

**ASAE S217.12 DEC01 (ISO+730-1:1994)
Three-Point Free-Link Attachment for Hitching Implements
to Agricultural Wheel Tractors**



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Three-Point Free-Link Attachment for Hitching Implements to Agricultural Wheel Tractors

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0 Forward

0.1 This document is equivalent to ISO 730-1:1994 E. Differences between ASAE S217.11 and ISO 730-1 pertain to the following areas; 1) implement mast height, 2) PTO to lower hitch point distance, 3) power stroke, 4) mast kick-up, and 5) two Category 4 sizes. Designers of new tractors and implements shall design to ISO 730-1, but should be aware

of the quantity of equipment in use designed to ASAE S217.11 and consider these differences when completing new designs. Table 0 summarizes the differences between ISO 730-1 and ASAE S217.11. It is presented only as a brief overview of the differences. Designers should review both Standards so that they are fully aware of any subtle differences not contained in this overview.

0.2 Implement mast: The standard implement mast height is shown in Table 4, dimension “h”. There is no change from ASAE S217.11 implement mast heights for Category 1 and 4. Category 2 and 3 ASAE implement mast heights are approximately 125 mm shorter. Footnote 1 of Table 4 notes the ASAE S217.11 implement mast heights to inform both the tractor and implement designer for consideration during the transition period of their equipment to ISO 730-1.

0.3 PTO to lower hitch point: ISO 730-1 provides a dimensional overlap with ASAE S217.11 in the horizontal dimension from the PTO to the lower hitch points when the lower link is horizontal for Categories 1 and

Table 0 – Comparison

Dimensions in mm

Description	Hitch Category	ISO 730-1	ASAE S217.11
Dimensions associated with Implement			
Implement mast height (Clause 0)	1	460+/-1.5	457
	2	610+/-1.5	483
	3	685+/-1.5	559
	4L	685+/-1.5	686
	4H	1,100+/-1.5	Not Available
Special hitch categories (Clause 0.7)	1N	400	Not Available
	2N	683	Not Available
	3N	825	822.5–825.5
	4N	920	919–922
Dimensions associated with tractor			
PTO to Lower hitch point (Clause 0.3)	1	500–575	508–559
	2	550–625	508–559
	3	575–675	508–559
	4L	575–675	508–559
	4H	610–670	Not Available
Minimum transport height (Clause 0.4)	1	820	813
	2	950	914
	3	1,065	1,016
	4L	1,200	1,120
	4H	1,200	Not Available
Power range (Clause 0.5)	1	610	559
	2	650	610
	3	735	660
	4L	760	762
	4H	900	Not Available
Upper link attaching points (Clause 0.6)	1, 2, 3, 4	–3 to 3 deg +10 to 15 deg	Not Specified

Table 1 – Categories

Category	PTO power at rated rotational frequency of engine ¹⁾ kW
1	up to 48
2	up to 92
3	80 to 185
4	150 to 350

¹⁾Determined in accordance with ISO 789-1.

2. This overlap allows the designer to meet both ASAE S217.11 and ISO 730-1 with the same components. This condition is not the same for Categories 3 and 4 as the ISO 730-1 minimum dimension is 16mm longer than the ASAE S217.11 maximum. As a result, tractors and equipment designed for use in the North American market should be designed to the minimum ISO dimensions. This will assure backward compatibility between new tractors and old implements.

0.4 Minimum height for highest position: ISO 730-1 recognizes the growth of tire sizes in the industry, which accounts for differences between ISO 730-1 and ASAE S217.11 in the minimum height for the highest position (transport height).

0.5 Power range: ISO 730-1 recognizes the growth in both tractor power and implements size. These larger fully mounted implements require additional power range.

0.6 Upper link attaching points: ISO 730-1 recognizes that implements worldwide can generally be divided into two classes; 1) those requiring near parallel lift and 2) those requiring maximum tail clearance when fully raised. Clause 4.1.2 for these reasons specifically requires two different upper link points on the tractor.

0.7 Special hitch categories (narrow): ISO 730-1 recognizes special “narrow” hitch categories commonly used in the North American “row” crop market. This information is found in Footnote 1 of Table 2.

0.8 Category 4 light and heavy: ISO 730-1 recognizes the need for both a “light duty” and “heavy duty” hitch category within the current Category 4 power range.

1 Scope

This part of S217.12 (ISO 730) specifies the dimensions and requirements of the three-point linkage for the attachment of implements or equipment to the rear of agricultural wheeled tractors. It specifies four categories to be used on different ranges of agricultural tractors as shown in Table 1.

Category 4 has been divided into two parts, 4L and 4H, depending on the location of the power take-off (PTO). Category 4L and 4H dimensions apply to tractors with the PTO, respectively, below and above the rear axle centerline.

