5 COUPLING OF IMPLEMENTS

The section "**COUPLING OF IMPLEMENTS**" contains the necessary information on the peculiarities of the intended use of the BELARUS tractor of your model including the recommendations on the Coupling of implements, selection of machines, conditions of safe use of the tractor and determining the steerability criterion, rules of correct completing of machine-tractor aggregates (hereinafter referred to as the MTA or tractor-based aggregate) as well as some other necessary documentation, making it possible to assess the possibility of using the tractor with machines within MTA's.

The recommendations for Coupling of implements of the specific agricultural technical means differing in their nomenclature and performance characteristics, including description of their design, information on their adjustment, procedure of completing the MTA and technique of performance of the works are provided in the applied operating documentation for agricultural machines.

5.1 Intended use of the tractor

- *Purpose and specialization:*

Wheeled universal agricultural-purpose tilling tractor providing the operation of machines as a power source.

- *Kinds of the main agricultural works to be performed:*

Cultivation and harvesting of row crops, sowing of cereal crops, harvesting of straw and grasses, transportation works, fertilizing and spraying of fields and gardens, overall tillage, harrowing and ploughing.

- *Method of use:*

Coupling of machines with the help of three-point mounted attachments and hitching mechanisms within the MTA.

- *Conditions of coupling of machines:*

The tractor provides the possibility of operation of the machines, the performance characteristics of which are compatible in the part of the coupling capability with the characteristics of the tractor itself such as connecting dimensions, possibility of motion at the necessary speed, power take-off and realization of a tractive force under specific operation conditions, overall dimensions, allowable vertical static loads on the hitch mechanisms and the chassis.

- *Operation constraint:*

The possibilities of use of the tractor under specific conditions with the aggregated machines are determined by the allowable range of the rated tractive forces at the hook and power of the engine and limited by the maximum allowable loads on the tractor, hitching capabilities of the running gear and allowable skidding, working motion speed, allowable power take-off and mass of the machines to be aggregated.

The tractor driver working on the tractor bears the personal responsibility for observance of the road regulations and safety precautions as well as for correctness of using the tractor in accordance with the Operating Manual for the tractor. Prior to performing the works, the tractor driver shall read also the technical documentation for the machine to be operated with the tractor.

Attention!

1. Coupling of the attached machines (loaders, bulldozers) is not related to the intended use of the BELARUS tractor.
2. No permit for joint operation of the BELARUS tractors with the mounted, trailed, semi-mounted and semi-trailed machines is required provided such operation comply fully with this Operating Manual for the tractor and does not fall outside the allowable framework of its use. In this case the Minsk Tractor Works shall not bear any responsibility for the failures, breakages and other troubles in the operation of the tractor arisen due to incorrect selection and/or improper use of the machines with the tractor. The agreement of the coupling of the mounted, trailed, semi-mounted and semi-trailed agricultural machines is a recommended procedure.

5.2 Checking the correctness of forming the machine-tractor aggregate

The operation of the tractor with the aggregated machines being either overloaded or underloaded shall not be allowed. In the first case, there will be increased wear of the parts of the tractor, excessive fuel consumption and decrease of the productivity of the aggregate while in the second case there will decrease of the economic characteristics and, particularly, productivity and increase of the fuel consumption. Therefore, the tractor driver shall first of all make sure that the MTA has been formed correctly and its recommended speed in the most favourable.

In the tractor operation there are two main speed modes:

A) OPERATING

This mode is the main one. The variation of the operating motion speed which affects the quality of performing the job in accordance with the agrotechnical requirements. The operating manuals for individual machines contain the allowable operating speed ranges. Any variation of the working motion speed of the tractor with the aggregated machine including the operating manoeuvring during the operating motion is only allowable within the limits to be determined by the agrotechnical requirements. The initial operating speed is set usually within these limits together with the machine grasp width and operating depth (fit).

B) AUXILIARY MODE

This mode is characterized by the tractor motion speed with the aggregated machine in the near transport speed (in idling when performing the turns and motion to another place) with the operating elements engaged. The speed mode of the tractor with the machine in the near-transport mode is generally limited by the safety requirements. Due to relatively short duration of the turns and necessity of following the guidelines for limitation the transport speed when moving from one field to another, the respective tractor speed in the mode is often close to the operating one.

If the machine to be aggregated has been selected, it is only necessary to determine the operating speed and respective gear.

The operating speed of the tractors during the operation under field conditions is limited first of all by the quality of the work to be performed. Besides, for traction machines it is limited by the tractive and hitching capabilities of the tractor and for traction and driven aggregates – by the allowable power of the PTO and hydraulic takeoff as well as by the throughput capacities of the machine tools.

Checking the correctness of formation of the aggregate according to the rotational speed of the engine crankshaft.

In practice, the operating motion speed of the tractor is selected based on the tachospeedometer readings. While knowing the range of agrotechenically allowable speeds, the tractor gear (motion speed), in which the tractor shall enter this range, is determined.

The normal load on the tractor should be considered such a load, at which the readings of the crankshaft rotational speed on the tachospeedometer would be lower (by not more than 6%) than the rated value specified in the manufacturer's documentation. Drop of the rotational speed by the value exceeding 6% indicates the engine overloading. The increase of the rotational speed above the rated one indicates the engine underloading.

The main condition of the optimal coupling of the BELARUS tractor is proper use of the engine power which is characterized by the load factor expressing the degree of use of the tractor's rated power for performing the jobs by the aggregated agricultural machines. For each group of agricultural operations objectively approximate values of the degree of use of the engine's rated power exist. On the average the reserve power should make up 10…15% of the engine rated power.

The correctly selected operating mode of the tractor is understood as such coupling of the tractor with observing all the operating rules and limitations, which ensure not only performance of the work in accordance with the agrotechnical requirements for the working operation to be performed, such as engine loading mode, speed mode of the aggregate, allowable skidding mode as well as compliance with all the recommendations for safe use of the tractor (speed selection, loading modes).

The engine loading degree can be varied by increasing or reducing the number of machines, varying the grasp width, operating depth as well as motion speed in the process of the operating motion of the aggregate. If the efficient loading of the engine by varying the number of machines and operating speed is impossible, the respective partial operating mode should be chosen by reducing the fuel feed.

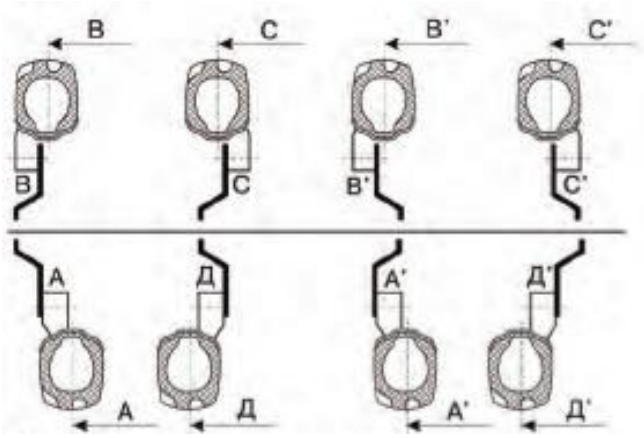
The engine loading degree is determined by the crankshaft rotational speed. It is necessary to work at the crankshaft rotational speed slightly exceeding the rated value (indicated on the tachospeedometer). If the operating speed is below the required value, a lower gear shall be put in.

