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REPORT ON PROJECT B17.282 - TRUCK WRECKER 5 TON GS, M543, M816,(U)
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DEPARTMENT OF DEFENCE
DEFENCE SCIENCE AND TECHNOLOGY ORGANIZATION

ENGINEERING DEVELOPMENT ESTABLISHMENT

MARIBYRNONG, VICTORIA

REPORT
ON
PROJECT B17.282
TRUCK, WRECKER 5 TON GS, M543, M816
RECOVERY LIMITS

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16. ABSTRACT

Tests were conducted to establish the lift-tow capacity of the Wreckers 5 ton GS, with Winch, Diesel M816, Diesel M543A2 and Petrol M543. The Diamond Reo and Leyland Contractor tractors were used as towed vehicles, being the heaviest at present in the Army inventory.

Limitations on handling are discussed and recommendations are made. In addition a method is given whereby the maximum suspended towed load for each wrecker can be determined.

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ENGINEERING DEVELOPMENT ESTABLISHMENT

REPORT

ON

PROJECT B17.282

TRUCK WRECKER 5 TON GS M543, M816 -

RECOVERY LIMITS

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REPORT

ON

PROJECT B17.282

TRUCK, WRECKER, 5 TON GS: M543, M816-

RECOVERY LIMITS

FOREWORD

This report details the tests carried out to establish the lift-tow capacity of the Trucks, Wrecker, 5 ton GS, with Winch, Diesel M816, Diesel M543A2 and Petrol M543. Limitations on handling the Diamond Reo and Leyland Contractor tractors are discussed and recommendations are made.

In addition a method is given whereby the safe maximum suspended towed load for each wrecker can be determined.

Maribyrnong
24 Aug 77

(J.C. WISDOM)
Head,
Engineering Development Establishment

ENGINEERING DEVELOPMENT ESTABLISHMENT

REPORT

ON

PROJECT B17.282

TRUCK WRECKER 5 TON GS, M543, M816 -

RECOVERY LIMITS

INTRODUCTION

1. The objective of the project was to establish the lift-tow capacity of the Trucks Wrecker, 5 ton GS with Winch, Diesel M816, Diesel M543A2 and Petrol M543. The project originated because of uncertainty about the capacity of the wreckers to support in-service heavy vehicles. The tests were carried out in accordance with the Trials Directive TD106 BP (Annex A) at the Trials and Proving Wing (TPW) Monegeetta of the Engineering Development Establishment (EDE). Their report 106BP is attached as Annex B.

PROJECT ENGINEER

2. Mr R.M. Huntington, Vehicle Design Group, Mechanical Engineering Division, EDE.

AIM

3. The aim of the project was to:

   a. establish dimensional and axle load data for the purpose of correcting and updating the relevant EMEI; and

   b. conduct a non-destructive trial to determine the upper recovery limits of the M543, M816 and M543A2 in relation to a suspended tow of the Diamond Reo and Leyland Contractor heavy vehicles.

METHOD

4. The Truck Tractor GS for Semi-trailer Cargo 18 Tonne (Diamond Reo) and Truck Tractor GS with Winch for Semi-trailer Lowbed 32/55 Tonne (Leyland Contractor) were selected as the towed vehicles, being the heaviest at present in the Army inventory.

5. The second-class road running was carried out over the TPW circuit which is considered representative of relatively severe conditions, incorporating normal gradients up to 1 in 6 and sharp corners, one in particular having a radius of 25 m on an adverse camber, together with an uphill gradient of 1 in 8.

6. As the limitation on towing is directly related to driver control of the combination the conclusions are of necessity based largely on the subjective assessment of experienced drivers and trials officers.

CONCLUSIONS

7. The conclusions drawn from the results of these tests are summarized in the following paragraphs.

8. Only drivers experienced in suspended towing with M816 or M543 should operate the combinations tested. Even the M816 - Diamond Reo on rear suspended tow, which is the most controllable combination, is inferior in steering control to any other vehicle or combination in use by Army.

9. For the type of pick up used (see Annex B) the M816 is capable of suspended towing of the Diamond Reo, front and rear, and the Leyland Contractor, front, provided due care is taken. On sealed roads with good even surfaces 'weave' developed in all the combinations at speeds in excess of 38 km/h and where the surface was uneven or undulating. 'Weave' and front axle bounce occurred at speeds exceeding 32 km/h.

10. On second class roads a gradient of 1 in 5 could be negotiated from a direct approach. Cornering was marginal towing the Leyland Contractor and on the corner described in para 5 steering control was on one occasion reduced so that the combination had to be backed up for a further attempt. The recommended maximum safe speed on second class roads is 32 km/h.

11. The M543A2 and M543 were both similar in performance, the former being marginally the better of the two. Both vehicles were significantly worse than the M816 due to the lower front axle load. Because of the poor steering performance they are satisfactory only for suspended towing of the Diamond Reo on rear lift. The speed limitation for this combination is the same as for the M816, para 9 and 10.

12. Suspended towing of the Diamond Reo and Leyland Contractor is not recommended except in an emergency. The TPW second class circuit was negotiated without mishap, albeit with some difficulty, for these two combinations.

13. The Leyland Contractor cannot be suspended towed on a rear lift as apart from the difficulty of coupling up, calculations show that the wrecker front axle would be completely unloaded.

14. As neither the Diamond Reo nor Leyland Contractor are off-road vehicles, only limited cross-country tests were carried out with the former vehicle on rear suspended tow. It can be concluded that any of the combinations could negotiate relatively dry cross-country terrain within the limitations of gradient and turning radius applicable to the second-class road operation.