Dimensions and requirements for the three-point linkage for the attachment of implements or equipment to the front of agricultural tractors are given in ISO 8759-2[3].

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of S217.12 (ISO 730). At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of S217.12 (ISO 730) are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ASAE S349.2 DEC98, Test Procedure for Measuring Hydraulic Lift Capacity on Agricultural Tractors Equipped With Three-Point Hitch

SAE J711 MAR91, Tire Selection Tables for Agricultural Tractors of Future Design

SAE J2708 APR93, Agricultural Tractor Test Code

ISO 789-1:1990, Agricultural tractors—Test procedures—Part 1: Power tests for power take-off.

ISO 2332:1993, Agricultural tractors and machinery

— Connection of implements via three-point linkage

— Clearance zone around implement.

3 Definitions

For the purposes of this part of S217.12 (ISO 730) the following definitions for components and dimensions in 3.2. The last element of the definition number in 3.2 is also the key number for the element of dimension in Figures 1, 2 and A1.

3.1 General

3.1.1 linkage: Combination of one upper link and two lower links, each articulated to the tractor and the implement at opposite ends, in order to connect the implement to the tractor.

3.1.2 hitch point: Articulated connections between link and implement.

NOTE 1 For geometrical purposes the hitch point is the centre of the articulated connection between link and implement.

3.1.3 link point: Articulated connection between link and tractor.

NOTE 2 For geometrical purposes the link point is the centre of the articulated connection between link and tractor.

3.1.4 three-point hitch coupler: Device which facilitates the connection of the tractor three-point linkage to the implement.¹⁾

3.2 Linkage components and dimensions

3.2.1 upper link: Upper linkage element, fitted with an articulated connection at both ends.

3.2.2 lower link: Lower linkage element, fitted with an articulated connection at both ends.

3.2.3 upper hitch point: Articulated connection between the upper link and the implement.

3.2.4 lower hitch point: Articulated connection between a lower link and the implement.

3.2.5 upper link point: Articulated connection between the upper link and the tractor.

3.2.6 lower link point: Articulated connection between a lower link and the tractor.

3.2.7 upper hitch attachment: Pin, usually detachable and forming part of the upper link assembly, by which an upper link is secured.

3.2.8 lower hitch attachment: Pin, or clevis and pin, usually attached to the implement, by which a lower link is secured.

3.2.9 upper link attachment: Pin by which the upper link is connected to the tractor.

3.2.10 lynch pin: Pin, usually fitted with a spring-retaining device, by which an articulated connection is retained in position.²⁾

3.2.11 lift rods: Connections that transmit force to the lower links for raising and lowering.

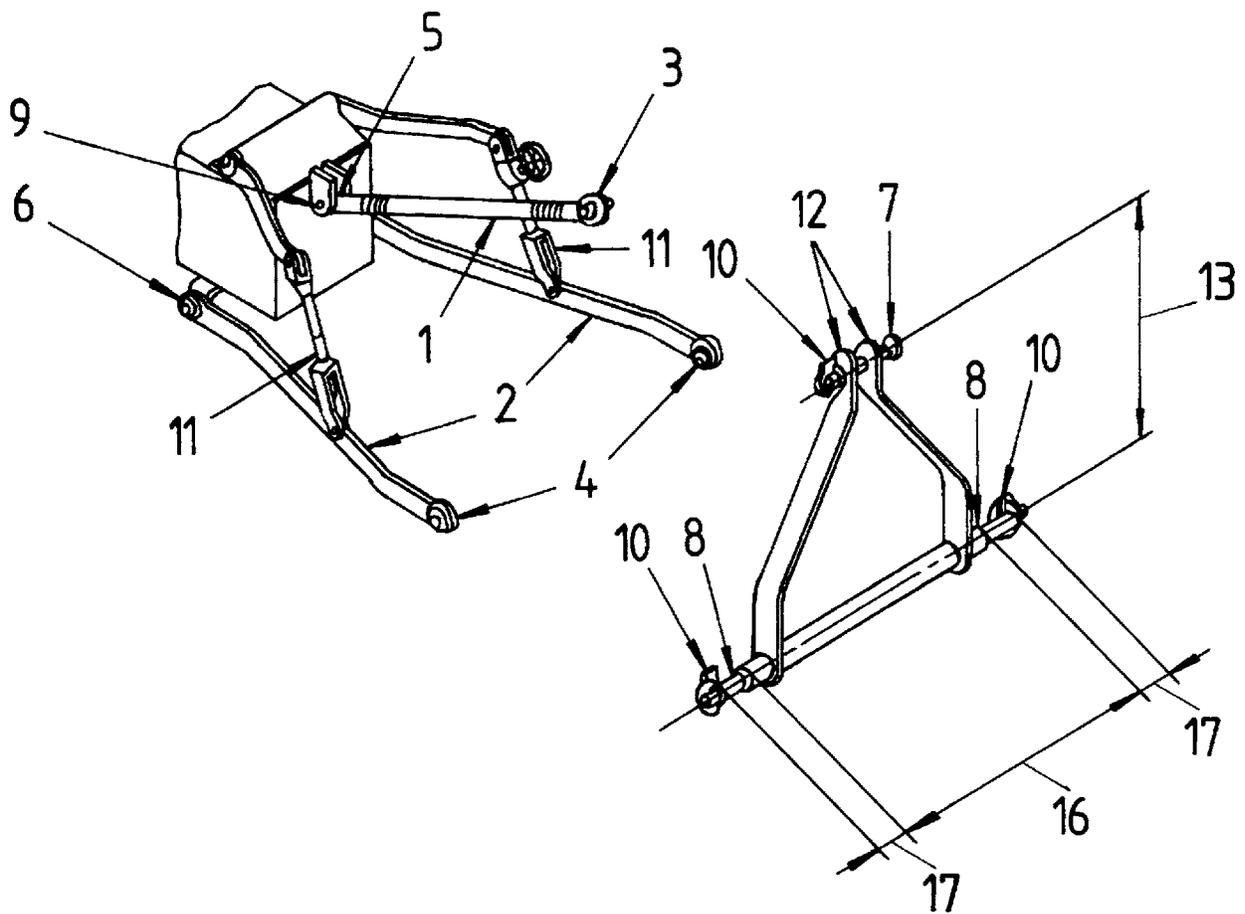
3.2.12 mast: Component that provides location of the upper hitch point on the implement.