Allowable skidding mode. One of the main special requirements consists in observance of the allowable skidding limits: 16% for wheeled tractors with two driving axles and up to 18% for wheeled tractors with one driving axle. The MTA shall be completed and the speed mode shall be selected within the limits of allowable skidding. Excessive skidding of the tractor propulsion devices causes the destruction of structural particles of the soil with subsequent development of the wind and water erosion.

5.3 Wheel tread setting

Front wheels 420/70R24 (or 14.9R24)

Wheels position	Tread, mm
A	1540
B	1635
C	1850
Д	1950
A’	1700
B’	1800
C’	2020
Д’	2090



Wheels position with a disk overturn (A’, B’, C’, Д’) should be used in exceptional cases only.

Rim fastening with reference to a disc:
A (A’), C (C’) — inner; B, (B’), Д (Д’) — outer;
C, Д — wheel exchange; A’, B’, C’, Д’ — disk overturn

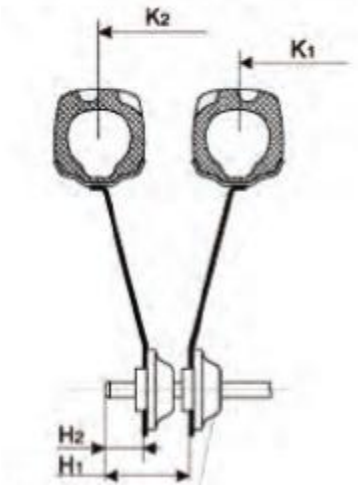
Rear wheels

Tyre type	Wheel position	Tread size K, mm	Hub H setting-out size* to semi-axle end, mm
18,4R38	A C		
16,9R38	A C		

* A tread change by H-value corresponds to a hub position change equal to H/2 from each side.

Rear wheels doubling for wheel specific pressure decrease on the ground

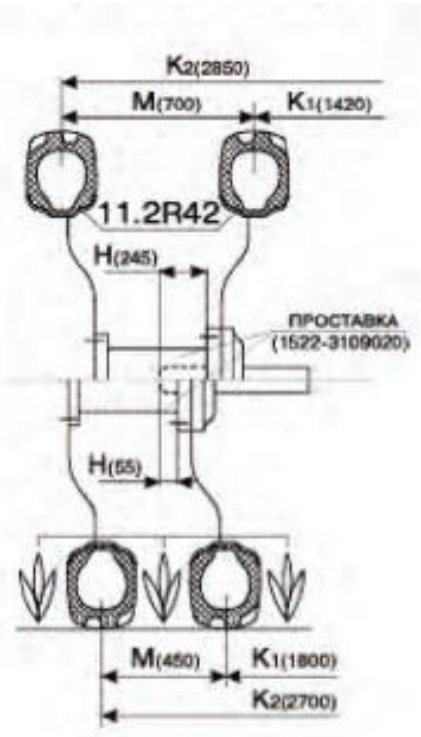
Tire type in a set	Tread size K1, K2, mm	Hub fixed size H1, H2, mm
18.4R38+18.4R38		
16.9R38+16.9R38		



Doubled hubs

Rear wheels doubling for inter-row cultivation of the crops using extra tires (optional)

Inter-rows	Wheels tread K1, K2, mm K		Cultivated crops
	front	rear	
	11,2R24	11,2R42+ spacer+ 11,2R42	
450 500	1800 (A') 1500 (B)	1800+2700 1500+2500	Sugar-beet
600	1820 (A')	1800+3000	Feeding beet, vegetables
700 750	1400 (A)* 1500 (B)*	1420+2850 1500+3000 (2930)	Maize, potatoes — in hackles*



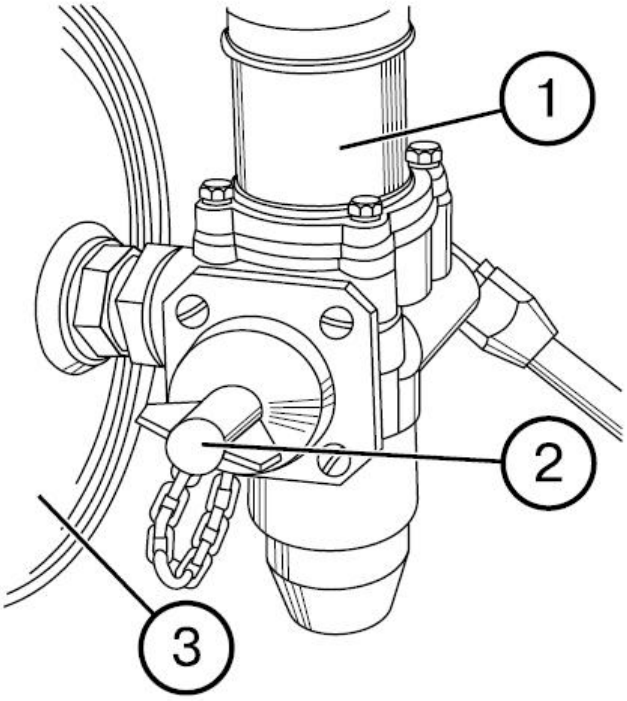
A spacer 1522-3109020-01 is used for inter-rows of 450 mm and 700 mm; the spacers for other inter-rows width are developed and shipped by a buyer's request (optional).

Sizes in brackets are given for inter-rows of 750 mm

5.4 Tires inflation

Inflate the tires using an air bleed valve of a pressure regulator (1) in the following order:

- bleed air from a balloon (3) of the pneumatic system through a valve of condensate ejection valve;
- unscrew a butterfly-nut (2) of an air bleed valve connecting pipe;
- connect a tire inflation hose to the air bleed connecting pipe and a tire's valve;
- switch a compressor on and inflate a tire up to a required pressure level, controlling it by a tire manometer;



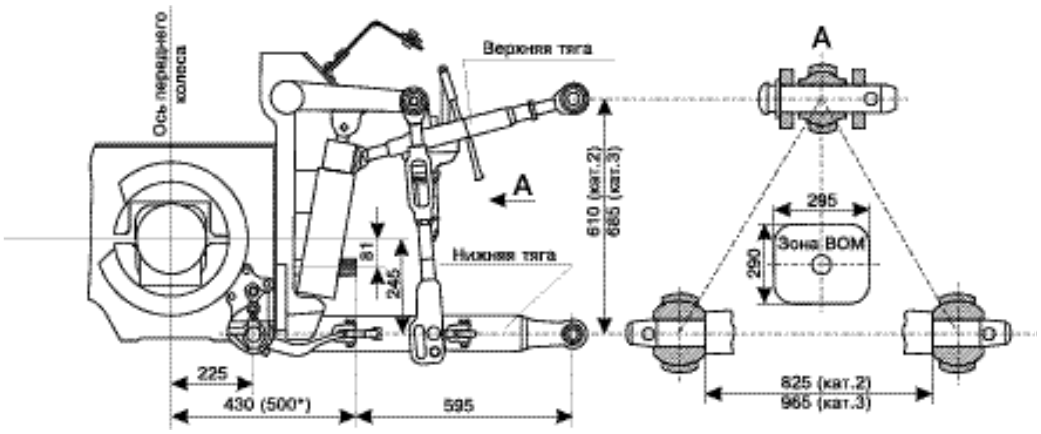
IMPORTANT! If pressure in a balloon exceeds 7,7 kgf/cm^2, the compressor is switched over to idling by a pressure regulator and tires inflation stops automatically. Thus, control a pressure level by an indicator on the dashboard and decrease pressure through a condensate ejection valve if necessary.

