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DEFICIENCIES AND SUGGESTED MODIFICATIONS

<u>Deficiency</u>	<u>Suggested Modification</u>
1. Inadequate steering characteristics inherent within the CD-850-3 cross-drive transmission were revealed during test operation. These deficiencies are listed as follows: a. Tendency of vehicle to oversteer at high speed when the operator attempts to make a minor change in direction. b. Loss of adequate steering control when the vehicle speed exceeds that of engine, such as when coasting downgrade.	1. The CD-850-3 transmission be modified to incorporate output type steering. During tests conducted to evaluate performance of a CD-850 transmission equipped with this type steering system appreciable improvement was observed in high speed steering and a correction of steering deficiencies noted when operating vehicles under coasting conditions. See Appendix H, Correspondence, H-4.
2. The accelerator is positioned in such a manner that the driver's leg becomes excessively tired after applying full throttle for an extended period.	2. The accelerator should be so arranged that the driver can apply full throttle without undue leg or foot fatigue.
3. The accelerator and foot brake are so arranged in relation to each other that difficulty is experienced when releasing the accelerator and applying the brake. Since the accelerator is located beneath and forward of the brake lever, movement of the foot from the accelerator, in order to apply the brake, is hampered by the toe being caught beneath the brake lever. This interference is particularly noticeable by drivers having large feet or those wearing bulky type footwear.	3. Rearrange brake lever and accelerator so as to provide sufficient clearance for the driver's feet during the manipulation of these controls.

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4. Initially, application of the foot brake lever requires excessive pressure to overcome the brake lever return spring. This pressure is required when the knee is bent so that the leg has little lever advantage.	4. Decrease the effort required to initially actuate brake lever or so arrange that leg will be in a more advantageous position when necessary force is applied.
5. Care must be exercised not to allow the foot to slip off the foot brake lever during brake application, since when returning under action of its return spring the lever is likely to strike the shin of the driver's other leg. This danger is also present when releasing the parking brake.	5. Reposition lever or reduce length of rearward travel of brake lever upon being released in order that lever is unlikely to strike driver's leg.
6. The drivers' seats are not adjustable from front to rear. This does not allow drivers of various leg lengths to position themselves in relation to controls so as to facilitate operation.	6. Provide seats which are adjustable from front to rear in addition to its present elevation adjustment mechanism.
7. Two Medium Tanks, M46, burned when overturned during test operation. See Appendix H, Correspondence, H-5.	7. Recommend a thorough investigation be conducted by the Ordnance Department with a view of eliminating the hazard of fire within these vehicles when overturned.
8. Sand shields are easily bent, become lost during operation, and are difficult to re-install after damage.	8. Provide a flexible non-metallic type sand shield less susceptible to damage.
9. The following principal deficiencies were noted in the CD 850-3 cross-drive transmission:	9. Principal deficiencies of the transmission be corrected by application of modifications as follows:

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a. Brakes:	a. Brakes:
(1) Failure of brake plates due to warping and shrinking.	(1) Provide improved brake plates.
(2) The brake apply strut ("cigar") between the bell crank and brake cam ring within transmission end cover became dislocated resulting in loss of brakes on one side of vehicle.	(2) A means be provided to insure that the brake apply strut cannot fall out of its proper position.
b. Steering differential failed frequently during test operation.	b. A more reliable type steering differential be provided, possibly of increased size and strength.
c. An excessive number of input shaft bearings failed during test.	c. A more reliable input shaft bearing be provided.
d. Oil seal rings, particularly converter, failed during test.	d. More effective seal rings be provided.
e. Oil pump gears and shafts failed.	e. Increase durability of oil pump gears and shafts.
10. During night operation, the out-board exhaust mufflers and pipes on test vehicles are visible for a distance of approximately 500 yards without vision aids.	10. Redesign and relocate the mufflers to eliminate visibility due to glowing pipes and mufflers during night operation. (See item 25.)
11. Service headlights are not provided with a means for adjusting the headlight beams.	11. Provide means for effecting headlight beam adjustment.

