



METAL-FACH



**FEEDER WAGON
"OPTIMAL", "BEL-MIX"
T659/1, T659/2, T659/3, T659/4, T659/5
USER MANUAL - PART 1
TRANSLATION OF THE ORIGINAL USER MANUAL
ISSUE 2
JANUARY 2026**



EC DECLARATION OF CONFORMITY

The undersigned, Jacek Kucharewicz, President of the Board,	
hereby declares, with full responsibility, that the complete machine:	
FEEDER WAGON	
1.1.	Brand (trading name of the manufacturer) Metal-Fach
1.2.	Type: T659
1.2.1.	Variant: -
1.2.2.	Version: -
1.2.3.	Trade name(s) (if any): OPTIMAL T659/1, BEL-MIX T659/2, BEL-MIX T659/3, BEL-MIX T659/4, BEL-MIX T659/5
1.3.	Category, subcategory and vehicle speed indicator S2a
1.4.	Company name and manufacturer's address: Metal-Fach Sp. z o.o. ul. Kresowa 62 16-100 Sokółka, Poland
1.4.2.	Name and address of the manufacturer's authorised representative (if applicable) N/A
1.5.1.	Location of the manufacturer's nameplate At the right side; in the front part of the frame
1.5.2.	Method used to fix the manufacturer's nameplate: Riveted, glued
1.6.1.	Location of the vehicle identification number on the chassis In the front part of the right beam
2.	Machine identification number:
3.	Function
referred to in this declaration, meets the requirements of: Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC (OJ of the European Union L 15 of, 09/06/2006, p. 24)	
<p>In addition, the machine meets the requirements of the following harmonised standards: <u>PN-EN 703:2021-12, PN-EN ISO 4254-1:2016-02/A1:2022-05,</u> <u>PN-EN ISO 12100:2012, PN-EN ISO 20607:2019-08</u></p> <p>and of the following standards: PN-ISO 3600:1998, PN-ISO 11684:1998</p>	
<p>The person responsible for making the technical documentation of the machine available is the Head of the Design and Technology Department, Metal-Fach sp. z o.o., ul. Kresowa 62, 16-100 Sokółka, Poland</p> <p>This EC Declaration of Conformity shall become null and void if the machine is modified or reconstructed without the manufacturer's consent.</p> <p>This user manual is an integral part of the product. The product may be passed on to another person only in perfect technical condition, accompanied by the user manual and the declaration of conformity.</p>	

Sokółka
(Place)

16/12/2025
(Date)

Jacek Kucharewicz
(Signature)

President of the Management Board
(position)

Machine data

Machine type:	Feeder wagon
Type designation:	T659/1, T659/2, T659/3, T659/4, T659/5
Serial number ⁽¹⁾	_____
Machine manufacturer:	METAL-FACH Sp. z o.o. 16-100 Sokółka ul. Kresowa 62 Telephone: (0-85) 711 98 40 Fax: (0-85) 711 90 65
Seller:	_____
Address:	_____ _____
Phone/Fax.:	_____ _____
Delivery date:	_____
Owner or user:	Last Name: _____
	Address: _____ _____
	Phone/Fax.: _____

*Delete as applicable

⁽¹⁾ The data is located on the machine nameplate located on the front part of the machine main frame

Contents

Part 1

INTRODUCTION	9
1. Basic information.....	11
1.1 Introduction	11
1.2 Identification of OPTIMAL T659/1, BEL-MIX: T659/2, T659/3, T659/4, T659/5	11
1.3 Intended use of the feeder wagon	15
1.4 Basic equipment	17
1.5 Transport	17
1.6 Environmental hazards	19
1.7 Decommissioning.....	20
2. Safety of use	21
2.1 Information obligation.....	21
2.2 General regulations for work safety and use	21
2.3 Operational safety	21
2.4 Pneumatic and hydraulic systems	24
2.5 Working with the PTO	25
2.6 Eliminating the causes of spontaneous blockages	27
2.7 Eliminating blockages	27
2.8 Noise emissions.....	27
2.9 Fire precautions	27
2.10 Residual risk	28
2.10.1 Residual risk description.....	28
2.10.2 Residual risk assessment.....	29
2.11 Warning and information stickers	29
3. Design and operation principle	35
3.1 Main technical data	35
3.2 Design of the feeder wagon	38
3.2.1 Single-rotor feeder wagon T659/1, double-rotor feeder wagon T659/5	38
3.2.2 Single-rotor feeder wagon BEL-MIX T659/2	39
3.2.3 Single-rotor feeder wagon BEL-MIX T659/3	40
3.2.4 Double-rotor feeder wagon BEL-MIX T659/4	41
3.3 Chassis.....	42
3.3.1 Self-supporting structure.....	42
3.3.2 Frame structure of the single-rotor feeder wagon	43