- disconnect the pump from the tire's valve and the air bleed valve connecting pipe;
- switch a compressor off and screw a butterfly-nut on the air bleed valve connecting pipe;

5.5 Hitch and towing drawbar devices

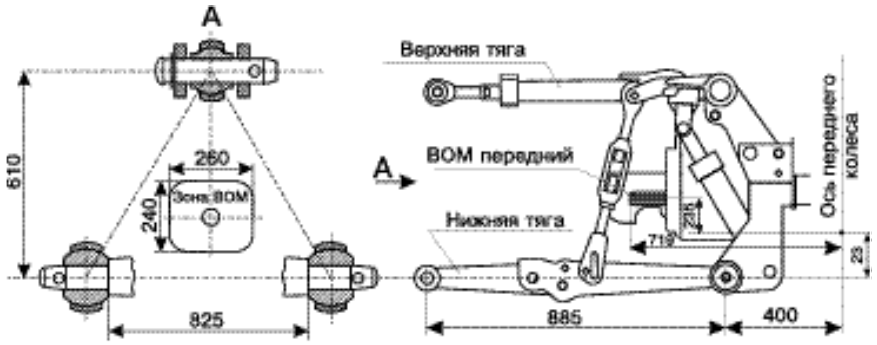
Rear lift linkage HL-2 (3)

Implements: mounted ones (ploughs, cultivators, seeders, milling cutters, etc.), semi-mounted ones (ploughs, soil-cultivating machines, seeders, potato harvesters, etc.).



Ось переднего колеса	Front wheel axle
Верхняя тяга	Upper rod
Нижняя тяга	Lower rod
Зона ВОМ	PTO area
Кат.	Cat.

Front lift linkage HL-2 (if installed)



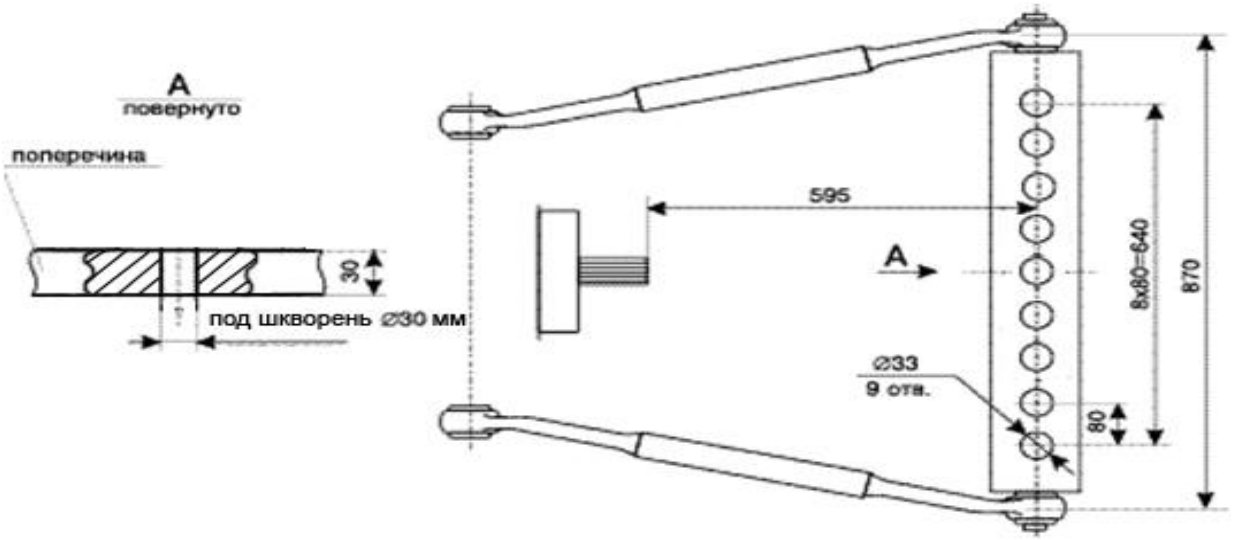
Верхняя тяга	Upper rod
Нижняя тяга	Lower rod
ВОМ передний	Front power take-off shaft
Зона ВОМ	PTO area
Ось переднего колеса	Front wheel axle

Characteristics	Rear HL-2 (3)		Front HL-2
	cat. 2	cat. 3	
Lower rods	solid		separable
Lower rods length: solid, mm	885		885
Links hinges width: upper, mm	51		51
lower, mm	38 or 45		38 or 45
Connecting elements rated diameter:			
upper rod pin, mm	22*	32	22 or 25
lower rods hinges, mm	28*	37	28
Distance between the PTO end and a suspension axle, mm	595		544
Loading capacity:			
on a suspension axle, kN	43		20
at 610 mm offset, kN	28		18

* Pin and transitional bushings in a tractor set of tools and accessories.

Towing drawbar TD-1 (cross-bar)

Implements: semi-mounted ones (seeders, potato planters, potato harvesters, vegetables harvesters, etc.), semi-trailers (mowing machines, press-pickups, haulm pickers, etc.), equipment with a trailing clevis on the towbar.

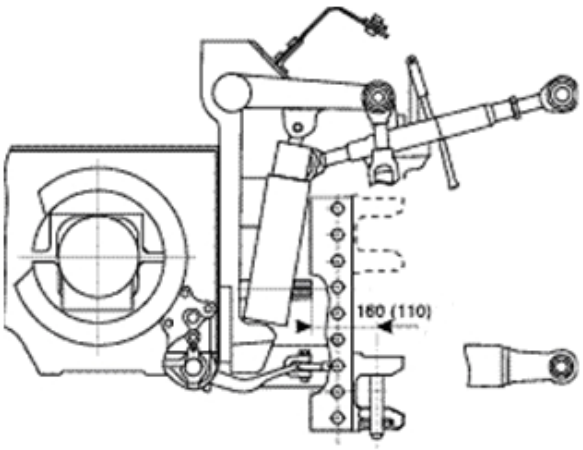


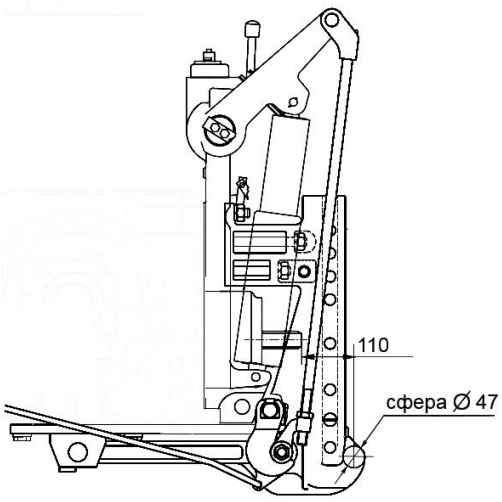
Повернуто	Turned
Поперечина	Crossbar
Под шкворень	For connecting pin
Отв.	Bore

TD-1 (with a lining for a hinge or without it)	A cross-bar on a suspension axle of a hitch linkage in a configuration HL-2
Distance between the PTO end and a connecting pin axis, mm	595
Connecting pin diameter, mm	30
Vertical load on a TD, kN	6,5
Implement turning angle with reference to a tractor, degrees	± 60

Towing drawbar TD-2 (TD-2В – clevis; TD-2К - hook)

Implements: semi-trailers (semi-trailers, fertilizer machines, etc.), trailers (disk harrows, soil-cultivators, hulling machines, coupling of harrows, cultivators, seeders, etc.).

