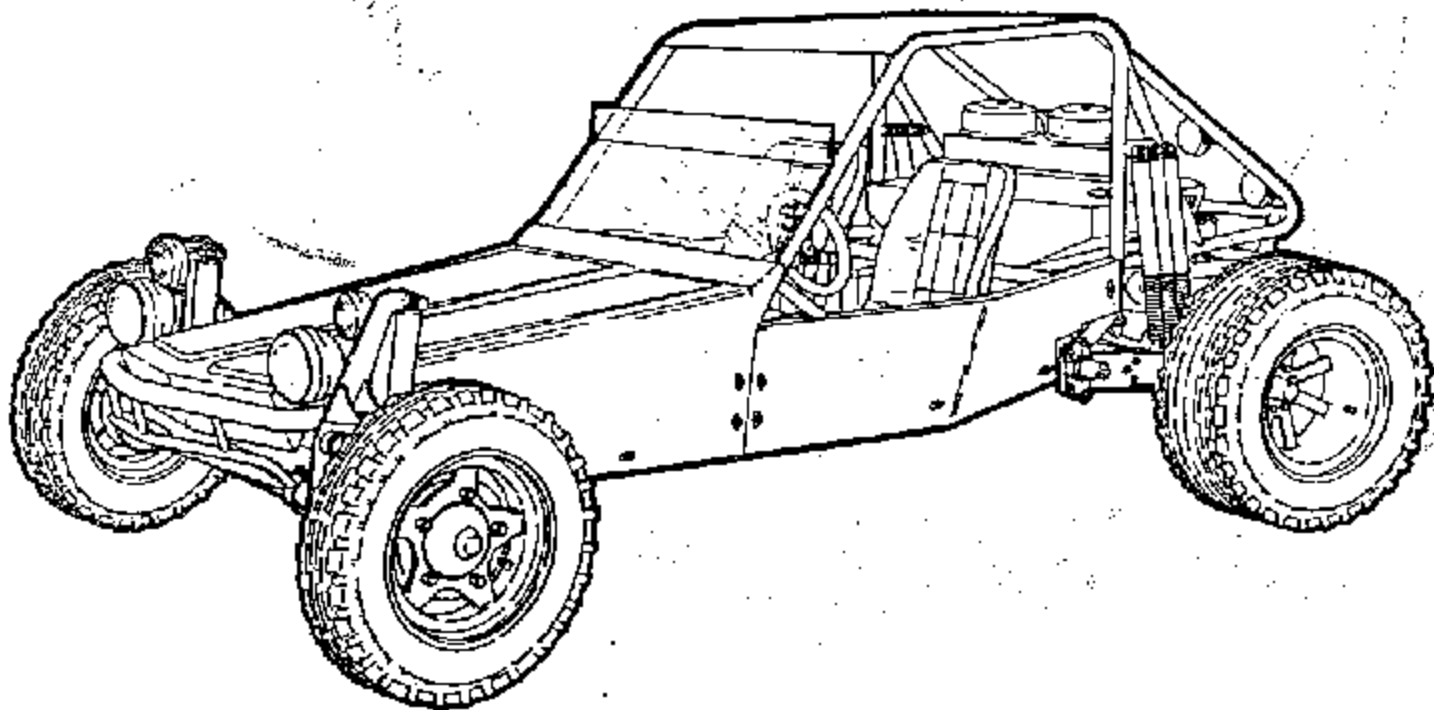


EM-1150-10

**OPERATOR'S MANUAL FOR THE  
SURROGATE FAST ATTACK VEHICLE (SFAV)**



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## SFAY OPERATOR'S MANUAL

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## Section 1. INTRODUCTION

1-1. SCOPE. This manual contains operator's instructions for the Surrogate Fast Attack Vehicle (SFAV). Shop maintenance, service, and repair instructions for the SFAV are contained in EM-1150-23, parts are included in the parts manual EM-1150-23P. The SFAV (figure 1-1) was developed and produced by Emerson Electric and Chenoweth companies for the U.S. Army Tank-Automotive Command under contract DAAE07-82-L-4004.

1-2. PURPOSE OF EQUIPMENT. The SFAV provides a fast, maneuverable vehicle capable of operating on rough, off-road terrain. The versatility of the SFAV allows for a wide variety of applications.

1-3. GENERAL DESCRIPTION. The SFAV consists of a welded, tubular 4130 Chromoly frame; a modified Volkswagen engine; and a 4-speed forward, 1-speed reverse synchro-mesh transmission. An internal battery unit provides electrical power to operate the ignition, lights, and other electrically operated auxiliary devices (table 1-1).