15. As the wrecker CES contributes very little to the front axle load the suspended towing ability is virtually unaffected when the CES is reduced or eliminated. This was confirmed by a limited test.

16. Some secondary aspects arising from these tests are:

a. The strength of the towbar tube and the chain attachment are inadequate and constitute a safety hazard. This confirms the previous opinion of EDE based on our own experience and discussion with other users.

b. The inter-vehicle brake hose is not suitable for coupling to the Diamond Reo and Leyland Contractor. Although there was no evidence of braking problems under the test conditions, it is recommended that this deficiency be rectified.

c. The Holmes steering lock would seem to be a useful addition to the wrecker CES.

d. The wrecker bogie load exceeds the NAASRA recommendations for non-permit axle loads. This problem is common to commercial heavy recovery operations and the normal practice is for the State authorities to issue a 'tow truck permit' where appropriate.

RECOMMENDATIONS

17. All the previous conclusions are directly related to suspended towing of the Diamond Reo and Leyland Contractor. But it is possible to reach a more general quantitative conclusion based on the front axle load of the wreckers, enabling the lift-tow capacity to be established for other suspended towed loads and types of hook up.

18. The front axle load by static measurement of the M816, M543A2 and M543 when suspended towing a casualty is limited as follows:

a. For general use the front axle load should exceed 2500 kg for a casualty GVM up to 10 tonnes. For casualties in excess of 10 tonnes the minimum front axle load of 2500 kg should be increased by 20 kg for every 1 tonne by which the casualty exceeds a GVM of 10 tonnes.

b. Provided the terrain to be negotiated does not include steep grades and sharp corners the front axle load may be reduced to 1770 kg. At this load steering control is marginal and due care must be exercised. For reasons of safety it is not recommended for use in hilly terrain as on uphill corners steering control may be lost and the corner may not be negotiated.

c. Due to poor steering control a front axle loading of less than 1770 kg is not recommended.

19. It is of interest to note that these recommendations, together with the recommended suspended towing limit for the twin boom wrecker are consistent with the statement made on the Holmes operating instructions, EMEI VEHICLE D 376:

'The towing limit of a completed wrecker is governed by the amount of weight remaining on the wrecker front wheels while towing a vehicle. It must be at least one half the weight that was on the wrecker front wheels before lifting the vehicle in tow. That is the minimum front end weight required for safe steering.'

This section entitled 'How to determine the towing limit of your wrecker' continues with a method of calculating the maximum suspended load for a particular wrecker.

20. There are certain terrain conditions where the current wreckers cannot be recommended for use in recovering some vehicles. Since there is no suggestion in Annex B that the vehicles being recovered overload the wrecker bogie, the problem to be resolved is the poor steering control. One possible solution would be to provide a second vehicle, not necessarily a wrecker, and double head the combination. This would provide better steering control by reducing the traction required from the wrecker and would provide a positive steering restraint should steering control be lost. It would not significantly degrade the manoeuvrability once the rig is on the road. Such a configuration would need to be thoroughly tested before it could be recommended.

ANNEX A TO
EDE 15/77

COPY OF TRIAL DIRECTIVE

TD106 BP

TRUCK WRECKER 5 TON GS M543 AND M816

RECOVERY LIMITS

COPY

ENGINEERING DEVELOPMENT ESTABLISHMENT

ENGINEERING FACILITIES DIVISION

TRIAL DIRECTIVE

TD 106BP
Issue 1
Job No V17.282/3

PROJECT TRUCK WRECKER 5 TON GS M543 AND M816 - RECOVERY LIMITS

Security Classification

Existence of Trial: Unclassified
Trial Results: Unclassified
Other: Unclassified

PERSONNEL

Project: F. Stevens Tel: 173
Trials: D. Ayers Tel: 334
Liaison Tel:

EQUIPMENT FOR TRIAL

1. Truck Wrecker 5 Ton GS with Winch Diesel M816, Census Code 6285 (M816)
2. Truck Wrecker 5 Ton GS with Winch Diesel M543A2, Census Code 6285 (M543A2)
3. Truck Wrecker 5 Ton GS with Winch Petrol M543, Census Code 6286 (M543)

SUPPORT EQUIPMENT

1. Truck Tractor GS for Semi Trailer Cargo 18 Tonne, Census Code 6845 (Diamond Reo)
2. Truck Tractor GS with Winch for Semi Trailer Lowbed 32/55 Tonne, Census Code 6815 (Leyland Contractor)

TRIAL REQUIREMENT

Conduct dimension check and establish recovery limits of the equipment for trial as detailed in Trial Instructions attached at Annex A.

RELATED INFORMATION

TARGET DATE 28 May 76

EQPT LOCATION/DISPOSAL TPW/EDE

TRIAL REPORT TO TG Type: Final Copies: 4 By (Date): 11 Jun 76

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(Sgd) J. ATKINSON

Engineer in Charge
Trials Group

Date: 26 MAR 1976

TRIAL INSTRUCTIONS

References: A. EMEI Vehicles D360 - Truck Wrecker 5 Ton GS with Winch M816: Data Summary Issue 1

B. EMEI Vehicles D350 - Truck Wrecker 5 Ton GS M543: Data Summary Issue 2

INTRODUCTION

1. The capacity of the M816, M543 and M543A2 wreckers to support the current Army heavy vehicles on suspended tow is not accurately known.

AIM

2. The aim of this trial is to:

a. establish dimensional and axle load data for the purpose of correcting and updating the relevant EMEIs; and

b. conduct a non-destructive trial to determine the upper recovery limits of the M543, M816 and M543A2 in relation to a suspended tow of the Diamond Reo and Leyland Contractor heavy vehicles.