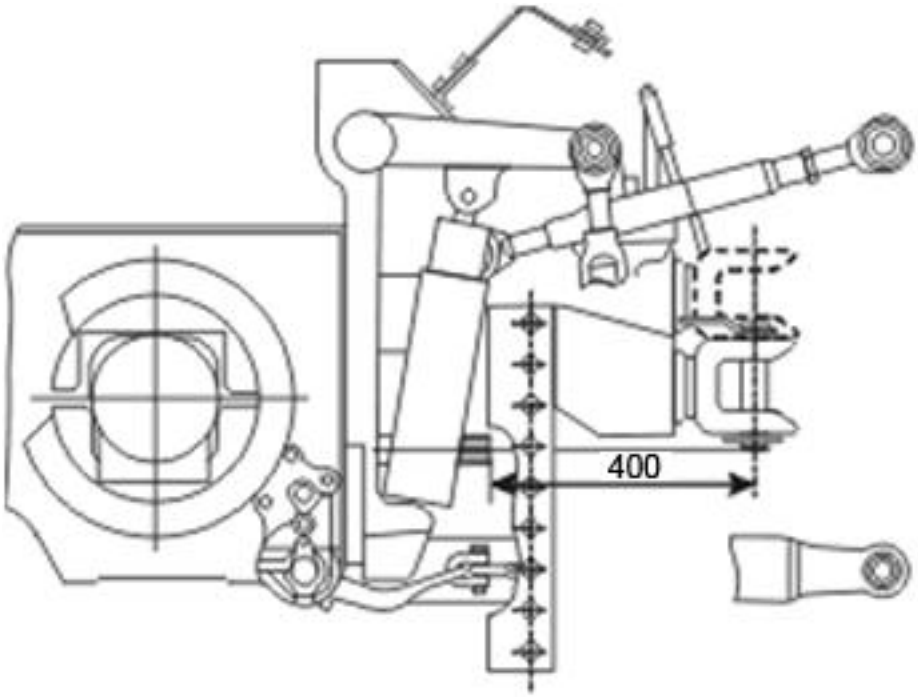




Towing drawbar	A clevis (with a possibility of vertical movement)	Hook
Distance between the clevis or a hook sphere and a supporting surface, mm	493…898 (till the jaw axis) in a stepped way	457
Clevis position for the implements with PTO drive	Extreme lower or extreme upper	-
Distance between the PTO end and connecting pin axis, mm	160 or 110	110
Connecting pin diameter, mm	30	sphere Ø 47
Vertical load on a TD, kN	25	20
Implement turning angle with reference to a tractor, degrees	± 65	± 65

Towing drawbar TD-3B (yoke)

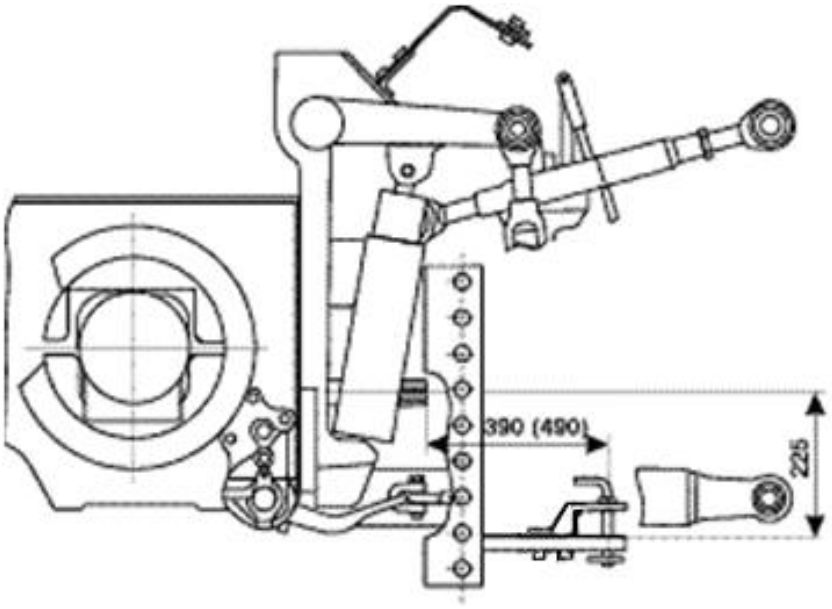
Implements: trailers (motor-type double-axle trailers, etc.), semi-trailers (the same as for a TD-1).



Towing drawbar	A rotating clevis (with a possibility of a vertical movement)
Distance between the clevis and a supporting surface, mm	435…905 or 589…1059 (with a clevis overturn) in a stepped way
Clevis position for the implements with PTO drive	Extreme lower or extreme upper including a clevis overturn
Connecting pin diameter, mm	40
Distance between the PTO end and connecting pin axis, mm	400
Vertical load on a TD, kN	12
Implement turning angle with reference to a tractor, degrees	± 55 (trailers) ± 85 (agricultural machines)

Towing drawbar TD-1M-01 (drawbar)

Implements: semi-trailers (the same as for a TD-2B and a TD-3B), trailers (the same as for a TD-2B and a TD-3B).



Towing drawbar	A clevis with a possibility of a position change with reference to the PTO end
Distance between the clevis and a supporting surface, mm	442
Distance between the PTO end and connecting pin axis, mm	390 or 490
Connecting pin diameter, mm	30
Vertical load on a TD, kN	12
Implement turning angle with reference to a tractor, degrees	± 85

5.6 Hitch linkage and hydraulic system use

Rear hitch linkage of HL-2 type is produced in accordance with GOST 10677 (corresponds to the cat.2 according to ISO 730/1) with the possibility of modification according to the connecting dimensions for HD-3 (Category 3). Due to this the tractors are equipped with transitional bushings of lower and upper rods, which are installed in the rods hinge pivots, connected to the implement.

Subject to their availability there is a possibility of connecting the implements with the dimensions, corresponding to the HD-2 (category 2).

Front hitch linkage of HL-2 type is produced according to GOST 10677 (corresponds to the cat. according to ISO 730/1). Supplied on request.

The rear hitch linkage consists of three rods (one upper and two lower ones) the front ends of which are coupled by means of joints with the tractor and the rear ends of which are coupled with the free joints for connecting with the link pins of the aggregated machines. It is intended for coupling the rear-mounted machines to the tractor, transmission of tractive force during the operation and adjustment of their position during the operation or motion in the transport state.

The hitch linkage provides the coupling of the following types of the machines and implements:

- mounted ones using the three-point mounting (upper and lover rods);
- semi-mounted (lower rods);
- semi-trailed using the crossbar on the mounting axle (lower rods).

The external limit rods with adjustable length serve for preventing the attached machines from swinging.

The following adjustments of the rear hitch linkage in the vertical and horizontal planes by means of the upper rod, braces and limit rods are provided for ensuring the required position of the machine:

A. Altering the length of the upper rod

- equal penetration (equalizing the depth of travel of the tools located one after another in the direction of the tractor motion); if the frame of the mounted plough is tilted forward as seen in the direction of the tractor motion and the front plough body ploughs deeper than the rear one does, elongate the upper rod and shorten the same, if the front body ploughs with less deepness than the rear one does.

B. Altering the brace length.

- position of the machine in the horizontal plane;
- uniform operating depth provided by the tools of the mounted machine over the grasp width;

Important: The length of the left brace of the hitch linkage is 475 mm and not to be altered without special necessity, usually the length of the right brace is to be adjusted. When using the crossbar on the mounting axle and operating one-way ploughs, the length of the braces shall be equal.