1-4. LIMITATIONS. The SFAV is equipped with a 16-gallon fuel tank, which provides a range of approximately 300 miles at an average speed of 30 mph, or 8 to 10 hours of vehicle operation. The SFAV can be operated in most weather conditions from light snow or rain to hot, dry, and dusty.

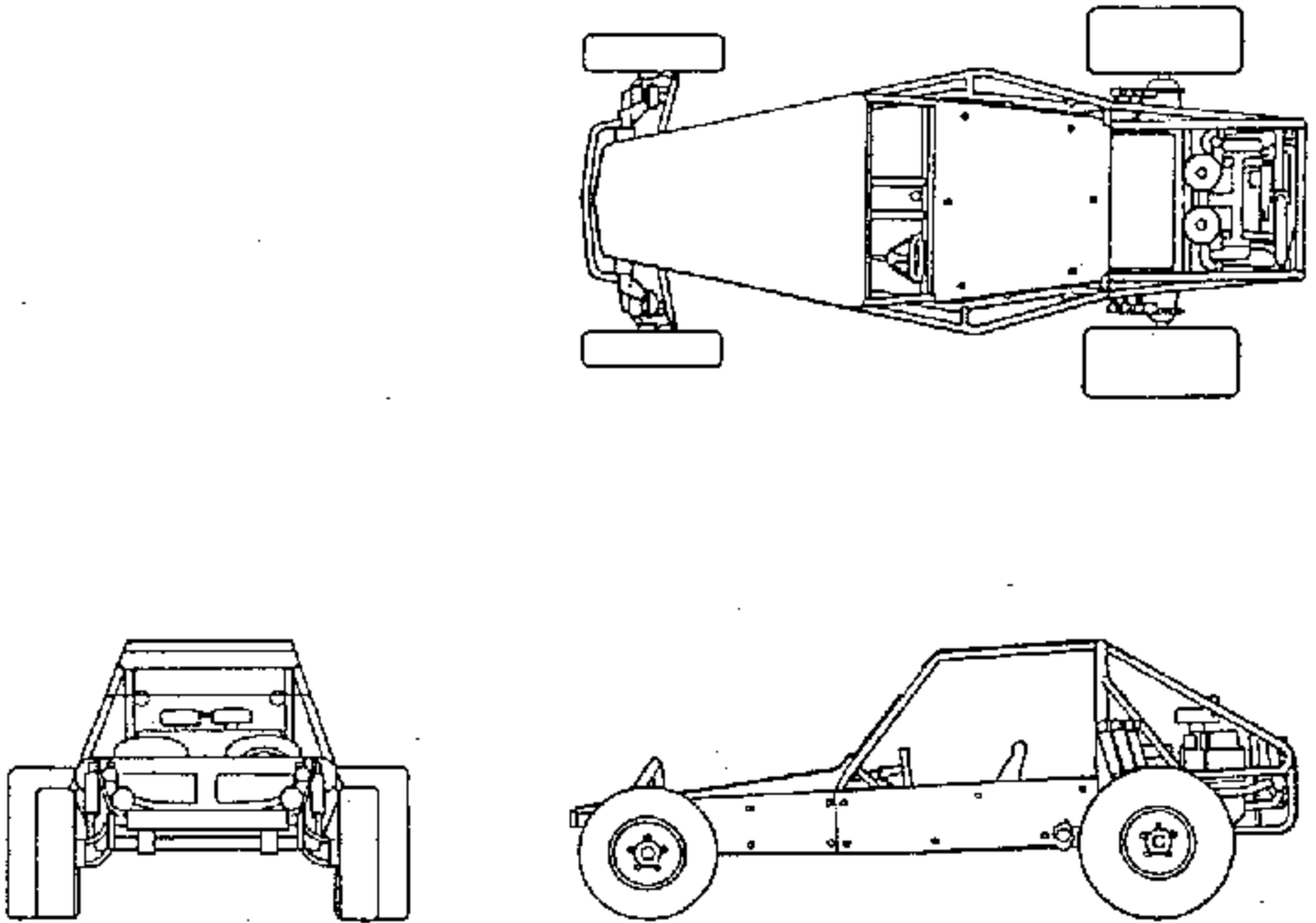
1-5. SAFETY. Throughout this manual safety factors are indicated by warnings, cautions, and notes. Personnel using this manual must understand and adhere to these safety notations. The terms are defined as follows:

WARNING

A procedure or step that if not followed correctly could result in injury or loss of life to personnel.