3.2.13 mast height: Vertical distance between the upper hitch point and the common axis of the lower hitch points.

3.2.14 lower hitch point height: Height of the center of the lower hitch points above ground level when they are fully lowered using the full

¹⁾For examples, see annex B [4] to [7].

²⁾See annex B [2].



Key

- | | | | |
|---|------------------------|----|-------------------------|
| 1 | Upper link | 9 | Upper link attachment |
| 2 | Lower link | 10 | Linch pin |
| 3 | Upper hitch point | 11 | Lift rods |
| 4 | Lower hitch point | 12 | Mast |
| 5 | Upper link point | 13 | Mast height |
| 6 | Lower link point | 16 | Lower hitch point span |
| 7 | Upper hitch attachment | 17 | Linch pin hole distance |
| 8 | Lower hitch attachment | | |

Figure 1 – Components of three-point hitch

extent of manual adjustment provided in the lift rods in conjunction with the movement range with the lower hitch point axis maintained horizontal to the ground in a transverse plane.

3.2.15 levelling adjustment: Movement, measured vertically, of either lower hitch point higher or lower than the other, to allow inclination of the implement, measured with one lower link horizontal.

3.2.16 lower hitch point span: Distance between the shoulders of the lower hitch pins against which the sides of the lower link ball joints abut.

3.2.17 linch pin hole distance: Distance from the centerline of the linch pin hole to the shoulder of the hitch pin.

3.2.18 movement range: Vertical movement of the lower hitch points corresponding to the power travel of the lift, excluding any adjustment in the lift rod linkage.

3.2.19 transport height: Total height of the lower hitch points above the ground using the full extent of manual adjustment provided in the lift rods in conjunction with the movement range, with the lower hitch point axis maintained horizontal to the ground in a transverse plane.

3.2.20 lower hitch point clearance: Clearance expressed as a radial dimension from the lower hitch point axis to the outside diameter of the tyre, mudguard or other part of the tractor, measured in a longitudinal vertical plane with the implement raised to transport height and all side-sway prevented.