GENERAL

3. Select either the M816 or M543A2 to carry out the trial. If the dimensions and weights of the remaining two wreckers are not significantly different from the trial vehicle then actual suspended towing trials of the other two may not be necessary. If the differences are considered significant then some restricted trials may be required. The Trial Engineer will advise.

4. Throughout the trial all vehicles, including those on suspended tow, are to be equipped with their CES complete and correctly stowed. The wreckers are to carry a passenger or equivalent weight. Vehicles on suspended tow are not to have either driver or passenger.

5. Before attempting any towing of either the Diamond Reo or Leyland Contractor the propellor shaft between the transmission and operating differential must be disconnected.

PROCEDURE

Dimensions

6. Determine the following dimensions for:

a. Leyland Contractor and Diamond Reo:

(1) Axle spacing.

(2) Rear axle to most suitable rear lift point.

(3) Front axle to most suitable front lift point.

(4) Position of centre of gravity (C of G).

(5) Height of rear lift point above ground.

(6) Height of front lift point above ground.

b. M543, M543A2 and M816:

(1) Axle spacing.

(2) Rear axle to towing pintle.

(3) Rear axle to crane hook (horizontal distance), when the lines are in the vertical position. This is to be measured with the boom fully retracted and the stabilizer legs in each position in turn.

(4) Pitch of the holes in the stabilizer legs.

(5) With the hook hanging free, the horizontal distance between the vertical centre line of the hook and a line drawn vertically down from the extremity of the boom. This is to be done with the stabilizer legs in the lowest position.

(6) Height above the ground of the towing pintle.

Axle Loads

7. Measure the axle loads of all vehicles solo and fully stowed as outlined in 4.

8. From the axle loadings obtained, and assuming a suitable casualty distance from the wrecker, calculations are to be made to eliminate any configurations where it is obvious that the maximum permissible load for the wrecker rear bogie will be exceeded.

Lifting

9. Acceptable configurations are to be subjected to a lifting trial with the wrecker boom fully retracted, at maximum practical luff position, and supported by the stabilizer legs. In this attitude the load lines should be vertical or falling slightly away from the wrecker at the bottom.

10. Spacing between the vehicles will be a matter of judgement, but should be as close as possible, with the proviso that the wrecker be able to complete a full-lock circle without fouling.

11. With the casualty on suspended tow measure the following:

a. Wrecker bogie load.

b. Wrecker front axle load.

c. Maximum and minimum heights that the casualty has to be lifted (depending on the angle of the spreader bar, terrain to be crossed and safety aspects) at two locations:

(1) the leading wheels, and

(2) the lift point.

d. Distance between the rear axle of the wrecker and the lift point of the casualty.

12. The spreader bar supplied with the M543 is in question and comments are required on its suitability. If it is considered unsatisfactory for trials it may be necessary to construct or borrow a more suitable spreader bar.

Towing

13. When the Trials Officer is satisfied with the safety of the towing configuration, 200 km running on First Class Roadway is to be carried out.

14. If the running in 13 is successful then 100 km of running on Second Class Roadway is to be attempted. During this running the performance on gradients is to be established.

15. If running on the Second Class Roadway is successful, then, at the discretion of the Trials Officer, some Cross-Country running may be attempted, provided the maximum permissible cross-country loading of the wrecker rear bogie is not exceeded. A description of the terrain, and distance travelled, is to be included in the report.

16. Should running on First or Second Class Roadway be unsuccessful, the Trials Engineer will advise on any further trial work.

REPORTING

17. The recovery limits will be largely subjective, but particular attention is to be paid to steering, braking, and general stability, which are to be given detailed comment.

18. All reporting is to be given in SI units. Where measurements are taken in Imperial units these, along with the conversion factors used, are to be quoted.

19. Still monochrome photographs are required of:

a. all towing configurations, showing identification of the vehicles involved;

b. defects; and

c. incidents.

ANNEX B TO
EDE 15/77

COPY OF TRIALS AND PROVING WING

REPORT No 106BP

COPY

FILE No. 2320-Y10-7

MINUTE

Folio .....

To.....ME(V).....

Subject.Trucks, Wrecker, 5 Ton GS, M543 and M816.....

References: A. ME(V) Work Request 42/76

B. TD106 BP

1. Herewith one copy of TPW Report 106 BP on the determination of the upper recovery limits of the subject vehicle.

2. The following additional comments are made to certain paragraphs of the Report:

a. Paragraph 18. The steering lock from the CES of the Wrecker 5 Ton GS with Twin Boom, Mechanical (Census Code No 6284) consists of a length of webbing, with tensioning buckle and hooks, and is used to keep a casualty's steering wheel from turning when it is on rear suspended tow. It is recommended that this piece of equipment be added to the CES of all types of Wreckers.

b. Paragraph 34. The slight advantage of the M543A2 over the M543 is the heavier front axle load. It also has more engine torque available.

c. Paragraph 35. The dangers inherent in those extreme conditions of loading are such that the need for skilled recovery crews must be emphasised.

(Sgd) R. LUMSDEN

18 Mar 76

for Engineer in Charge
Trials Group

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ENGINEERING DEVELOPMENT ESTABLISHMENT

TRIALS AND PROVING WING, MONEGEETTA

REPORT No 106BP

TRUCKS WRECKER 5 TON GS M543 AND M816 - RECOVERY LIMITS

References: A. Trial Directive 106BP
B. Job No V17.282/3
C. EDE File No 2320-Y10-7

INTRODUCTION

1. As the recovery capabilities of the Trucks Wrecker 5 Ton GS M543 and M816 (wreckers) were not accurately known, Trials and Proving Wing Monegeetta (TPW) was tasked with their testing in conjunction with the current Army heavy vehicles on front and rear suspended tow.