CAUTION

A procedure or step that if not followed correctly could result in damage to, or destruction of, equipment.



SFAV-2223-01

Figure 1-1. Surrogate Fast Attack Vehicle (SFAV).

Table 1-1. SFAV Leading Particulars

<b>Performance</b>	
Speed (Maximum)	75 mph
Horsepower	94 hp @ 5000 rpm
Fuel Consumption	22 mpg (est. average)
Fuel Capacity	16 gallons
Turning Radius	22 feet (minimum)
<b>Physical Characteristics</b>	
Length	146 inches (approximate)
Width (outside wheel to wheel)	76 inches (approximate)
Height	57 inches (approximate)
Ground Clearance	13.2 inches (minimum)
Gross Curb Weight (GCW)	1540 pounds
Gross Vehicle Weight (GVW)	2440 pounds
<b>Engine Data</b>	
Type Engine	Modified VW 1984 cc, 4 cyl.
Fuel System	87 octane regular (or unleaded)
Type Cooling	Air cooled
<b>Electrical System</b>	
System Voltage	12 V
Alternator Output	14 V/51 A
Battery Capacity	100 ampere hours
<b>Chassis Characteristics</b>	
Frame Type	Welded, tubular, 4130 Chromoly
Suspension (Front)	Standard fixed torsion gas-filled shocks
Suspension (Rear)	Modified with dual gas-filled shocks
Wheels (Front)	5-lug 15 X 5.0
Wheels (Rear)	5-lug 15 X 8.0 offset

Table 1-1. SFAV Leading Particulars - (continued)

Tires (Front)	E78-15 (radial)
Tires (Rear)	31.0 X 11.50 R15 (radial)
Brakes	
Service	4-wheel drum, hyd.
Parking	Button-type Park-Lock
Cutting	Rear wheel hyd., handle-operated
Transmission	
Type	4-speed synchro-mesh transaxle

NOTE

Emphasizes an essential procedure to ensure correct operation or maintenance.

The following is a list of common sense safety rules that should be practiced by personnel who operate or maintain this vehicle.

- a. Report any unsafe conditions in material or equipment. Warn others of such conditions or of hazardous actions noted that result from failure to observe safety precautions.
- b. Always wear helmet, goggles, and seat belts when operating the SFAV.
- c. Gasoline shall not be used as a cleaning solvent.
- d. Refuel only in well-ventilated areas.
- e. Do not refuel during thunderstorms.
- f. Do not refuel vehicle until engine is turned off and lights are off.
- g. No smoking or open flame in vicinity of refueling area.
- h. If gasoline contains lead, avoid skin contact. If contact occurs, wash immediately and thoroughly with soap and water.
- i. Keep a CO<sub>2</sub> portable fire extinguisher close when refueling.
- j. Use a special carrying strap when transporting batteries to avoid spilling acid on skin or clothing. If acid comes in contact with skin or clothing, wash immediately with water.



## Section II. PREPARATION FOR USE

2-1. UNPACKING AND ASSEMBLY. The SFAV and equipment will be delivered either on vehicle trailers or by commercial carrier. Paragraph 2-2 describes the preparation-for-use procedure when delivered by trailer. Paragraph 2-3 describes the preparation-for-use procedure when delivered by commercial carrier.

2-2. TRAILER UNLOADING. When the SFAV is shipped on either dual or single handling trailers, it will be tied down with front and rear turnbuckle units to the trailer frame. The transmission will be set in gear and the parking brake set. The gas tank will be drained and the battery disconnected. The following procedures must be followed when removing the SFAV from a single trailer or from the rear of a dual trailer.

WARNING

Improper handling or failure to follow proper unloading procedures could result in injury to personnel, serious damage to the SFAV, or damage to the handling equipment.

a. Single-Trailer Unloading

(1) Position towing vehicle and trailer containing SFAV in a clear area providing at least 50 feet to rear of trailer and set towing vehicle brakes. Trailer must remain attached to towing vehicle.

(2) Perform a visual inspection of SFAV wheels, engine, frame, and tie-down points for obvious damage caused during transportation. Report all discrepancies immediately to receiving authority before proceeding.

(3) Lower trailer loading ramp(s).

(4) Have SFAV driver sit in SFAV and press brake pedal fully and hold in that position. Ensure transmission is in gear.

(5) Remove SFAV-to-trailer holddown turnbuckles in four locations and swing turnbuckles clear of SFAV wheels.