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12. Engine oil coolers frequently failed at the lower corners during test operation.	12. Pressure capacity of coolers should insure an adequate margin of safety.
13. Oil lines to crew compartment heater and from engine and transmission to coolers often split, resulting in loss of oil. If undetected, these leaks jeopardize the life of the power components.	13. A more reliable oil line be provided. Flexible metallic lines have been used with success under test conditions at this board.
14. Explosions occur in the engine crankcase which blows the oil filler cap and bayonet gauge out of the engine oil filler tube.	14. The cause of these explosions should be eliminated since crews are endangered while working over an operating engine in addition to the damage which results to the filler cap and oil gauge. Recommend an investigation be conducted to determine and eliminate the cause of these explosions.
15. Test vehicles emit a considerable amount of smoke from the exhaust when descending a steep grade. This smoke is also often noted during operation immediately after the vehicles have been halted suddenly. From a tactical standpoint this condition is considered a major deficiency. See Appendix F, Photographs, F-6.	15. Application of corrective modification to prevent described smoking is necessary.
16. The Medium Tank, M46, was found to be deficient in hill-climbing ability. Test vehicles halted due to lack of power on a slope of approximately 55 percent. No track slippage occurred.	16. Efforts be continued to improve gradeability of test vehicles. Recommend that final drive units providing increased gear reduction be considered to improve gradeability at the expense of top

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	speed performance. See Appendix H, Correspondence, H-3 and H-4.
17. Several failures of the parking brake lever shaft occurred on test vehicles.	17. A more durable parking brake lever shaft be provided.
18. Test vehicles are occasionally inadvertently steered and gear ranges changed due to application of force by driver in trying to steady his body movement while negotiating rough terrain.	18. Steering and shifting controls be replaced by a rigidly mounted steering device (a wheel is recommended) and fingertip shift lever similar to that of an automobile. This device would enable the driver to brace himself when negotiating rough terrain.
19. The moistureproof generators provided for test vehicles are not designed for operation under water. Their location is such that if 12 inches of water is present in the engine compartment, the main generators will become inoperative. The auxiliary generator is located approximately 4 inches higher and probably will also fail due to movement of water occasioned by vehicle motion.	19. Waterproof generators, if practical, be provided. In the event this is not feasible, the generators be relocated to enable this vehicle to meet its fording requirement of 42 inches without special kit.
20. Lubricant within all track support rollers on test vehicles was found to be water emulsified after fording operation.	20. The effectiveness of grease seals of the track support rollers and compensating idler wheels be improved to preclude entrance of water during fording operations.
21. Rotor coils within the magnetic clutch assembly of the Sawyer-Bailey oil cooling fans occasionally rotate between the magnetic poles. This rotation results in	21. A modification be devised to prevent rotation of rotor coil between magnets.

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an inoperative fan due to resultant electrical short circuit.	
22. Numerous failures of electrical sending units and switches occurred during test operation.	22. Reliable electrical sending units and switches be provided. Eliminate transmission filter pressure differential sending unit.
23. An excessive number of roadwheel bearings failed during test operation.	23. OG-Grease, O.D., all purpose, OG-00 was used during test in accordance with Detroit Arsenal instructions. Recommend further investigation be made to determine the suitability of this type grease for use at temperatures above 32° F.
24. Engine air cleaner housings became defective due to holes torn in the housing when small metal tabs were broken loose from the cleaner. See Appendix F, Photographs, F-27.	24. Recommend elimination of these metal tabs since they serve no useful purpose on cleaners for the Medium Tank, M46.
25. During operation in wooded or brush covered areas, broken twigs and leaves are ignited by the outboard muffler and present a fire hazard.	25. Redesign and relocate the mufflers to eliminate the hazard of igniting brush, leaves, or twigs by the outboard mufflers. (See item 10.)
26. Control linkages along floor of tank hull between driver's and engine compartments are susceptible to freezing during periods of intermittent freezing and thawing temperatures. The operation of the control linkages is also often hampered by accumulation of trash and formation of rust. Due to the inaccessibility of these linkages	26. Provide a waterproof sheath within which the control linkages may be enclosed throughout the length of the vehicle or rearrange linkages so as to get them off the floor of the tank hull where they are constantly exposed to accumulated water and trash within the hull.

