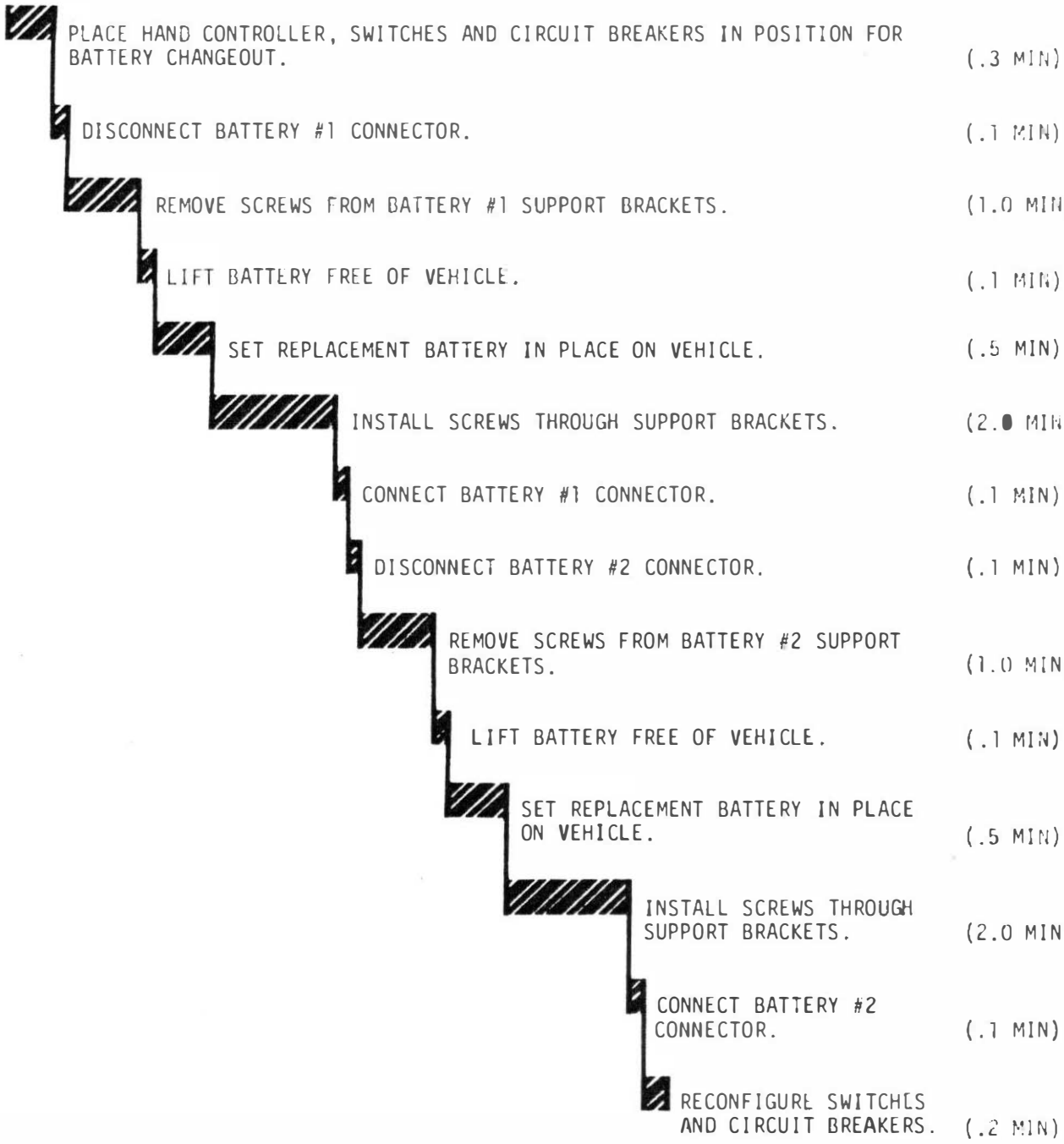


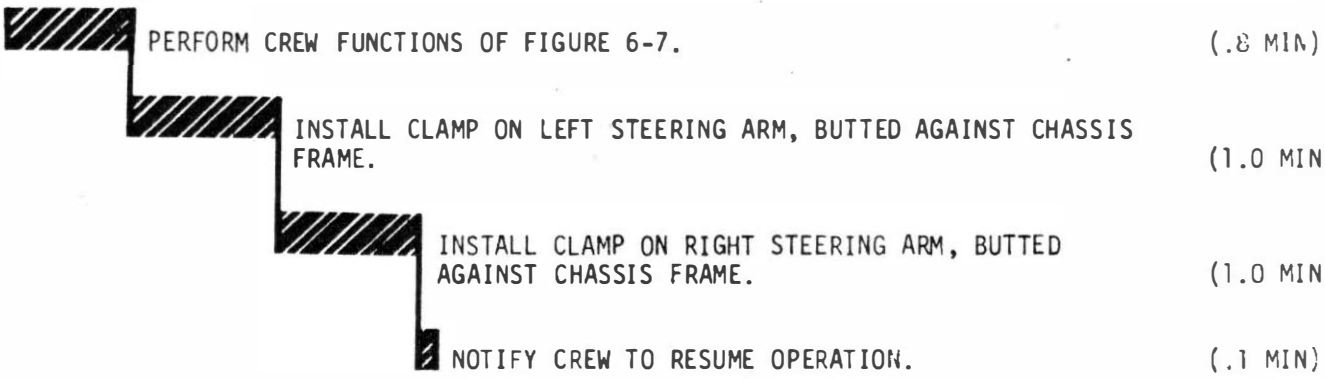
TOTAL TIME 8.1 MIN

FIGURE 6-9. 1G TRAINER BATTERY CHANGEOUT

PERFORM CREW FUNCTIONS OF FIGURE 6-6.	(1.0 MIN)
REMOVE 6 SCREWS FROM WHEEL HUB AND REMOVE HUB.	(1.5 MIN)
INSERT BLANK HUB IN WHEEL.	(.1 MIN)
RE-INSTALL 6 SCREWS IN BLANK HUB.	(2.0 MIN)
NOTIFY CREW TO RESUME OPERATION.	(.1 MIN)

TOTAL TIME 4.7 MIN

FIGURE 6-10. 1G TRAINER TRACTION DRIVE DECOUPLING TIMELINE



TOTAL TIME 2.9 MIN

FIGURE 6-11. 1G TRAINER STEERING DECOUPLING TIMELINE

SECTION 7

OPERATING PROFILES

7.1 LRV OPERATING PROFILE

7.1.1 Normal Operating Profile

The LRV is designed for nominal operation in accordance with the profile shown in figure 7-1 for a lunar surface stay time of 78 hours.

7.1.1.1 Sortie Profile

- The normal sortie profile consists of a maximum of 3 hours of driving time and 3 hours of station time, to total 6 hours per LRV sortie.
- The normal sortie will be accomplished with all four traction drives and both steering assemblies active.
- During the sortie, stops will be made at periodic intervals to update LRV navigation system. At these stops, the crew will report indicator readouts per 2.6.

NOTE

Navigation updates will be performed only if indicator HEADING differs from MCC Calculated heading by more than 2°.

- The LRV navigation system and console displays will remain energized throughout the six hour sortie duration.
- At stops exceeding five minutes, the power to the traction drive units, steering motors, and drive controller will be turned off (accomplished by placing STEERING FRONT and REAR switches OFF; LF, RF, LR, RR DRIVE POWER switches OFF, and ± 15VDC switch OFF).
- Circuit breakers and switch settings will be set to utilize both batteries at approximately the same rate, (e.g., steering for the front wheels powered from Battery No. 1 and steering for the rear wheels from Battery No. 2).
- Power from the auxiliary connector will be supplied only as required by the LCRU for special cases.
- Driving speed during the sortie will be varied at the crew's discretion. The speed profile for a sortie leg would consist of beginning at zero, accelerating to a desired driving speed, repeating cycles of decelerating to a slower speed, re-accelerating to the desired driving speed, and decelerating to stops. Speed will vary between zero and 14 km/hr.
- Operation of the LCRU high gain antenna and the television camera will be conducted only when the LRV is stopped. The low gain antenna will be manually oriented during LRV traverses.