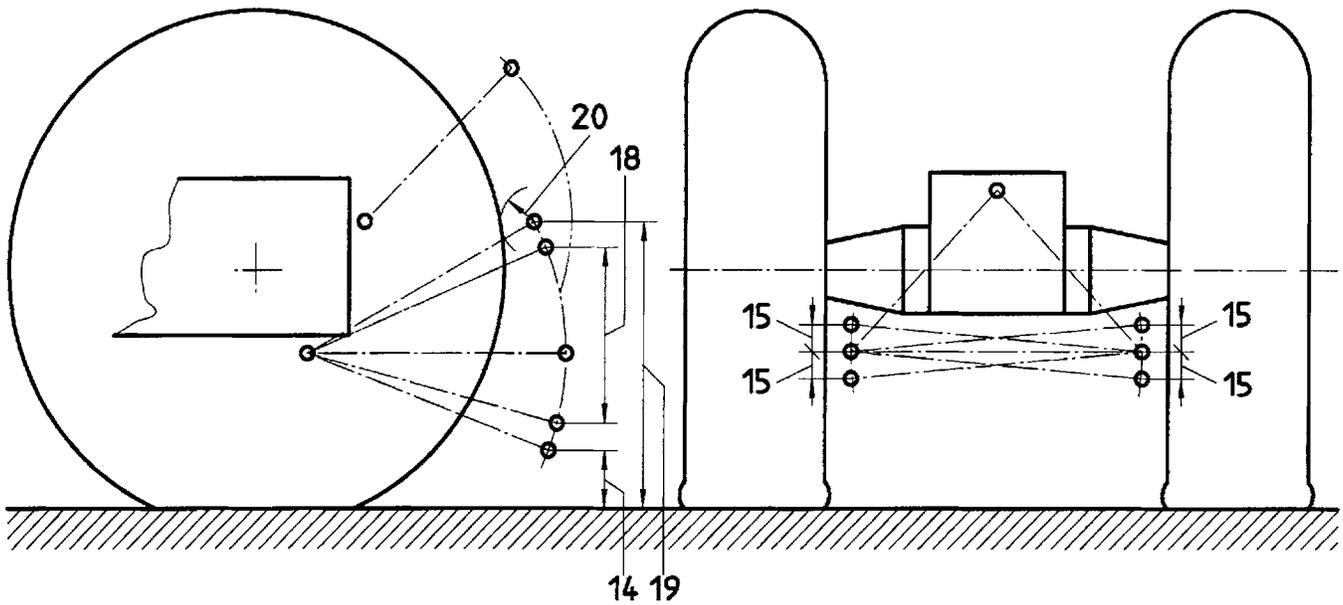
3.2.21 pitch: Angle of the mast to the vertical, considered positive when anticlockwise viewed from the left-hand side of the tractor.

3.2.22 mast adjustment: Usable range of pitch of the mast from a vertical plane. It is measured at the maximum and minimum height of the lower hitch points above the ground between which the mast (3.2.12), when using the specified mast height, can be adjusted to any inclination between $+5^\circ$ and -5° from the vertical.

NOTES

3 Mast adjustment is not shown in figure.

4 Adjustment of the mast controls the pitch of the implement. Specifying the mast adjustment to be provided enables the tractor designer to determine the minimum acceptable adjustment of the

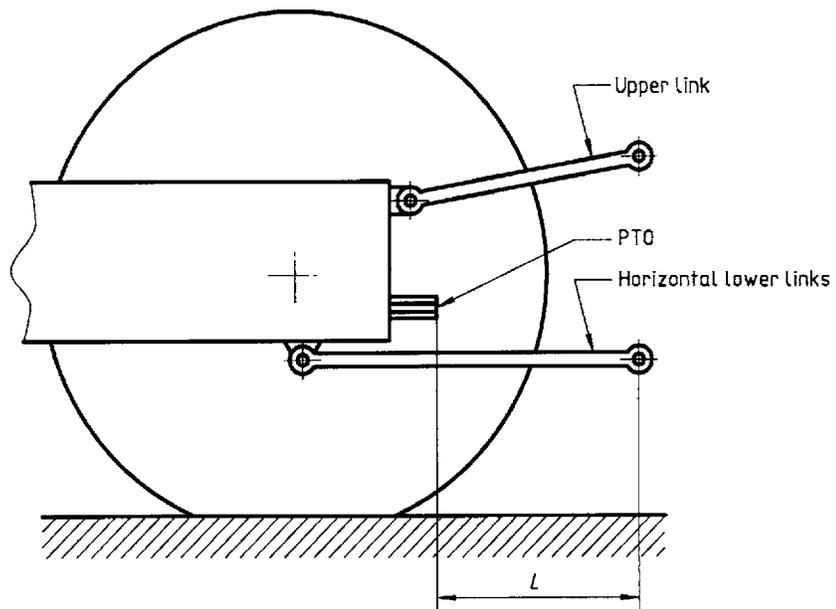


Key

- 14 Lower hitch point height
- 15 Levelling adjustment
- 18 Movement range
- 19 Transport height
- 20 Lower hitch point clearance