D. Altering the length of both braces and upper rod for the transport position of the machine.

- clearance: at least 300 mm;

- sufficient safe distance between the members of the tractor and those of the machine excluding the contact of the machine members with the tractor (the clearance shall be at least 100 mm).

E. Altering the length of both braces

- when transporting the machine (with the top position of the hitch linkage), the limit rods shall be shortened to the maximum extent within the existing adjustment for limiting the swinging of the machine during the motion to avoid the damage of the tractor members in possible emergencies;

- when operating the mounted and semi-mounted soil cultivating machines with passive tools intended for overall tillage (share and chisel ploughs, stubble-breaking ploughs, deep tillers and other machines), it is necessary to ensure the free motion (swinging) of the lower rod in the horizontal plane to the distance of 125 mm to each side from the longitudinal plane of the tractor unblocking the limit rods; no limitation of the grasp width by means of the rods is allowed;

- when operating agricultural machines (except for ploughs, deep tillers and other similar machines for overall tillage of the soil with passive tools), ensure a partial blocking to limit the swinging of the lower rods in the horizontal plane to not more than 20 mm.

Attention!

Failure to follow the recommendations for adjusting the limit rods and braces can cause the rupture of the rods and support brackets or other breakages.

C. Adjusting the brace

During the operation, the braces are connected usually with the lower rods through the holes in the brace forks.

To improve the transversal contour following (cultivators, sowing machines, etc.) and reducing the loads on the hitch linkage during the operation with the wide-coverage machines, it is necessary to ensure the free movement of one lower rod in the vertical plane relatively to another rod. To do this, it is necessary to adjust the braces in such a way that a free movement of one lower rod in the vertical plane relatively to another rod would be achieved. Such adjustment is ensured by connecting the braces through the slots.

The rear hitch linkage is controlled by moving the respective hydraulic distributor control levers from the cab as well as by the external pushbutton panel which provide the positioning of the lower rods of the rear hitch linkage to the necessary height.

Attention!

The necessary peculiarities and method of adjustment of position of the machines aggregated by means of mounted attachments in accordance with the peculiarities of performing the job and agrotechnical requirements are given in the operation documentation for the machines. If such data are unavailable, obtain obligatorily the necessary information from the manufacturer or seller of the machine.

The universal hydraulic system for controlling and adjusting the hitch linkages of the tractor provides additionally the following functional capabilities for the rear hitch linkage:

- correction of the speed of lifting and lowering the lower rods;
- restriction of the height of lifting the lower rods;
- selection of the necessary method of adjustment of position of the lower rods;
- correction of the operating depth;
- possibility of operation with the machines provided with height-related method of adjustment of the height of travel of the tools (the depth is adjusted by the carrier wheel of the machine).

The hydraulic system provides the following methods of adjustment of the position of the mounted and semi-mounted machines and their tools:

a) having no carrying wheels:

power: the depth is adjusted in accordance with the draught resistance of the machine;

position: the machine is held in the specified position relatively to the tractor body;

combined: the power and position methods in any relationship;

b) provided with carrying wheels:

combined: the power and position methods in any relationship.

The hydraulic system for controlling the mounted attachments ensures the possibility of additional oil takeoff for providing the operation of the aggregated machines.

The tractor is provided with free hydraulic outlets for servicing the aggregated technical means by means of he applied high-pressure hoses.

The oil consumption is 45...55 l/min (depending on the technical state of the hydraulic pump). The oil takeoff by the hydraulic cylinders of the aggregated machine shall not exceed 16 l. The level in the hydraulic oil tank should be checked with the plugs of the working cylinders retracted.

The shutting off and rupture members included in the spare parts and accessories kit of the tractor (optionally) are provided for preventing the losses of oil when aggregating the technical means or unforeseen disconnection. The hydrostatic power intake is possible through one of the outlets for supplying the special-purpose hydraulic motors. To avoid the overheating of the hydraulic system, the work pressure shall not exceed 11 MPa (110 kgf/cm^2) that corresponds to the power of 11 kW, not more. A separate pipeline is provided for draining oil from the hydraulic motor with bypassing the distributor.

The tractor is equipped with fittings having the conditional flow passage Dc = 12 mm and connection thread M20x1.5. In case of necessity of connection of the aggregated machines with different thread, the required adaptors with the conventional flow passage of at least Dc = 12 mm should be manufactured.

ATTENTION! The oil in the working cylinders of the aggregated machine shall be clean and correspond to the brand used in the tractor. Failure to fulfil these requirements can cause failure of the hydraulic units of the tractor.

The adaptation and modification of the structural elements of the hydraulic system of the tractor except for those permitted by this Operating Manual is only allowed after consultation with the manufacturer.

5.7 Using the towing drawbar

The tractor can be equipped with towing drawbars of various types providing the coupling of trailed and semi-trailed machines, the coupling arrangements of which meet the following requirements:

- compatibility of the coupling dimensions and the height of the drawbar position referring to the supporting surface;
- the machines are provided with fixed drawbars;
- the trailers hitches are equipped with a device facilitating the coupling of the trailer with/uncoupling of it from the towing drawbar of the tractor;
- the vertical load on the towing drawbar shall not exceed the values permitted by the tractor manufacturer.

The tractor is equipped with a rear lifting device in the form of vertical guiding plates. The device is intended for fastening the towing drawbar TD-2 and TD-3 of the design provided by the manufacturer.

It makes it possible to reposition the connection link of the TD to the height and facilitates the dismantling.

The towing drawbar TD-1 (the crossbar is on the mounting axle of the hitched drawbar HL-2) is only intended for aggregating with semi-mounted and semi-trailed machines for performing the jobs at the speed of $\leq$ 15 km/h. The crossbar has a number of holes for connection. The normally aggregated machine is coupled through the middle hole of the crossbar.

In case of necessity of matching the track of the tractor with the aggregated machine (mainly harvesting) with insignificant draught resistance, an asymmetric connection is allowed. The crossbar shall be acquired to the consumer's order.

Taking into consideration that the TD-2B, TD-3B and TD-1M-01 occupy a certain fixed height position, the connecting devices of the semi-trailed machines should be implemented with a regulated support, providing possibilities of positional height regulations of the machine drawbar loop.

5.8 PTO and drive of the machines

In case of correct location of aggregated machines power intake shaft (PIS) relatively to the tractor PTO, the cardan shafts of the standard design can be installed.

The rear PTO shaft provides a synchronous machines drive (active semi-trailers, planting machines etc.), alongside of it the use of the shank type is not important.

The motion speed should not exceed 10 km/h.

Front PTO shaft is used together with the front hitch linkage or with its bracket (without rods installation) and is designed for the drive of front hinge machines (rotary cultivators, moving machines, pumps, etc.)

To avoid the overloads of the PTO drive when aggregating with the inertial machines (pickup balers, fodder harvesters, etc.), it is necessary to use the cardan shaft with the overrunning clutch on the PIS side.

When using the rear PTO shaft at 540 rpm and front PTO shaft at 1000 rpm it is necessary to install a protective coupling from the PIS side, which limits the power take-off

over the allowable values (not over 50-60 kW, respectively). It is possible to install the protective coupling also to protect the drive from overloading.

Characteristics of tractor PTO shafts shanks are given in the tables 1 and 2.

Attention!

1. For providing the protection of the PTO drive, it is expedient to equip the machine with a protective coupling.
2. To avoid the overloads of the PTO drive when aggregating with the inertial machines (fodder harvesters, etc.), it is necessary to use the cardan shaft with the overrunning clutch or combined clutch on the PIS side.
3. The working torque on the cardan shaft shall not exceed the allowable torque on the PTO.