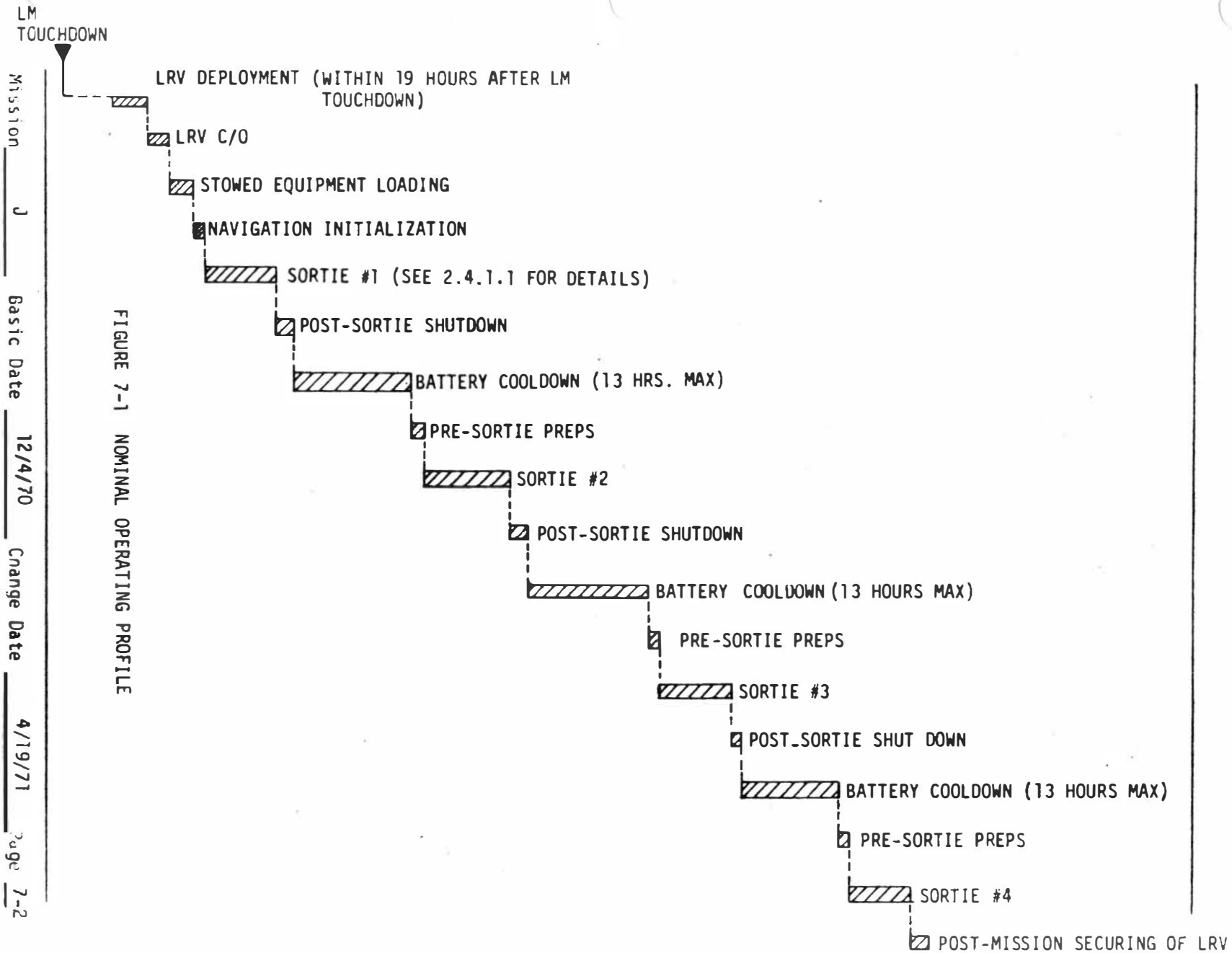


FIGURE 7-1 NOMINAL OPERATING PROFILE

7.1.1.1 (Continued)

o Science experiment equipment will be transported by the LRV only. Operation of the science equipment will be done only when the LRV is stopped.

7.1.2 Contingency Operating Profiles

Operating profiles for contingencies depend upon the specific contingency experienced. The following paragraphs contain operating profiles for a selected number of cases.

7.1.2.1 LRV Operating Profile with Failure of Traction Drive Units

The operating profile for a contingency caused by failure of a traction drive assembly (motor or harmonic drive) would be the same as that for normal operation with the following exceptions:

a. The specific traction drive would be uncoupled to allow "free wheeling" of that traction drive and drive power and control to that traction drive would be switched off. (Braking for the uncoupled wheel would be lost).

b. Speed/slope capability would be limited to that shown in Appendix A.

NOTE

1. If the right rear traction drive is decoupled, the speed indication on the console speedometer will not function.

2. If two traction drives are decoupled, the navigation odometer will not function.

7.1.2.2 LRV Operating Profile with Failure of One Steering Motor

The operating profile for a contingency caused by a failure of one steering motor would be the same as for the normal profile with the following exceptions:

a. Power to the disabled steering motor would be switched off.

b. The steering decoupling mechanism for the disabled steering motor would be activated by the crew. (This action is reversible for the rear steering motor only).

c. The minimum turning radius of the vehicle will be 6.2 meters as opposed to 3.1 meters with both steering motors operable.

7.1.2.3 LRV Operating Profile with Failure of One Battery

In the event of failure of one battery, all switches would be set to select the appropriate busses being supplied power from the remaining operable battery. For example, if Battery No. 1 fails, all control panel selections showing use of Bus A would be switched to select Bus C, since Bus C is supplied power from Battery No. 2 Each battery is capable of carrying the entire power load of the LRV.

7.1.2.3 (Continued)

The temperature rise in the remaining operable battery would be greater, however, causing the battery temperature to reach its upper limit in a shorter time as shown in Appendix A.

Range would be less, the specific amount depending on the point in the mission at which the failure occurs. Consult Appendix A for range capabilities.

7.2 1G TRAINER OPERATING PROFILE

7.2.1 Normal 1G Trainer Operating Profile

The 1G Trainer is designed for nominal operation in accordance with the profile shown in figure 7-2.

7.2.1.1

- Sortie begins with fully charged batteries installed in the vehicle and enough charged batteries or chase vehicle power available to support the duration and/or length of the sortie. (See Appendix B for battery capability).
- Science stops should be scheduled at points in the sortie corresponding time-wise, to battery change-out requirements.
- Battery change-out will be accomplished without removing power to the navigation system when changeout must be done in mid-sortie.
- Sortie time is not limited by trainer capability except for battery life limitations, and sun angle if sun is used for gyro update.

NOTE

Pre-calibrated check points can be used in place of sun for heading reference. This option allows use of the 1G Trainer on cloudy days, etc. and does not require ephemeris data.

- The normal sortie will be accomplished with all four traction drives and both steering assemblies active.
- During the sortie, stops will be made at periodic intervals to update the navigation system. At these stops the crew will also report temperatures of traction drives and batteries and state of charge of each battery.

NOTE

Navigation updates will be performed only if indicated heading differs from calculated heading by more than 2°.

- The navigation system will remain energized throughout the sortie.
- Driving speed during the sortie will be varied at the crew's discretion. The speed profile for the sortie leg would begin at zero, accelerate and decelerate to avoid obstacles, maintain constant speed over very smooth surfaces,