CAUTION

Do not start engine to remove the SFAV from trailer under its own power. Care must be taken to inspect the SFAV completely before starting engine.

(6) With two personnel at front of SFAV on trailer, have driver put transmission in neutral, release brakes, and have two personnel roll SFAV backward down trailer ramps to a clear area.

(7) Secure ramps and equipment on trailer.

(8) Perform initial receiving checks in accordance with table 4-1 in section IV of this manual.

b. Dual-Trailer Unloading

NOTE

The front end of the SFAV is normally secured to the trailer tilt assembly by tie-downs at the front and by the winch hook and cable fastened under the SFAV frame just in front of the transmission shield plate.

(1) Check that winch cable and hook is securely fastened to center frame, forward of transmission shield plate. Take out all slack in cable using winch electrical control on trailer.

WARNING

The SFAV must be securely fastened to the winch hook and cable. Failure to ensure security could result in the vehicle's breaking loose during the next step and causing injury to personnel or equipment damage.

- (2) Release parking brake and set transmission gear shift in neutral.

NOTE

Two personnel are required for the following steps.

- (3) With the vehicle tilted in front-end-upward position, remove tie-downs at front of SFAV and trailer. Leave SFAV securely fastened to winch hook.

- (4) Remove two tilt assembly braces at high end of tilt assembly. Tilt assembly will not tilt downward.

- (5) Both personnel move to rear of SFAV and lower end of tilt assembly and lift tilt assembly and rear of SFAV (lift weight is approximately 100 pounds). Tilt assembly and vehicle will tilt downward.

- (6) With tilt assembly and vehicle in nose-down position, secure tilt assembly lower end with link pin through holes provided in trailer frame rail and tilt assembly.

- (7) At winch control switch on trailer, set switch to extend cable holding SFAV on tilt assembly. SFAV will move down tilt assembly and rest on flat surface of rear of trailer bed.

- (8) Have driver sit in SFAV and press brake pedal. Hold pressure on brake until completion of the following step.

- (9) At winch control switch on trailer, set switch to extend cable. When cable is slack, remove hook from under SFAV.

- (10) When driver in SFAV releases brakes, other personnel roll vehicle down aft ramps to clear area.

(11) Secure ramps and equipment on trailer for travel.

(12) Visually inspect vehicle for obvious transportation damage. Report all discrepancies immediately to receiving authority.

(13) Perform initial receiving checks in accordance with table 4-1.

2-3. UNLOADING/UNPACKING FROM COMMERCIAL CARRIER. When shipped by commercial truck or air travel, SFAV is chained into position. Normally, gas tank and oil reservoirs are drained to comply with transportation regulations. Parking brake should be set, and transmission should be in gear.

#### WARNING

Observe all local authority safety precautions during unloading of SFAV from carrier vehicle to prevent injury to personnel or damage to equipment.

- a. Remove hold-down chains.
- b. Roll SFAV down aircraft ramp, or off truck as applicable, ensuring adequate clearance.
- c. Visually inspect SFAV for obvious transportation damage. Report all discrepancies immediately to receiving authority.

#### CAUTION

Do not attempt to start engine until receiving inspection and initial checks have been completed in accordance with table 4-1.

### Section III. THEORY OF OPERATION

3-1. GENERAL. The SFAV is a lightweight, tubular-frame, all-terrain vehicle capable of high-speed, cross-country travel. The SFAV is designed for high maneuverability and agility during operational applications. The SFAV is operated in the same manner as any automotive vehicle with the exception of the added hand-operated hydraulic cutting brakes attached to the rear wheels, which are used to stop either wheel to perform sudden skid/steer turning maneuvers.

3-2. ENGINE. Power for the SFAV is provided by a modified Volkswagen four-cylinder, air-cooled engine with opposed cylinder arrangement. The engine has an 8:1 compression ratio and a 1984 cc piston displacement. Using 87-octane regular fuel, the engine can produce 94 hp at 5000 rpm and a speed of 75 mph. At a speed of 30 to 40 mph the SFAV range is at least 200 miles on a tank of gas (16-gallon tank).

3-3. TRANSMISSION. The SFAV transmission is a Chenoweth Bullec Box, four-speed, synchro-mesh transaxle with a 5.42:1 ring and pinion ratio. The rated input torque capacity is 195 foot-pounds. Maximum output torque from a standing start is 2065 foot-pounds. Under operation in first gear it is 2065 foot-pounds, second gear 1268 foot-pounds, third gear 939 foot-pounds, and fourth gear 699 foot-pounds.