AIM

2. a. To establish dimensional and axle load data for the purpose of confirming or correcting the relevant EMEI's; and

b. conduct a non-destructive trial to determine the upper recovery limits of the wreckers in relation to suspended towing of typical casualties.

EQUIPMENT FOR TRIAL

3. a. Truck Wrecker 5 Ton GS with winch Diesel M816, Census Code 6285 (M816);

b. Truck Wrecker 5 Ton GS with winch Diesel M543 A2, Census Code 6285 (M543 A2); and

c. Truck Wrecker 5 Ton GS with winch Petrol M543, Census Code 6286 (M543).

SUPPORT EQUIPMENT

4. a. Truck Tractor GS for Semi Trailer Cargo 18 Tonne, Census Code 6485 (Diamond Reo); and

b. Truck Tractor GS with winch for Semi Trailer Lowbed 32/55 Tonne Census Code 6815 (Leyland Contractor).

TRIALS SUBJECTS

5. Pre trial inspection proved the standard clamp attaching chains of the Bar, Two Vehicle (tow bar) provided with the wreckers to be of insufficient length to be fastened around the rear axle housing of the Diamond Reo, and these were replaced with longer chains.

6. The tow bar clamps were modified by removing the chain retaining hooks, which tend to straighten under load, and providing two tapped holes to enable each chain to be retained by studs and washers fitted directly through the links, as agreed with the Project Engineer.

7. Deficiencies in the CES of the M816 were made up with ballast of filled sand bags.

8. No rear suspended towing of the Leyland Contractor was undertaken with any of the wreckers as the position of the rear brake actuator rods and the torsion bar anchor brackets precluded attachment of the tow bar.

9. Repeated failures of the sliding leg in the tow bar, when extended, necessitated a modification as detailed in Section 1b of Annex B.

10. As the differences in the dimensions and axle loads of the M543 A2 and the M543 were insignificant, only limited trials were carried out with the M543.

11. For determination of axle loads, and for the limited towing trials, the M543 which was not equipped with CES was ballasted with ammunition boxes filled with screenings.

12. As all wrecker bogie loads with vehicles on suspended tow exceeded the limit of the TPW weighbridge, these loads have been estimated (Annex A).

13. During the trials, no inter-vehicle braking between the wreckers and the vehicles on suspended tow (combinations) was possible. The Diamond Reo has no provision for connection of brake hoses, and the coupling on the Leyland Contractor is designed as an output air line, not an intake line.

14. As the Diamond Reo rear brakes lock on when brake line air pressure is insufficient, the adjustments to the brake actuators located at the rear of the rear axle were 'backed off' before moving this vehicle on suspended tow.

15. Due to the safety of the combinations being unknown, the requirement of para 13 of Ref A was altered by carrying out the second class running before any first class running on public roads.

16. Additional to the requirement of para 4 of Ref A, the front axle load of the unstowed M543 in combination with the Leyland Contractor was recorded, and limited trials were conducted in this condition.

17. Only limited cross country running with one combination, the M543 A2 with the Diamond Reo on rear suspended tow, was carried out.

18. For all rear suspended towing the steering lock from the CES of the Wrecker 5 Ton GS Twin Boom F4 was used to maintain directional control of the towed vehicle.

EXECUTION

19. Second class running was carried out on the TPW circuit.

20. Most of the first class running was carried out on the Lancefield-Bulla road, with limited running on the Sunbury-Gisborne-Monegeetta roads because of their steeper gradients.

21. Limited cross country trials were conducted on the TPW course.

22. Except for deviations stated in paragraphs 15 and 16, the trials were conducted according to Ref A.

23. Axle loads were determined in Imperial units and converted to SI units using the factor of 2.2 lb to 1 kg.

24. Trials were conducted during the period 26 Mar 76 to 28 Jul 76. Further centre of gravity checks were made on 19 Aug 76.

25. The TPW representative attached to the trial was Mr F.K. O'Sullivan.

RESULTS

26. Dimensional and axle load data is shown at Annex A to this report.

27. Details of each combination and photographs are recorded as sections at Annex B to this report as follows:

a. Sections 1, 1a, and 1b cover the second class running of the Wrecker M816 in conjunction with the Diamond Reo on both rear and front suspended tow, and the Leyland Contractor on front suspended tow,

b. Section 2 is in condensed form and covers the second class running of the wrecker M543 A2 with both support vehicles. Details of the limited cross country running of this wrecker with the Diamond Reo on rear suspended tow are given as Section 2a,

c. Section 3 covers the first class running of both the M816 and M543 A2 with the support vehicles,

d. Section 4 covers the limited trials conducted with the unstowed M543 in combination with the Leyland Contractor.

28. Due to the reduced front axle loading of the wreckers in each combination, the possibility arose of the wrecker's front wheels either leaving the surface on steep gradients or side slipping on tight corners. To lessen this possibility, first gear in low range was selected before entering a gradient or corner. Sudden acceleration was also avoided.

COMMENTS

29. As the tow bar has proved defective during all suspended towing trials, some consideration should be given to providing a more robust type, compatible with all vehicles.

30. Use of the tow bar clamps and chains could be eliminated by having all vehicles fitted with brackets, in the appropriate positions, to accept the pins of the tow bar swivel ends.

31. Because of the CES deficiencies, a full CES stocktake was carried out and items from another CES were weighed to ascertain the ballast needed. (see paragraph 7).

