet to the students. b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have. c. Inform students they will be using the vehicle and Interactive Engaging Technical manual (IETM) to complete the exercises. d. Inform students they will have **approximately 30 minutes** to complete the practical exercise. e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet. f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so. g. Students will be broken up into groups of no more than five. h. Ask if there are any questions. i. Students may begin. j. **Troubleshoot “Rear Differential Will Not Engage” FIK Kit induced fault.** k. Mark Go/No Go Sheets accordingly. 1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished. 2. Once the Practical Exercise is complete, the Lead Instructor must sign each student’s Solution Sheet.
Feedback Requirements	Provide feedback to ensure student learning.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 6D-1
Troubleshoot Open Circuit on Rear Axle Diff

Name____

Date____

Training Location____

Troubleshoot Open Circuit on Rear Axle Diff	**Go**	**NO GO**	**Initials**
Verified the Fault			
Located proper troubleshooting fault in the IETM			
Followed all warning cautions and notes			
Correctly followed troubleshooting track in TM			
Correctly repaired fault (per TM)			
Verified fault was corrected			

Instructor Signature____

Appendix C
JLTVA1 Practical Exercise Sheet No. 6E
Open Circuit on Inter Axle Diff

Title	Open Circuit on Inter Axle Diff (FIK WP 6-2 Code 107-05 Open Circuit on Inter Axle Diff)
Lesson Number/ Title	06 Drivetrain
Introduction	We will now perform a P.E. on the JLTVA1 applicable to the CTIS.
Motivator	As a maintainer it is important you know how to troubleshoot drivetrain failures and resolve electrical or mechanical malfunctions.
Enabling Learning Objective B	Action: Troubleshoot the JLTVA1's drivetrain Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity
Safety Requirements	It is the responsibility of the Soldier to follow all U.S. Army safety guidelines as well as local unit SOPs.
Risk Assessment	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	Let's explore the electrical system on the JLTVA1
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide JLTVA1 FIK PE Instructions Job Aid **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils
Special Instructions	Instructor Note: Instructor will need to prep the vehicle for the troubleshooting task by inserting **FIK: WP Code 107-05 Open Circuit on Inter Axle Diff** using the FIK PE Instructions Job Aid, "JLTVA1 FIK Validated Faults_IG" Assistant Trainers: If possible, it would be acceptable to have an assistant instructor install the fault while the primary instructor is training.

	Facilitation Tip: Simulate the exercises as appropriate; means using the Interactive Engaging Technical Manual (IETM), following the task, discussing, and completing each step until task is complete. Students will not remove the installed components.

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Interactive Engaging Technical manual (IETM) to complete the exercises.

d. Inform students they will have **approximately 30 minutes** to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five.

h. Ask if there are any questions.

i. Students may begin.

j. Mark Go/No Go Sheets accordingly.

   1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

   2. Once the Practical Exercise is complete, the Lead Instructor must sign each student’s Solution Sheet.

k. **Troubleshoot “Open Circuit on Inter Axle Diff” FIK Kit induced fault.**

l. When everyone is finished collect solution sheet.

Feedback Requirements

Provide feedback to ensure student learning.

Appendix C
JLTVA1 Practical Exercise Sheet No. 6E-1
Troubleshoot Open Circuit on Inter Axle Diff

Name____

Date____

Training Location____

Troubleshoot Open Circuit on Inter Axle Diff	**Go**	**NO GO**	**Initials**
Verified the Fault			
Located proper troubleshooting fault in the IETM			
Followed all warning cautions and notes			
Correctly followed troubleshooting track in TM			
Correctly repaired fault (per TM)			
Verified fault was corrected			

Instructor Signature____

US Army

SFAE-CSS-JC-JL
MS 640 BLDG 302 RM 113
6501 E 11 Mile Road
Warren, MI 48397-5000

INSTRUCTOR GUIDE

Joint Light Tactical Vehicle (JLTVA1) Maintainer Course

LESSON

07 Suspension, Hydraulics and Steering

SECTION I. ADMINISTRATIVE DATA

All Courses Including This Lesson

Course Number	Version	Course Title
JLTVA1_MAINT_01	3.0	Introduction and Safety
JLTVA1_MAINT_02	3.0	Vehicle Familiarization
JLTVA1_MAINT_03	3.0	Electrical
JLTVA1_MAINT_04	3.0	Engine
JLTVA1_MAINT_05	3.0	Transmission
JLTVA1_MAINT_06	3.0	Drivetrain
JLTVA1_MAINT_07	3.0	Suspension, Hydraulics and Steering
JLTVA1_MAINT_08	3.0	Air Systems, Brakes and CTIS
JLTVA1_MAINT_09	3.0	End of Course

Task(s) Taught (*) or Supported

Task Number	Task Title
IV.A.1	Research applicable vehicle and service information, vehicle service history, service precautions, and technical service bulletins.
IV.B.7	Inspect and test air suspension pressure regulator and height control valves, lines, hoses, dump valves, and fittings; adjust, repair or replace as needed.
IV.B.3	Inspect shock absorbers, bushings, brackets, and mounts; replace as needed.
IV.C.9	Inspect, remove and install front stabilizer bar (sway bar) bushings, brackets, and links.
VIII.F.7	Purge and/or bleed system in accordance with manufacturers' recommended procedures.
IV.B.9	Measure and adjust ride height; determine needed action.
IV.2.2	Determine recommended type of power steering fluid; check level and condition; determine needed action.
VIII.A.1	Identify system type (closed and open) and verify proper operation.
N/A	*Sensor Addressing: Readdress Ride Height IMU
A60000G_00_CQFAAAA	*DRAIN AND RECHARGE SPRINGS
A6000_00_HGFAAAA	*HPG NITROGEN SPRING, FR, REPLACEMENT

	*FR Half Shaft Remove/Replacement
A600N_00_CGFAAAC	*ROLL CTRL CIRCUIT HYD BLEED/CHARGE
A600N_00_CGFAAAB	*ROLL CTRL CIRCUIT HYDRLICS DISCHARGE
A600Q_00_CGFAAAB	*SHOCK INTEG ACCUM NITRO BLEED/CHARGE
A600Q_00_HGFAAAA	*SHOCK REPLACEMENT
A74100S_00_PQFAAAA	*RECHARGE SHOCKS WITH NITROGEN
A600N0C_00_AQFABAA	*INSPECT FR ACCUMULATOR PRESSURE
A600Q08_00_AQFABAA	*INSPECT REAR ACCUMULATOR PRESSURE
A600N0U_00_ANFABAA	*INSPECT FRONT SHOCK MEASUREMENT
A60020J_00_ANFABAA	*INSPECT SHOCK AND BEARINGS
AA0080S_00_NGFAACC	*Troubleshoot Suspension Does Not Operate: Code 14-55_HPG HYD CIRCT OUTPUT OOR HI
AA0080S_00_NGFAACH	*Troubleshoot Suspension Does Not Operate: 14-60_RL UP VALVE OUTPUT OOR HI
N/A	*HPG Pump Remove/Replacement

Reinforced Task(s)

NA

Academic Hours

The academic hours required to teach this lesson are as follows:

Academic	Resident Hours	Methods
5 hr		ILT
23 hr		PE
Total Hours:	28 hr	

Test Lesson Number

Hours	Lesson Number Version	Lesson Title
1 hr 30 min	Test A	09_End of Course and Final Exam
1 hr 30 min	Test B	09_End of Course and Final Exam

Prerequisite Lesson(s)

Hours	Lesson Number Version	Lesson Title
N/A	N/A	N/A

Clearance Access

Security Level: Distribution C
Requirements: Distribution authorized to U.S. Government agencies and their contractors only.

Foreign Disclosure Restrictions	FD7. This product/publication has been reviewed by the product developers in coordination with the Oshkosh Corporation foreign disclosure authority. This product is NOT releasable to students from foreign countries.

References

Number	Title	Date
2320-01-652-5218	JLTVA1 GP IETM	April 2018
2320-01-652-5250	JLTVA1 HGC IETM	April 2018
2320-01-653-5208	JLTVA1 UTL IETM	April 2018
2320-01-653-5246	JLTVA1 CCWC IETM	April 2018

Student Study Assignments

None

Instructor Requirements

JLTVA1 Certified Instructor (3)

Prepared to use IETM: JLTVA1 GP maintenance work packages in EMS-NG to conduct guided tours of IETM during classroom instruction; specifically, Suspension, Shock Removal and Replacement task, safety, and preconditions

Additional Support Personnel Requirements

Name	Student Ratio	Qty	Man Hours
N/A			

Equipment Required for Instruction

ID Name	Student Ratio	Instructor Ratio	Spt	Qty	Exp
Laptop	1:1	1:1	No	15	Yes
Projector	1:15	1:1	No	1	Yes
JLTVA1 with BII	1:5	1:1	No	3	Yes
MSD with EMS NG/IETM	1:5	1:1	No	1/JLTVA1	Yes
FIK Kit	1:5	1:1	No	3	Yes
Jack Service Cart Kit JLTVA1	1:5	1:1	No	2/JLTVA1	Yes
Nitrogen Service Kit	1:5	1:1	No	3	Yes
Electric Oil Service Kit	1:5	1:1	No	3	Yes

Materials Required

Instructor Materials:
Instructor Guide
FIK

Student Materials:
Student Guide

Classroom, Training Area, and Range Requirements

ID Name	Qty	Student Ratio	Setup Mins	Cleanup Mins
Classroom, 15 Student	1	1:15	30	30
Shop, 3 Bays	1	1:5	30	30

Ammunition Requirements

DODIC Name	Qty	Student Ratio	Setup Mins	Cleanup Mins
N/A				

Instructional Guidance / Conduct of Lesson

NOTE: Before presenting this lesson, instructors must thoroughly prepare by studying this Lesson and identified reference material

Proponent Lesson Plan Approvals

Name	Rank	Position	Date
N/A			

SECTION II. INTRODUCTION

Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of Instruction:	5 mins
Instructional Strategy	Lecture & Group Discussion

Motivator

The suspension system of the JLTVA1 is one of the most exciting and powerful innovations of this tactical vehicle, however, the intelligent and responsive capabilities are the result of a high-pressure gas system. As maintainers of the JLTVA1, there is an especially challenging responsibility when servicing the suspension systems; the most important aspect of maintaining this system is to focus on the task at hand and follow every step of the work package in the proper sequence. Failure to use the required safety measures and special tools has an increased likelihood of injury or death to personnel and/or damage to the vehicle.

Terminal Learning Objective 7.

NOTE: Inform the students of the following Terminal Learning Objective requirements.

Upon completion of this lesson, you will be able to:

Action:	Maintain the JLTVA1's suspension and hydraulic-dependent systems
Conditions:	Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials
Standards:	Without injury or death to personnel and reaching the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activities.

Safety Requirements

It is the responsibility of the student/warfighter to follow safety guidelines as well as local unit SOPs.

Risk Assessment Level

Low

Environmental Considerations

It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.

Evaluation

A Check on Learning will be conducted at the end of each lesson to help reinforce and monitor the proper transfer of knowledge to students

At the end of the course a written final exam will be administered of which each student/warfighter must earn 80% or greater to pass this course.

Throughout the lessons/modules practical exercises are conducted. Students will need to complete each exercise with 100% accuracy (to include remedial training if necessary) before the Performance Evaluation Checklist is signed, to ensure students can properly conduct maintenance procedures. PE's are graded using a "go/no go" criteria, of which all students/warfighters must earn all "go's" (100%).

Instructional Lead-In

(Slide #1)

As maintainers of the JLTVA1, you have an especially challenging responsibility when servicing the suspension systems of this vehicle.

However, because of the technology used in the TAK-4i suspension, the JLTVA1 has the capabilities to conduct various military operations by maneuvering over varied terrain ranging from mountainous to open desert, to urban. This next lesson will inform you of what can be serviced and how to provide maintenance to those parts/systems.

(Slide #2)

Today, we are going to learn about one of the most powerful and unique suspension technologies in the world today. We are going to watch a short clip featuring the JLTVA1 suspension.

Instructor Note

Play the video: *JLTVA1 Launch*" (3 minutes) to motivate interest to learn about this suspension.

Use Slide #3 to provide students with an overview of what to expect from this lesson with regards to content, and time spent in class versus time on the truck.

SECTION III. **PRESENTATION**

(Slide #3)

a. Lesson overview

1. Lesson length is 28 hours - Of that time there will be around 5 hours of classroom and 23 hours on the truck.

2. Course purpose

    a) Intro the TAK-4i suspension

    b) Components of suspension

    c) Maintenance & troubleshooting

    d) Hydraulics & steering

3. Course completion requirements

    a) Attend all lessons

    b) Complete practical exercises with 100% accuracy and pass the final exam with 80% or better.

Enabling Learning Objective A.

(Slide #4)

Upon completion of this lesson, you will be able to:

Action:	Correlate the JLTVA1's suspension system/subsystem and components with their location, purpose, function and maintenance requirements
Conditions:	Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials
Standards:	Without injury or death to personnel and reaching the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activities.

1.

(Slide #5)

ELO A – LSA 1

Learning Step/Activity:	Introduction to JLTVA1 Suspension
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	5 mins
Media Type:	PPT and Video

(Slide #6)

a. Safety/Cease Training (CT) Brief

1. Safety is the primary consideration when working with the JLTVA1. It is your obligation to observe all safety precautions and warnings and use the correct tools and safety equipment.

2. Risks specific to suspension: There are risks associated while working underneath the JLTVA1 due to the unique style suspension system.

   a) Crushing Risk: Suspension failure could cause the chassis to lower down into a decompressed position leaving as little as 5 inches of clearance under the vehicle and zero clearance in the wheel well.

   b) High-Pressure Gas Risks: Exposure to whip of ruptured lines and hoses and exposure to uncontrolled venting of high-pressure gas.

3. Practical exercises, demonstrations etc.

   a) A safety brief will be given before certain practical exercises and demonstrations (as needed).

4. Warnings, Cautions and Notes

   a) It is your responsibility to use the IETM to identify any warnings, cautions, and notes and especially the precondition of prepping the vehicle for each maintenance service.

(Slide #7)

b. Special tools (See Figure 7.1)

Figure 7.1 Special tools: Hydraulic charge cart (left) Suspension service kit (center) JLTVA1 jack service cart kit (right)

1. A list of special tools for the JLTVA1 is available in the IETM under its own link in the main menu. The IETM provides a full comprehensive list of all tools needed for each work package.

2. Special tools required for each task are listed at the top of every work package, preceding the procedure steps. There are three special tools **required** to conduct suspension maintenance tasks. There are no shortcuts or recommended substitutions due to the risk of injury to personnel or damage to property that will most likely result from any compromise.

   a) Hydraulic charge cart – Needed for field level shock maintenance such as charging, purging air and filling with oil.

   b) Suspension service kit– Field level maintenance kit which is required for hydraulic and nitrogen charging of suspension components.

   c) JLTVA1 jack service cart kit – This kit is used for any maintenance task that requires lifting of the vehicle. Absolutely required for servicing the brakes, suspension, control arms and wheel ends.

Instructor Note

The training approach is to:

1. Provide big picture understanding about the JLTVA1's suspension features and capabilities.

2. Then, explain the capabilities are possible due to three subsystems; and provide **a high-level introduction to the function** of each subsystem. Then, go into detail of each of the three subsystems:

   - HPG Springs will be trained completely from components, PEs and maintenance/troubleshooting because the high-pressure gas system is dedicated solely to the springs and not shared with the other two suspension subsystems.

   - Shock absorber and Roll Control Circuits are trained together as they are integrated systems which share components.

   - Hydraulics and steering are taught last.

(Slide #8)

c. TAK-4i Theory of Operation

Instructor Note

Play CGI video "Extreme Mobility" (3 minutes) which will demonstrate the agility and responsiveness of the TAK-4i suspension on the JLTVA1.

(Slide #9)

1. The off-road performance demonstrated in that video clip is possible due to the TAK-4i suspension assembly.

2. What makes the TAK-4i suspension different is the technology enables several systems and subsystems to work together.

a) The engine is customized to have increased power and endurance and it drives the transmission.

b) The transmission is customized to shift faster and smoother at higher speeds even over rough terrain. The engine and transmission coupling enable the JLTVA1 to go from stopped to 50 mph in less than 20 seconds.

c) The drivetrain is customized within a double-wishbone suspension design which enables all four-wheel assemblies to have fully independent suspension.

d) The TAK-4i suspension enables and supports independent articulation of all wheel ends and absorbs jounce as well as keeping the crew capsule level, enabling the operator and crew to maintain control and safely traverse rough terrain.

(Slide #10)

d. TAK-4i Capabilities

1. The suspension used in the JLTVA1 is an Oshkosh TAK-4i Suspension which is a high-pressure gas suspension

2. The system delivers vertical wheel travel of 20 in. and full steering angle.

3. The suspension is capable of 12 inches jounce and 8 inches rebound (at operational ride height).

4. All suspension and steering components are positioned high in the chassis for protection from debris and terrain obstacles.

5. The suspension system is designed to maximize traction, ride quality, and fuel efficiency

6. It will adjust nitrogen gas pressure in the suspension to correspond to the suspension system setting selected by the operator.

7. The suspension system has six settings; five for Operators and one only Maintainers can access. Ride height adjustments may take up to 5 minutes but are typically completed in less than 1 minute. The six ride height settings are:

   a) Operational

   b) Tie Down

   c) Loading

   d) Fording

   e) Suspension Aided Egress System (SAES)

f) Manual (Maintenance mode only)

8. Let's look at some of the suspension subsystems that enable suspension function.

(Slide #11)

e. Introduction to Suspension System Subassemblies

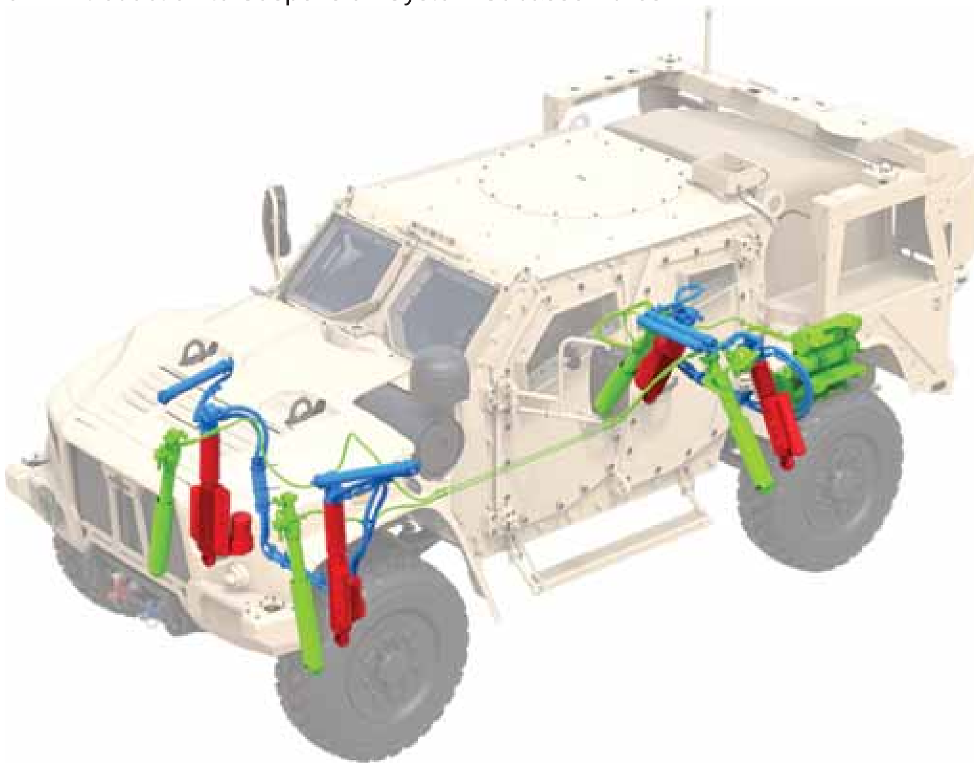


Figure 7.2 JLTVA1 TAK-4i Suspension System

1. The image displayed shows the TAK-4i suspension intact and in real-world positioning on a JLTVA1. (See Figure 7.2).

2. The TAK-4i is comprised of three suspension subsystems.

   a) The HPG Springs (green color in image)

   b) Shock absorber assemblies (red in image)

   c) Roll control circuit (blue in image)

(Slide #12)

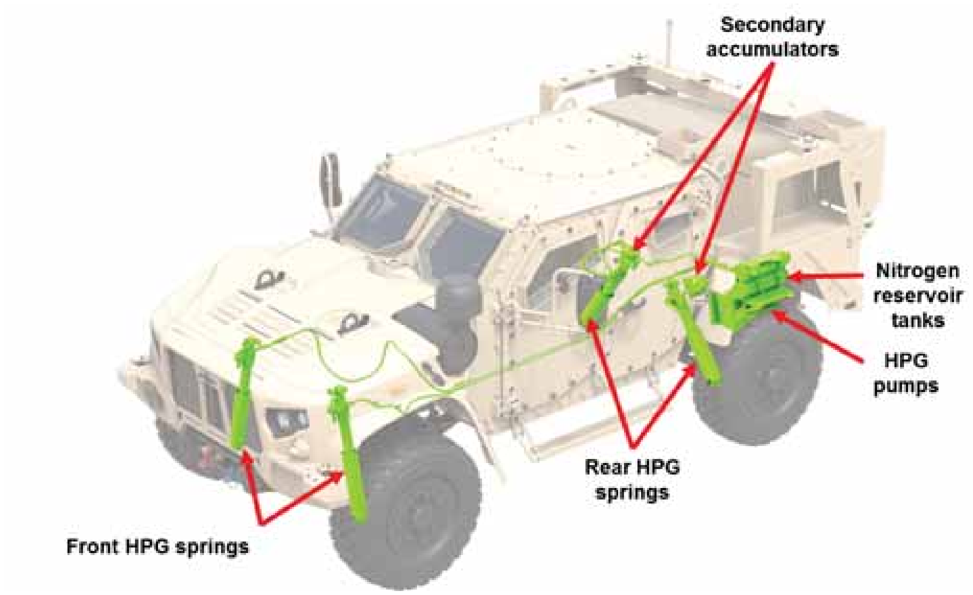


Figure 7.3 JLTVA1 High-Pressure Gas Spring System

3. Springs and HPG System

   a) The springs (Figure 7.3) in the suspension system perform one function that is similar to standard independent suspension system springs. The difference is this spring tube allows for nitrogen to move in and out to adjust ride height.

(Slide #13)

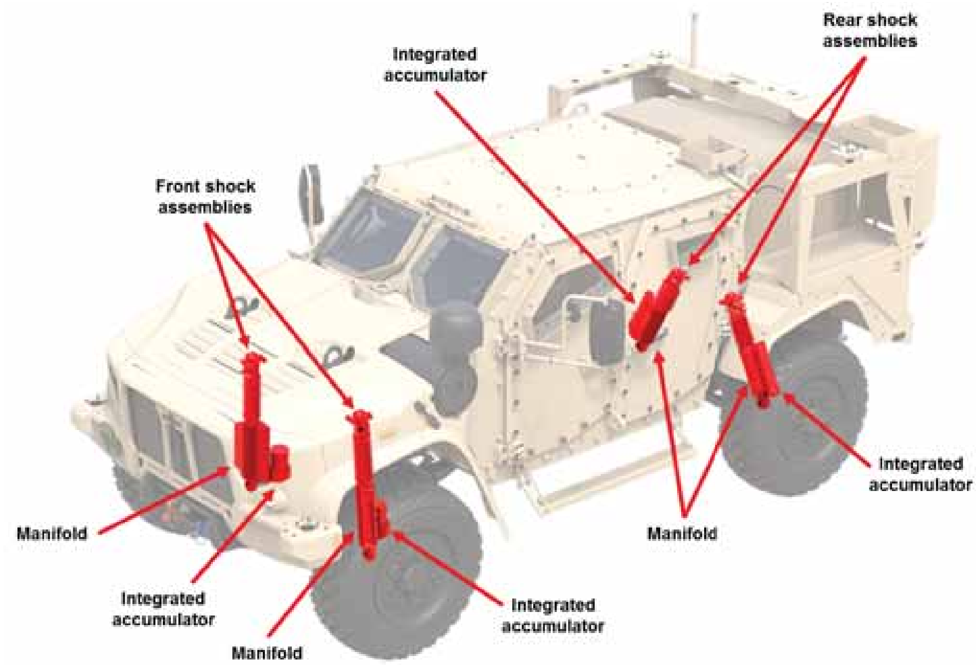


Figure 7.4 Shock Absorber Assemblies

4. Shock absorber assemblies

   a) Shock Absorber Assembly – The system includes a manifold, valves, and porting that work along with a piston to allow for progressive dampening for a smooth ride over rough terrain. The shock absorber assembly has an integrated accumulator which is charged with nitrogen.

(Slide #14)

5. Roll Control Circuit

   a) Instead of a traditional sway bar, the TAK-4i uses a hydraulic system referred to as the roll control circuit. The roll control circuit uses the principle of opposing forces to reduce body roll which provides for lighter, smoother operation than a standard system.

(Slide #15)

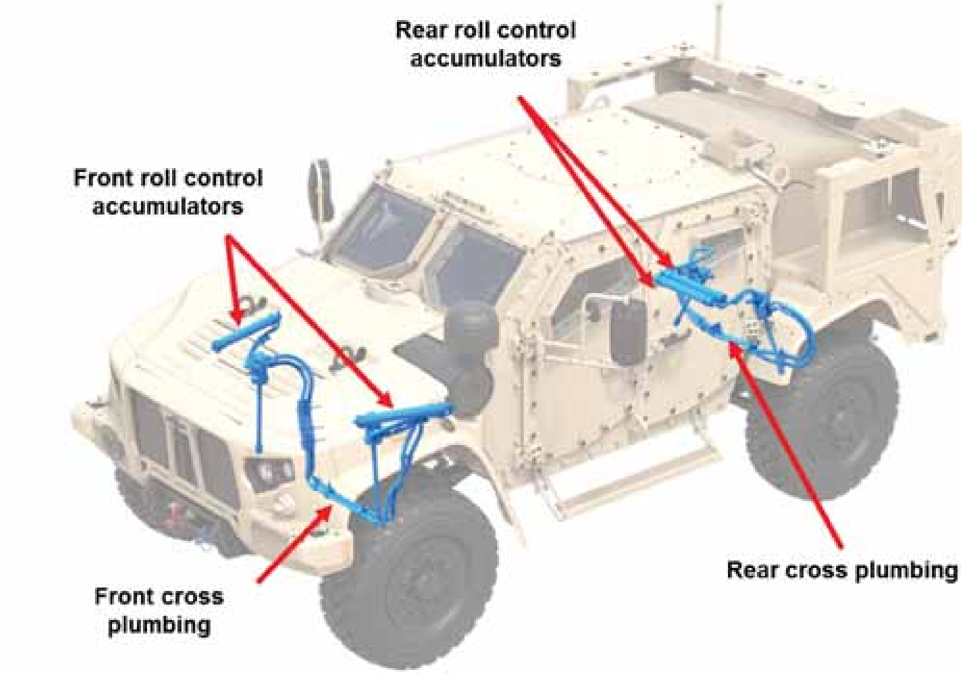


Figure 7.5 Roll Control Circuit

b) The roll control circuit uses pressurized nitrogen and hydraulic oil which is cross-plumbed side-to-side and integrated into the shock absorber assembly system (Figure 7.5).

c) The nitrogen for the roll circuit system is only stored in the accumulator. It is separate from the nitrogen used in the spring system.

d) The roll control circuit has nothing to do with ride height adjustments other than it articulates along with the springs, as they extend or retract. There are no physical connections between the springs and the roll circuit.

Check on Learning

(Slide #16-17)

Q: There is an increased risk of servicing the JLTVA1's TAK-4i suspension than servicing a traditional suspension, why?
A: Because the TAK-4i is a pressurized suspension system which uses high pressure gas and pressurized hydraulics, there is an increased risk of injury during service.

Q: What are the two specific safety risks involved when servicing the JLTVA1 suspension system?
A: The two risks are potential crushing of personnel if vehicle is not properly supported using safety equipment (suspension lock out braces and jack service kits) in the event of a suspension failure, and the other is a risk of injury from the spring's high-pressure gas system.

Q: Instead of a traditional sway bar, the JLTVA1 uses what?
A: A Roll Circuit Cross-Plumbing that contains and controls pressurized nitrogen and hydraulic oil.

Q: Instead of a simple shock, the JLTVA1 TAK-4i uses what?
A: Shock absorber assembly system, which is a system made of multiple components.

Q: The TAK-4i has replaced the steel spring with what device?
A: High-pressure gas (HPG) spring mechanism.

Summary

(Slide #18)

So far, you've just received a high-level overview of the JLTVA1 suspension capabilities, and an introduction to the TAK-4i functionality.

High Level Suspension Assembly Review:

- There are three subsystems that work together to create the TAK-4i suspension system. They are:
  - HPG springs
  - Shock absorbers
  - Roll control circuits

- The springs are a closed circuit, but the shock absorber assemblies are a two-purpose unit as they are cross-plumbed into the roll control circuits via diaphragms, manifolds, pistons, seals, etc.

- High pressure gas springs use compressed nitrogen in steel tubes
  - There are four HPG springs

- Shock absorber assembly
  - There are four: one for each wheel however, the two on each axle (front and rear) are cross-plumbed side-to-side which become part of one roll circuit

- Roll circuit system serves as a sway bar
  - There are two: one front and one rear as they are integrated side-to-side with the shock absorbers

Transition

Now we will learn about the HPG Springs. We are going to learn about the springs completely starting with components, PEs and continue into maintenance/troubleshooting before we learn about the other two subsystems.

The high-pressure gas system is dedicated solely to the springs and not shared with the other two suspension subsystems, so keep that in mind as we continue.

Enabling Learning Objective B.

(Slide #19)

Upon completion of this lesson, you will be able to:

Action:	Troubleshoot the HPG Spring system of the JLTVA1 suspension
Conditions:	Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials
Standards:	Without injury or death to personnel and reaching the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activities.

1.

(Slide #20)

Instructor Note

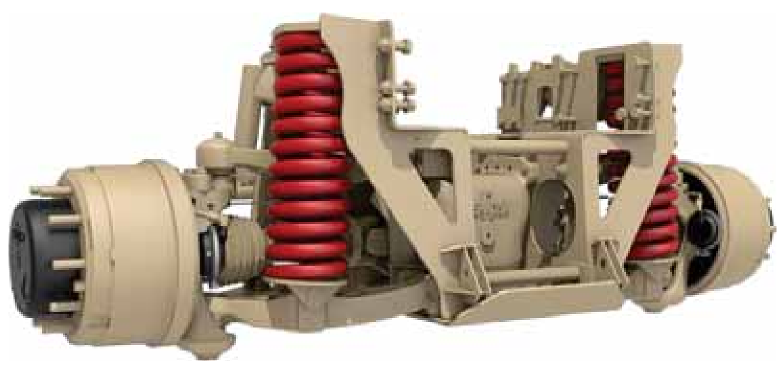
Use the Learning Step slides to aid with transitions across topics. These slides provide queues to the student of the content covered and topics up next.

ELO B – LSA 1

Learning Step/Activity:	Suspension Subassembly – HPG Springs
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	45 mins
Media Type:	PPT

(Slide #21)

a. Overview - HPG Spring



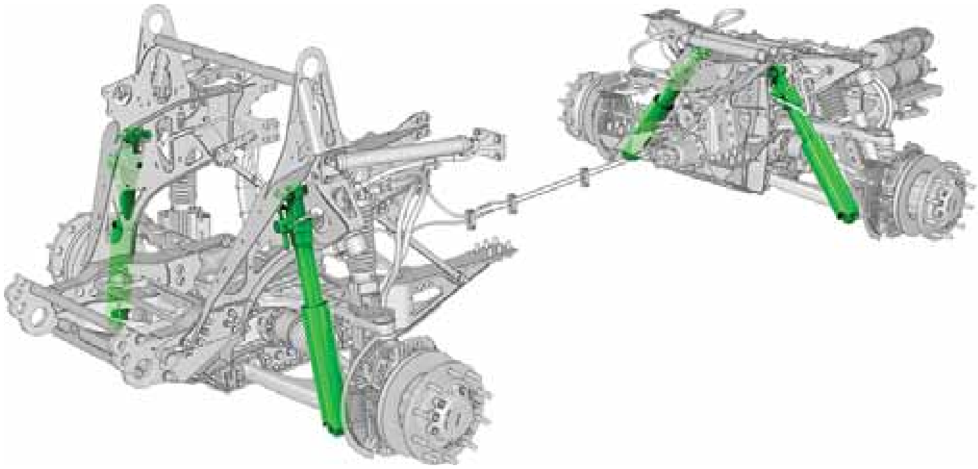


Figure 7.6 Coiled Spring in TAK-4 Suspension (above)
TAK-4i Springs (Front on left/Rear to right)

1. The JLTVA1 utilizes a TAK-4i independent suspension system. At each corner of the truck, is a High-Pressure Gas (HPG) spring and custom passive damper, tuned specifically for the JLTVA1 mission profile. (Figure 7.6)

    a) Traditional springs used on tactical wheeled wheels are leaf spring, coil springs, or air bags which serve to provide driver comfort by absorbing jounce, store energy for release later, and to provide a ride height for the vehicle. (Figure 7.6)

        1) For all those traditional methods, when the vehicle is in motion and a bump is encountered, the spring will compress/flex then return to normal ride height.

        2) Those functionalities are still true for the JLTVA1 TAK-4i; however, the JLTVA1 spring system is much more advanced.

(Slide #22)

Figure 7.7 HPG Spring Absorbing Jounce

Figure 7.8 HPG Spring for ride height change

2. JLTVA1 springs are dual purpose. They serve to:

   a) Absorb jounce (Figure 7.7)

   b) Make vehicle ride height changes or adjustments (Figure 7.8)

(Slide #23)

Figure 7.9 TAK-4i High Pressure Gas Spring

3. Primary purpose of HPG spring (Figure 7.9)

   a) **The spring's primary purpose is to maintain ride height, keep tires in contact with road, and isolate the chassis from changes in terrain.**

      1) The spring is a steel canister that contains the nitrogen. The upper tube is channeled, and the lower tube supports a steel rod.

         (a) Nitrogen gas is compressible and can absorb jounce thereby providing the spring action.

         (b) There is a piston inside the spring to help contain and move the nitrogen.

         (c) The spring expands, or contracts, based upon how much nitrogen goes into the upper portion of the spring.

      2) When functioning as spring, it is a closed system. It is functioning as a spring when it is not being used to conduct ride height changes.

(Slide #24)

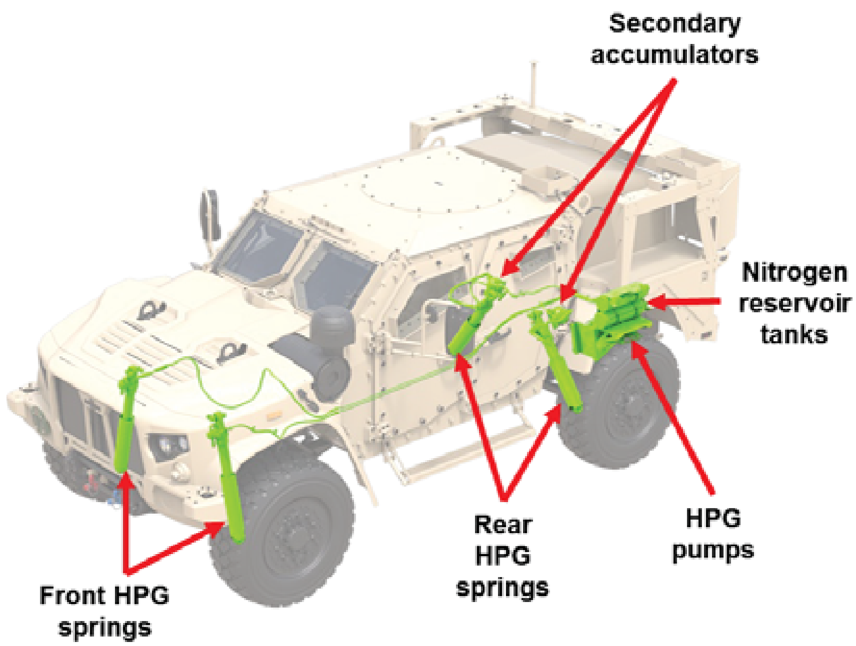


Figure 7.10 HPG Spring System

4. Second purpose of HPG springs - Ride height adjustments

   a) Ride height commands are controlled through the DSDU which is integrated with the J1939 Databus and sensors throughout the HPG system. The HPG spring system has two gas piston pumps that are hydraulically driven. The pumps move the nitrogen from the reservoirs through a series of solenoid-operated distribution valves through the manifold to the springs.

   b) When the nitrogen gas is pumped out of the reservoir and into the springs, the JLTVA1 ride height goes up/increases. When the nitrogen is removed from the springs, they compress and reduce ride height. The HPG Nitrogen reservoirs are located in the left rear of the vehicle. (Figure 7.10)

(Slide #25)

Figure 7.11 Spring controls vehicle ride height (tie down, operational, fording)

   c) There are five ride height mode settings available to operators and maintainers, and an additional setting for maintainers only. (Figure 7.11)

      1) LOADING

2) TIE DOWN

3) OPERATIONAL

4) SAES - Suspension Aided Egress System levels the chassis (reduces the slope to some degree) to make it easier to open the doors when enter/exit on hillside.

5) FORDING (MUX panel)

6) MANUAL ADJUST – only available to maintainers

Instructor Note
Immediately upon concluding the HPG spring classroom training the students will have the opportunity to identify the spring assembly components on the JLTVA1 and the instructor will verbalize the actions of the components and systems while the ride height changes are occurring. This will assist the students with putting it all together.

(Slide #26)

b. HPG Spring System Components

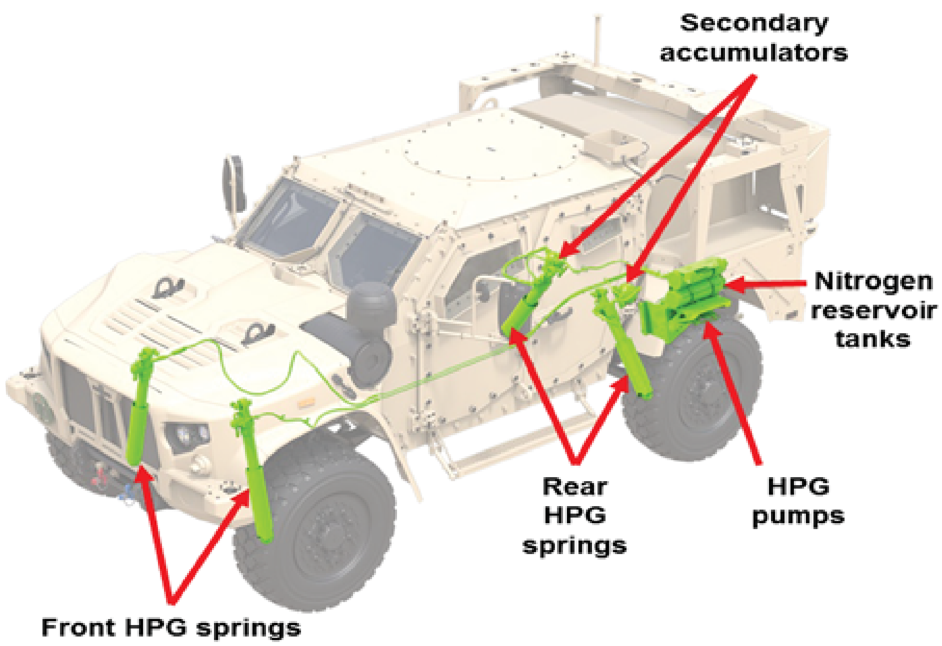


Figure 7.12 HPG Spring System Components

1. HPG Spring System Component Overview (Figure 7.12)

a) The HPG Spring system consists of the following components:

1) HPG Springs

2) Sensors

3) HPG plumbing

(a) Nitrogen manifold

(b) Tubing & Hoses – tubing is hard lines and hoses are soft/flexible lines

(c) HPG Reservoir

(d) HPG pump

(Slide #27)

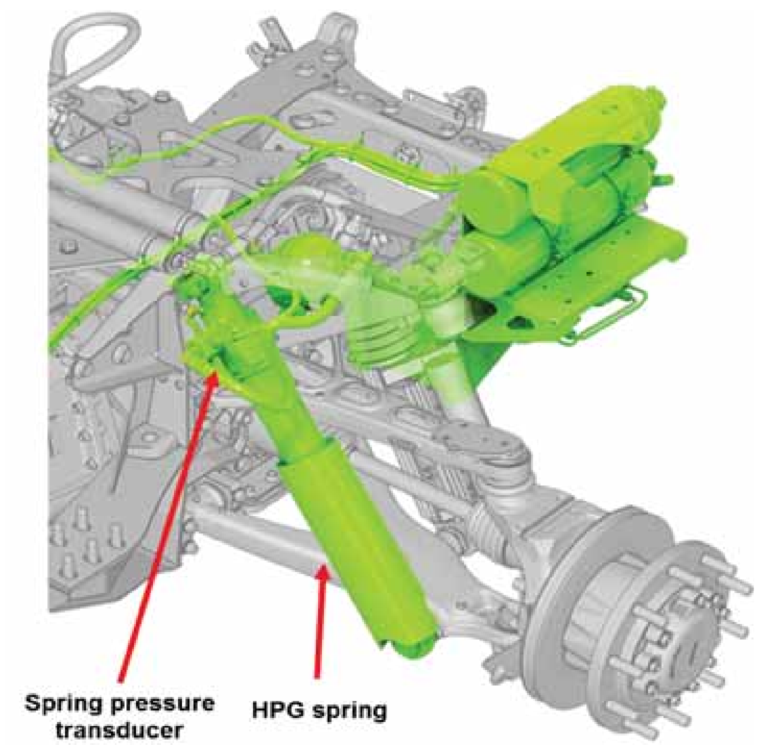


Figure 7.13 HPG spring and pressure transducer (rear suspension shown)

2. Springs

a) The JLTVA1's suspension springs are High Pressure Gas (HPG) cylinders, utilizing nitrogen gas as the spring element.

b) The springs are compact and lightweight, allowing enhanced wheel travel, steering angle, and cargo space.

c) The nitrogen enters the spring from the top, supplied by high-pressure hoses which are connected to the HPG pumps. (There are no hydraulic ports or feeds on the spring; it is a containment cylinder).

d) Each spring is fully sealed and preassembled with internal position sensors to monitor vehicle ride height and provide feedback to the suspension control system.

e) Each spring has a Spring Pressure Transducer sensor located at the top of the spring and nitrogen tubing. (Figure 7.13)

f) There is a free-floating piston within each spring to move the nitrogen into and out of the spring. The piston requires lubrication therefore hydraulic oil is present in the lower portion of the spring cylinder. This hydraulic oil is installed in the spring during manufacture and is non-serviceable.

g) Springs are NOT interchangeable as the front springs are longer than the rear springs. The fittings on each spring are also set for their position on the truck; front left (FL), front right (FR), rear left (RL) and rear right (RR)

h) Springs are a remove-and-replace component.

