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Test on an air-cushion assisted trailer ACAT-1: introduction & test program

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FIG. _____
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POUR

REFERENCE Discussion with Dr. D.C. MacPhail
RÉFÉRENCE _____

LTR-ENG-35

**TEST ON AN AIR-CUSHION ASSISTED
TRAILER ACAT-1
INTRODUCTION & TEST
PROGRAM**

SUBMITTED BY E.P. Cockshutt
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SUMMARY

The Air Cushion Assisted Trailer [ACAT-1] is described, its relevant specifications set out, and the NRC test program laid down.

1. INTRODUCTION

The ACAT-1 was built to a Dept. of Environment (Logging Section, Forestry Division) specification, by Gaymor Trailers Ltd., with an air cushion load relief system subcontracted by Jones Kirwan & Associates (now HoverJak Ltd.) under a PAIT contract.

After completion of the vehicle, and some trials by HoverJak Ltd., NRC, (DME), Engine Laboratory has undertaken to pursue the attached test program to assess the performance of the vehicle under various conditions. It is then intended in a separate program to carry out field trials in an actual logging industry situation.

This Lab. Test Report forms the first of a series of test notes, to be issued with all possible speed to those concerned with the vehicle's development. A formal report will be issued at the conclusion of the NRC experimental program.

2. SPECIFICATION

The specification of the vehicle is quoted from the original PAIT document;—

"Technical Objectives of Proposed "Air Cushion Assist""

(a) Function:

- (1) To lighten the load on wheels by an amount equivalent to one-half the payload;
- (2) To allow summer hauling of forest products in areas of the boreal forest where, even though a road is built, it lacks a substantial base for heavy duty hauling, except when in a frozen condition; and
- (3) To allow full trailer loads to be hauled on low standard roads out to main haul roads, when such low standard roads are below normal standards for timber hauling due to lack of gravel or due to climatic conditions.

Technical Objective [original PAIT document since altered where marked (X)]

The air cushion assist on the logging trailer will reduce the load on the supporting wheels by one-half or more and will distribute the weight on an air cushion with extremely low pressure (approximately 2 psi).

Technical Specifications of Trailer

- (1) Standard 8 ft logging semi-trailer - 35 ton payload - rated capacity;
- (2) Overall length - 40 ft; (X)
- (3) Overall Width - 8'6";
- (4) End racks - 8' high;
- (5) Main rails - 14" I-Beam construction;
- (6) Suspension - "Neway" 44,000 lbs. tandem with springs;
- (7) Axles - 22,000 lb. capacity;
- (8) Tires - 11:00 x 20 x 12 ply - 8 only;
- (9) Ring gear type of fifth wheel for attaching to tractor;
- (10) Rims - demountable type;
- (11) Brakes - air actuated from tractor - 12 1/4" x 5 1/2" x 3/4";
- (12) Lighting system - as per provincial regulations; and
- (13) Weight of semi-trailer - 14,000 lbs.

Technical Specifications of Air Cushion Assist

- (1) Engine - Ford Industrial 429 cu. in. rated at 320 h.p. (S.A.E.) at 4,000 r.p.m.; [Approx. 140 h.p. Continuous Limit]
- (2) Clutch - B.L.M. centrifugal and flexible coupling combined;
- (3) Fans - 2 only Joy Industrial 4 ft diam. capable of producing 20,000 C.F.M. of air at 2,000 r.p.m. and giving a fan pressure of 1.8 psi and ground pressure of 1.4 psi; (X)
- (4) Fan Drive - belt and pulley working on a ratio of 1.8 to 1; (X) (Direct Drive)
- (5) Suitable duct work through main frame of semi-trailer;
- (6) Skirting material - multi-cells attached to under-carriage of semi-trailer - rubber hyperlon fabric composite;

- (7) Fuel - gasoline - tank capacity - 50 gal.; and
(8) Weight of air cushion package - 4,000 lbs.

Various operating conditions are specified:-

DESIGN CASE I - on-road with a relatively light load relief.
This case has subsequently been stated to be obsolete. (X)

DESIGN CASE II a - Sidebodies not fitted.