32. As the bogie axle loads of the wreckers in any combination exceed the road limits as set down by Vehicle Limits - NAASRA,* a permit is necessary from the appropriate authority before travelling with a combination on a public road in any State.

* National Association of Australian State Road Authorities.

SUMMARY

33. The trials results and drivers' opinions show that the M816 was the most suitable wrecker in all combinations.

34. The M543 A2 and M543 were comparable in many aspects, but the M543 A2 had a slight advantage. It was considered the better of the two vehicles for suspended towing.

35. Only fully qualified and experienced operators should be in control of any combination.

CONCLUSION

36. The M816 is the most suitable of the three wreckers for suspended towing of the Diamond Reo and Leyland Contractor. Care must be exercised with the Leyland Contractor on front suspended tow in controlling speed at corners and in general towing.

37. The M543 A2 and M543 both have a limited recovery capacity due to their lighter front axle loads, and are considered suitable for rear suspended towing only of the Diamond Reo.

38. It is recommended that rear suspended towing of the Leyland Contractor be not done with any of the wreckers due to its excessive bogie load.

29 Sep 76

(Sgd) W.L. FOWLES
Maj
OC TPW

Annexes: A. Axle Loads and Vehicle Dimensions.

B. Detailed Results.

AXLE LOADS

Vehicle Configuration	Front Axle	Bogie	Gross Vehicle
SOLO			
M816	5078 kg	11938 kg	17016 kg
M543 A2	4233 kg	11607 kg	15840 kg
M543	4175 kg	11620 kg	15795 kg
Diamond Reo	4365 kg	3844 kg	8209 kg
Leyland Contractor	5816 kg	7547 kg	13363 kg
VEHICLE COMBINATION		(Estimated)	
M816/Diamond Reo - rear suspended	2660 kg	17436 kg	
M816/Diamond Reo - front suspended	2463 kg	17805 kg	
M816/Leyland Contractor - front suspended	2329 kg	19282 kg	
M543 A2/Diamond Reo - front suspended	1712 kg	17565 kg	
M543 A2/Diamond Reo - rear suspended	1769 kg	17087 kg	
M543 A2/Leyland Contractor - front suspended	1655 kg	18710 kg	
M543/Diamond Reo - rear suspended	1769 kg	17029 kg	
M543/Diamond Reo - front suspended	1655 kg	17484 kg	
M543/Leyland Contractor - front suspended	1578 kg	18696 kg	
M543 Unladen/Leyland Contractor - front suspended	1534 kg	17626 kg	

DIMENSIONS

Specification	Leyland Contractor (mm)	Diamond Reo (mm)	M816 (mm)	M543 A2 (mm)	M543 (mm)
1. Front axle to intermediate axle	3695	2948	3870	3880	3875
2. Intermediate axle to rear axle	1480	1300	1370	1375	1370
3. Rear axle to rear lift point	N/A	280			
4. Front axle to front lift point	1520	1150			
5. Centre of Gravity					
a. height	958	890			
b. distance from front axle	2645	1670			
6. Height of rear lift point above ground	N/A	835			
7. Height of front lift point above ground	700	460			
8. Rear axle to towing pintle			1200	1210	1215
9. Rear axle to crane hook.					
Hole position of shipper braces No 1			2100	2095	2111
No 2			2045	2038	2057
No 3			1973	1959	1984
No 4			1873	1873	1886
10. Pitch of holes in shipper braces			210	210	210
11. Distance from crane hook to end of boom			182	190	180
12. Height above ground of towing pintle			760	735	745

DIMENSIONS

Specification	M816		M543 A2	
	Diamond Reo (mm)	Leyland Contractor (mm)	Diamond Reo (mm)	Leyland Contractor (mm)
13. Height above ground of:				
a. Leading wheels rear suspended 1st and 2nd class	160	-	160	-
" " " " cross country	-	-	290	-
b. Lift point 1st and 2nd class	1115	-	1115	-
" " cross country	-	-	1310	-
c. Leading wheels, front suspended	290	290	290	290
d. Lift point	1030	1250	1030	1250
14. Distance between rear axle of wreckers to lift point				
a. Rear suspended	2510	-	2520	-
b. Front suspended	2600	1900	2610	1910

ANNEX B TO
REPORT No 106BP

SECTION 1. Wrecker M816/Diamond Reo. Rear Suspended Tow. Second Class Roads.

Procedure

1. The chains of the tow bar clamps were positioned around the rear axle housing on each side of, and adjacent to, the rear differential of the Diamond Reo.

2. To obtain a lift as close as possible to the rear of the Diamond Reo, the lifting chains were attached around the chassis side rails immediately forward of the rear crossmember.

3. The tow bar and wrecker shipper braces were not extended, but the boom was extended approximately 380 mm to give a perpendicular lift. Refer photograph No 1 (page B2).

4. The M816 axle loads in combination were:

Front axle	2660 kg
Bogie	17436 kg

Towing

5. Using the driving technique described in para 32, a gradient of 20% was negotiated from a direct approach and, although the steering was light, no directional control was lost.

6. A 90^{o} turn of small radius could be negotiated satisfactorily without front wheel side slip being induced.

7. Braking was satisfactory, with no instability during near emergency application on level surfaces. Normal application was required to halt the combination on gradients.

8. The combination was stable and handled satisfactorily on other sections of the course. 32 km/h is considered the maximum safe speed on second class roadway.

1. M816 with Diamond Reo rear suspended.

SECTION 1a. Wrecker M816/Diamond Reo. Front Suspended Tow. Second Class Roads.