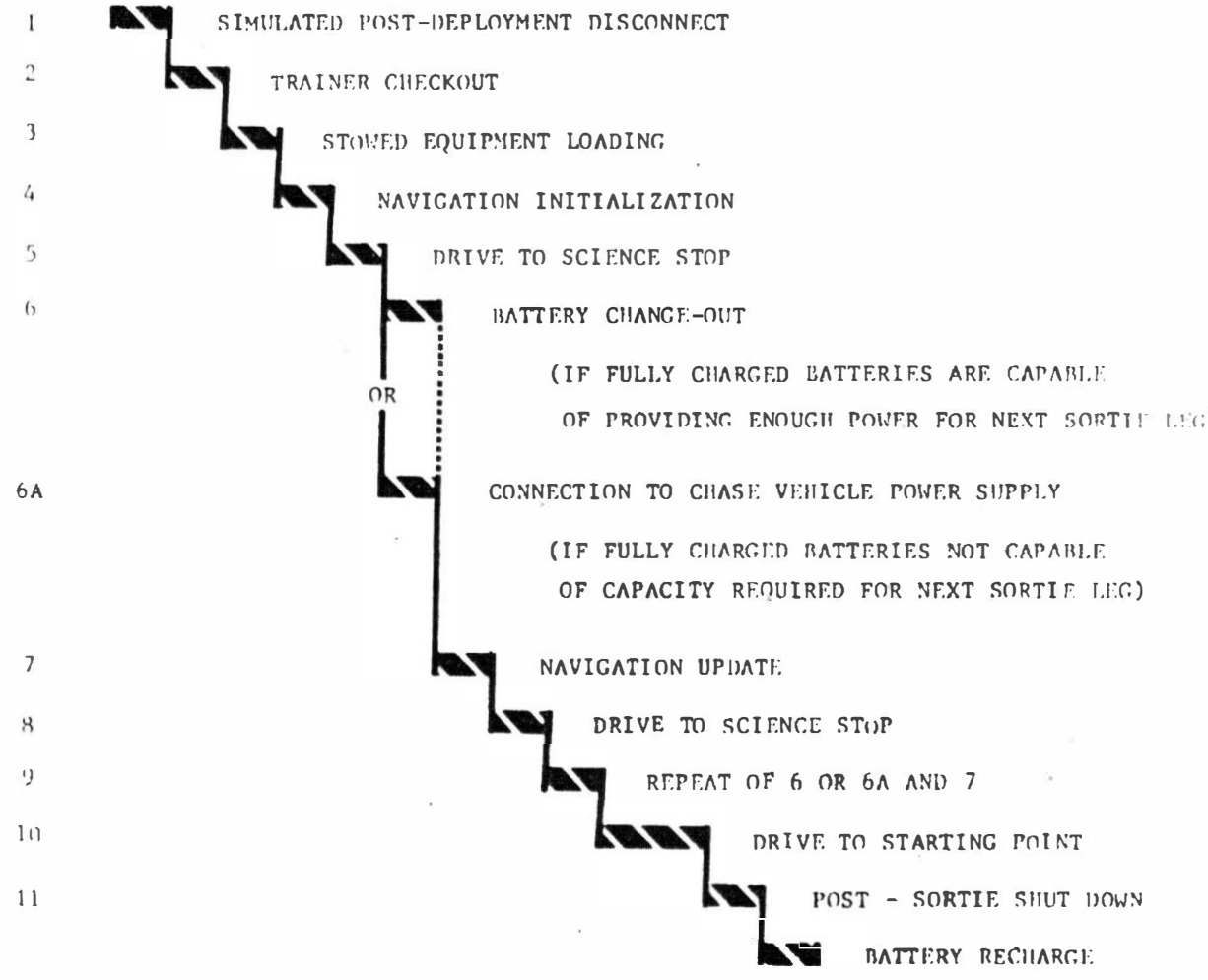


FIGURE 7-2. NOMINAL OPERATING PROFILE FOR 1G TRAINER

decelerate to observe geologic features, reaccelerate for driving and decelerating to a stop at science stations. Speed will vary between zero and 16 km/hr.

7.2.2 Contingency Operating Profiles

Operating profiles for contingencies depend upon the specific contingency experienced. The following paragraphs contain operating profiles for a selected number of cases.

7.2.2.1 Operating Profile with Failure of Traction Drive Unit

The operating profile for a contingency caused by failure of a traction drive assembly (motor or gear box) would be the same as that for normal operations with the following exceptions:

a. The specific traction drive would be uncoupled to allow free wheeling of that traction drive and drive power and control to that traction drive would be switched off.

NOTE

1. Decoupling of 1G Trainer traction drives requires a mechanic to physically do the decoupling. Simulated decoupling devices are provided for simulation of astronaut interface, but will not actually provide the decoupling. See Section 8.

2. If the right rear traction drive is decoupled, the speed indicator on the console will not function.

3. If two traction drives are decoupled, the navigation odometer will not function.

7.2.2.2 Operating Profile with Failure of One Steering Motor/Gear Reducer

The operating profile for a contingency caused by a failure of one steering motor would be the same as for the normal profile with the following exceptions:

a. Power to the disabled steering motor/gear reducer would be switched off.

b. The steering arms would be clamped by a technician.

NOTE

The simulated steering decoupling rings provided for crew interface will not effect steering decoupling.

c. Steering radius would be twice as great as with both motors operable. The driver should exercise greater caution when avoiding obstacles.

SECTION 8

1G TRAINER NON-CREW PROCEDURES

8.0 INTRODUCTION

This section contains procedures to be performed by personnel other than crew members in support of 1G Trainer Operations. Electrical block diagrams for the 1G Trainer are provided in Figures 8-1 through 8-8.

8.1 GENERAL PROCEDURES

8.1.1 Visual Inspection

Prior to, and at the conclusion of, each sortie or mission, visually inspect the vehicle for the following:

a. Finish or surface damage
b. Structural integrity of parent materials, welds, and other mechanical joints
c. Loose fasteners
d. Electrical cable abrasion, fraying, temperature damage, shorting, loose connector
e. Hydraulic line damage
f. Evidence of mechanical interference
g. Dust or debris in suspension and steering joints and bushings
h. Brake, battery, or shock absorber leakage
i. General configuration

CAUTION

Any discrepant item noted during this inspection must be corrected prior to vehicle operation.

8.1.2 General Repair

8.1.2.1 Finish or Surface Damage

All unpainted aluminum surfaces may be touched up if required by use of the processes specified in MIL-C-5541 Type I, Grade A or B, Class I. Information covering painted surfaces is carried on the appropriate piece-part drawing. Sharp nicks or any local surface deformation which could be a stress riser should be blended to the surrounding surface and refinished.

8.1.2.2 Structural Integrity

Loss of structural integrity or permanent deformation in the chassis, suspension, or any load bearing member should be considered grounds for immediate

