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14. ABSTRACT
The procedures in this TOP describe the vehicle characteristics to be obtained during testing of wheeled and tracked vehicles and their components. Physical characterization of test vehicles and their subsystems provides a profile that is vital to the evaluation transportability, performance, and mobility studies. The data are also critical to dynamic model development and evaluation.

15. SUBJECT TERMS

Dimentions	Weight distribution	Moments of Inertia	Metacenter
Vehicle frontal area	Characteristic data sheet	Power train	Suspention
Wheel geometry	Vehicle clearance angles	Armament	Gun control systems

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US ARMY DEVELOPMENTAL TEST COMMAND
TEST OPERATIONS PROCEDURE

*Test Operations Procedure 2-2-500 14 February 2008
DTIC AD No.: ADA489252

VEHICLE CHARACTERISTICS

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*This TOP supersedes TOP 2-2-500, dated 3 December 1981.

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1. SCOPE.

This Test Operations Procedure summarizes the vehicle characteristics to be obtained during testing of wheeled and tracked vehicles and their components.

1.1 Purpose.

Physical characterization of test vehicles and their subsystems provides a profile that is vital to the evaluation of transportability, performance, and mobility studies. The data are also critical to dynamic model development and evaluation.

The development of a vehicle's physical characteristics requires measurements that include dimensions, weight, center of gravity, moments of inertia, and ground pressure. Procedures for determining vehicle physical characteristics are contained in documents such as Allied Vehicle Testing Publications (AVTP) and various Society of Automotive Engineering (SAE) publications.

Vehicle characterization also requires the identification and description of the overall test vehicle and its various subsystems and components such as engine, power train, armament, etc. Much of this data can be obtained from technical manuals, manufacturer's publications, and engineer design drawings.

1.2 Limitations.

These procedures can be utilized for wheeled and tracked vehicles, their subsystems and components, and various trailers and semi-trailers.

2. FACILITIES AND INSTRUMENTATION.

2.1 Facilities.

Required facilities are as follow:

a. For determining vehicle dimensions a flat, level area which should be covered if possible.

b. For measurement of the metacenter of a test item a fresh water fording basin large enough and deep enough to float the vehicle under test.

c. To measure moments of inertia:

(1) Cradle-type rigid frame, with test item support carrier, suspension links and pivots about which the carrier can oscillate.

(2) A separate facility or add-on modifications to create a torsional pendulum carrier to obtain the polar moment of inertia.

(3) A method of imposing the exciting force.

d. A large enough area or room to allow the test item to be photographed from a distance of approximately 100m (300ft).

e. For roll angle measurement, a rigid platform capable of tilting a test item parallel to its longitudinal axis. The platform must remain essentially planar throughout testing.

2.2 Instrumentation.

Instrumentation required for the measurement of the various physical characteristics are as follow:

Devices for Measuring	Permissible Measurement Uncertainty (see Note 1)
Length	0.3%
Angle	0.5 deg
Tire pressure	1.0%
Time	0.001 sec
Weight	0.5%
Area: tire prints, frontal	2.0%

Note 1: The permissible measurement uncertainty is the two-standard deviation value for normally distributed instrumentation calibration data. Thus 95% of all instrumentation calibration data readings will fall within two standard deviations from the known calibration value.

3. REQUIRED TEST CONDITIONS.

3.1 Preparation for Test.

a. Review all instructional material issued with the test vehicles by the manufacturer, contractor, or government, as well as reports of previous testing of the same types of vehicles.

b. Select the applicable test procedures to be used based on the requirements documents and purpose of the test. Obtain copies of and review the applicable AVTP's and SAE test procedures.

c. Prepare data collection sheets to record all pre-test information, conditions of test, test results, and observations that would be valuable in analysis and assessment.

d. Ensure that all test personnel are familiar with the required technical and operational characteristics of the item and with the required test procedures.