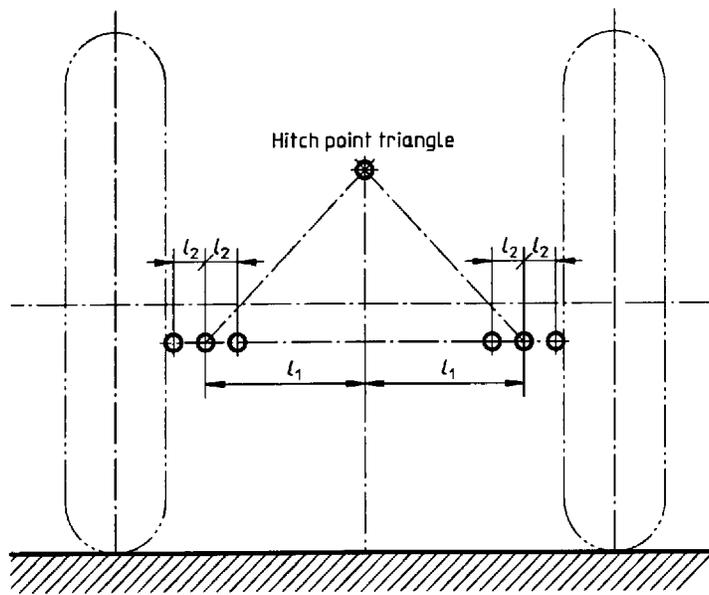
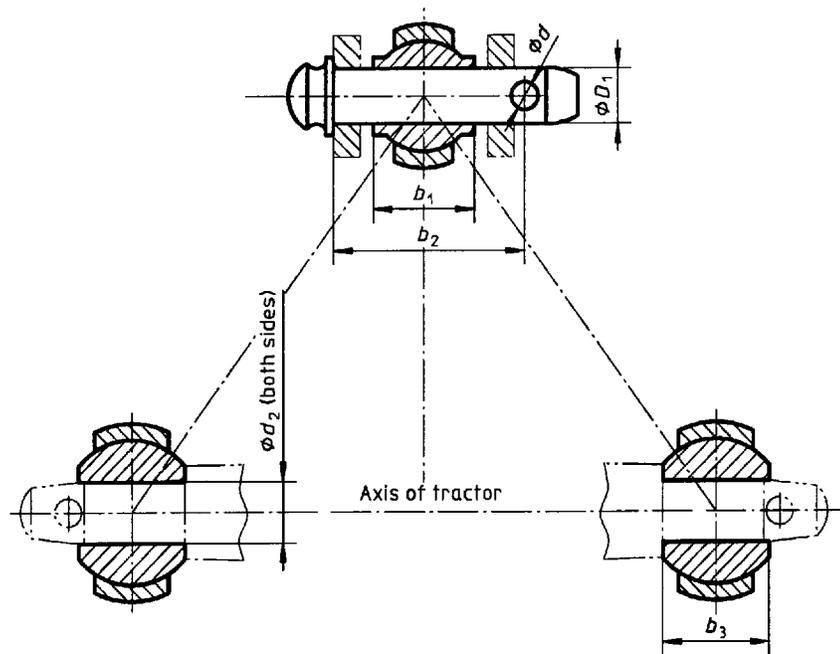
NOTE — Some dimensions are shown in figures 1 and A.1.

Figure 2 – Dimensions of three-point hitch



NOTE — Dimension *L* is given in table 2.

Figure 3 – Distance from PTO to lower link points



NOTE — Dimensions are given in table 2, except d , in table 4.

Figure 4 – Dimensions concerning tractor hitch points

Table 2 – Dimensions concerning tractor hitch points

Dimensions in millimeters

Dimension	Description	See figure	Category				
			1	2	3	4L	4H
Upper hitch points							
D_1	Diameter of hitch pin	4	19 _{-0.08} ⁰	25,5 _{-0.13} ⁰	31.75 _{-0.2} ⁰	45 _{-0.8} ⁰	45 _{-0.8} ⁰
b_1	Width of ball	4	44 max.	51 max.	51 max.	64 max.	64 max.
b_2	Linch pin hole distance	4	76 min.	93 min.	102 min.	140 min.	140 min.
Lower hitch points							
d_2	Diameter of hitch pin hole	4	22.4 ₀ ^{+0.25}	28.7 ₀ ^{+0.3}	37.4 ₀ ^{+0.35}	51 ₀ ^{+0.5}	51 ₀ ^{+0.5}
b_3	Width of ball	4	35 _{-0.2} ⁰	45 _{-0.2} ⁰	45 _{-0.2} ⁰	57.5 _{-0.5} ⁰	57.5 _{-0.5} ⁰
l_1	Lateral distance from lower hitch point to centerline of tractor ¹⁾	4	359	435	505	610 or 612	610 or 612
l_2	Lateral movement of lower hitch point	4	100 min.	125 min.	125 min.	130 min.	130 min.
L	Distance from end of power take-off to center of lower hitch point, with the lower link horizontal ²⁾³⁾	3	500 to 575	550 to 625	575 to 675	575 to 675	610 to 670

¹⁾It may be necessary to vary these dimensions in the case of specialized implements. Where a shorter distance between the lower hitch points appears necessary, the following values are preferred:

- 218 mm for category 1;
- 364 mm for category 2;
- 435 mm for category 3;
- 489 mm for category 4.

²⁾If a three-point hitch coupler is used, dimension L may be shortened accordingly, so that the distance between PTO and power input connection (PIC) remains the same.

³⁾Dimensions apply only to nominal diameter [1] 35 mm PTO-shafts and shall be increased by 100 mm if a nominal diameter [1] 45 mm PTO-shaft is used.

length of the top link in relation to the points of attachment of the linkage. It also permits the implement designer to determine the range of operating depths of the implement over which pitch adjustment can be obtained.