(Slide #28)

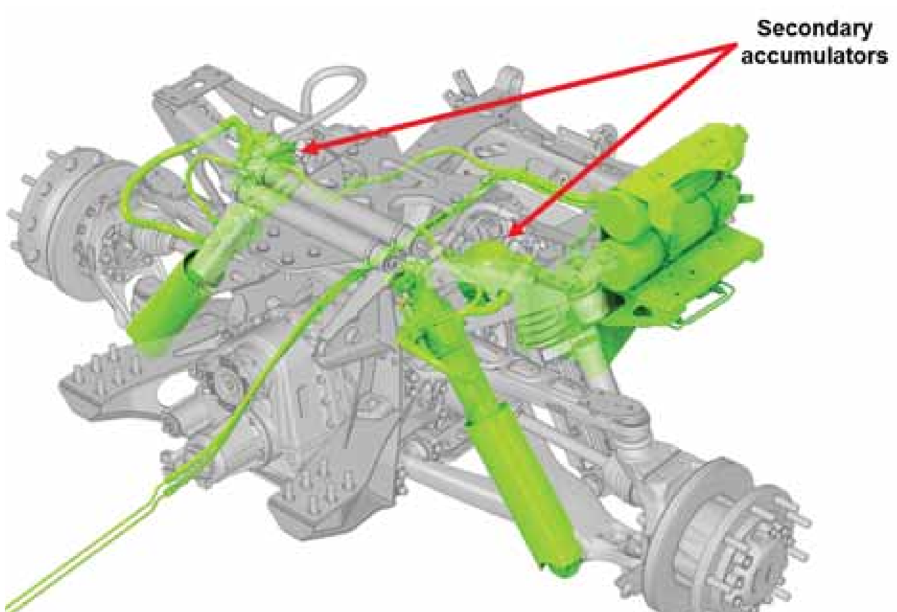


Figure 7.14 Secondary accumulators (on rear suspension only)

i) Additional component in rear spring assembly - secondary accumulators

1) The rear springs are almost identical to the front springs, with the exception that rear springs have secondary accumulators plumbed in.

2) The secondary accumulators are separate components and are not integral to the rear HPG springs.

3) The purpose of the secondary accumulators is to increase the capacity/volume of nitrogen to the rear spring to increase spring rate for added payload.

4) Located one on each side of the rear suspension assembly. They are ball-like in shape. (Figure 7.14)

5) Secondary accumulators are charged to 1900-psi for most configurations and increased to 2300-psi for EFP armor.

(Slide #29)

3. Sensors

a) Spring Sensor Circuit Overview

b) The chart below lists sensors that communicate to the HPG system and Inertial Measurement Unit (IMU), their location, more information about the sensor and where the alerts outputs are visible to operator/maintainer.

Sensor Location	Function	**Sensor Communication to 3G Controller**	Indicator
HPG Reservoir Press Sensor	Monitors pressure in nitrogen reservoirs	Required for adjustable height suspension operation	
Spring pressure transducer (Figure 7.13 above)	Provides readings of HPG pressure in each spring to the Suspension SCIM.	Located toward the top of each spring	DSDU: Vehicle Weight Calculation Dash Indicator: SUSPENSION NOT LEVEL when pressure is outside of 80-psi from balanced pressure
Ride Height Sensors	Measure the stroke of the spring. Located inside the spring. These are data bus sensors that communicate with the Suspension SCIM, Suspension Power Module, and the 3G controller over the suspension CAN.	Maintainers must use the DSDU to check the ride height measurement of each HPG spring.	DSDU MANUAL will display spring information for all four springs

Inertial Measurement Unit (IMU)	Measures the roll and pitch of the JLTVA1 chassis. Located at the center of the capsule of the vehicle (not on or in the spring).	Assists with calculations for suspension aided egress system (SAES). Calculations conducted by 3G Controller Pitch/Roll output is visible on the DSDU DRIVE/ INCLINOMETER Screen	VEHICLE WEIGHT CALCULA-TION
Hydraulic Oil Temperature Sensor	Monitors the hydraulic oil temperature. This is relevant to springs because the vehicle hydraulic pump drives the HPG Nitrogen pumps.	Provides pressure reading to the Front SCIM. The SCIM provides pressure data to the 3G via J1939. If the hydraulic oil temperature exceeds 212°F, the 3G will disable the HPG pumps until the temperature falls below 200°F	SPNSN ERROR

Figure 7.15 Suspension Sensor Chart

(Slide #30)

Figure 7.16 HPG nitrogen reservoirs

4. HPG Reservoirs

   a) There are two HPG nitrogen reservoir tanks

   b) Both are located at the left rear corner of the vehicle. Even though there are two tanks, they are plumbed together and act as one large reservoir.

c) Nitrogen reservoirs are charged on average to approximately 2000-psi but vary according to ambient temperature.

d) Refer to the IETM for the correct charge as settings are dependent upon current ambient air temperatures of the vehicle.

(Slide #31)

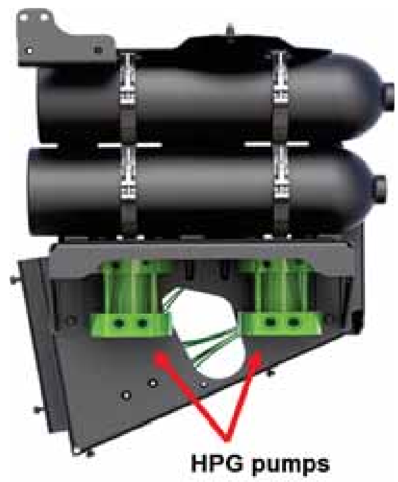


Figure 7.17 HPG Nitrogen Pumps

5. HPG pumps (Figure 7.17)

a) The HPG pumps are driven by the vehicle hydraulic pump which is driven by the engine's secondary belt. When a ride height adjustment is requested, the engine speed increases to 1500 RPM to provide increased hydraulic pump output.

b) The pumps are capable of compressing nitrogen gas up to 3,000-psi.

c) The pumps always pump in the same direction. The 10-position manifold controls the direction of the nitrogen flow. When the manifold directs the flow to the springs, they extend when the manifold directs the nitrogen to the reservoir tanks the springs compress.

d) Pumps are located directly below the nitrogen reservoirs.

e) Pump operation is controlled by the pump hydraulic manifold. The manifold houses three solenoid valves; one hydraulic circuit valve that controls hydraulic flow into the manifold, and a control valve for each pump.

f) The solenoid valves in the pump hydraulic manifold are controlled by the Suspension SCIM. When pump operation is required, the SCIM will energize the hydraulic circuit valve to allow hydraulic flow into the manifold. It will then alternately energize each control valve to operate each pump in turn; when a control valve is energized, it opens and provides hydraulic flow into the pump, which pushes the pump piston and forces nitrogen out of the pump. When a control valve is deenergized, it allows the hydraulic pressure to be vented from the pump, a spring returns the pump to its at-rest position, and the pump draws in nitrogen for the next pumping cycle.

g) The HPG pumps are 100% maintenance-free; they are remove-and-replace components.

h) Pump housings are manufactured from lightweight forged 6061-T6 aluminum.

(Slide # 32)

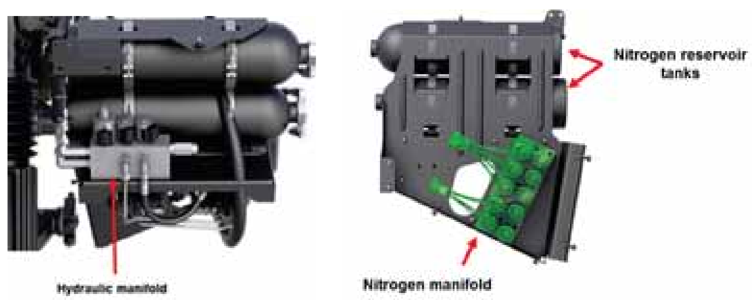


Figure 7.18 Hydraulic Manifold (left) and Nitrogen Manifold (right)

1. Hydraulic manifold

   a) The hydraulic manifold is located directly above the pumps at the left rear of the truck. (Figure 7.18)

   b) The manifold houses three solenoid valves; one nitrogen circuit valve that controls nitrogen flow into the manifold, and a control valve for each pump.

2. Nitrogen manifold

   a) The solenoid valves in the 10-position nitrogen manifold are controlled by the Suspension SCIM.

   b) Ten-position manifold

      1) Two control solenoids are for supply (extend springs) and return (contract springs) of nitrogen and are controlled by the Suspension SCIM.

      2) Eight solenoids direct flow of nitrogen out to springs and are controlled by the Suspension Power Module

Instructor Note

Ask Students:
Are there any questions about the spring components or functionality?
Next, we’re going to put it all together and learn about the nitrogen flow paths for ride height increases and decreases.

(Slide #33)

c. Spring Function for Ride Height Adjustments

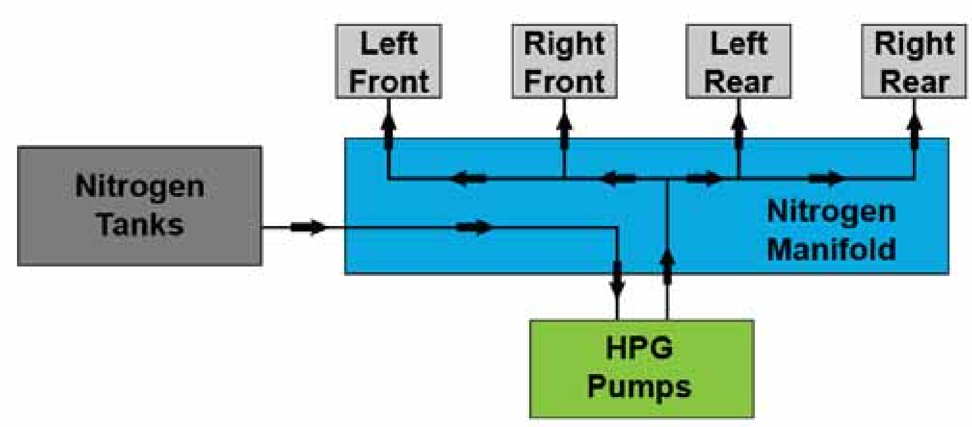


Figure 7.19 Arrows show direction of flow: manifold directing nitrogen to springs. Pump in use (green)

1. Ride height **increase with pumps**

    a) The piston pumps will engage when the sensors report there is a 70-psi differential between the spring and the nitrogen tank. Ride height sensors, pressure transducers and the HPG Nitrogen reservoir pressure sensors communicate pressure readings to the J1939 Databus which in turn communicates to the internal control systems to turn pumps on or off as required during height adjustments.

    b) HPG pumps always run in the same direction; it is the solenoids in the manifold that direct the flow. The manifold directs nitrogen supply to HPG springs, and the spring extends. (Figure 7.19)

    c) You will know when the pumps are engaged because you'll hear them. The pumps make a recognizable sound because they do NOT work in unison; they alternate which creates a rhythmic sound.

    d) You will also hear the engine ramp up. To complete a suspension adjustment in less time the engine RPM will automatically increase to approximately 1500 RPM.

(Slide #34)

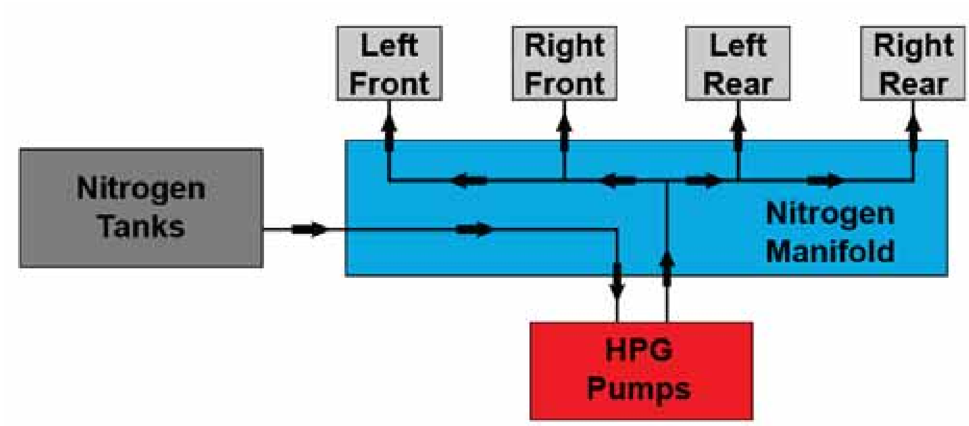


Figure 7.20 Arrows show direction of flow: manifold directing nitrogen to springs. Pump not in use (red)

2. Ride height **increase without pumps**

   a) The general nature of high-pressure gas is that high pressure will overcome low pressure, so when there is higher pressure in the nitrogen reservoirs and the solenoids are engaged to open the manifold valves the gas will flow from the reservoirs into the springs extending them. (Figure 7.20)

   b) Ride height increase without pumps occur anytime the vehicle was commanded (forced) to a low ride height for tie down, loading or was all the way down resting on the jounce bumpers for maintenance.

(Slide #35)

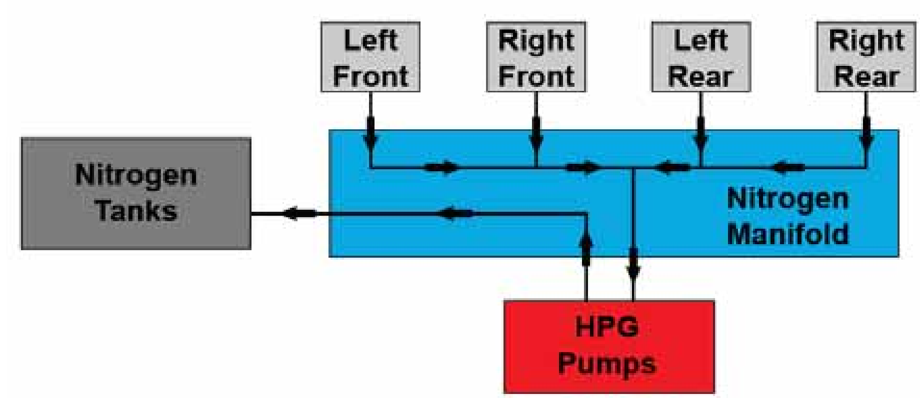


Figure 7.21 Arrows show direction of flow: manifold directing nitrogen to Nitrogen reservoir tanks. Pump not used (red)

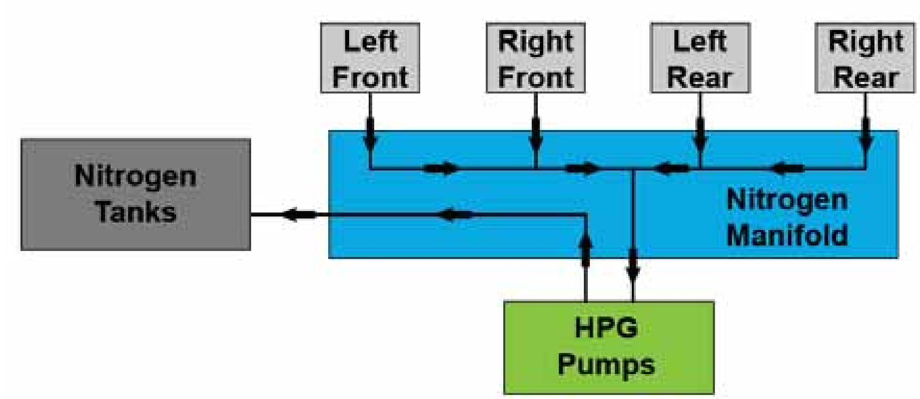


Figure 7.22 Arrows show direction of flow: manifold directing nitrogen to Nitrogen reservoir tanks. Pump in use (green)

3. Ride height **decrease without pumps**

   a) The nitrogen will naturally flow towards the reservoirs when the solenoids and manifold valves are open if there is more pressure in the springs than in the reservoir tanks (Figure 7.21)

4. Ride height **decrease with pumps**

   a) The pumps are required to compress springs for LOADING and TIE DOWN ride height settings.

   b) First, the system waits for the nitrogen to flow naturally to decrease ride height then the pumps engage when the springs are outside 70-psi of commanded ride height to assist moving the nitrogen out of the springs to lower the vehicle to the required vehicle height. (Figure 7.22)

(Slide #36)

d. Pump activity with ride height commands

1. As the HPG pumps are hydraulically driven the engine RPM will automatically increase when an adjustment is selected. The engine will remain at high idle RPM until the ride height command is completed.

2. As mentioned previously, the engine is going to ramp up to increase power to the HPG pumps, so **do not put your foot on the service brake while the JLTVA1 is adjusting ride height as it will disrupt the command.**

(Slide #37)

e. Disrupting Ride Height Commands

Figure 7.23 Applying service brake interrupts ride height commands

Figure 7.24 DSDU ride height abort command

1. Interrupted Commands: A safety design built into the JLTVA1 is that the transmission must be in neutral and the parking brake applied when giving a ride height change command.

    a) If either the transmission is shifted out of neutral or the service brake is applied during an adjustment, the ride height command is disrupted (Figure 7.23) and the engine speed will return to normal idle speed.

    b) Interrupting ride height adjustments extends the time to complete the ride height adjustment because the engine speed returns to normal idle speed. If driving the vehicle is attempted during this time, vehicle speed is limited to 10 mph.

2. Aborted Commands:

    a) When adjustment selection is aborted by making the abort selection in the DSDU (Figure 7.24), all suspension operation will cease. The vehicle will not be level and the SUSP NOT LEVEL light will be illuminated.

b) A suspension setting will have to be reselected in order to complete the adjustment. If driving the vehicle is attempted in this condition, it will be limited to 18 MPH.

Check on Learning

(Slide #38-39)

Q: The springs have two purposes, what are they?
A: The springs are used to provide for suspension movement and make vehicle ride height changes or adjustments.

Q: Where does the nitrogen for ride height increases come from?
A: The nitrogen for increasing ride height is stored in the HPG Nitrogen Reservoir tanks (at the rear of the truck).

Q: Do the springs share their nitrogen source with any other JLTVA1 system?
A: No, the HPG springs have their own nitrogen tanks and pumps.

Q: Where is the nitrogen manifold located?
A: The 10-position manifold is located right behind (inside – towards the center of the truck) the HPG pumps and HPG reservoirs at the rear of the vehicle on the driver's side.

Q: When a ride height change is given that requires the HPG Pumps to engage the engine ramps up, why does that happen?
A: The HPG pump is hydraulically powered and driven by the engine's secondary belt the engine RPM will automatically increase when an adjustment is selected.

Q: What happens if you put your foot on the service brake while a ride height adjustment is occurring?
A: It disrupts the command; the engine decreases RPMs and the ride height change takes longer to complete.

Summary

(Slide #40)

The TAK-4i uses four high-pressure gas springs, supplied from the high-pressure nitrogen system to act as a spring and to make ride height adjustments.

Some basics about the HPG springs are:

- Springs are high pressure gas within steel tubes
- The springs have their own nitrogen plumbing circuit – not shared with roll circuit
- The spring and suspension system have many sensors monitoring HPG pressures and communicating ride height
- All but one ride height command is made using the DSDU
- Nitrogen manifold allows nitrogen to be fed and removed from spring system
- HPG pumps are driven by the hydraulic pump
- The hydraulic pump is driven by the engine's secondary belt

Transition

Let's go to the truck and look closer at the components as well as the system in action.

Bring your worksheets as we will also do two other practical exercises pertaining to the HPG spring.

2. **(Slide #41)**

ELO B – LSA 2

Learning Step/Activity:	HPG Spring Assembly Component ID
Method of Instruction:	Practical Exercise
Instructor to student ratio:	1:5
Time of instruction:	30 mins
Media Type:	None

(Slide #42)

Instructor Note
The beginning of the PE has the instructor providing a demonstration of a ride height change while verbalizing the HPG process and component function as it is occurring.

See Appendix C: PE No. 7A - 1

Check on Learning None

Summary None

Transition Next, we'll learn about how to service and maintain the HPG Spring system.

3. **(Slide #43)**

ELO B – LSA 3

Learning Step/Activity:	HPG Spring Assembly Maintenance
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	45 mins
Media Type:	PPT

(Slide #44)

a. HPG Spring Maintenance

1. The HPG Springs are a nonrepairable item, if one is damaged it is a remove/replace task. Other maintenance tasks you can expect include:

a) HPG Spring Remove and Replace

b) Spring Sensor Addressing

c) Spring Sensor/Ride Height Calibration

d) IMU Remove and Replace

e) IMU Calibration

f) Spring bleeding

g) HPG tank charging

h) Rear spring secondary accumulator charging

(Slide #45)

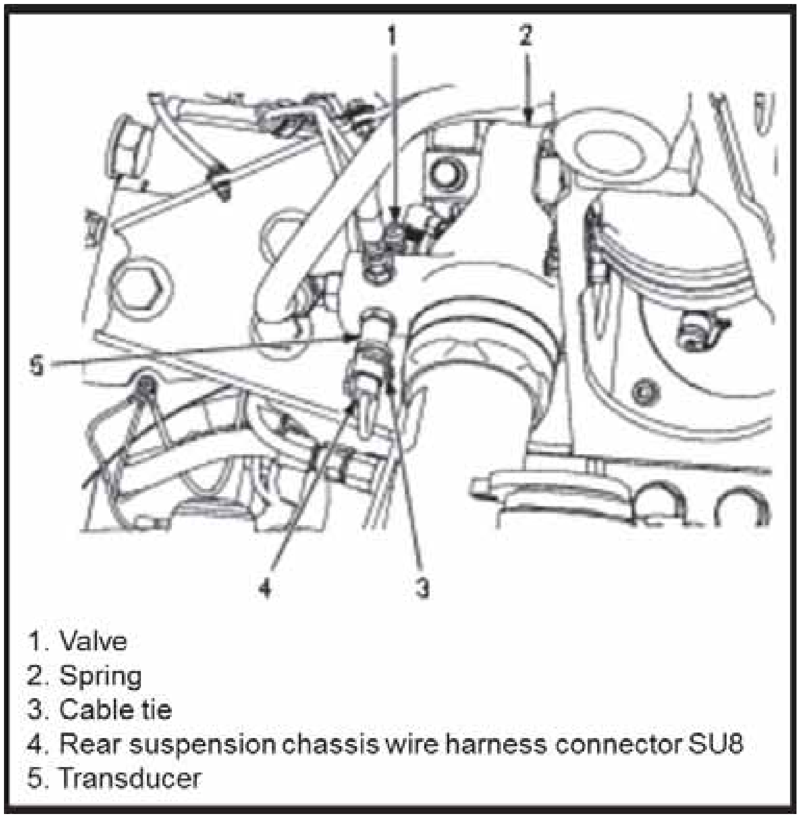


Figure 7.25 Spring intact within assembly

2. Spring Remove/Replace (Figure 7.25)

   a) You will know when a spring needs to be replaced if/when:

      1) Poor ride quality

      2) Inability to make ride height adjustments

      3) It is physically loose while still attached to the truck; meaning it has give/play when you check it manually.

   b) Always perform proper troubleshooting to determine if spring replacement is required.

   c) Follow the IETM and be sure to completely and accurately meet the work package preconditions and follow-on tasks.

(Slide #46)

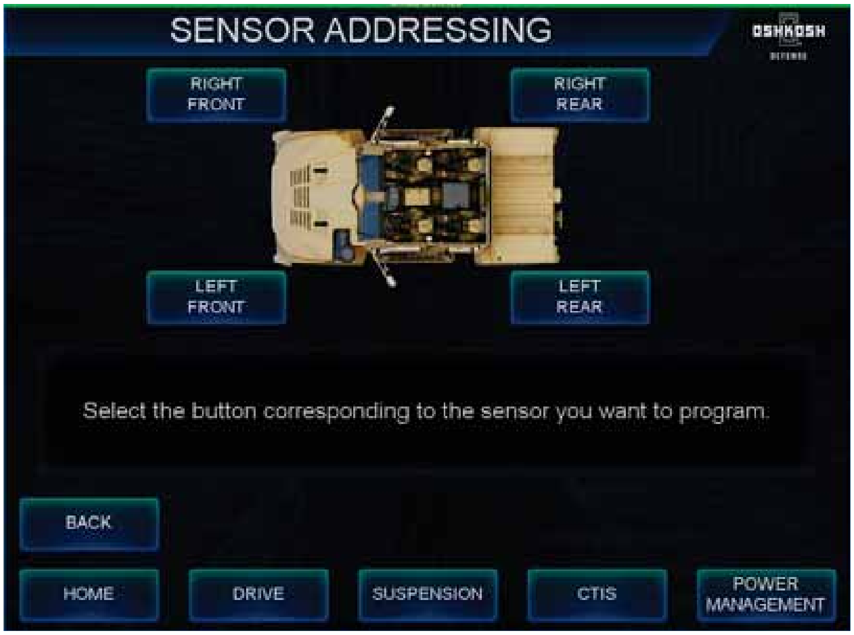


Figure 7.26 DSDU Sensor Addressing Screen

Figure 7.27 Ride height sensors

3. HPG Spring Sensor Addressing

   a) This task will need to be performed whenever a spring is replaced. Since the ride height sensor is integral to the spring, a new sensor will need to be addressed in the system. This is so the system can identify the new sensor and know on which corner of the vehicle it is installed.

b) From the suspension menu options, select Sensor addressing. You will see the screen displayed below; select which spring was replaced and needs to be readdressed. (Figure 7.26)

c) Go to the Suspension Menu> Sensors > SENSOR ADDRESSING

d) Disconnect all Ride Height Sensors except the sensor you are addressing. (Figure 7.27)

(Slide #47)

Figure 7.28 Calibration

4. Spring Sensor/Ride Height Calibration

a) When replacing an HPG spring, the JLTVA1 may require a ride height calibration. (Figure 7.28) This will allow the system to set the vehicle to the proper height as communicated by the ride height sensors. Accurate calibration is required for the suspension system to operate properly.

b) If this is not done, the vehicle will not correctly recalibrate itself as required and may cause handling problems.

c) When calibrating ride height, be sure the CTIS setting is at HIGHWAY.

(Slide #48)

Figure 7.29 IMU location (in crew capsule)

Figure 7.30 Select CALIBRATE from the Suspension Menu

Figure 7.31 Select CALIBRATE IMU to begin calibration

5. Replace and Calibrate IMU

   a) The IMU may need to be replaced when a fault code is displayed, certain suspension settings are unattainable (SAES, for example), or when data is not available for the inclinometer. It is located within the center of the crew capsule. (Figure 7.29)

   b) New IMUs will require electronic calibration to the suspension system, performed in the DSDU. (Figure 7.30 and 7.31) IMU calibration should only be performed when the IMU is replaced, or system operation could be affected.

(Slide #49)

Figure 7.32 HPG Spring

6. Spring bleeding

   a) Over time, nitrogen in the spring may bleed past the seals of the spring's internal floating piston and into the oil below the piston. This will put internal pressure on the opposite side of the piston and make the spring want to retract slightly. The more nitrogen pressure there is below the piston, the more pronounced this retractive force will be. This will be most apparent when the vehicle is raised off the ground and all nitrogen has been recovered and vented from the spring; at this point, if it is difficult or impossible to move the spring on its upper and lower mounts (spherical bearings), there is likely nitrogen pressure below the piston. Therefore, whenever a spring is removed, this nitrogen pressure must also be bled off.

b) The bleeder screw located on the side of the spring body is used to bleed nitrogen pressure. (Figure 7.32)

c) When all nitrogen has been removed from the spring (in accordance with the work package), place a drain hose on the bleed screw, direct it into a suitable container, and crack the bleed screw.

d) NOTE: During this bleeding process, some oil will also be lost from the spring. While this is normal and expected, this oil cannot be replaced due to the construction of the spring. Therefore, bleeding should be done slowly to minimize oil loss. If this procedure is done repeatedly, and too much oil is lost from the spring, eventually the spring will need to be replaced.

e) Always follow the proper spring removal procedure in the IETM.

(Slide #50)

Figure 7.33 DSDU Screen for Checking Spring Pressures (Sensor Button)

7. Checking Spring Pressure

a) The 3G Controller monitors input from sensors to make sure the vehicle ride height is at “operational” height, or at the commanded ride height, and assesses if all four vehicle corners are level.

b) The DSDU will display indicators if any of the components supporting the HPG Spring need adjustment. (Figure 7.33)

(Slide #51)

Instructor Note
Inform students: This is an animated video demonstration of how to charge the nitrogen reservoirs. These animations are available in the IETM. To play video animation hover over the image in the PowerPoint presentation, and the play bar will appear. **Click the play icon to play video** on slide: HPG Reservoir Charge

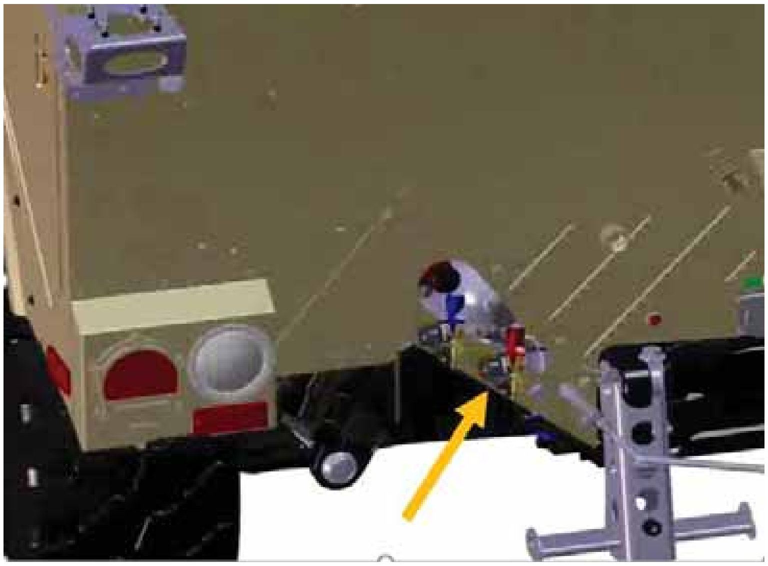


Figure 7.34 HPG Nitrogen Reservoir Charge Location

8. HPG Reservoir Charging

   a) Use the HPG Nitrogen Charge Kit

   b) Always follow the correct procedure in the IETM work package for using the components in the suspension service kit. (Figure 7.34 image from IETM animation)

      1) The proper line to use for charging the HPG reservoirs has one threaded Haplex fitting on one end and a quick-connect fitting on the other.

      2) Use the gas pressure regulator and the digital pressure gauge included in the suspension service kit to monitor and control charging pressure.

   c) Always adhere to all warnings and cautions when working with high pressure nitrogen gas.

   d) Refer to the IETM for charging pressures as they are dependent upon ambient air temperatures.

(Slide #52)

Instructor Note
Inform Students: This is an animated video demonstration of how to charge the secondary accumulator. These animations are available in the IETM. To play video animation hover over the image and the play bar will appear. Click the play icon to play video on slide: HPG Spring's Secondary Accumulator Charge and read sub bullet 3) below.

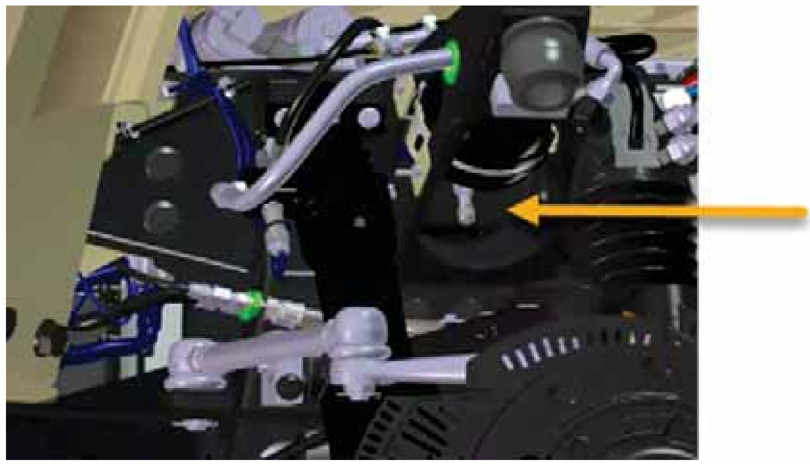


Figure 7.35 charging port of secondary accumulator

9. Rear spring secondary accumulator charging

   a) The secondary accumulators are located near the rear two HPG springs. (Figure 7.35 image from IETM animation) They are charged to their specified static pressure using the same service kit line used to charge the HPG reservoirs. Again, use the included pressure regulator and gauge to monitor and control accumulator pressure.

   b) Secondary accumulator pressure should be checked annually or every 3,000 miles and adjusted as necessary.

(Slide #53)

b. HPG Spring Troubleshooting

Figure 7.36 Dash Indicators: Suspension Error and Suspension Not Level

1. Practical Implications/Understanding Indicators and DSDU Alerts

   a) Springs and Hydraulic pump have sensors and calibration technology they will communicate to the operator by illuminating indicators on the dash and displaying the alert in the DSDU.

   b) Two of the most frequent indicators are the Suspension Error and Suspension Not Level. (Figure 7.36) The bullets below explain the rationale regarding the most common cause of each indicator and how to address the issue.

(Slide #54)

Figure 7.37 Dash Indicator: Suspension Error

   c) Suspension Error

      1) If the high-pressure gas (HPG) pumps run continuously for 10 minutes, the SPNSN ERROR light will illuminate and the pumps will automatically stop running to prevent overheating.

2) The system will clear the SPNSN ERROR light after a five-minute waiting period which will reenable the pumps and allow ride height adjustments again.

3) The suspension system monitors the hydraulic oil temperature to prevent overheating. If the hydraulic oil temperature exceeds 212°F, the SPNSN ERROR light will illuminate and suspension operation will be suspended. (Figure 7.37)

4) When the hydraulic oil temperature drops below 200°F, the SPNSN ERROR light will turn off, and the system will allow ride height adjustments again.

(Slide #55)

Figure 7.38 Dash Indicator: Suspension Not Level

d) Suspension Not Level

1) SPNSN NOT LEVEL may appear when starting the JLTVA1

(a) This is normal if the vehicle has been sitting (not running) and the suspension settles unevenly over a period of time.

(b) If the Suspension Not Level indicator is on, the vehicle will be limited to 18 MPH.

(c) To clear the indicator, select OPERATIONAL from the suspension screen and allow the system to adjust to operational ride height.

2) If SPNSN NOT LEVEL indicator appears when braking, accelerating, and cornering. (Figure 7.38)

(a) The indicator is functioning as designed and is simply communicating that it is recalculating the ride height, IMU and pressure sensor inputs as the suspension ride height or pressure is outside of expected limits for vehicle.

(b) It is only a problem that needs to be investigated if the light remains illuminated.

3) If SPNSN NOT LEVEL indicator appears when Loading/Unloading/Vehicle Modifications:

(a) If a significant change to weight or payload of vehicle has taken place, a ride height adjustment operation may need to be performed.

(b) To clear the indicator, ride height adjustment commands may need to be conducted two to four times to achieve optimal level operation.

4) The trigger to generate SPNS NOT LEVEL indicator is when pressure is outside of 80 psi from balanced pressure.

(Slide #56)

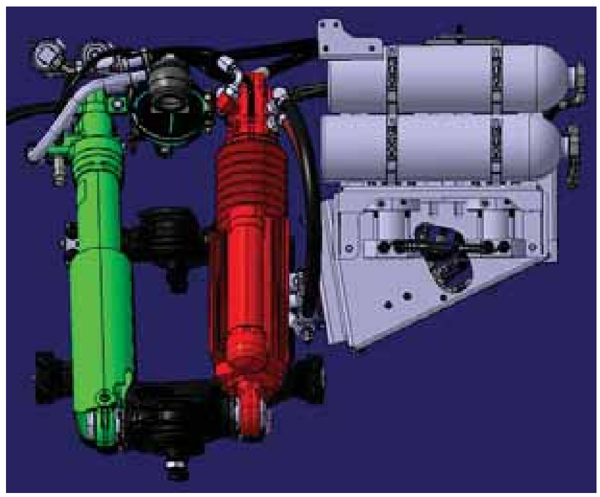


Figure 7.39 Spring (green) potential for leakage only at attachments

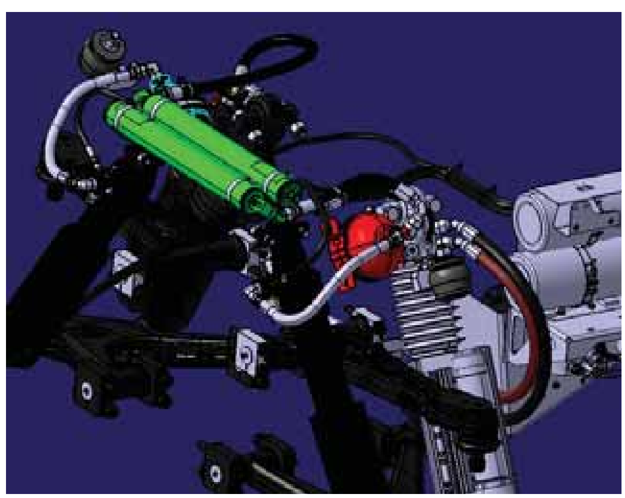


Figure 7.40 Secondary Accumulator (red)

2. Slow Changes in Suspension Height

a) Any leak in the system would result in a slow change to the suspension height.

1) Spring Leaks: Would occur at the interfaces with the plumbing connecting to the spring (ORB fittings or face seals) (Figure 7.39)

2) Secondary Accumulator (Figure 7.40)

   (a) Ride Height Increase: If there was an internal perforation the suspension height would increase.

   (b) Ride Height Decrease: If the accumulator were to burst the suspension height would decrease.

(Slide #57)

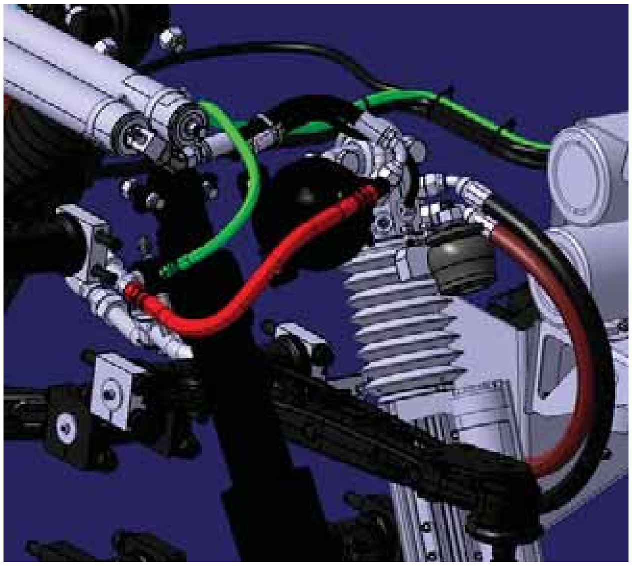


Figure 7.41 Nitrogen hose from manifold (green)
Nitrogen hose from secondary accumulator (red)

3) Nitrogen Hose Leaks

   (a) The HPG hose from the nitrogen manifold (Green) & the PG hose from the secondary accumulator (Red). (Figure 7.41)

   (b) Both would result in a suspension height decrease.

Note
Never remove hoses while system is pressurized. Rapid change in height will occur.

Check on Learning

(Slide #58)

Q: When you calibrate the sensors, what setting must the CTIS be set?
A: The CTIS must be in the HIGHWAY setting to verify wheels have consistent pressure/level.

Q: What are the two most frequent indicators for the suspension system?
A: The Suspension Error and Suspension Not Level indicators that illuminate on the dash.

Q: When would you be required to address the ride height sensors?
A: Anytime an HPG spring has been replaced.

Q: Why is it important to address the ride height sensor?
A: To ensure the DSDU is accurately aligned with the new spring so it can properly complete ride height calculations and adjustments.

Summary

(Slide #59)

You will know when a spring needs to be replaced if/when:

- Poor ride quality
- Inability to make ride height adjustments
- It is physically loose while still attached to the truck; meaning it has give/play when you check it manually.

In addition to the physical inspections, remember to follow the maintenance schedule.

Anytime a spring is replaced, the new spring will need to have its sensor addressed and the spring ride height will need to be calibrated.

The same is true for replacing the IMU, the new IMU must be addressed to the databus and the IMU calibrated.

All Spring and Ride Height calibrations are conducted using the DSDU.

To troubleshoot the HPG Spring System use the IETM troubleshooting tracks and follow all steps completely.

Transition

Our next step is to put everything you've learned about the spring system together and do some hands-on troubleshooting and maintenance tasks. But first a quick safety refresher specific to the suspension.

4.

(Slide #60)

ELO B – LSA 4

Learning Step/Activity:	Suspension Functions Do Not Operate
Method of Instruction:	Practical Exercise
Instructor to student ratio:	1:5
Time of instruction:	45 mins
Media Type:	None

(Slide #61)

a. Safety notification for Maintainers – Prior to Practical Exercises

TOPIC	Activity	SEVERITY
Crushing Injuries	Maintenance	Severe

DESCRIPTION	CORRECTIVE ACTION(S)
There is a risk associated with maintain the TAK-4i because it is a pressurized suspension system. **Commanded Operations:** • JLTV will lower in about minute from FORDING to TIE DOWN • Silent Changes! From FORDING the JLTV descends to OPERATIONAL ride height without pumps (pumps will engage if commanded to a height lower than OPERATIONAL) **Hose Breaches or Leaks:** • When the lines HPG hoses/hard lines that go to the springs are compromised, rapid depressurization will occur and the spring will collapse quickly! • Do not over torque fittings. • **Risks from HPG Maintenance include:** • Whip • Nitrogen injected into bloodstream • Crushing	1. To prevent crush risks, suspension strut braces are to be used. 2. When working on any pressurized system you must refer to the IETM and follow the steps in the exact prescribed sequence. *Caution: Do not over torque. Hairline fracture result form over torqueing; the fractures expand from the high pressure causing the lines to whip.*

Figure 7.42 Safety Information

1. The chart above identifies potential risks which may result from failure to follow the IETM, failure to adhere to safety notes and cautions and/or failure to use the proper equipment or tools when servicing the JLTVA1 suspension system. (Figure 7.42)

(Slide #62)

See Appendix C: PE No. 7B – 1

5. ELO B – LSA 5

Learning Step/Activity: Code 14-60 RL Up Valve Output Out of Range

Method of Instruction: Practical Exercise

Instructor to student ratio: 1:5

Time of instruction: 30 mins

Media Type: None

See Appendix C: PE No. 7C– 1

6. ELO B – LSA 6

Learning Step/Activity: Front HPG Spring & Half Shaft Remove/Replace

Method of Instruction: Practical Exercise

Instructor to student ratio: 1:5

Time of instruction: 5 hrs.

Media Type: None

See Appendix C: PE No. 7D-1

7.	ELO B – LSA 7 Learning Step/Activity: Sensor Addressing Method of Instruction: Practical Exercise Instructor to student ratio: 1:5 Time of instruction: 1 hr Media Type: None See Appendix C: PE No. 7E – 1
Check on Learning	None
Summary	None
Transition	Now that we have discussed the HPG springs and the active part of the suspension system, we will now move into the other passive areas of the suspension. As mentioned in the introduction, the TAK-4i 4-wheel independent suspension maintains vehicle stability by harnessing two opposing forces that both strive for equilibrium, the outcome of which is a responsive suspension system. Next, we will learn about the shock absorber and roll circuit systems.
Enabling Learning Objective C.	**(Slide #62)** Upon completion of this lesson, you will be able to: Action: Troubleshoot the shock absorber and roll circuit systems of the JLTVA1 suspension Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel and reaching the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activities.
1.	**(Slide #63)** ELO C – LSA 1 Learning Step/Activity: Suspension Subassembly – Shock Absorber Assembly Method of Instruction: Lecture Instructor to student ratio: 1:15 Time of instruction: 30 mins Media Type: PPT

(Slide #64)

Instructor Note
Use the Learning Step slides to aid with transitions across topics. These slides provide queues to the student of the content covered and topics up next.

(Slide #65)

a. Shock Absorber Assembly Overview

1. The shock absorber assembly functions as a “normal shock” reducing jounce/rebound forces.

2. The shock absorber portion of the assembly is an oil-filled shock integrated with a nitrogen accumulator at the base. The oil in this portion of the shock absorber assembly is installed during manufacture and is not serviceable.

3. The upper portion of the assemblies are the main control components of the roll control circuit and are cross-plumbed, left and right, to each other.

4. The roll accumulators are plumbed into each side (left and right) of the roll circuit and provide static opposing pressure (nitrogen against hydraulic) and expansion volume to the circuit. This is a characteristic unique to the TAK-4i.