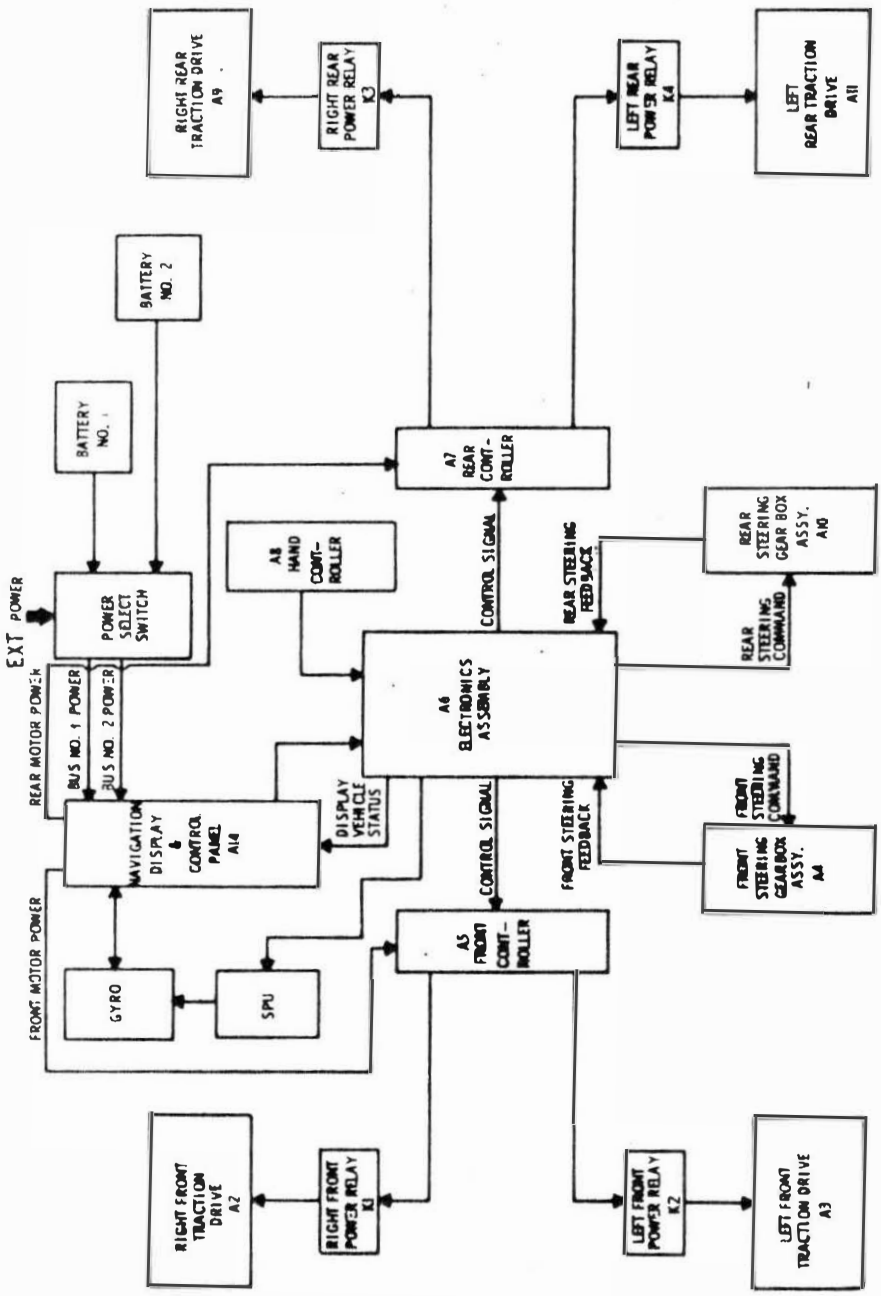


FIGURE 8-1

1G TRAINER BASIC VEHICLE BLOCK DIAGRAM

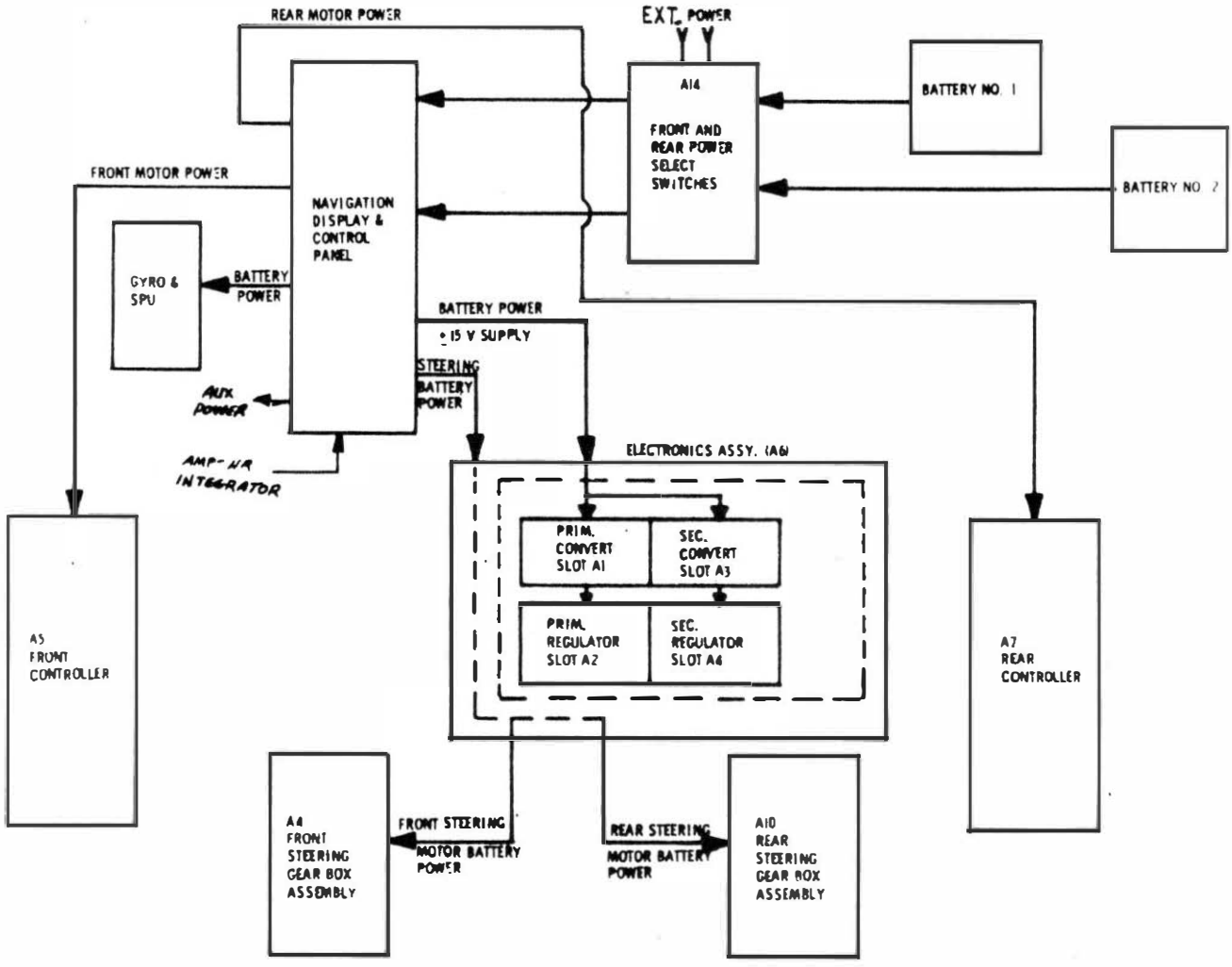


FIGURE 8-2 1G TRAINER VEHICLE POWER DISTRIBUTION BLOCK DIAGRAM

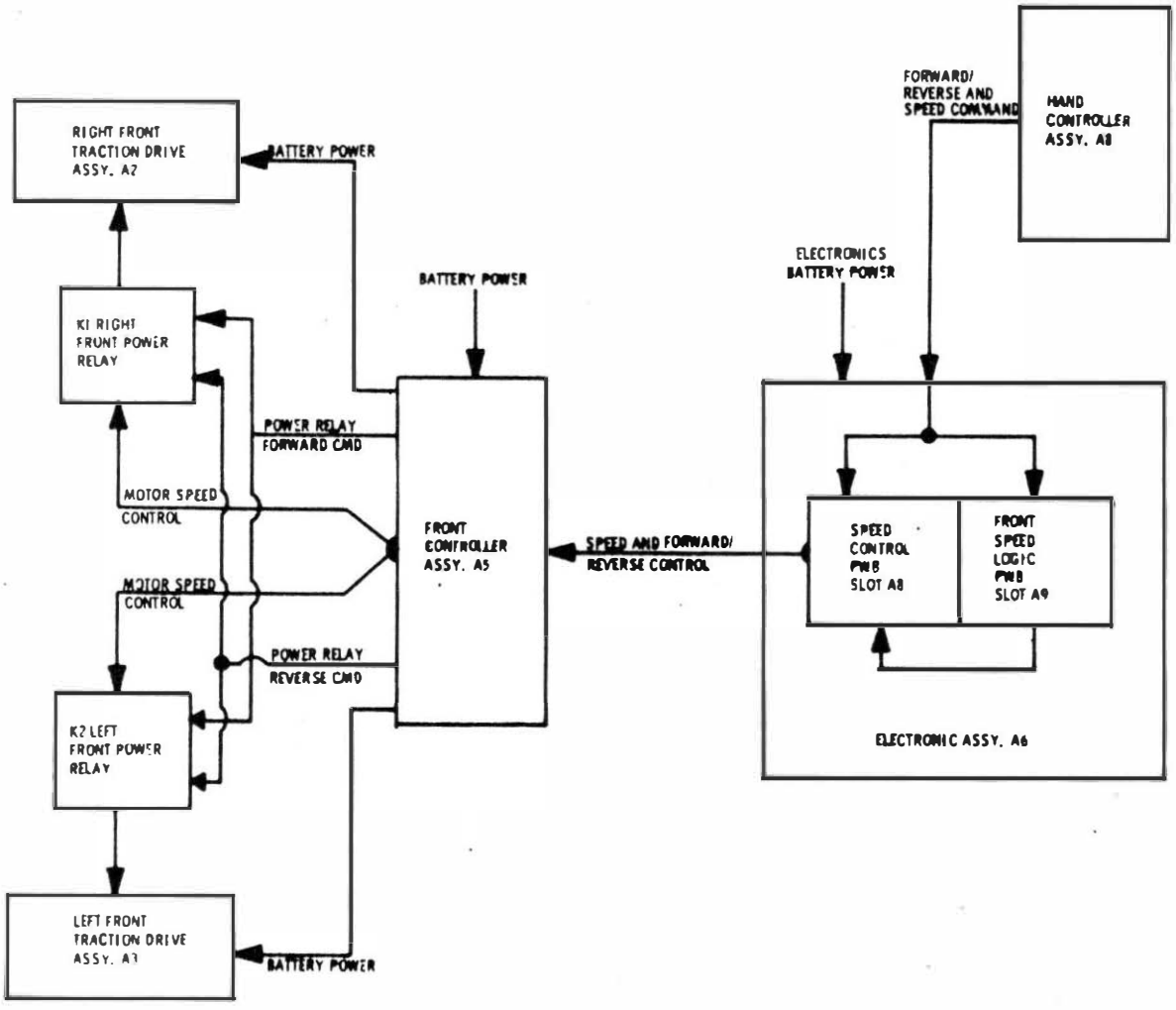


FIGURE 8-3

1G TRAINER VEHICLE FRONT TRACTION DRIVE
ELECTRICAL SIGNAL ROUTING BLOCK DIAGRAM

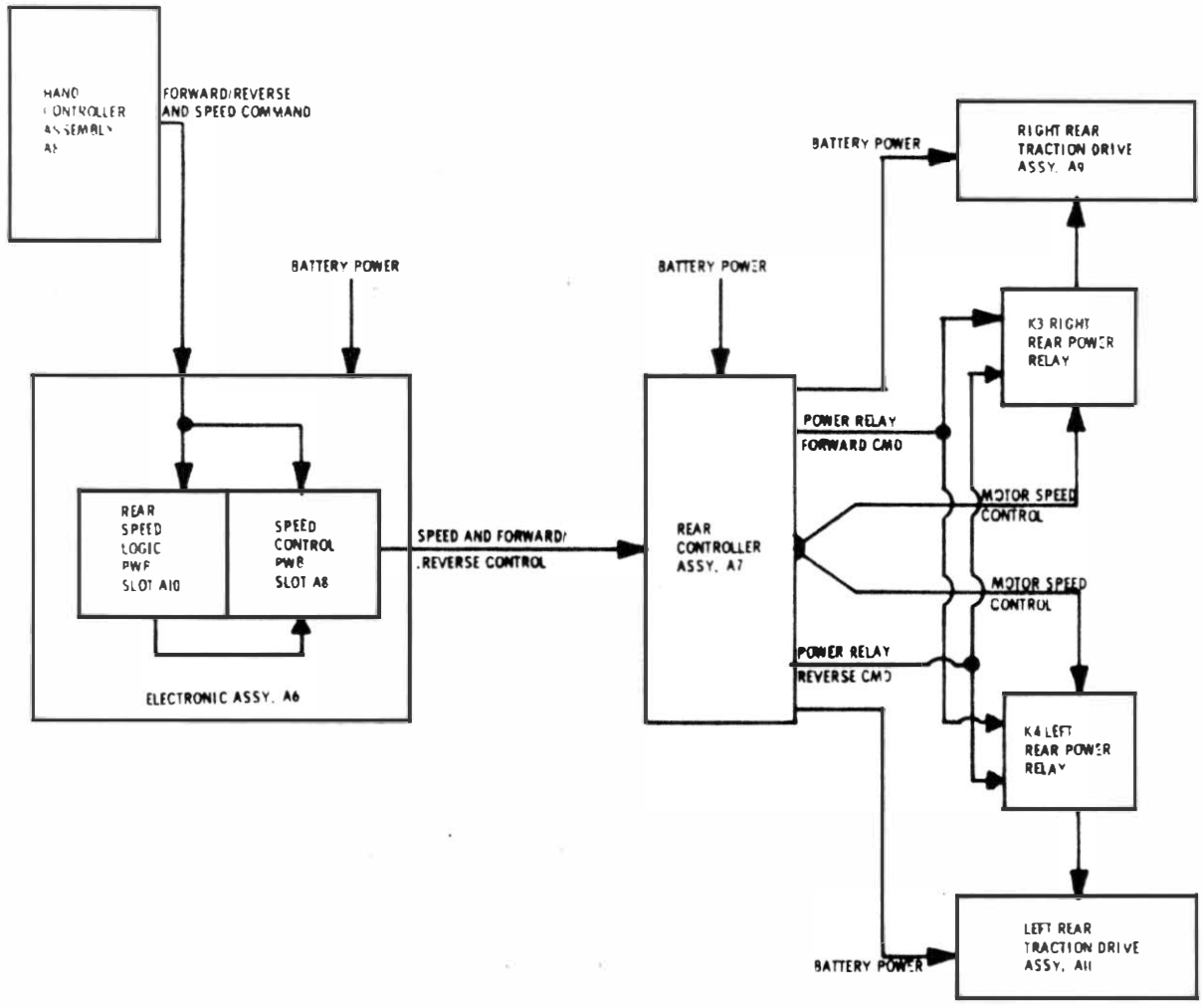


FIGURE 8-4 1G TRAINER VEHICLE REAR TRACTION DRIVE ELECTRICAL SIGNAL ROUTING BLOCK DIAGRAM

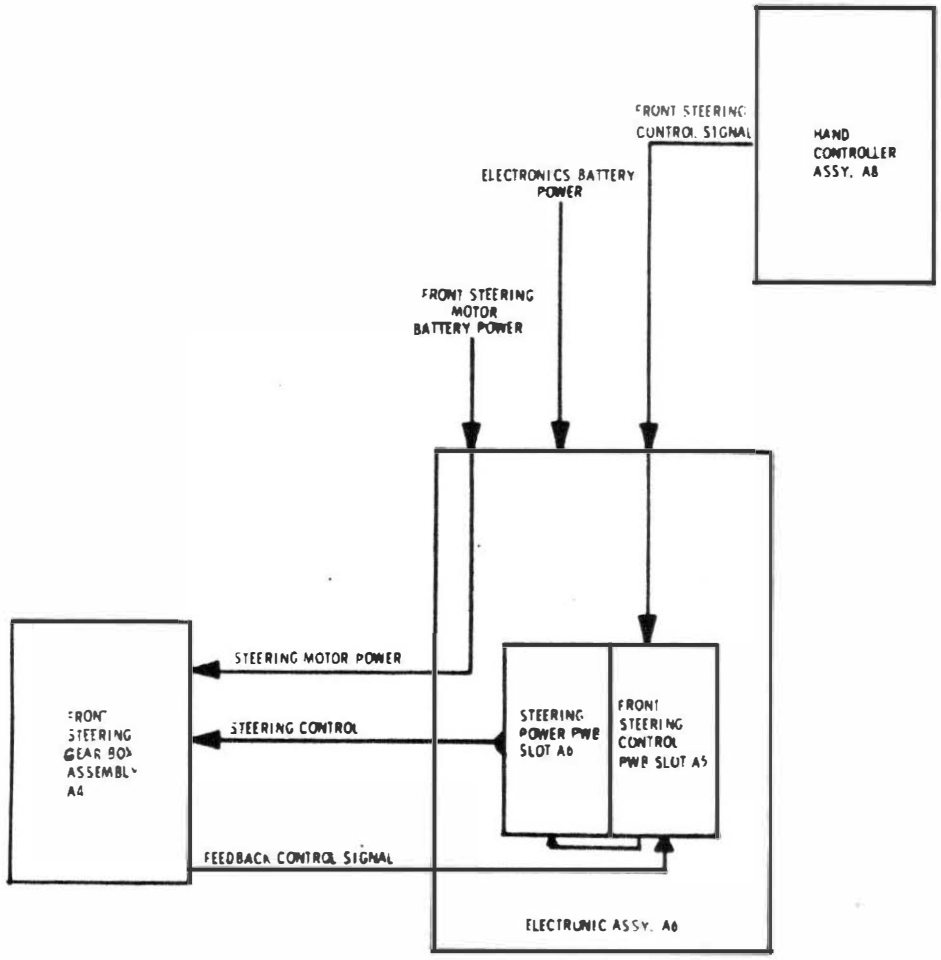


FIGURE 8-5 1G TRAINER VEHICLE FRONT STEERING
ELECTRICAL SIGNAL ROUTING BLOCK DIAGRAM

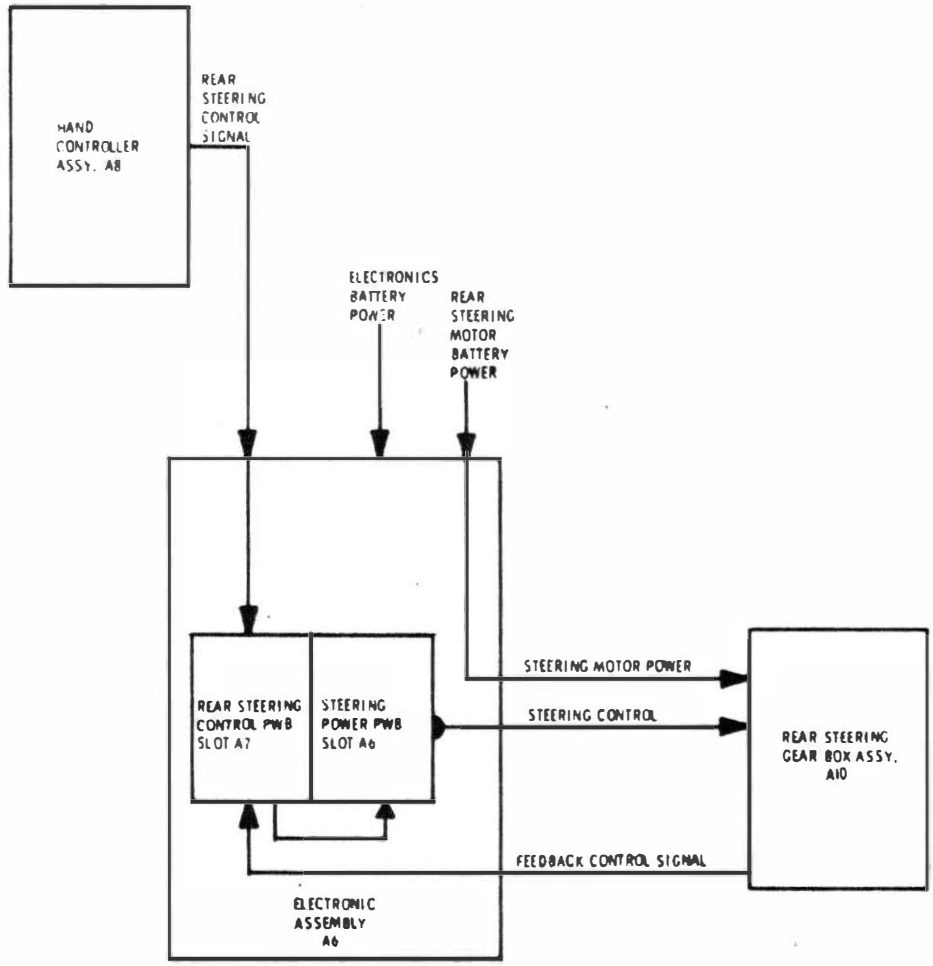


FIGURE 8-6 1G TRAINER VEHICLE REAR STEERING
ELECTRICAL SIGNAL ROUTING BLOCK DIAGRAM