3.2.23 torsional free float distance: Vertical distance that either of the lower hitch points can move free relative to the other to allow the implement to roll, with lower links initially horizontal.

3.2.24 transport pitch: Pitch reached by the mast when lifted to standard transport height from a position with horizontal lower links and vertical mast.

3.2.25 horizontal convergence distance: Horizontal distance from the lower hitch points to the point of convergence of the lower links when the lower links are horizontal and laterally symmetrical, seen in a plan view (see Figure A1).

3.2.26 vertical convergence distance: Horizontal distance from the

lower hitch points to the point of convergence formed in the vertical longitudinal plane by the top link and the lower links (see Figure A1).

4 Tractor

4.1 Dimensions

Dimensions apply to the tractor equipped with the normal range of tire sizes as recommended by the tractor manufacturer.

4.1.1 Hitch points

The dimensions concerning the hitch points shall be as given in Figures 3 and 4, and Table 2.

4.1.2 Upper link point

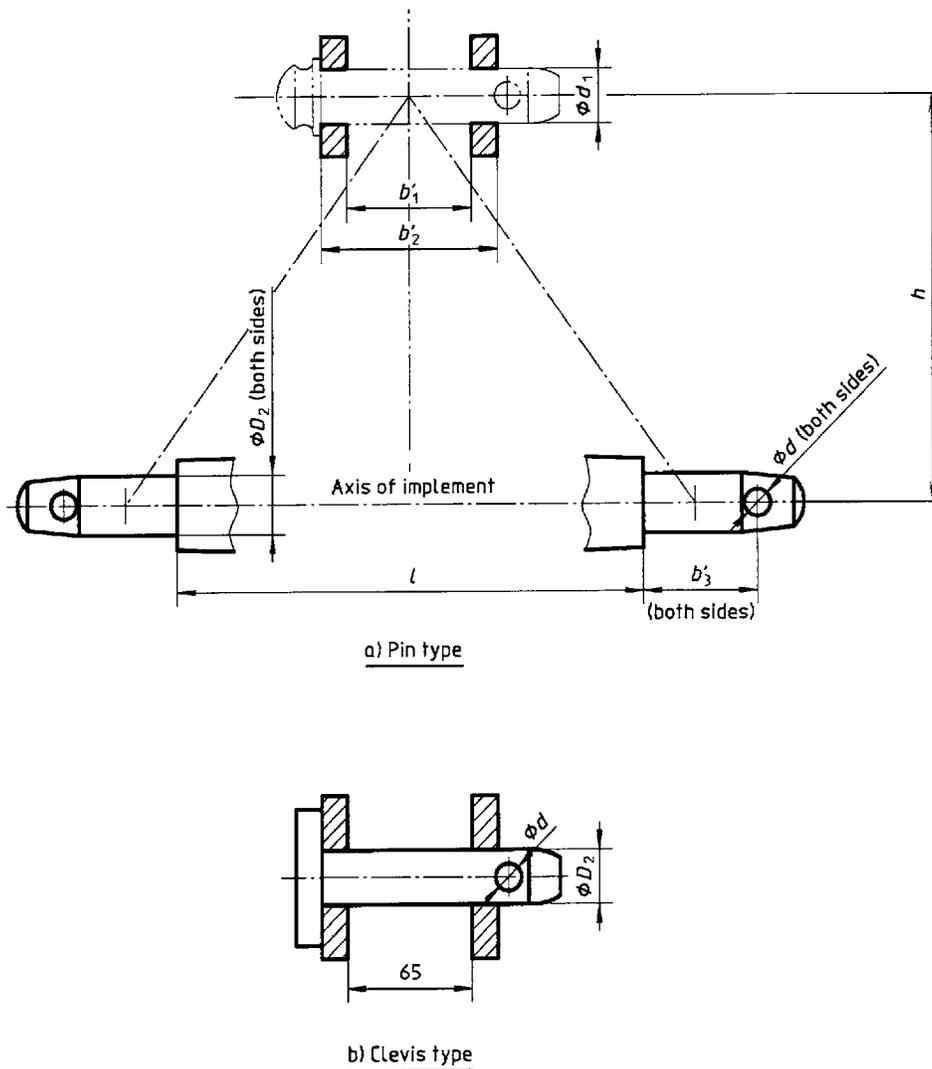
Upper link point arrangements shall be provided so that transport pitches of -3° to $+3^\circ$ and $+10^\circ$ to $+15^\circ$ can be achieved with the standard mast height.