3.3.3	Frame structure of the double-rotor feeder wagon	44
3.4	Tank.....	44
3.5	Discharge windows - safety zone	45
3.6	Screw.....	47
3.7	Brake	48
3.7.1	Service brake	48
3.7.2	Parking brake	50
3.8	Transmission system	52
3.8.1	Without two-speed gear.....	52
3.8.2	With two-speed gear.....	52
3.9	Gear lubrication system.	53
3.10	Hydraulic system of the T659 feeder wagon	53
3.11	Balance system.....	55
3.12	Electrical system	56
	NAME AND ABBREVIATION INDEX.....	58
	ALPHABETICAL INDEX	59
	NOTES	61

Part 2

4.	Instructions for use.....	7
4.1	Feeder wagon preparation for use.....	7
4.1.1	Feeder wagon inspection after delivery	7
4.1.2	Preparing the feeder wagon for the first start-up	7
4.1.3	Changing the drawbar position	8
4.1.4	First start-up	9
4.2	Connecting and disconnecting the feeder wagon	10
4.3	Tank loading and feedstock preparation.....	13
4.4	Feedstock mix analysis	15
4.5	Unloading	15
4.6	Two-speed gear operation.....	15
4.7	Counterblade adjustment	16
5.	Technical maintenance	19
5.1	Maintaining the driving axle and brakes.....	19
5.1.1	Driving axle maintenance	19
5.1.2	Brake maintenance.....	20
5.1.3	Tyre maintenance, disassembly of wheels.....	22
5.2	Pneumatic system maintenance.....	24
5.2.1	System tightness and visual inspection of the pneumatic braking system	24
5.2.2	Air filter cleaning	25
5.2.3	Draining the air tank	26
5.2.4	Replacement of flexible connection lines	27
5.2.5	Cleaning and maintenance of pneumatic line fittings	27
5.3	Hydraulic system maintenance.....	28
5.3.1	Onboard hydraulic system	29
5.4	Maintenance of the electrical system and warning components	31
5.5	Lubrication.....	31
5.6	Gear maintenance.....	35
5.7	Belt conveyor operation.....	38
5.8	Entering the tank	40
5.9	Removal and adjustment of the cutting blades	40
5.10	Cutting blade sharpening.....	42

5.11	Cleaning and maintenance	42
5.12	Tightening torques of screw connections.....	44
5.13	Troubleshooting	45
	NAME AND ABBREVIATION INDEX.....	46
	ALPHABETICAL INDEX	47
	NOTES.....	49

INTRODUCTION

The information included in the user manual is valid as of the date it was drawn up. The manufacturer reserves its right to make design changes to machines, and due to this, some values or illustrations might not correspond to the actual specifications of the machine supplied to the user. The manufacturer reserves its right to make design changes without amending these instructions. The user manual is part of the basic equipment of the machine. Before using the machine, the user is obliged to read the contents of this user manual and to comply with its recommendations. This will ensure the safe operation and reliable performance of the machine.

The machine has been built in compliance with the standards in force and current regulations of the law. This user manual defines the basic safety and operation principles of a feeder wagon made by Metal-Fach. OPTIMAL: T659/1, BEL-MIX: T659/2, T659/3, T659/4, T659/5.

The significant obligations of the manufacturer are shown in the Warranty Card, which includes the complete regulations currently in force regarding guarantee services.

If you do not understand the information in the instruction manual, consult the original reseller of this machine or the manufacturer directly.

The spare parts catalogue is provided a separate list and is available on the manufacturer's website: www.metalfach.com.pl.

Pursuant to the Act of 4 February 1994 on copyright and related rights (Journal of Laws of 2018, item 1191), this user manual is protected by copyright. It is prohibited to copy and distribute the contents and figures herein without the consent of the copyright owner.

The Warranty Card, including the terms and conditions of warranty, is attached to this Instruction Manual as a separate document.

Manufacturer's address:

Metal-Fach Sp. z o.o.

ul. Kresowa 62

16-100 Sokółka

Contact:

Telephone: +48 (0-85) 711 98 40

Fax: +48 (0-85) 711 90 65

The symbols used in this manual:



DANGER

Hazard warning symbol: indicates a severe hazard that, if not avoided, may result in death or serious injury. This symbol warns against the most dangerous situations.



CAUTION

This symbol points to especially important information and recommendations. Non-compliance can lead to serious damage to the machine, as a result of its incorrect operation.



WARNING

This symbol indicates potential hazards that, if not avoided, can result in death or serious injury. This symbol indicates a lower level of risk of injury than the DANGER symbol.



symbol indicating useful information.



This symbol indicates maintenance activities which should be performed periodically.

1. Basic information

1.1 Introduction

THE USER MANUAL IS PART OF THE BASIC EQUIPMENT OF THE FEEDER WAGON

The feeder wagon has been designed to prepare, transport and dispense feed directly to cattle feeding stations.

To operate the machine safely, adhere to and follow all the instructions set forth in this Instruction Manual. Abiding by the guidelines provided in the Instruction Manual ensures safe operation for the User, and also prolongs the machine's service.

