The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE RECOMMENDED PRACTICE

SAE ARP4852 REV. A

Issued 1995-06
Revised 1997-12

Submitted for recognition as an American National Standard

Superseding ARP4852

SPECIFICATION FOR TOWBARLESS PUSH-BACK TOW VEHICLES

FOREWORD

This SAE Aerospace Recommended Practice (ARP) describes the dimensions, design, layout, performance, and capability of a towbarless tow vehicle (TLTV), mainly used for push-back operation on the nose gear.

This tow vehicle will basically be used for aircraft listed in 1.3.

Overall design of the unit is to allow operations under climatic conditions as stated under 5.1 and safe operations during day and night conditions on airport aprons, runways, taxiways, and in hangars.

TABLE OF CONTENTS

QUESTIONS REGARDING THIS DOCUMENT: (412) 772-8510 FAX: (412) 776-0243
TO PLACE A DOCUMENT ORDER: (412) 776-4970 FAX: (412) 776-0790

1. GENERAL REQUIREMENTS:

The tow vehicle should be designed for towbarless push-back of all specified aircraft on the ground.

The design will ensure that the unit will safely secure the aircraft nose landing gear within the coupling system for any operational mode.

The purpose of this towing procedure is to achieve a safer and faster operation than is possible with conventional towing equipment.

1.1 One-Man Operation:

A one-man operation is required with all functions to be performed by the driver. Good visibility is required for controlled and safe operations, during day and night conditions.

1.1.1 Under-Belly Operation: The coupling of the nose landing gear by the towbarless tow vehicle (TLTV) must be possible in all extensions of the nose strut of the following aircrafts:

a. B-747
b. B-767
c. B-777
d. A-300
e. A-310
f. A-330
g. A-340
h. DC-10
i. MD-11
j. L-1011

1.2 The TLTV has to be designed to carry out the following tasks:

1.2.1 Push-Back: Push-back shall be defined as the moving of a loaded airplane in a backward direction from a parking position to the taxiway. Movement typically includes push-back with a turn, stop and short tow forward to align the airplane. Aircraft engines may or may not be running.

1.3 Aircraft Nose Gear Load:

The TLTV push-back should be designed for use with the following aircrafts:

a. TLTV Push-Back CAT I:

A/C with a maximum nose gear ground reaction load up to 15 tons metric (33 100 lb) (static)

Dynamic loads must be calculated by the tow vehicle manufacturer.

B-727/737/757
A-319/320/321
MD-80/90
F-100
DC-9/MD-80 Series

b. TLTV Push-Back CAT II:

Reinforced version for A/C with a nose gear ground reaction up to 36 tons metric (79 400 lb) (static)

Dynamic loads must be calculated by the tow vehicle manufacturer.

B-727/737/757/767/777
A-300/310/319/320/330/340
MD-11/80/90/DC-10/DC-8
L-1011
F-100

c. TLTV Push-Back CAT III:

A/C with a nose ground reaction up to 45 tons metric (99 200 lb) (static)

Dynamic loads must be calculated by the tow vehicle manufacturer.

B-767/747/777
A-300/310/330/340
MD-11/DC-10
L-1011

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this specification and references cited herein, the text of this specification takes precedence. Nothing in this specification, however, supersedes applicable laws and regulations unless a specific exemption has been obtained. The TLTV must fully comply with the most recent issue to the following documents, standards, specifications, and practices as applicable to airport ramp operations.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

ARP1247	General Requirements for Aerospace Ground Support Equipment Motorized and Nonmotorized
AIR1328	Aircraft Support Equipment Stability Analysis
ARP1330	Welding of Structures for Ground Support Equipment
AIR1375	Minimum Safety Requirements for Special Purpose Airline Ground Support Equipment
AIR1838	Pictograms for Ground Support Equipment
ARP5283	(DRAFT) Nose Gear Towbarless Tow Vehicle Basic Test Requirements
ARP5284	(DRAFT) TLTV - Aircraft NLG Steering and Tractive Force Protection Systems or Alerting Devices - Inspection, Maintenance, and Calibration Requirements
ARP5285	(DRAFT) Towbarless Towing Vehicle Operating Procedure

2.2 Applicable References:

Industry wide towbarless tow vehicle test specification issued by applicable airframe manufacturers

Federal occupational safety and health standards (OSHA), subpart N

California occupational safety and health standards (CAL-OSHA)

CEN Regulations

EEC Machinery Directive

National traffic codes and regulations

Applicable mechanical engineering standards, recommended practices, and safety rules (including FAR, JAR 25.1529, etc.)