(Operation on Public Roads)

Gross Weight = 76000 lb

Payload = 40000 lb (includes air
cushion package)

Weight taken by air cushion = 35700 lb

Maximum width = 8' 6"

The cushion system is split into two separate pallets having a compensator bag area of 83.0 square feet and a cushion area of 70.5 square feet. The corresponding bag and mean cushion pressures are 1.5 psi and 1.76 psi respectively.

Taking into consideration the engine power and duct losses the fan design delivery pressure is 2.0 psi with a flow of 13500 cfm.

DESIGN CASE II b - Sidebodies fitted

(Operation On A Private Road)

Gross Weight = 106000 lb

Payload = 70000 lb (includes air cushion
package).

Weight taken by air cushion = 58000 lb

Maximum Width = 13.0 feet

The addition of the wings to increase the width from 8'6" to 13 feet has changed the bag area for each pallet to 121 square feet and the cushion area to 118 square feet. The corresponding pressure changes are 1.68 psi and 1.75 psi respectively.

It can be seen that the cases required the same cushion pressure and therefore will have the same operating point on the fan characteristic.* However, the bag pressure

* This statement is in some doubt. (HSF)

relief value will need to be reset from 1.5 psi to 1.68 psi.

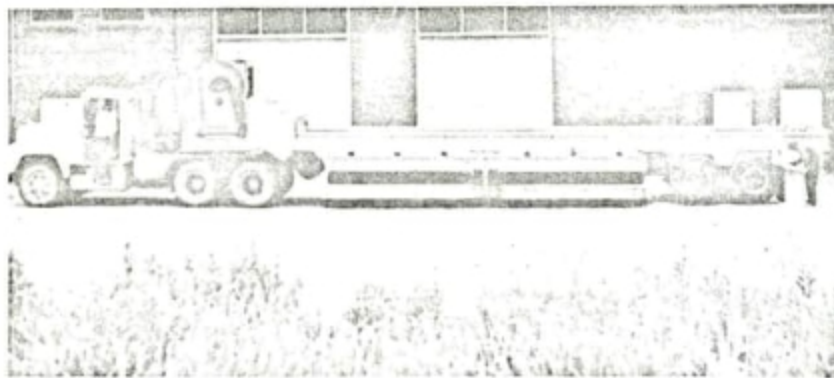
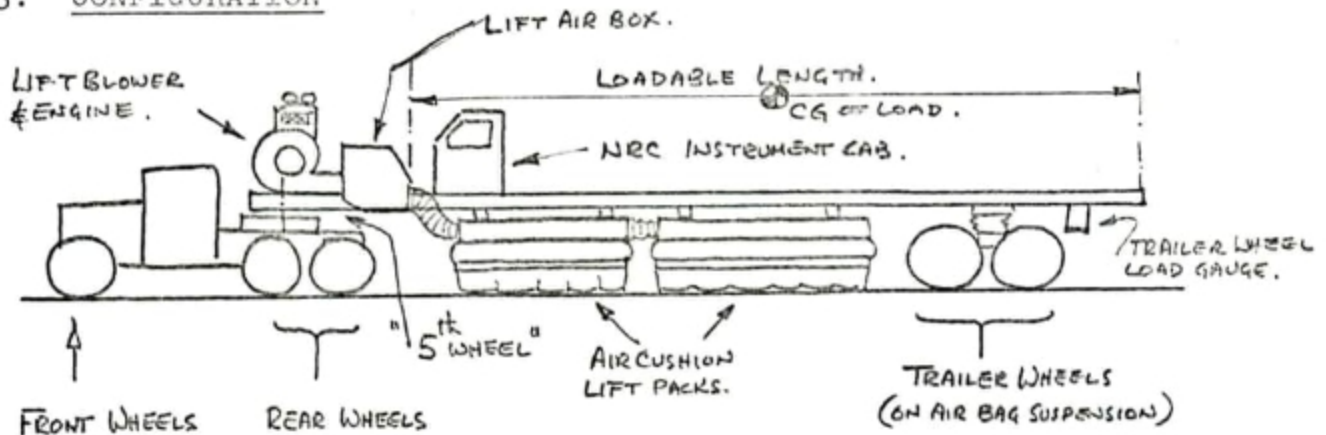
[The above cases II a and II b are copied from HoverJak Tech Note 74-31.]

Owing to mechanical difficulties in fitting the sidebodies, it has been decided to carry out the test program to Case II a, with the possibility of fitting the sidebodies for a test at the end of the program.