3.2 Test Controls.

Prior to testing ensure that:

a. The vehicle has been prepared and equipped in accordance with standard use and/or within the specifications presented in the test plan.

b. The vehicle is payloaded in accordance with the test plan.

c. The vehicle is fully serviced (fuel, oil, water as required) and all auxiliary equipment is installed (weapons, ammunition, communication equipment as required).

d. The vehicle track tension or tire pressures are adjusted to specified levels.

e. If so equipped, auxiliary equipment will be placed in the stowed/transport position.

3.3 Characteristics Data Sheet.

Prepared as a reference, the data sheet consists of a photograph of the test item and a listing of its principal dimensions and functional characteristics. An example of a characteristic data sheet is presented in Appendix A.

3.4 Restrictions.

Unless otherwise specified, all physical dimensions will be measured with the test item positioned on a level, paved surface. Local safety procedures will be carefully followed.

4. TEST PROCEDURES.

4.1 Vehicle Characteristics (Assembly and Component Data).

Assembly and component characteristics are acquired to provide a complete description of the test item. Specific data are also required to input parameters to various mobility models. Various component and structural characteristics can be obtained from technical manuals, manufacturer's handbooks, and engineering design drawings. These data can include, but are not necessarily limited to, the items listed in paragraph 5, Data Required.

4.2 Physical Characteristics.

When a TOP, ITOP, AVTP, and/or SAE procedure are referenced for determination of a particular physical characteristic, the instrumentation, facilities, test procedures, data required, and data presentation paragraphs presented in those documents are to be utilized.

4.2.1 Physical Dimensions.

Pertinent physical dimensions are determined using standard mensurative instrumentation such as steel tape measures, plumb bobs, straightedges, and clinometers. General guidance is provided in SAE procedures J1100[1**] and J701[2] and AVTP 01-10[3].

4.2.2 Weight Distribution.

Determine the total weight and weight distribution characteristics of the test item and its specified components in accordance with TOP 2-2-801[4]. For tracked vehicles use ITOP 2-2-801(1)[5].

4.2.3 Center of Gravity (CG).

Determine the center of gravity of the test vehicle in accordance with TOP 2-2-800[6]. For tracked vehicles use ITOP 2-2-800(1)[7].

4.2.4 Ground Pressure.

Determine ground pressure in accordance with TOP 2-2-801. For tracked vehicles use ITOP 2-2-801(1).

4.2.5 Tire Measurements.

Determine pertinent tire measurements in accordance with TOP 2-2-704[8], SAE J2013[9], and/or SAE J2047[10].

4.2.6 Moments of Inertia.

Determine vehicle moments of inertia in accordance with either TOP 2-2-600[11] or AVTP 01-50[12].

4.2.7 Metacenter.

Determine the vehicle metacenter in accordance with TOP 9-2-251[13], Paragraph 12, or AVTP 01-40[14].

4.2.8 Basic Vehicle Frontal Area.

Determine the basic vehicle frontal area of the test item in accordance with the attachment to OMSAPC Advisory Circular A/C No. 73[15], presented as Appendix B.

4.2.9 Roll Angle (Simulated Lateral Acceleration).

Determine the vehicle roll angle in accordance with TOP 2-2-002[16].

** Superscript numbers correspond with those in Appendix D, References.

4.3 Performance Characteristics.

4.3.1 Acceleration, Maximum and Minimum Speeds.

Determine full-throttle acceleration characteristics and maximum and minimum speed capabilities for each gear range of the test vehicle in accordance with TOP 2-2-602[17]. For tracked vehicles use ITOP 2-2-602(1)[18].

4.3.2 Fuel Consumption.

Determine pertinent fuel consumption characteristics of the test vehicle in accordance with TOP 2-2-603[19]. For tracked vehicles use ITOP 2-2-603(1)[20].

4.3.3 Drawbar Pull.

Determine vehicle drawbar pull characteristics in accordance with TOP 2-2-604[21]. For tracked vehicles use ITOP 2-2-604(3)[22].

4.3.4 Towing Resistance.

Measure vehicle power losses from form suspension and running gear by conducting tests in accordance with TOP 2-2-605[23]. For tracked vehicles use ITOP 2-2-605(1)[24].