Standards and safety rules especially applicable to electrical installations

2.2 (Continued):

Local Airport Regulations:

If local regulations add requirements to 2.8 to 2.10, they have to be made known to seller and adhered to.

3. DIMENSIONS:

3.1 TLTV Push-Back CAT I and II:

a. Length: Maximum 8000 mm (315 in) without towing device
b. Width: 3500 mm (138 in) without mirrors
c. Turning Circle Radius: Maximum 9000 mm (355 in)
d. Ground Clearance: Minimum 150 mm (6 in)
e. Cabin Height: With cab retracted maximum 1650 mm (65 in), if under belly operations are performed

3.2 TLTV Push-Back CAT III:

a. Length: Maximum 10 000 mm (394 in) without towing device
b. Width: Maximum 4200 mm (166 in) without mirrors
c. Turning Circle Radius: Maximum 11 000 mm (433 in)
d. Ground Clearance: Minimum 150 mm (6 in)
e. Height: With cab retracted, unloaded maximum 1650 mm (65 in), if under belly operations are performed

4. PERFORMANCE:

4.1 Tractive force shall be variable depending on the aircraft type according to 4.4. The tractive forces must be sufficient to move A/C from standstill even under bad surface conditions and aircraft engines on idle speed.

The fore-aft load limiting device should be set as a function of the airplane to be towed. This value must not be exceeded during normal towing (acceleration/braking).

Tractive braking forces and oversteer forces applied to the aircraft shall be limited by a fail safe load limiting devices.

To ensure that the tow vehicle does not negatively impact the certified safe life of the airplane nose landing gear, the tow vehicle must be assessed according to the requirements specified by the airframe manufacturer.

4.2 Speed:

a. An empty tow vehicle (without aircraft) shall be capable of a maximum speed of no less than 30 kph (19 mph).

b. A loaded tow vehicle (with airplane) shall be capable of a speed of at least 6 kph (4 mph).

4.3 Acceleration:

Maximum speed shall be achieved as quickly as possible, but the acceleration forces must stay within the limits given by the A/C manufacturers, so that there is no negative influence on the structural integrity and safe life-limits of the NLGs.

4.4 Deceleration:

Tow vehicle acceleration and deceleration force values during towing operation must be in accordance with aircraft manufacturer's requirements and applicable regulatory requirements (FAR, JAR, etc.). Traction force on the aircraft shall be limited by a protective device.

(Braking Ratio): Tow vehicle minimum 40% empty, without aircraft

5. DESIGN DETAILS:

5.1 Diesel Engine:

Operation with kerosene JET A1 should be possible.

Standard system shall be designed for temperatures down to -20 °C (-4 °F). A design for temperatures between -20 °C (-4 °F) and -40 °C (-40 °F) should be an option.

The engine will conform to latest exhaust emission regulations according to the location where the tow vehicle will be used.

5.1.1 Provisions for long intervals between oil changes shall be taken; such as filters, oil quality, and constructional features.

5.1.2 Calculation of power output shall be based on 760 torr. (14 069 psi), 20 °C (+68 °F), and 60% humidity.

5.1.3 The chosen engine shall be widely in use and of proven design.

5.1.4 The engine will be adequately accessible for maintenance and inspection.

5.1.5 Engine replacement must be possible within an acceptably short time through the top or side of the chassis, using standard hoist equipment and shop means. For removal, it should only be necessary to disconnect supply and control lines, linkages, exhaust and intact piping, fuel lines, and possibly a drive shaft.

A power converter or mechanical transmission could remain with the engine.

5.1.5.1 Engine shall be provided with adequate hoist provisions offering safe load bearing capability.

5.1.6 The unit shall be equipped with an efficient exhaust system, located to prevent entrance of exhaust gases into the cab, or discharge into a wheel casing.

5.1.7 The engine shall be started electrically.

5.2 Power Train:

5.2.1 ASR (traction control/slip positive control), or differential locks, or other means to avoid decreased traction forces as well as skidding controls must be provided on each wheel.

5.2.2 Four- or two-wheel drive systems are applicable, but preferably four-wheel drive to prevent wheel skidding.

5.2.3 Powertrain from engine to the wheels shall be of proven type.

Gear shifting by hand shall not be required in the operational mode. In case of an automatic transmission (via a torque converter), gear change must be smooth.

5.2.4 It should be possible to tow the tow vehicle with a minimum speed of 5 kph (3 mph) over a long distance.

5.3 Wheels, Tires, Axles:

5.3.1 Tire sizes and suitable tire tread have to be chosen to suit all airport operations.

Each tire shall have, at minimal inflation pressure, a rated carrying capacity at least equal to the gross load normally imposed on it by a fully equipped and ballasted tow vehicle. For cases of tire failure, tire must safely accept one-third of the maximum ballasted tow vehicle gross weight.