3-4. ELECTRICAL SYSTEM. The SFAV has a 12 V electrical system for lighting and accessories. It has a 14 Vdc, 51 A alternator with a .75 alternator-to-engine speed ratio. A single 12 V lead acid battery supplies power to the system. The starting motor is a Volkswagen type II, direct gear drive, with a 300 A maximum capacity. The voltage regulator is a solid-state Motorola that operates at 13.5 V.

3-5. BRAKES. Service brakes are Volkswagen drum brakes hydraulically operated on all four wheels. The hydraulically operated parking brake has a 70 percent grade holding ability at gross vehicle weight.

## Section IV. OPERATING INSTRUCTIONS

4-1. PRESTART PROCEDURES. Before each day's operation complete the preoperational checks listed in table 4-1 to ensure continuing reliable operation of the SFAV.

4-2. USE AND FUNCTION OF CONTROLS AND INDICATORS. Operators should become completely familiar with the use and function of the following controls and indicators.

### a. Controls

(1) Steering Wheel. The steering wheel is a 12-inch, 3-spoke, sponge vinyl wheel intended for off-road use because of its ability to absorb shocks and vibrations. The SFAV has a 1.5 turn ratio from lock-to-lock.

(2) Clutch Pedal. The clutch pedal operates the SFAV hydraulic clutch linkage used along with a dual master cylinder.

(3) Brake Pedal. The brake pedal is used with a dual master cylinder to operate the SFAV four-wheel hydraulic brakes.

(4) Gas Pedal. The gas pedal controls the amount of gas to the carburetor and subsequently the speed of the SFAV.

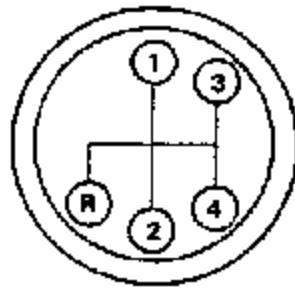
(5) Gear Shift. The gear shift (figure 4-1) is linked to the synchromesh transmission and is used to select any of four speeds forward and one reverse. To engage reverse, press down on gear shift lever and move it all the way to the left and down.

(6) Parking Brake. The parking brake (figure 4-2) is located on the floor next to the gear shift. It is attached to the hydraulic line. To lock the parking brake, press the foot brake and hold while pushing the parking brake button down. To release the parking brake, simply press the foot brake.

Table 4-1. Preoperational Check List\*

- a. Check spline bolts on constant velocity joints for security.
- b. Check shock absorber mountings for security.
- c. Check tires for pressure, cuts, tears, or cracks.
- d. Check wheel lugs for security.
- e. Check spark plug wires for proper connection and signs of wear.
- f. Check alternator drive belt for signs of wear.
- g. Check engine oil level. Ensure oil cap is secure.
- h. Inspect carburetor air cleaners (2) for cleanliness.
- i. Inspect skid plate below engine for signs of excessive oil leakage.
- j. Check fuel level.
- k. Ensure gas tank cap is secure.

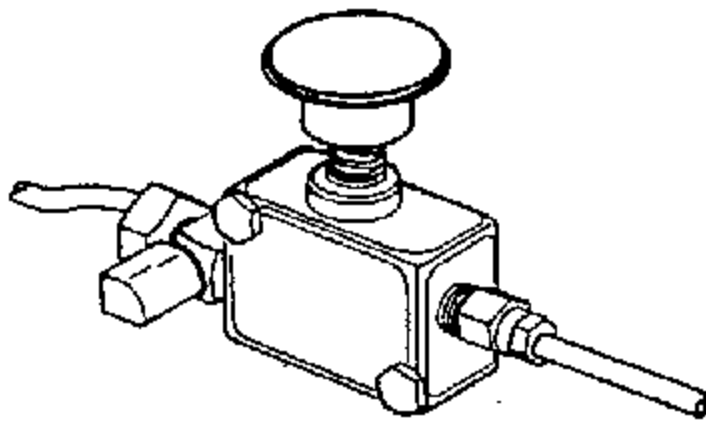
\*Checks should be performed daily before starting SFAV.



SFAV-2223-02

Figure 4-1. Gear Shift.





SFAV-2223-03

Figure 4-2. Parking Brake.