4.3.5 Braking.

Determine the vehicle's ability to brake from various road speeds in accordance with TOP 2-2-608[25]. For tracked vehicles use TOP 2-2-627[26].

4.3.6 Steering.

Determine the vehicle turning radii and/or diameters in accordance with TOP 2-2-002. For tracked vehicles use ITOP 2-2-609(1)[27].

4.3.7 Gradeability and Side Slope Performance.

Determine the maximum speed required by the test vehicle to negotiate specified grades and its side slope performance in accordance with TOP 2-2-610[28]. For tracked vehicles use ITOP 2-2-610(1)[29].

4.3.8 Standard Obstacles.

Determine the vehicle's ability to negotiate the various obstacles presented in TOP 2-2-611[30]. For tracked vehicles use ITOP 2-2-611(1)[31].

4.3.9 Fording.

Determine the ability of the test vehicle to ford water of a specified depth in accordance with TOP 2-2-612[32]. For tracked vehicles use ITOP 2-2-612(1)[33].

4.3.10 Gun Control Systems. Determine gun control performance characteristics in accordance with TOPs 3-2-506[34] and 3-2-603[35].

5. DATA REQUIRED.

5.1 Vehicle Characteristics.

5.1.1 General.

a. Manufacturer, nomenclature, serial, model, and USA registration numbers and number of personnel transported.

b. The type and quality of construction of the test item, its subsystems and components, ancillary equipment, kits, chassis, body and armor

c. Photographs of the test item, its components and ancillary equipment, as required, to include complete and reduced illustrating the front, side, rear, top, and three-quarter front and rear views.

5.1.2 Engine.

a. Manufacturer, type design.

b. Model and serial numbers.

c. Maximum torque and horsepower rating and corresponding engine speed.

d. Number of cylinders, cylinder arrangement, firing order.

e. Displacement including bore and stroke.

f. Compression ratio.

g. Engine torque and specific fuel consumption values per TOP 2-2-700[36].

h. Governor; make and model.

i. Cooling system; type of radiator and capacity, coolant type, fan size, number of blades, and air flow volume.

j. Fuel system; description.

(1) Type fuel, octane rating.

(2) Type filter, make and model.

(3) Type fuel pump, make and model.

k. Lubrication system; description/type of oil, oil pump, oil filter, oil cooler(s) and thermostat regulation.

l. Electrical system; description/type of generator/alternator, voltage capacity, maximum output.

m. Exhaust system; description/type.

n. Special equipment; description/type of compressor, cold start aid, etc.

5.1.3 Power Train.

a. Transmission; description/ type, manufacturer, torque rating.

(1) Clutch; description/type.

(2) Converter; description/type, stall-torque multiplication.

(3) Gearbox; description/type, number and ratio of gears.

(4) Lubrication system; description/type of oil, oil pump, oil filter, oil cooler(s) and thermostatic regulation.

(5) Cooling system; description/type.

(6) Power take-off system(s); description/type, torque requirement and gear ratio.

b. Transfer gearbox; description/type, number and ratio of gears.

c. Drive/Propeller shafts; description/type, including:

(1) Number of and location.

(2) Axle ratio.

(3) Wheel reducer(s) ratio.

(4) Differential lock and control.

d. Final drives; manufacturer, type, reduction ratio.

e. Wheels; manufacturer, type and number per axle.

f. Tires; manufacturer, type, including:

(1) Number per axle.

(2) CTIS pressure settings.

(3) Speed limit for each pressure setting.

(4) Pertinent dimensions.

g. Performance curves determined in accordance with TOP 2-2-703[37].

5.1.4 Auxiliary Engines.

a. Type of engine, air cleaner, and cooling.

b. Horsepower and generator/alternator capacity.

c. Type of ignition system.

5.1.5 Suspension.

a. Type.

b. Springing system; description, type, and characteristics.

c. Shock absorbers; description, type, and arrangement.

d. Stops; description, type, and characteristics.

e. Number and diameter of road wheels and support rollers.

f. Unsprung weight.

