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Provides a method for accurately determining weight distribution and ground pressure of wheeled and tracked vehicles.

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US ARMY TEST AND EVALUATION COMMAND
TEST OPERATIONS PROCEDURE

DRSTE-RP-702-101
*Test Operations Procedure TOP 2-2-801 7 August 1981
AD No. A102702

WEIGHT DISTRIBUTION AND GROUND PRESSURE
(Wheeled and Tracked Vehicles)

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1. SCOPE. This TOP describes procedures for accurately determining weight distribution and ground pressure of wheeled and tracked vehicles. It does not provide procedures for determining ground pressure distribution on surfaces such as aircraft floors for tracked vehicles. For information on this subject, see YPG Report No. 308.[1**]

2. FACILITIES AND INSTRUMENTATION.

2.1 Facilities.

ITEM	REQUIREMENT
Ballast material to simulate vehicle load	
Material for making inked imprint of contact area	

2.2 Instrumentation.

ITEM	MAXIMUM PERMISSIBLE ERROR OF MEASUREMENT***
Platform scales or portable wheel scales	±0.5% or ±1% reading
Planimeter	±0.5% reading
Tape measure	±3 mm

*This TOP supersedes MTP 2-2-801, 22 May 1970. — AD-871926

**Footnote numbers correspond to reference numbers in Appendix A.

***Values may be assumed to represent ± 2 standard deviations; thus, the stated tolerances should not be exceeded in more than 1 measurement of 20.

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3. REQUIRED TEST CONDITIONS.

3.1 Method.

a. Inspect the test vehicle as described in TOP 2-2-505[2] to determine the condition of the test vehicle and to ensure that vehicle configuration is as specified in the test plan, including:

(1) Equipment on the vehicle
(2) Fuel quantity

b. Add ballast to simulate crew, passengers, cargo, or ammunition as required.

3.2 Data Required. Measure and record the following:

a. Net and gross weights of vehicle
b. Weight and location (distribution) of ballast
c. Prescribed tire pressures (wheeled vehicles)
d. Data as obtained in 3.1 above

4. TEST PROCEDURES.

4.1 Weight Distribution Test. Weight distribution is a term used to describe the division of vehicle weight among suspension members that transmit the weight to the ground. Weight distribution influences the life of all suspension parts and, to a great extent, temperature buildup in rubber components. It also affects mobility, riding quality, steering, and braking. Weight distribution is determined with and without payload weights, each wheel (single or dual) being measured statically. For tracked vehicles, weight reactions are obtained under the track beneath each road wheel.

Weight distribution of tracked and wheeled vehicles is determined with platform scales or highway wheel scales.

4.1.1 Wheeled Vehicles.

a. Method. Perform the following with full payload and then with no load:

(1) Position wheeled vehicle with each wheel on a separate scale.
NOTE: Dual wheels are considered one wheel for test purposes.
(2) Record scale value for each wheel position.

b. Data Required. Record the following for each wheel:

(1) Location of wheel
(2) Scale readings of each wheel in kilograms

4.1.2 Tracked Vehicles.

a. Method. Perform the following with full payload and then with no load (if required):

(1) Position tracked vehicle so that it can be driven one track at a time over the scales.

(2) Drive the tracked vehicle slowly forward onto the scale. Stop the vehicle as each road wheel is sequentially positioned on the scale platform. NOTE: Use of vehicle brakes should be minimal for accurate scale readings. The wheel loads resulting from a towed vehicle without tracks will be different.

(3) Observe and record the scale reading.

(4) Observe and record total weight of the vehicle on the track when all road wheels are on the scale.

(5) Drive the tracked vehicle slowly off the scales. Stop the vehicle as each road wheel is removed from the platform.

(6) Observe and record the scale reading.

b. Data Required. Record the following:

(1) Scale readings for each track as each road wheel is positioned on the scale, driving onto and off the scale platform

(2) Total weight of vehicle on track being tested with all road wheels on the scale (in kilograms)

4.2 Ground Pressure Test. Ground pressure is the unit loading produced by vehicle suspension components in contact with the ground, and is based on total vehicle weight divided by the track or tire contact area. The contact area is that part of a suspension system that is in direct contact with the ground and has a function in supporting the vehicle weight.

Mean or nominal ground pressure is the gross weight of the vehicle divided by the area in contact with soft ground. For tracked vehicles, this assumes a depth of penetration of track blocks to a level permitting the entire projected area of the track to impose a load on the ground. Specific ground pressure is the gross vehicle weight divided by the actual contact area at zero penetration. The actual ground pressure produced by suspension components on a local area of ground is usually nonuniformly distributed beneath the ground-contacting part and can be determined only from complex calculations that take into consideration any unequal wheel loading and the flexibility, form, and dimensions of the ground-contacting part.

Ground pressure affects mobility and rate of wear of tires and tracks. Ground pressure is particularly used to check the design objective or specification. It gives some indication of mobility under soft-surface conditions requiring flotation (mud or snow), although other factors such as track dimensions may influence the results.

Ground pressures are normally determined with the vehicle carrying the specified load (payload or on-vehicle equipment). Nominal ground pressure is obtained for general comparison of vehicles; specific ground pressure is more applicable to unit loading on wheeled vehicle tires and is indicative of wear rate and temperature buildup that can be expected.

4.2.1 Wheeled Vehicles. Perform the following with the vehicle carrying full payload, unless otherwise specified:

a. Method.

(1) Determine the load at each wheel (in kilograms) using procedures as described in paragraph 4.1.1.a.

(2) Measure contact area of each tire (in square centimeters) using planimeter and inked imprint of the tire at standard inflation pressure.

b. Data Required. Record the following:

(1) Location of wheel
(2) Data as obtained in step a above

4.2.2 Tracked Vehicles. Perform the following with the vehicle carrying full payload, unless otherwise specified:

a. Method.

(1) Measure overall track width in centimeters
(2) Measure length of track between projected centerlines of front and rear road wheels in centimeters
(3) Measure total vehicle weight (in kilograms)

b. Data Required. Record data as obtained in paragraph a above.

5. DATA PRESENTATION. Present all data in tabular or other suitable form as appropriate.

5.1 Weight Distribution. For wheeled vehicles, determine the percentage of gross weight supported by each wheel. For tracked vehicles, use the average load on each road wheel to obtain a percentage of gross weight supported by each.

5.2 Ground Pressure. For wheeled vehicles, determine ground pressure at each wheel by dividing the load at each wheel by the measured contact area of the tire. For tracked vehicles, determine the nominal ground pressure (P_n) as follows:

$$P_n = \frac{W}{2bL} \times 98.06$$

when: P_n = nominal ground pressure (kPa)

W = vehicle weight (kg)
b = overall track width (cm)
L = length of track between projected centerlines of front and rear road wheels (cm)
98.06 = conversion factor to metric

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APPENDIX A
REFERENCES

1. Methodology Investigation, Final Report, Aircraft Floor Loading Distribution for Tracked Vehicles, TECOM Project No. 7-CU-RDT-YPI-004, YPG Report No. 308, John W. Kuipers, US Army Yuma Proving Ground, Arizona, March 1977.

2. Test Operations Procedure 2-2-505, Inspection and Preliminary Operation of Vehicles, 14 July 1977.