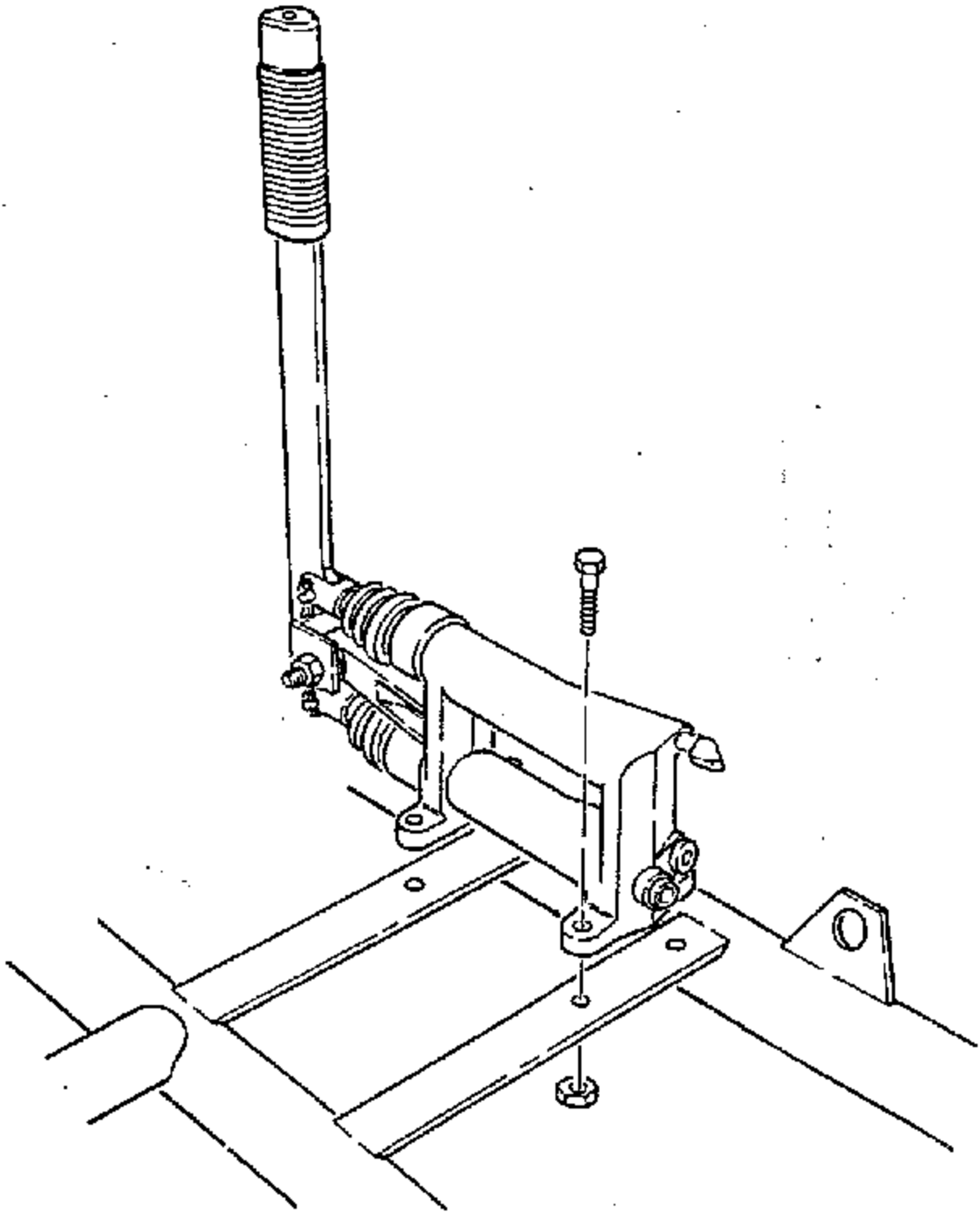
(7) Cutting Brake. The cutting brake (figure 4-3) is located between the seats and is connected to the rear hydraulic brakes. Its purpose is to assist in skid/turns by providing differential braking to the rear wheels. When making a left skid/turn, pull the handle back. When making a right skid/turn, push the handle forward.

#### WARNING

Using the cutting brake for skid/turns is a developed skill and should not be attempted by the novice driver unless supervised. Attempting to use the cutting brake at high speeds could result in personal injury and damage to the SFAV.