1.2 Identification of OPTIMAL T659/1, BEL-MIX: T659/2, T659/3, T659/4, T659/5

The feeder wagon should be identified by the stamped VIN number and the nameplate, which are located in the front right part of the machine.

The location of the nameplate and the VIN number for the different variants of the feeder wagon are shown in Figure 2; 3; 4. The data on the nameplate of the feeder wagon, together with its explanation, are shown in Figure 1.

A	METAL-FACH SP. Z O.O.	 ul. Kresowa 62, 16-100 Sokółka, Poland tel.: +48 (85) 711 98 40-45, fax: +48 (85) 711 90 65 Wóz paszowy			
B	SUMW08xxxxSSKxxxx				
C	13780 kg	Typ	T659/4	Nacisk na zaczep	7 kN
D	A-0: 700 kg	Nazwa handlowa	BEL-MIX T659/4	KJ	04
E	A-1: 6890 kg	Rok produkcji	20xx		
F	A-2: 6890 kg	VIN	SUMW08xxxxSSKxxxx		
		Masa własna	XXXX kg		
		 www.metalfach.com.pl			

Figure 1. The nameplate and the VIN number.

Key to the fields on the nameplate:

A – Manufacturer's name;

B - VIN;

C- Maximum permissible total weight of the vehicle

D – Maximum permissible hitch eye pressure;

G – Permissible maximum weight on the first rear axle;

F - Maximum permissible weight on the second rear axle (for BEL-MIX T659/4);

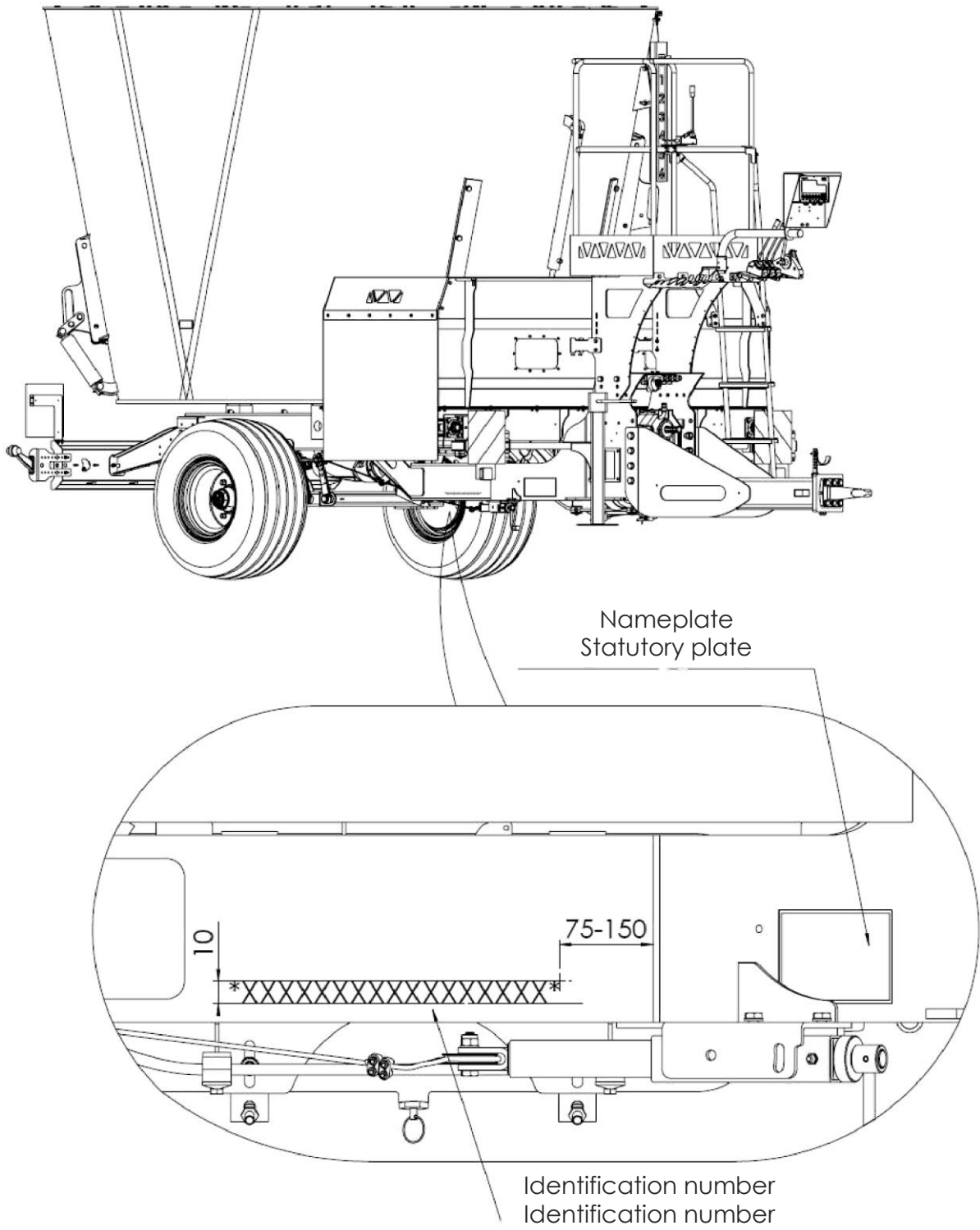


Figure 2. Location of identification plate and the serial number for the BEL-MIX T659/2 and BEL-MIX T659/4 wagon

