Operating Requirements for Power Take-Off Drives — SAE J721f

SAE RECOMMENDED PRACTICE

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OPERATING REQUIREMENTS FOR POWER TAKE-OFF DRIVES - SAE J721f

SAE Recommended Practice

Report of Tractor Technical Committee approved June 1953 and last revised June 1975. Conforms to report of FIEI Advisory Engineering Committee.

1. PURPOSE AND SCOPE

1.1 This SAE Recommended Practice was prepared to assist manufacturers of tractors and pto-driven machines in providing suitable means of power tansmission from the tractor to the driven machine.

1.2 SAE J718 and J719 specify the essential dimensions of tractor components necessary to enable manufacturers of driven machines to provide for the satisfactory hitching of their machines to any make of tractor. The successful performance of all tractor and driven-machine combinations likely to be met in field service requires consideration of many factors other than the dimensional relationships established in the aforementioned SAE Standards. Some of the more important of these factors are as follows.

2. INSTRUCTIONS FOR THE OPERATOR

2.1 The tractor manufacturer shall provide a safety instruction in a prominent place on the tractor specifying:

2.1.1 The normal operating speed of the rear power take-off shaft (540 or 1000 rpm).

2.1.2 That the tractor drawbar is to be adjusted and locked in a position so that the drawbar hitch point is located in accordance with dimensions shown in SAE J718 for the 540 rpm power take-off shaft and in SAE J719 for the 1000 rpm power take-off shaft.

2.1.3 That powerline safety shields are to be kept in place.

2.2 The implement manufacturer shall provide an instruction in a prominent place on the implement specifying:

2.2.1 The normal operating speed of the power take-off drive to the implement (540 or 1000 rpm).

2.2.2 That the powerline safety shields are to be kept in place.

2.3 The operator's manuals for both tractors and power take-off driven implements shall also include the preceding information.

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

3. IMPLEMENT HITCH AND POWERLINE DESIGN REQUIREMENTS

3.1 The hitch and powerline of any pto-driven machine, when the machine is hitched to any tractor that conforms to SAE J718 and J719 should provide satisfactory operation over any terrain the machine is likely to encounter. To meet any such operating conditions, provisions should be made in the powerline and hitch of the driven machine to prevent any of the following from occurring:

3.1.1 The universal joints in the powerline from reaching a locking angle.

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

3.1.3 The telescoping of the powerline from shortening to a solid position.

3.2 In normal forward operation the universal joints in the powerline of the driven machine should be in straight alignment as nearly as possible, and should be positively indexed with respect to each other so as to maintain the torsional-load fluctuations at the lowest possible value. Extreme care should be taken to determine load fluctuations or load reversals when employing one or three universal joints in a powerline.

3.3 VERTICAL DRAWBAR LOADS

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

3.3.2 The maximum vertical static loads which the equipment shall impose upon the tractor drawbar are shown in Table 1. The dynamic loads imposed upon the tractor drawbar and equipment hitch, at these static load ratings, will be considerably higher. Established in accordance with SAE J708, paragraph 2.5.

4. MAXIMUM BENDING LOAD LIMITATIONS FOR

POWER TAKE-OFF SHAFT DRIVES EMPLOYING V-BELTS OR CHAINS—

4.1 The power take-off drive of tractors is designed primarily to transmit torsional loads. When V-belt or chain drives with the driving sheave or sprocket mounted directly on the power take-off shaft are used, bending loads on the shaft should be checked carefully. The total bending load imposed on the tractor power take-off shaft by drives of this type should not be in excess of values shown in the table.

Position of Load Application	1-3/8 Dia Power Take Off		1-3/4 Dia Power Take Off	
	lb	kg	lb	kg
At end of power take-off shaft	500	227	800	363
Between power take-off shaft rear bearing and/or at groove in outside diameter of power take-off shaft splines	600	272	1000	454

The tractor power take-off shaft and bearing mountings should successfully withstand the magnitude of bending loads shown in the table.

5. POWERLINE PROTECTIVE COUPLINGS AND MAXIMUM TORSIONAL LOAD LIMITATIONS FOR POWER TAKE-OFF SHAFTS—

5.1 The dynamic torsional loads on power take-off drives should be checked carefully. Because of the large amount of kinetic energy available at the power take-off shaft, instantaneous torsional loads and fluctuating operating loads far in excess of the average rated horsepower of the tractor may be transmitted. Transmittal of these excessive loads can result in premature failure of the driving parts.

5.2 Implements subject to high starting loads or plugging should be equipped with an overload protective device in the powerline which will protect the drive against torsional overloads of sufficient magnitude to cause mechanical failure of either tractor or implement parts.

5.3 In consideration of the foregoing factors it is desirable for implements to conform to the following conditions:

5.3.1 The instantaneous operating loads should not exceed 9000 lb-in (103.7 kg-m) for the 1-3/8 diameter shaft or 15,000 lb-in (172.8 kg-m) for the 1-3/4 diameter shaft under conditions where there is no reversal of load. When a repetitive reversal of load is encountered, the aforementioned load limitations must be reduced by the amount of the reverse load. When the frequency of the instantaneous load does not exceed 10 cycles/hr, implements imposing loads greater than 9000 lb-in (103.7 kg-m) for the 1-3/8 diameter shaft or 15,000 lb-in (172.8 kg-m) for the 1-3/4 diameter shaft should have a powerline protective device which does not exceed a maximum instantaneous slip value of 15,000 lb-in (172.8 kg-m) for the 1-3/8 diameter shaft or 26,000 lb-in (299.6 kg-m) for the 1-3/4 diameter shaft.

5.3.2 The requirements in paragraph 5.3.1 will generally be met with a smooth-surface frictional type of powerline protective device which does not exceed a breakaway value of 4000 lb-in (46.1 kg-m) for the 1-3/8 diameter shaft or 6400 lb-in (73.7 kg-m) for the 1-3/4 diameter shaft when checked under static conditions. Snap-type spring-loaded jaw clutches should not be evaluated under static conditions, and, therefore, must comply with paragraph 5.3.1 above.

5.3.3 Power take-off implements which are capable of being loaded with a continuous torque in excess of 3000 lb-in (34.6 kg-m) at the drive shaft shall be equipped with a low friction telescoping shaft incapable of transmitting an axial thrust in excess of 1500 lb (680 kg).

5.3.4 Tractors capable of imposing inertia loads on the powerline as high as those previously mentioned should have a power take-off drive capable of transmitting a torque equivalent to that described in paragraph 5.3.1 without failure. Tractors which are not capable of transmitting a torque of this magnitude, should have a drive of sufficient strength to transmit the maximum torque they are capable of delivering to the power take-off drive.