Table 3 – Lift, movement range, and levelling adjustments

Dimensions in millimeters

Definition	Subclause	Category				
		1	2	3	4L	4H
Lower hitch point height	3.2.14	200 max.	200 max.	230 max.	230 max.	230 max.
Levelling adjustment	3.2.15	100 min.	100 min.	125 min.	150 min.	150 min.
Movement range	3.2.18	610 min.	650 max. ¹⁾	735 min.	760 min.	900 min.
Transport height point (lower point axis to be horizontal throughout)	3.2.19	820 min.	950 min.	1,065 min.	1,200 min.	1,200 min.
Lower hitch point clearance	3.2.20	100 min.	100 min.	100 min.	100 min.	100 min.
Mast adjustment height	3.2.22					
highest position		508 min.	610 min.	660 min.	710 min.	710 min.
lowest position		200 max.	200 max.	230 max.	255 max.	255 max.
Torsional free float	3.2.23	60 min.	60 min.	75 min.	75 min.	75 min.

¹⁾For tractors with PTO power above 65 kW, this dimension shall be 700 mm minimum.



NOTES

1 Dimensions are given in table 4.

2 The clevis type mounting only applies to categories 2, 3 and 4. The dimension 65 mm shall be changed when accommodating the U-frame coupler according to ISO 11001-1.

Figure 5 – Dimensions concerning implement hitch attachments

4.1.3 Torsional free float

Torsional free float shall be provided at a distance as given in Table 3. It shall be possible to block the torsional free float.

4.1.4 Lift, movement range and levelling adjustments

The ranges of lift, movement range and levelling adjustment shall be as specified in Table 3.

4.1.5 Convergence distances

See Annex A.

4.2 Restriction of transport height

Tractors shall have means by which the operator can easily restrict the transport height by, for example an adjustable stop, particularly to avoid damage to the PTO-shafts of the machine.

4.3 Interchangeability

Provisions shall be made in the design of the lower links, or by the use of double-ended hitch attachments, to enable implements based on the dimensions of Category 1 to be fitted to linkages made in accordance with Category 2 or vice versa. The same applies in the case of Categories 2 and 3.

5 Implement

5.1 Dimensions

The hitch attachments dimensions shall be as given in Figure 5 and Table 4.

Table 4 – Dimensions concerning implement hitch attachments

Dimensions in millimeters

Dimension (see Figure 5)	Description	Category				
		1	2	3	4L	4H
Upper hitch attachment						
d_1	Diameter of hitch pin hole	19.3 $^{+0.2}_0$	25.7 $^{+0.2}_0$	32 $^{+0.25}_0$	45.2 $^{+0.3}_0$	45.2 $^{+0.3}_0$
b'_1	Width between inner faces of yoke	44.5 min.	52 min.	52 min.	65 min.	65 min.
b_2^*	Width between outer faces of yoke	69 max.	86 max.	95 max.	132 max.	132 max.
Lower hitch attachment						
D_2	Diameter of hitch pin	22 $^0_{-0.2}$	28 $^0_{-0.2}$	36.6 $^0_{-0.2}$	50.8 $^0_{-1.1}$	50.8 $^0_{-1.1}$
b_3^*	Linch pin hole distance	39 min.	49 min.	52 min.	68 min.	68 min.
l	Lower hitch point span ¹⁾	683±1.5	825±1.5	965±1.5	1,166.5±1.5	1,166.5±1.5
Other dimensions						
d	Diameter for linch pin hole for upper hitch pin	12 min.	12 min.	12 min.	17.5 min.	17.5 min.
	for lower hitch pins	12 min.	12 min.	17 min.	17.5 min.	17.5 min.
h	Mast height ²⁾	460±1.5	610 ±1.5	685±1.5	685±1.5	1,100±1.5

¹⁾It may be necessary to vary these dimensions in case of specialized implements. Where a shorter distance between the lower hitch points appears necessary, the following values are preferred:

- 400 mm for category 1;
- 683 mm for category 2;
- 825 mm for category 3;
- 920 mm for category 4.

²⁾Additional mast heights may be provided for specialized implements and frame-type three-point hitch couplers as given by other standards (e.g. 483 mm for category 2 and 559 mm for category 3 as given by SAE J 715 [8]). These additional mast heights shall be within a range of +200 mm from the standard mast height given in the table.

5.2 Clearance zone

The clearance for the implement shall be as given in ISO 2332, which also shows the clearance needed around hitch points.

**APPENDIX A
(informative)
Convergence distances**

This annex gives recommendations for choosing the vertical and the horizontal convergence distances for the three-point linkage to achieve good working conditions for implements, in particular soil-working implements such as ploughs.

The aim with these recommendations is to make it possible to achieve an effective tractor-implement combination under all conditions.

A.1 Horizontal convergence distance

The horizontal convergence distance (see Figure A1) is of great importance for the horizontal stability of implements. (See Annex B [9] to [16].)

If the horizontal convergence distance is too large, the lateral stability of directional implements is decreased. For ploughs this means an uneven and crooked first furrow.

If the horizontal convergence distance is too short, non-directional implements, such as harrows, easily find equilibrium positions somewhat

asymmetric to the tractor. For many implements, especially long multirow ones, this leads to decreased quality of work.