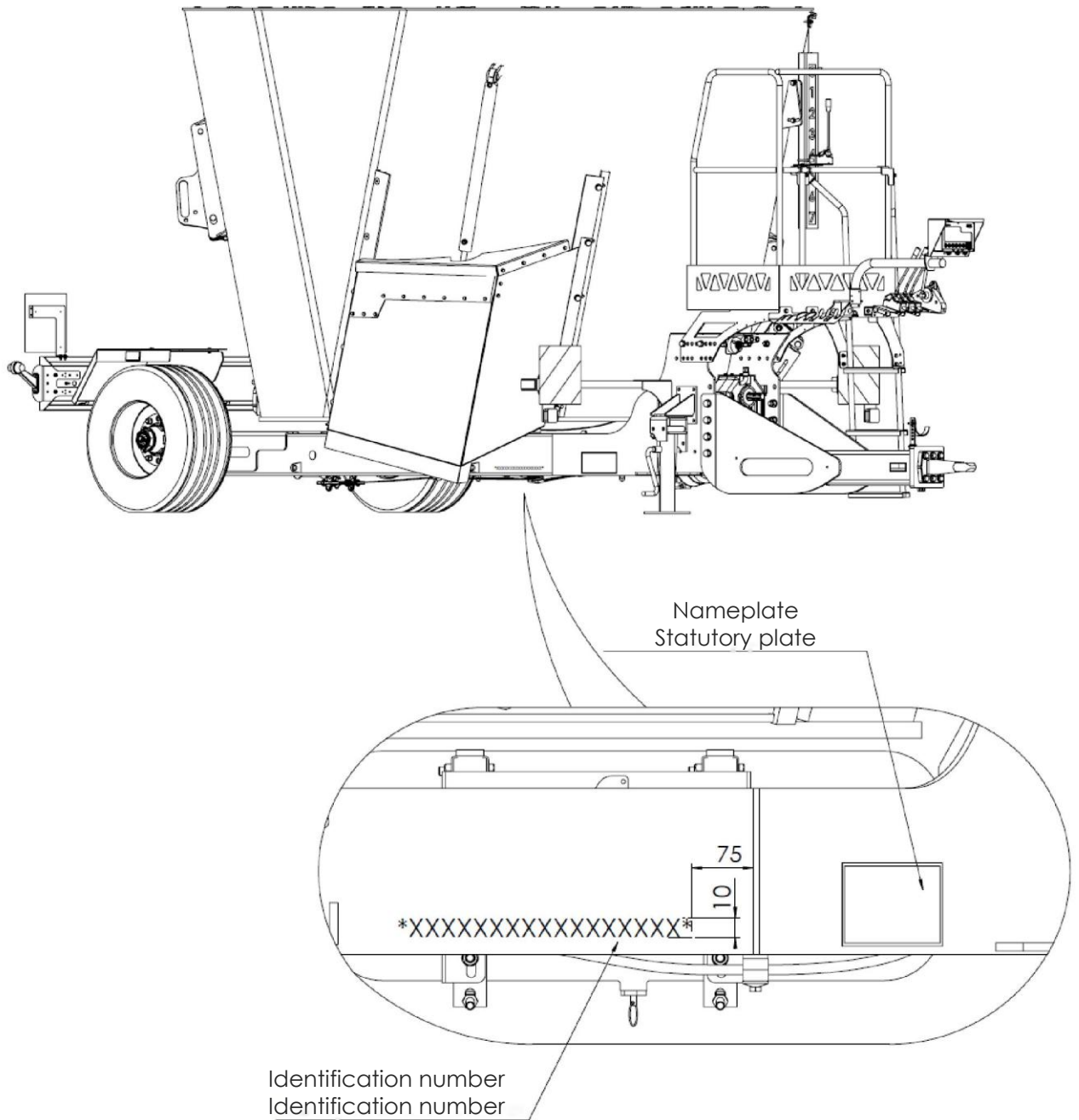


Figure 3. Location of the identification plate and the serial number for the BEL-MIX T659/3 wagon