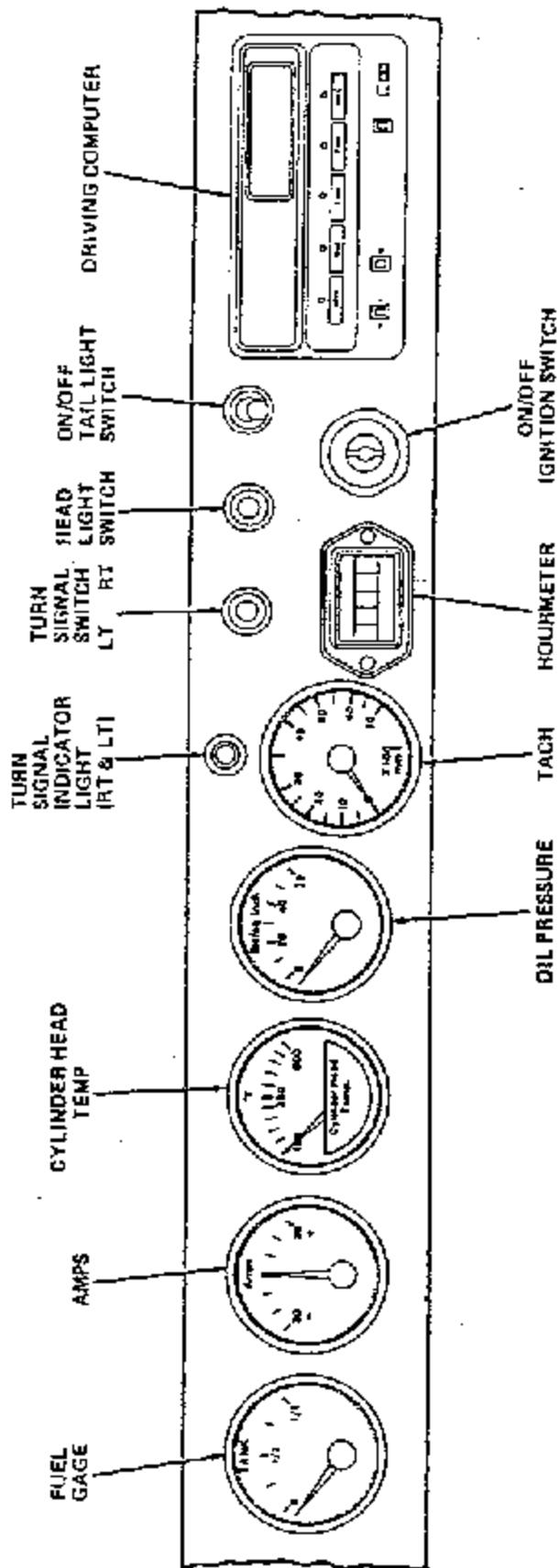
#### b. Indicators (figure 4-4)

- (1) FUEL Gauge. Indicates amount of gas in fuel tank.
- (2) AMPS Gauge. Indicates electrical system amperage.
- (3) CYLINDER HEAD TEMP Gauge. Indicates engine temperature.
- (4) OIL PRESSURE Gauge. Indicates engine oil pressure.
- (5) Tachometer. Indicates engine revolutions per minute. Is red lined to indicate maximum suggested revolutions per minute in each of the four forward gears.
- (6) HOURMETER. Indicates total engine operating hours.
- (7) Clock/Speedometer. Provides a digital display of vehicle miles per hour and time of day.
- (8) Turn Signal Switch. Indicates right or left turns by initiating flashing lights attached to rear frame of SFAV and on the front frame above the headlights.



SFAV-2223-04

Figure 4-3. Cutting Brake.



SFAV 7223-06

Figure 4-4. SFAV Indicator Panel.

(9) Turn Signal Indicator. Flashes when turn signals are moved right or left.

(10) Headlight and Taillight Switches. Headlight switch controls on/off and high and low beams. Taillight switch controls on/off.

(11) Ignition Switch. Key-operated switch to turn SFAV electrical system on and off.

4-3. POSTOPERATIONAL CHECKS. After each operation, visually inspect the SFAV for damage, loose connections, or oil and fuel leaks. Report any discrepancies to maintenance personnel. Wash vehicle thoroughly.

Section V. MAINTENANCE INSTRUCTIONS

5-1. PREVENTIVE MAINTENANCE. Crew level service and inspection maintenance is limited to the following:

a. Service

(1) Removing and Installing Wheels

(a) Using the supplied jack (never attempt to lift the SFAV with a bumper jack) raise the SFAV until the wheel is free of the ground.

(b) Remove lug bolts by turning them counterclockwise (left). When replacing wheel, torque lug bolts 87 to 95 foot-pounds. Pneumatic wrenches cannot provide torque accurately.

(2) Servicing Air Cleaners

(a) Unscrew wing nut and remove cover.