Experience shows that most implements will function well with the following horizontal convergence distance:

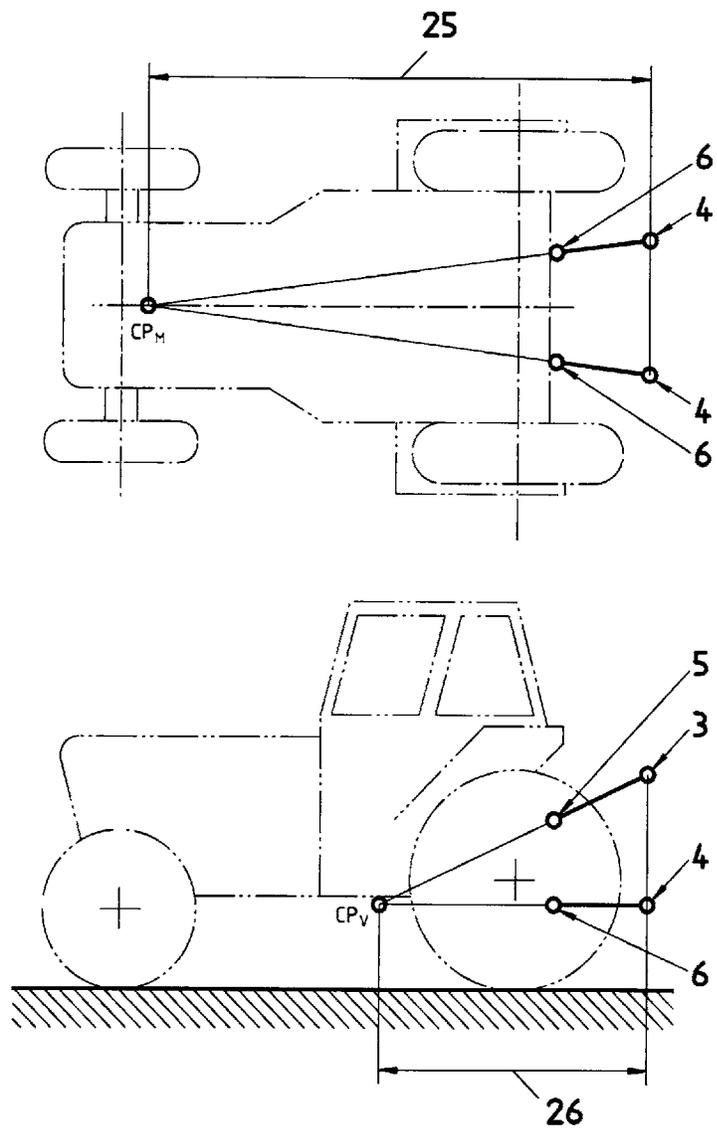
- Category 1: 1,700 mm to 2,400 mm
- Category 2: 1,800 mm to 2,400 mm
- Category 3: 1,900 mm to 2,700 mm
- Category 4: 1,900 mm to 2,800 mm

A.2 Vertical convergence distance

The vertical convergence distance (see Figure A1) is important for stable working conditions and makes it possible

- to reduce the influence of tractor movements (pitching, rolling, turning) on connected implements;
- for designers of implements to apply the optimal technical decisions and design criteria for working bodies of an implement and to use the mass of the implement properly;
- to provide for wide interchangeability of tractors and implements designed by different producers.

To achieve these properties for a linkage, it is recommended that the vertical convergence distance is not less than 0.9 times the tractor wheelbase.



Key

- 3 Upper hitch point
- 4 Lower hitch point
- 5 Upper link point
- 6 Lower link point
- 25 Horizontal convergence distance
- 26 Vertical convergence distance

- CP_V Vertical virtual hitch point
- CP_M Horizontal virtual hitch point

Figure A1 – Convergence distances

Annex B
(informative)
Bibliography

B.1 Literature concerning main body of standard

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3. ISO 8759-2:1985, *Agricultural wheeled tractors—Front-mounted linkage and power take-off—Part 2: Front linkage.*
4. ISO 11001-1:1993, *Agricultural wheeled tractors and implements—Three-point hitch couplers—Part 1: U-frame coupler.*
5. ISO 11001-2:1993, *Agricultural wheeled tractors and implements—Three-point hitch couplers—Part 2: A-frame coupler.*
6. ISO 11001-3:1993, *Agricultural wheeled tractors and implements—Three-point hitch couplers—Part 3: Link coupler.*
7. ISO 11001-4:1994, *Agricultural wheeled tractors and implements—Three-point hitch couplers—Part 4: Bar coupler.*
8. SAE J 715-OCT 88 *Three-Point Free-Link Hitch Attachment of Implement to Agricultural Wheeled Tractors.*

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