5. The hydraulic oil used in the roll circuit is a unique oil and is serviceable.

(Slide #66)

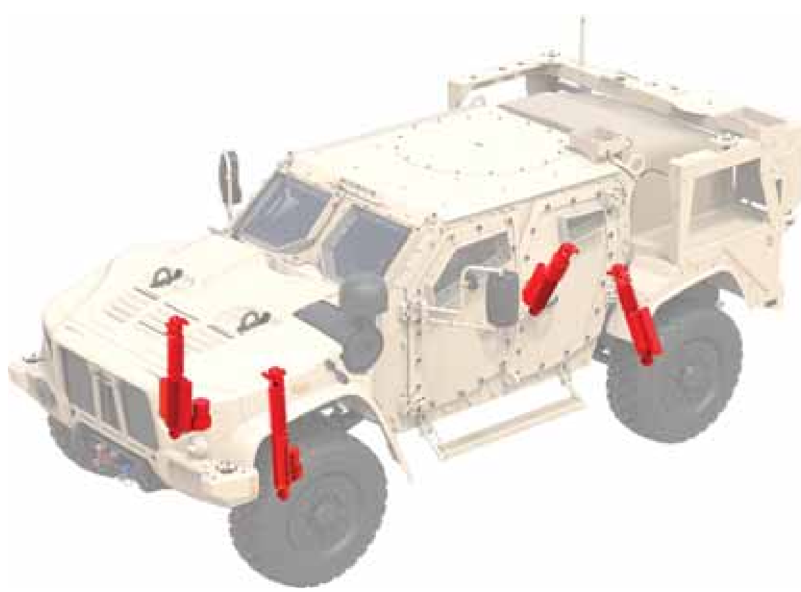


Figure 7.43 shock absorber assemblies (isolated w/o roll circuit plumbing)

6. Shock absorber assemblies do NOT have sensors or electrical components. (Figure 7.43) This portion of the suspension is completely mechanical, which means:

   a) There will never be a shock or roll circuit indicator on the MUX panel or DSDU.

   b) Indicators of shock absorber assembly problems are:

      1) Poor performance.

      2) Visual observations such as leaks and leaning.

(Slide #67)

b. Shock Absorber Assembly Components

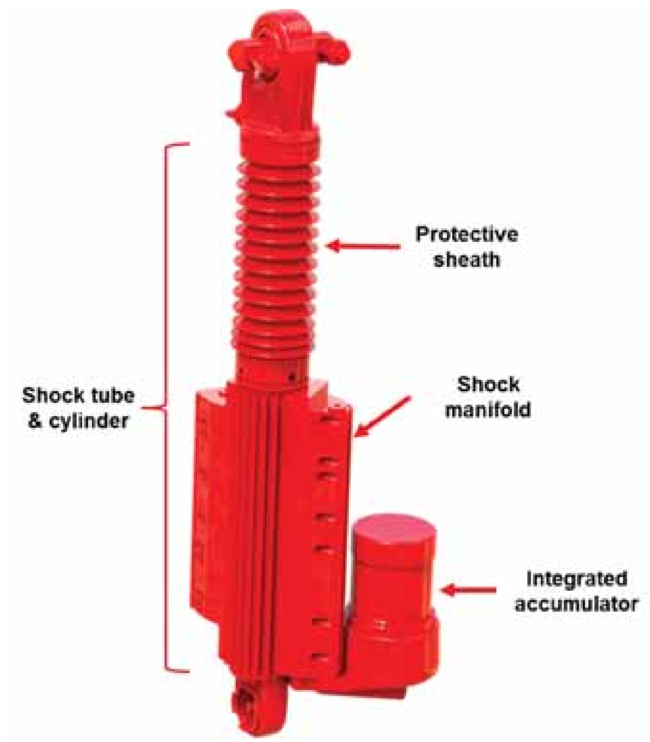


Figure 7.44 Shock Absorber Assembly Components

1. Each shock absorber assembly has a protective sheath around the shock rod, and the rod retracts and extends within the sheath. (Figure 7.44)

   a) Protective sheath

   b) Rod

   c) Hydraulic manifold

   d) Integrated accumulator

(Slide #68)

c. Shock Absorber Assembly Operation (entire assembly) (Figure 7.45)

7.45 Shock absorber assembly integrated with roll circuit

1. Each shock absorber assembly has an integrated accumulator charged with nitrogen to assist with shock dampening. The accumulator will absorb rapid inputs and will provide a reaction force as the pressure in the accumulator increases; the reaction force in the accumulator helps push the hydraulics back into the shock to extend the rod and maintain wheel-to-ground contact.

2. Hydraulic pressure feeds through the center of the shock into the sleeved region of the manifold to provide resistance to the force exerted on the shock, thus providing a shock ratio for extension/ contraction. This ratio is specifically engineered for the JLTVA1.

(Slide #69)

3. The sleeve pushes back on the piston to extend the shock absorber.

4. The manifold at the bottom of the shock absorber assembly provides for controlled oil flow within the shock and is plumbed together with an integrated nitrogen accumulator.

5. Integrated accumulator

   a) Works with valves on the manifold to allow hydraulic oil to move within the shock by providing progressive dampening

   b) Charged to 620-psi front and 660-psi rear

6. As the shock moves further down its stroke, more valves open allowing additional dampening or progressive dampening of the oscillations of the HPG springs. The shock will get harder and harder to compress as it reaches a fully compressed state.

(Slide #70)

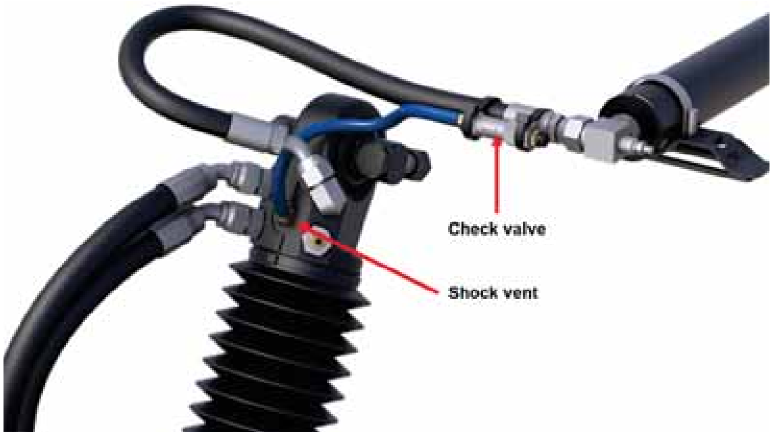


Figure 7.46 Shock absorber vent and check valve

7. A vent allows for system to reach full stroke.

    a) Shock vent located on top of shock (Figure 7.46)

    b) Check valve for vent is at the end of the hose

(Slide #71)

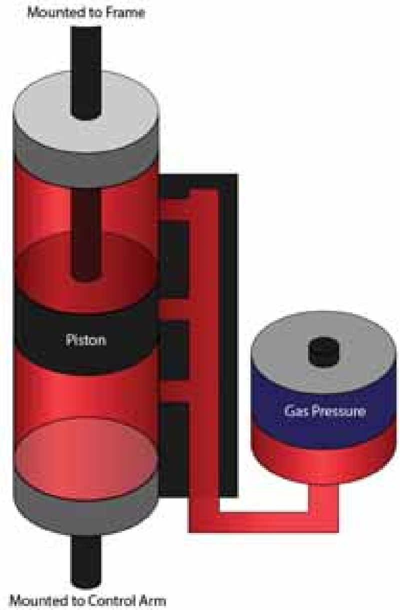


Figure 7.47 Theory of operation via illustration of shock absorber, manifold, and integrated accumulator

8. Diagram of flow/function

   a) This is what it looks like when you put it all together. (Figure 7.47)

      1) As the shock extends and contracts over bumps, oil is forced to transfer between the areas above and below the piston.

      2) As the piston moves within the shock body, it will force the oil through various dampening valves located between the shock body and the manifold. These valves control the dampening rate of the shock depending on where it is in its travel.

      3) The integrated accumulator provides opposing force pressure to ensure smooth and fast operation of the shock, preventing cavitation (low pressure bubble formation and oil foaming) and chatter (high pressure intermittent hydraulic lock).

      4) The closed circuit has harnessed the pressure of opposing forces and constantly strive for equilibrium.

Instructor Note
Ask if there are any questions before continuing.

Check on Learning

(Slide #72)

The purpose of the TAK-4i shock absorber is to absorb irregularities in the driving surface by maintaining wheel-to-ground contact.

Q: The integrated accumulator is a component of the shock absorber assembly, explain the function of the integrated accumulator in aiding with shock absorption/dampening and maintaining wheel-to-ground contact.
A: Each shock absorber assembly has an integrated accumulator, which is charged with pressurized nitrogen; the nitrogen provides resistance to push the hydraulics back into the shock to extend the rod and maintain wheel-to-ground contact

Q: What is the charge of the integrated accumulators for the front and rear suspension (two different charges)?
A: Charged to 620-psi front and 660-psi rear

Summary

(Slide #73)

The shock absorbers, the cross-plumbing and the roll control accumulators all work together to provide a highly responsive suspension. All three systems work together, are plumbed together, and work within a closed circuit to harness the power of the opposing forces of pressurized hydraulics and pressurized gas.

Transition

The last system to learn about for the JLTVA1 suspension is the roll circuit.

2. **(Slide #74)**

ELO C – LSA 2

Learning Step/Activity:	Roll Circuits
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	30 mins
Media Type:	PPT and Animated Graphic

(Slide #75)

a. Roll Circuit Overview

Figure 7.48 Rear suspension with roll circuit (highlighted in blue)

1. The roll circuit is integrated into the shock absorber assemblies by Equal Area Position Sensitive Cross Plumbing (EP-X). The two assemblies are connected and work in tandem; the shock absorber assemblies absorb and control the spring oscillation while the roll circuit controls body roll during cornering.

2. The roll control accumulators are plumbed into both ends of the roll circuit.

3. They are charged with a fixed amount of pressurized nitrogen. (Figure 7.48)

(Slide #76)

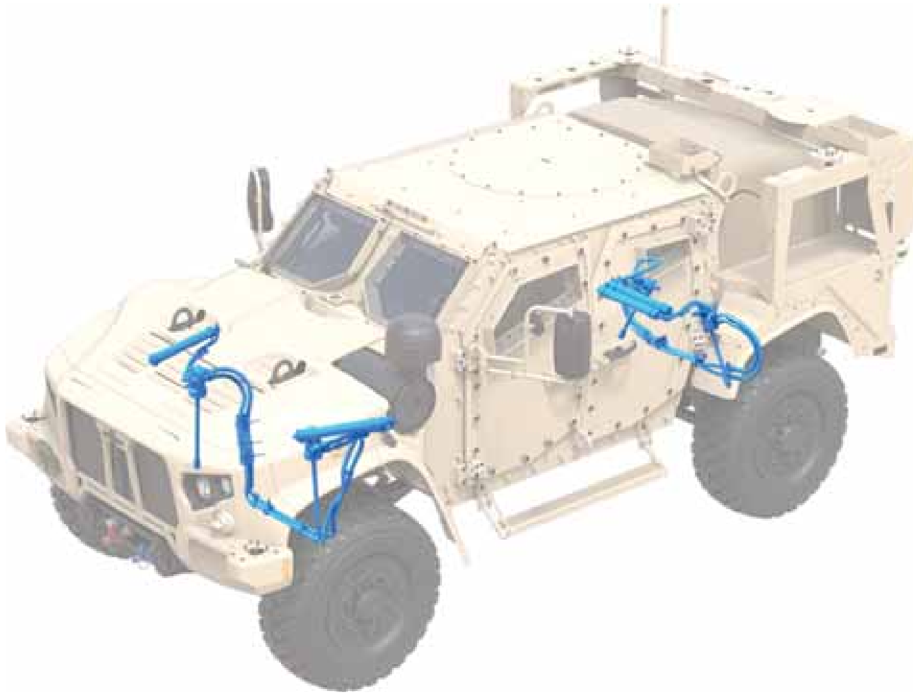


Figure 7.49 Roll control circuits (one front and one rear)

4. Roll Circuit Features (Figure 7.49)

   a) The purpose of the roll circuit is to act as a hydraulic sway bar.

   b) The tactical design of the roll control circuit features:

      1) Light weight

      2) Compact

      3) More ground clearance than traditional suspension

      4) Provides additional suspension articulation

Instructor Note:
Transition Statement: Let's walk through the cross-plumbing of the front end of this vehicle, starting on the driver's side. Focus on the connections between the components.

(Slide #77)

b. Roll Circuit Components

1. The roll circuit consists of three components;

   a) Upper portion of shock absorber assemblies

b) Equal-Area Position-Sensitive Cross Plumbing (EP-X)

c) Roll control accumulators

2. Shock Absorber assemblies were discussed a moment ago, so we'll continue to the next subassembly.

(Slide #78)

Figure 7.50 Front roll circuit cross plumbing (blue)

3. EP-X Cross Plumbing (Figure 7.50)

a) The roll circuit is engineered to always seek equilibrium throughout the plumbing circuit. This is referred to as Equal-Area Position-Sensitive Cross Plumbing (EP-X).

b) EP-X Cross Plumbing requires both sides of the roll circuit to have the same amount of oil on the piston side and the rod side, this enables us to x-plumb without initiating a hydraulic lock.

(Slide #79)

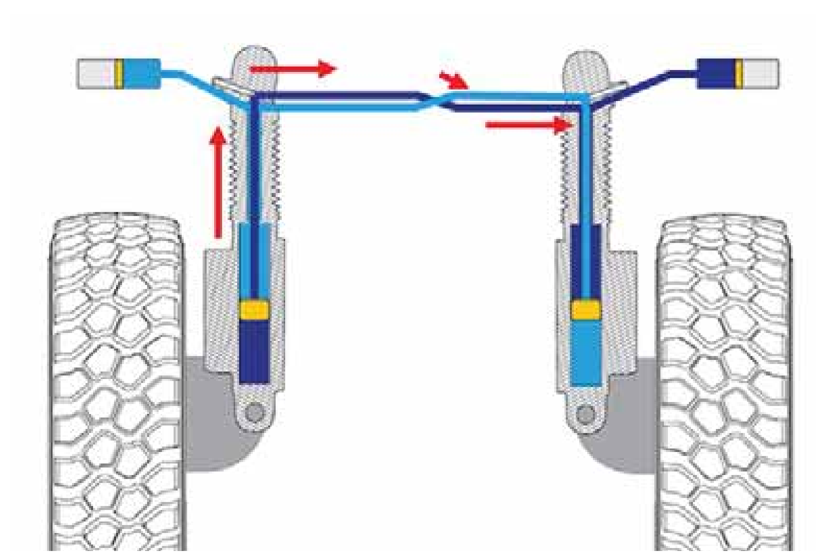


Figure 7.51 Illustration of roll circuit (blue) integrated into shock absorber (gray)

c) The roll circuit is plumbed into the shock absorber assembly but remains isolated from the manifold and integrated accumulator of the shock absorber assembly. The cross-plumbing circuit is isolated from the shock absorber circuit. (Figure 7.51)

1) The two sides of each roll circuit, connected by the EP-X cross-plumbing, are plumbed “cap-to-rod”, left to right meaning from the top (extend) port of one to bottom (retract) port of the other.

2) Hydraulic oil travels through the cross-plumbing across the vehicle to the opposite wheels’ shock.

3) The hydraulic plumbing from the driver side shock leaves the shock via one of two ports, then travels across the vehicle through hydraulic hoses, then connects to the passenger side shock.

4) The direction of flow of the hydraulic oil is dependent upon whether the wheel is going up/jounce, or down/rebound.

(Slide #80)

Instructor Note:
Play animated graphic while reading the description below. The arrows in the animation indicate the directional flow of hydraulic oil. You may pause or repeat the animation to give the explanation/discussion.

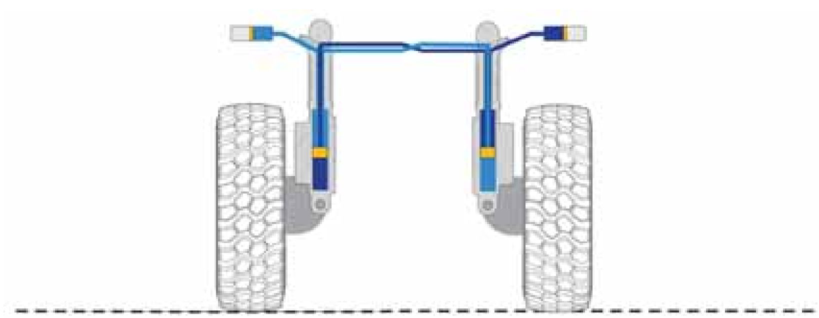


Figure 7.52 EP-X Scenario A: Hydraulic flow if one wheel up

5) **EP-X Scenario A: Only driver wheel goes up** (Figure 7.52)

(a) If the driver side wheel goes up, then shock contracts (because the piston is being shoved into the bore) which causes the hydraulic oil to exit the driver side cylinder at the cap, which is plumbed to flow into the passenger side cylinder at the rod.

(b) Because the passenger-side shock was already balanced and didn’t have any excess room for the driver’s side hydraulic oil, the excess hydraulic oil is pushed into the passenger-side roll control accumulator. The oil will find its way back to the driver’s side shock when the wheel goes back to neutral and opens, providing space for the oil to return.

(Slide #81)

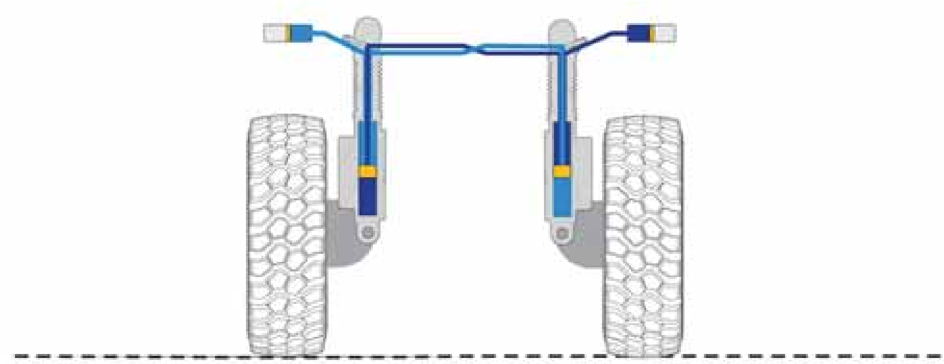


Figure 7.53 EP-X Scenario B: Equal area positioning

6) **EP-X Scenario B: Both front wheels go up (speed bump)**

   (a) Example: Both front wheels go down. If you're driving the JLTVA1 and you crest a speedbump, both front tires will be pushed toward the ground to reduce jounce.

   (b) Due to loss of contact with the ground and the equal volumes of oil that are cross plumbed, there is no net movement of the pistons in the roll control accumulators; because they both are pushing oil toward each other in the cross plumbed circuit the wheels are forced to the ground. (Figure 7.53)

7) Regardless of the terrain each wheel is seeking the ground and stability as a result of EP-X.

Instructor Note
Transition Statement: Any questions about the roll control circuit cross-plumbing?

(Slide #82)

Figure 7.54 Front suspension roll control accumulators

4. Roll Control Accumulators

   a) The roll control accumulators are positioned bilaterally on the roll circuit of the front suspension (Figure 7.54).

   b) The roll control accumulators are positioned together in the center of the suspension in the rear of the vehicle.

   c) The roll control accumulator is a component that requires service, meaning you will have to bleed and charge them, (physically damaged are not serviceable) so it is important you understand the theory of operations of this component.

(Slide #83)

Figure 7.55 Roll control accumulator piston (represented as red box to right)

d) The roll control accumulator is comprised of the sealed canister/ pressure chamber, the accumulator itself. (Figure 7.55)

e) Internal free-floating piston - There is hydraulic oil on one side of the roll control accumulator, compressed nitrogen is on the other side and the free-floating piston separating the two sides.

f) As mentioned previously, the hydraulic oil in the roll circuit is a unique oil called Bilstein oil. The roll circuit is specifically designed to use only Bilstein oil. Using any other oil will damage components and have a detrimental effect on performance.

g) Nitrogen charge ports are located on one end of each roll accumulator.

h) Hydraulic charge ports are located low on each EP-X hydraulic line (front and rear) on the left side of the vehicle.

5. Component operation

a) In the previous example where the driver's side wheel went downward while the passenger side wheel was stable, the hydraulic oil was directed to go into the accumulator because the passenger shock was already full of hydraulic oil.

b) The passenger side roll control accumulator affords the system with a place for the hydraulic oil to stay momentarily but will soon find itself pushed back into the shocks due to the HPG pressurized nitrogen on the other half of the accumulator.

Instructor Note:
Any questions about the operation of the roll circuit?

(Slide #84)

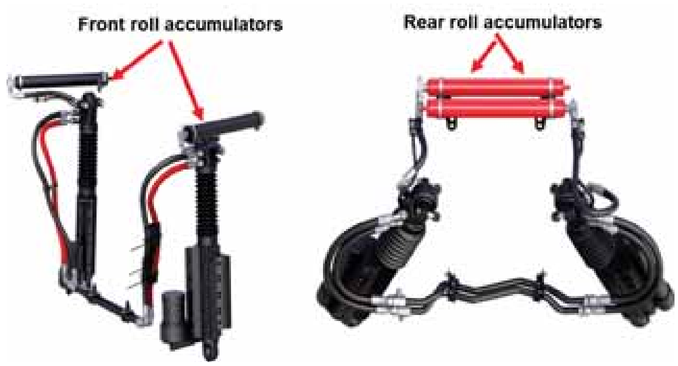


Figure 7.56 Front suspension (left) and rear suspension (right)

6. Components: Front vs. Rear (See Figure 7.56)

   a) The difference between the front and rear systems with regards to the shock absorber assemblies and roll control circuit is the positioning of the roll control accumulators.

   b) The rear suspension has both roll control accumulators positioned side-by-side in the center of the suspension

   c) The front suspension's roll control accumulators are positioned bilaterally, one on each side of the suspension.

Instructor Note
Transition Statement: Any questions about the roll control accumulators?

Check on Learning

(Slide #85-86)

The JLTVA1 has two roll control circuits, one in the front and one in the rear.

Q: The general construction of the roll control circuit consists of three components, what are they? (Refer to images below for assistance)
A: Shocks (two), EP-X cross-plumbing, and roll control accumulators (two).

Figure 7.57 Front (left) and rear (right) roll circuits

Q: The purpose of a roll control accumulator is two-fold, what are the two functions?
A: They provide both static opposing pressure (nitrogen against hydraulic) and expansion volume for the roll circuit.

Q: The EP-X cross-plumbing connects to the shock absorber assemblies, yet the hydraulic oil for the shock absorbers and the hydraulic oil for the roll control circuits never mix. How does this work?
A: The top portion of the shock absorber is dedicated to the roll circuit, and the roll circuit plumbing is tubed through the shock absorber to travel across the system to the other shock absorber and roll control accumulator. This hydraulic section of the shock absorber assembly is isolated from the hydraulics of the shock absorbing lower section.

Q: How are do the accumulators provide static opposing pressure and expansion volume?
A: Each accumulator contains a nitrogen charge; the gas is compressible which enables the accumulator to absorb the movement of hydraulics while also providing an opposing resistive force.

Summary

(Slide #87)

The shock absorbers, the cross-plumbing and the roll control accumulators all work together to provide a highly responsive suspension.

All three systems work together, are plumbed together, and work within a closed circuit to harness the power of the opposing forces of pressurized hydraulics and pressurized gas.

Because the suspension system is a closed circuit, the accumulators do not have pumps and subsequently require pressure checks and charging. Only the HPG springs have pumps, and that is to enable your Operators to make vehicle ride height changes.

Transition

Any questions? Alright, now let’s get out to the truck and go eyes-on with the shock absorber assemblies, roll control circuit, and roll control accumulators.

3.

(Slide #88)

ELO C – LSA 3

Learning Step/Activity:	Shock Absorber Assemblies & Roll Circuit Component ID
Method of Instruction:	Practical Exercise
Instructor to student ratio:	1:5
Time of instruction:	30 mins
Media Type:	None

(Slide #89)

See Appendix C: PE No. 7F - 1

Instructor Note

Conduct Check on Learning and Summary of practical exercise in the shop to use the JLTVA1.

Check on Learning	None
Transition	Any questions? Now that you are quite familiar with the JLTVA1 suspension systems, our next objective is to focus on how to maintain it and understand indicators of poor performance or problems.

4. **(Slide #90)**

ELO C – LSA 4

Learning Step/Activity:	Suspension Maintenance and Troubleshooting
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	45 min
Media Type:	PPT/Video

(Slide #91)

a. Suspension Maintenance Overview

1. Basic wear and tear

a) The suspension system has moving parts which will wear out over time. It is required to inspect the components of the suspension periodically to make sure that they are within tolerance. This could include measuring shock length, hydraulic pressure, and nitrogen pressures (at different locations.)

2. Indicators of poor performance

a) Dash indicators

1) Suspension Error – Continuous amber light indicates there is a fault within the suspension system or one of the timeouts/ overtemperature thresholds have been met.

2) Suspension Not Level is a dash indicator that will illuminate when a pressure differential of 80-psi or greater is detected between springs. As stated previously, this may occur after the vehicle has sat idle for a period of time.

(a) This indicator may turn on and off during normal operation while the JLTVA1 is navigating uneven terrain.

(b) The indictor is only a concern when it stays on even when the JLTVA1 is parked on level ground and in operational ride height.

b) DSDU

1) Suspension notifications displayed on the DSDU are from communications of faults within the HPG springs system.

2) The shock absorber assemblies and roll circuit do not have sensors and will not display information on the DSDU.

c) Physical Observations

1) If the vehicle is riding rough or visibly evident damage has occurred, the system will require maintenance.

2) Not responsive to ride height commands.

3) Excessive lean on front, rear, or an individual corner of the vehicle.

(Slide #92)

3. Safety

a) Always use the suspension lock out braces when performing maintenance on the suspension unless the vehicle is supported by jack stands from both ends. Rapid loss of nitrogen pressure will cause the vehicle to drop abruptly.

4. Special tools

a) Maintenance on the suspension system requires the use of nitrogen and hydraulic charging carts, as well as the suspension service kit which will have the appropriate hoses, gauges and fittings.

5. Resources

a) Maintainers should ALWAYS use the TM when performing maintenance tasks on the JLTVA1. Sequence is extremely important when servicing or maintaining the suspension.

Figure 7.58

(Slide #93)

b. Vehicle Inspection and Routine Maintenance

Figure 7.59 Pressure gauges for nitrogen charge cart

1. Checks

    a) Vehicle walk arounds; look for leaks, listen for excessive or unusual noise. The easiest way to identify if the suspension is working correctly, is to do a visual inspection and try to identify if anything is leaking or physically broken.

2. Scheduled maintenance

    a) Scheduled maintenance covers visual and technical inspection of suspension components. For example, during the annual PMCS, accumulator pressures should be checked using the nitrogen charge cart. (Figure 7.59)

(Slide #94)

3. Bleed Suspension Prior to Maintenance

    a) Bleeding procedures should be done prior to removing any suspension component, or if air has been introduced to the system. Prior to performing any maintenance on the shock absorber assemblies, the maintainer must relieve the hydraulic pressure from the cross plumbing. Failure to comply can result in damage to the roll control accumulator.

    b) There are two bleed screws for each corner of the roll circuits; one at the hydraulic inlet to the roll accumulator, and one toward the top of each shock absorber assembly.

    c) While bleeding the roll circuit hydraulics, always start at the roll control accumulator bleeder valves, as they are the furthest downstream from the charge port.

        1) Pay attention to the pressure of the hydraulic charge cart while bleeding and be sure to keep it within the IETM-specified pressure range. Bleeding at high pressure can cause severe injury.

2) All four corners of the JLTVA1 roll control circuits will be bled the same way.

(Slide #95)

d) Anytime bleeding procedures are being performed, the vehicle should be suspended or braced with the suspension lock out braces. Once pressure is relieved from the system, there will be limited support from the suspension.

e) When bleeding nitrogen from any of the accumulators or the HPG springs, be sure to take note of any hydraulic oil being expelled. This would indicate worn or failed internal components and requires further inspection. Nitrogen circuits should never have any hydraulic oil mixed in.

f) When bleeding nitrogen circuits, be sure to be in a well-ventilated area. Nitrogen is not toxic or poisonous; however, it can displace oxygen in a confined area and cause asphyxiation.

(Slide #96)

c. Shock Absorber and Roll Control Circuit Maintenance

Figure 7.60 Shock absorber assembly replacement (retracted state)

1. Servicing the JLTVA1 shock absorber may include:

a) Physical inspections – No sensors/electronics for DSDU

b) Shock Removal/Replacement

1) You will not do any maintenance on a shock absorber assembly; they can only be serviced as a unit.

2) Removing and replacing a shock absorber requires following an extensive and lengthy process. The order in which the procedure is performed is critical, so be sure to follow the IETM step-by-step.

3) New shocks come in a fully retracted configuration, with caps on the hydraulic ports to prevent contamination. (Figure 7.60) Shocks cannot be installed while they are retracted and will need to be extended for use (refer to IETM for instructions).

4) A high-level description of the work package is below:

   (a) Preconditions: There are preconditions to removing and replacing shock absorber including: Depressurize the HPG Springs, Roll Control Circuit, and Hydraulics

   (b) Shock Removal

   (c) Shock Disassembly

   (d) Extend Replacement Shock for Use

   (e) Shock Installation

   (f) Follow-on Tasks: There are follow-on tasks required to complete a shock removal and replacement including: Bleed/Charge the Roll Control Circuit and Hydraulics

5) Due to the length of time required for conducting a shock removal and replacement, the safety equipment and special tools involved we will watch an abbreviated video demonstration prior to conducting the practical exercise. Each of the tasks conducted in the video are bulleted below as well.

(Slide #97)

Instructor Note
Inform students: This is an animated video demonstration of how to extend the shock absorber using the cart. These animations are available in the IETM. Play video for learners while reading bullets below. Video: Shock Extension

Figure 7.61 Illustration of shock maintenance animation (See IETM to view)

c) To extend the shocks use the hydraulic charging cart to apply Bilstein oil to extend the shock

1) Note: An animated example of this procedure is available in the IETM. (Figure 7.61)

2) Remove Potential Bubbles: After the replacement shock is extended tip the shock to a 45° angle then back to vertical position to ensure there are no bubbles inside the hydraulic channel.

3) Then connect the shock to the charging cart again and complete the charge so the shock is fully extended. The shock should be filled through the extend port which is the top port on the cap of the shock.

4) Cap the shock hydraulic ports promptly after extending for use, until ready to connect the cross plumbing.

d) After the shock has been installed and the cross plumbing has been connected, the maintainer should complete a bleeding procedure, before charging to operational pressure.

e) Once components have been replaced, and bleeding procedures have been completed, the components will be ready for charging.

(Slide #98)

Instructor Note
Inform students: This is an animated video demonstration of how to charge the shock absorber's integrated accumulator. These animations are available in the IETM. Play video for learners while reading bullets below. Video: Charging Integrated Accumulators of Shock Absorber

f) Charging integrated accumulators (no animation in presentation)

1) The same thing applies to the integrated accumulators as the roll control accumulators. The only difference here is that the integrated accumulator has a diaphragm separating the nitrogen from the hydraulic oil, and not a free-floating piston. Both the integrated accumulator and roll control accumulators have Schrader valves to charge the nitrogen.

2) Always follow the correct procedure in the IETM work package for using the components in the suspension service kit.

(a) The proper line to use for charging the integrated accumulators is braided steel and has a threaded Schrader fitting on one end and a quick-connect fitting on the other.

(b) Use the gas pressure regulator and the digital pressure gauge included in the suspension service kit to monitor and control charging pressure.

(Slide #99)

2. Servicing the JLTVA1 Roll Control Circuit

   a) Maintenance for the front and rear roll circuit is very similar, in addition to regular inspections some maintenance tasks are:

      1) Regular inspection

      2) Periodic bleed/charge if pressures are too low

      3) Bleed Bilstein oil out of roll circuit

      4) Bleed nitrogen out of roll circuit

      5) Accumulator maintenance:

         (a) Bleed/charge roll control accumulator

         (b) Remove/replace roll control accumulator

(Slide #100)

Instructor Note
Inform students: This is an animated video demonstration of how to charge the roll control accumulator. These animations are available in the IETM. Play video for learners while reading bullets below. Video: Charging Roll Circuit Accumulators

Figure 7.62 Illustration of roll control accumulator charge maintenance animation (See IETM to view)

   b) Charging roll control accumulators

1) The roll circuit accumulators have a free-floating piston internally. These pistons provide the resistance against the Bilstein oil.

2) For the system to perform correctly, the nitrogen needs to be applied to the accumulator prior to hydraulic oil bleed and charging procedures, because the pressure from the gas will move the free-floating piston all the way down the accumulator which helps in discharging the hydraulic pressure.

3) The nitrogen should be regulated to the IETM-specified pressure.

4) All the nitrogen components should be given a few minutes to stabilize when specified pressure is achieved, to verify accurate charge has been achieved, and no leaks are present.

5) Animated Example of this procedure is available in the IETM. (Figure 7.62)

(Slide #101)

Instructor Note
Inform students: This is an animated video demonstration of how to charge the hydraulic roll circuit. These animations are available in the IETM. Play video for learners while reading bullets below. Video: Roll Circuit Hydraulic Charge

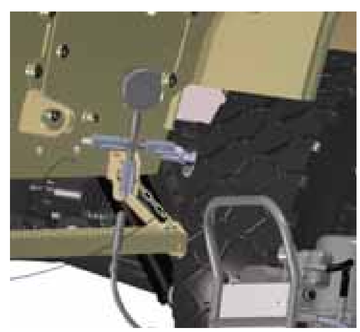


Figure 7.63 Illustration charging hydraulics of roll circuit maintenance animation (See IETM to view)

c) Charging the roll circuit with Bilstein oil

1) Charging the hydraulic side of the roll circuit is typically the last part of the suspension system to receive pressure.

2) There are four charge ports for the roll circuit on the JLTVA1. They are located on the cross-plumbing lines on the driver side of the vehicle.

3) There are two on the front, and two on the rear. The front and the rear are charged in the same way, with different pressures.

4) Charging should only occur after the roll control accumulators have been charged with nitrogen.

5) Note: When connecting the charging lines to the charging ports, it might feel like the lines are tight; that is a result of the pin being under both spring and oil pressure. You will have to overcome with the charging line by tightening the fitting.

6) Once the hydraulic roll circuit has been charged to the specified pressure, the charge cart should remain connected while the pressure stabilizes. (Figure 7.63)

NOTE

It is important to remember to disconnect the charging lines from the charge ports on the truck, prior to removing them from the charging manifold.

(Slide #102)

Warning and Caution

Shock Removal:

Shock hydraulic system and HPG nitrogen system are high pressure systems. Take care when working on or around shock hydraulic system and HPG nitrogen system by wearing proper protective gear. Read procedures prior to performing task. Failure to comply may result in injury or death to personnel.

Cover or plug all hoses, lines, tubes, fittings, and openings immediately after disconnection to prevent contamination. Failure to comply may result in damage to equipment.

Instructor Note

Allow students time to look in the IETM and look at the resources and directions they'll have available to them later, to ensure they are familiar and comfortable.

- Open EMS-NG to the JLTVA1 Suspension Maintenance WPs.
- Open Shock Removal and Replacement WP
- Walk through at high level:
  - Preconditions & Safety
  - Open one of the Preconditions to show it is another lengthy maintenance process
  - Back to Shock R/R and show how many steps are in that one task (over 20)
  - Emphasize tasks must be completed in correct sequence - critical for safety and avoiding risk.

Inform students: As you can see from the work package in the IETM, Shock Removal and Replacement is a lengthy process, so to save time we are going to watch **a video demonstration of this maintenance task.**

(Slide #103)

Play the video demonstration – *Shock Removal and Replacement* (20 min)

(Slide #104)

d. Troubleshooting Shock Absorber and Roll Control Circuit

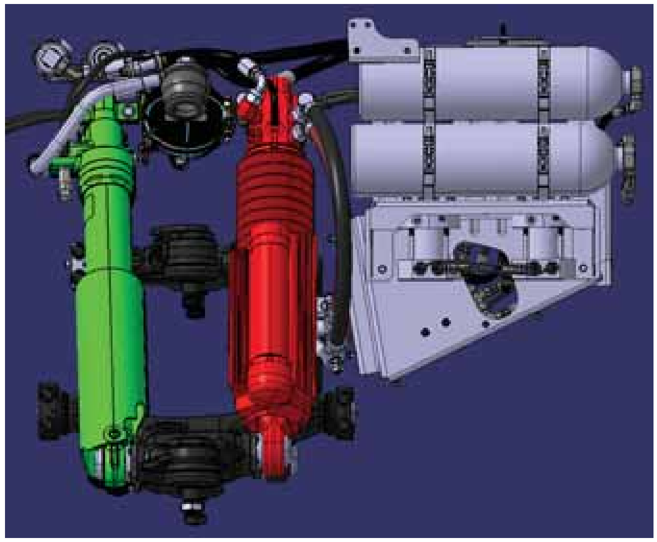


Figure 7.64 Shocks (red) could cause ride height changes if their integrated accumulator has a leak (Figure 7.65)

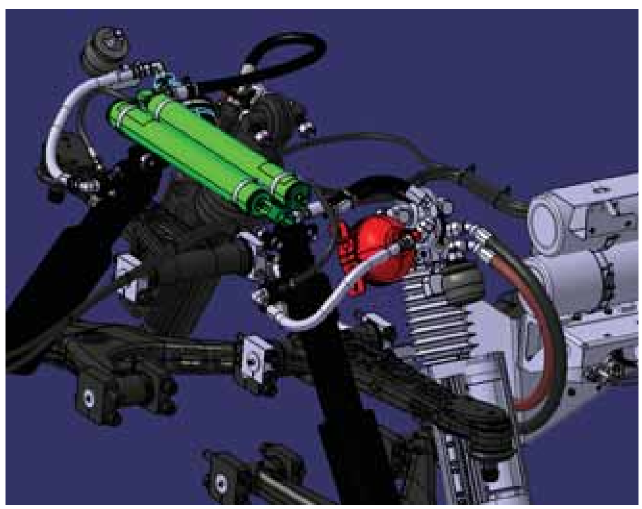


Figure 7.65 Roll Control Accumulators (green) of rear suspension

1. Slow Ride Height Change

   a) The shocks may be the cause of slow ride height changes if there were an internal leak in the integrated accumulator or in the bypass circuit. (Figure 7.64)

2. Side to Side Shift

   a) A leak in the roll accumulator would result in a small side to side shift or increased body roll due to the equal area balance of the accumulator.

Check on Learning	**(Slide #105)** **Q:** Where should a maintainer start bleeding the hydraulics? Hint, they are the furthest downstream from the charge port. **A:** Always start at the roll accumulator bleeder valves. **Q:** Where are the bleed screws for the roll circuit hydraulics? **A:** On the top of the shock absorber assembly. The driver's side bleed screw bleeds the passenger side shock absorber assembly and the passenger side bleed screw bleeds the driver side. **Q:** After the maintenance tasks are completed, which part of the system is charged first: the roll accumulator nitrogen; or the roll circuit hydraulics? **A:** Charge the roll accumulators with nitrogen first.
Summary	**(Slide #106)** **Instructor Note** Review/Provide correct answers for label diagram. See solutions sheet. Sequence Matters! The order of the tasks required to provide service to the TAK-4i suspension system doesn't just matter…it's critical to your safety. As you saw on the video and the next practical exercise, the sequence for preparing and maintaining the suspension system generally requires: • Suspend vehicle • Depressurize HPG Spring system • Relieve pressure from hydraulic roll circuit • Relieve nitrogen pressure from roll accumulator • Complete your maintenance, and it's time to reassemble the suspension system. • Charge roll accumulator - nitrogen. • Bleed Roll Circuit • Charge roll circuit with hydraulic • Charge HPG Springs Remember to check your HPG reservoir pressure as it may or may not need charging after you conduct maintenance procedures.
Transition	Time for some hands-on. Let's go to the truck and do some light maintenance tasks for our PE. Before we go to the shop, we must do a quick safety review about the high-pressure systems risks and crushing risks. Remember, there is ZERO clearance between the tire and the wheel well if suspension collapses, and only about 5 inches under the chassis.
5.	**(Slide #107)** ELO C– LSA 5 Learning Step/Activity: Preconditions of Shock Remove/Replace: Depressurize Nitrogen System and Components

Method of Instruction:	Guided Practical Exercise
Instructor to student ratio:	1:5
Time of instruction:	1 hr
Media Type:	None

(Slide #108)

a. Proactive Safety Notification

TOPIC	Activity	SEVERITY
Crushing Injuries	**Maintenance**	**Severe**

Figure 7.66 Without safety equipment clearance under JLTVA1 is five inches/no clearance in wheel wells

(Slide #109)

See Appendix C: PE No. 7G – 1

6.	ELO C – LSA 6 Learning Step/Activity: Shock Removal Method of Instruction: Practical Exercise Instructor to student ratio: 1:5 Time of instruction: 5 hr Media Type: None See Appendix C: PE No. 7G – 1
7.	ELO C – LSA 7 Learning Step/Activity: Follow-On Tasks of Shock Removal and Replacement: Bleed/Charge Roll Control Circuit Hydraulics and Recharge Nitrogen System and Components Method of Instruction: Guided Practical Exercise Instructor to student ratio: 1:5 Time of instruction: 3 hr 30 min Media Type: None See Appendix C: PE No. 7H – 1
Check on Learning	None
Summary	None
Transition	Any questions about the TAK-4i suspension? Next, we'll cover the hydraulic and steering systems.
Enabling Learning Objective D.	**(Slide #110)** Upon completion of this lesson, you will be able to: Action: Troubleshoot the hydraulic and steering system failure Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel and reaching the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activities.

1. **(Slide #111)**

ELO D – LSA 1

Learning Step/Activity:	Hydraulics and Steering
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	20 mins
Media Type:	PPT

Instructor Note
Use the Learning Step slides to aid with transitions across topics. These slides provide queues to the student of the content covered and topics up next.

(Slide #112)

a. Hydraulic Theory of Operations

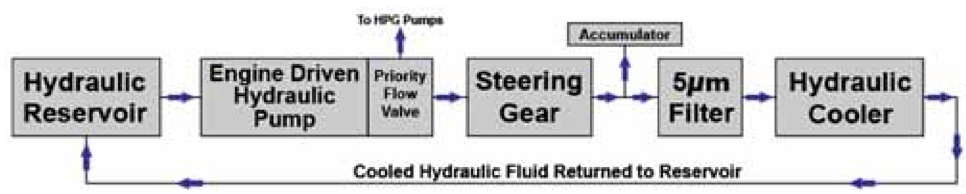


Figure 7.67 Hydraulic flow for Steering

1. Hydraulic Pump Overview

   a) The hydraulic pump has a primary function of providing hydraulic flow to the steering gear for the power steering function. The secondary function is to drive the high-pressure gas (HPG) pumps for ride height adjustments. The pump has an internal priority flow valve, which controls flow direction to either the steering or the HPG piston pumps.

2. Hydraulic Flow for Steering

   a) The hydraulic pump receives oil from the hydraulic tank and provides 4 GPM at 800 RPM through the priority flow valve to the steering gear. Once oil passes through the steering gear, flow will continue through a 5-micron return filter, and then on through the oil cooler before returning to tank.

   b) With oil being diverted to the hydraulic manifold for suspension operation, the priority flow valve will provide minimal pressure and flow to the steering gear. (Figure 7.67)

   c) A nitrogen-charged accumulator is used to dampen pressure pulses in the return line from the steering gear when traversing rough terrain at higher speeds.