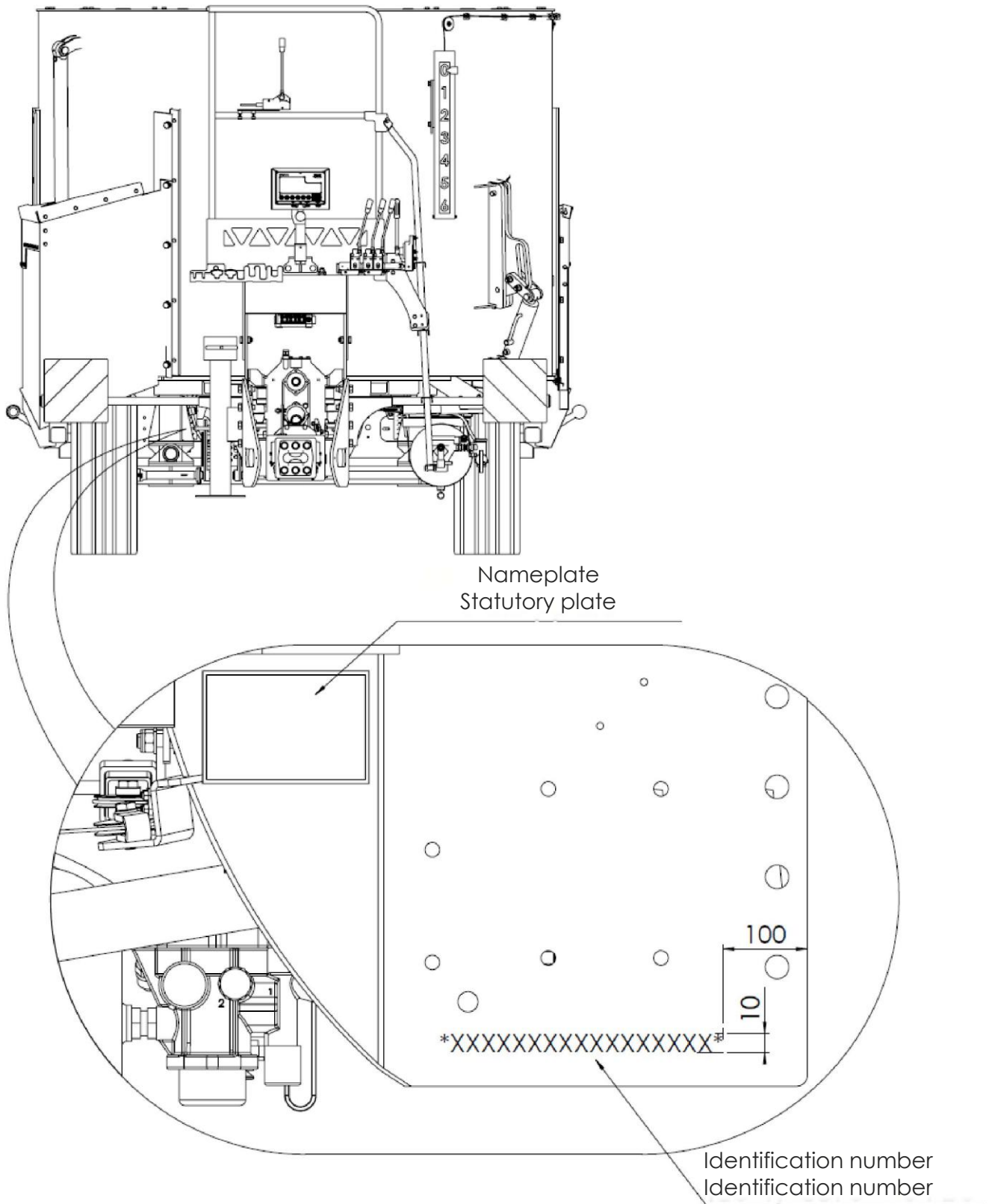


Figure 4. Location of the nameplate and the serial number for the OPTIMAL T659/1 and BEL-MIX T659/5 wagons



CAUTION

CAUTION!

Driving on public roads with the feeder wagon without the rating plate or with an illegible rating plate is prohibited.



Upon purchase, check the compliance of the factory number located on the machine rating plate with the number written in the Instruction Manual and Guarantee Certificate - it is crucial for recognizing the guarantee. When contacting the technical service, the seller, or the manufacturer, the User is obliged to provide the information included on the machine's rating plate.



The user manual is an essential piece of equipment of every feeder wagon.

If the machine is sold to another user, the user manual must be accompanied to the machine. It is recommended that the supplier of the feeder wagon keeps a record of every confirmation of receipt signed by the buyer, when the user manual is handed over with the machine to the new user.

Please read the operating instruction carefully!

If you follow its recommendations, it will be possible to avoid hazards, operate the machine efficiently and productively, and maintain the warranty for the duration granted by the manufacturer.



CAUTION

CAUTION!

The feeder wagon must not be operated by persons who have not read this manual.