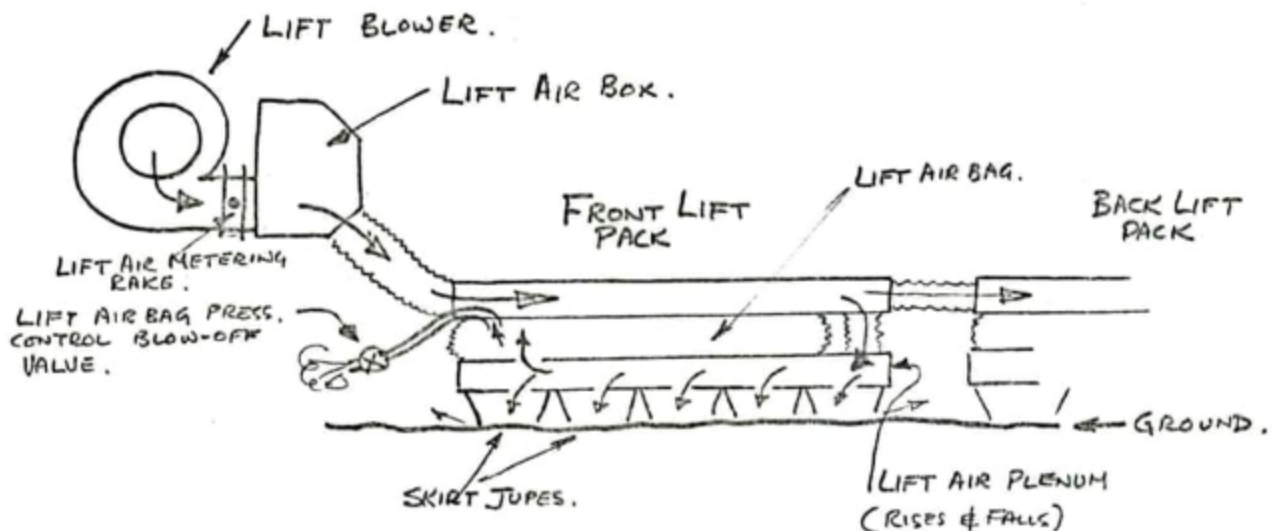
Tests will take place over hard road, gravel road, and soft track, and at various lifts up to the design case.

The lift engine and blower, ducting, and lift packs, plus the NRC instrumentation cab and observer, are estimated to weigh approximately 5000 lb. This will be confirmed by weighing later in the program. It is therefore to be assumed that in the Design Case II a, the design condition will be met by adding 15000 lb of disposable load; normally with its CG midway along the trailer deck, simulating a log load. Design airlift is then defined as being that required to balance this load, and return the wheels of tractor and trailer to their unloaded condition.

3. CONFIGURATION



60,000 lb. Gaymor logging truck fitted with Hover-JaK air cushion pack under trailer for carriage of heavy loads over poor roads.



LIFT AIR BAG ACTS AS CONSTANT-PRESSURE SUSPENSION SPRING, TRANSFERRING LIFT FROM CUSHION-PROPER TO TRAILER, & ALLOWING LIFT AIR PLENUM TO RISE & FALL WITH ROAD CONTOUR, THUS MINIMISING SKIRT-DEFLECTION & COMPENSATING FOR ANY SKIRT WEAR.

ACAT - 1 DIAGRAM OF LIFT SYSTEM

4. TRIALS PROGRAM

- Stage
1. Blower Calibration.
 2. Rear Suspension Calibration.
 3. Roll Tests
 - a. Without air cushion assist
 - b. With air cushion assist.

Move to L.E.T.E.

4. Weigh and determine C.Gs.
 [Repeating rear suspension calibration]
5. Comparison of Ground Pressure.
 Cushion Pressure.
 Lift Airbag Pressure.
 Actual Load Relief.

6. Preliminary handling and driving familiarisation.

Compare Lift Airflow, Static & Moving.

Further stages will be planned in the light of these experiments.

An LTR will be issued at each stage enumerated above.
The program is scheduled for completion on July 1st 1975.

5. REPORT DISTRIBUTION

This series of LTRs is LIMITED, and will be distributed only to:-

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