ANSI/ASABE S648-5.1 NOV2021
Agricultural Field Equipment Braking — Part 5: Requirements for the Interface between Towing Vehicle and Towed Vehicles

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Developed with the assistance of the members of the Association of Equipment Manufacturers (AEM), members of the Farm Equipment Manufacturers Association (FEMA) and members of the Agricultural Manufacturers of Canada (AMC). Approved as an ASABE and American National (ANSI) standard March 2020; revised November 2021.

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1 Purpose

The purpose of this standard, when used in conjunction with ANSI/ASABE S648-1, is to define the requirements for interfacing towing vehicle service and parking brakes with towed vehicles with a service brake system, a parking brake system or both.

2 Scope

This part of ANSI/ASABE S648 establishes the minimum requirements for interfacing the service brake system and parking brake system on towing agricultural field equipment with the service brake system and parking brake system on towed agricultural field equipment.

The requirements of this part of ANSI/ASABE S648 are applicable to dual line hydraulic and pneumatic systems but does not preclude the use of other equivalent systems.

These requirements and minimum performance criteria are directed to the operation and parking of agricultural field equipment having a maximum design ground speed greater than 6 km/h (3.7 mile/h).

3 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ANSI/ASABE S648-1, Agricultural Field Equipment Braking — Part 1: General Requirements

ANSI/ASABE S648-4, Agricultural Field Equipment Braking — Part 4: Requirements for Towed Vehicles

ISO 1728:2006, Road vehicles — Braking connections between motor vehicles and towed vehicles — Interchangeability

ISO 3583:1984, Road vehicles — Pressure test connection for compressed-air pneumatic braking equipment

ANSI/ASABE AD5675:2008, Agricultural tractors and machinery — General purpose quick-action hydraulic couplers

ISO 5676:1983, Tractors and machinery for agriculture and forestry — Hydraulic coupling — Braking circuit

ISO 15171-1:1999, Connections for fluid power and general use — Hydraulic couplings for diagnostic purposes — Part 1: Coupling not for connection under pressure

ISO 16028:1999 and Amd 1:2006, Hydraulic fluid power — Flush-face type, quick-action couplings for use at pressures of 20 MPa (200 bar) to 31,5 MPa (315 bar) — Specifications

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4 Terms and Definitions

For the purposes of this document, the terms and definitions found in ANSI/ASABE S648-1 apply.

5 General Requirements

5.1 The connections of the braking systems between towed and towing vehicles shall be provided as below:

— one service brake control line; and

— one supplemental line.

5.2 A towing vehicle authorized by the manufacturer to tow a vehicle as categorized in ANSI/ASABE S648-4 equipped with a service brake system and a parking brake system or a service brake only function, shall satisfy the following conditions:

a) The braking system of the towed vehicle is normally operated in conjunction with the service brake system or parking brake system of the towing vehicle.

b) When the service brake system of the towing vehicle is actuated, it shall also provide a graduated braking action for the service brake system of the towed vehicle.

c) Application of the towed vehicle brakes alone is permitted when the operation of the towed vehicle brakes is initiated either

— manually; or

— automatically for the sole purpose of vehicle stabilization.

d) It is permissible that towed vehicle brakes are applied automatically up to a time of five (5) seconds without the operation of the service brake system, secondary braking system or parking brake system of the towing vehicle.

e) If either the supplemental line or the control line between the towing vehicle and towed vehicle should fail, it shall still be possible to brake the combination with the performance prescribed for the secondary braking system.

5.3 The flexible hoses and cables connecting towing and towed vehicles shall be a part of the towed vehicle.

5.4 Graduated braking for the towed vehicle is only required when the service brake system of the towing vehicle is actuated while the engine is running.

5.5 In the case of a failure (e.g., fracture or leak) in the supplemental line, it shall be possible for the operator to fully or partially actuate the towed vehicle brakes, by means either of the service brake system control device or of the parking brake system control device, unless this failure automatically causes the towed vehicle to be braked.

5.6 Compatibility requirements

Vehicles requiring brakes shall fulfill the requirements of this section.