1.3 Intended use of the feeder wagon


The feeder wagon is used to prepare, transport and dispense feed directly to cattle feeding stations. It enables the preparation of a feedstock mixes consisting of roughage (e.g. hay, straw, silage) and concentrated feedstock (e.g. cereal middlings, beet pulp). The feedstock ingredients are dropped into a tank, where they are cut by the screw knives and thoroughly mixed, and then discharged through discharge windows into the trough or feeding aisle.

The feeder wagon can be driven safely on public roads, thanks to its lights and braking system which meet all the requirements of road traffic regulations.

The feeder wagon can work with agricultural tractors equipped with an external hydraulic system, 12V electrical system, brake sockets and a bottom transport hitch with a load capacity of at least 25kN. The feeder wagon can be equipped with a drawbar with screwed eye phi 40, phi 50 and K80. The minimum tractor power required for proper machine operation is 35kW.

The operator shall use the machine in accordance with its intended use by the proper and safe operation and maintenance of this feeder wagon as follows:

- Read and follow the recommendations in this manual,
- Safe and correct operation of the machine,
- Always maintain or have the machine maintained on schedule.
- Comply with the general safety regulations.
- Comply with the traffic laws.



DANGER

DANGER!

The feeder wagon must not be used contrary to its intended purpose, in particular to:

- carry people and animals
- operate it with exceeded payloads
- for mixing and transporting toxic and flammable materials
- for transport of building materials, individual objects or any materials that are not included in its intended use

Unauthorised structural modifications to the feeder wagon shall void the manufacturer's liability for consequential damage.

Table 1. Requirements for agricultural tractors

Description	Requirements	UoM
Braking system 2-line braking system Pressure rating of the system	Sockets conforming to PN-ISO-1728:2007 650-800	kPa
Hydraulic system Hydraulic oil Nominal pressure Oil purity	HL 46 16 20/18/15 acc. to ISO 4406-2021	MPa
Electrical system Electrical system voltage Connection socket	12 7-pin acc. to ISO 1724	V
Tractor hitch Minimum vertical load-bearing capacity of the hitch	2,500	kg
Minimum power demand of the tractor	OPTIMAL T659/1: 35-50 BEL-MIX T659/2: 35-70 BEL-MIX T659/3: 35-60 BEL-MIX T659/4: 60-90 BEL-MIX T659/5: 60-90	kW
Minimum turning radius	6	m

1.4 Basic equipment

The basic equipment of each feeder wagon includes:

- user manual;
- warranty certificate and warranty conditions;
- user manual for the balance;
- articulated telescopic (PTO) shaft;
- a bracket for fixing a slow-vehicle marking plate;
- a parking brake;

1.5 Transport

The feeder wagon is sold fully assembled and does not require any further assembly. It is delivered to the User by means of motor transport or independently, when coupled with a tractor.



CAUTION

CAUTION!

General health and safety regulations must be observed when loading and unloading the feeder wagon. Those operating the loading and unloading equipment must have the required authorisation to use it.



CAUTION

CAUTION!

It is prohibited to attach slings of lifting devices to the upper mounting brackets of the load crate in order to lift, load or unload a complete feeder wagon.

If transported on a platform, secure the feeder wagon by means of clamping straps or chains with a tensioning mechanism. Such securing solutions must have a valid safety certificate. Place chocks or other elements without any sharp edges under the wheels of the feeder wagon to prevent the machine from rolling. Attach the chocks to the platform of the means of transport. Special attention must be paid during loading and unloading, so as not to damage the equipment of the feeder wagon and its paint coating. Attach the fastening straps or chains to the shipping brackets welded to the frame of the hopper.

Before loading the spreader on the platform, couple it with the tractor's hitch and connect the brake system lines. Use unfolding ramps to drive the Spreader onto the low loader.



DANGER

DANGER!

Improper use of fasteners can cause an accident.



CAUTION

CAUTION!

Pay particular attention to the angle of inclination of the ramps on the low loader. It may not exceed 10°. Excessive inclination of the ramps can result in damage to both the feeder wagon and the transportation trailer.

The feeder wagon is designed for public road traffic as a machine attached to the lower hitch of an agricultural tractor.

Before merging with the traffic on public roads, make sure that the tractor is fully manoeuvrable. The load acting on the front axle of the tractor must be at least 20% of the tractor's weight, this also applies when transporting and operating a loaded feeder wagon. If this condition is not satisfied, the front axle of the tractor must be additionally loaded.

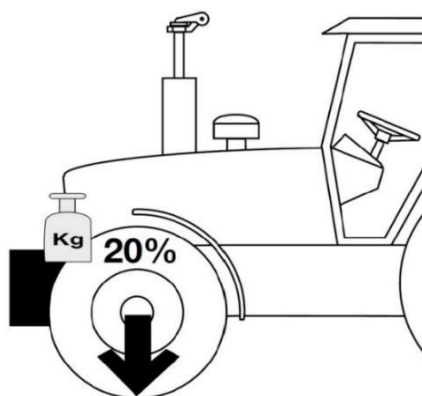


Figure 12. Minimum front axle load of the tractor



CAUTION

CAUTION!