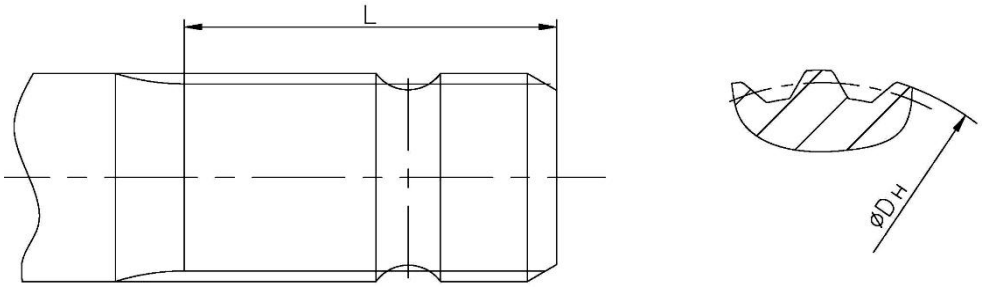


Fig.1

Characteristics of the PTO drive — Table 1

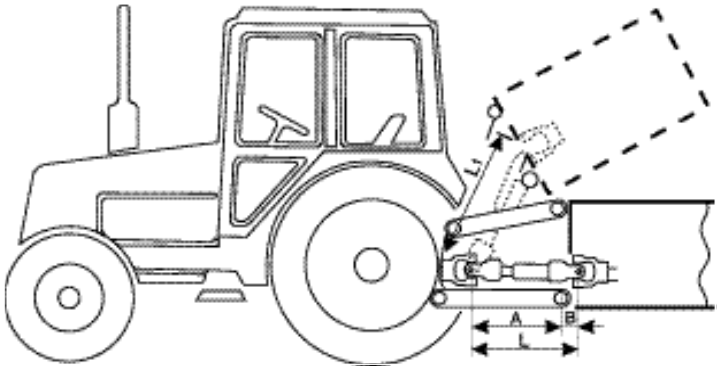
Characteristics	Designation (see Fig. 1)	**PTO1**	**PTO 1C**	**PTO 2**
Splines length, mm	**L**	76	78	64
Outer diameter, mm	**D_H**	35	38	35
Number of splines	**n**	6	8	21

Table 2

PTO	Shank type	Rotational speed, rpm		Transmitted power, kW (h.p.)
		of the PTO	of the engine	
Rear independent	PTO 1C PTO 1 PTO 2	540 540 1000	2037 2037 2100	60 (80) 60 (80) 80 (120)
Front independent	PTO 2	1000	1845	50 (68)
Rear synchronous	PTO 1C PTO 1 PTO 2	4,18 rev/1 meter of travel		60 (80)

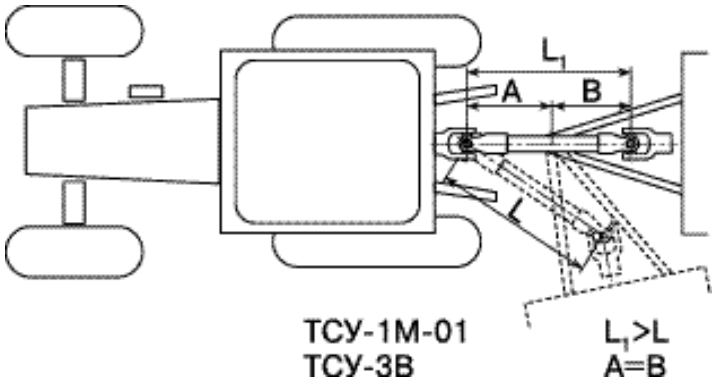
5.9 Schemes of attachment

A cardan shaft length is determined by distance L (the shaft is entirely moved) at horizontal position of the lower rods. A shaft lengthening is effected when lifting the implement, so it is necessary to check telescopic elements overlap in an upper position. A hinge inclination is more from a PTO side than from a power intake shaft side.

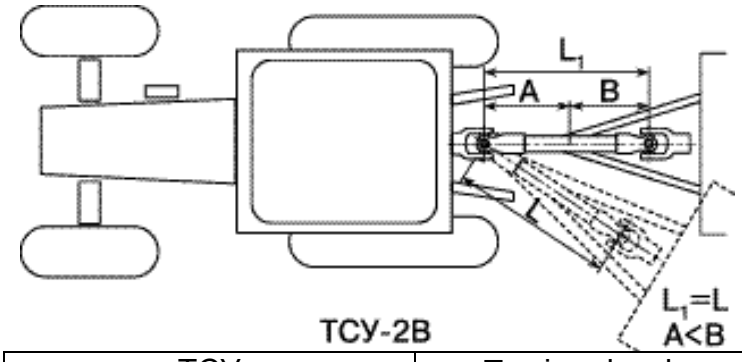


L1 > L; A > B

Cardan shaft length L is determined at the implement turning by a maximum angle with reference to a tractor. If equality A=B is not observed, a rotation irregularity is suddenly increases, resulting in the shaft overloading.



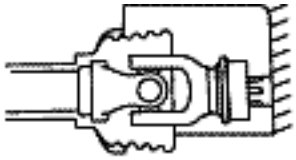
A cardan shaft length remains unchanged at the implement turning with reference to a tractor. A rotation irregularity of the cardan shaft appeared on the way is compensated by an angular velocity hinge installation.



ТСУ	Towing drawbar

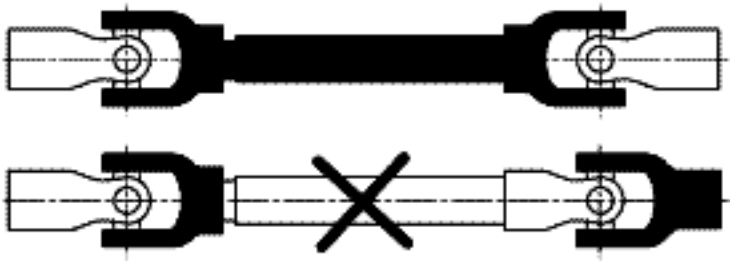
5.10 Cardan shaft installation

Installation of a cardan shaft with a protective casing in combination with a PTO protective cover ensures safety of the connection (Picture Л-15а).



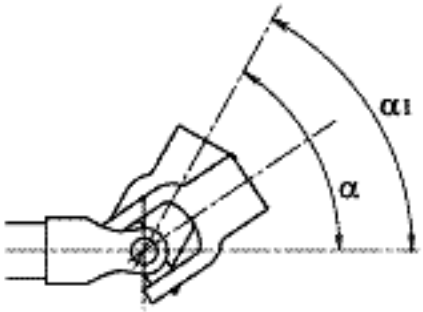
а)

End clevises should be in the same plane (Picture Л-15б).



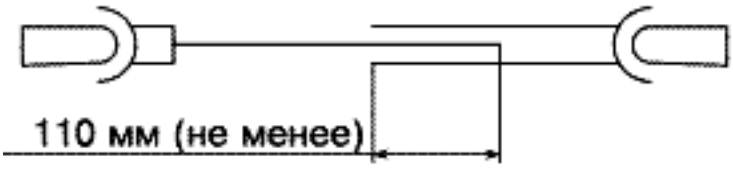
б)

PTO	Cardan hinges inclination angle (max. degrees)	
	Universal	Equal angular velocities
Engaged	22	25 (50 short-run)
Disengaged	55	55



в)

Cardan shaft telescopic elements overlapping should not be less than 110 mm to avoid disconnecting and jamming of the connection (Picture Л-15г).