(Slide #113)

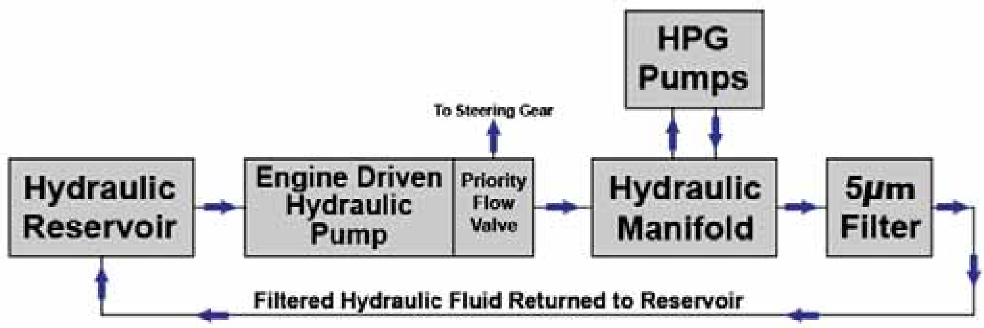


Figure 7.68 Flow to HPG spring for suspension adjustment

3. Hydraulic Flow for Suspension

   a) If RPM is increased due to a suspension ride height adjustment being selected, the pilot operated priority flow valve will move allowing flow to be re-directed to the hydraulic manifold to run the HPG piston pumps. With oil being diverted to the hydraulic manifold for suspension operation, the priority flow valve will provide minimal pressure and flow to the steering gear.

   b) Once flow is returned from the hydraulic manifold, it will then pass through a separate hydraulic filter and return to tank.

   c) When suspension changes are no longer required, and the vehicle has returned to idle, the priority flow valve will be returned to its normal state via "spring return" and provide operational flow and pressure to the steering gear.

(Slide #114)

b. Hydraulic System Components

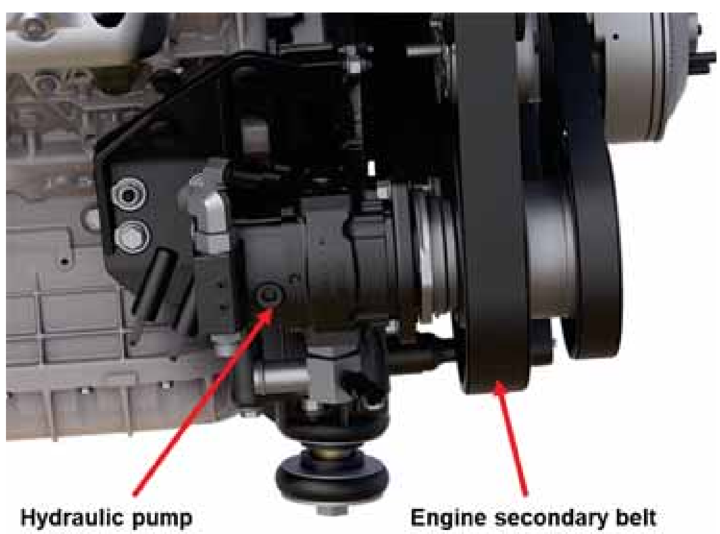


Figure 7.69 Hydraulic system components

1. Hydraulic pump

    a) The hydraulic system is powered by a belt-driven gear pump with a 1.29 cubic inch (21.1cc) displacement per revolution.

    b) The pump is mounted on the lower right front of the engine.

    c) Equipped with an integrated Pressure/Flow Compensator Valve (PFCV) which modulates pump output to only what is required

2. Engine Secondary belt

(Slide #115)

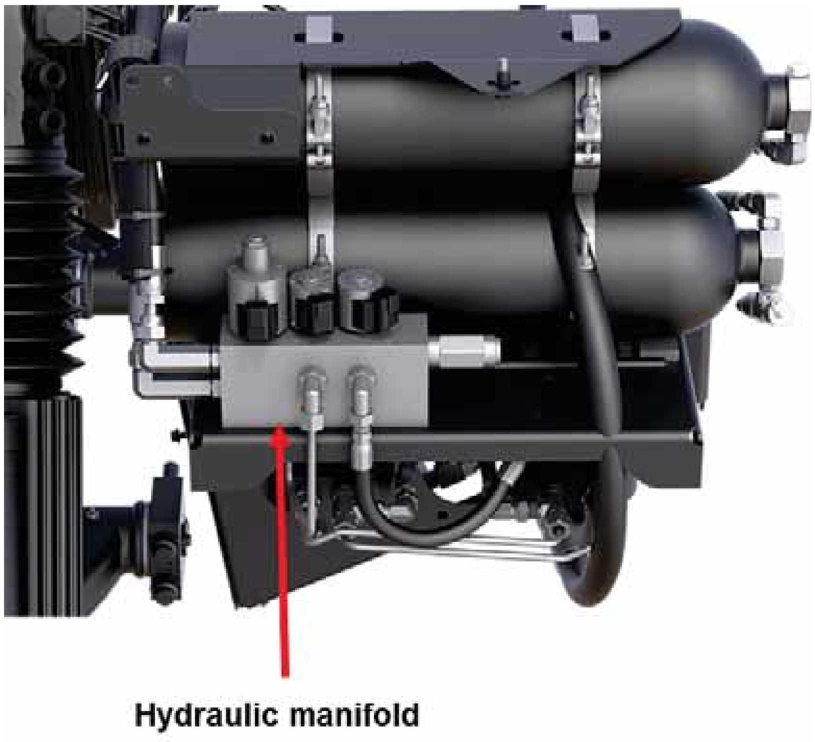


Figure 7.70 Hydraulic manifold

3. Hydraulic manifold

    a) Has two smaller solenoids supply hydraulic oil to front & rear HPG piston pumps driving nitrogen circuit

    b) Distribution manifold

    c) Supplies 4 GPM at 3,250 psi to the HPG suspension circuit, which is used to raise and lower the suspension.

(**Slide #116)**

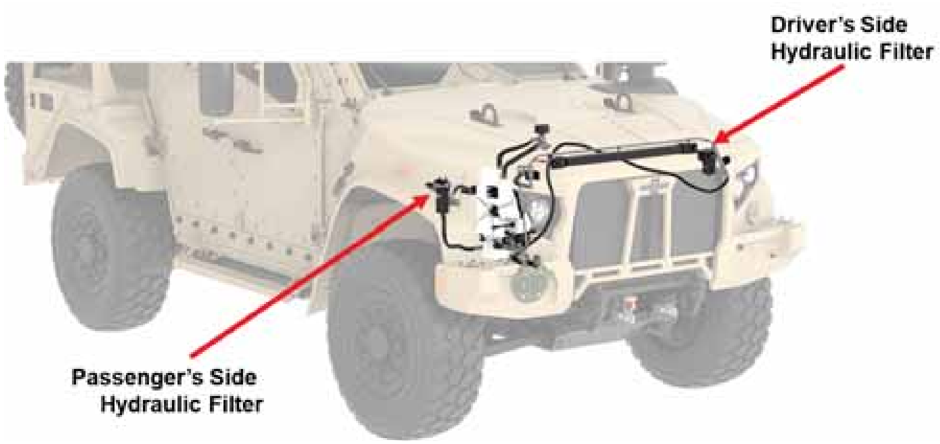


Figure 7.71 Hydraulic manifold

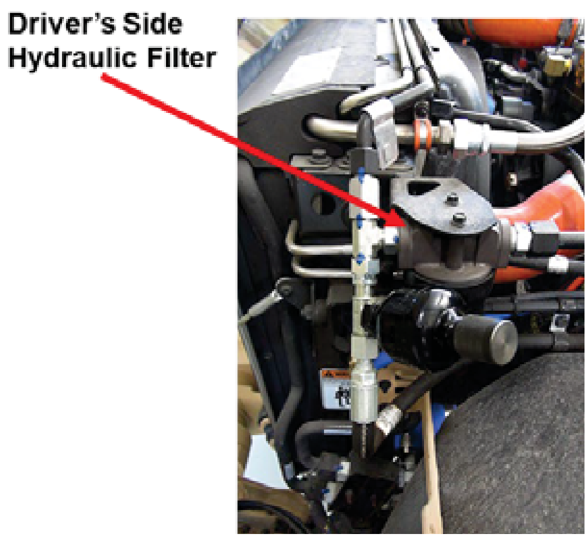


Figure 7.72 Hydraulic filters passenger side and driver side (immediately above)

4. Accumulator

   a) Located on the return line from the steering gear near the filter

   b) Charged with approximately 65 psi of nitrogen

5. Hydraulic Filters

   a) There are two five-micron return filters each with a 50-psi bypass to remove contaminants.

   b) One return filter is located on the return from the steering circuit (Figure 7.71)

   c) The other return filter is located on the return from the HPG circuit.

6. Hydraulic cooler

    a) Located in the cooling pack, mounted on top of the radiator.

    b) Cools the hydraulic oil prior to it returning to tank.

7. Hydraulic tank

    a) Mounted to the right side of the engine.

    b) Capacity is 6.5 quarts of 0W-30

(Slide #117)

c. Hydraulic Pump System Operation

1. The hydraulic pump receives oil from the hydraulic tank and provides 4 GPM at 800 RPM through the priority flow valve, to the steering gear.

2. Once oil passes through the steering gear, flow will continue through a filter, and then on through the oil cooler, before returning to tank. (Figure 7.73)

3. At optimal performance:

    a) Flow Rate: 4 GPM

    b) Pressure: 3250-psi

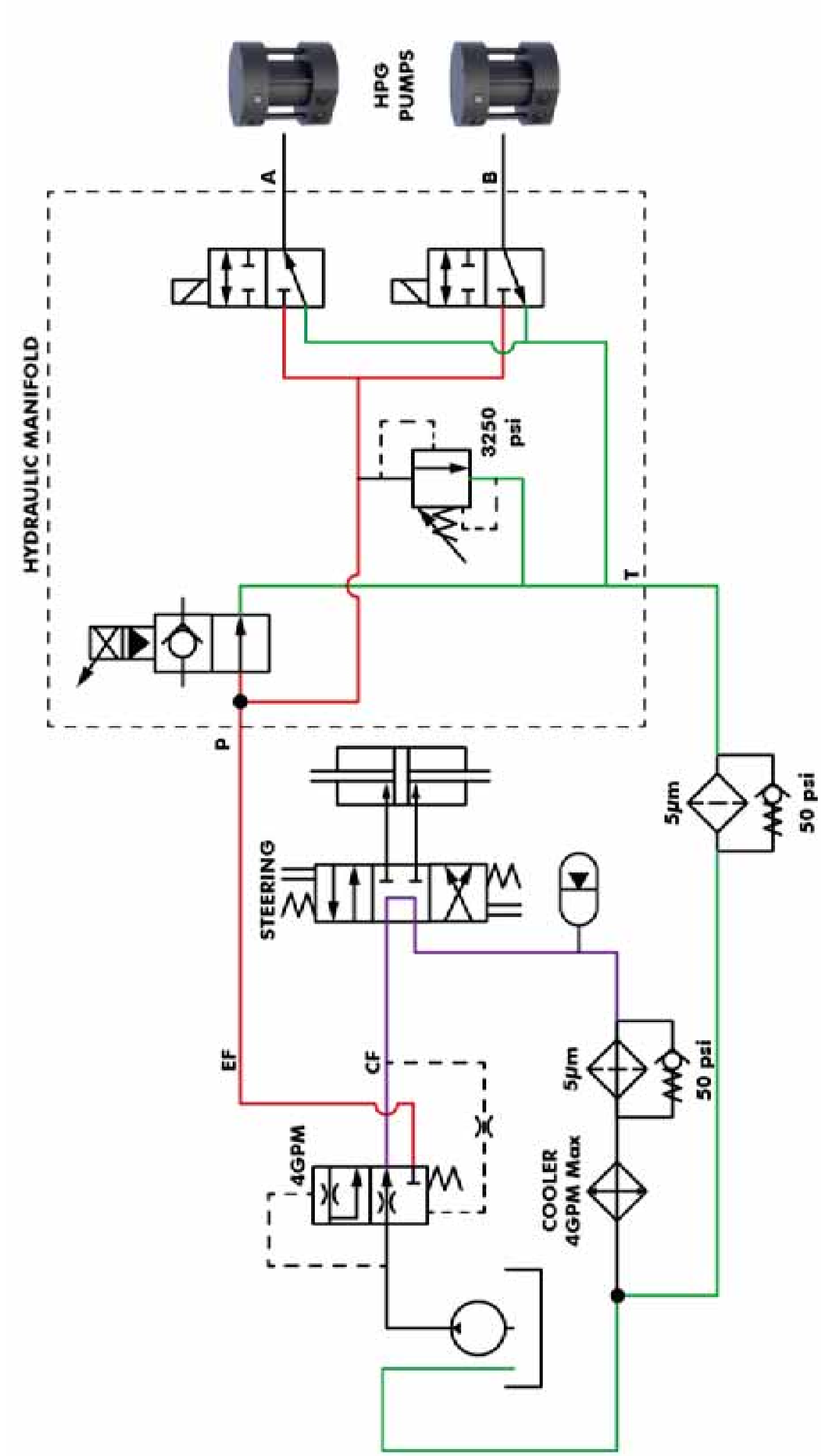


Figure 7.73 Hydraulic pump schematic

(Slide #118)

d. Steering Components (Figure 7.74)

Figure 7.74 Steering components (in red)

1. Steering Knuckle
2. Mechanical (Toe) links and shafts
3. Steering Gear
4. Idler Arm
5. Steering Column/Wheel

Check on Learning

(Slide #119)

Q: The hydraulic system controls both the power steering as well as the HPG piston pumps. What internal component controls the direction of the flow to the steering and/or HPG pumps?
A: The pump has an internal priority flow valve, which controls flow direction to either the steering or the HPG piston pumps.

Q: Explain why it is safe for the hydraulic pump that supports steering capabilities, to be the primary hydraulic pump enabling ride height changes.
A: Ride height changes should occur when the vehicle is not in motion and is on a level surface etc. therefore steering capability should not be required at the same time as a ride height change.

Q: During a ride height adjustment, oil is diverted to the hydraulic manifold for suspension operation, explain the flow of the hydraulics after the ride height command is completed.
A: When suspension changes are no longer required, and the vehicle has returned to idle, the priority flow valve will be returned to its normal state via “spring return” and provide operational flow and pressure to the steering gear.

Summary	**(Slide #120)** The hydraulic system is dual purpose, it controls both the power steering as well as the HPG Piston pumps. The pump has an internal priority flow valve, which controls flow direction to either the steering or the HPG piston pumps. When a ride height command is given, the ride height takes precedence over steering.
Transition	Any questions? Next, we go to the truck to identify the hydraulic system and steering system components.
2.	**(Slide #121)** ELO D – LSA 2 Learning Step/Activity: Hydraulics and Steering Component ID Method of Instruction: Guided Practical Exercise Instructor to student ratio: 1:5 Time of instruction: 30 mins Media Type: None **(Slide #122)** See Appendix C - PE No. 7J – 1
Check on Learning	None
Transition	Now that you are familiar with the components and the system functionality, we'll continue by learning about the hydraulics' and steering system's maintenance needs.
3.	**(Slide #123)** ELO D – LSA 3 Learning Step/Activity: Hydraulic and Steering Maintenance and Troubleshooting Method of Instruction: Lecture Instructor to student ratio: 1:15 Time of instruction: 10 mins Media Type: None **(Slide #124)** a. Hydraulic and Steering Systems Maintenance

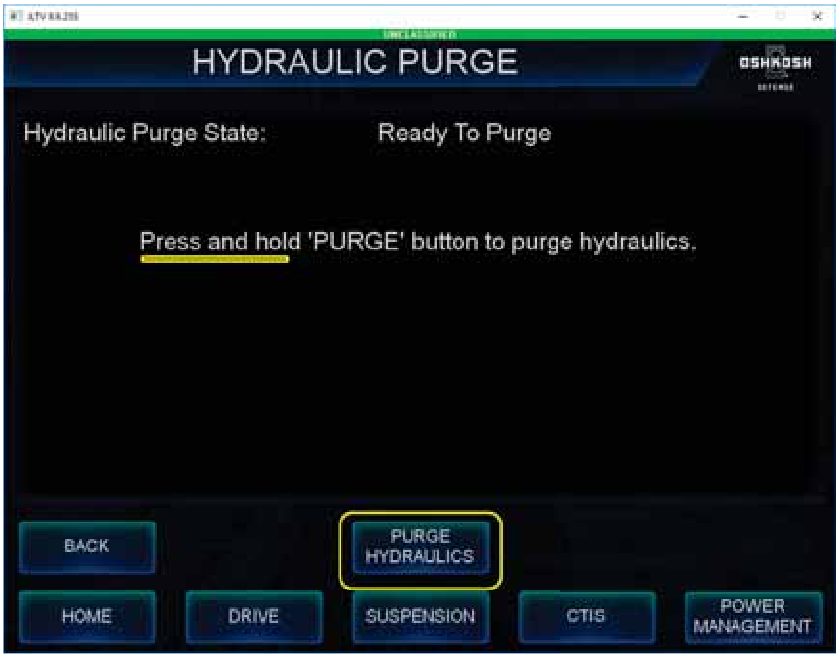


Figure 7.75 DSDU screen for conducting hydraulic purse.

1. PMCS – Scheduled Maintenance

   a) Inspections: The maintainer should verify that the hydraulic system is free of leaks and damage, that the tank has sufficient hydraulic oil to function, and add oil if necessary.

2. Anytime a hydraulic component is changed or removed from the HPG pump hydraulic circuit, the maintainer should perform a hydraulic purge from the DSDU. (Figure 7.75)

   a) This prevents air from causing cavitation in the HPG pumps which would lead to premature failure.

   b) The hydraulic purge allows for hydraulic oil to pass internally from the hydraulic pump, through the hydraulic manifold to the HPG pumps, and back to the hydraulic tank. This will purge any air from the circuit.

   c) The DSDU screen is displayed above; note you must press and hold the PURGE HYDRAULICS button. (See Appendix D – DSDU Job Aid Sheets for step-by-step DSDU screens)

(Slide #125)

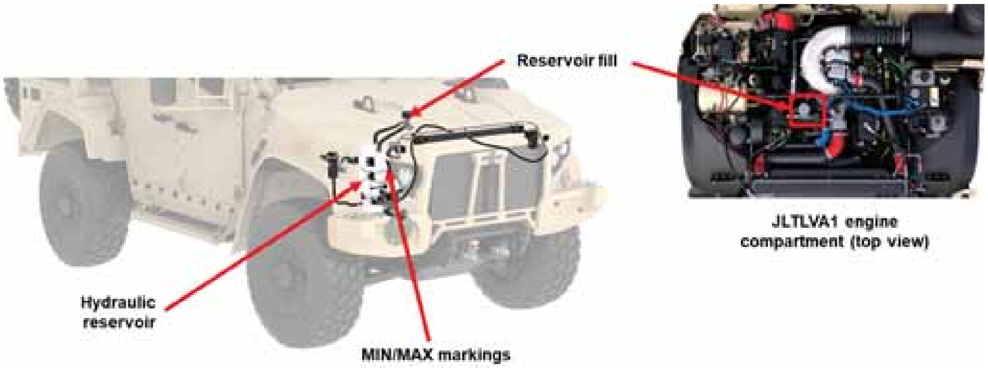


Figure 7.76 Hydraulic Reservoir Fill and Check

3. Main Hydraulic Reservoir Drain/Fill

   a) There is easy access to the main hydraulic reservoir fill port with the hood up and a remote filler neck allows for refilling.

   b) There are MIN and MAX markings located on the top front corner of the translucent reservoir (Figure 7.76) to determine the hydraulic fluid level. The fluid level must be inspected before each use of the JLTVA1 to ensure that there is adequate fluid based on operating temperatures.

   c) The drain for the hydraulic system is on the bottom of the reservoir accessible from the wheel well area.

   d) Troubleshooting might need to be done if it is difficult to steer the truck or if suspension ride height adjustments are not being completed.

(Slide #126)

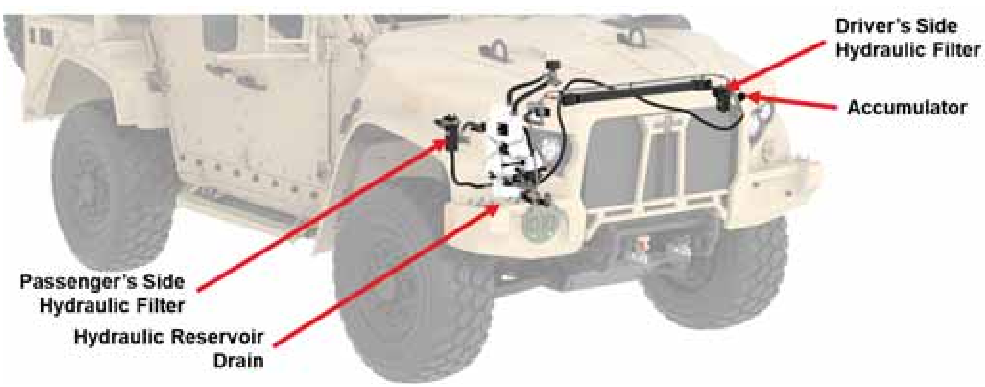


Figure 7.77 Hydraulic reservoir fluid check and drain – driver's side

4. Replace Hydraulic Filters

a) There are two hydraulic filters on the JLTVA1 that require service, both located under hood in the engine compartment. One is located on the driver’s side and one on the passenger’s side (Figure 7.77). Both filters are located on low pressure return lines.

5. Accumulator

a) Nitrogen charge pressure should be approximately 65 psi.

b) Nitrogen pressure should be checked during scheduled maintenance IAW the technical manual and if necessary, adjusted according to specification

(Slide #127)

Figure 7.78 Steering Components (in red)

6. Steering maintenance may include:

a) Inspections - Components requiring inspection are the ball joint boots, constant velocity joint (CV) boots, and drag link boots.

b) Poppet adjustment

c) Toe inspection/adjustment

(Slide #128)

d) Lubrication - The steering shaft knuckles must be greased as part of annual service using the standard zerk fittings located at each knuckle.

7. Component Locations: Because the steering shafts will require minimal service, they are in a position that does not impact the operation of the JLTVA1 yet provide easy to access. The interior steering shaft is protected by the lower dash cover and require only an Allen wrench to access. The exterior shaft is accessible from either under the vehicle or from the tire well. (Figure 7.78)

8. B-Kit Armor - Access is restricted when the B-kit is installed, but it is still possible to perform the task without removal of the B-kit.

(Slide #129)

b. Troubleshooting

1. Symptoms, Indicators and Possible Causes

a) Noises

1) Groaning noises while turning may be a sign of a failing hydraulic pump. This type of pump noise may be present during suspension adjustments but may be difficult to hear due to increased engine speed.

2) Clunking or thumping noises when steering is most likely caused by loose or worn steering components.

b) Steering Wheel

1) Difficulty steering will be the most common issue which could result from a failing pump, priority flow valve, or steering gearbox.

2) It could also result from mechanical stiffness or binding in the steering linkage.

c) Leaks

1) Part of the walk-around and inspection process is to look for leaks under your vehicle. Since the hydraulic system uses 0W-30 oil, leaking fluid will be golden in color.

d) Suspension adjustments

1) A bad priority flow valve that restricts flow to the HPG pumps could result in slow or no pump operation while attempting to adjust the suspension.

e) DSDU for Maintenance

1) If the system is opened or any components are replaced, the system must be purged using the Hydraulic Purge function in the DSDU (as described earlier).

Check on Learning	**(Slide #130)** **Q:** How many hydraulic filters are there on a JLTVA1? **A:** 2 **Q:** Changing what components would cause the hydraulic system to be purged using the DSDU? **A:** The hydraulic pump, hydraulic manifold, HPG manifold, HPG pump **Q:** What is the purpose for purging the hydraulic system? **A:** It removes air from the components which could cause damage to the system if ran with air in the system. **Q:** Describe the procedure for purging the hydraulic system. **A:** Reconnect line to HPG pump. Then, on the DSDU screen select hydraulic purge, wait for no air to be present in the line, press back on DSDU screen.
Summary	**(Slide #131)** The hydraulic pump has an internal priority flow valve which controls flow direction to either the steering or the HPG piston pumps. When a ride height command is given, the ride height takes precedence over steering; however, a smaller, much reduced amount of hydraulic oil is provided to steering system. The rest of the hydraulic system of pumps, filtering and cooling is standard. The steering system uses a simple construction with familiar components. Steering system components are robust and relatively easy to access for performing adjustments/alignment or for component replacement.
Transition	Are there any questions? The next step is to go the truck. The practical exercise provides the opportunity to practice hydraulic drain and fill.
4.	**(Slide #132)** ELO D – LSA 4 Learning Step/Activity: Troubleshoot Hydraulics and Steering Method of Instruction: Practical Exercise Instructor to student ratio: 1:5 Time of instruction: 1 hr 20 mins Media Type: None **(Slide #133)** See Appendix C: PE 7K – 1
Check on Learning	None

Summary	None
Transition	Take a break if you need one, and let's meet in the classroom to wrap up the Suspension, Hydraulics and Steering Module.

SECTION IV.	SUMMARY

Method of Instruction:	Lecture
Instructor to student ratio	1:15
Time of Instruction:	5 mins
Instructional Strategy	Lecture and Q&A

Check on Learning

(Slide #134-135)

Q: The springs have two purposes, what are they?
A: The springs are used to provide for suspension movement and make vehicle ride height changes or adjustments.

Q: Can the JLTVA1 make a ride height adjustment without using the HPG pumps, and when would the pumps engage?
A: Yes, ride height changes can occur without engaging the HPG pumps if the spring has a higher pressure than the tank; all that need occur is for the solenoids to open then gasses will transfer to the area of lesser pressure (tank). The high-pressure pumps will not engage until there is a 70-psi differential between the spring and the nitrogen tank.

Q: What is the purpose of the hydraulic manifold, and where is it located?
A: The hydraulic manifold is located on the driver side, rear of the vehicle, next to the HPG reservoir and it supplies hydraulic oil to the HPG pumps to move nitrogen through the system.

Q: Sometimes the Operator will make a ride height command and the pumps will not engage. How is that possible, and what are the parameters at which the pumps will engage?
A: The general nature of high-pressure gas is that high pressure will overcome low pressure. Therefore, if the spring has a higher pressure than the tank then all that needs to happen is for the solenoids to open and the gasses will transfer without engaging the HPG pumps.

Q: Can you use the DSDU to check the shock absorber and roll circuit?
A: No, the shock absorber assemblies and roll control circuits are completely mechanical and do not have electrical sensors communicating with the DSDU.

Q: What are the two safety procedures applicable to servicing the JLTVA1 suspension?
A: Use the suspension lock-out braces anytime you are evaluating the JLTVA1 suspension to prevent being crushed in the wheel-well, and always attach the jack stands to securely suspend the vehicle off the ground before conducting suspension maintenance.

Summary

(Slide #136)

You have just learned how to maintain the JLTVA1 TAK-4i suspension system. It is important you are able to maintain the JLTVA1's suspension enabling it to conduct various military operations by maneuvering over varied terrain, from mountainous to open, desert to urban, during all weather conditions both day and night with limited and poor visibility. The JLTVA1 suspension in fully operational condition can climb an 18-inch step and keep going.

This four-wheeled independent responsive system is made capable due to the three subsystems that work together to form the suspension system.

They are the HPG Springs, shock absorber assemblies and the EP-X Cross plumbing that forms the roll circuit.

- Remember that the HPG springs are a separate circuit and do not share any high-pressure gas or plumbing with any other system. They act as a spring to help reduce jounce, and they also provide the vehicle ride height and enable ride height adjustments using the DSDU. To conduct ride height changes the HPG Springs require the hydraulic pump to be secondarily dedicated to the power steering; full power returns to steering as soon as the ride height is accomplished.

- The shock absorbers perform normal shock function by maintaining wheel-to-ground contact but are also shared by the roll circuit. The roll circuit provides resistance to the top portion of the shock to push the rod/piston back towards the ground, and the shock absorber also has the roll circuit plumbing travel through it to enable the cross-plumbed suspension circuit.

- The roll circuit’s function is to fight body roll, which is accomplished using the roll control accumulators to provide the pressure to help the shock absorbers maintain wheel-to-ground contact and to absorb and transfer the hydraulic oil as needed to reduce sway and roll.

- The hydraulic pump powers the HPG pumps and supports the TAK-4i suspension.

Maintenance - The TAK-4i suspension is a pressurized suspension system, servicing this system exposes maintainers to two specific risks; crushing due to suspension failure and high-pressure gas injury due to failure to follow proper depressurizing sequence prior to maintenance. For your safety, the safety of other personnel and to avoid damaging the vehicle, it is important that you always use the IETM and follow the safety and vehicle precondition actions in the proper sequence, then begin the maintenance work package.

Appendix A

07_JLTVA1_ MAIN_SuspHydSteer_PPT_V3.0.pptx

Appendix C
JLTVA1 Practical Exercise Sheet No. 7A
HPG Spring Component Identification

Title	**HPG Spring Component Identification**
Lesson Number/ Title	07 Suspension/Hydraulics/Steering
Introduction	We will now identify the components of the High-Pressure Gas (HPG) system.
Motivator	Because of the HPG suspension system, the JLTVA1 fords 60 inches of water, be put on different decks of the ship, and can be transported by land, sea, and air. Now, you as the maintainer, will be able to identify all the components of the HPG system that enables ride height changes.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Enabling Learning Objective A	Action: Correlate the JLTVA1's suspension system/subsystem and components with their location, purpose, function and maintenance requirements Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel and reaching the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands on activities.
Risk Assessment Level	Low HPG Whip Risk – this is a demonstration and students should not be touching or near any HPG Spring components. Low Crushing Risk – this is a demonstration and students should not have activity within the wheel well area or under the vehicle.
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	This Practical Exercise will give you the opportunity to identify the components of the High-Pressure Gas (HPG) system, familiarity and comfort with this system is necessary to provide maintenance to the JLTVA1.
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils

Special Instructions

Below are the instructions for how to prepare for the practical exercise.

<table>
<tr><th>Preparation</th><th>Instructor Notes</th></tr>
<tr><td>TM Reference:</td><td>N/A</td></tr>
<tr><td>Time Required for Prep:</td><td>N/A</td></tr>
<tr><td>Symptom/Purpose:</td><td>System and component familiarization</td></tr>
<tr><td>Prepare Area for PE:</td><td>N/A</td></tr>
<tr><td>Configure Vehicle for PE:</td><td>Instructor Note: Instructor will need to prep the vehicle for the component identification task.

Vehicle Prep:
Belly armor removed (if B-Kit installed)
Cowl armor removed (if B-Kit installed)
JLVT on Jack Stands or Suspension Lock-out Braces Installed
Splash Guards removed
Drop Battery Tray
Remove rear skid plate</td></tr>
<tr><td>Instructor Preparation:</td><td>• Ensure instructors have located and understand the purpose all components before conducting component location.
• Review the basic information below as required.</td></tr>
<tr><td>Safety</td><td>Instructors will monitor the exercise and ensure students are properly adhering to safety guidelines while working on the vehicle.
There are risks associated with maintain the TAK-4i because it is a pressurized suspension system. Risks from HPG system are:
• HPG Whip if a line cracks
• Crushing in the wheel well and under the vehicle.
• Students are to stand away from the wheel areas and try to see the DSDU and dash during demonstration.</td></tr>
</table>

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises.

Component	Location and Function
HPG springs	The HPG springs have some oil areas and some hydraulic areas. They are separated by a piston. It is not abnormal to find some oil on the gas side for the piston and some gas on the oil side of the piston. When extending, HPG is fed into the top part of the spring. When retracting, HPG is removed from the top part of the spring.
HPG piston pumps:	The HPG piston pumps are what pull nitrogen through the system and into the spring system for operation. There are two, you can hear them both due to their alternating pattern.
Hydraulic manifold and solenoids	The hydraulic manifold is what distributes hydraulic oil to the piston pumps to run the system.
Ten-position nitrogen manifold	The ten-position manifold is the distribution mechanism for the nitrogen throughout the system. There are ten solenoids because it requires a pair of solenoids to raise and lower (8) each spring unit and one set for supply and return (2).
Nitrogen reservoir	The nitrogen reservoir is the reservoir that contains the nitrogen for the spring systems. It is typically charging to around 1900-2500 psi at 60 °F.
HPG spring ride height sensors	The ride height sensors are located internally in the spring unit. These sensors have a connector at the top of the spring unit that communicate on the sensor bus to the 3G controller to relay spring length.
Secondary accumulator	Provides additional spring dampening for the suspension system for a smoother ride over rough terrain.
Pressure transducers	Monitor and send data to the network related to HPG pressures found in the springs.

d. Inform students they will have approximately 30 minutes to complete the rest of the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

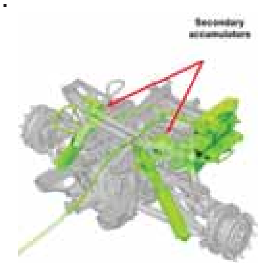
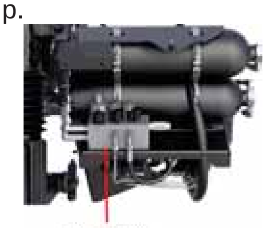
f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

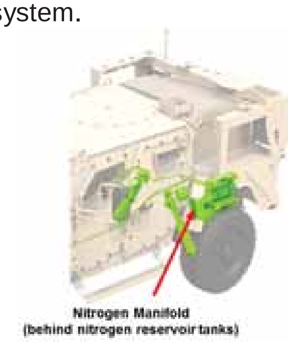
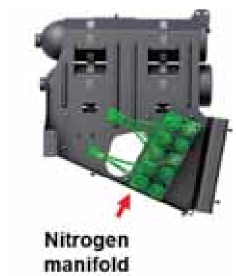
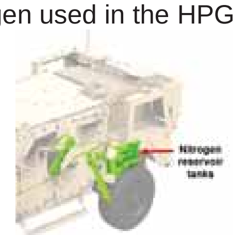
g. Students will be broken up into groups of no more than five.

h. Ask if there are any questions.

i. Students may begin.

j. **Point out the following components on the transmission and explain the components function.** Students may begin. Below are components and their function which the instructor may use to assist with the Go/No Go rubric.

Component	Location/Function
Instructor note:	The following components should be identified and described by students
HPG Springs:	The springs are the portion of the suspension system that forces the truck up and down based on nitrogen pressure. Look like a black solid tube. 
Secondary Accumulators:	Provide a progressive spring rate. Are on the rear spring assembly only, are black in color and ball-like in shape; there is one for each rear spring. 
HPG Piston Pumps:	The piston pumps receive oil from the hydraulic pump and drives nitrogen in or out of the 8-position supply manifold. Both pumps are located in the rear of the truck below the nitrogen reservoirs. 
Hydraulic Manifold and Solenoids:	The hydraulic manifold distributes hydraulic oil to the hydraulic pumps to move the nitrogen. The big solenoid is hydraulic supply to the manifold, the smaller solenoid in the front is for the front piston pump and the smaller solenoid to the rear is for the rear piston pump. 

Ten-position Nitrogen manifold:	This manifold is the control manifold for the nitrogen system.  
Nitrogen reservoir:	The nitrogen reservoirs are the storage tanks for the nitrogen used in the HPG system. 
HPG spring ride height sensor:	The HPG Spring ride height sensors are used for telling the computer system the ride height by pressure. They are located internal to each spring. The connectors for the ride height sensors are black on the front and yellow on the rear.

k. Fill out the Go/No-Go sheet accordingly.

1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

2. Once the Practical Exercise is complete, the Lead Instructor must sign each student's Solution Sheet.

Feedback Requirements

Provide feedback to students to ensure comprehension.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 7A-1
HPG Spring Component ID

Name____

Date____

Training Location____

HPG Spring Component ID	Go	NO GO	Initials
HPG Springs			
Secondary Accumulator			
HPG Piston Pumps (Front and Rear)			
Hydraulic Manifold and Solenoids			
Ten Position nitrogen Manifold			
Nitrogen Reservoir			
HPG Spring Ride Height Sensors			

Instructor Signature____

Appendix C
JLTVA1 Practical Exercise Sheet No. 7B
Suspension Functions Do Not Operate

Title	FIK 7-1 Suspension Functions Do Not Operate
Lesson Number/ Title	07 Suspension/Hydraulics/Steering
Introduction	We will now perform a P.E. troubleshooting the spring of the TAK-4i suspension.
Motivator	Suspension functionality is critical to the mission readiness of the JLTVA1
Enabling Learning Objective B	Action: Troubleshoot the HPG Spring system of the JLTVA1 suspension Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel and reaching the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands on activities.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Risk Assessment	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	Let's explore the electrical system on the JLTVA1
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide JLTVA1 FIK PE Instruction Job Aid **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils
Special Instructions	**See FIK # 7-1 Suspension Functions Do Not Operate** using the FIK PE Instructions Job Aid. • Facilitation Tip: Simulate the exercises as appropriate; means using the Interactive Engaging Technical Manual (IETM), following the task, discussing, and completing each step until task is complete. Students will not remove the installed components. • Assistant Trainers: If possible, it would be acceptable to have an assistant instructor install the fault while the primary instructor is training.

Procedures	a. Instructor distributes the Practical Exercise worksheet to the students. b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have. c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises. d. Inform students they will have approximately 45 minutes to complete the practical exercise. e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet. f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so. g. Students will be broken up into groups of no more than five. h. Ask if there are any questions. l. Students may begin. m. Use the FIK PE Instructions Job Aide for Instructor Notes and Answer Key to assist with the Go/No Go rubric. n. Mark Go/No Go Sheets accordingly. 1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished. 2. Once the Practical Exercise is complete, the Lead Instructor must sign each student's Solution Sheet.
Feedback Requirements	Provide feedback to ensure student learning.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 7B-1
Suspension Functions Do Not Operate

Name____

Date____

Training Location__________________________________

Suspension Functions DNO	**Go**	**NO GO**	**Initials**
Verified the Fault			
Located proper troubleshooting fault in the IETM			
Followed all warning cautions and notes			
Correctly followed troubleshooting track in TM			
Correctly repaired fault (per TM)			
Verified fault was corrected			

Instructor Signature____

Appendix C
JLTVA1 Practical Exercise Sheet No. 7C
Code 14-60 RL Up Valve Output OOR High

Title	FIK #7-2 Code 14-60 RL Up Valve Output OOR High
Lesson Number/ Title	07 Suspension/Hydraulics/Steering
Introduction	Proper maintenance on the suspension and drive system is important to vehicle readiness.
Motivator	The suspension system provides many functions for your JLTVA1. This PE covers troubleshooting of the HPG spring system.
Enabling Learning Objective B	Action: Troubleshoot the HPG Spring system of the JLTVA1 suspension Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel and reaching the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands on activities.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Risk Assessment	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	Let's explore the electrical system on the JLTVA1
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide JLTVA1 FIK PE Instruction Job Aid **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils
Special Instructions	Below are the instructions for how to prepare for the practical exercise. Go to FIK PE Instructions Job Aid **FIK # 7-2 Code 14-60 RL Valve Output OOR High**.

- Facilitation Tip: Simulate the exercises as appropriate; means using the Interactive Engaging Technical Manual (IETM), following the task, discussing, and completing each step until task is complete. Students will not remove the installed components.
- Assistant Trainers: If possible, it would be acceptable to have an assistant instructor install the fault while the primary instructor is training.

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises.

d. Inform students they will have approximately 30 minutes to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five.

h. Ask if there are any questions.

o. Students may begin.

p. Use the FIK PE Instructions Job Aide for Instructor Notes and Answer Key to assist with the Go/No Go rubric.

i. Mark Go/No Go Sheets accordingly.

1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

2. Once the Practical Exercise is complete, the Lead Instructor must sign each student’s Solution Sheet.

Feedback Requirements

Provide feedback to ensure student learning.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 7C-1
Code 14-60 RL Up Valve Output Out of Range

Name____

Date____

Training Location____

Code 14-60 RL Up Valve Output Out of Range	**Go**	**NO GO**	**Initials**
Verified the Fault			
Located proper troubleshooting fault in the IETM			
Followed all warning cautions and notes			
Correctly followed troubleshooting track in TM			
Correctly repaired fault (per TM)			
Verified fault was corrected			

Signature____

Appendix C
JLTVA1 Practical Exercise Sheet No. 7D
Front HPG Spring & Half Shaft Remove/Replace

Title	Front HPG Spring & Half Shaft Remove/Replace
Lesson Number/ Title	07 Suspension/Hydraulics/Steering
Introduction	Half shaft replacement is required in the event of CV joints or shaft damage.
Motivator	Proper maintenance on the suspension and drive system is important to vehicle readiness.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Enabling Learning Objective B	Action: Troubleshoot the HPG Spring system of the JLTVA1 suspension Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel and reaching the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands on activities.
Risk Assessment Level	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	This exercise of removing the half shaft includes preconditions which require the removal of the HPG Spring due to the location of the HPG Spring and half shaft.
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils
Special Instructions	Below are the instructions for how to prepare for the practical exercise.

Preparation	Instructor Notes
TM Reference:	Maintenance procedures, 10-Front axle>1004 Steering and leaning mechanism, Half shaft replacement
Time Required for Prep:	1-5 min
Symptom/Purpose:	
Prepare Area for PE:	
Configure Vehicle for PE: NOTE:	Belly armor removed (if B-Kit installed) Cowl armor removed (if B-Kit installed) JLVT on Jack Stands or Suspension Lock-out Braces Installed Splash Guards removed Drop Battery Tray ****Visually confirm BRAKE PADS were REINSTALLED after the caliper maintenance exercise.**
Instructor Preparation:	Be very familiar with the IETM as well as the practical exercise write up as there as several NOTES that require instructors to coach through gaps of the IETM documentation.
Safety	Instructors will monitor the exercise and ensure students are properly adhering to safety guidelines while working on the vehicle.

-Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises.

d. Inform students they will have approximately **5 hours** to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five.

h. As the measurements are being taken, the students should show the location of the sensors to the instructor

i. Ask if there are any questions.

j. Students may begin. Below are key steps the instructor may use to assist with the Go/No Go rubric.

Step	Instructor Notes/Answer Key
HPG Spring Removal IETM Work Package:	Maintenance Procedures > Maintainer – Maintenance Procedures > 16 Suspension System > 1601 - Springs >High Pressure Gas (HPG) Nitrogen Spring, Front Replacement
	Log into DSDU as Maintainer Depressurize HPG System (using DSDU)
	NOTE: Vent remaining Nitrogen from the spring being removed. The IETM does NOT state to do this; however, it is required.
	Follow the IETM WP steps to complete the task of HPG Spring Removal.
Half Shaft Removal IETM Work Package:	Maintenance procedures>10 Front axle>1004 Steering and leaning mechanism>Half Shaft Replacement.
Perform all equipment conditions	Standard list plus: Cage brakes Front high presser gas nitrogen spring removed
Perform task	Follow TM
Preform follow on maintenance	Uncage brakes Install Front high presser gas nitrogen spring
Verify system functions properly	Test system

k. Mark Go/No Go Sheets accordingly.

Feedback Requirements

Debrief the Activity: Provide tips and insights into potential “go wrongs” and reasons/rational for things that occurred during the PE.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 7D-1
Front HPG Spring & Half Shaft Remove/Replace

Name____

Date____

Training Location____

Front HPG Spring & Half Shaft Remove	**Go**	**NO GO**	**Initials**
Front HPG Spring Removal			
1. Located proper Maintenance track in the IETM			
2 Followed all warning cautions and notes			
3. Perform all equipment conditions			
4. Depressurize Nitrogen System			
5. Vent remaining Nitrogen from the spring being removed.			
6. Remove Spring - Correctly followed Maintenance tracks in TM			
7. Correctly Preformed all follow-on maintenance per TM			
Half Shaft Removal/Replacement			
1. Located proper Maintenance track in the IETM			
2 Followed all warning cautions and notes			
3. Preform all equipment conditions			
4 Correctly followed Maintenance tracks in TM			
5. Correctly Preformed all follow-on maintenance per TM			

Instructor Signature____

Appendix C
JLTVA1 Practical Exercise Sheet No. 7E
Ride Height and Sensor Addressing

Title	Ride Height and Sensor Addressing
Lesson Number/ Title	07 Suspension/Hydraulics/Steering
Introduction	We will now perform a P.E. on the JLTVA1 applicable to any and all variants.
Motivator	When replacing the HPG springs, the JLTVA1 will require that a ride height sensor be identified and then calibrated. This is required for the suspension system to operate properly. If this is not done, the vehicle will not correctly recalibrate itself as required and may cause handling problems.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Enabling Learning Objective B	Action: Troubleshoot the HPG Spring system of the JLTVA1 suspension Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel and reaching the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands on activities.
Risk Assessment Level	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	This Practical Exercise will give you the opportunity to discuss the skills required to provide maintenance to the JLTVA1 suspensions system under normal conditions.
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils

Special Instructions

Below are the instructions for how to prepare for the practical exercise.