5.6.1 Towing vehicle compatibility requirements shown in Figure 1 and Table 1 shall be fulfilled. Towed vehicle compatibility requirements shown in or Table 2 or Table 3 shall be fulfilled.

5.6.1.1 The compatibility requirements of this section shall only apply when the towed vehicle is at maximum transport mass. These requirements shall be confirmed by calculation and utilized during the design process.

5.6.1.2 In all cases, the value of the transmitted pressure at the coupler, p_m, shall be on the ordinate axis (x-axis).

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5.6.2 Towing vehicle/towed vehicle compatibility

F_M = total normal static reaction force of road surface on wheels of a towing vehicle, N (lbf)

p_m = pressure at coupler of control line, kPa (psi)

T_M = sum of braking forces at the periphery of all wheels of towing vehicle, N (lbf)

T_R = sum of braking forces at the periphery of all wheels of towed vehicle, N (lbf)

5.6.2.1 Towing vehicle compatibility requirements

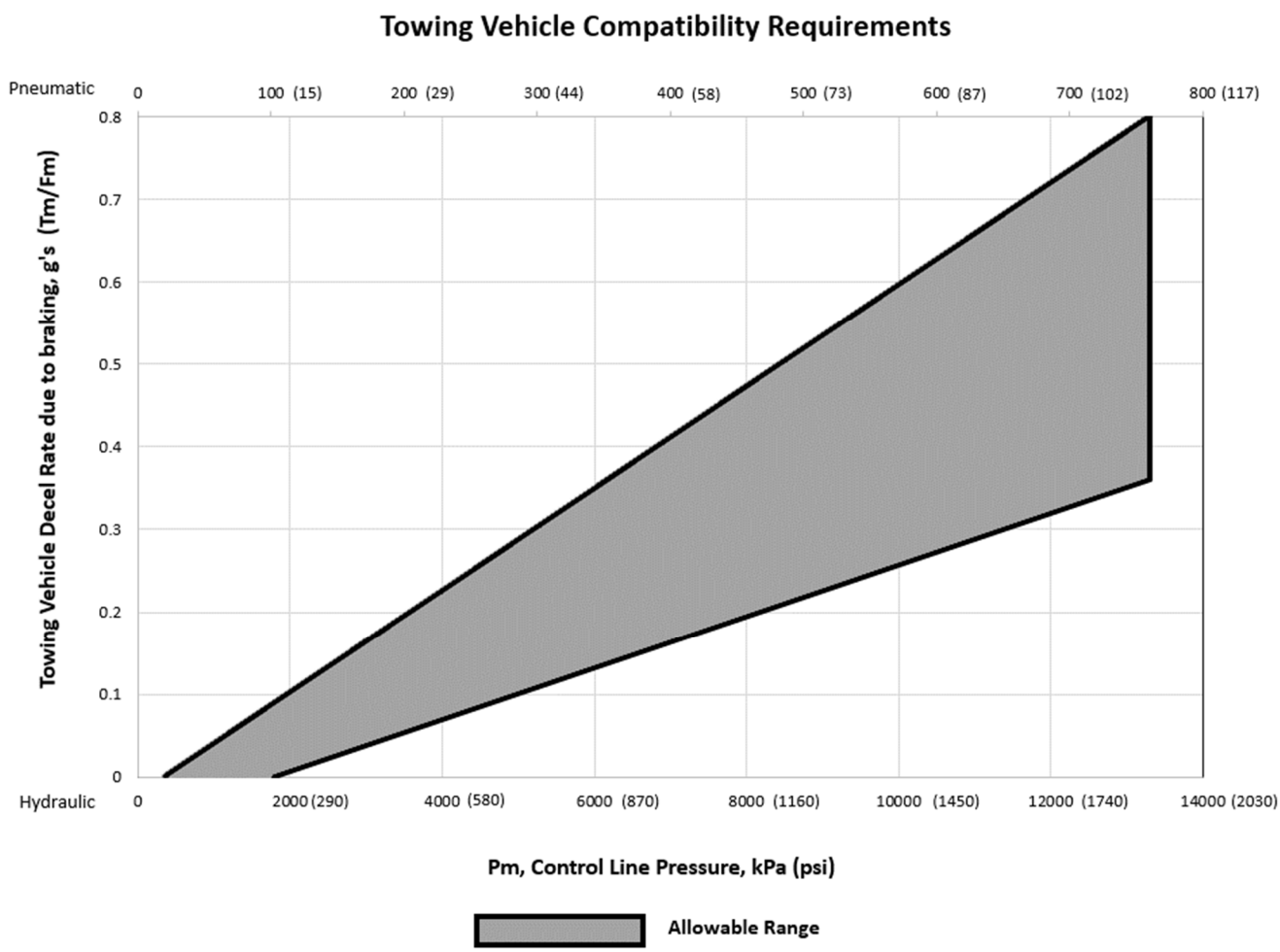

Figure 1 – Permissible relationship between braking rate T_M/F_M and the control line pressure p_m for towing vehicles

Table 1 – Towing vehicle allowable control line pressure, p_m

T_M/F_M	Towing Vehicle Allowable Control Line Pressure	
	Pneumatic Pressure Range, kPa (psi)	Hydraulic Pressure Range, kPa (psi)
0.01	60 (9) ± 40 (6)	1,065 (154) ± 715 (104)
Maximum	≤ 750 (109)	≤ 13,300 (1,929)

5.6.2.1.1 The permissible relationship between the braking rate T_M/F_M and the pressure p_m shall lie within the areas shown on Figure 1 for all pressures from 350 kPa (51 psi) – 13,300 kPa (1,929 psi) for hydraulic and from 20 kPa (2.9 psi) – 750 kPa (109 psi) for pneumatic control lines.

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5.6.2.1.2 The compatibility bands in Figure 1 should not be extended beyond 13,300 kPa (1,929 psi) for hydraulic systems or 750 kPa (109 psi) for pneumatic systems.

5.6.2.1.3 It shall be ensured that at the coupler of the supplemental line a pressure of at least 650 kPa (94 psi) pneumatic is available when systems are at the minimum pressure. This pressure shall be demonstrated without applying the service brakes.