During the transport of the machine on public roads adapt the speed to the traffic conditions and do not exceed the speed of 30 km/h.

Before transporting the feeder wagon, make sure that:

- the feeder wagon is properly coupled to the tractor and the hitching device is secured against accidental disconnection
- the braking system of the feeder wagon and the tractor is working correctly
- the lights on the feeder wagon and tractor are working correctly, and the front dipped lights of the feeder wagon, are set in the transport position;
- the discharge window gates are in their lowest position;
- the hydraulic and pneumatic lines are arranged in such a way that they are protected from damage during travel
- the parking jack is raised to its uppermost position;
- the parking brake is released.

Traffic regulations must be observed during transport on public roads. During emergency parking of the tractor with the attached machine the driver must:

- Ensure that no safety hazard is caused on the road when stopping the vehicle
- Park the vehicle as close to the edge of the road as possible, parallel to the road centre line
- stop the tractor's engine, remove the key out of the ignition switch and engage the parking brake
- Outside a built-up area, place a warning triangle between 30 and 50 metres behind the vehicle and switch on hazard-warning lights
- when in a built-up area, switch on the hazard-warning lights and place a warning triangle behind the vehicle, unless it is installed on a bracket on the rear of the machine; make sure that it is clearly visible to other road users;
- in the case of a breakdown, undertake relevant steps to secure the area where the breakdown occurred.



CAUTION

CAUTION!

The operator must read the user manual and follow the guidelines contained therein.



CAUTION

CAUTION!

When driving a trailer-towing vehicle, particular caution must be exercised as the vehicle's centre of gravity shifts upwards.

Use only technically sound and certified fastening accessories. Before you select the fastening accessories, read their manufacturers' operating instructions.



DANGER

DANGER!

Check the components coupling the tractor and the machine, as their improper use can cause an accident.

1.6 Environmental hazards

Leaking hydraulic and gear oils can pose a direct threat to the natural environment. Carry out all maintenance and repairs in areas with an oil-resistant surface if there is a risk of oil leakage. If an oil leak occurs, secure the source of the leak and collect the spilled oil. When collected, all pollutants must be stored in tightly closed, oil-resistant, and marked, containers.



DANGER

DANGER!

Store used hydraulic and gear oil or any collected residue mixed with absorbent materials in tightly sealed containers. Do not use food containers for this purpose.



CAUTION

CAUTION!

Dispose of all waste oil and used oil, in accordance with the applicable regulations.

It is forbidden to dispose of oil into the sewage system or water reservoirs.

1.7 Decommissioning

If the machine is to be withdrawn from use, the user must comply with the national regulations regarding withdrawal from use and recycling of end-of-life machines, applicable in the given country. Before dismantling, remove all oil from the hydraulic systems and gearboxes.



DANGER

DANGER!

When dismantling, use suitable tools, lifting equipment and personal protective equipment such as gloves, shoes, protective clothing, glasses, etc.

Avoid contact with skin. Prevent any oil leaks.

Dispose of all waste oil and used oil, in accordance with the applicable regulations.

When replacing worn, damaged or unrepairable parts and components send them to recyclable material sites.

2. Safety of use

2.1 Information obligation



CAUTION

CAUTION!

If the feeder wagon is sold to other users, remember to attach the user manual, while the person receiving the machine must undergo training, according to the guidelines contained herein.

2.2 General regulations for work safety and use

Before each start-up, the feeder wagon must be checked for safe operation, i.e:

- Observe the generally applicable safety and accident-prevention regulations, and follow the information provided in this Instructions Manual;
- Observe all safety symbols, warnings, and information inscriptions on the feeder wagon which provide important guidelines for safe operation.
- Operate the feeder wagon only if all required devices are connected and protected against unintentional disconnection or opening (e.g. hitch and drawbar, couplings, PTO shaft);
- Before starting work, learn how to operate all devices and controls and their functions as it will be too late to do this during the operation
- Persons under the influence of alcohol or other psychoactive substances, and those who are not trained and do not hold proper driving licences are prohibited from operating the trailer.

2.3 Operational safety

- 1) Before using the machine, the user must read and understand the content of this Instruction Manual. During operation, observe all the guidelines included in this manual.
- 2) If any information contained in this manual is unclear, please contact the seller running an authorised technical-support service on behalf of the manufacturer, or contact the manufacturer directly.
- 3) Careless and improper use and operation of the feeder wagon, as well as failure to observe the recommendations contained in this manual, are dangerous to health and life.
- 4) Failure to observe the safety rules poses a threat to the health and life of the operators, and third parties.
- 5) Please note that residual risks exist, so exercising the safety rules must be a priority when operating the feeder wagon.
- 6) Use of the machine contrary to its intended purpose is prohibited. Anyone using the machine in a manner other than that described in the manual assumes full responsibility for any consequences resulting from such incorrect use.