5.3.2 Wheel change shall be a simple operation using standard tools.

5.3.3 Wheel arches shall provide ample space for wheel articulation and turning, mounting, and operation with snow chains.

5.4 Brakes:

5.4.1 A braking system shall be installed complete with all necessary equipment to safely control the fully equipped and ballasted tow vehicle under all operating conditions.

The brake mechanism shall be readily accessible for adjustments. The service brake shall have two independent systems. In case of failure of one system, a signal lamp will flash on the cab instrument panel.

Deceleration forces shall stay within the limits given by the aircraft manufacturer.

5.4.2 The service brake shall operate on all wheels with a nonfading deceleration. To assist the operator, the service brake must be power assisted.

5.4.2.1 The parking brake shall engage on at least two wheels and shall hold a fully ballasted tow vehicle being in neutral shift at standstill. Emergency release for parking brake spring actuator to be provided.

5.4.2.2 Applied parking brake shall be indicated in cab by a red warning lamp.

5.4.3 Simultaneously acting on the service brake and the parking brake must be impossible by a safety device.

5.5 Steering:

5.5.1 Steering Mode:

Front axle steering
Four-wheel and cab steering (option)

NOTE: In case of four-wheel steering "front" always defines the direction the driver is facing.

5.5.2 Steering mode shall be selected while tow vehicle is not moving.

5.5.3 External Turning Radius: Both categories shall be as small as possible (see Section 3).

5.5.4 In case the tow vehicle has to be towed away, the front wheel steering has to be functional even with an engine failure at a velocity of approximately 5 kpm (3 mph) and for a period of 30 min minimum.

5.5.5 Nose Gear Oversteer Protection: The tractor shall be equipped with a fail-safe oversteer alerting device that:

a. activates an in-cab (red) warning light and audible alarm to indicate the maximum safety limit has been reached, and

b. requires a specific recordable action to complete the pushback/towing operation (in order to make it unmistakable to the tow vehicle driver that an inspection of the nose landing gear by an authorized person must be initiated).

In addition, it is desirable that the device activates an in-cab (amber) warning light and audible signal to indicate an operational limit has been reached. The oversteer warning system shall allow sufficient time for the tow vehicle operator to take appropriate action to avoid reaching a safety limit.

The system shall be automatically activated when the airplane is coupled to the tow vehicle.

The oversteer device shall be designed to protect the range of aircraft that can be handled by the tow vehicle.

In addition an optional system may provide a structural fuse (or other reliable load limiting system) on the tow vehicle which will prevent the application of loads on the nose landing gear that exceed the airframe manufacturer's specified limit.

5.6 Electrical System:

5.6.1 The tow vehicle shall be provided with a complete and good commercial quality electrical starting and lighting system. The system shall be made from reliable components.

5.6.2 The system shall operate with 24 V (or 12) DC system with battery capacity to suit electrical demand.

5.6.3 The following illumination is required:

5.6.3.1 Headlights at front.

5.6.3.2 Marker lights at front and rear.

5.6.3.3 A combination of lights for indicator lights, for direction flashers, braking and taillight. Direction flashers shall be visible from the side.

5.6.3.4 Warning beacons shall be fitted according to airport regulations.

5.6.3.5 Lamps shall be provided to illuminate coupling area.

5.6.3.6 A main battery switch is to be provided.

5.7 Tow Coupling (for Recovery of Tow Vehicle):

5.7.1 A universal coupling shall be provided at the center of the front end.

5.7.2 There shall be a recovery coupling for emergencies on one side at the rear end.

5.8 Cab:

5.8.1 Provision must be made to have good visibility of the coupling area.

5.8.2 Driver's seat shall be fully adjustable in height, seating position, and backward position.

5.8.3 Cabin shall have a sunshine roof (glass with sun protection/tinted) and be located directly above the driver's seat.

5.8.4 The side windows shall be designed as sliding windows. All windows shall be furnished with electrical heating or equivalent to prevent mist forming (option).

5.8.5 Front and rear windows shall be installed in an appropriate angle to minimize reflection.

5.8.6 Ventilation and heating of the cabin shall be provided.

5.8.7 The vehicle shall have front and rear windshield wipers separately activated. Wiper interval switch shall be standard. Washers shall be available as standard.