5.6.2.1.4 Compatibility adjustments are permitted by the towing vehicle to allow use with towed vehicles designed to legacy requirements and with towed vehicle trains.

5.6.2.2 Towed vehicle compatibility requirements

Brake force requirements versus respective control line pressures for towed vehicles are defined in Table 2 and Table 3.

Table 2 – Minimum required brake force, T_R, versus control line pressure, p_m, for towed vehicles with maximum design ground speed of less than or equal to 32 km/h (20 mile/h)

Minimum Required Brake Force, N	Pneumatic Pressure Range, kPa (psi)	Hydraulic Pressure Range, kPa (psi)
Maximum transport mass, kg × 0.95	≤ 650 (94)	≤ 11,500 (1,668)
Maximum transport mass, kg × 0.62	340 (49) ± 50 (7)	5,300 (769) ± 900 (130.5)
No braking	≤ 20 (3)	≤ 350 (51)

Table 3 – Minimum required brake force, T_R, versus control line pressure, p_m, for towed vehicles with maximum design ground speed of greater than 32 km/h (20 mile/h)

Minimum Required Brake Force, N	Pneumatic Pressure Range, kPa (psi)	Hydraulic Pressure Range, kPa (psi)
Maximum transport mass, kg × 5.00	≤ 650 (94)	≤ 11,500 (1,668)
Maximum transport mass, kg × 2.45	340 (49) ± 50 (7)	5,300 (769) ± 900 (130.5)
No braking	≤ 20 (3)	≤ 350 (51)

6 Hydraulic Braking System Requirements

6.1 General performance requirements for vehicles authorized to tow vehicles fitted with hydraulic braking systems

6.1.1 Couplers

6.1.1.1 The hydraulic control line is the connecting line between the male connector on the towing and the female connector on the towed vehicle. The connectors on this line shall comply with ISO 5676:1983. Control line can be used in the absence of the supplemental line.

6.1.1.2 The hydraulic supplemental line is the connecting line with the male connector on the towing and the female connector on the towed vehicle. The connectors on this line shall comply with ISO 16028:1999 and AMD 1:2006, size 10.

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