г)

110 мм (не менее)	110 mm (not less)

5.11 Selection of ploughs, cultivators and harrows

The selection of the ploughs,cultivators, harrows and other tilling machines for the basic and for the shallow works is made taking into consideration the allowable range of pulling forces, exerted by the tractor on the stubble – 18,0…27,0 kN.

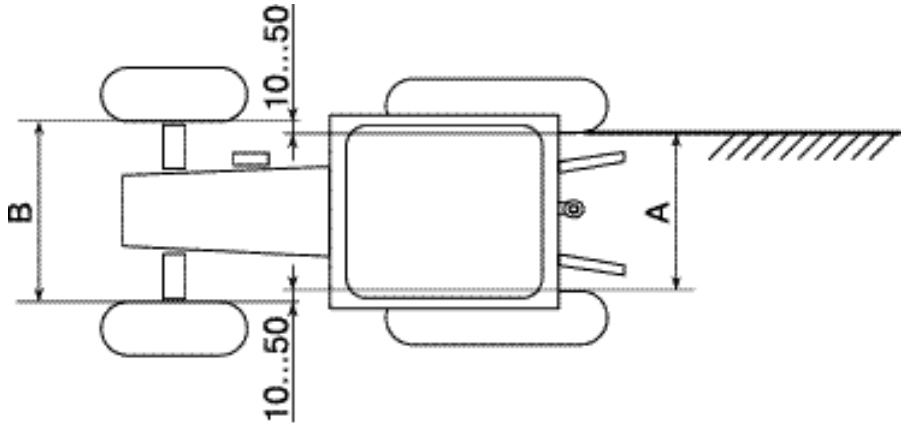
Ploughing is the most power-consuming kind of work. According to the pulling values the tractor can be aggregated with a four-bodies share plough with a furrow grip width of 30…40 cm by 15..22 cm of cultivation depth on the middle-tight soil of normal humidity. Traditionally “Belarus” tractors in combination with units are used as per scheme of «tractor wheels are in a furrow». In this case a relevant wheels placing is required when working with standard, reverse and turning ploughs.

The type of the plough, the grip width (number of plough-bodies) depends on the soil, its mechanical makeup, debris infestation, tillage depth. One body of a plough requires approximately 15...20 kWt on the middle-tight soils by the tillage depth up to 20 cm and 35 cm of the body grip width.

To achieve a smooth ploughing, reverse (doubled) or turning ploughs providing one-sided layer turn are used.

Scheme of wheels placing when attaching 4…5-bodies ploughs.

Ploughing according to the scheme *“TRACTOR WHEELS ARE IN A FURROW”*



To obtain a tread size, add a profile width of a relevant tire to A and B sizes.

Despite the variety of ploughs constructions there are some general principals and the order of their preparation to the work with the tractor.

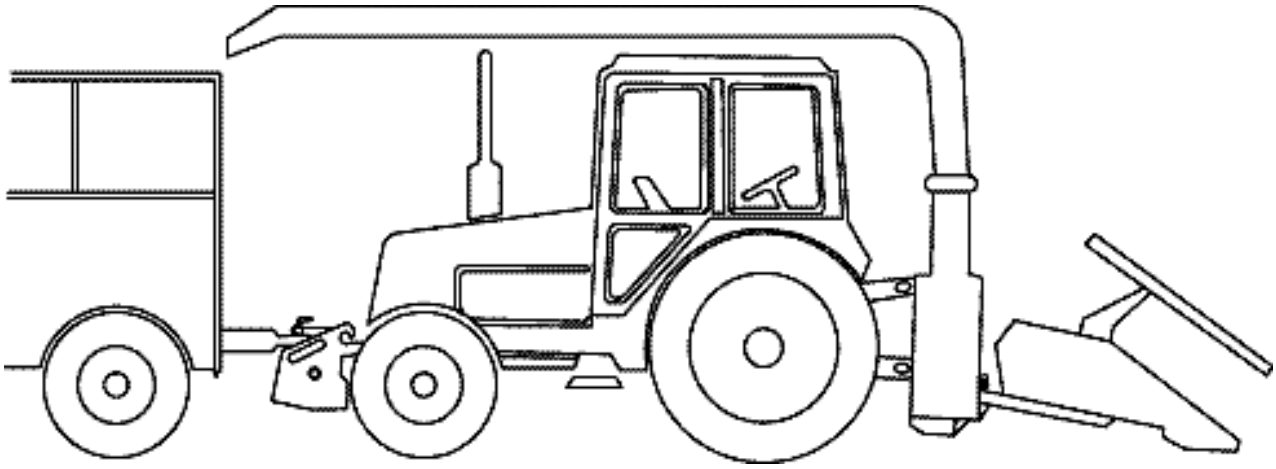
The type of plough is selected according to the running range of the rated pulling forces, soils type, cultivation depth, and the type of the plough body is selected in accordance with the agrotechnical requirements.

- The plough is prepared so that the requirements concerning the technical state of the operating units, auxiliary devices were met.

- The part of the aggregate preparation is a correct adjustment of the mechanisms of the tractor hitch linkage for the set up operating conditions and a preliminary setting the rear cultivation depth. It is recommended to check the ploughs as well as other soil cultivating machines on a specially equipped test area with the hard surface and a striping, corresponding to the correct positioning of the operating units. Examining using a binder or a long straight stick is enough in the field environment. If the blades of the ploughshare are situated at different height, and the plough bodies are in different planes, then the plough shall move unsteady, the drawbar resistance and the fuel consumption will increase.

5.11 Operating at reverse motion

A number of works (feedworks, sugar-beat harvesting, etc.) requires driving of the agricultural unit across a harvested field. In this case technological process fulfillment at reverse motion justifies extra costs. In this case mounted and semi-mounted implements are used (mini-harvesters, harvesters, etc.). A trailer for receiving grinded stuff which is connected to a tractor via front towing device (also if front weights are installed) or via cross-bar at a suspension axle of the front hitch linkage HL-2 can be attached to make a harvesting aggregate unit. Reset to a reverse gear and than to forward gear again takes 3...5 min.



Driving on the roads of general purpose is performed only at forward motion. The motion on reverse is not permitted as signaling and lighting equipment is designed only for forward motion.

5.12 Choosing travel speed

The speed of motion of the tractors on public roads can be limited by the technical possibilities of the tractor and aggregated machine in accordance with the sign provided on the technical mean, characteristics of the machines (method of coupling , overall dimensions, operating weight and absence of the braking system) as well as motion conditions.