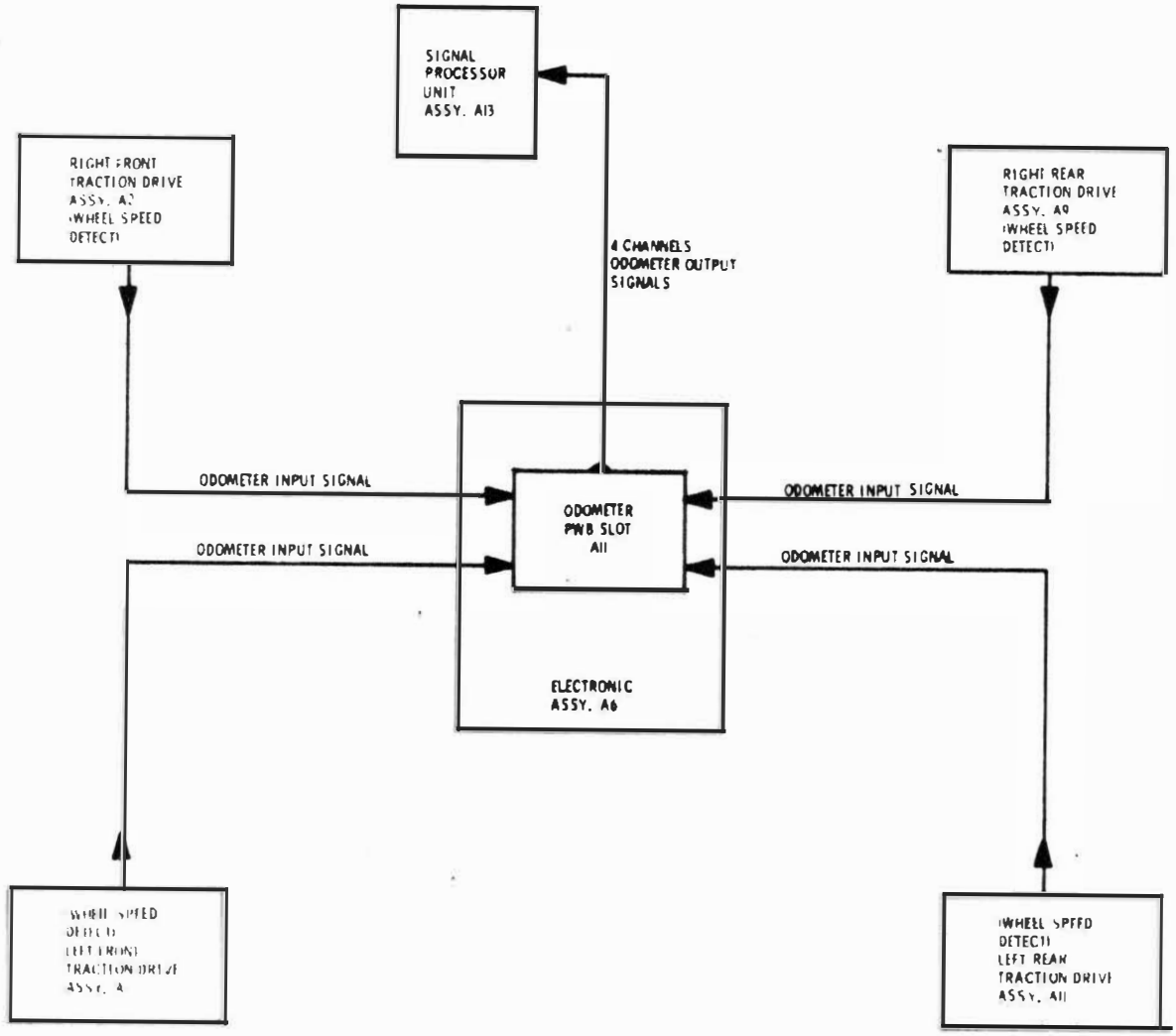


FIGURE 8-7 1G TRAINER VEHICLE ODOMETER ELECTRICAL SIGNAL ROUTING BLOCK DIAGRAM

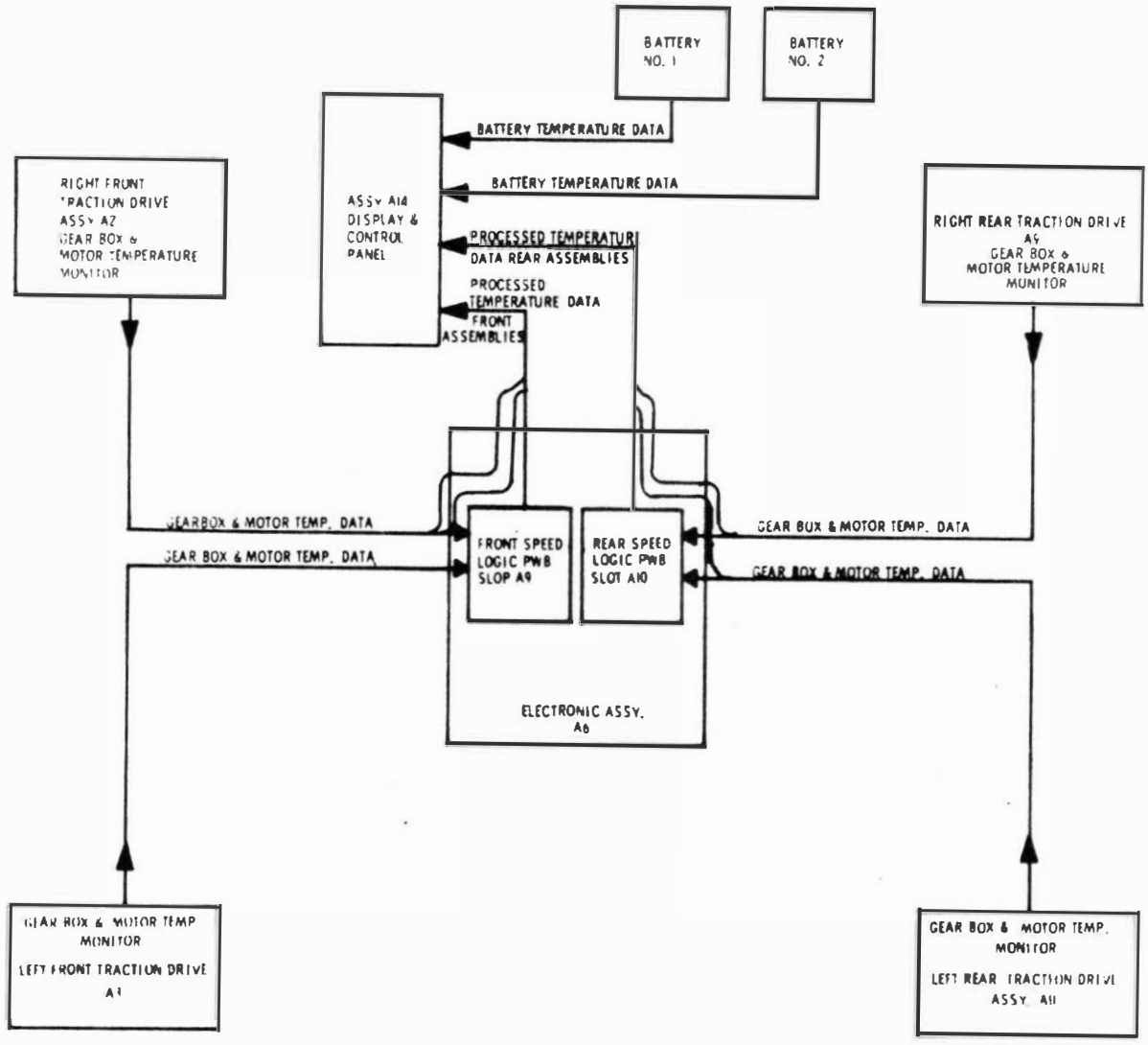


FIGURE 8-8 1G TRAINER VEHICLE TEMPERATURE DIAGNOSTICS ELECTRICAL SIGNAL ROUTING BLOCK DIAGRAM

8.1.2.2 (Continued)

discontinuance of vehicle operation. Engineering support should be solicited for specific repair instructions.

8.1.2.3 Loose Fasteners

Retighten fasteners. Replace any damaged threaded insert. Verify that the appropriate locking medium was used.

8.1.2.4 Cable Damage

Replace the wire if conductor damage has occurred. If damage is limited to insulation, repair with tape, shrink tubing or a like material with insulating and moisture resistant properties similar to the original material.

8.1.2.5 Hydraulic Line Damage

Repair using conventional techniques.

8.1.2.6 Mechanical Interferences

Steering/suspension interference may be caused by improper gain setting (Section 8.2.3.1). Inspect interference to determine cause and treat any permanent structural deformation as a loss of structural integrity. Replace any damaged component or subassembly that has caused or resulted from the interferences.

8.1.2.7 Dust or Debris

(See cleaning.)

8.1.2.8 Leakage

Replace leaking component on subassembly - see cleaning.

8.1.2.9 Configuration

The vehicle configuration should be as described in the top assembly drawing.