(b) Take out paper filter and sponge. Clean sponge with solvent. Replace sponge if necessary.

(c) Remove filter element frame and clean used oil from pan using solvent.

(d) Add new oil to pan.

(e) Install new paper filter, cleaned sponge, and cover. Secure with wing nut.

(3) Touch-up Paint

(a) Use provided touch-up paint to cover cracked or chipped paint on frame, towing attachments, and draw bars.

(b) Allow time for paint to dry.

b. Inspection

(1) Ensure shock bolts and wheel lug nuts are tight.

(2) Make sure front frame shims are in place.

(3) Check engine, brake, clutch, and battery fluid levels. Check battery cable connections.

(4) Check for engine and transmission leaks.

(5) Ensure steering linkage is tight.

(6) Check tire pressure (18 psi front and 20 psi rear).

(7) Operate all lights and turn signals.

(8) Make a visual inspection of transfer and final drive assembly, exhaust system, springs and shocks, frame, cab, hood, hull, bumper guards, and marine fenders.

(9) Keep SFAV clean.

(10) Refer all other maintenance requirements, including lubrication, to organization level maintenance and Emerson Maintenance Manual EM-1150-23.

5-2. FREQUENCY OF SERVICE. Table 5-1 provides the recommended frequency of service so that the crew can notify organization level maintenance when the various maintenance functions (except for the air cleaner, which is a crew function) are required.

Table 5-1. Frequency of Maintenance

<u>Maintenance Function</u>	<u>Frequency*</u>
Oil Change	Every 25 hours
Transmission Oil Change	Every 210 hours
Air Filter	Whenever dirty
Fuel Filter	Every 50 hours
Grease Front End	Every 25 hours
Rocker Arm Adjustment	Every 130 hours
Grease Constant Velocity Joints	Every 265 hours

\*Based on 12 hours = 1 week

30 miles = 1 hour

20,000 miles = 1 year (approximately)



## Section VI. TRANSPORTATION AND STORAGE

6-1. DISASSEMBLY. No disassembly is required to prepare the SFAV for shipment. However, if the SFAV is to be shipped by air, safety regulations require that the fuel be drained and the battery be disconnected. Normally, the SFAV will be rolled on and off aircraft, rail cars, or truck beds and securely fastened into position with turnbuckles or other effective security devices to ensure against load shifting during transport. Under normal conditions, crew personnel will only be involved in transporting the SFAV short distances using trailers specially designed for that purpose.

6-2. DUAL-TRAILER LOADING. Loading the SFAV into the forward section of a dual trailer is accomplished as follows:

a. Position trailer in a clear area that provides a minimum of 50 feet clearance to rear of trailer. Set towing vehicle brakes. Keep trailer attached to towing vehicle during loading. Lower trailer loading ramps.

b. Back SFAV to base of ramps. Ensure SFAV is centered behind trailer with front and rear wheels in line with trailer ramps.

c. Attach winch cable and hook securely to center frame, forward of transmission shield plate, and take up slack in cable using winch electrical control on trailer.

NOTE

Two people are required to accomplish the following steps.

d. Place gear shift lever in neutral. Do not start engine.

CAUTION

Do not attempt to start engine and back SFAV up the trailer ramps, as the strain on the transmission may result in transmission damage.

- e. Release parking brake by pressing brake pedal.
- f. With one person in SFAV to steer and the other person operating the winch, carefully pull SFAV into forwardmost part of trailer.
- g. Ensure SFAV is centered on trailer and that when loaded, both rear wheels rest flush with front of tire paths on trailer.
- h. Set parking brake and place gear shift lever in gear.
- i. Tie SFAV securely to tilt frame.
- j. Unfasten link pin at lower end of tilt frame from trailer frame rail and tilt assembly. Lift to fully raised position.
- k. Fasten lift bars to raised aft end of tilt frame using link pins.
- l. Tie front end of SFAV securely to base of tilt frame.

6-3. SINGLE-TRAILER LOADING. Vehicle loading onto a single trailer or the aft end of a dual trailer is accomplished as follows:

- a. Position trailer in a clear area that provides a minimum of 50 feet clearance to rear of trailer and set towing vehicle brakes. Keep trailer attached to towing vehicle during loading.
- b. Lower trailer loading ramps.
- c. Have driver drive SFAV up trailer ramps and park all the way forward on single trailer, or wedge under lift frame on dual trailer.
- d. Turn off ignition, set parking brake, and place gear shift lever in gear.
- e. Tie SFAV securely to trailer frame and secure loading ramps on trailer.