<table>
<tr><th>Work to be performed by the tractor</th><th>Coupling peculiarities</th><th>Motion speed, km/h, not more than</th><th>Remarks</th></tr>
<tr><td>1. Towing trailers and semitrailers</td><td rowspan="3">The tractor is only ballasted with standard basic or additional front and wheel weights manufactured by the Republican Unitary Enterprise “Minsk Tractor Works”</td><td></td><td rowspan="4">Selection of the towing drawbars for the coupling is determined by the coupling dimensions and allowable static vertical load on the drawbar of the tractor</td></tr>
<tr><td>a) on public roads</td><td>30,0</td></tr>
<tr><td>b) under field conditions and on roads without category</td><td>20,0</td></tr>
<tr><td>2. Transfer of the agricultural machines to the place of operation and movement within machine-tractor aggregates from one field to another</td><td></td><td></td></tr>
<tr><td rowspan="4">a) by means of the traction drawbars TD-1M, TD-2 and TD-3</td><td rowspan="2">The machine is equipped with the service brake system</td><td>30,0</td><td>The machine weight is not more than 6000 kg</td></tr>
<tr><td>20,0</td><td>The machine weight is not more than 6000 kg</td></tr>
<tr><td rowspan="2">The machine is not equipped with the service brake system</td><td>20,0</td><td>The machine weight is not more than 6000 kg</td></tr>
<tr><td>15,0</td><td>The machine weight is not more than 6000 kg</td></tr>
<tr><td>b) by means of TD-1, TD-1Ж-01</td><td rowspan="3"></td><td>15,0</td><td></td></tr>
<tr><td>c) by means of hitch linkage HL-2</td><td>20,0</td><td>The weight of the tractor within the MTA is not more than 6500 kg</td></tr>
<tr><td></td><td>15,0</td><td>The weight of the tractor within the MTA is not more than 6500 kg</td></tr>
<tr><td>d) twinned rear wheels of the tractor</td><td rowspan="2"></td><td>20,0</td><td rowspan="2"></td></tr>
<tr><td>e) twinned front wheels of the tractor</td><td>15,0</td></tr>
<tr><td>f) Solution in the tyres of the tractor wheels
-front
-rear</td><td></td><td>
10,0
15,0</td><td></td></tr>
<tr><td>3. Motion on slopes and sharp turns; overcoming obstacles at reverse with the implement in transport position</td><td></td><td>10,0</td><td></td></tr>
<tr><td>4. Performing technological agricultural-purpose jobs</td><td colspan="3">When selecting the working motion speed, it is necessary to follow the agrotechnical requirements for performing the job by the machine with the account of the working conditions, allowable tractor speed range, tractor configuration, recommendations of the manufacturer of the tractor and the implement.</td></tr>
</table>

5.143Safety of tractor coupling

To ensure the trouble-free operation of the tractor and aggregated machines as well as to exclude accidents and emergencies, we recommend you to read carefully this Operating Manual for the tractor and follow strictly the recommendations contained herein at any time. Please, observe strictly all the safety recommendations and accident prevention regulations.

Failure to observe the accident prevention regulations can cause the threat for the life and material damage due to breakdown of the tractor or aggregated machine and loss of all the rights for the compensation for damages including that according to the warranties. Do not risk your health or life due to failure to observe the accident prevention regulations. The worker shall not be allowed to operate the tractor including aggregating the implements with it or performing its maintenance unless he/she has red and understood ALL the guidelines concerning the operation of the tractor and accident prevention regulations.

MOTION ON PUBLIC ROADS AND HAULING OPERATIONS

Actually for the half of the time of its operation, the tractor is used on transport communication driving on public roads. Therefore, the transport MTAs are subject to exclusive safety standards. The vehicles such as tractor trailers or semitrailers shall be equipped with service and parking brakes and safety chains (ropes). The load-carrying capacity of the vehicles (trailers, semitrailers, fertilizer distributors and spraying machines) depends on the relief of the locality, slope and condition of the roads. With the account of the allowable longitudinal slope of 12 degrees, the total weight of the semitrailer (trailer) equipped with brakes shall not exceed 12000 kg and that on relatively flat area (with the slope of less than 4%) with dry hard road pavement – not more than 15000 kg.

The tractor's track value shall correspond to the conditions of the works to be performed, technical characteristics of the tractor and ensure the safe use of the tractor within machine-tractor aggregates. When driving the tractor on the slopes and sharp turns increase the tractor's track for increasing the stability.

The service brake actuator is made as a single-wire scheme which is controlled from the workplace of the tractor operator. The parking brake actuator shall be located on the machine.

5.14 Ways of increase of drawbar features and passing ability of the tractors

Drawbar features increase of the tractor can be changed as follows:

1 increase in adhesive weight of the tractor;

2 increase in tire traction to the ground.

Increase in adhesive weight of the tractor can be achieved by virtue of:

- application of hinge-mounted quick-detachable ballast;
- filling up the tires with water (solution);

Increase in tire traction to the ground can be achieved by virtue of:

- selection of optimal tire pressure depending on the operation conditions and load on the tractor axles;
- application of the rear axis differential blocking;
- wheels doubling.

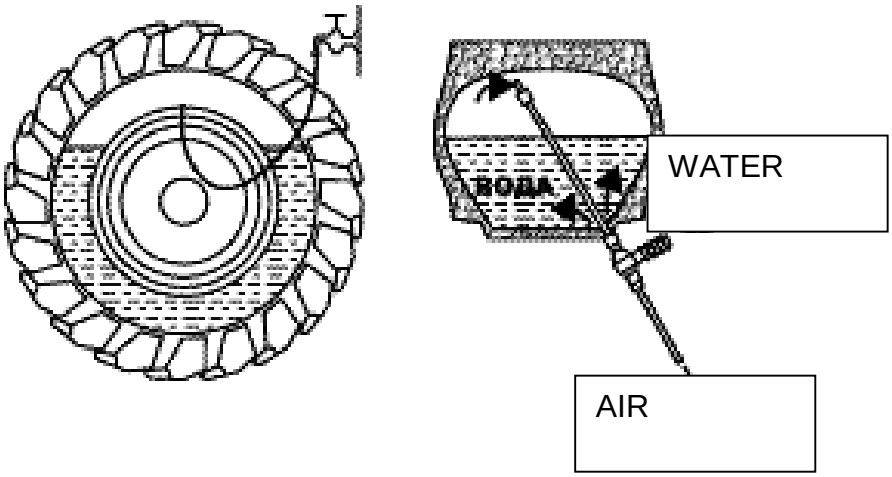
Attention: additional wheels loading by filling tires up with water (solution) shall be used only in case when the tire traction to the ground is poore in adverse conditions (on sandy, waterlogged soils etc.).

Tires filled up with liquid impair the tractor travelling comfort at a speed exceedind 20 km/h, and in case if the tire runs into any obstacle, carcass break can happen!

You must not fill in the tires with water (solution) for more then 75% of ther volume as oversize amount of liquid can result in tires break-down!

If water (solution) is used in front or rear tires, tire stiffness, track depth and firming of soil is improved. If it is essential to use water (solution), it is recommended to fill in all tires up to equal levels not exceeding 40%.

Filling in the tires with water (solution for more than 40% shall be applied as an ultimate alternative!



Tires filling up with liquid

Tire	Water quantity, l (at 75 % of filling)	Water quantity, l (at 40% of filling)
420/70R24	183	97
14.9R24	172	91
18.4R38	412	219
16.9R38	356	189
11.2R24	80	42

A recommended water pouring should not exceed 40% of the full volume

5.15 Doubling of wheels

To improve the passing ability on boggy areas and forest lands and to improve drawbar features during operation on mellow soils (on waterlogged soils, in fields, prepared for seeding), doubling of the tractor wheels is used. Doubling of wheels in combination with minimum ballasting in standard soil conditions allows coupling with heavy-duty compound implements in fields with different slope.

Attention: double tires shall not be used for improvement of lifting and drawbar power as they serve for pressure relieve during operation in field!

Effect of wheels doubling on the tractor drawbar dynamix on mellow soils appears as follows. In the area of the nominal drawbar power and at slow speed slipping is decreasing by 1.4 times and drawbar power is increasing. When operated with low hook drawbar power and at high speed, the drawbar power of the double-wheeled tractor is less than of single-wheeled tractor due to the increased rolling resistance.