5.1.6 Tracks.

a. Type and model.

b. Pitch and pitch diameter.

c. Overall width and ground contact area.

d. Type of grousers including hardness and height.

e. Type of sprocket including material, hardness, number of teeth, and pitch angle and diameter.

f. Type of fastening (lock nuts, wedges, caps, etc.).

g. Material.

5.1.7 Wheel Geometry.

a. Camber angle.

b. Caster angle.

c. Pivot angle.

d. Static toe-in.

e. Turning angles.

5.1.8 Braking System.

a. Type.

b. Braking circuit; description, diagram, characteristics (braking with respect to pedal effort).

c. Parking brake; description, type.

d. Retarder; description, type, characteristics.

5.1.9 Steering.

a. Steering wheel; diameter, number of turns lock to lock.

b. Power assistance; description, type, characteristics (steering box, power pump, etc.).

5.1.10 Electrical System.

Circuit diagram and nominal voltage.

a. Batteries; manufacturer, type, voltage capacity, location, number, master switch location.

b. Generator/alternator; manufacturer, type, power output, voltage.

c. Regulator; manufacturer and type.

d. Starter; manufacturer, type, and characteristics.

e. Power take-off; type and location.

f. Trailer power connector; type and location.

5.1.11 Lighting System.

a. Type and description; normal, blackout, infrared, accessory.

b. Conformity with highway code.

5.1.12 Pneumatic Equipment.

a. Air compressor; manufacturer, type, characteristics including drive type , drive-engine ratio.

b. Tanks; capacity, maximum pressure, number.

c. Pressure regulator; manufacturer, type, characteristics.

d. Coupling heads; number, type.

5.1.13 Vehicle Tools and Equipment. Listing.

5.1.14 Capacities.

a. Air cleaners.

b. Cooling system.

c. Engine oil.

d. Fuel tank(s), gross and usable.

e. Transmission.

f. Differentials

g. Transfer case.

h. Wheel reducers.

i. Final drives.

j. Power steering system.

k. Braking system.

l. Hydraulic system.

5.1.15 Self-Recovery Winch.

a. Maximum rated line pull.

b. Cable diameter and length.

5.1.16 Frame or Hull.

Type and fabrication method.

5.1.17 Personnel Heaters.

Type, location, and capacity.

5.1.18 Vehicle Winterization.

Temperature limits with and without kits.

5.1.19 Communication Equipment.

Type of both external and internal.

5.1.20 Primary Armament.

a. Type and nomenclature.

b. Bore evacuation and length.

c. Type of breechblock, equilibration (gun balance), and muzzle attachments.

d. Weight of gun assembly and tube.

e. Gun mount; nomenclature, recoil type and distance, replenisher.

5.1.21 Secondary and Auxiliary Equipment.

a. Nomenclature.

b. Location.

c. Type mount and special equipment.

5.1.22 Ammunition.

a. Type.

b. Velocity.

c. Quantity.

d. Location.

5.1.23 Ammunition Handling Equipment.

a. Dispensing devices.

b. Loaders and/or autoloaders.

c. Hoists.

5.1.24 Ventilation Equipment.

Fan type and capacity.

5.1.25 Sighting Equipment and Viewing Devices.

a. Nomenclature.

b. Purpose.

c. Location.

d. Type reticle.

e. Diopter adjustment.

f. Magnification.

g. Range limits.

h. Special equipment.

5.1.26 Gun Control System.

a. Nomenclature and type.

b. Power requirements.

c. Special requirements.

5.2 Physical Characteristics.

5.2.1 Dimensions.

a. Vehicle dimensions, overall and reducible (prepared for shipment and/or airdrop).

(1) Length (reference SAE J1100, code L103).

(2) Width (code W103).

(3) Height (code H101).

(4) Volumes, as appropriate.

b. Wheeled vehicle dimensions.

(1) Wheelbase (code L101).

(2) Track (code W101).

(3) Front and rear overhang length (codes L104&L105).

(4) Front and rear overhang height.

(5) Ground clearance (code H156).

(6) Ground clearance location (code H156).

(7) Inside width, length, and height of body (cargo space dimensions).

