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**SAE J721 MAY87**

**Operating  
Requirements for  
Tractors and Power  
Take-Off Driven  
Implements**

SAE Standard  
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OPERATING REQUIREMENTS FOR TRACTORS  
AND POWER TAKE-OFF DRIVEN IMPLEMENTS

1. PURPOSE AND SCOPE:

- 1.1 This SAE Standard was prepared to assist manufacturers of tractors and implements in providing suitable means of transmitting power from the tractor power take-off to the implement, and satisfactory hitching of the implement to the tractor.
- 1.2 The SAE Standard J1170, Rear Power Take-Off for Agricultural Tractors, provides dimensions relating to the tractor power take-off shaft, master shield, and drawbar; also, provides specifications for the splined power take-off shaft and the mating connector; and, establishes and defines three sizes and/or types of power take-off shaft dimensions.
- 1.3 The SAE Standard J715 SEP83, Three-Point Free-Link Hitch Attachment of Implements to Agricultural Wheeled Tractors, sets forth requirements for the attachment of three-point hitch implements or equipment to the rear of agricultural wheel tractors.
- 1.4 The successful performance of all tractor and implement combinations likely to be met in field service requires consideration of factors other than the dimensional relationship provided in the aforementioned SAE standards.

2. DEFINITIONS:

- 2.1 Power Take-Off (PTO) means an external shaft on the rear of a tractor to provide rotational power to implements.
- 2.2 Implement Input Driveline (IID) and Implement Input Connection (IIC): Refer to ASAE Standard S318.8, Safety for Agricultural Equipment.

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2.3 Implement Input Connection (Ref. para. 2.11 ASAE S318.8).

### 3. INSTRUCTIONS FOR THE OPERATOR:

3.1 The implement manufacturer shall provide a sign in a prominent place on the implement specifying the required tractor drawbar hitch point location and/or implement hitch adjustments.

3.2 The implement operator's manual shall also include the above information.

3.3 If a conversion assembly is made available for changing tractors or implements from 540 to 1000 rpm or from 1000 to 540 rpm, these conversion assemblies shall include a sign specifying the power take-off speed and the corresponding drawbar adjustments.

3.4 For recommended safety instructions, refer to SAE Standard J208 JUL83, Safety for Agricultural Equipment.

### 4. IMPLEMENT DRIVELINE AND HITCH REQUIREMENTS:

4.1 Provisions should be made in the IID and IIC and hitch of the implement to prevent any of the following from occurring during normal operation when attached and operated according to the instructions of the implement manufacturer to any tractor which conforms with SAE Standards J1170 and J715 SEP83:

4.1.1 The universal joints in the IID from reaching a locking angle.

4.1.2 The telescoping section of the implement driveline from separating beyond the point where there is sufficient bearing to provide for proper operation.

4.1.3 The IID from sustaining damage from telescoping to a solid position.

4.1.4 The IID or its shields from sustaining damage due to contacting the implement hitch or hitch pin, or any tractor parts such as master shield or three-point hitch linkage.

#### 4.2 Vertical Loads on Drawbars:

4.2.1 The minimum vertical static loads which the tractor drawbar must withstand are shown in Table 1.

4.2.2 The maximum vertical static loads which the implement shall impose upon the tractor drawbar are shown in Table 1. The dynamic loads imposed upon the tractor drawbar and implement hitch will be considerably higher than static load ratings.

4.2.3 The use of a hitch extender will require a reduction in the vertical static load to limit the maximum bending moment in the tractor drawbar to that allowed in paragraph 4.2.1.

TABLE 1 - VERTICAL STATIC LOADS ON DRAWBARS

Max Power <sup>a</sup>	Drawbar Load	
	kN	lbf
14.9-74.6 kW (20-100 hp)	3.34 + 0.15 per kW for excess over 14.9 kW	750 + 25 per hp for excess over 20 hp
74.6-186.4 kW (100-250 hp)	12.23 + 0.06 per kW for excess over 74.6 kW	2750 + 10 per hp for excess over 100 hp
186.4-372.5 kW (250-500 hp)	18.90 + 0.03 per kW for excess over 186.4 kW	4250 + 5 per hp for excess over 250 hp

<sup>a</sup>Maximum drawbar power established per SAE Standard J708 DEC84, Agricultural Tractor Test Code.

5. MAXIMUM BENDING LOAD LIMITATIONS FOR POWER TAKE-OFF SHAFT DRIVES EMPLOYING V-BELTS OR CHAINS:

- 5.1 The PTO shaft of tractors is designed primarily to transmit torsional loads. The total bending load imposed on the tractor PTO shaft by V-belt or chain drives should not be in excess of values shown in the following table:

Position of Load Application	1-3/8 Diameter Power Take-Off		1-3/4 Diameter Power Take-Off	
	kN	(lbf)	kN	(lbf)
At the end of the PTO shaft	2.22	(500)	3.56	(800)
Between the PTO shaft rear bearing and/or at the groove in the outside diameter of the PTO shaft splines	2.67	(600)	4.45	(1000)

The tractor PTO shaft and bearing mountings should successfully withstand this magnitude of bending loads shown in the table.

6. TORSIONAL LOAD CONSIDERATIONS:

- 6.1 Because of the large amount of kinetic energy available at the PTO shaft, instantaneous torsional loads and fluctuating operating loads in excess of the average rated power of the tractor may be transmitted.

7. PTO SHAFT AND IMPLEMENT DRIVELINE THRUST LOAD LIMITATIONS:

- 7.1 The tractor PTO shall be designed to accept IID telescoping thrust force values in Table 2 based on PTO power at rated engine speed as established per SAE Standard J708 DEC84, Agricultural Tractor Test Code. A properly maintained implement at its designed power shall not impose IID telescoping thrust forces upon the tractor PTO in excess of the values in Table 2, recognizing that instantaneous thrust forces may exceed these values.

TABLE 2 - PTO THRUST FORCES

	PTO Power		Thrust	
	kw	(hp)	kN	(lbf)
1-3/8 PTO	15-25	(20.1-33.5)	7.00	(1575)
	Over 25-40	(33.5-53.6)	9.00	(2025)
	Over 40-60	(53.6-80.5)	11.00	(2475)
	Over 60-110	(80.5-147.5)	13.00	(2925)
	Over 110	(147.5)	14.00	(3150)
1-3/4 PTO	Over 110	(147.5)	18.00	(4050)

8. REFERENCES:

- ASAE 207  
 ASAE 331  
 ASAE 318  
 ISO 500