Preparation	Instructor Notes
TM Reference:	**Maintenance Procedures>** 00 General maintenance>Drivers Smart Display Unit>Maintainer Login and Operation>Sensor Addressing
Time Required for Prep:	N/A
Symptom/Purpose:	After spring replacement addressing is required
Prepare Area for PE:	N/A
Configure Vehicle for PE:	Vehicle Prep: Belly armor removed (if B-Kit installed) Cowl armor removed (if B-Kit installed) JLVT on Jack Stands or Suspension Lock-out Braces Installed Splash Guards removed Drop Battery Tray Skid Plate removed
Instructor Preparation:	**Do NOT calibrate the IMU when prompted;** this exercise is about addressing the ride height sensor located within the HPG spring.
Safety	Instructors will monitor the exercise and ensure students are properly adhering to safety guidelines while working on the vehicle.

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical Manual (TM) to complete the exercises.

d. Inform students they will have approximately **1 hour** to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be divided into groups of no more than five.

h. Ask if there are any questions.

i. Students may begin. Below are key steps the instructor may use to assist with the Go/No Go rubric.

Step	Instructor Notes
	Do NOT calibrate the IMU. This exercise is about addressing the ride height sensor located within the HPG spring. Then calibrating/recording the new HPG spring measurements.
IETM Work Package:	**Maintenance Procedures>** 00 General maintenance>Drivers Smart Display Unit>Maintainer Login and Operation>Sensor Addressing **Note:** Use caution and be certain to select the correct IETM work package for Sensor Addressing.
Verify CTIS setting:	Use DSDU
Navigate to suspension system screen:	Use DSDU
Perform sensor addressing exercise:	Use DSDU
Isolate the HPG Sensor to Address:	Disconnect 3 sensors NOT being Addressed (Done manually at each corner of JLTVA1)
Remove Jounce Bumpers:	Follow IETM
Lower vehicle to hard stops:	Use DSDU
Calibrate ride height sensors:	Use DSDU
	Students are to select NO **when DSDU asks if they** want to calibrate **the IMU.**
Verify Repairs:	Use DSDU

j. Mark Go/No Go Sheets accordingly.

1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

2. Once the Practical Exercise is complete, the Lead Instructor must sign each student’s Solution Sheet.

Feedback Requirements

Provide feedback to students to ensure comprehension.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 7E-1
Sensor Addressing

Name____

Date____

Training Location____

Sensor Addressing	**Go**	**NO GO**	**Initials**
Log into Maintainer Mode			
Verify CTIS setting			
Navigate to Suspension System screen			
Perform Sensor Address Exercise - Isolate Sensor that needs to be addressed			
Remove Jounce Bumpers			
Lower vehicle to hard stops			
Calibrate ride height sensors			
Verify Repairs			

Instructor Signature____

Appendix C
JLTVA1 Practical Exercise Sheet No. 7F
Shock Absorber Assembly and Roll Control Circuit Component ID

Title	Shock Absorber Assembly and Roll Control Circuit Component ID
Lesson Number/ Title	07 Suspension/Hydraulics/Steering
Introduction	We will now perform component identification of the shock absorber system and roll circuit components.
Motivator	Understanding how a system works is half the battle. Knowing where everything is the other half to the story.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Enabling Learning Objective C	Action: Troubleshoot the shock absorber and roll circuit systems of the JLTVA1 suspension Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel and reaching the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands on activities.
Risk Assessment Level	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go Evaluation
Instructional Lead-In	This Practical Exercise will give you the opportunity to get familiar and increase your comfort level regarding the rest of the suspension components. Use this time wisely as component location and understanding their functionality is a prerequisite required for troubleshooting.
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils
Special Instructions	Below are the instructions for how to prepare for the practical exercise.

Preparation	Instructor Notes
TM Reference:	N/A
Time Required for Prep:	0 if vehicle is prepped
Symptom/Purpose:	Gain familiarization with suspension system and components
Prepare Area for PE:	N/A
Configure Vehicle for PE:	Belly armor removed (if B-Kit installed) Cowl armor removed (if B-Kit installed) JLVT on Jack Stands or Suspension Lock-out Braces Installed Splash Guards removed Drop Battery Tray Skid Plate removed
Instructor Preparation:	Ensure instructors have located and understand the purpose all components before conducting component location.
Safety	Instructors will monitor the exercise and ensure students are properly adhering to safety guidelines while working on the vehicle.

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises.

d. Inform students they will have approximately 30 minutes to complete the practical exercise.

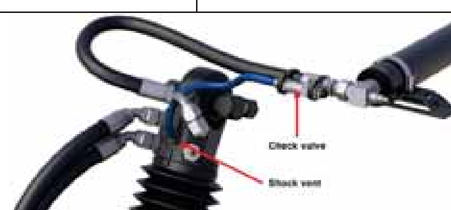
e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five.

h. Ask if there are any questions.

i. **Point out the following components on the transmission and explain the components function.** Students may begin. Below are components and their function which the instructor may use to assist with the Go/No Go rubric.

Components	Location/Function
	The purpose of this practical application is for learners to become familiar with the components on the JLTVA1 system. The instructor to student ratio is 1:5.
	Students will need to identify and describe the function of the components on the JLTVA1 suspension system.
	Instructors will monitor the application and ensure students are properly adhering to safety guidelines while working on the vehicle. Instructors will assist students on finding work packages associated with the tasks they are trying to do.
Roll control accumulator:	Nitrogen charged accumulator that balances hydraulic forces and nitrogen forces to reduce body roll.
Shock absorber assembly:	The entire unit houses the roll circuit hydraulics and the shock absorber unit.
	
Shock Absorber Vent:	
Shock Absorber Check Valve:	
	
Roll circuit bleeder screws:	Allows for bleeding of the hydraulics in the roll circuit.
Roll circuit vent check valves:	Allows for overpressure protection of the shock absorber system.
Roll circuit nitrogen charge ports:	Allows roll control accumulators to be charged with nitrogen.
Roll circuit hydraulic charge ports:	Allows for roll circuit to be drained and filled with oil.
Shock absorber manifold:	Provides dampening of spring oscillations.
Integrated accumulator:	Contains nitrogen charge to assist with spring dampening.
Integrated accumulator charge port:	Location to charge integrated accumulator with nitrogen.

j. Mark Go/No Go Sheets accordingly.

1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

2. Once the Practical Exercise is complete, the Lead Instructor must sign each student's Solution Sheet.

Feedback Requirements

Provide feedback to students to ensure comprehension.

Appendix C
JLTVA1 Practical Exercise 7F-1
Shock Absorber Assembly and Roll Control Circuit Component ID

Name____

Date____

Training Location____

Shock Absorber Assembly and Roll Control Circuit ID	**Go**	**NO GO**	**Initials**
Identify and describe the Roll control accumulator			
Identify and explain the Shock Absorber Assembly			
Identify and describe the Roll Circuit Bleeder Screw			
Identify and describe the Roll Circuit vent check valve			
Identify and describe the Roll circuit nitrogen Charge Ports			
Identify and describe Roll circuit Hydraulic charge ports			
Identify and describe Shock absorber manifold			
Identify and describe Integrated accumulator			
Identify and describe Integrated accumulator charge port			

Instructor Signature____

Appendix C
JLTVA1 Practical Exercise Sheet No. 7G
Preconditions for Shock R/R

Title	Guided Practical Exercise: Preconditions for Shock Removal: Depressurize Nitrogen System and Components
Lesson Number/ Title	07 Suspension/Hydraulics/Steering
Introduction	In this next set of practical exercises, we will be learning how to provide maintenance to the TAK-4i suspension, which requires knowledge of the springs to depressurize the system as well as knowledge of the shock absorbers and roll control circuits. These suspension maintenance tasks are applicable to any and all variants of the JLTVA1 family. The next three practical exercise are going to give you the opportunity to practice a shock removal and replacement, the steps you just learned about from the video in the classroom. The PEs are broken down as: • Shock Removal Preconditions (depressurize systems and components) • Shock Removal and Replacement (the actual tasks) • Follow-On Maintenance of Shock Removal Note: The MAC chart indicates a Shock Removal/Replacement would take about three hours, however, with the preconditions and follow-on maintenance this task when done in on your own may take approximately seven to eight hours.
Motivator	Prior to removing any shock absorber there are several layers of Equipment Preconditions that must be completed. If all preconditions are not completed in the required sequence, there is a risk of injury and/or damage to the vehicle.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Enabling Learning Objective B	Action: Troubleshoot the shock absorber and roll circuit systems of the JLTVA1 suspension Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel and reaching the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands on activities.
Risk Assessment Level	**Medium – HPG Injury Risk** Follow IETM. Complete all preconditions and read entire work package prior to beginning the task. Use the correct tools per the IETM. **DO NOT Torque HPG components** unless directed by IETM. Read and comply with all cautions and warnings. **Medium - Crushing/Pinch points** Complete all Preconditions and read entire work package prior to beginning the task. Use the correct tools per the IETM. **Use suspension lockout braces and/or Suspension Lift Kit in compliance with IETM.** Read and comply with all cautions and warnings.

Environmental Considerations

It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.

Evaluation

Practical Exercise Go/ No Go sheet

Instructional Lead-In

This Practical Exercise will give you the opportunity to discuss the skills required to provide maintenance to the JLTVA1 suspensions system under normal conditions.

Resource Requirements

Instructor Materials:
EMS NG with IETM
Instructor Guide

Student Materials:
MSD with EMS NG/IETM
Student guides
Pens/Pencils

Special Instructions

Below are the instructions for how to prepare for the practical exercise.

Preparation	Instructor Notes
TM Reference:	**Maintenance Procedures>**Maintainer Maintenance Procedures>16 Suspension System>1604 Shock Absorber Equipment>Shock Replacement
Time Required for Prep:	N/A
Symptom/Purpose:	N/A
Prepare Area for PE:	N/A
Configure Vehicle for PE:	Vehicle Prep: Belly armor removed (if B-Kit installed) Cowl armor removed (if B-Kit installed) JLVT on Jack Stands or Suspension Lock-out Braces Installed Splash Guards removed Drop Battery Tray Skid Plate removed
Instructor Preparation:	Instructor must be familiar with the TAK-4i suspension and with the IETM suspension work packages (including all Preconditions) prior to conducting the exercise.
Safety	This is a guided practical exercise; therefore, instructors shall point out the components, demonstrate use of special tools and explain the significance of the task prior to students completing any hands-on activities. Instructor shall monitor the exercise and ensure students are always properly adhering to safety guidelines and aligned with the IETM.

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical Manual (TM) to complete the exercises.

d. Inform students they will have approximately **1 hour** to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be divided into groups of no more than five.

h. Ask if there are any questions.

i. Students may begin. Below are key steps the instructor may use to assist with the Go/No Go rubric.

Step	Instructor Notes
IETM Work Package:	**Maintenance Procedures>**Maintainer Maintenance Procedures>16 Suspension System>1604 Shock Absorber Equipment>Shock Replacement
Precondition #1:	Roll Control Accumulator Bled
	Precondition: Depressurize Nitrogen System
	Use DSDU to depressurize nitrogen springs on all four corners of JLTVA1. Lower vehicle to hard stops – minimum requirement is each HPG Spring must be at or below 200 psi.
	Depressurize Roll Control Accumulator - Follow IETM Steps 3 and 6 instruct to open a valve, make sure the nitrogen manifold is open to prevent nitrogen from escaping before the tank is connected.
Precondition #2:	Shock Integrated Accumulator Bled
	Depressurize Shock Integrated Accumulator – Follow IETM

j. Mark Go/No Go Sheets accordingly.

1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

2. Once the Practical Exercise is complete, the Lead Instructor must sign each student’s Solution Sheet.

Feedback Requirements

Provide feedback to students to ensure comprehension.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 7G-1
Preconditions for Shock R/R

Name____

Date____

Training Location__________________________________

<table>
<tr><th colspan="2">Preconditions for Shock R/R</th><th>Go</th><th>NO GO</th><th>Initials</th></tr>
<tr><td colspan="2">Found correct IETM work package: Shock Removal</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Read first precondition: Roll Control Accumulator Bled</td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">Completed Precondition for Roll Control Accumulator</td><td>Navigate IETM to Nitrogen Depressurization Task (Task resides within DSDU links; must scroll down to find task)</td><td></td><td></td><td></td></tr>
<tr><td>Depressurize Nitrogen System: Use DSDU to Lower vehicle to hard stops. All Corners of suspension must be below 200 psi</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Discharged Roll Control Accumulator</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Read second precondition: Shock Integrated Accumulator Bled</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Discharged Shock Integrated Accumulator</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Followed all warnings, cautions and notes</td><td></td><td></td><td></td></tr>
</table>

Instructor Signature____

Appendix C
JLTVA1 Practical Exercise Sheet No. 7H
Shock Removal and Replacement

Title	Shock Removal and Replacement
Lesson Number/ Title	07 Suspension/Hydraulics/Steering
Introduction	You've just watched a shock removal and replacement demonstration; this exercise provides the hands-on training for maintaining the TAK-4i suspension.
Motivator	Understanding how a system works is half the battle. Knowing where everything is the other half to the story.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Enabling Learning Objective C	Action: Troubleshoot the shock absorber and roll circuit systems of the JLTVA1 suspension Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel and reaching the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands on activities.
Risk Assessment Level	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage
Evaluation	Practical Exercise Go/ No Go sheet (or we could get a drawing and make them label the component too…on the worksheet)
Instructional Lead-In	Now that you have completed the preconditions for the Shock Removal work package by discharging the nitrogen system and components it is safe to remove the shock absorber.
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils
Special Instructions	Below are the instructions for how to prepare for the practical exercise.

Preparation	Instructor Notes
TM Reference:	**Maintenance Procedures>**Maintainer Maintenance Procedures>16 Suspension System>1604 Shock Absorber Equipment>Shock Replacement
Time Required for Prep:	0 if JLTVA1 is prepped
Symptom/Purpose:	insert
Prepare Area for PE:	Vent exhaust if indoors and JLTVA1 engine is running to complete ride height adjustments. Ensure Special Tools available: Charge Cart Ensure tools required for Roll control accumulator Bleed/Charge are available: 1. General Mechanic Tool Kit 2. Drain Pan 3. Suspension Service Kit PN: 4323321 4. Torque Wrench 300-inch pounds PN: KTC S0987 5. Technical nitrogen PN: 12602073 Tools Required for Roll Control Circuit Hydraulics Bleed and Charge: 1. General Mechanic Tool Kit 2. Electric Oil Pump Kit PN: 4100636 3. Drain Pan 4. Suspension Service Kit PN: 4323321 5. Torque Wrench 300-inch pounds PN: KTC S0987 6. Bilstein Shock Oil 5 Gallons PN: 2011070 (UI: PT)
Configure Vehicle for PE:	Instructor Note: This task will need to be done whenever removing or replacing a suspension component on the JLTVA1. This is a step by step procedure that must be followed correctly for proper suspension performance. Failure to drain the hydraulics properly or bleed the system upon recharging can cause suspension problems and poor suspension performance. Belly armor removed (if B-Kit installed) Cowl armor removed (if B-Kit installed) JLVT on Jack Stands or Suspension Lock-out Braces Installed Splash Guards removed Drop Battery Tray Skid Plate removed

Instructor Preparation:	• To conduct this exercise, the instructor must understand the principles on how the system works because the IETM covers both the front and rear suspension systems and it can be confusing. • PROVIDE HELP: The instructor should locate “Roll Control Accumulator Bleed/Charge” and “Roll Circuit Hydraulics Bleed/Charge” work packages in the IETM. The procedures should be read to the class and discussed on the truck before conducting the demonstration. • Supervision and Guidance: The instructor(s) will lead the demonstration by showing the students how to access the field level maintenance procedures found in the IETM. All tools and required materials should be obtained before conducting this task.
Safety	

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises.

d. Inform students they will have approximately **5 hours** to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five.

h. Ask if there are any questions.

i. Students may begin. Below are key steps or information to aid the instructor in conducting the PE and completing student Go/No Go rubrics.

Instructor Notes	
Note: The IETM takes the maintainer through the hydraulic bleed during the roll control accumulator bleed/charge, but not charging the hydraulics. If the maintainer tries to do both tasks to completion based on the IETM direction, they will likely damage equipment.	
One of the preconditions is to depressurize the HPG system. This may seem strange as these are both are separate circuits. It is important to remember that the roll circuit and the HPG springs are linked mechanically at the lower control arm.	
Because we are working specifically with the roll circuit, we want to ensure there is no additional tension on the system from external sources, so we raise the vehicle off the ground and drop spring pressure to allow for the best servicing of the roll circuit. The principals involved are as follows: 1. The roll circuit consists of a nitrogen charged portion and a hydraulically charged portion. 2. The hydraulics must be bled before the nitrogen is discharged, otherwise it will cause the floating piston in the roll control accumulator to move in the wrong direction, which is very hard to fix. Also, if you discharge the nitrogen first it will not have pressure to bleed the hydraulic oil. Hydraulics are always bled first, then nitrogen. 3. When charging, always charge nitrogen first. This will allow for the system to balance and properly pressurize when charged with hydraulic pressure. 4. Always bleed the hydraulics when charging the hydraulic system. If the hydraulics are not bled, the suspension will have bubbles in it, and it will not perform properly. **Now that you understand the principals involved in this procedure, ensure you follow all instructions in the IETM as required to do this task properly.**	

Step	Instructor Notes/Answer Key
IETM Work Package:	**Maintenance Procedures>**Maintainer Maintenance Procedures>16 Suspension System>1604 Shock Absorber Equipment>Shock Replacement
Safety:	Complete all preconditions. This work package has many preconditions which must be completed in the correct sequence to safely complete this task.
Precondition conducted in previous PE:	**Nitrogen System Depressurized**
Precondition conducted in previous PE:	Roll Control Accumulator Bleed/Charge
Precondition conducted in previous PE:	Shock Integrated Accumulator Bled
Perform Task	Follow IETM and complete Shock

	Removal and Replacement task.
	Stop PE after task complete but prior to follow-on tasks as that is the next PE.

j. Mark Go/No Go Sheets accordingly.

1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

2. Once the Practical Exercise is complete, the Lead Instructor must sign each student's Solution Sheet.

Feedback Requirements Review the material covered in the training event. Ask the students if there are any questions and probe the class to ensure understanding.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 7H-1
Shock Removal and Replacement

Name____

Date____

Training Location____

Shock Removal and Replacement	Go	NO GO	Initials
Located correct work package in IETM			
Removed Shock			
Extended Shock for Use			
Replaced Shock			
Followed all Cautions and Warnings in IETM			

Instructor Signature____

Appendix C
JLTVA1 Practical Exercise Sheet No. 7I
Follow-on Tasks of Shock Removal/Replacement

Title	Guided Practical Exercise: Shock Replacement/**Follow-On Maintenance:** Bleed/Charge Roll Control Circuit Hydraulics and Recharge Nitrogen System and Components
Lesson Number/ Title	07 Suspension/Hydraulics/Steering
Introduction	This practical exercise gives you the opportunity to practice the follow-on maintenance tasks required to complete the shock replacement and return the vehicle to functional condition.
Motivator	Prior to removing any shock absorber there are several layers of Equipment Pre-Conditions that must be completed. If all preconditions are not completed in the required sequence, there is a risk of injury and/or damage to the vehicle.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Enabling Learning Objective B	Action: Troubleshoot the shock absorber and roll circuit systems of the JLTVA1 suspension Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel and reaching the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands on activities.
Risk Assessment Level	**Medium - HPG Injury Risk** Follow IETM. Complete all preconditions and read entire work package prior to beginning the task. Use the correct tools per the IETM. **DO NOT Torque HPG components** unless directed by IETM. Read and comply with all cautions and warnings. **Medium - Crushing/Pinch points** Complete all Preconditions and read entire work package prior to beginning the task. Use the correct tools per the IETM. **Use suspension lockout braces and/or Suspension Lift Kit in compliance with IETM.** Read and comply with all cautions and warnings.
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	This practical exercise will give you the opportunity to discuss the skills required to provide maintenance to the JLTVA1 suspension system.
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide

Student Materials:
MSD with EMS NG/IETM
Student guides
Pens/Pencils

Special Instructions

Below are the instructions for how to prepare for the practical exercise.

Preparation	Instructor Notes
TM Reference:	**Maintenance Procedures>**Maintainer Maintenance Procedures>16 Suspension System>1604 Shock Absorber Equipment>Shock Replacement
Time Required for Prep:	N/A
Symptom/Purpose:	
Prepare Area for PE:	N/A
Configure Vehicle for PE:	Vehicle Prep: Belly armor removed (if B-Kit installed) Cowl armor removed (if B-Kit installed) JLVT on Jack Stands or Suspension Lock-out Braces Installed Splash Guards removed Drop Battery Tray Skid Plate removed
Instructor Preparation:	Instructor must be familiar with the TAK-4i suspension and with the IETM suspension work packages (including all Preconditions) prior to conducting the exercise.
Safety	This is a guided practical exercise; therefore, instructors shall point out the components, demonstrate use of special tools and explain the significance of the task prior to students completing any hands-on activities. Instructor shall monitor the exercise and ensure students are always properly adhering to safety guidelines and aligned with the IETM.

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical Manual (TM) to complete the exercises.

d. Inform students they will have approximately **3.5 hours** to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be divided into groups of no more than five.

h. Ask if there are any questions.

i. Students may begin. Below are key steps the instructor may use to assist with the Go/No Go rubric.

Step	Instructor Notes
IETM Work Package:	**Maintenance Procedures>**Maintainer Maintenance Procedures>16 Suspension System>1604 Shock Absorber Equipment>Shock Replacement
Follow-On Maintenance #1:	Charge Shock Integrated Accumulator Roll Control Accumulator
Follow-On Maintenance #2:	Charge Roll Control Accumulator
Follow-On to #2 Above:	Navigate IETM to Pressurize Nitrogen System Task (Task resides within DSDU links; must scroll down to find task)
	Pressurized Nitrogen System
	Bleed and Charge Roll Control Circuit Hydraulics
	Tested system by running it through a functions test
	Completed third follow-on task: Install Wheel/tire
	Install splash guard
Task Completed:	Lower Vehicle
Test:	Test Suspension

j. Mark Go/No Go Sheets accordingly.

1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

2. Once the Practical Exercise is complete, the Lead Instructor must sign each student’s Solution Sheet.

Feedback Requirements

Provide feedback to students to ensure comprehension.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 7I-1
Follow-on Tasks of Shock Removal/Replacement

Name____

Date____

Training Location____

<table>
<tr><th colspan="2">Follow-on Tasks of Shock Removal/Replacement</th><th>Go</th><th>NO GO</th><th>Initials</th></tr>
<tr><td colspan="2">Located correct step of work package in IETM (follow-on tasks from Shock Removal/Replacement)</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Completed first follow-on task: Charge Shock Integrated Accumulator</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Completed second follow-on task: Charge Roll Control Accumulator</td><td></td><td></td><td></td></tr>
<tr><td rowspan="6">Completed Follow-On Maintenance for Roll Control Accumulator</td><td>Navigate IETM to Pressurize Nitrogen System Task (Task resides within DSDU links; must scroll down to find task)</td><td></td><td></td><td></td></tr>
<tr><td>Pressurized Nitrogen System</td><td></td><td></td><td></td></tr>
<tr><td>Bleed and Charge Roll Control Circuit Hydraulics</td><td></td><td></td><td></td></tr>
<tr><td>Inspected HPG Nitrogen system for Leaks</td><td></td><td></td><td></td></tr>
<tr><td>Installed Front Splash Guard</td><td></td><td></td><td></td></tr>
<tr><td>Lowered Vehicle</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Completed third follow-on task: Install Wheel/tire</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Tested system by running it through a functions test</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Followed all warnings, cautions and notes</td><td></td><td></td><td></td></tr>
</table>

Instructor Signature____

Appendix C
JLTVA1 Practical Exercise Sheet No. 7J
Hydraulic and Steering Component ID

Title	Hydraulic and Steering Component Identification
Lesson Number/ Title	07 Suspension/Hydraulics/Steering
Introduction	We will now perform component identification of the shock absorber system and roll circuit components.
Motivator	Understanding how a system works is half the battle. Knowing where everything is the other half to the story.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Enabling Learning Objective C	Action: Troubleshoot the hydraulic and steering system failure Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel and reaching the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands on activities.
Risk Assessment Level	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet (or we could get a drawing and make them label the component too…on the worksheet)
Instructional Lead-In	The purpose of this demonstration is to increase familiarization to components of the JLTVA1 hydraulic and steering systems. This task is to familiarize them with the JLTVA1 component locations and functionality as preparation for the following troubleshooting practical exercise.
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils

Special Instructions

Below are the instructions for how to prepare for the practical exercise.

Preparation	Instructor Notes
TM Reference:	N/A
Time Required for Prep:	0 if vehicle is prepped
Symptom/Purpose:	Gain familiarization with suspension system and components
Prepare Area for PE:	N/A
Configure Vehicle for PE:	Belly armor removed (if B-Kit installed) Cowl armor removed (if B-Kit installed) JLVT on Jack Stands or Suspension Lock-out Braces Installed Splash Guards removed Drop Battery Tray Skid Plate removed
Instructor Preparation:	Ensure instructors have located and understand the purpose all components before conducting component location.
Safety	Instructors will monitor the exercise and ensure students are properly adhering to safety guidelines while working on the vehicle.

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises.

d. Inform students they will have approximately **30 minutes** to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five.

h. Ask if there are any questions.

i. **Point out the following components on the transmission and explain the components function.** Students may begin. Below are components and their function which the instructor may use to assist with the Go/No Go rubric.

Components	Location/Function
	The purpose of this practical application is for learners to become familiar with the components on the JLTVA1 system. The instructor to student ratio is 1:5.
	Students will need to identify and describe the function of the components on the JLTVA1 suspension system.
Engine Secondary Belt	Located: Front of Engine Purpose is to drive HPG Pump
Hydraulic Pump	Located: Mounted lower right front of engine Provides 4GPM flow rate @800 RPM, 3250 psi peak pressure
Hydraulic Manifold	Located; Left rear/under splash guard Purpose is to supply the HPG suspension circuit to raise and lower the suspension
Hydraulic Filters (2)	One Located: Left side of cooling panel Purpose is to remove contaminants Second Located: near the front right shock Purpose is to remove contaminants
Hydraulic Cooler	Located: in the cooling pack Purpose is to cool hydraulic oil prior to returning to the tank
Hydraulic Tank	Located: right side of engine (Cap is in the center front) Capacity: 6.5 quarts of OW30
Steering Knuckle	Located: Inside the wheel end hub assembly Purpose: Houses the ball joints which allow the vehicle to turn
Mechanical Toe Links and Shafts	Located: All four axles are attached to knuckles and arms Purpose is to move the wheel ends with the steering system
Steering Gear	Located under the vehicle - rear part of front subframe Purpose is to move attached components in accordance to movement of steering wheel
Idler Gear	Located under the vehicle - to the right of the steering gear Purpose is to assist the steering gear with turning the vehicle
Steering Column/Wheel	Located in the capsule in the center of the dash of the driver's area Purpose is to provide the operator with a device to control vehicle direction (steering control)

j. Mark Go/No Go Sheets accordingly.

1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

2. Once the Practical Exercise is complete, the Lead Instructor must sign each student's Solution Sheet.

Feedback Requirements

Provide feedback to students to ensure comprehension.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 7J-1
Hydraulic and Steering Component ID

Name____

Date____

Training Location____

Hydraulic and Steering Component ID	**Go**	**NO GO**	**Initials**
Identify and explain the engine secondary belt			
Identify and describe the hydraulic Pump			
Identify and describe the hydraulic manifold			
Identify and describe both hydraulic filters			
Identify and describe the hydraulic cooler			
Identify and describe the hydraulic tank			
Identify and describe steering knuckles and lubrication points			
Identify and describe steering shaft lubrication points			
Identify and describe steering gear			
Identify and describe idler gear			

Instructor Signature____

Appendix C
JLTVA1 Practical Exercise Sheet No. 7K
Hydraulics System Drain/Fill/Bleed

Title	Hydraulics System Drain/Fill/Bleed
Lesson Number/ Title	07 Suspension/Hydraulics/Steering
Introduction	The hydraulic system is a critical system for this tactical vehicle as it powers many systems, therefore vehicle performance and/or functionality would be reduced, or compromised, if the hydraulic system is not functioning properly.
Motivator	Servicing the Hydraulic system is a key part of vehicle readiness.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Enabling Learning Objective	Action: Conduct maintenance on the hydraulic and steering system Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel and reaching the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands on activities.
Risk Assessment Level	Low
Environmental Considerations	Vent exhaust if indoors and JLTVA1 engine is running to complete ride height adjustments. It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	This practical exercise will give you the opportunity to practice the skills required to provide maintenance to the JLTVA1 hydraulic and steering system.
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils
Special Instructions	Below are the instructions for how to prepare for the practical exercise.

Preparation	Instructor Notes
TM Reference:	**Maintenance Procedures>**Maintainer Maintenance Procedures>043 Hydraulic, fluid, air, and vacuum system >Fluid Tanks or Reservoirs >Hydraulic system drain/fill/bleed
Time Required for Prep:	N/A if vehicle prepped from previous PE
Symptom/Purpose:	Filling the Hydraulic
Prepare Area for PE:	Ensure Special Tools available: Charge Cart
Configure Vehicle for PE:	Belly armor removed (if B-Kit installed) Cowl armor removed (if B-Kit installed) JLVT on Jack Stands or Suspension Lock-out Braces Installed Splash Guards removed Drop Battery Tray Skid Plate removed
Instructor Preparation:	Confirm the proper oil, filter and other equipment are ready and available for this exercise.
Safety	Instructors will monitor the exercise and ensure students are properly adhering to safety guidelines while working on the vehicle.

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises.

d. Inform students they will have approximately **1 hour 20 minutes** to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five.

h. Ask if there are any questions.

i. Students may begin. Below are key steps the instructor may use to assist with the Go/No Go rubric.

Step	Instructor Notes/Answer Key
Locate Proper task in IETM	**Maintenance Procedures>**Maintainer Maintenance Procedures>043 Hydraulic, fluid, air, and vacuum system > 4308 Fluid Tanks or Reservoirs >Hydraulic system drain/fill/bleed
Preform all equipment conditions	Follow IETM
Preform task	Follow IETM
Key Step:	Remove passenger side splash guard
Key Step:	Remove engine splash guard
Key Step:	Replace hydraulic oil filters (step 5 of WP) **NOTE: To avoid waste** from unnecessarily replacing a good filter you may verbalize the filter replacement task instead of actually doing the task. • Use the IETM to show students the step/read it. • Go to the JLTVA1 to show filter location. Do not remove the filters unless you have the replacement filters available, they are: • OSK PN: Filter, Hydraulic: 4268224 • OSK PN: Filter, Hydraulic: 4189413
Key Step:	Fill Reservoir **NOTE: To avoid a spill** ensure students fill the reservoir slowing to prevent overflow which makes a mess on the engine.
NOTE:	**DO NOT REPEAT Steps 4-11 three times** unless you are training in an artic environment. Repeating steps 4-11 of the Drain/Fill work pack are for artic conditions only.
Verify Hydraulic system works properly	Test system by running it through a functions test

j. Mark Go/No Go Sheets accordingly.

1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

2. Once the Practical Exercise is complete, the Lead Instructor must sign each student's Solution Sheet.

Feedback Requirements

Provide students with feedback real-time during the exercise to ensure comprehension.

Debrief the Activity: Provide tips and insights into potential "go wrongs" and reasons/rational for things that occurred during the PE.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 7K-1
Hydraulics System Drain/Fill/Bleed

Name____

Date____

Training Location____

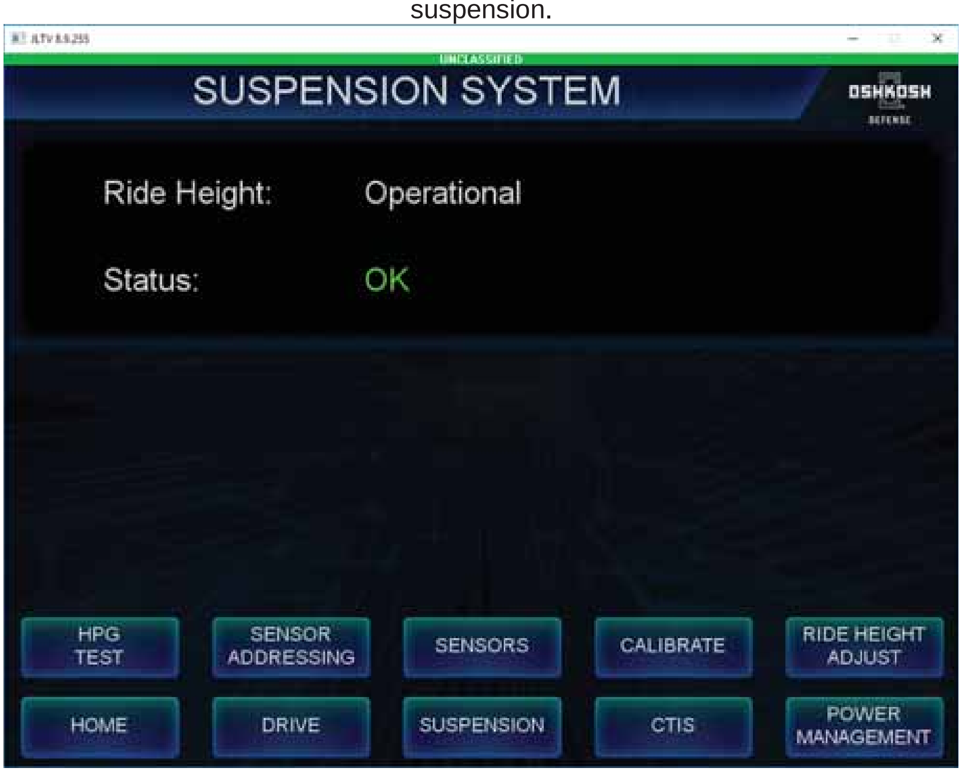
Hydraulics System Drain/Fill/Bleed	**Go**	**NO GO**	**Initials**
1. Located proper Maintenance track in the IETM			
2. Followed all warning cautions and notes			
3. Perform all equipment conditions			
4. Correctly followed Maintenance tracks in IETM			
5. Correctly Preformed all follow-on maintenance per IETM			

Instructor Signature____

Appendix D
DSDU Job Aid Sheets for Suspension

The first step to accessing suspension screens is to select SUSPENSION from the main menu at the bottom of the screen.

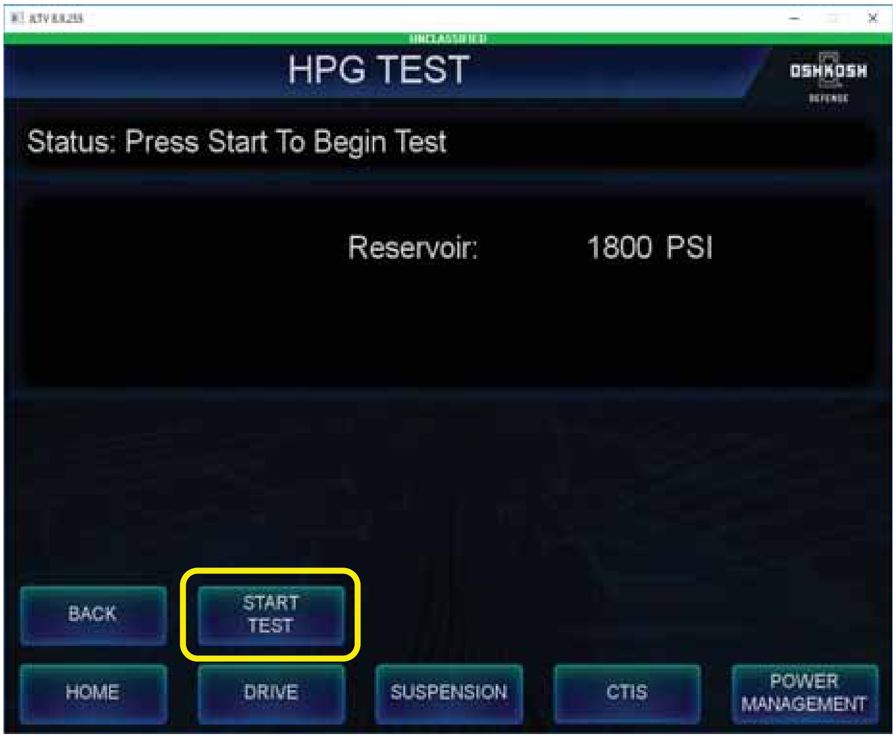
The following screen is the Suspension's Main Menu – lists tasks and information available regarding the suspension.



HPG Reservoir Pressure Test:
The first option is the HPG Test which is how to test the pressure within the HPG Reservoir. First select the HPG TEST button, then START TEST on the next screen.

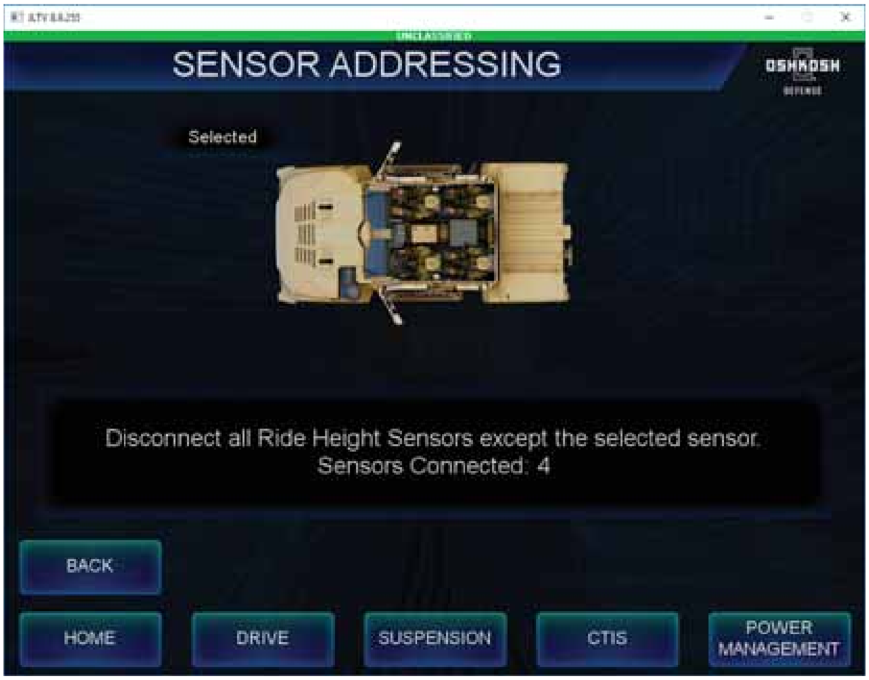
The results of the test are displayed on the following screen.

Sensor Addressing:
The next button on the Suspension Menu is Sensor Addressing.
IMU Sensors and Ride Height Sensors must be calibrated whenever an HPG spring is replaced.



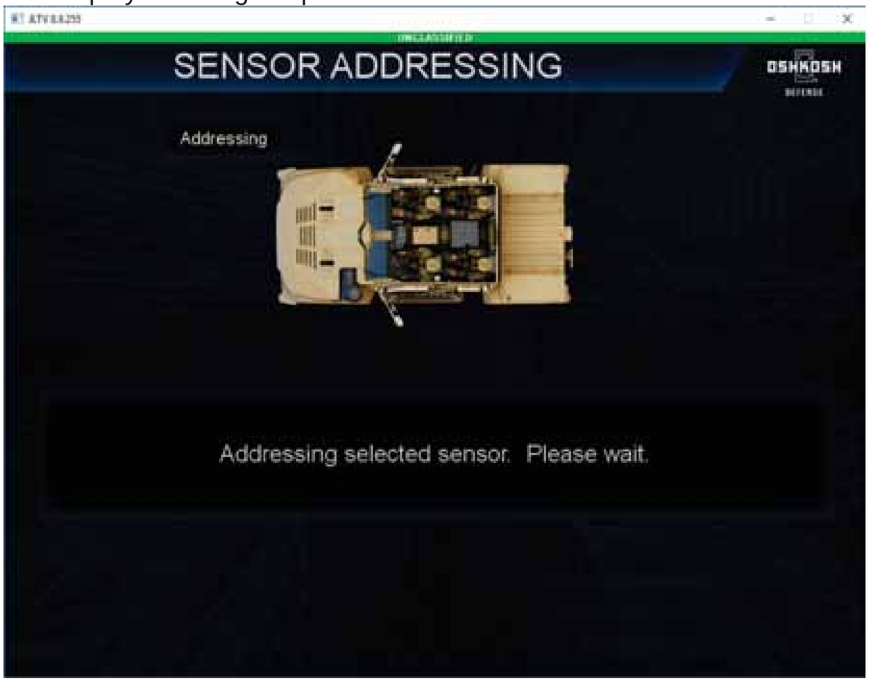
The next screen provides buttons for each corner of the suspension. Select the corner that needs the sensor addressed by pushing the button for that corner.

All other corners (other than the corner to address) must be disconnected to isolate the sensor. Disconnecting sensors is a physical action done by hand on the truck.

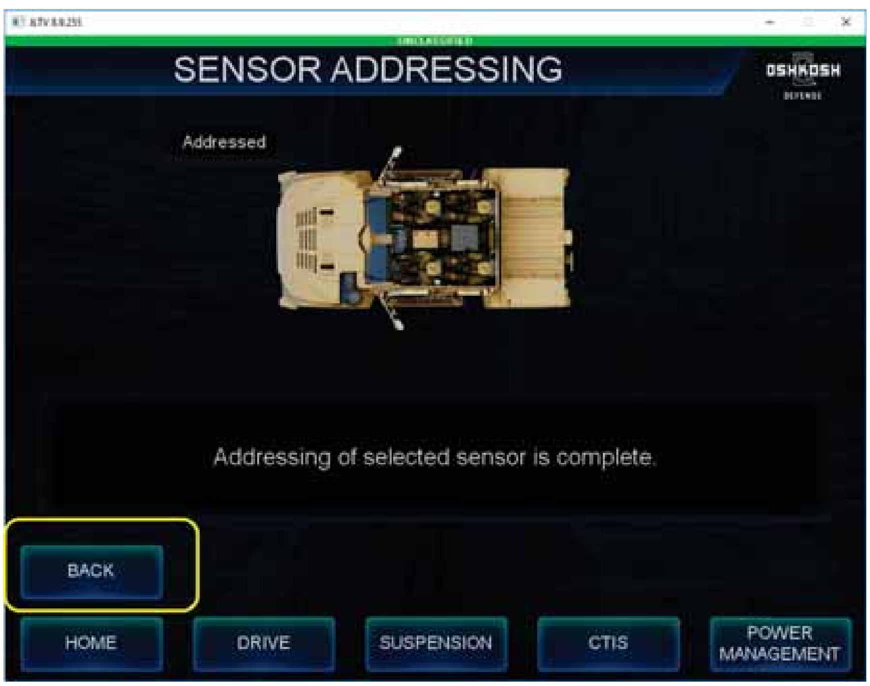


Upon selecting a corner to address the DSDU will ask you to confirm your selection.