8.1.3 Cleaning

At the conclusion of each vehicle mission, remove any accumulation of sand, dust, or other foreign material. Clean hydraulic fluid or like contamination with a Freon Degreaser, or equivalent. Battery electrolite (KOH) should be treated in accordance with specific instructions (Section 8.2.8.5). Do not apply adhesive backed tape to the electrical cables because later removal may also remove the silver coating.

8.1.4 Storage

a. Long Term Storage. The vehicle should be stored inside a controlled access area wherein the ambient temperature is 70 + 20°F and the relative humidity does not exceed 90 percent. Batteries should be removed and stored separately. Periodic visual inspection should be made of the vehicle as defined in Section 2.1.1 and the ambient conditions should also be monitored.

b. Short Term Storage. For overnight or other short term storage the vehicle should be covered; however, batteries need not be removed. Ambient conditions must be within a range of -20°F to +120°F, with relative humidity less than 100 percent.

8.1.5 Safety Considerations

Vehicle operation should not be attempted by untrained personnel because of its unique control and handling characteristics. Driving skills must be developed only after a period of verbal direction and checkout, followed by actual operation under the surveillance of an instructor. Under no circumstances shall vehicle operation be other than specified in this Operation Manual.

CAUTION

Vehicle design specifications required that a minimum of three wheels support the vehicle at all times. Operation of the vehicle over terrain wherein two wheels support the entire vehicle may cause serious structural damage.

8.2 SPECIFIC PROCEDURES

8.2.1 Chassis

Visually inspect in accordance with Section 8.1.1. No additional adjustment or maintenance is required.

8.2.2 Hand Controller

No periodic adjustment or maintenance is required on the unit. Hand controller characteristics are shown in Figures 1-12, 1-13 and 1-14.

8.2.2.1 Lubrication and Cleaning of the Hand Controller

This operation should be done at a maximum of 300 hour intervals. Cleaning and relubricating has to be done with the hand controller removed. The slide attached to the boot should be removed from the hand controller assembly during this operation to prevent damage to the boot.

With the hand controller removed (see Section 8.3.1), clean the unit thoroughly. Clean all gear meshes and rubbing surfaces with "Freon Degreaser" cleaning fluid (dispensed from a pressurized can) or equivalent. Relubricate areas with Dow Corning "MOLYKOTE" or equivalent.

8.2.3 Suspension

Suspension clearance and alignment procedures will be required only if removal or replacement procedures have been performed on suspension and related traction drive or steering linkages. No suspension maintenance is required other than as part of the pre and post sortie visual inspection of the vehicle (Section 8.1.1).

8.2.3.1 Clearance and Alignment Adjustments

a. Locate vehicle on level surface.

b. Load vehicle with 520 pounds distributed as follows:

245 lb. driver seat
245 lb. passenger seat
130 lb. equally distributed over rear

NOTE: If the vehicle includes any of the following: LCRU, high gain antenna, camera, rear-deck payload packages, the stated 130 pound rear-deck payload shall be decreased accordingly.

8.2.3.1 (Continued)

c. Use torsion bar bracket screws to position adjustable torsion bar retainer until 35 cm minimum ground clearance exists when measured at the crew compartment corners.

d. If inadequate adjustment exists remove the torsion bar (see Section 8.3.2) and rotate one additional spline.

e. Apply power to both steering systems and position at electrical zero.

f. Lay a straight edge across the center of the drive cover of both left side traction drive assemblies.

g. If a clearance of more than 1/16 inch exists between the cover and straight edge, unlock one (or both if required) steering tie rod and adjust until straight edge is flat on both hubs.

h. Repeat the procedure using right side traction drive assemblies.

i. Lock tie rod nuts.

j. Locate vehicle wheels on teflon pads or other low friction material.

k. Attach a protractor to the drive cover of both front traction drive assemblies.

l. Apply front steering power and electrically zero the steering.

m. Zero the protractor, allowing adequate clearance for complete steering movement.

n. Record steering displacement at both wheels while applying full steering command in both left and right turn direction.

CAUTION

Interference may occur between the wheel, fender and steering linkage.

o. If interference occurs, adjust potentiometer R16 of printed wiring board RTV 20217 in the CW direction.

p. Trim potentiometer R16 until inside wheel displacement is 48° minimum.

q. Repeat procedure for rear steering.

8.2.3.1 (Continued)

Acceptance test data on steering operation and hand controller position versus wheel angles is presented in Table 8-1 for reference only.

8.2.4 Traction Drive

No Traction Drive adjustments are required; however, each unit can be mechanically decoupled to simulate LRV degraded operation or to permit towing without back-driving the motors (see Section 8.2.5.3, a through c). The preventive maintenance described in sections 8.2.4.1 through 8.2.4.3 is necessary.

8.2.4.1 Pre and Post Mission

Visually inspect per Section 8.1.1.

8.2.4.2 Every 50 Hours of Operation

Clean air filter as follows:

a. Remove traction drive blower.
b. Remove filter material.
c. Clean or wash in water.
d. Dry and re-install.

8.2.4.3 Every 200 Hours of Operation

Relubricate gearbox as follows:

a. Remove traction drive assembly from the vehicle.
b. Remove hub assembly with drive cover and outer bearing by removing the eight brake disc screws.
c. Secure brake disc to king pin by tieing two places, using hub mounting screw holes.
d. Disconnect gearbox thermostat retainer band.
e. Remove any cable clamps, ties or restraints as needed and work gearbox thermostat cable through gearbox flange as far as possible.
f. Remove gearbox mounting screws.

CAUTION

Do not remove the brake disc and seal or damage the thermostat cable.

g. Remove the three planetary stages and degrease.

h. Degrease the gear housing.

Steering Proportionality				
Hand Controller Angle	Degrees Rotation of Wheel from Neutral Position			
	LF Wheel	RF Wheel	LR Wheel	RR Wheel
Right Soft Stop (S. S)	15	26	28	16-1/2
Right H. S.	19-1/2	49-1/4	48	21-1/4
Left S. S.	29	17-1/2	16	26
Left H. S.	48-1/2	21-1/2	21	51-1/2

NOTES: 1. DATA IS FOR REFERENCE ONLY
2. DATA IS FROM 1G TRAINER ACCEPTANCE TEST

TABLE 8-1 1G TRAINER STEERING OPERATION DATA

8.2.4.3 (Continued)

i. Repack all planetary gears and bearings with RTV 21119-001 lubricant.
j. Reassemble gearbox and verify that the output stage bearing is seated against the retaining ring.
k. Re-assemble.

8.2.5 Wheels

Wire wheels or pneumatic tires may be interchanged as sets.

8.2.5.1 Wire Wheels

Visually inspect in accordance with Section 8.1.1. Discontinue wheel use when wire breakage approaches 200 wires. Loose tread strips may be wired in place, since disassembly is not practical.

8.2.5.2 Pneumatic Tires

Visually inspect in accordance with Section 8.1.1. Repair, using conventional commercial tire techniques. For most operations inflate the tire to 30 psig - approximately 13.9 inch rolling radius (as measured from the hub center to the operating surface). Do not exceed 40 psig. Air pressure may be reduced for soft soil operation.

8.2.5.3 Wheel Decoupling

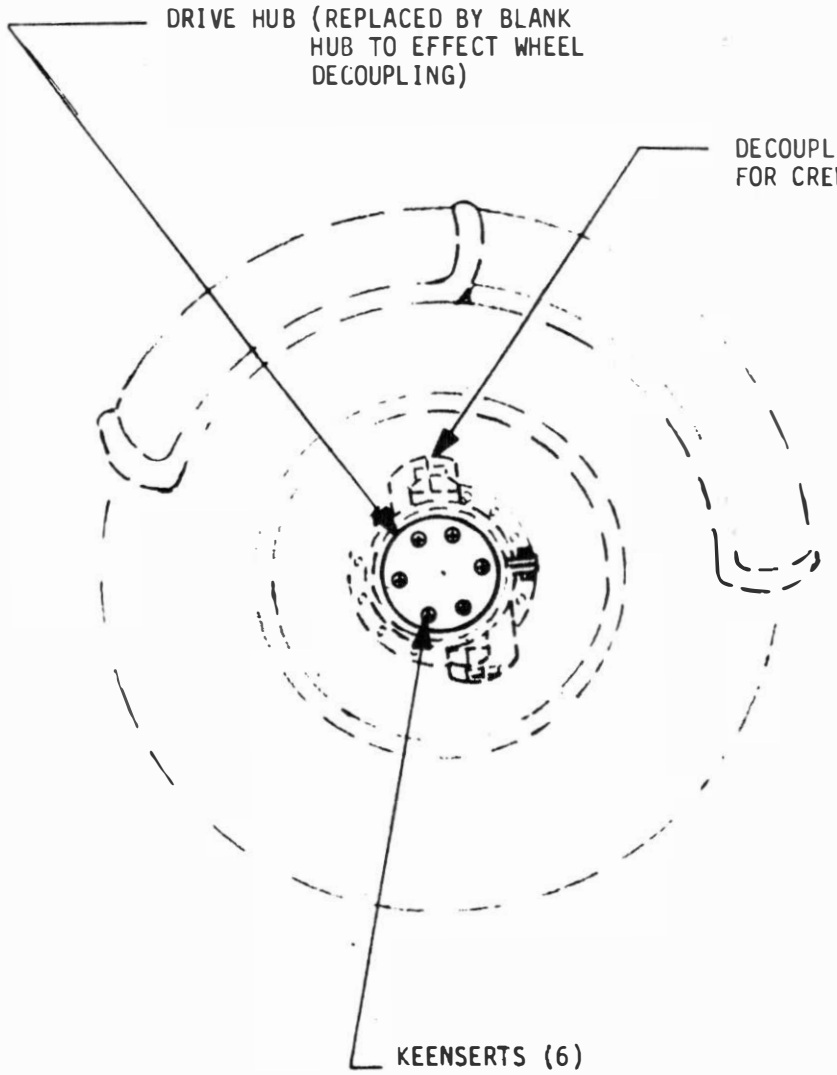
This procedure is for decoupling any of the four wheels. Nonfunctional decoupling clips are installed on each wheel for LRV simulation. The actual decoupling is accomplished by replacing drive hubs with blanks.