(8) Height of body from ground, with and without load (code H100).

(9) Height of loading platform, with and without load (code H252).

(10) Height of pintle, with and without load.

(11) Distance of pintle to front of vehicle.

(12) Height of fifth wheel, with and without load.

(13) Distance of kingpin to front of vehicle (tractor).

(14) Distance of kingpin to rear wheel (tractor).

(15) Distance of kingpin to rear axle of trailer.

(16) Distance of front of trailer to kingpin.

(17) Trailer swing radius (SAE J701).

c. Tracked vehicle dimensions.

(1) Wheelbase.

(2) Track.

(3) Ground clearance.

(4) Ground clearance location.

(5) Height of turret, upper edge.

(6) Height of turret ring.

(7) Length of track between projected centerlines of front and rear road wheels.

(8) Overall track width.

(9) Relative centerline position of sprocket, idler wheel, support rollers, and road wheels.

(10) Cargo space dimensions, if applicable.

d. Components, attachments, and kits (removed to reduce vehicle dimensions).

(1) Length, width, height, and volume, as appropriate.

(2) Number of personnel and manhours required to remove component(s) and the equipment and tools required.

e. Wheeled/tracked vehicle angular dimensions as shown in Appendix C.

(1) Angles of approach and departure.

(2) Ramp breakover angle.

(3) Towing angles (with associated trailers), vertical and horizontal foul angles, cant angles.

f. Wheeled/tracked vehicle positional dimensions.

(1) Overhang and height of towing pintle and recovery eyes.

(2) Quantity, position, and height of pertinent lighting fixtures; head, tail/stop, convoy, spot, reflectors, turn indicators, etc.

(3) Lifting and tiedown provisions location with respect to a prescribed vehicle component.

g. Armament dimensions.

(1) Type of armament and description of mounting.

(2) Height of weapon above ground.

(3) Amount of angle traverse.

(4) Maximum angles of elevation and depression.

(5) Location of turret centerline relative to the vehicle.

(6) Distance from the center of the turret and the trunnion to the gun muzzle.

(7) Overall length of vehicle with the weapon over the front and in travel position if different.

(8) Height to turret ring.

h. Vehicle system drawings depicting position, geometry, connectivity, and layout of the following:

(1) Suspension springs and attachment point locations.

(2) Suspension dampers and attachment point locations.

(3) Torque rods and panhard bar locations.

(4) Steering linkages locations.

(5) Bump and rebound stop locations.

5.2.2 Weight Distribution.

a. Total weight and weight distribution characteristics of the vehicle with and without its towed load, for curb, payloaded, and combat weight conditions.

b. Weight totals of the test item for various modes of shipment, airdrop, and /or swimming operations.

c. Weight of designated vehicle components.

5.2.3 Center of Gravity (CG).

Longitudinal, transverse, and vertical components of the vehicle center of gravity with respect to a common reference point.

5.2.4 Ground Pressure.

Vehicle ground pressure characteristics at specified payload conditions.

5.2.5 Tire Measurements.

a. Deflection.

b. Contact area.

c. Bulge width.

d. Section height.

e. Section width.

f. Overall width.

g. Overall diameter.

h. Tread depth.

i. Tread width.

5.2.6 Moments of Inertia.

The mass moments of inertia of the test item(s) about all three centroidal axes (roll, pitch, and yaw).

5.2.7 Metacenter.

a. Flotation line and surface.

b. Free-board and drought.

c. Static list and trim.

d. Metacentric radius.

e. Metacentric height.

f. Stability diagram.

5.2.8 Basic Vehicle Frontal Area.

The area projected in the vertical plane by the pertinent vehicle profile (front, side, rear, quarter, etc.).

5.2.9 Roll Angle (Simulated Lateral Acceleration).

a. Roll angle at liftoff of each wheel.

b. Side slope at liftoff of each wheel.

5.3 Vehicle Performance Characteristics.

5.3.1 Acceleration, Maximum and Minimum Speeds.

a. Time-velocity characteristics from idle to maximum speed.

b. Vehicle maximum and minimum speeds attained in various gear ranges for each specified vehicle configuration.