The screen below is displayed during the process.



When the sensor has been addressed the screen below will be displayed. Select the BACK button to return to the Suspension Menu.



Sensors:
The third button of the Suspension Menu is for___ sensors.
Use this screen to….

The fourth suspension option is to calibrate the ride height sensor or the IMU. However, before providing those options the DSDU will first prompt you to lower the JLTVA1

Lowering the JLTVA1 to the Hard Stops slides will be displayed prior to offering a calibration option.

Press and hold the LOWER button until the JLTVA1 no longer moves lower in height. Then select CONFIRM when the JLTVA1 is lowered to the hard stops.

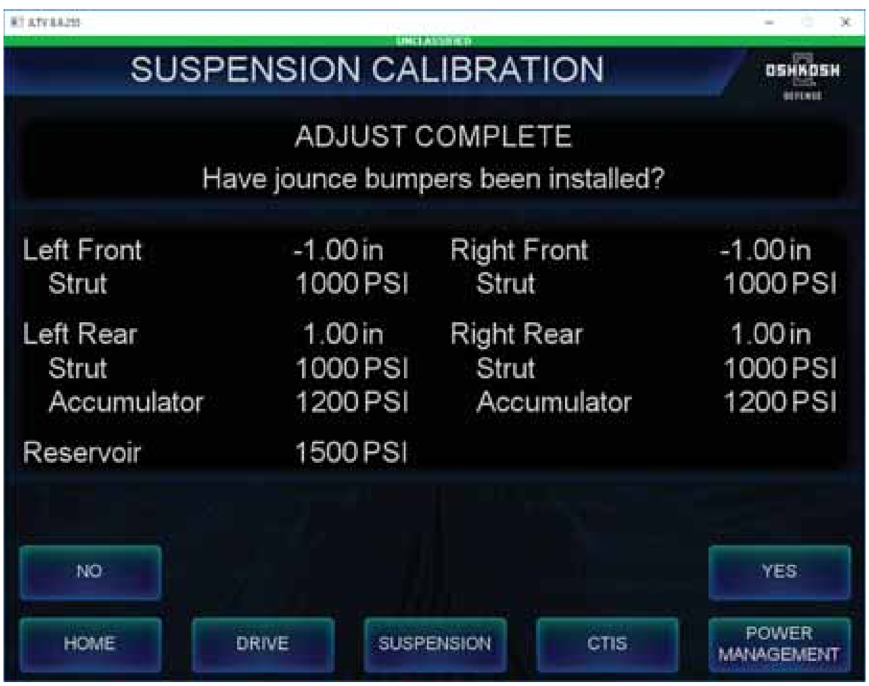
After confirming contact with the hard stops two calibration options will appear: CALIBRATE IMU and CALIBRATE RIDE HEIGHT.

Only calibrate an IMU when it is new part due to replacement.


SUSPENSION CALIBRATION
OSHKOSH
Please Wait… Requesting IMU sensor calibration
Left Front -1.00 in
Strut 1000 PSI
Right Front -1.00 in
Strut 1000 PSI
Left Rear 1.00 in
Strut 1000 PSI
Accumulator 1200 PSI
Right Rear 1.00 in
Strut 1000 PSI
Accumulator 1200 PSI
Reservoir 1500 PSI
ABORT
HOME
DRIVE
SUSPENSION
CTIS
POWER MANAGEMENT


SUSPENSION CALIBRATION
OSHKOSH
IMU SENSOR CALIBRATION COMPLETE
Is it OK to raise the suspension?
Left Front -1.00 in
Strut 1000 PSI
Right Front -1.00 in
Strut 1000 PSI
Left Rear 1.00 in
Strut 1000 PSI
Accumulator 1200 PSI
Right Rear 1.00 in
Strut 1000 PSI
Accumulator 1200 PSI
Reservoir 1500 PSI
CANCEL
YES
HOME
DRIVE
SUSPENSION
CTIS
POWER MANAGEMENT


SUSPENSION CALIBRATION
OSHKOSH
Please Wait… Requesting operational ride height
ADJUSTING…
Left Front -1.00 in
Strut 1000 PSI
Right Front -1.00 in
Strut 1000 PSI
Left Rear 1.00 in
Strut 1000 PSI
Accumulator 1200 PSI
Right Rear 1.00 in
Strut 1000 PSI
Accumulator 1200 PSI
Reservoir 1500 PSI
ABORT
HOME
DRIVE
SUSPENSION
CTIS
POWER MANAGEMENT


SUSPENSION CALIBRATION
OSHKOSH
ADJUST COMPLETE
Have jounce bumpers been installed?
Left Front -1.00 in
Strut 1000 PSI
Right Front -1.00 in
Strut 1000 PSI
Left Rear 1.00 in
Strut 1000 PSI
Accumulator 1200 PSI
Right Rear 1.00 in
Strut 1000 PSI
Accumulator 1200 PSI
Reservoir 1500 PSI
NO
YES
HOME
DRIVE
SUSPENSION
CTIS
POWER MANAGEMENT

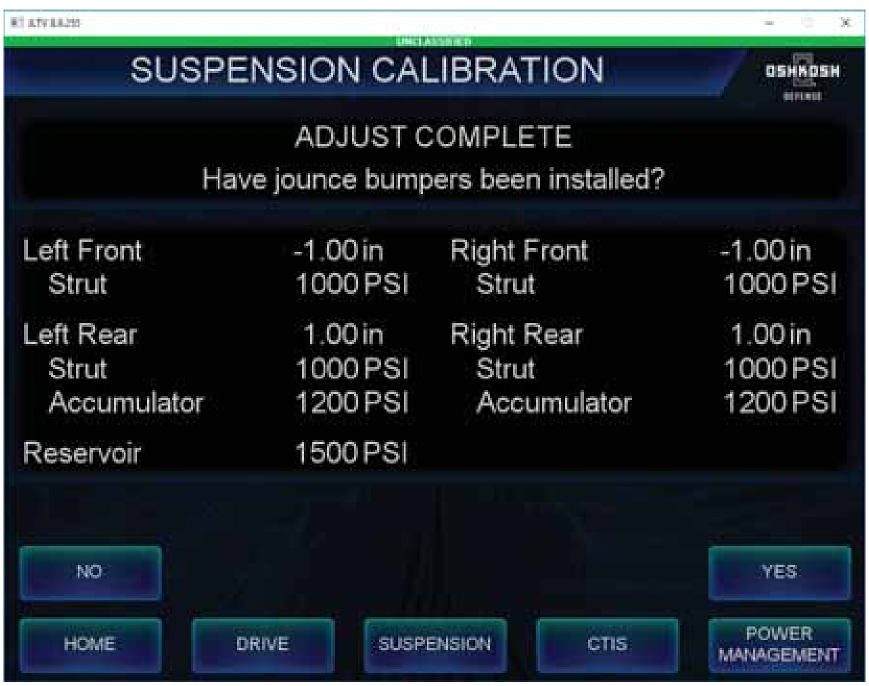
Calibrate Ride Height Sensors

From the suspension menu select CALIBRATE, the vehicle will prompt you through slides to lower the JLTVA1 to the hard stops then **select CALIBRATE RIDE HEIGHT**

When the calibration is complete the DSDU ask if it is safe to raise the JLTVA1. Select YES if it is safe to raise the vehicle and everybody is away from the vehicle.

The DSDU will raise the JLTVA1 to operational ride height.

Select YES after installing the jounce bumpers

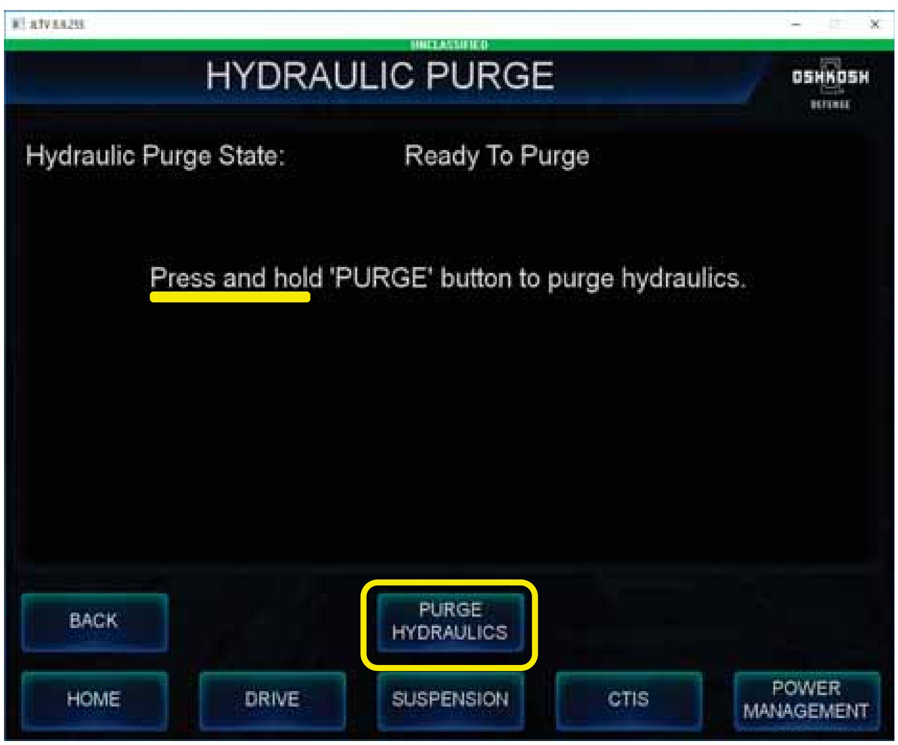


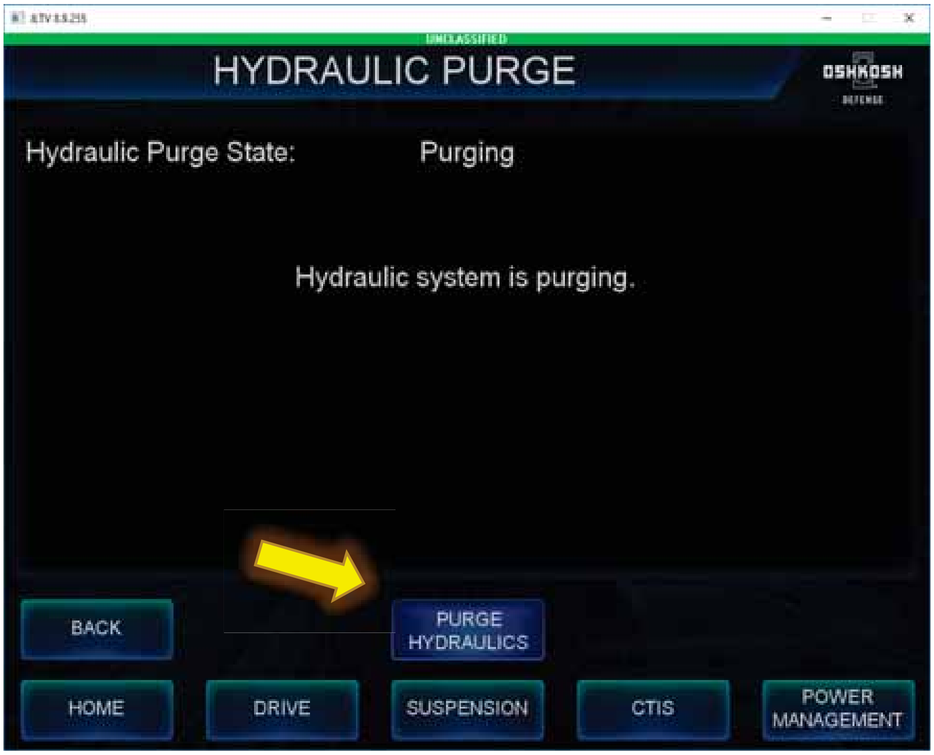
The last screen of RIDE HEIGHT SENSOR CALIBRATION is a confirmation screen.
Select BACK if you need to return to the suspension menu, or HOME to exit submenu.

The last suspension meu option is RIDE HEIGHT ADJUST.
Select this button to follow the ride height adjustment procedures.

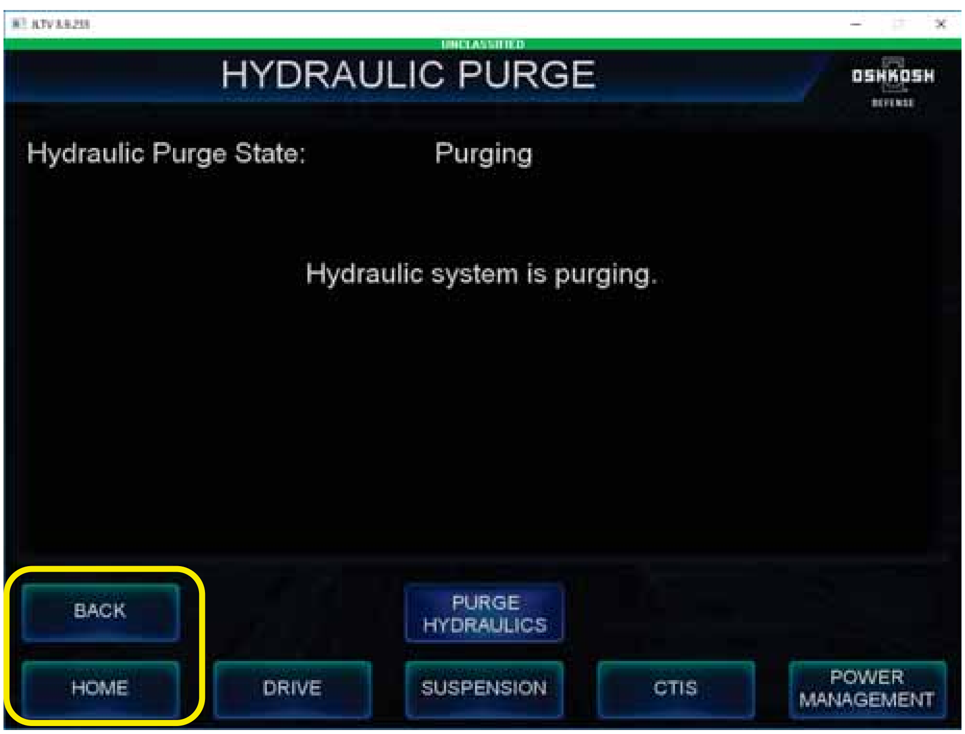
HYDRAULIC PURGE

Conduct a hydraulic purge when you must open the hydraulic lines between the hydraulic pump and the HPG Nitrogen pump or replace the HPG Nitrogen pump. (Follow the steps in the IETM)





When the hydraulic purge is complete, select BACK or HOME.



US Army
SFAE-CSS-JC-JL
MS 640 BLDG 302 RM 113
6501 E 11 Mile Road
Warren, MI 48397-5000

INSTRUCTOR GUIDE

Joint Light Tactical Vehicle (JLTVA1) Maintainer Course

LESSON

08 Air Systems, Brakes and CTIS

SECTION I. ADMINISTRATIVE DATA

All Courses Including This Lesson

Course Number	Version	Course Title
JLTVA1_MAINT_01	3.0	Introduction and Safety
JLTVA1_MAINT_02	3.0	Vehicle Familiarization
JLTVA1_MAINT_03	3.0	Electrical
JLTVA1_MAINT_04	3.0	Engine
JLTVA1_MAINT_05	3.0	Transmission
JLTVA1_MAINT_06	3.0	Drivetrain
JLTVA1_MAINT_07	3.0	Suspension, Hydraulics and Steering
JLTVA1_MAINT_08	3.0	Air Systems, Brakes and CTIS
JLTVA1_MAINT_09	3.0	End of Course

Task(s) Taught (*) or Supported

Task Number	Task Title
III.A.1.6	Inspect and test air system pressure controls: governor, unloader assembly valves, filters, lines, hoses, and fittings; adjust or replace as needed.
III.A.1.10	Inspect and test brake application (foot/treadle) valve, fittings, and mounts; check pedal operation; replace as needed.
V.B.12	Bleed and/or flush brake system.
III.A.3.4	Manually release (cage) and reset (uncage) parking (spring) brakes in accordance with manufacturers' recommendations.
III.C.4	Test and check operation of antilock brake system (ABS) air, hydraulic, electrical, and mechanical components; perform needed action.
AA1080W_00_NGFAAAW	11-25_SA RIGHT PMV SOL SHRT TO GND
AA1080W_00_NGFAAAG	11-07_SA LEFT WSS OPEN OR SHORTED
AA10J_00_NGFAABO	CTIS DNO (ELECTRICAL)
A650A0S_00_NGFAAAE	107-05_OPEN-INTERAXL DIFF
A650A0S_00_NGFAAAI	107-09_OPEN-REAR AXL DIFF

Reinforced Task(s)

Task Number	Task Title
N/A	

Academic Hours

The academic hours required to teach this lesson are as follows:

Academic	Resident Hours	Methods
2 hr		ILT
5 hr 50 min		PE
Total Hours:	7 hr 50 min	

Test Lesson Number

Hours	Lesson Number Version	Lesson Title
1 hr 30 min	Test A	09_End of Course and Final Exam
1 hr 30 min	Test B	09_End of Course and Final Exam

Prerequisite Lesson(s)

Hours	Lesson Number Version	Lesson Title
N/A	N/A	N/A

Clearance Access

Security Level: Distribution C
Requirements: Distribution authorized to U.S. Government agencies and their contractors only.

Foreign Disclosure Restrictions

FD7. This product/publication has been reviewed by the product developers in coordination with the Oshkosh Corporation foreign disclosure authority. This product is NOT releasable to students from foreign countries.

References

Number	Title	Date
2320-01-653-6557	JLTVA1 GP IETM	April 2018
2320-01-653-6495	JLTVA1 HGC IETM	April 2018
2320-01-653-6516	JLTVA1 UTL IETM	April 2018
2320-01-653-6534	JLTVA1 CCWC IETM	April 2018

Student Study Assignments

None

Instructor Requirements

JLTVA1 Certified Instructor (3)

Additional Support Personnel Requirements

Name	Student Ratio	Qty	Man Hours
N/A			

Equipment Required for Instruction

ID Name	Student Ratio	Instructor Ratio	Spt	Qty	Exp
Laptop	1:1	1:1	No	15	Yes
Projector	1:15	1:1	No	1	Yes
JLTVA1 w/BII	1:5	1:1	No	3	Yes
MSD with EMS NG/IETM	1:5	1:1	No	3	Yes
GMTK	1:5	1:1	No	3	Yes
FIK	1:5	1:1	No	3	Yes
Special Tool – Jack Service Cart Kit JLTVA1	2:5	2:1	No	6	Yes

Materials Required

Instructor Materials:
Instructor Guide

Student Materials:
Student Guide

Classroom, Training Area, and Range Requirements

ID Name	Qty	Student Ratio	Setup Mins	Cleanup Mins
Classroom, 15 Student	1	1:15	30	30
Shop, 3 Bays	1	1:5	30	30

Ammunition Requirements

DODIC Name	Qty	Student Ratio	Setup Mins	Cleanup Mins
N/A				

Instructional Guidance / Conduct of Lesson

NOTE: Before presenting this lesson, instructors must thoroughly prepare by studying this Lesson and identified reference material

Proponent Lesson Plan Approvals

Name	Rank	Position	Date
N/A			

SECTION II.	INTRODUCTION

Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of Instruction:	5 min
Instructional Strategy	Lecture & Group Discussion

Motivator

We learned about the engine, electrical systems, and transmission that make the JLTVA1 go then learned about the suspension and drivetrain systems that enable it to move. Next, we'll learn about how to make it stop. This module will educate you on brakes and air systems. The brakes of the JLTVA1 are of course mission critical. Failure or inefficiency of servicing the brakes will most likely result in the injury or death of personnel and/or damage to the vehicle.

Terminal Learning Objective 8.

NOTE: Inform the students of the following Terminal Learning Objective requirements.

Upon completion of this lesson, you will be able to:

Action:	Maintain the JLTVA1's air, brake, antilock braking system (ABS) and central tire inflation system (CTIS)
Conditions:	Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials
Standards:	Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity

Safety Requirements

It is the responsibility of the student/warfighter to follow safety guidelines as well as local unit SOPs.

Risk Assessment Level

Low

Environmental Considerations

It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.

Evaluation

At the end of the course a written final exam will be administered of which each student/warfighter must earn an 80% or greater to pass this course. Throughout the lessons/modules practical exercises will be provided and graded using a "go/no go" criteria, of which all students/warfighters must earn all "go's" (100%).

Instructional Lead-In

(Slide #1)

In lesson six, you learned about how the JLTVA1 moves from the drivetrain. In the upcoming module, you'll learn what mechanisms are in play to make the JLTVA1 stop or at least slow down. Now, we move into braking systems and CTIS.

SECTION III. **PRESENTATION**

(Slide #2)

Lesson Overview
This course will be almost eight hours long- one-third will be classroom and two-thirds will be training on the truck.

We'll learn about:

- Air system and brake systems
- Antilock braking system (ABS)
- CTIS
- ABS testing & troubleshoot ABS

As per usual, you must attend all training and pass all exams.

Enabling Learning Objective A.

(Slide #3)

NOTE: Inform the students of the following Enabling Learning Objective requirements.

Upon completion of this lesson, you will be able to:

Action:	Correlate the JLTVA1's braking systems/subsystems and components with their location, purpose, function and maintenance requirements
Conditions:	Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials
Standards:	Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activity.

1.

(Slide #4)

Instructor Note

Inform Students:
To accomplish the learning objective we are going to learn about the following topics in separate learning steps. Starting with the Air and Brake System.

ELO A – LSA 1

Learning Step/Activity:	Air System and Brake Systems
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	50 min
Media Type:	PPT

(Slide #5)

a. Air-powered Subsystem Overview

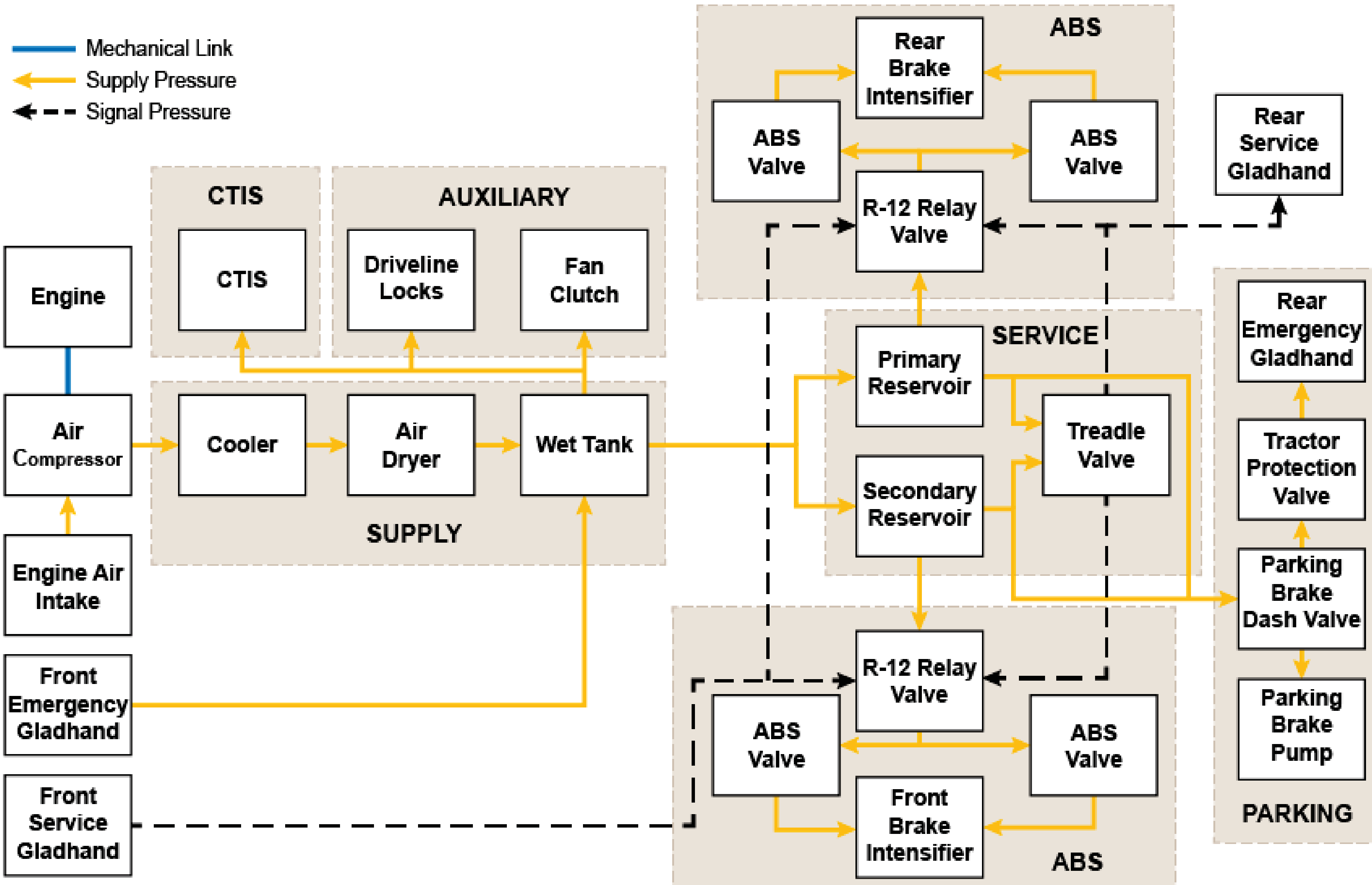


Figure 8.1 Air System Architecture

1. Air is supplied and distributed out to all systems which require air pressure to work. (Figure 8.1)

2. The air system on the JLTVA1 consists of five parts

   a) Supply system

   b) Brake system

   c) Parking brake system

   d) CTIS

   e) Auxiliary systems.

(Slide #6)

3. Air-powered Subsystems overview:

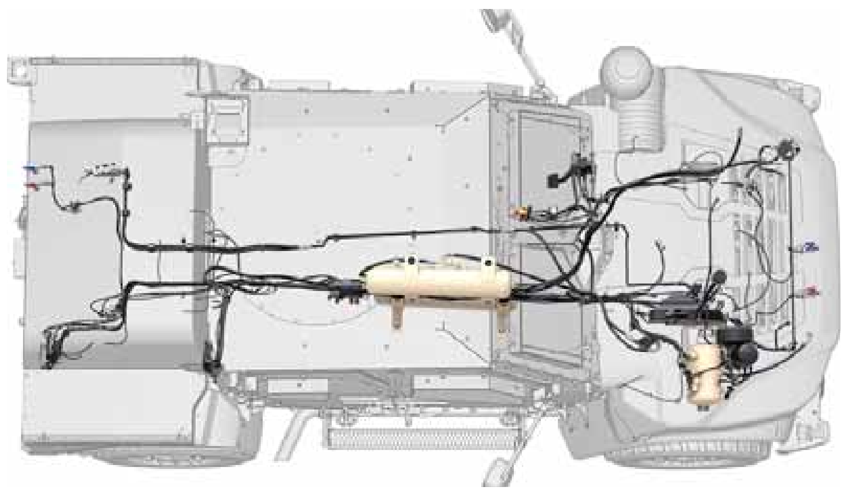


Figure 8.2 JLTVA1 Air System

   a) Supply system

      1) The air system takes clean, filtered air and distributes it to all systems that require air pressure to work. (Figure 8.2)

   b) Brake system

      1) The brake system is an air-over-hydraulic system.

      2) Air pressure works on actuators to apply a force on the master cylinder to build hydraulic pressure and apply the brakes.

   c) Parking brake system

      1) The parking brake has a pneumatic pump that builds hydraulic pressure to release the brakes.

2) The concept of spring applied, and pressure released still applies for this parking brake system, but it is accomplished in a different way.

d) CTIS

1) The CTIS system is a pneumatically controlled system that monitors the tires' pressure and manages tire pressure and controls all four tire's air supply channels separately.

e) Auxiliary systems

1) The air operated auxiliary systems on the JLTVA1 are the same pneumatically supported systems on other military trucks and include the fan clutch, heater system, and driveline locks.

(Slide #7)

b. Air Supply System

1. Air Supply Theory of Operation

a) An engine-belt-driven air compressor powers the JLTVA1 pneumatic system. The air compressor collects air from the engine intake and sends it through the air dryer to the air tanks. From the air tanks, air is distributed to all circuits of the pneumatic system.

1) This air system has three tanks.

(a) The Wet Tank supplies air to the primary and secondary brake system reservoirs.

(b) The Primary Tank supplies air to the rear brake system.

(c) The Secondary Tank supplies air to the front brake system.

2. Air Supply Components

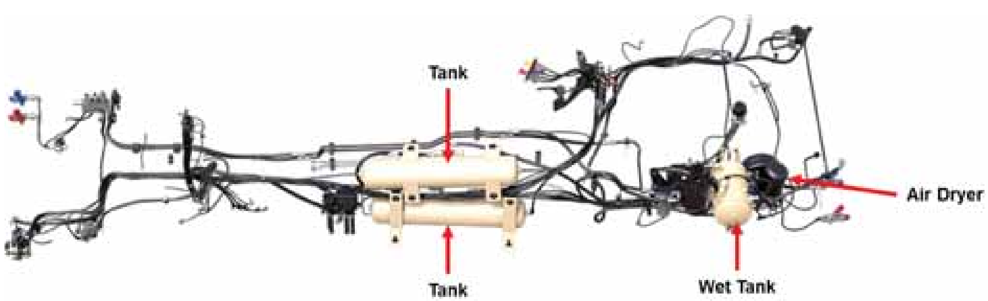


Figure 8.3 Supply system

a) The supply system consists of the engine air filter, air compressor, air dryer, governor, wet tank, and primary and secondary air tanks. (Figure 8.3)

(Slide #8)

Figure 8.4 Air compressor

b) Air compressor (Figure 8.4)

1) The air compressor is a Bendix TU-FLO 550 compressor that produces 13.2 CFM at 1250 RPM.

2) The air compressor is engine-driven and supplies air to the air tanks when the engine is running. Air from the compressor passes through a steel braided hose and through the cooling pack before it enters the air dryer. The governor controls the air compressor. When air system pressure reaches 130 psi, the governor unloads the air compressor and it stops supplying air. When air system pressure drops to 110 psi, the governor re-engages the air compressor and it starts supplying air again.

3) The air inlet port has a screen on it to ensure no large particles can enter the piston chamber.

4) The compressor is liquid cooled with engine coolant and lubricated with engine oil.

(Slide #9)

c) Air dryer

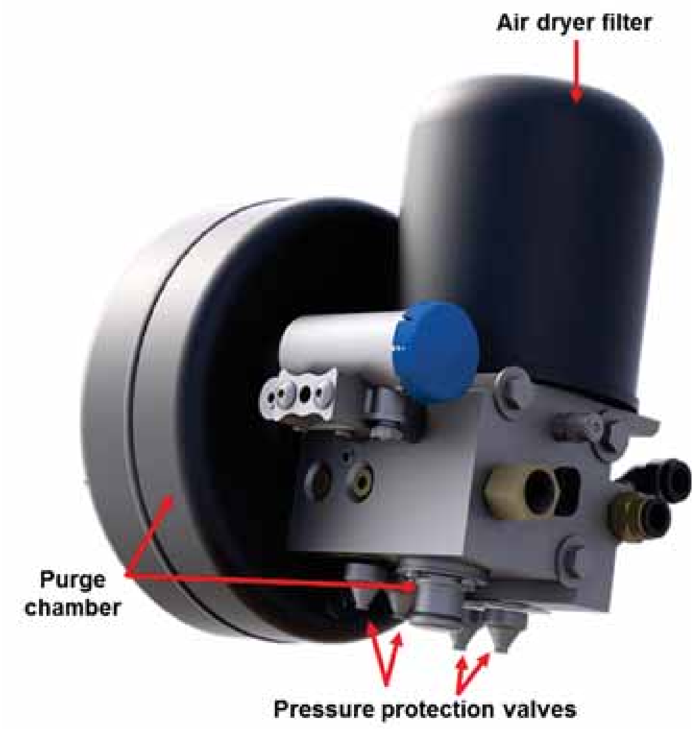


Figure 8.5 Air Dryer

1) The air dryer collects and cleans the air before it enters the pneumatic system, providing clean, dry air to the brake system components.

2) The air dryer has an integrated purge chamber, pressure protection valves (PPVs), heater/thermostat element and filtering. (Figure 8.5)

3) The air dryer is located by the wet tank in the engine bay. The governor is mounted to the air dryer. Internally in the air dryer, there are four pressure protection valves.

4) The four PPVs are in the air dryer discharge manifold. Three are set to 109-psi and one is set to 103-psi. It is critical that if the air dryer is replaced or serviced, and the discharge air hose is removed from the port, that it is put back in the correct location to ensure the correct 109-psi PPV is used.

5) Discharged air from the air dryer is then fed out to the wet tank located in the engine compartment on the right-hand side of the truck. From the wet tank, air is fed to the primary tank and secondary tank.

6) The air dryer over pressure protection valve is set to 150-psi.

7) The air dryer also has a heater/thermostat element in the purge valve to prevent freezing of the valve.

(a) The resistance below 40° F should be 6-9 Ohms.

(b) When the temperature is above 90° F the resistance should be over 1000 Ohms.

(Slide #10)

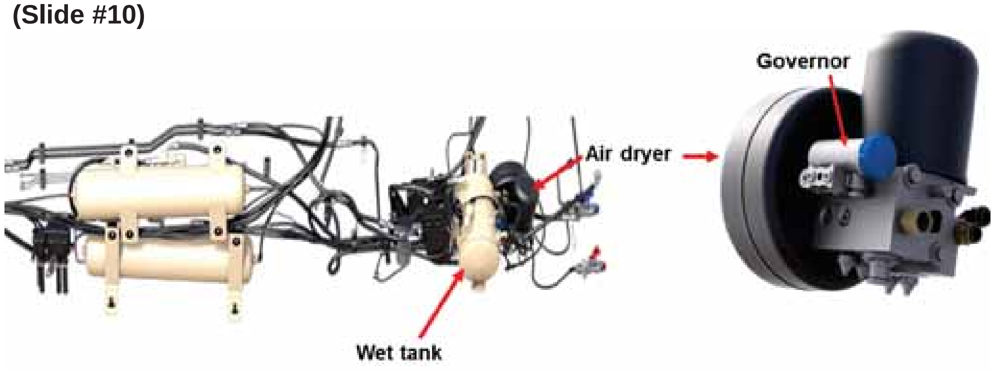


Figure 8.6 Governor and Wet Tank

d) Governor (Figure 8.6)

1) The governor mounts to the rear of the air dryer assembly.

2) It is a non-adjustable governor with a cut-in pressure of 110-psi and a cut-out pressure of 130-psi.

e) Wet tank (Figure 8.6)

1) The wet tank is located on the right side of the truck in the engine bay.

2) This wet tank holds 675 cubic inches of air.

3) Once pressure reaches above 65-psi, air will be released to the primary and secondary air tanks located in the capsule tunnel.

(Slide #11)

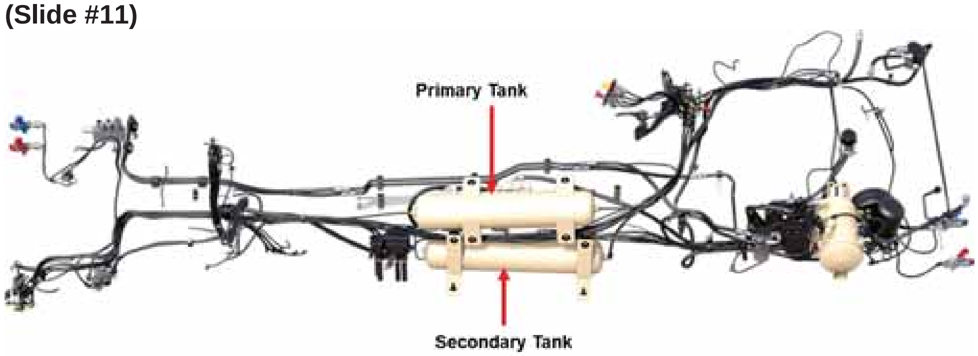


Figure 8.7 Primary and Secondary Air Tanks

f) Primary Tank

1) The upper of the two tanks. Located in the center tunnel. (Figure 8.7)

2) The Primary Tank supplies air to the rear brake system and is isolated from the wet and secondary reservoirs by check valves to maintain air pressure and emergency braking capability in case of a failure in the secondary air system.

g) Secondary Tank

1) The lower of the two tanks. Located in the center tunnel. (Figure 8.7)

2) The Secondary Tank supplies air to the front brake system and is also isolated from the wet and primary reservoirs by check valves to maintain air pressure and emergency braking capability in case of a failure in the primary air system.

(Slide #12)

c. Parking Brake System

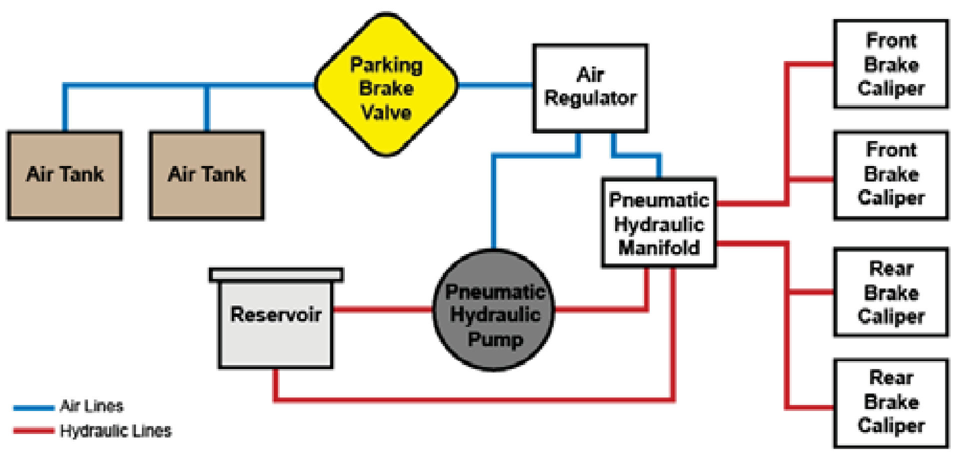


Figure 8.8 Parking Brake System diagram

1. Parking Brake System Theory of Operation

a) The parking brake design uses the principle of a spring-applied pressure-released parking brake control. However, instead of using pneumatic pressure directly to release the application springs, the JLTVA1 uses pneumatically driven hydraulic pressure applied to the Spring Applied Hydraulic Released (SAHR) chamber in the caliper. This is done through the manifold and the pump units on the right rear of the truck. (Figure 8.8)

b) When the parking brake valve on the dash is pressed, air passes through the valve out to a pressure regulating valve.

c) From the pressure regulating valve air feeds to the pneumatic-hydraulic manifold where a t-fitting feeds to a pilot valve and to the pneumatic-hydraulic pump.

d) As the air pressure builds on the manifold, the pilot valve opens to allow hydraulic fluid to pass. That same air also drives the pneumatic-hydraulic pump which sends the hydraulic fluid through the pilot valve to the caliper to release the parking brakes.

e) When applying the parking brake, air is vented from the system through the parking brake valve in the cab (knob pulled out). This drops the 60-psi holding pressure that maintains the balance in the pneumatic and hydraulic system.

f) When the pressure is gone, the springs in the calipers will push the hydraulic fluid back out of the chambers and the parking brake will reapply.

g) The parking brake hydraulic supply goes to all four wheels. All four brake calipers are applied when the parking brake is applied.

(Slide #13)

2. Parking Brake System Components

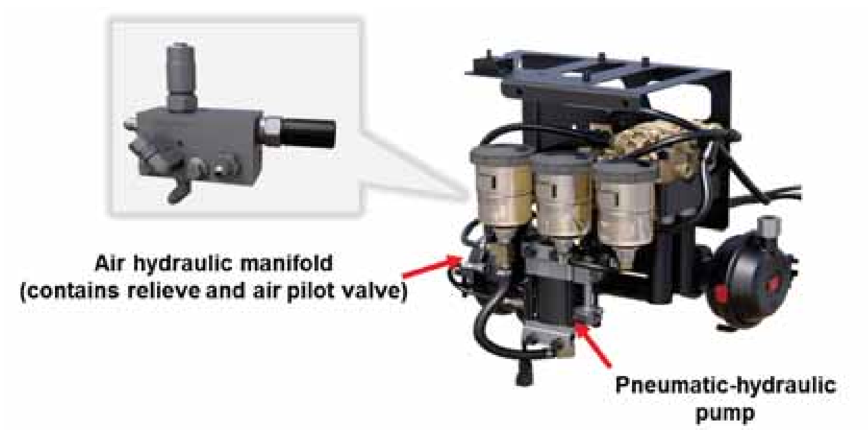


Figure 8.9 Pneumatic-hydraulic pump

a) Pneumatic and hydraulic system components

1) Park brake valve

(a) Provides air pressure for application and holding of the parking brake system. It has a 60-psi hold pressure to keep the valve in the applied position.

2) Air regulator

(a) Manages the air that is supplied to the system. Once the pressure reaches its set limit, the regulator valve will shut off the supply to the air-hydraulic manifold. The remaining pressure in the system is fed back to maintain the park brake valve in the released position.

3) Air hydraulic manifold

(a) Contains an air pilot valve and a pressure relief valve. As the air pressure builds on the manifold, the air pilot valve opens to allow hydraulic fluid to pass. The air pilot valve is in the open position when the park brake valve is pressed. This allows for hydraulic fluid to pass when the pump is running. The relief valve is used on the hydraulic side of the system. We discuss more about this in the hydraulic components section. (Figure 8.9)

(1) Pilot valve - The pilot valve is a 2-position, 6-port valve that activates by air. In its normal state, hydraulic fluid can go back to the reservoir, which drops line pressure and allows for the springs at the calipers to apply the parking brakes. When applying air pressure to the valve, the spool valve shifts and opens to allow pressurized hydraulic fluid to feed out to the calipers.

(2) The relief valve - Set at 2700-psi to protect the hydraulic lines from bursting when the air-hydraulic pump pressurizes the system.

4) Pneumatic-hydraulic pump (Figure 8.9)

(a) Is driven by air that is supplied to the pump by the park brake valve on the dash. The pump sends hydraulic fluid through the pilot valve, and out to the caliper.

(Slide #14)

Figure 8.10 SAHR Caliper

5) SAHR calipers (Figure 8.10)

(a) Have a spring activated mechanism that holds the brake in the applied position when the system is not pressurized.

(b) The calipers require 1800-psi to release the parking brakes.

(c) If there is a catastrophic loss of air (or just low air that builds pressure), the low air indicator light illuminates, and an audible alarm will sound.

(d) If air pressure drops below 45-psi, the spring brakes will apply.

(e) There is no warning for the hydraulic part of the system, but the spring brakes engage if there is a loss of pressure.

(Slide #15)

d. Service Brake System

1. Theory of Operation

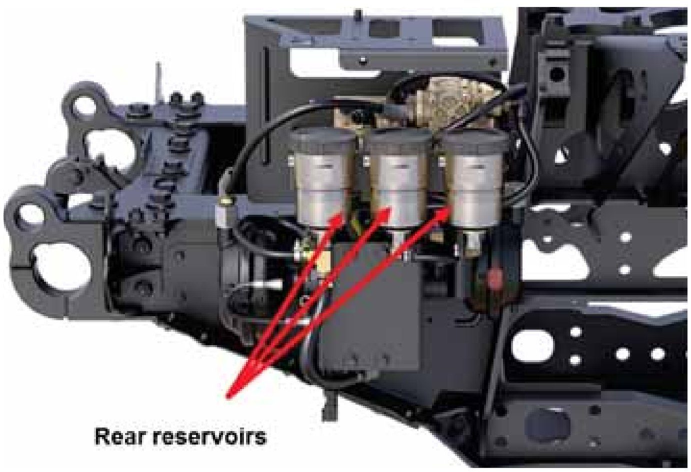


Figure 8.11 Rear reservoirs

a) The service brakes on the JLTVA1 each have independent reservoirs to supply hydraulic fluid to the calipers. (Figure 8.11)


Figure 8.12 Caliper

b) The JLTVA1 uses a caliper assembly style brake system with an integrated caliper parking brake system. (Figure 8.12)

c) The service brakes system uses two systems: pneumatic (air) and hydraulic.