Procedure

1. After removing the clamps and chains from the tow bar, and the front towing shackles from the Diamond Reo, the tow bar was fitted directly to the towing shackle brackets. Refer photograph No 1 (page B3).

2. The lifting chains were passed around the front axle between the springs and wheels.

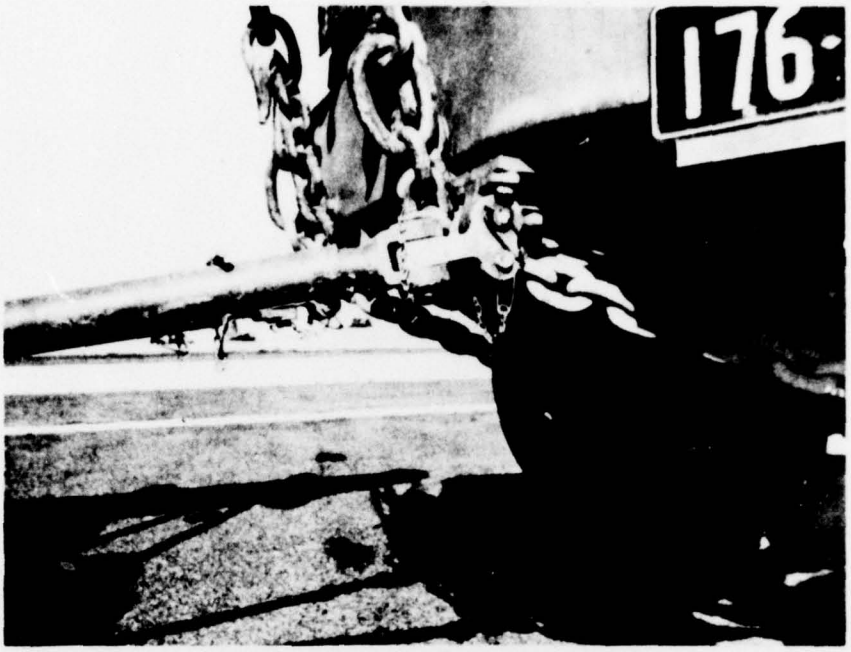
3. The tow bar and shipper braces were not extended, but the boom was extended approximately 150 mm. Further extension of the boom is not recommended as it would reduce the safe clearance between the lifting equipment and the front of the Diamond Reo. Refer photograph No 2 (page B3).

4. The M816 axle loads for this combination were:

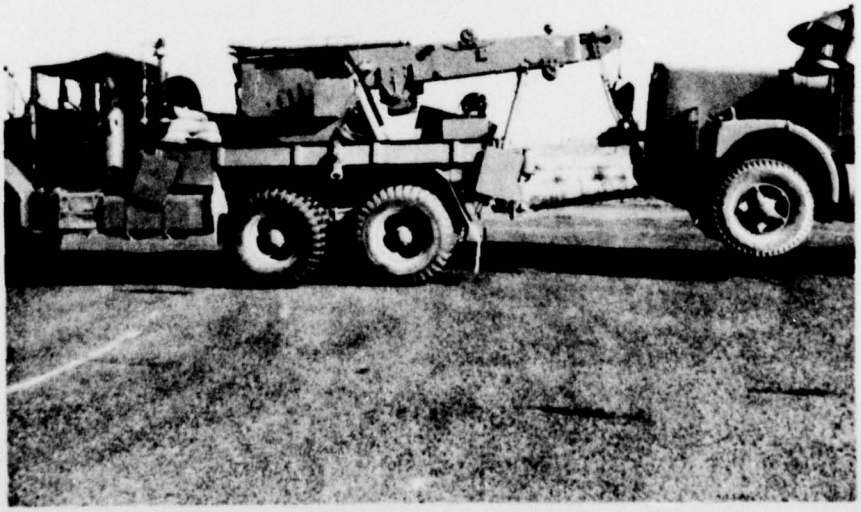
Front axle	2463 kg
Bogie	17805 kg

Towing

5. Although the M816 front axle load was less in this condition than with the Diamond Reo on rear suspended tow, the braking was satisfactory and the steering characteristics were similar on the same gradients and turns. 32 km/h is again considered the maximum safe speed.



1. Tow bar attached to front of Diamond Reo.



2. M816 with Diamond Reo front suspended.

SECTION 1b. Wrecker M816/Leyland Contractor. Front Suspended Tow. Second Class Roads.

Procedure

1. The tow bar clamp chains were positioned around the front axle adjacent to the spring seats, between the springs and the wheels of the Leyland Contractor.

2. The lifting chains were attached around the front axle between the tow bar clamps and the wheels.

3. With the tow bar fully extended and the shipper braces extended to the second hole, a perpendicular lift was obtained with the boom fully retracted. Refer photograph No 1 (page B6).

4. The M816 axle loads for this combination were:

Front axle	2329 kg
Bogie (estimated)	19282 kg

Towing

5. After 24 km of running the tow bar failed. A replacement tow bar also failed after 2 km of towing. Refer photographs No 1 and 2 (page B6).