5.3.2 Fuel Consumption.

a. Type/grade of fuel used.

b. No load, road load, and full load fuel consumption characteristics, as required.

c. Standard course fuel consumption.

d. Fuel consumed during operations on individual courses for endurance testing.

e. Vehicle usable fuel capacity.

5.3.3 Drawbar Pull.

Vehicle drawbar pull and horsepower characteristics at various road speeds in each pertinent gear range.

5.3.4 Towing Resistance.

Vehicle resistance-to-towing characteristics for each desired weight configuration.

5.3.5 Braking.

Vehicle stopping distance from various road speeds.

5.3.6 Steering.

Minimum wall-to-wall and curb-to-curb turning diameters of the test item(s) for all designed steering modes.

5.3.7 Gradeability and Side Slopes.

a. Maximum speed attained by the test vehicle when negotiating specified grade(s).

b. Maximum side slope satisfactorily negotiated by the test vehicle.

5.3.8 Standard Obstacles.

a. Ramp angle.

b. Trench crossing capability.

c. Vertical obstacle height.

d. Bridging distance

5.3.9 Fording.

Fording depth capability of the test vehicle, with and without kit, if supplied.

5.3.10 Gun Control Systems.

a. Maximum and minimum power traversing rates.

b. Maximum and minimum gun power elevating rates.

c. Manual traversing and elevating handcrank force.

d. Maximum force at breech-operating velocity.

e. Cartridge case ejection velocity.

6. PRESENTATION OF DATA.

Required data will be presented in narrative, tabular, graphical and/or pictorial format as appropriate and include the following:

a. Vehicle/component description and characteristics.

b. Diagrams and /or drawings depicting appropriate dimensions.

c. Test data records.

d. Photographs, as required.

APPENDIX A. CHARACTERISTIC DATA SHEET



Physical data	Armament
Weight; curb, GVW, combat	
Payload	Armor
Towed load	
Length	Crew number
Width	
Height	Capacities
Reducible height	Coolant
Ground clearance	Crankcase (engine oil)
Tread	Transmission
Wheelbase	Transfer
Angle of approach	Differentials
Angle of departure	Fuel tank(s)
Winch capacity	
Power train	Performance
Engine	Maximum speed
Model and type	Gradeability
Maximum horsepower @ rpm	Turning diameter
Maximum torque @ rpm	Cruising range
Fuel type	Fording depth
Transmission, transfer, gear boxes	
Model and type	
Gear ratios	
Suspension type	
Steering, type	
Tires/Tracks; type and size, rolling distance	
Electrical system; type and capacity	
Brake system; service and parking brake type	

APPENDIX B. FRONTAL AREA MEASUREMENT PROCEDURE

1. Vehicle Preparation.

a. Place the vehicle as nearly as possible in the desired final position. That is, centered on the sightline and the appropriate distance from the camera.

b. Use the floor jacks to move the vehicle to its final position. The vehicle center line at each end of the vehicle should be within l/2 in (15 mm) of the sightline and both centerlines must fall on the same side of the sightline to minimize error.

c. Place the standard area frame around the vehicle at the point of the maximum vehicle cross-sectional area.

d. The camera shall be located at the same elevation as the mid-point of the overall vehicle height. Care should be taken when adjusting the camera height above the floor to correct for differences in floor elevations between the vehicle location and camera location.

2. Photographic Preparation and Exposure.

a. Set the camera and lens up so that the front lens element is at the desired distance from the vehicle, the lens is level, and the center of the lens is at a height equal to one-half of the overall height of the vehicle. Any necessary corrections must be made for differences in elevation between the vehicle and camera sites.

b. Choose a backdrop color to provide maximum contrast with the vehicle. Illuminate the vehicle, backdrop, standard area frame, and vehicle under-carriage in order to achieve maximum contrast between the vehicle and backdrop.

c. Using the camera viewfinder, insure that the wheels are straight ahead.

d. Examine the viewfinder image or take test shots to insure that the entire vehicle and standard area frame are imaged on the film.

e. Measure the light on the vehicle and backdrop and calculate the exposure required.

f. Film Exposure - If possible, use a mirror lockup to minimize camera vibration and an air bulb shutter release. Use an aperture as small as practical to increase depth of field. The field of focus should include the entire vehicle if possible. Bracket the calculated shutter speed to insure the best possible exposure.