(Slide #16)

2. Service Brake System Pneumatic and Hydraulic Components

a) Pneumatic system components

1) The pneumatic components that make up the brake system are the primary and secondary air tanks, the treadle valve, the R-12 relay valves, and the modulating valves.

2) Primary and secondary air tanks

(a) The air tanks supply air for the front (secondary) and rear (primary) braking systems. They are in the center tunnel of the cab, under the truck.

(b) The primary air tank and the secondary air tank have the same volume capacity of 1300 cubic inches.

(c) The pressure transducers sending signals for air pressure are found threaded into the air tanks. Sending Unit 1 (SU1) is for the primary tank (top tank) and SU2 is for the secondary tank (bottom tank).

3) Primary and secondary tank pressure sensor

(a) Circuit breaker 9 supplies 24V ignition power to sending unit (SU) 1 and SU2.

(b) SU1 and SU2 have independent signal wires.

Instructor Note

The signal from the primary air tank pressure sensor is sent via wire 1120 to MC9, pin O at the instrument panel.

The secondary pressure sensor signal is sent via wire 1119 to MC9, pin U at the instrument panel.

4) Treadle valve

Figure 8.13 Treadle valve

(a) The JLTVA1 uses a standard treadle valve with supply air coming from the primary and secondary air tanks.

(b) When pressed down air can pass through the valve and out to the control side of the R-12 relay valve. (Figure 8.13)

(Slide #17)

5) R-12 relay valves

(a) Are standard air valves found on many other medium and heavy truck platforms.

(b) The relay valve is a two position 6 port valve that is activated by a control signal.

(c) When in its non-control signal state, tank pressure (typically around 130-psi), waits at the supply port of the valve.

(d) On the delivery side, the porting vents to atmosphere. When the control signal is received from the treadle valve, the valve shifts position. Air is then allowed to feed from the supply port to the delivery port, through the modulating valves, and out to the brake intensifiers.

6) Modulating valves (Figure 8.14)

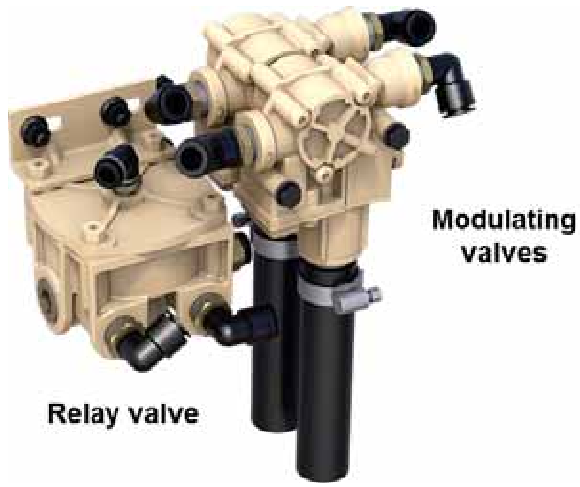


Figure 8.14 Modulating valves

(a) The action of these valves will be discussed in further detail within the ABS section.

(b) At a high-level, once air passes through these valves, it feeds to the master cylinder to pressurize fluid to activate the brakes.

(Slide #18)

b) Hydraulic Components

1) The hydraulic components of the brake system are the brakes' hydraulic reservoirs, the brake intensifiers, and the caliper.

2) Hydraulic reservoirs

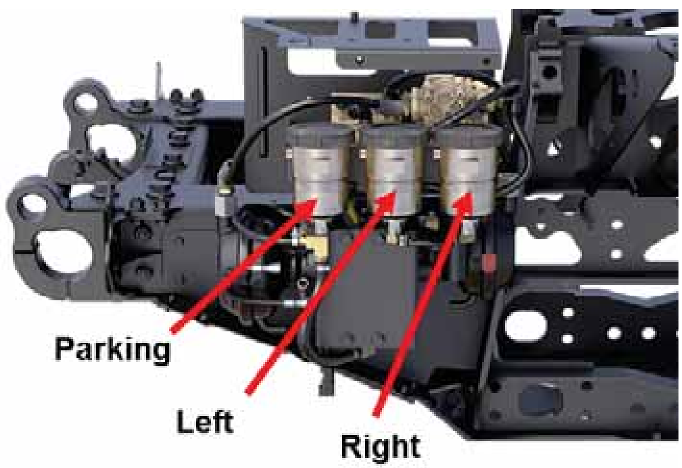


Figure 8.15 Rear reservoirs

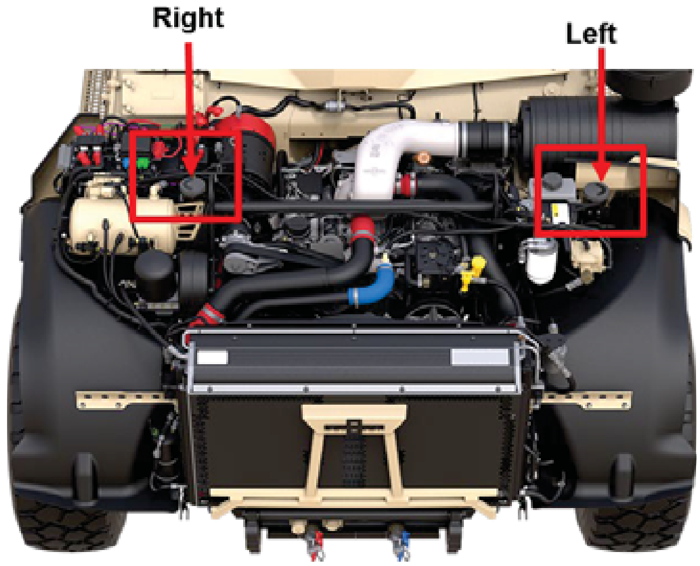


Figure 8.16 Front reservoirs

(a) There are 5 reservoirs on the JLTVA1 - One for each wheel's brake and one for the parking brake.

(b) Rear Hydraulic Reservoirs - There are three reservoirs on the right rear of the truck: left rear, right rear, and parking brake reservoir. (Figure 8.15)

(c) Front Hydraulic Reservoirs - One reservoir is on the front left side of the truck for front left brakes, the other is on the front right side for the right brakes. (Figure 8.16)

(d) Filling reservoirs - Maintain fluid in the appropriate brake reservoir to the max fill line with DOT 4 brake fluid.

(e) The initial fill from factory is 2 quarts of DOT 4 brake fluid.

(Slide #19)

3) Brake intensifier (Figure 8.17)

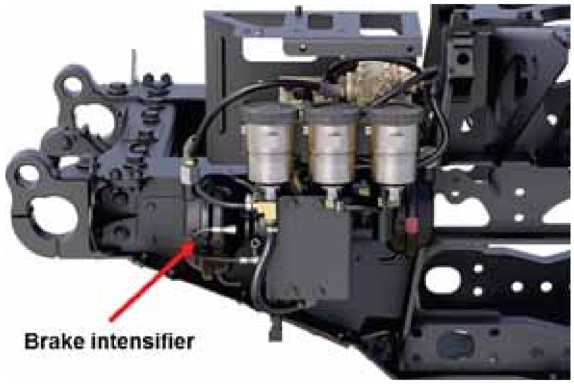


Figure 8.17 Brake Intensifier

(a) There are four (4) independent service brakes circuits, so each wheel has its own ABS modulator valve, brake fluid reservoir, brake caliper, and air-over-hydraulic brake intensifier.

(b) The brake intensifiers work on the principle of Pascal's Law, which simply stated means that compressed liquids in a confined space will transfer pressure equally to all surfaces in contact with the compressed liquid. The brake intensifier boosts the hydraulic pressure in a vehicular braking system.

(c) The air-over-hydraulic intensifier converts air pressure to increased hydraulic pressure, providing up to 1650-psi acting on the dual pistons inside the calipers. This is possible because the air side of the intensifier is a larger diameter piston (almost 2x the size of the hydraulic piston). The force compounds because of the surface area difference and the air piston having more surfacing area.

(d) If one circuit fails, or becomes damaged in combat, three circuits remain operational. Brakes remain functional with air compressor failure or engine stall with incremental reduction in pressure after every application. After a minimum of 10 applications, the pressure will drop enough that parking brakes will begin to apply. The service brakes can also be activated through the front glad-hand connections if the vehicle is towed by another vehicle.

4) Brakes applied

(a) Air from the treadle valve is sent to the R-12 relay valves, through the modulator valves, and then to the brake intensifiers which push on the master cylinder which forces the hydraulic fluid out to the caliper to actuate the brakes.

5) Brakes released

(a) When the brakes release, the air pressure vents off to atmosphere from the R-12 relay valves. This relieves the hydraulic pressure that held the brakes applied.

(Slide #20)

c) Caliper (Figure 8.18)

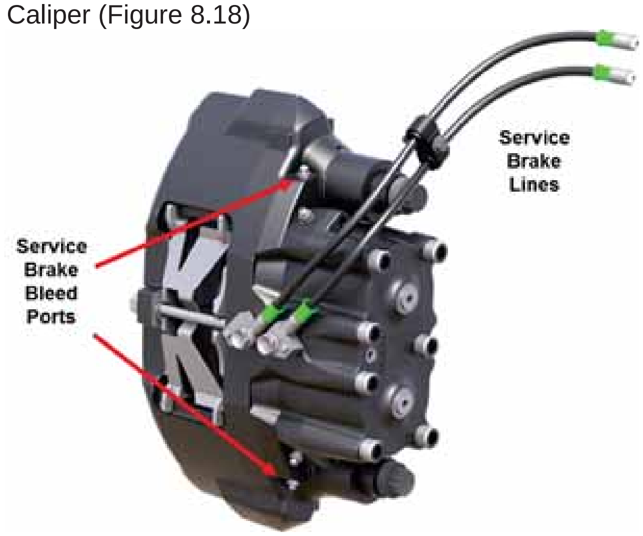


Figure 8.18 Service brake bleed ports and lines

1) The caliper assembly has two bleeding ports and two lines.

(a) The two bleed ports allow for the caliper to be mounted on any wheel assembly.

(b) The two lines that go to the caliper are for the parking brake and the service brake. During normal operation (when driving down the road), the parking brake hydraulic line will be pressurized at all times and the service brake line will be pressurized when the service brakes are applied. When parked with the parking brake set, both lines have no pressure.

(Slide #21)

2) Piston

Figure 8.19 Brake piston

(a) An internal piston controls the application and release of the brakes (Figure 8.19).

(b) The middle part (the part with the visible threads) is the parking brake release. The back part (the right-side shaft side of the image) is where the Belleville washers are that maintain spring application pressure on the brake pads.

(c) When hydraulic fluid from the parking brake is fed into the center cavity, it forces the Belleville washers to compress-releasing the parking brake.

(d) The now-compressed Belleville washers (right portion of the image) receive service brake hydraulic pressure when the brakes are applied. The whole unit will move in the bore to apply the service brakes.

(e) As the unit compresses and releases, the threaded middle part of the mechanism will ratchet in the bore allowing only one-way rotation of the component. This ratcheting action is what provides for the automatic adjustment in the brake mechanism.

Check on Learning

(Slide #22)

Q: How is the principle of the parking brake unique? What is the benefit of this design?
A: The parking brake uses a pneumatically driven hydraulic pressure applied to the calipers. The benefit to using this design it that it saves space, and its proven technology that has built in parking brake redundancy.

Transitions

What questions do you have before we go out to the truck to identify the components of the brake system?

2.

(Slide #23)

ELO A – LSA 2

Learning Step/Activity:	Brake Component ID
Method of Instruction:	Practical Exercise
Instructor to student ratio:	1:5
Time of instruction:	30 mins
Media Type:	None

(Slide #24)

See Appendix C: PE 8A-1

Check on Learning

None

Summary

None

Transition	Any questions before we go back into the classroom to discuss maintenance of the brake system?

3 **(Slide #25)**

ELO A – LSA 3

Learning Step/Activity:	Air System and Brake System Maintenance and Troubleshooting
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	10 min
Media Type:	PPT

(Slide #26)

a. Brake Maintenance

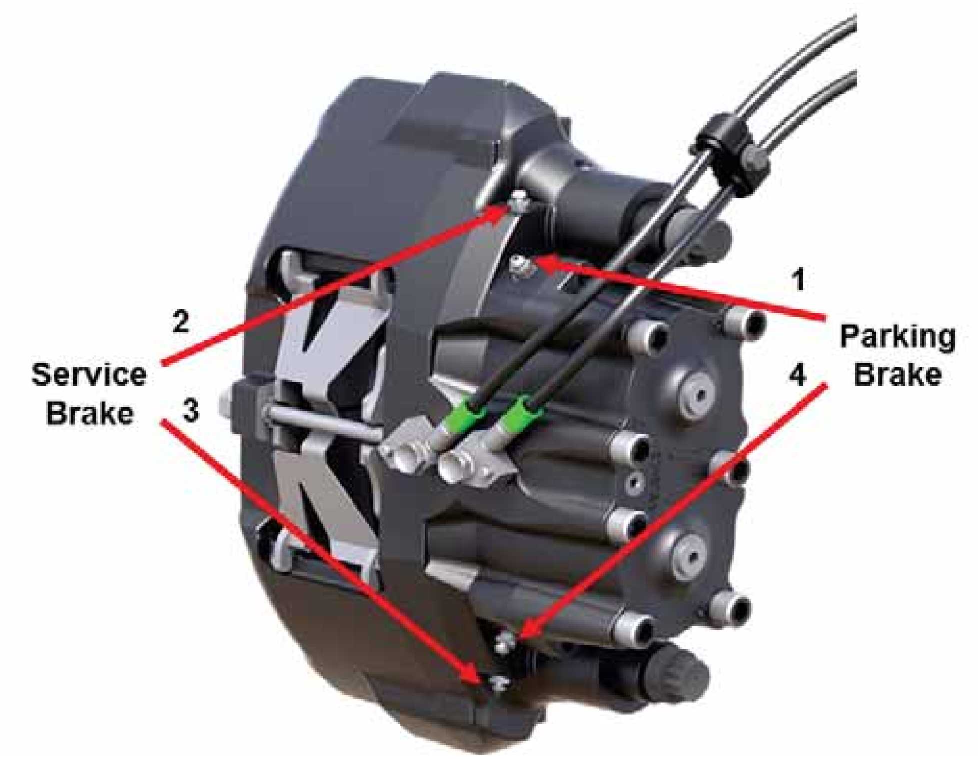


Figure 8.20 Bleed screw pairing for parking vs. service brakes

1. Bleeding brakes (Figure 8.20)

   a) If the hydraulic circuit is opened (exposed to air), then the brakes must be bled. The bleeding procedure is the same for both the parking brake system and the service brake system.

   b) Vehicle air pressure should be 130 psi and will need to build back up while bleeding.

c) While bleeding the brake system, you must maintain fluid in the appropriate brake reservoir to the max fill line with DOT 4 brake fluid.

d) Parking and service brake bleeder screws are on each caliper (Figure 8.20)

1) Parking brake valves are 1 and 4

2) Service brake valves are 2 and 3

e) Bleeding will be done at the upper bleed valve first then bleed the lower valve. Ensure you bleed the correct pair of bleed valves for the system.

2. Bleeding Multiple Calipers

a) If bleeding multiple calipers do it in this order:

1) Right rear

2) Left rear

3) Left front

4) Right front

(Slide #27)

Instructor Note

Video:
Play the video *Caging Brakes*
It is only a few minutes long.

Purpose:
It demonstrates how to cage the brakes, from an Operator's role, but is useful for maintainers as well.

Tee-Up Video/Inform Students:
To save some time we are going to watch a video demonstrating caging of the brakes instead of doing it as a practical exercise. The video will give you a good look at the components and task sequence, however, it is shot to support an Operator's needs. Maintainers may use slightly different tools to cage the brakes. Always perform this procedure in accordance with the proper Work Package in the IETM.

(Slide #28)

3. Adjusting calipers

Figure 8.21 Build air pressure to 125 psi

a) The calipers are self-adjusting; however, follow this procedure if they need to be adjusted.

1) Start engine and build system air pressure to a minimum of 130-psi (Figure 8.21)

2) Release parking brake (ensure wheels are chocked)

3) Pump service brakes 15 times or until low air warning alarm sounds (TM 9-2320-452-10)

4) Apply parking brake and build system air pressure back to a minimum of 125-psi

5) Repeat Steps 2) through 4) a total of six times

6) Add fluid to any reservoir that is not full

(Slide #29)

4. Routine brake maintenance

Figure 8.22 Service brake inspection points

a) Inspection should be performed every 3,000 miles or annually whichever comes first. Refer to preventive maintenance checks and services (PMCS) in the IETM for full procedures.

b) Designated inspection points (Figure 8.22)

1) Brake pads for minimum thickness (min. 0.2 in.)

2) Brake rotors for evidence of overheating, uneven wear, or gouges

3) Brake rotors for minimum thickness (min. 1.3 in.)

4) Brake calipers for evidence of overheating, secure attachment, leaks, and torn piston boots

5) Brake caliper slide pins for wear

6) Brake caliper banjo bolt guards

7) Retainer springs to verify they are in position and for evidence of damage due to bending or rubbing

8) Brake line routings along the control arms to the calipers for wear or damage

c) Anytime the backing plate has been removed it must be aligned so that it does not rub on the rim. Failure to do this task may damage the rim.

Check on Learning

(Slide #30)

Q: How does the automatic brake adjustment mechanism in the brake caliper work?
A: As the brake is compressed and released, the threaded middle part of the mechanism will ratchet into the bore of the caliper; the ratcheting device allow only one-way rotation of the component. This ratcheting action is what provides the automatic adjustment in the brake mechanism.

Transition

What questions do you have before we head out to the truck?

4.

(Slide #31)

ELO A – LSA 4

Learning Step/Activity:	Caliper Maintenance
Method of Instruction:	Practical Exercise
Instructor to student ratio:	1:5
Time of instruction:	3 hr
Media Type:	None

(Slide #32)

See Appendix C: PE 8B-1

Check on Learning

None

Summary	**(Slide #33)** We learned about the air system that supports the air-powered systems on the JLTVA1. The JLTVA1 has both service brakes and parking brakes. The parking brake is mechanical. • Brake system is an air-over-hydraulic system • Parking brake has a pneumatic pump that builds hydraulic pressure to release the brakes • CTIS system - Pneumatically controlled system that monitors the tires' pressure and manages tire pressure based on user inputs to the DSDU • Supply system consists of engine air filter, air compressor, air dryer, governor, wet tank, and primary and secondary air tank • Pneumatic components in the brake system: primary and secondary air tanks, the treadle valve, the R-12 relay valves, and the modulating valves • If the brake hydraulic system opens, the brakes must be bled. The bleeding procedure is the same for both the parking brake system and the service brake system • Inspection should be performed every 3,000 miles or annually whichever comes first. Refer to preventive maintenance checks and services (PMCS) in the IETM for full procedures
Transition	Any questions? We'll continue and learn about the Antilock Braking System utilized on the JLTVA1.
Enabling Learning Objective B.	**(Slide #34)** Upon completion of this lesson, you will be able to: Action: Troubleshoot the ABS system Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel and reaching the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activities.
1.	**(Slide #35)** **Instructor Note** Inform Students: To accomplish the learning objective we are going to learn about the following topics in separate learning steps. Starting with the Antilock Braking System. ELO B– LSA 1 Learning Step/Activity: Antilock Braking System (ABS) Method of Instruction: Lecture Instructor to student ratio: 1:15 Time of instruction: 15 mins Media Type: PPT

(**Slide #36)**

a. Theory of Operations of Antilock Braking System

1. The ABS prevents wheel lockup during braking to maintain vehicle directional control and stability and minimizes stopping distance. The ABS monitors wheel speed and modulates air pressure applied to the brake for a wheel, or pair of wheels, to prevent lockup in low-traction situations. The ABS has both a Highway and off-road mode.

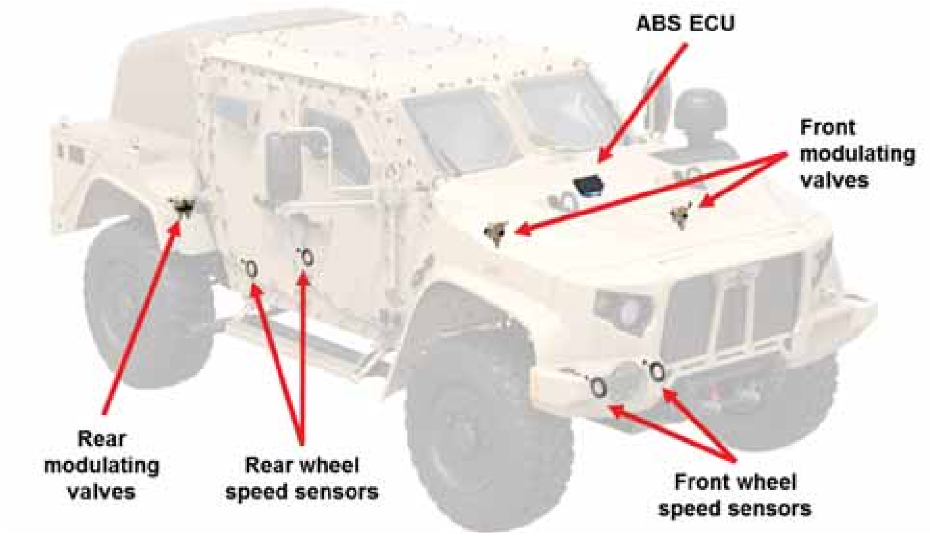


Figure 8.23 Antilock Brake System Components

2. The ABS system (Figure 8.23) is comprised of:

   a) ABS Electronic control unit (ECU)

   b) Wheel speed sensors

   c) Modulating valves

(Slide #37)

b. ABS Components

Figure 8.24 ABS Electronic control unit

1. ABS Electronic control unit (Figure 8.24)

   a) The ABS ECU is the controller for the ABS.

b) It receives inputs from the Engine ECM, transmission, and wheel speed sensors to manage the brake system in the event of wheel slip.

c) The ABS ECU mounts in the cab behind the dash (driver's side) on the bulkhead.

d) Electrical power

1) There are 3 color-coded connectors used in the ABS ECU.

2) The ABS ECU receives 24V power:

Note

With the implementation of ECP OSKW8402R2, the 12/24 VDC mVEC replaced each circuit breaker with a fuse. This update may be present in the vehicle. Refer to Lesson 03 Electrical Appendix D, page 1 for the conversation table.

(a) 24V of power is provided from F35 (located in the chassis mVEC) to the X1 connector on the ABS ECU.

(b) 24V is provided from CB22 (of the Cab mVEC) to the X1 connector.

3) The ECU communicates on the Engine CAN Bus.

Instructor Note

F35 (located in the chassis mVEC) supplies 24V power on wire 1200 to pin 16 of the X1 connector on the ABS ECU. CB22 of the Cab mVEC provides 24V on wire 1075 to pin 3 of the X1 connector. (Refer to Appendix D for the conversion chart in Lesson 03 Electrical for updated fuse numbers.)

(Slide #38)

2. Wheel speed sensors (WSS) (Figure 8.25)

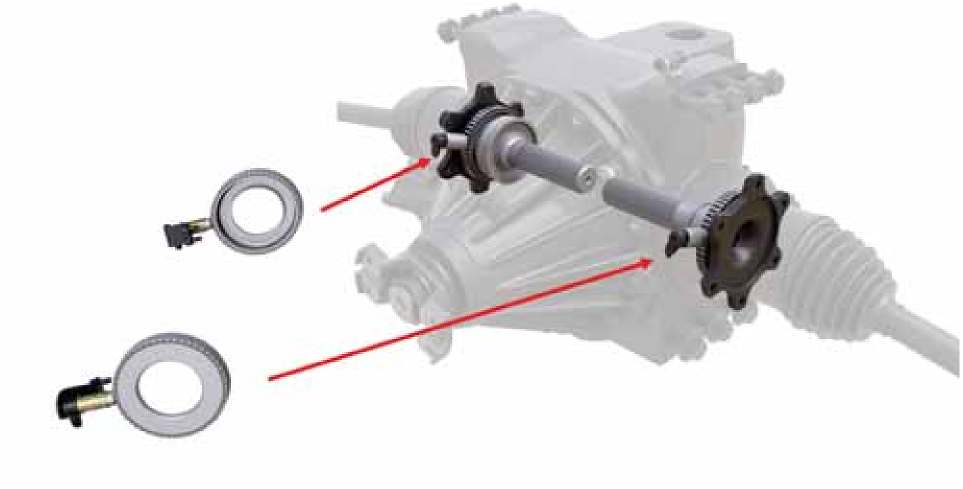


Figure 8.25 Wheel speed sensors (isolated on left/in CV shaft to right)

a) There are four-wheel speed sensors on the truck that monitor the tone rings.

b) Tone rings are located inside the bearing housing on each of the CV half shafts.

c) The WSS are mounted with a sensor clamping sleeve and have a protective guard.

d) The WSS have a magnetic core and copper coil encasement with a metallic cover.

e) The resistance reading of the ABS WSS is typically around 1500-2500 Ohms.

   1) If testing voltage, test for a minimum of .25 VAC at about ½ wheel rotation per second.

   2) The above values indicate/verify a good coil and a good signal from the WSS.

(Slide #39)

3. Modulating valves

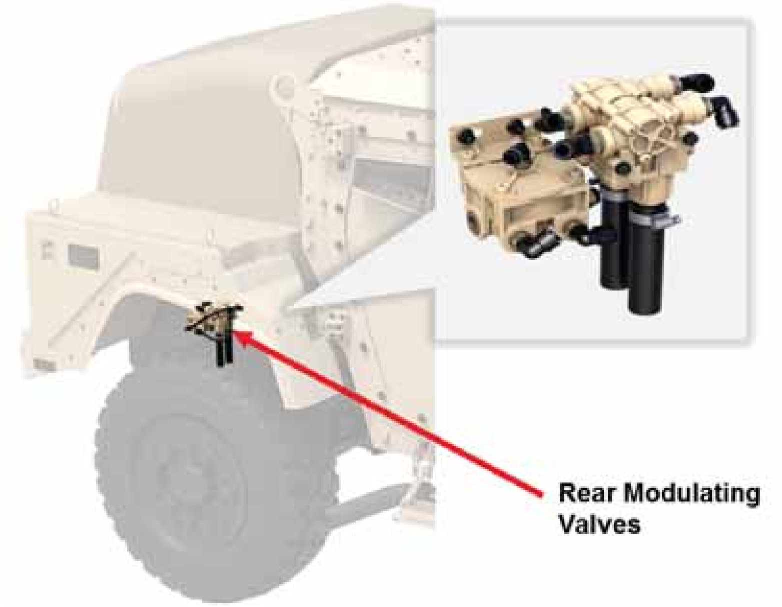


Figure 8.26 Rear modulating valves

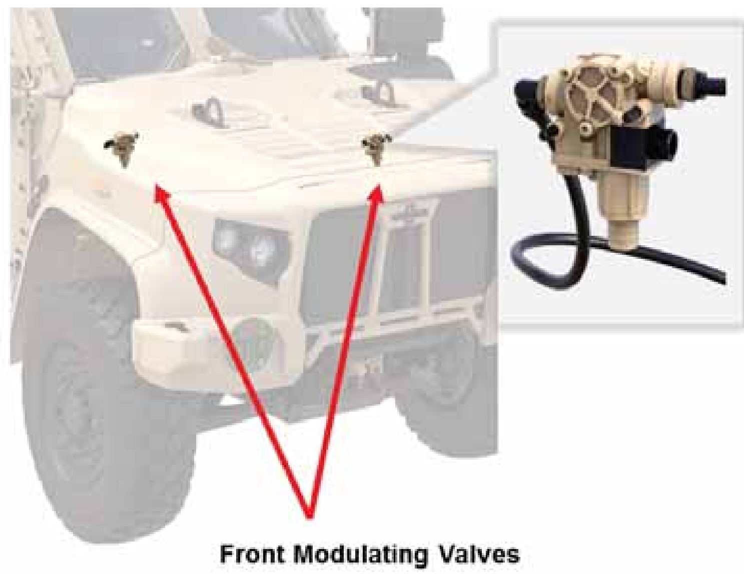


Figure 8.27 Front modulating valves

a) There are four modulating valves or Pressure Modulating Valves (PMV). Two are located on the rear of the truck (together) near the brake fluid reservoirs. (Figure 8.26). The two in front located one on each side of the engine compartment for the associated brake controls. (Figure 8.27)

b) These valves contain two solenoids:

   1) Hold solenoid

   2) Release solenoid

c) These solenoids are typically 14 -16 Ohms individually. Because they share a common ground, you can check the resistance of the two solenoids together which should read about 28 - 32 Ohms.

(Slide #40)

c. ABS System Operation

1. Startup operation

a) During startup, the ABS ECU sends out a signal to each of its controlled components to verify function.

b) The ABS ECU cycling the modulating valves creates a clicking sound from the vehicle.

c) Chuff test

1) To do a Chuff test: Press the brakes during the ABS automated start-up test to listen for a chuffing sound.

2) The chuffing sound verifies that the PMV's are working correctly.

2. Normal operation

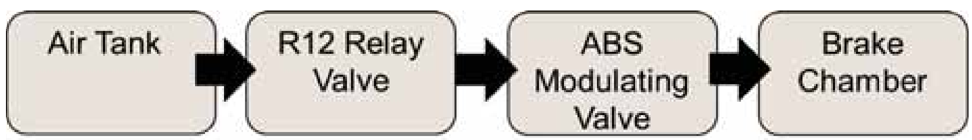


Figure 8.28 Flow of supply air for ABS

a) In normal operation mode, the ABS ECU monitors the AC voltage signals of the wheel speed sensors.

b) During normal (non-ABS) braking, no power is supplied to the modulating valves. Supply air from the R-12 relay valve will enter the supply port of the modulating valve.

c) The air then pushes down on the exhaust portion of the valve and blocks the vent which allows the air to leave the delivery port and apply the brakes normally. (Figure 8.28)

1) When the brakes are released, the air vents off from the R-12 relay valve. The modulating valves internal exhaust passage remain in the same position until air pressure in the system reaches about ½ psi.

2) At ½ psi the supply diaphragm will seat, and a small amount of air will release out of the exhaust port. This allows for a soft release of the brakes.

(Slide #41)

3. Antilock mechanism

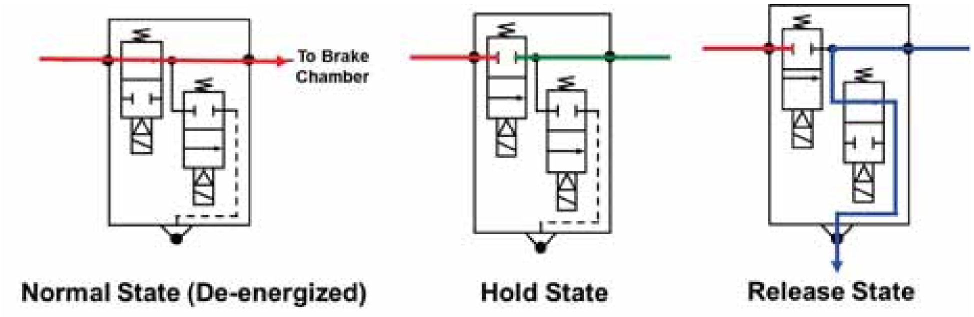


Figure 8.29 ABS ECU controls the hold-release solenoids

a) When the ABS ECU sees a change in tire rotational speed, it will process the event based on the information it receives from the wheel speed sensors.

b) If the ABS ECU sees the wheel speed signal goes flat all at once and the information it is receiving from the transmission and the engine tell the system that the truck is still moving, the ABS ECU will begin controlling the brakes to allow the operator to maintain control of the vehicle.

c) Brake control is accomplished by energizing and de-energizing the hold-release solenoids rapidly. The images above show the solenoids in three states. (Figure 8.29)

(Slide #42)

d) The ABS ECU energizes the hold-release solenoids in the PMVs to apply and release the brakes. Once the ABS ECU determines it needs to modulate the brakes, it alternates both the hold and release solenoids.

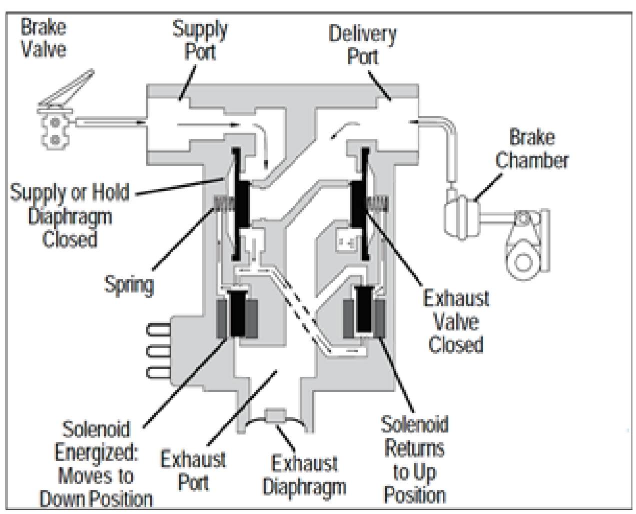


Figure 8.30 Modulator shown in hold position

1) When ***the hold solenoid*** is energized, air is not allowed to enter the brake air chamber. (Figure 8.30)

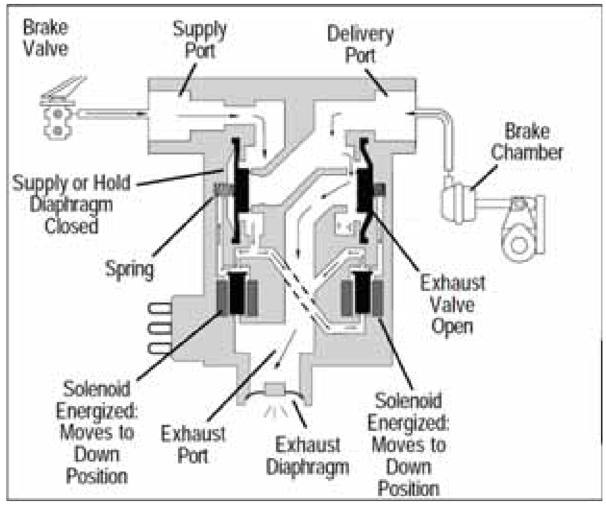


Figure 8.31 Modulator shown in exhaust position

2) When the release solenoid is energized (the exhaust solenoid) the air that was in the chamber releases reducing holding pressure and allows the wheels to move/rotate. (Figure 8.31)

3) Once the wheel comes back up to speed, the ABS ECU de-energizes the release solenoid, and then de-energizes the hold solenoid to allow brake pressure to be reapplied. The ECU will repeat this process if it determines there is impending wheel lockup.

Check on Learning

(Slide #43)

Q: Where are the modulating valves?
A: The rear modulating valves are together in the rear of the truck near the brake fluid reservoirs, and the front modulating valves are within the engine compartment one on each side of the engine.

Q: How can the ABS wheel speed sensors be tested?
A: By checking resistance or by testing for voltage output with the wheel in motion.

Transition

Are there any questions? Let’s go to the shop and apply what we’ve learned about the ABS on the truck.

2.

(Slide #44)

ELO B – LSA 2

Learning Step/Activity:	ABS System Maintenance and Troubleshooting
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	5 min
Media Type:	PPT

(Slide #45)

a. ABS Maintenance

1. Maintenance of the ABS requires regular inspections of the wheel speed sensor cleanliness and verifying the exhaust ports are clean and serviceable.

b. ABS Troubleshooting

1. If a fault code appears on the DSDU, or an ABS light illuminates (unless axle locks are on, or the CTIS controller is in a setting other than highway) and the dash light remains illuminated, then you must investigate.

Symptom/Issue	**Probable Cause**
Sensor malfunction	Sensors contaminated with dirt or with metal shavings.
Wiring problems	Disconnected, broken, contaminated from extreme environments or major neglect

Figure 8.32 ABS troubleshooting guide of symptoms and probable cause of issue

a) The malfunction triggering the dash is *rarely* a problem with the brakes themselves but is more often a malfunction with one of the sensors. (Figure 8.32)

1) Sensor malfunction is most often caused because the sensors become contaminated, either with dirt or with metal shavings.

b) It is also possible that the problem is a malfunction in the sensory wiring. (Figure 8.32)

1) Wiring problems typically happen either due to driving through extreme environments, or by major neglect of your braking system.

c) Inspect the wiring to the sensors by measuring resistance to all related components to ensure the wiring and the sensors are fully functional.

2. The Electronic Stability Control (ESC) helps the JLTVA1 keep traction to the driving surface.

3. The Electronic Stability Control (ESC) helps the JLTVA1 keep traction to the driving surface.

a) The ESC Active Light (right) will flash when actively controlling the vehicle. The ESC is controlled by an input sent from the steering angle sensor and the IMU on the databus to the 3G Controller then to the ABS ECU. Then when the ESC is triggered, the ATC and ABS PMVs control the vehicle’s steering stability.

b) Both ESC Off and Active lights will illuminate steady amber when the ESC is disabled, either manually or from a system fault.

c) It can be disabled depending on the situation. First, disable the ESC Off manually. The ESC disable button is located in front of shift selector. To disable, put vehicle in HWY mode in the CTIS then depress the button. Secondly, ESC is automatically disabled when CTIS is in any mode other than HWY. Another way the ESC is automatically disabled is when the transaxle is in low range. As well as, if a driveline lock is engaged utilizing HWY; however, this is not a common occurrence.

d) There is a fault with the ESC when both the dash indicators (ESC Off and ESC Active) are steady amber if ESC is not manually or automatically disabled. The steering angle sensor, IMU, and brake pressure switch are new faults within the ABS/ESC system. These faults will be sent form the ABS ECU to the 3G Controller, to the DSDU for fault code retrieval, and the dash to turn the indicator on. These codes can be viewed in the IETM under ABS troubleshooting.

Check on Learning

(Slide #46)

Q: When troubleshooting the ABS, one of two things occurs as warnings – what are they?
A: A fault code appears on the DSDU and an ABS light illuminates

Transition

Are there any questions? Next, we're going out to the truck to apply what we've learned.

3.

(Slide #47)

ELO B – LSA 3

Learning Step/Activity:	Code 11-07 Drivers Side Front Wheel Speed Sensor Open or Shorted
Method of Instruction:	Practical Exercise
Instructor to student ratio:	1:5
Time of instruction:	30 mins
Media Type:	None

(Slide #48)

See Appendix C: PE 8C-1

4.

ELO B – LSA 4

Learning Step/Activity:	Code 11-25 Passenger Side Front PMV Solenoid Shorted to Ground
Method of Instruction:	Practical Exercise
Instructor to student ratio:	1:5
Time of instruction:	30 min

Media Type: None

See Appendix C: PE 8D-1

Check on Learning

None

Summary

(Slide #49)

- The antilock brake system (ABS) uses three components to monitor and minimize slip between the road and the tires.
  - Wheel speed sensors
  - Modulating valves
  - ECU

- When the ABS ECU sees a change in tire rotation, the ABS ECU processes the event based on the information received from the wheel speed sensors.

- The ABS ECU energizes/activates the solenoids in the PMV's to apply and release the brakes. Once determined it needs to modulate the brakes, it energizes both the hold and release solenoids.

- If it decides it needs to reapply the brakes, the ABS ECU deenergizes the supply solenoid allowing for the application pressure to reapply to the system and brake action to occur again.

- Maintenance of the ABS requires regular inspections of the wheel speed sensor cleanliness and verifying the exhaust ports are clean and serviceable.

- Troubleshooting:

  - Testing ABS Components: As we saw, the components of the ABS can be tested quickly and easily to verify electrical operation of the system.

  - Wire Inspections: An open circuit in a wheel speed sensor wire will prevent the sensor signal from reaching the ABS ECU. Without this signal, the ABS ECU will be unable to determine the speed of the affected wheel.

Transition

Instructor Note
Return the classroom to continue with lesson.

Any questions about brakes, or ABS?
The next topic is a different air-powered system, the Central Tire Inflation System, commonly referred to as CTIS.

Enabling Learning Objective C.	**(Slide #50)** Upon completion of this lesson, you will be able to: Action: Troubleshoot the CTIS pneumatic powered system Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel and reaching the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands-on activities.

1.

(Slide #51)

Instructor Note

Inform Students:
To accomplish the CTIS learning objective we are going to learn about the following topics, starting with the theory of operation and components of CTIS.

ELO C – LSA 1

Learning Step/Activity:	CTIS
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	10 mins
Media Type:	PPT

Instructor Note

Q&A Interaction to stimulate prior knowledge:
Ask students: How many of you are familiar with the FMTV CTIS system?

Ask students: Tell me about how the FMTV CTIS works, the power supply and the air supply.

Transition: The JLTVA1 uses a different CTIS system, not the same one used on the FMTV.

- CTIS FMTV – Single channel system, an ECU and a PCU
- CTIS JLTVA1 - A four-channel system; one dedicated to each wheel end. The PCU and ECU are combined into one unit the MCU.

(Slide #52)

a. Theory of Operations of CTIS

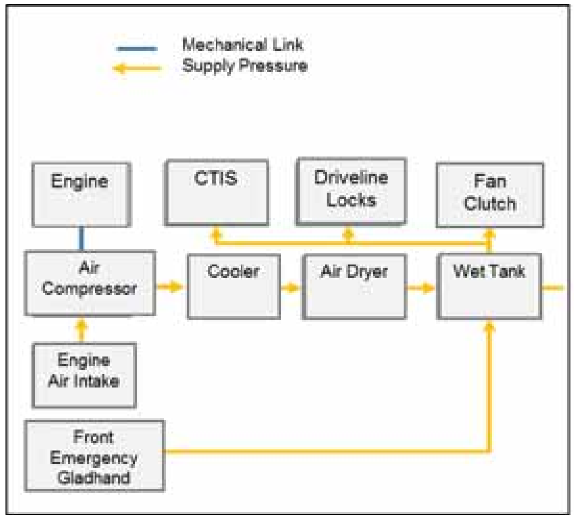


Figure 8.33 Air Supply to CTIS for JLTVA1

1. The CTIS system manages tire pressures and provides the capability for tire pressures to be adjusted from within the JLTVA1 capsule.

2. CTIS JLTVA1 - A four-channel system; one dedicated to each wheel end. The PCU and ECU are combined into one unit the MCU. There is no Run Flat option on the JLTVA1 since it is all automated.

3. An engine-belt-driven air compressor powers the JLTVA1 pneumatic system. Air transfers from the compressor, cooler, dryer to the wet tank which distributes air to the CTIS. (Figure 8.33)

4. The MCU monitors, adjusts, and can isolate individual tires for increased mobility.

5. The CTIS will automatically isolate a tire from the rest of the system if it detects a compromised tire. The isolation protects the remaining three tires, as well as the pneumatic system, from pressure loss.

6. The MCU integrates with J1939 communication network which enables the driver to control tire pressures and driveline lock settings.

(Slide #53)

CTIS Mode	Front Axle	Inter-axle	Rear Axle
Highway	Open	Open	**Open**
Cross-Country	Open	Locked	**Open**
Mud/Sand/ Snow	Open	Locked	**Locked**
Emergency	Open	Locked	**Locked**
Driveline locks are activated based on CTIS or manual control settings.			

Figure 8.34 Driveline locks status per CTIS setting

7. The CTIS controls communicate to the vehicle's driveline lock system and automatically apply the appropriate default level of driveline locks for each terrain setting. The lock settings per CTIS mode are displayed in the chart above. (Figure 8.34)

   a) The driver has the ability to manually select higher levels of driveline lock via the lock and unlock dash buttons but cannot select lower levels than the default.