a. Hand Controller - parking brake position with throttle control in neutral.
b. DRIVE POWER Switches (4) - OFF.
c. STEERING Switches (2) - OFF.
d. + 15 VDC Switch - OFF.
e. Remove the six Phillips-head screws from the hub of the wheel to be decoupled (figure 8-9).
f. Remove the drive hub.
g. Obtain a blank "decoupling" hub.
h. Insert the blank hub into the wheel.
i. Install the six screws into the blank hub to secure the hub to the wheel.
j. Notify crew to resume operation.

8.2.6 Brakes

8.2.6.1 Brake Adjustments - Maximum Stopping Effort

a. Install long master cylinder actuating levers on both cylinders and connect external springs.



TYPICAL FOR ALL FOUR WHEELS

FIGURE 8-9 1G TRAINER WHEEL DECOUPLING

8.2.6.1 (Continued)

NOTE: If lever operation results in a spongy effect or in brakes with leak down, bleed the system of entrapped air before proceeding.

b. Connect cable clevis to the top lever holes.

c. With the hand controller forward (brakes off), concurrently adjust cable lengths at the hand controller yoke for both master cylinders.

(1) Maintain horizontal position of the yoke (equalized load).
(2) Adjust length until the brake pulley position is as shown in Figure 8-10. Maintain corresponding relative rotational position between pulleys.
(3) Maintain clearance between the actuation lever and the master cylinder piston with clevis adjustment.

d. Remove master cylinder covers and verify fluid level.

e. Concurrently adjust the actuation lever position (with the clevis) until no clearance exists between the lever and piston. Continue to adjust until application and release of the brakes with the hand controller results in the absence of an oil spout in the fluid reservoir.

f. Readjust the clevis(es) the minimum amount necessary for consistent occurrence of the oil spout.

g. Re-verify fluid level and install the reservoir cover.

h. Braking effort may be verified as follows:

(1) Adapt a 200 ft. lb. capacity torque wrench to the center of a blank traction drive cover, RTV 20613. (A 5/8 diameter high strength socket head bolt may be used).
(2) Install adapted cover in place of any existing drive cover.
(3) Remove vehicle weight from the traction drive.
(4) Set the hand controller to the park position.
(5) Attach torque wrench with 7/8 inch socket to the adapter cover.
(6) Torque with wrench until the wheel rotates - indicated value should be approximately 195 ft. lbs.

NOTE: If substantially less torque is measured the nonlinear pulley may be incorrectly positioned and the procedure should be repeated starting at Step 8.2.6.1.c.

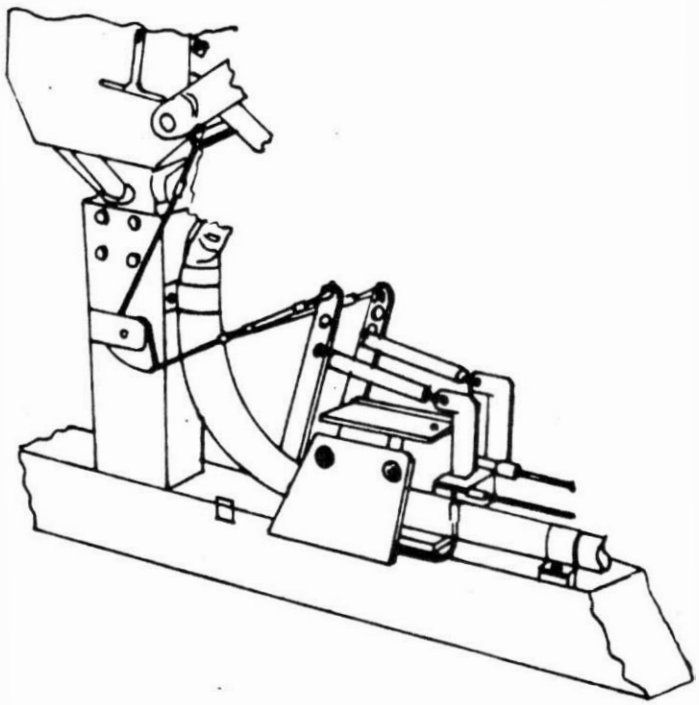


FIGURE 8-10 1G TRAINER BRAKE LINKAGE

8.2.6.2 Brake Adjustments - Degraded Operation

a. Install long master cylinder actuating levers on both cylinders and connect external springs. Verify reservoir fluid level.

NOTE: If lever operation results in a spongy effect or in brakes which leak down, bleed the system of entrapped air before proceeding.

b. Connect cable clevis to the lower lever holes.

c. With the hand controller forward (brakes off), concurrently adjust cable lengths at the hand controller yoke for both master cylinders.

(1) Maintain horizontal position of the yoke (equalized load).
(2) Adjust length until the brake pulley position is as shown in Figure 8-10. Continue adjustment, shortening cable length to maximum amount possible. Maintain corresponding relative rotational position between pulleys.
(3) Maintain clearance between the actuation lever and the master cylinder piston with clevis adjustment.

d. Concurrently adjust the actuation level position (with the clevis) until no clearance exists between the lever and piston.

e. Braking effort may be verified as follows:

(1) Adapt a 200 ft. lb. capacity torque wrench to the center of a blank traction drive cover, RTV 20613. (A 5/8 inch diameter high strength socket head bolt may be used).
(2) Install adapted cover in place of any existing drive cover.
(3) Remove vehicle weight from the traction drive.
(4) Set the hand controller to the park position.
(5) Attach torque wrench with 7/8 inch socket to the adapter cover.
(6) Torque with wrench until the wheel rotates - indicated value should be approximately 60 ft. lbs.

NOTE: If substantially more torque is measured, install short master cylinder actuating levers and repeat the procedure.

8.2.7 Steering Unit

No adjustments are required to the steering gearboxes after installation.

8.2.7.1 Clean and Relubricate Steering Gearboxes

This operation should be done at not less than 50 hour or more than 300 hour intervals. Because of the inaccessibility of the front steering unit, clean and lubrication procedure should be accomplished, if the front cover panel

8.2.7.1 (Continued)

has to be removed for other service operations (not to exceed 50 hours as mentioned previously).

Cleaning the steering gearboxes should be done by first blowing out any dirt or dust with compressed air. Gears are to be cleaned with "Freon Degreaser" fluid or equivalent. Relubricate the gear teeth with Dow Corning "MOLYKOTE" or equivalent.

8.2.7.2 Steering Decoupling

a. Verify the crew has manually positioned the forward or rear wheels (whichever is to be simulated as the decoupled wheels) to the straight ahead position.

b. Hand Controller - parking brake position with throttle control in neutral.
c. DRIVE POWER Switches (4) - OFF.
d. STEERING Switches - OFF.
e. Obtain two steering arm clamps.

f. Place steering arm clamp on the left and right hand steering arms, in such a position that the clamps are butted against the outside of the chassis frame where the steering arms pass through the frame (figure 8-11).

g. Open the FORWARD STEERING Circuit Breaker on the display and control console if forward steering arms were clamped. Open the REAR STEERING Circuit Breaker if the rear steering arms were clamped.

h. Notify crew to resume operation.

8.2.8 Drive Power

The Drive Power Subsystem consists of a Control Electronics package, two Drive Controllers, and two 34 VDC Ni-Cad batteries.

8.2.8.1 Control Electronics

No periodic adjustment or maintenance is required. Inspect the exterior in accordance with Section 8.1.1

8.2.8.2 Drive Controller

No periodic adjustment or maintenance is required. Inspect the exterior in accordance with Section 8.1.1.