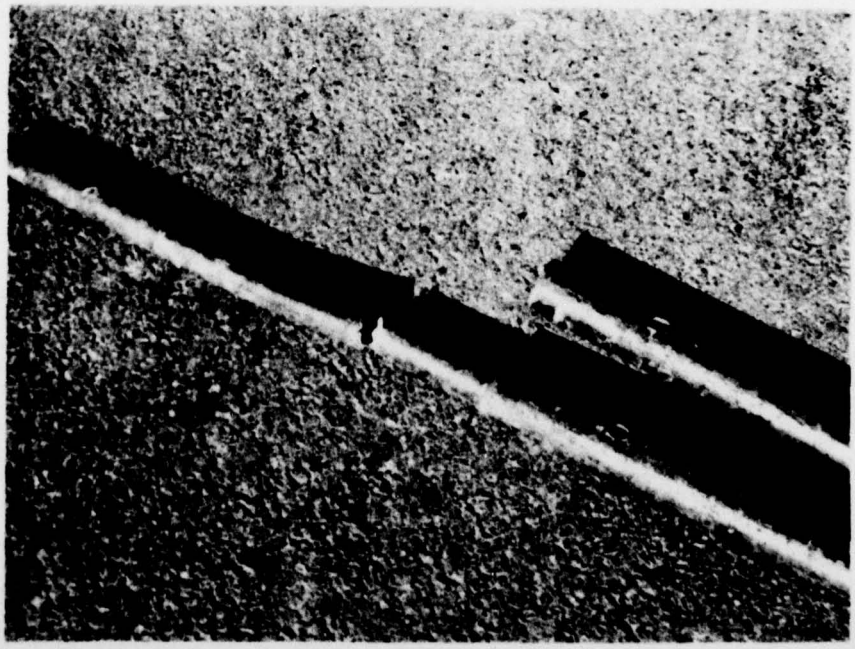
6. Towing trials were postponed until a modification was made by fabricating boxed sections which fitted around the original external tow bar legs. Refer photograph No 3 (page B7).

7. After resuming towing, a 20% gradient was negotiated from a direct approach. Although the steering was light, there was no evidence of loss of control.

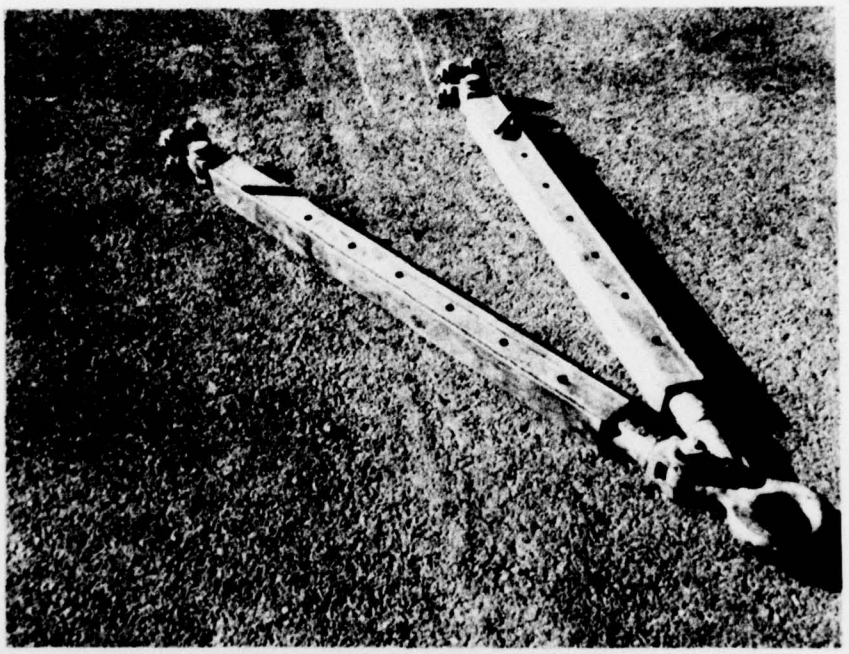
8. In a 90^{o} turn of small radius, steering control was marginal with front wheel side slip evident. On one occasion the combination was backed up and another approach made before the turn was negotiated.

9. The braking and handling were satisfactory. 32 km/h is considered the maximum safe speed.

1. M816 with Leyland Contractor front suspended. Tow bar failure also shown.



2. Close up of tow bar failure.



3. Modified tow bar.

SECTION 2. Wrecker M543 A2/A11 Combinations. Second Class Roads.

Procedure

1. This section pertains to the M543 A2 with the Diamond Reo on both rear and front suspended tow, and the Leyland Contractor on front suspended tow. To eliminate repeating procedures and other aspects, it is condensed to give a comparison with the previous sections dealing with the M816.