(Slide #54)

8. Pressure settings are controlled electronically through the DSDU.

   a) The DSDU has a dedicated CTIS screen for adjusting the vehicle's load and terrain settings.

9. CTIS terrain options

Figure 8.35 CTIS terrain options

   a) Operators have the control to change CTIS settings to navigate various terrains and environments; changes may be selected while JLTVA1 is in motion.

   b) There are four CTIS preprogrammed terrain settings within the DSDU. Once an option is selected, the tires change pressure to the programmed settings. (Figure 8.35)

      1) Highway

      2) Cross Country

      3) Mud Sand and Snow

      4) Emergency

   c) Refer to the technical publications for additional information about tire pressures as they vary based on weight setting, terrain setting and environmental conditions.

(Slide #55)

b. CTIS Components (Figure 8.36)

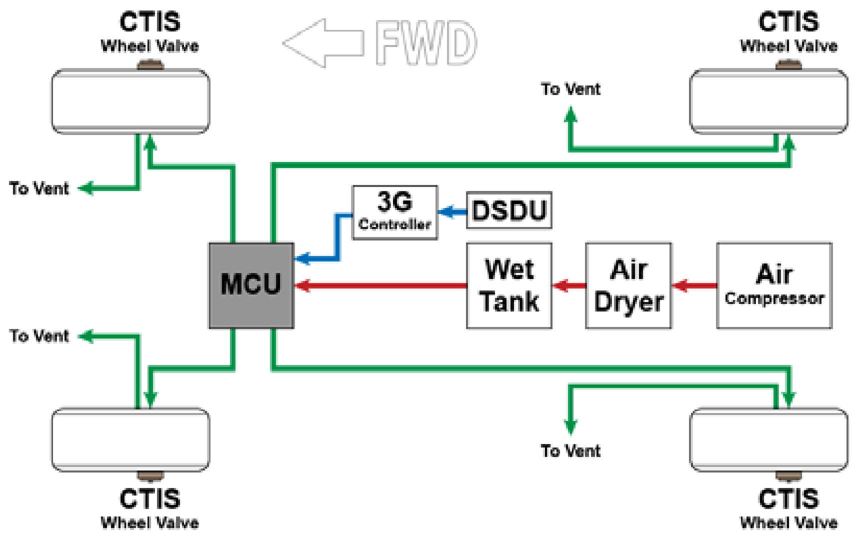


Figure 8.36 JLTVA1 four-channel CTIS

1. The system's primary mechanisms are:

    a) Air supply system

    b) Mechatronic control unit (MCU)

    c) Pressure transducer

    d) Pressure Regulating Valve

    e) Pressure Switch

    f) Wheel valves

2. Air Supply System

    a) Components discussed during CTIS Theory of Operation

    b) Work together with spring pressure and pneumatic forces

    c) Work the same as on all other wheeled tactical vehicles

(Slide #56)

3. Mechatronic Control Unit (MCU)

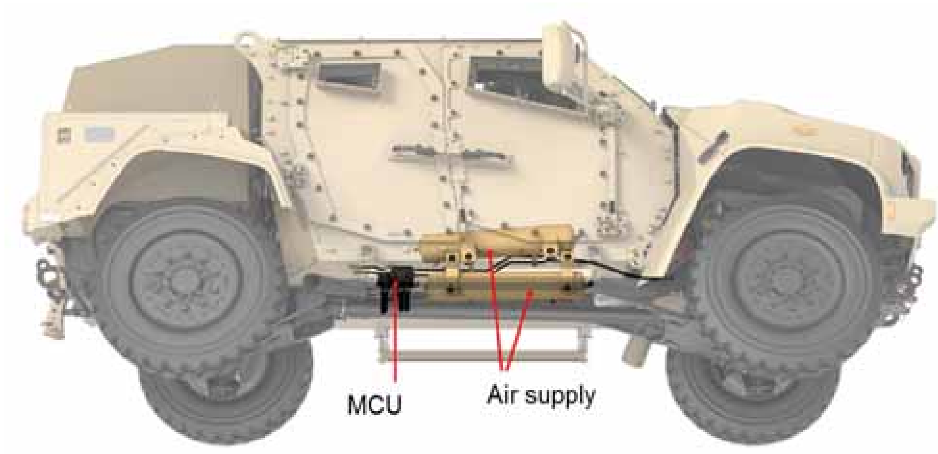


Figure 8.37 MCU located to rear of air tanks

a) The MCU is located in the center tunnel to the rear of the air tanks.

b) The MCU monitors and adjusts tire pressures and can control driveline lock settings and is integrated with the J1939 Data Network to utilize the DSDU for operator control. (Figure 8.37)

c) MCU Electrical Circuit

1) The MCU receives 24V of power from CB 20.

2) Ground is supplied via wire 1435.

3) Ignition sense is received from wire 1075.

4) The MCU receives user requests from the J1939 network inputs to pins D1 (CAN+) and D2 (CAN-). The J1939 communicates to the MCU which energizes the appropriate solenoids to inflate or delate tires.

(Slide #57)

Figure 8.38 Mechatronic Control Unit

5) There are 7 solenoids found inside the MCU: supply, deflate, control, Channel 1, Channel 2, Channel 3, and Channel 4. (Figure 8.38)

(a) Supply Solenoid - If the request is to supply air out to the system, the MCU will energize the supply solenoid and use air pressure to work a valve inside the MCU to allow air to enter the supply system.

(b) Deflate Solenoid - If a lower pressure setting is required, the deflate solenoid is energized.

(c) Control Solenoid - The control solenoids energize to allow the supply air to reach the control valves for the individual channels

(d) Channel Solenoids (4) - Open the valves enabling air to travel to the assigned tire.

(Slide #58)

6) Pressure transducer

(a) Located inside the MCU between the supply valve and the control valve.

(b) Used by the MCU electronic controls to conduct pressure checks every 15 minutes.

(c) Once the air pressure passes the individual channels, the MCU opens the solenoid needed to supply air out to the wheel valves to fill the tires.

7) Pressure Regulating Valve

(a) Located inside the MCU.

(b) There is an 8-psi pressure regulating valve on the deflate solenoid. This valve manages back pressure on the wheel valves to keep them open to allow air to deflate out of the tire. If the tires need to deflate, the control solenoid and the deflate solenoid will energize.

(Slide #59)

4. Pressure Switch

a) The pressure switch is located on the secondary air tank just upstream (toward the wet tank) of the check valve that supplies air into the tank.

1) There is power waiting on each side of the pressure switch. When air pressure builds to its desired psi (112 ±8 psi), the switch will close, and a ground will be applied to the MCU output signal, which tells the MCU it can be pneumatically active.

5. Wheel Valves

Figure 8.39 CTIS tire pressure

a) The wheel valves work together with spring pressure and pneumatic forces working to keep the valve open or closed based on the needs of the system. (Figure 8.39)

b) The wheel valves work the same as on all other wheeled tactical vehicles with CTIS.

Check on Learning

(Slide #60)

Q: Where is the pressure transducer, what is its purpose, and how often does the CTIS Mechatronic Control Unit do the periodic checks?
A: The pressure transducer is located between the supply valve and the control valve and it conducts pressure checks every 15 minutes.

Q: The JLTVA1 does not have a “Run Flat” control option on the CTIS screen. Explain why.
A: The JLTVA1’s four-channel CTIS system provides control of each tire independently, therefore multiple wheel valves will not be open at the same time. As a result, the risk of multiple tires deflating due to a leak in one tire has been eliminated. (There is a Run Flat Insert Kit available)

Transition

Any questions before we continue to troubleshoot.

2.

(Slide #61)

ELO C – LSA 2

Learning Step/Activity:	CTIS Maintenance and Troubleshooting
Method of Instruction:	Lecture
Instructor to student ratio:	1:15
Time of instruction:	5 mins
Media Type:	PPT

(Slide #62)

a. CTIS Maintenance and Troubleshooting

1. Maintenance

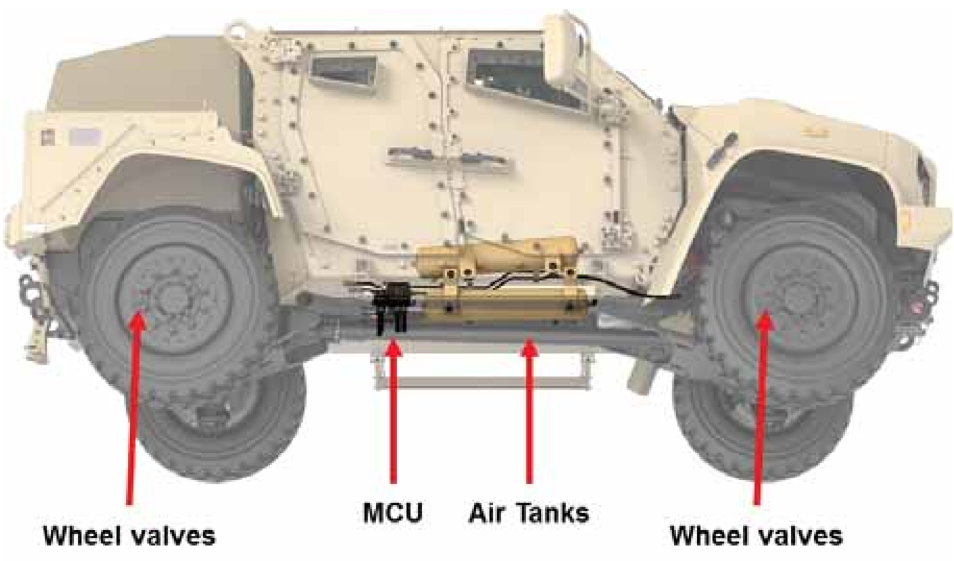


Figure 8.40 Inspect MCU and wiring, air supply from tank to wheel valves

a) Periodic inspections of the CTIS wiring and hoses extend the life of the CTIS. (Figure 8.40)

b) Inspect the wheel valves for leaks or damage regularly.

Figure 8.41 CTIS Off Button with amber lights indicating disabled status

c) **In a cold environment, ensure CTIS is shut off immediately upon key on and for the first five miles of driving**. To disable the CTIS push the CTIS OFF button on the chassis MUX panel. CTIS is disabled when the amber lights display on the button. (Figure 8.41)

CAUTION

When operating in temperatures below 32^0F (0^0C), the CTIS must be disabled during the first five miles (eight km) of operation. This allows the tires to warm up and ensures a tight seal between the tire and wheel. **Not allowing tires to warm up may cause damage to tires or seals. Failure to comply may result in damage to equipment.**

2. Troubleshooting

a) Listen for leaks in the system.

b) Check harness for damage.

c) Check DSDU for codes.

Check on Learning

(Slide #63)

Q: Explain the three steps to follow when troubleshooting the CTIS?
A: 1. Listen for leaks, 2. Check harness, 3. Check DSDU for codes.

Transition

Any questions before we go out the truck?

3.

(Slide #64)

ELO C – LSA 3

Learning Step/Activity:	CTIS Does Not Operate
Method of Instruction:	Practical Exercise
Instructor to student ratio:	1:5
Time of instruction:	30 mins
Media Type:	None

(Slide #65)

See Appendix C: PE 8E-1

Check on Learning

None

Summary

(Slide #66)

The CTIS system manages tire pressures. The wheel valves work together with spring pressure and pneumatic forces working to keep the valve open or closed based on the needs of the system.
The JLTVA1 has four CTIS preprogrammed terrain settings available at the push of a button. Once an option is selected, the tires change pressure to the designated ideal settings.

- Highway
- Cross Country
- Mud Sand and Snow
- Emergency

There are 7 solenoids found in the MCU that communicate with the DSDU and J1939 Databus.

CTIS Maintenance and Troubleshooting requires periodic inspections. Use the DSDU to check for codes.

Transition

Any questions about CTIS?

If not, we're wrapping up this module and will conclude with a little Q & A and a module summary of everything we've covered for air supply systems, brakes and CTIS.

SECTION IV.	SUMMARY

Method of Instruction:	Lecture
Instr Type (I:S Ratio)	1:15
Time of Instruction:	5 min
Instructional Strategy	Discussion

Check on Learning

(Slide #67)

Q: What are the process steps for bleeding the brakes?
A: The brakes are bled by ensuring the fluid levels in each reservoir are to the max full line, air pressure is at 130-psi then starting at the upper bleeding valve of the caliper bleed till no air is present tighten upper bleeding valve move to the lower bleed valve bleed till no air is present and tighten. Starting at the RR, LR, LF, RF.

Q: Explain the functionality that enables the adjustment of calipers? Why does pumping the brakes adjusts the calipers.
A: As the brake is compressed and released, the threaded middle part of the mechanism will ratchet into the bore of the caliper; the threads allow only one-way rotation of the component. This ratcheting action is what makes the automatic adjustment in the brake mechanism.

Q: What was observed when testing the PMVs from hold to release and why?
A: The resistance reading from hold to release was approximately double the readings from common to hold and from common to release. This is because, when testing from hold to release, both solenoids are being tested in series.

Summary

(Slide #68)

Figure 8.42

This module focused on the theory of operation of the pneumatic system of the JLTVA1 and the air supply that feeds the braking systems, CTIS as well as auxiliary system such as the fan clutch and driveline lock mechanism. (Figure 8.42)

We discussed the service brakes and parking brakes, focusing on the functionality then practiced component identification on the JLTVA1 for the braking systems.

You also learned about the functionality of the JLTVA1's antilock braking system. At a high-level you should know it uses three systems to monitor and minimize slip between the road and the tires. Those three systems are the:

- Wheel speed sensors
- Modulating valves
- ECU

The JLTVA1's CTIS system is different from the FMTV, as it has four-channels to control and maintain each tire independently. We discussed CTIS functionality, pneumatic supply, electrical power circuit and how to troubleshoot that system.

Appendix A

08_JLTVA1_ARMY_ MAIN_AirBrakesCTIS_PPT_V3.0.pptx

Appendix C
JLTVA1 Practical Exercise Sheet No. 8A
Antilock Brake System Component Identification

Title	Antilock Brake System Component Identification
Lesson Number/ Title	08 Air/Brakes/CTIS
Introduction	We will now perform a PE on the JLTVA1 applicable to the air and brake systems.
Motivator	Maintain the JLTVA1 braking systems to keep the vehicle mission ready.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Enabling Learning Objective A	Action: Correlate the JLTVA1's braking systems/subsystems and components with their location, purpose, function and maintenance requirements Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test or 100% accuracy on hands on activity.
Risk Assessment Level	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	This practical exercise will give you the opportunity to practice the skills required to provide maintenance to the JLTVA1 Air System and Brake System under normal maintainer conditions.
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide **Student Materials:** MSD with EMS NG/IETM Student guides Pens/Pencils
Special Instructions	Below are the instructions for how to prepare for the practical exercise.

Preparation	Instructor Notes
TM Reference:	N/A
Time Required for Prep:	N/A

Symptom/Purpose:	Familiarization with system and component location for troubleshooting
Prepare Area for PE:	1-2 ladders for viewing and prevent climbing on vehicle
Configure Vehicle for PE:	N/A
Instructor Preparation:	• Ensure instructors have located and understand the purpose all components before conducting component location. • Review the basic information below as required.
Safety	Instructors will monitor the exercise and ensure students are properly adhering to safety guidelines while working on the vehicle.

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and Technical Manual (TM) to complete the exercises.

d. Inform students they will have approximately 30 minutes to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the Go/No Go sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five.

h. Ask if there are any questions.

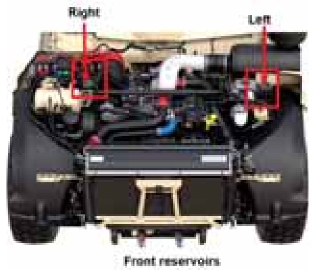
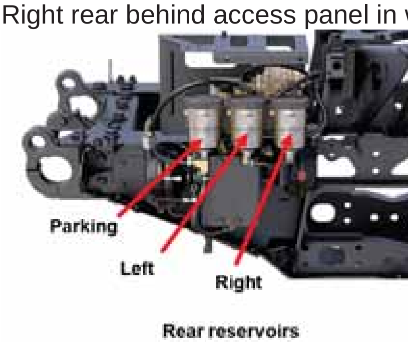
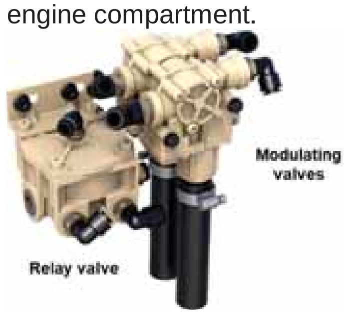
i. Students may begin.

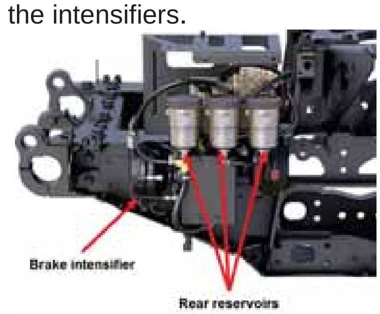
j. Mark Go/No Go Sheets accordingly.

1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

2. Once the Practical Exercise is complete, the Lead Instructor must sign each student’s Solution Sheet.

Component	Location/Function
Instructor note:	The following components should be identified and described by students. **This is a guided PE, if the student is unable to locate and explain the component independently the instructor(s) are to provide the answers and coaching.**
Pneumatic system components:	The pneumatic system components are described below for location and purpose.
Park brake valve	Located on the dash yellow knob with red locking lever 
Air Governor	Mounted on air dryer base (on the graphic it is the part with the blue cap) Mounted in engine compartment by wet tank. (right side) 
Air hydraulic manifold	On the side of the pneumatic-hydraulic pump, contains both the relieve and air pilot valve 

Pneumatic-hydraulic pump	Right rear, below 3 brake reservoirs. This is the pump for the Park break circuit. 
Relief valve	Internal to air hydraulic manifold
Pilot valve	Internal to air hydraulic manifold
Front Brake Fluid Reservoirs (2)	In engine compartment left and right side. 
Rear Fluid Reservoirs (3)	Right rear behind access panel in wheel well. 
Modulating Valves	One for each wheel. Rear two are mounted together behind brake reservoirs at right rear. Front are located on left and right side in engine compartment. 
Relay Valves	Same location as graphic shown above. Mounted with the modulating valves.

Treadle Valve	Valve hooked up to brake pedal in cab. 
Caliper	One at each wheel 
Brake Intensifier	Right rear of truck below and just to the rear of the reservoirs and to the front of the reservoirs for the rear. The front is on the left and right side of the engine compartment toward the upper rear of the wheel well. If you follow the line from the reservoirs it runs to the intensifiers. 
Brake Bleeder Ports (4)	Four located on each caliper. 

Feedback Requirements

Provide students with feedback to ensure comprehension.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 8A-1
Antilock Brake System Component Identification

Name____

Date____

Training Location__________________________________

Antilock Brake System Component Identification	**Go**	**No Go**	**Initials**
Pneumatic system components:			
Park brake valve			
Air regulator			
Air hydraulic manifold			
Pneumatic-hydraulic pump			
Relief valve			
Pilot valve			
Front Brake Fluid Reservoirs (2)			
Rear Fluid Reservoirs (3)			
Modulating Valves			
Relay Valves			
Treadle Valve			
Caliper			
Brake Intensifier			
Brake Bleeder Ports (4)			

Instructor Signature______________________________________

Appendix C
JLTVA1 Practical Exercise Sheet No. 8B
Caliper Maintenance

Title	Caliper Maintenance
Lesson Number/ Title	08 Air/Brakes/CTIS
Introduction	We will now perform a P.E. on the JLTVA1 applicable to the brake system.
Motivator	Calipers are a critical component to the function of stopping and or slowing the vehicle as they are the component that controls the correlation of operator commands such as slowing versus sudden stops. Alignment between the calipers and service brake components are critical.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Enabling Learning Objective A	Action: Correlate the JLTVA1's braking systems/subsystems and components with their location, purpose, function and maintenance requirements Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel and reaching the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands on activities.
Risk Assessment Level	Low – Electrical. Follow general shop safety to avoid risk. Low – Crushing. JLTVA1 should already be properly secured on lifting kits to avoid potential incidents from working around wheel ends.
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	This Practical Exercise will give you the opportunity to practice the skills required to provide maintenance to the JLTVA1 under normal maintainer conditions.
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide **Student Materials:** MSD with EMS NG/IETM DVOM Student guides Pens/Pencils

Special Instructions

Below are the instructions for how to prepare for the practical exercise.

Preparation	Instructor Notes
TM Reference:	**Maintenance Procedures**>12 Brakes (other than special purpose > Caliper Replacement
Time Required for Prep:	N/A vehicle secured and elevated from previous PE.
Symptom/Purpose:	N/A
Prepare Area for PE:	N/A
Configure Vehicle for PE:	Vehicle Prep: Belly armor removed (if B-Kit installed) Cowl armor removed (if B-Kit installed) JLVT on Jack Stands or Suspension Lock-out Braces Installed Splash Guards removed Drop Battery Tray
Special Tools for Task:	Adopter, Socket Wrench Drive ½ inch male and 3/8-inch female; drain pan, respirator/ air filter, socket wring ¼ inch Dr GPG deep 6mm socket wrench, ¾ inch DR, 12pt, 20mm wrench torque click, ratcheting, 3/8-inch pc 75-foot lb. wrench, torque dial 3/8-inch drive, 300 lb. inch.
Instructor Preparation:	Instructors must be familiar with the TAK4i Suspension and IETM procedures as the conducting the maintenance steps in the required order is critical to safety to personnel and preventing damage to the vehicle.
Safety	Instructors will monitor the exercise and ensure students are properly adhering to safety guidelines while working on the vehicle.

Procedures

a. Instructor distributes the Practical Exercise worksheet to the students.

b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have.

c. Inform students they will be using the vehicle and the IETM to complete the exercises.

d. Inform students they will have approximately one hour to complete the practical exercise.

e. Inform students that as they complete the exercise, they should have an instructor mark the Go/No Go sheet.

f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so.

g. Students will be broken up into groups of no more than five.

h. Ask if there are any questions.

i. Students may begin. Below are key steps the instructor may use to assist with the Go/No Go rubric.

Step	Instructor Notes
TM Reference:	**Maintenance Procedures**>12 Brakes (other than special purpose > Caliper Replacement
Step (List the key steps)	**Student Action (or Expected Values) or Instructor Note**
Locate Proper task in IETM	Maintenance procedures, 12 Brakes, (other than special purpose) Caliper replacement
Perform all equipment conditions	Wheel and Tire removed Brakes caged
Perform task	Follow TM
NOTE:	**IETM removal WP M12001 – Step 3 warning does NOT specify how to secure the caliper.**
NOTE:	IETM does NOT properly identify Bleed ports on caliper. **Instructor to assist student to confirm correct port identification.
NOTE:	Bleed tubes should be held onto by hand otherwise it will pop off during bleeding and spray.
Perform follow on maintenance	****NOTE: Watch fluid levels closely** Bleed Service Brakes Bleed Parking Brakes Uncage Brakes Install Wheel and Tire
	Confirm wheel handles properly

j. Mark Go/No Go Sheets accordingly.

1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished.

2. Once the Practical Exercise is complete, the Lead Instructor must sign each student's Solution Sheet.

Feedback Requirements

Provide feedback to students to ensure comprehension.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 8B-1
Caliper Maintenance

Name____

Date____

Training Location____

Caliper Maintenance	**Go**	**NO GO**	**Initials**
Located proper task in IETM			
IETM Pre Conditions completed			
Wheel and Tire removed			
Brakes caged			
Service Brakes bled			
Parking Brakes bled			
Uncage Brakes			
Installed Wheel and Tire			
Confirmed Wheel handles properly			

Instructor Signature: ____

Appendix C
JLTVA1 Practical Exercise Sheet No. 8C
ABS Troubleshooting Drivers Side Front Wheel Speed Sensor

Title	ABS Troubleshooting: FIK WP 8-1 Code 11-07 Drivers Side Front Wheel Speed Sensor Open or Shorted
Lesson Number/ Title	08 Air/Brakes/CTIS
Introduction	We will now perform a P.E. on the JLTVA1 applicable to troubleshooting the ABS.
Motivator	ABS functionality is critical to maintain the JLTVA1 to fully mission capable, this exercise provides troubleshooting practice for maintainers.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Enabling Learning Objective B	Action: Troubleshoot the ABS system Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel and reaching the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands on activities.
Risk Assessment Level	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	This Practical Exercise will give you the opportunity to practice the skills required to provide maintenance to the JLTVA1 under normal maintainer conditions.
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide JLTVA1 FIK PE Instruction Job Aid **Student Materials:** MSD with EMS NG/IETM DVOM Student guides Pens/Pencils
Special Instructions	Reference FIK WP 8-1 Code 11-07 Drivers Side Front Wheel Speed Sensor. Install according to instructions in the FIK PE Instructions Job Aide.

	Assistant Trainers: If possible, it would be acceptable to have an assistant instructor install the fault while the primary instructor is training. Facilitation Tip: Simulate the exercises as appropriate; means using the Interactive Electronic Technical Manual (IETM), following the task, discussing, and completing each step until task is complete. Students will not remove the installed components.
Procedures	a. Instructor distributes the Practical Exercise worksheet to the students. b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have. c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises. d. Inform students they will have approximately 40 minutes to complete the practical exercise. e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet. f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so. g. Students will be broken up into groups of no more than five. h. Ask if there are any questions. i. Students may begin. Below are key steps the instructor may use to assist with the Go/No Go rubric. j. Mark Go/No Go Sheets accordingly. 1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished. 2. Once the Practical Exercise is complete, the Lead Instructor must sign each student’s Solution Sheet.
Feedback Requirements	Provide students with feedback to ensure comprehension

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 8C-1
ABS Troubleshooting Driver Side Front Wheel Speed Sensor

Name____

Date____

Training Location____

ABS Troubleshooting Driver Side Front Wheel Speed Sensor	**Go**	**NO GO**	**Initials**
Verified the Fault			
Located proper troubleshooting fault in the IETM			
Followed all warning cautions and notes			
Correctly followed troubleshooting track in TM			
Correctly repaired fault (per TM)			
Verified fault was corrected			

Instructor Signature: ____

Appendix C
JLTVA1 Practical Exercise Sheet No. 8D
ABS Troubleshooting Passenger Side Front PMV Solenoid

Title	ABS Troubleshooting: FIK WP 8-2 Code 11-25 Passenger Side Front PMV Solenoid Shorted to Ground
Lesson Number/ Title	08 Air/Brakes/CTIS
Introduction	We will now perform a P.E. on the JLTVA1 applicable to troubleshooting the ABS.
Motivator	ABS functionality is critical to maintain the JLTVA1 to fully mission capable, this exercise provides troubleshooting practice for maintainers.
Safety Requirements	It is the responsibility of the warfighter to follow all applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Enabling Learning Objective B	Action: Troubleshoot the ABS system Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel and reaching the proficiency standards of 80% accuracy on a written test and 100% accuracy on hands on activities.
Risk Assessment Level	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	This Practical Exercise will give you the opportunity to practice the skills required to provide maintenance to the JLTVA1 under normal maintainer conditions.
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide JLTVA1 FIK PE Instruction Job Aid **Student Materials:** MSD with EMS NG/IETM DVOM Student guides Pens/Pencils
Special Instructions	**Reference FIK WP 8-2 Code 11-25 Passenger Side Front PMV Solenoid FIK WP 8-2. Install according to instructions in the FIK PE Instructions Job Aid.** Assistant Trainers: If possible, it would be acceptable to have an assistant instructor install the fault while the primary instructor is training.

	Prep and/or time to Install FIK is: - - minutes. Facilitation Tip: Simulate the exercises as appropriate; means using the Interactive Engaging Technical Manual (IETM), following the task, discussing, and completing each step until task is complete. Students will not remove the installed components.
Procedures	a. Instructor distributes the Practical Exercise worksheet to the students. b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have. c. Inform students they will be using the vehicle and Technical manual (TM) to complete the exercises. d. Inform students they will have approximately 20 minutes to complete the practical exercise. e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet. f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so. g. Students will be broken up into groups of no more than five. h. Ask if there are any questions. i. Students may begin. Below are key steps the instructor may use to assist with the Go/No Go rubric. j. Mark Go/No Go Sheets accordingly. 1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished. 2. Once the Practical Exercise is complete, the Lead Instructor must sign each student's Solution Sheet.
Feedback Requirements	Provide students with feedback to ensure comprehension

Appendix C
JLTVA1 Practical Exercise Solution Sheet 8D-1
ABS Troubleshooting Passenger Side Front PMV Solenoid

Name______________________________

Date______________________________

Training Location______________________________

ABS Troubleshooting Passenger Side Front PMV Solenoid	Go	NO GO	Initials
Verified the Fault			
Located proper troubleshooting fault in the IETM			
Followed all warning cautions and notes			
Correctly followed troubleshooting track in TM			
Correctly repaired fault (per TM)			
Verified fault was corrected			

Instructor Signature: ______________________________

Appendix C
JLTVA1 Practical Exercise Sheet No. 8E
CTIS Troubleshooting – CTIS DNO

Title	CTIS Troubleshooting: FIK WP 8-3: Central Tire Inflation System (CTIS) Does Not Operate
Lesson Number/ Title	08 Air/Brakes/CTIS
Introduction	We will now perform a P.E. on the JLTVA1 applicable to the CTIS.
Motivator	The CTIS system is a pneumatically controlled system that monitors all four JLTVA1 tires' pressure and manages tire pressure based on user inputs to the DSDU. The CTIS controller controls all four tire's air supply channels separately. Understanding this system and being familiar with the components are essential for maintaining this tactical vehicle.
Enabling Learning Objective C	Action: Troubleshoot the CTIS pneumatic powered system Conditions: Given the vehicle, equipment, tools, TM/IETM, SG, and resource materials Standards: Without injury or death to personnel to the proficiency standards of 80% accuracy on a written test or 100% accuracy on hands on activity
Safety Requirements	It is the responsibility of the warfighter to follow applicable U.S. Military safety guidelines as well as local unit SOPs, wear/use PPE and shop rules.
Risk Assessment	Low
Environmental Considerations	It is the responsibility of all students/warfighters and ARMY Civilians to protect the environment from damage.
Evaluation	Practical Exercise Go/ No Go sheet
Instructional Lead-In	Let's explore the CTIS on the JLTVA1
Resource Requirements	**Instructor Materials:** EMS NG with IETM Instructor Guide JLTVA1 FIK PE Instruction Job Aid **Student Materials:** MSD with EMS NG/IETM DVOM Student guides Pens/Pencils

Special Instructions	Instructor Note: Instructor will need to prep the vehicle for the troubleshooting task by inserting **FIK #8-3 CTIS Does Not Operate** using the FIK PE Instructions Job Aid. Assistant Trainers: If possible, it would be acceptable to have an assistant instructor install the fault while the primary instructor is training. Facilitation Tip: Simulate the exercises as appropriate; means using the Interactive Engaging Technical Manual (IETM), following the task, discussing, and completing each step until task is complete. Students will not remove the installed components.
Procedures	a. Instructor distributes the Practical Exercise worksheet to the students. b. Inform the students to fill out their name, date, and locations at the top of the solution sheet. Wait for students to finish and answer any questions they may have. c. Inform students they will be using the vehicle and Interactive Engaging Technical manual (IETM) to complete the exercises. d. Inform students they will have **approximately 30 minutes** to complete the practical exercise. e. Inform students that as they complete the exercise, they should have an instructor mark the GO/NO GO sheet. f. The student must locate, identify or perform each item on the checklist with 100% accuracy. Any student needing remediation will use any time left in the training day to do so. g. Students will be broken up into groups of no more than five. h. Ask if there are any questions. i. Students may begin. j. Mark Go/No Go Sheets accordingly. 1. During the Practical Exercise, the Assistant Instructor should initial as he/she observes the steps accomplished. 2. Once the Practical Exercise is complete, the Lead Instructor must sign each student’s Solution Sheet.
Feedback Requirements	Provide students with feedback to ensure comprehension.

Appendix C
JLTVA1 Practical Exercise Solution Sheet No. 8E-1
CTIS Troubleshooting – CTIS DNO

Name____

Date____

Training Location____

Troubleshoot CTIS Does Not Operate	**Go**	**NO GO**	**Initials**
Verified the Fault			
Located proper troubleshooting fault in the IETM			
Followed all warning cautions and notes			
Correctly followed troubleshooting track in TM			
Correctly repaired fault (per TM)			
Verified fault was corrected			

Instructor Signature____

US Army
SFAE-CSS-JC-JL
MS 640 BLDG 302 RM 113
6501 E 11 Mile Road
Warren, MI 48397-5000

INSTRUCTOR GUIDE

Joint Light Tactical Vehicle (JLTVA1) Maintainer Course

LESSON

09 End of Course and Final Exam

SECTION I. ADMINISTRATIVE DATA

All Courses Including This Lesson

Course Number	Version	Course Title
JLTVA1_MAINT_01	3.0	Introduction and Safety
JLTVA1_MAINT_02	3.0	Vehicle Familiarization
JLTVA1_MAINT_03	3.0	Electrical
JLTVA1_MAINT_04	3.0	Engine
JLTVA1_MAINT_05	3.0	Transmission
JLTVA1_MAINT_06	3.0	Drivetrain
JLTVA1_MAINT_07	3.0	Suspension, Hydraulics and Steering
JLTVA1_MAINT_08	3.0	Air Systems, Brakes and CTIS
JLTVA1_MAINT_09	3.0	End of Course

Task(s) Taught (*) or Supported

Task Number	Task Title
N/A	

Reinforced Task(s)

Task Number	Task Title
N/A	

Academic Hours

The academic hours required to teach this lesson are as follows:

Academic	Resident Hours	Methods
2 hrs.		ILT
Total Hours:	2 hrs.	

Test Lesson Number

Hours	Lesson Number Version	Lesson Title
1 hr 30 min	Test A	09_End of Course and Final Exam
1 hr 30 min	Test B	09_End of Course and Final Exam

Prerequisite Lesson(s)	**Hours** / **Lesson Number Version** / **Lesson Title** N/A / N/A / N/A

Prerequisite Lesson(s)

Hours	Lesson Number Version	Lesson Title
N/A	N/A	N/A

Clearance Access

Security Level: Distribution C
Requirements: Distribution authorized to U.S. Government agencies and their contractors only.

Foreign Disclosure Restrictions

FD7. This product/publication has been reviewed by the product developers in coordination with the Oshkosh Corporation foreign disclosure authority. This product is NOT releasable to students from foreign countries.

References

Number	Title	Date
2320-01-653-6557	JLTVA1 GP IETM	April 2018
2320-01-653-6495	JLTVA1 HGC IETM	April 2018
2320-01-653-6516	JLTVA1 UTL IETM	April 2018
2320-01-653-6534	JLTVA1 CCWC IETM	April 2018

Student Study Assignments

None

Instructor Requirements

JLTVA1 Certified Instructor (1)

Additional Support Personnel Requirements

Name	Student Ratio	Qty	Man Hours
N/A			

Equipment Required for Instruction

ID Name	Student Ratio	Instructor Ratio	Spt	Qty	Exp
Projector	1:15	1:1	No	1	Yes
Final Exams	1:1	1:1	No	15	Yes
Answer Key	N/A	1:1	No	1	Yes

Materials Required

Instructor Materials:
Instructor Guide

Student Materials:
Student Guide
Final Exams

Classroom, Training Area, and Range Requirements	

ID Name	Qty	Student Ratio	Setup Mins	Cleanup Mins
Classroom, 15 Student	1	1:15	30	30
Shop, 3 Bays	1	1:5	30	30

Ammunition Requirements

DODIC Name	Qty	Student Ratio	Setup Mins	Cleanup Mins
N/A				

Instructional Guidance / Conduct of Lesson

NOTE: Before presenting this lesson, instructors must thoroughly prepare by studying this Lesson and identified reference material

Proponent Lesson Plan Approvals

Name	Rank	Position	Date
N/A			

SECTION II.	INTRODUCTION
	Method of Instruction: Lecture Instructor to student ratio: 1:15 Time of Instruction: 5 mins Instructional Strategy Lecture & Group Discussion
Motivator	Maintain the JLTVA1 in order to conduct various military operations by maneuvering over varied terrain, from mountainous to open, desert to urban, during all weather conditions both day and night with limited and poor visibility
Terminal Learning Objective 09	**NOTE:** Inform the students of the following Terminal Learning Objective requirements. Upon completion of this lesson, you will be able to: Action: Complete JLTVA1 Maintainers Training Final Exam Conditions: After completing the previous eight training modules to acquire knowledge on all major JLTVA1 systems Standards: To the proficiency standards of 80% accuracy (minimum) on a written test
Safety Requirements	It is the responsibility of the student/warfighter to follow safety guidelines as well as local unit SOPs.
Risk Assessment Level	Low
Environmental Considerations	It is the responsibility of all students/warfighters and Army Civilians to protect the environment from damage.
Evaluation	At the end of the course a written final exam will be administered of which each student/warfighter must earn an 80% or greater to pass this course. Throughout the lessons/modules practical exercises are conducted. Students will need to complete each exercise with 100% accuracy (to include remedial training if necessary) before the Performance Evaluation Checklist is signed, to ensure students can properly conduct maintenance procedures. PE's are graded using a "go/no go" criteria, of which all students/warfighters must earn all "go's" (100%).
Instructional Lead-In	The Joint Light Tactical Vehicle Maintainers course provided training on the characteristic and performance capabilities of the JLTVA1, the theory of operation of every major vehicle system, and how to maintain each system; as well as how to use the IETM to maintain the vehicle as a whole following schedule procedures. Hands-on training and reinforcement opportunities were provided to ensure you have the skills required to maintain this vehicle. The following written exam is to reinforce all the knowledge you have acquired this week. The test may take approximately one hour and thirty minutes to complete.

SECTION III. **PRESENTATION**

Terminal Learning Objective

NOTE: Inform the students of the following Terminal Learning Objective requirements.

Upon completion of this lesson, you will be able to:

Action:	Complete JLTVA1 Maintainers Training Final Exam
Conditions:	After completing the previous eight training modules to acquire knowledge on all major JLTVA1 systems
Standards:	To the proficiency standards of 80% accuracy (minimum) on a written test

1. TLO 9 – LSA 1

Learning Step/Activity:	End of Course Review
Method of Instruction:	Lecture
Instr Type (I:S Ratio)	1:15
Time of Instruction:	10 min
Media:	PPT

(Slide #2)

a. Provide end of course wrap-up:

1. Lesson 1 Introduction and Safety
2. Lesson 2 Vehicle Familiarization
3. Lesson 3 Electrical
4. Lesson 4 Engine
5. Lesson 5 Transmission
6. Lesson 6 Drivetrain
7. Lesson 7 Suspension, Hydraulic Systems and Steering
8. Lesson 8 Air Systems, Brakes and CTIS

b. Resources

1. Follow maintenance schedules.
2. Look to IETM for guidance on general maintenance and troubleshooting tracks.
3. You may also refer to notes from this class in your student guide and job aids.
4. Don’t make any assumptions, always complete your diagnostic checklist.

5. And always follow all applicable safety cautions and warnings, and vehicle pre-conditions (prepping for your maintenance task) and use the appropriate tools.

c. Conclusion

1. This training program has provided you with the knowledge and skills required to provide basic mechanical services to the JLTVA1, and upon passing the written exam you will earn your JLTVA1 Maintainer Certification. To earn the confidence and expertise to become proficient at maintaining the JLTVA1, you will have to have regular contact with the JLTVA1 to know the truck, follow up on indicators displayed by the truck and consistently follow all maintenance protocols in the IETM.

2. TLO 9 – LSA 2

Learning Step/Activity:	Final Exam
Method of Instruction:	Test
Instructor to student ratio:	1:15
Time of instruction:	1 hr 30 min
Media Type:	None

(Slide #3)

a. Final Exam

1. Follow instructions in the test booklet.

2. There are four types of questions

   a) Matching

   b) Fill in the blank

   c) Multiple choice

   d) Short answer

3. Remember, a score of 80% or better is required to complete the course.

4. You will have one hour and thirty minutes to complete the exam.

Instructor Note

Ask students if there are any questions before handing out test. Answer questions as necessary.

See Appendix B – Final Exam for JLTVA1 Maintenance

- Distribute exams
- Read exam instructions to class
- Provide one hour and thirty minutes to complete exam

See Appendix B – Final Exam for JLTVA1 Maintenance Solutions

- Correct exams using answer key
- Collect/review all PE assessments to verify all 100% achieved

Students with 80% or greater score on final exam and all 100% “go’s” on PEs earn a JLTVA1 Maintenance Certificate.

- Students Not Satisfactory
  - Scores less than 80% must correct their answers and take a retest on that subject/topic/learning step, or the entire test if necessary.
  - Students with PE score(s) less than 100% have to be retested in the shop on the truck to ensure they understand/can demonstrate the skill they missed previously.
  - Upon passing remedial training the students may then earn their certificate.

SECTION IV. **SUMMARY**

Method of Instruction:	Lecture
Instr Type (I:S Ratio)	1:15
Time of Instruction:	15 mins
Instructional Strategy	Discussion

End of Course **(Slide #4)**

- Distribute certificates to those that earned them.
- Keep students that need retesting on exam or PE's after class to provide remedial training and assistance to pass the course.

APPENDIX A

09_JLTVA1_ ARMY_MAIN_Intro_PPT_V3.0.pptx

ACRONYM GLOSSARY

Truck	**JLTV - Joint Light Technical Vehicle** CCWC - Close Combat Weapon Carrier GP - General Purpose HG - Heavy Guns Carrier UTL – Utility Commander Smart Display Unit (CSDU) Driver Smart Display Unit (DSDU) Gunners Protection Kit (GPK) Interactive Electronic Technical Manual (IETM) Preventive Maintenance Checks and Services (PMCS)
General	Absorbed Glass Matte (AGM) Automatic Fire Extinguishing System (AFES) Basic Issue Items (BII) Cease Training (CT) Charge Air Cooler (CAC) Circuit Breaker (CB) Cold Cranking Amps (CCA) Commercial Off the Shelf (COTS) Components of End Item (COEI) Condition Based Maintenance (CBM) Constant Velocity (CV) Corrosion Prevention and Control (CPC) Grams per Mile (GPM) Gross Vehicle Weight (GVW) Health Management System (HMS) Heating, Ventilation, and Air Conditioning (HVAC) Illustrated Parts Breakdown (IPB) Infrared (IR) Low Voltage Differential (LVD) Mechatronic Control Unit (MCU) Multi Connector (MC) Pneumonic Control Unit (PCU) Positive Crankcase Ventilation (PCV) Revolutions per Minute (RPM) Volts Direct Current (VDC)
Communication	Command Control Computer Communication Intelligence Surveillance (C4ISR) Communication Network Databus/Controller Area Network (CAN) J1939
Electrical	Electronic Control Units (ECUs) Field Effect Transistor (FET) Multiplexed switch panel (MUX)

	multiplexed Vehicle Electrical Center (mVEC) Software Configurable Input Module (SCIM) Solid-State Power Controls (SPCC) Transmission Control Module (TCM)
Engine	Engine Control Module (ECM) Front Engine Accessory Drive (FEAD) High Pressure Common Rail (HPCR) Variable Geometry Turbocharger (VGT)
Transmission	Internal Mode Switch (IMS) Modulated Main (MAIN MOD) Pressure Control Solenoids (PCS) Torque Converter Clutch (TCC) Vehicle Automated Diagnostic System (VADS)
Drivetrain	
Suspension, Hydraulics, Steering	Equal Area Position Sensitive Cross Plumbing (EP-X) High Pressure Gas (HPG) Inertial Measurement Unit (IMU) Pressure/Flow Compensator Valve (PFCV) Suspension (SPNSN) Suspension Aided Egress System (SAES) Suspension Aided Egress System (SAES)
Air, Brakes and CTIS	ABS (antilock braking system) Central Tire Inflation System (CTIS) Pressure Modulating Valves (PMV) Pressure Protection Valves (PPVs) Spring Applied Hydraulic Released (SAHR)