5.8.8 Ergonomic guidelines are to be taken into consideration.

5.8.9 A mirror allowing observation of the nose landing gear during operation shall be installed in the cabin.

5.8.10 There shall be a storage compartment which can hold a 286 x 324 x 76 mm (11.25 x 12.75 x 3 in) size file.

5.8.11 Interior illumination of the cabin shall be 350 lux.

5.8.12 Two outside mirrors shall be provided to enable driver to observe area. Electrical heating and adjustment are optional.

5.8.13 Driver must have a good field of visibility from all seat positions.

5.9 Logic Connection of Driver's Seat and Driving Direction:

5.9.1 All controls shall be automatically defined by the direction the driver is facing.

5.9.2 The steering direction (mode) of the vehicle shall always be regarded as forward direction.

5.10 The tow vehicle shall be equipped with the following controls:

a. Throttle
b. Service brake
c. Flashers/dimming switch
d. Emergency stop button (limit braking force)
e. Direction selection (vehicle travel)
f. Parking brake

5.11 The tow vehicle shall be equipped with the following instruments/indicators:

a. Multiwarning signal (flashing)
b. Parking brake set

5.12 The tow vehicle shall be equipped with the following switches and indication/control lamps:

a. Ignition switch with anti-restart
b. Start/stop device for engine
c. Amber warning beacons
d. Light switches
e. Dim switch
f. Other illumination (working lamps)
g. Position lights
h. Windshield wipers and washers in front and rear
i. Heating/ventilation
j. Controls for coupling system
k. Switch to select type of aircraft
l. Heating for windows in front and rear (optional)
m. Heating for mirrors (optional)
n. Electrical adjustment for mirrors (optional)
o. Dimmer for panel illumination
p. Testing device for all alarm circuits/lamps
q. Steering angle indication (optional)

5.13 Monitoring and Alarm Circuits/Lights:

5.13.1 The following instrument indicators are mandatory on the operation panel in the cab:

a. Operation hour meter
b. Battery charging control light
c. Engine oil pressure (monitor and warning signal) light
d. Engine temperature of coolant (monitor and warning signal)
e. Engine coolant low level warning (buzzer)
f. Fuel gauge
g. Indication: "Vehicle ready for operation (second/simultaneous verification of A/C relevant settings) (Identification of type of aircraft by pick-up system)
h. Speedometer
i. High beam (headlight) is on (blue signal)
j. Heater is on
k. Flashers are on

5.13.2 The following should be optional and mounted in a panel accessible for engineering:

a. Monitors indicating:

1. Preliminary heating
2. Hydraulic oil
3. Hydraulic oil temperature
4. Maintenance required for hydraulic filter
5. Emergency steering in operation
6. Emergency stop is activated
7. Electrical clock

All operating instruments and alarm signals shall be labeled on the panel.

5.14 Miscellaneous:

Quick check points for hydraulic oil pressure shall be installed.

Jacking points for wheel change and general maintenance shall be provided on the chassis.

Size of fuel tanks shall allow a one day operation for approximately 12 h with 50% load.

5.15 Coupling System:

The tow vehicle should be designed for coupling to the aircraft's nose landing gear.

5.15.1 The nosewheel coupling and holding system must be capable of capturing all aircraft types defined in 1.3 with consideration to including telescoping of the nose landing gear strut and turn geometry of nonvertical nose landing gear designs (exception pressureless nosewheel tires).

5.15.2 The nosewheel wheel must only be captured at the tire tread surface.

5.15.3 While in the fully engaged position, the nosewheel wheel must remain stabilized in the locking mechanism under all dynamic conditions. The nosewheel wheel must be retained above the axle to prevent escape in the upward direction.

5.15.4 Aircraft will be braked by wheel chocks or the parking brake and may not be moved in horizontal direction during pick up or release.

5.15.5 In fully coupled position the clamp device of the coupling system must lock automatically so that in case of hydraulic failure the nose landing gear is not involuntarily releasable.

5.15.6 In case of failure of the coupling system and/or clamp device the nose landing gear shall be released via an emergency system and in case the emergency system fails it must be possible to free the wheel manually.

5.15.7 The coupling system must be able to identify the type or class of aircraft that has been picked up and if the wrong type of aircraft has been programmed by the operator (or in case of incorrect preselection of aircraft type) the prime mover of the tow vehicle will be locked.

6. OPTIONS:

Tow vehicle manufacturers must make the following options available to customers. The standard version of the towbarless tow vehicle will include all required provisions such as extra space to house optional components and wiring.

6.1 Automatic fire extinguisher system

6.2 Airplane communication

6.3 Air conditioning

6.4 Snow chains