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considerable difficulty is experienced in locating and eliminating the cause of these malfunctions.

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| 27. Considerable difficulty was experienced in locking the driver's and assistant driver's hatches in the closed position due to the failure of the locking plunger to seat properly in its boss upon actuation of the locking plunger lever. | 27. Modify present driver hatch locking device or replace with a locking device which will insure easy and secure locking of the driver's and assistant driver's hatches in the closed position. |
| 28. During operation, particularly when turning, the track noise of test vehicles was excessive. The movement of this vehicle may be detected on a still night at a distance of approximately 1000 yards. This track noise to a large extent nullifies the quietness of the power package during operation. | 28. Suggest experimentation be conducted using rubber mounted sprockets in an effort to reduce track noise. |
| 29. Engine and transmission mounts failed during test operation due to movement of the power package. This failure is believed due to excessive pressure applied to transmission by brake actuation, vibration of power package, and inherently poor design of mounts. | 29. Redesign mounts so as to improve durability. Rearrange transmission mounting bracket so as to provide an entirely enclosed bracket for transmission mount. |
| 30. Governor throttle levers broke during test operation. | 30. Replace with new type lever which provides greater durability. |
| 31. Brake linkages on early issue test vehicles were difficult to adjust. | 31. Install latest type brake linkages to facilitate adjustment. |
| 32. Air cleaners oil baths are extremely difficult to remove for servicing of the air cleaner due | 32. Provide additional clearance to facilitate the removal of the oil pan for servicing of the |

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to lack of clearance between the air cleaner and the floor of the turret.	air cleaner.
33. Transmission manual control levers were broken during operation.	33. Provide transmission control levers fabricated of a stronger material to increase durability.
34. Engine fan clutch bushing failed.	34. Provide a more reliable engine fan clutch bushing or assembly.
35. Spark plug wires on auxiliary engine were damaged inadvertently by mechanics who stepped on these wires during maintenance operation on the power package.	35. Extend the spark plug shield already provided on auxiliary engine to protect the spark plug wires.
36. Insufficient mileage was obtained on T84 rubber track. Tracks failed after from 200 to 500 miles of operation.	36. Equip vehicles with T80E1 steel track or with cold rubber T84 track.
37. During operation, battery electrolyte boiled. In some cases the batteries ruptured.	37. Provide batteries which will not boil and rupture, or provide a means for cooling present batteries.
38. The cruising range of the Medium Tank, M46, is insufficient. During test, cruising range on the highway was approximately 72 miles and on cross-country operation, approximately 50.	38. Provide increased capacity fuel tanks or greater fuel economy in power components.
39. Steering clutch ball bearing in transmission failed.	39. Install improved roller bearings.
40. Bolts and nuts loosened in the throttle linkage system, resulting in malfunctions.	40. Provide bolts and nuts which will not become loosened by vibration.

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41. Gas line quick disconnect units failed due to vibration, resulting in leaks.
42. For additional mechanical failures which occurred during test, see Appendix D, Mechanical Failures. The mechanical deficiency which contributed to or caused some failures was impossible to determine.

Suggested Modification

41. Provide a gas line quick disconnect unit constructed of a more durable metal which will eliminate wear as a result of vibration.
42. Recommend careful consideration of these failures be given by manufacturers and ordnance agencies in an effort to determine possible cause of failures and provide suitable corrective modifications.

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