2. The attaching and lifting procedures for each combination were identical to those detailed in the previous sections.

3. The wrecker axle loads for each combination were:

a. M543 A2/Diamond Reo Rear Suspended Tow

Front axle	1769 kg
Bogie (estimated)	17087 kg

b. M543 A2/Diamond Reo Front Suspended Tow

Front axle	1712 kg
Bogie (estimated)	17565 kg

c. M543 A2/Leyland Contractor Front Suspended Tow

Front axle	1655 kg
Bogie (estimated)	18710 kg

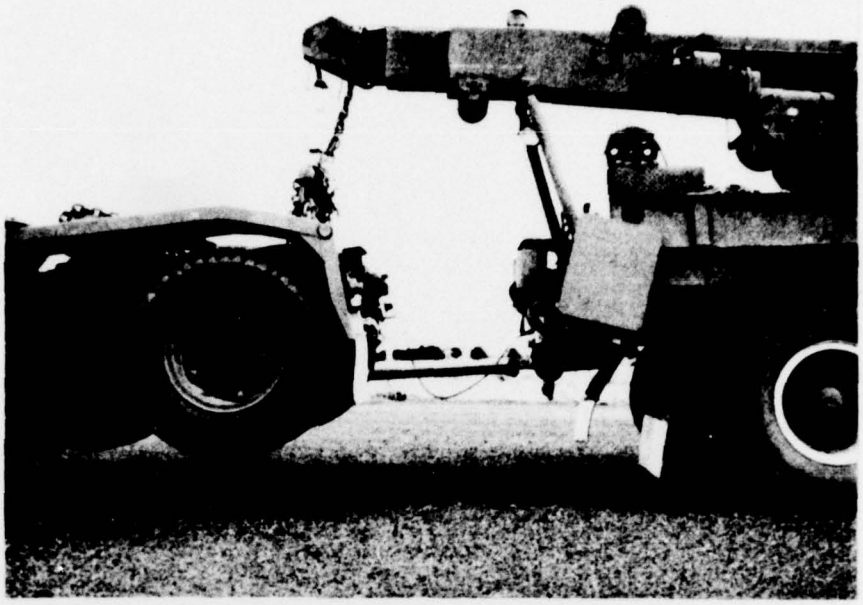
Towing

4. The gradient performance, braking and stability of each combination was satisfactory.

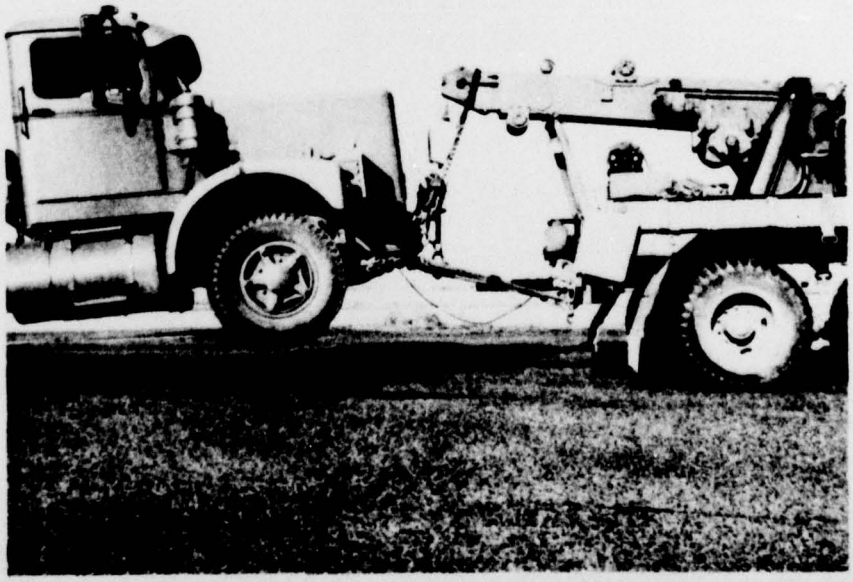
5. As the front axle load of the M543 A2 with each combination was lighter than the M816 front axle load for the similar combination, the limited steering characteristics on tight corners was more apparent.

6. With the Diamond Reo or the Leyland Contractor on front suspended tow, tight corners could not be negotiated without making two or more attempts by reversing the combination and making another approach.

7. 32 km/h is considered the maximum safe speed for each combination.



1. M543 A2 with Diamond Reo rear suspended.



2. M543 A2 with Diamond Reo front suspended.

3. M543 A2 with Leyland Contractor front suspended.

SECTION 2a. M543 A2/Diamond Reo. Rear Suspended Tow. Cross Country.

Procedure

1. The lifting chains and tow bar were attached at the same point, and the boom extended as described in Section 1.

2. The wrecker shipper braces were extended to the second holes, and the lifting hook lowered to give 290 mm of ground clearance for the intermediate wheels of the Diamond Reo.

Towing

3. 32 km of towing was completed over a cross section of the course which included one gradient of 17.5% with a side slope of 27%. Sections of the course were wet, but not slippery, and the combination was under control at all times. Speeds up to 8 km/h were recorded.

SECTION 3. Wreckers M816 and M543 A2/A11 Combinations. First Class Roads.

1. Speeds up to 48 km/h were attained but these were in excess of safety limits. The light steering condition gave rise to the combinations developing 'weave' and, on uneven sections which caused bounce, the front wheels of the wreckers had a tendency to leave the road surface.

2. At 32 km/h on uneven sections, and up to 38 km/h on smooth sections, these symptoms were not evident. Handling and braking were satisfactory.

3. When negotiating tight corners in the rear suspended tow combination, the steering control of both wreckers was satisfactory. The M816 was satisfactory with both front suspended tow combinations.

4. Steering control of the M543 A2 with the Diamond Reo on front suspended tow was poor, and unresponsive with the Leyland Contractor similarly suspended.

SECTION 4. Wrecker M543/Leyland Contractor. Front Suspended Tow. Second Class Roads.

1. Using identical attaching and lifting procedures as detailed in previous sections for the Leyland Contractor, 10 km of second class running was completed.

2. The ballast was then removed from the wrecker, axle loads were determined, and a further 10 km of running was carried out.

3. The M543 axle loads were as follows:

a. With Ballast

Front axle	1578 kg
Bogie (estimated)	18696 kg

b. Without Ballast

Front axle	1534 kg
Bogie (estimated)	17626 kg

4. As the wrecker front axle loads were almost equal in each condition, no difference in the general handling characteristics was evidenced.

5. The 20% gradient was negotiated although the steering was light.

6. Due to loss of steering control, 90° turns of small radius could not be negotiated unless the combination was reversed and two or more approaches made.

7. In an attempt to negotiate tight turns at the lowest speed possible, it was noted that the petrol engine could not maintain power at low engine rpm as could the diesel. This necessitated higher approach speeds, adding to the steering problem.

8. 32 km/h is considered the maximum safe speed.