3. Analysis.

a. Developing and Printing. Develop the film and enlarge the best exposure so that the maximum image size of the vehicle and standard area frame which can be printed on an 8 in by 10 in print is obtained.

b. Planimetry. Planimeter the image of the standard area frame on the print. Planimeter the vehicle image. The visible undercarriage components must be included, but air spaces may be subtracted. For light-duty vehicles only, it is not necessary to include vehicle mirrors, radio antennae, or other protuberances in the measurement of the vehicle reference area. Protuberances may be photographed and planimetered separately using the same technique used to determine the vehicle reference area.

c. Area Calculation. Calculate the vehicle frontal area by the following equation:

$$V = vS/s$$

where:

V = the vehicle frontal area.
v = the area of the photographic image of the vehicle.
S = the area of the standard area frame.
s = the area of the photographic image of the standard area frame.

APPENDIX C. VEHICLE CLEARANCE ANGLES

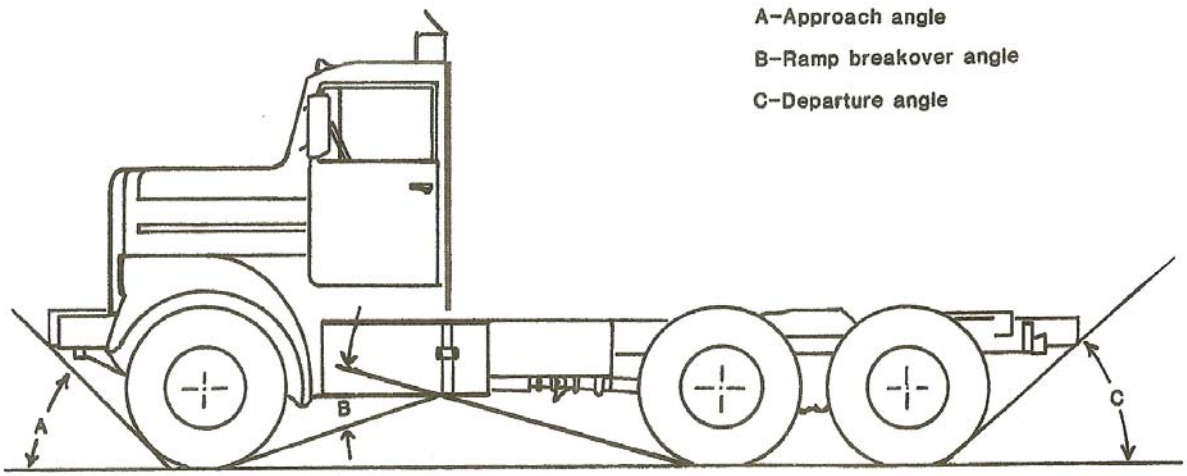


Figure C-1. Vehicle Clearance Angles.

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30. TOP 2-2-611, Standard Obstacles, 25 June 1980.

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For information only

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Forward comments, recommended changes, or any pertinent data which may be of use in improving this publication to the following address: Test Business Management Division (TEDT-TMB), US Army Developmental Test Command, 314 Longs Corner Road Aberdeen Proving Ground, MD 21005-5055. Technical information may be obtained from the preparing activity: Automotive Instrumentation Division (TEDT-AT-AD-I), US Army Aberdeen Test Center, 400 Colleran Road Aberdeen Proving Ground, MD 21005-5059. Additional copies can be requested through the following website: http://itops.dtc.army.mil/RequestForDocuments.aspx, or through the Defense Technical Information Center, 8725 John J. Kingman Rd., STE 0944, Fort Belvoir, VA 22060-6218. This document is identified by the accession number (AD No.) printed on the first page.