- 7) All safety-related information must also be passed on to all other users and operators of the feeder wagon.
- 8) Any structural and functional modifications of the feeder wagon release Metal-Fach Sp. z.o.o. from liability for damage to property or health.
- 9) The technical condition of the feeder wagon must be checked before each use.
- 10) It is prohibited to transport people or animals on the machine.
- 11) Use only the recommended PTO shafts with the correct parameters to transmit power from the shaft.
- 12) Do not use uncovered articulated telescopic shafts (without guards) for power transmission.
- 13) Before starting to drive, make sure that the parking brake is released and the braking-force regulator is in the correct position corresponding for the load status (it applies to a 2-line pneumatic system with a manual braking-force regulator).
- 14) The condition of the guards must be checked before each start-up of the feeder wagon. If any of the covers is found to be damaged, it must be replaced immediately.
- 15) Before disconnecting the PTO shaft, switch off the tractor engine and remove the keys.
- 16) It is forbidden to use a PTO shaft at speeds higher than 540 rpm, to overload the PTO shaft and the feeder wagon and to engage the clutch abruptly. Before starting the articulated telescopic shaft, ensure that the direction of rotation of the PTO is correct.
- 17) It is forbidden to pass over/under the PTO shaft or to stand on it either while the feeder wagon is in operation or at a standstill.
- 18) It is forbidden to use a damaged PTO shaft.
- 19) Load the feeder wagon only when the tractor is connected and its engine is on. The mixing screw must be running during loading.
- 20) Before operating the feeder wagon, ensure that there are no bystanders or undesirable objects preventing operation in or near the machine.
- 21) Make sure no one is standing nearby when loading silage/bales, as there is high risk of such an object falling from height.
- 22) Check the surroundings of the working area of the cutting tools, discharge windows and conveyors.
- 23) Climbing on the upper edges of the chamber is prohibited.
- 24) Repairs, lubrication, cleaning, blade replacement may only be carried out with the tractor engine switched off, the key removed and the parking brake applied.
- 25) The cutting blades are very sharp, so great care must be taken when assembling, dismantling, adjusting and sharpening them.
- 26) Each time before leaving the tractor, switch off the engine, remove the key and apply the parking brake.
- 27) Caution must be exercised when coupling and uncoupling the feeder wagon from the tractor. The machine should only be coupled with tractors of the appropriate class and engine power.

- 28) Operation of the feeder wagon may only be controlled from the driver seat of the tractor.
- 29) The feeder wagon must be cleaned of any residual feedstock each time at the end of work.
- 30) Climbing onto the machine platform and, in particular, into the tank is only possible when the machine is at an absolute standstill and the tractor engine is switched off.
- 31) When replacing knives, take extra care and use protective clothing and sturdy shoes.
- 32) Follow the acceptable axle loads, total weight, and transport dimensions.
- 33) Before driving, check the functioning of the lights and brakes, and prepare the feeder wagon in accordance with the recommendations provided in the "Driving on public roads" section.
- 34) Ensure that the feeder wagon is loaded in such a way that the material does not contaminate the roads when travelling on public roads.
- 35) At the end of work and before driving on a public road, remove any residues of the feedstock from the external parts of the machine to prevent it from falling down and contaminating roads.
- 36) Take into account all changes in vehicle behaviour, steering and braking performance due to the feeder wagon being coupled to it.
- 37) When driving with a coupled feeder wagon, take into account the distribution of the load and/or inertia forces, especially if the load is distributed asymmetrically.
- 38) Traffic regulations must be observed when driving a feeder wagon on public roads. Driving speed must always be adapted to the road conditions and must not exceed 30 km/h.
- 39) Always adjust your driving speed to the existing conditions. Avoid sudden up or downhill turns on sloping terrain.
- 40) Do not exceed the maximum permissible axle loads of the feeder wagon.
- 41) Exceeding the permissible technical load capacity of the feeder wagon can damage the machine, and cause the loss of its stability while driving, spillage of the load, and also compromise the safety of other road traffic. The braking system has been adapted to the permissible total weight of the feeder wagon, which, if exceeded, will considerably reduce the performance of the main brake.
- 42) Maintain a sufficient safe distance when turning back with the coupled equipment.
- 43) When reversing, ensure that you have sufficient visibility (if possible, have someone to assist you with guidance).
- 44) Take into account the inertia of the feeder wagon while taking turns.
- 45) Observe a minimum turning radius of approx. 6 m when turning and reversing.
- 46) The feeder wagon must be parked and stored on a level and paved surface. During storage, the machine should be supported on a jack, protected against spontaneous movement with a parking brake or by placing wheel chocks.
- 47) Work clothes for tractor drivers and shoes with anti-slip soles are recommended.
- 48) Risk of drawbar lifting when loading bales, silage blocks or other feedstock materials.
- 49) Feeder wagon preparation for operation (connecting hydraulic lines, pneumatic system, PTO shaft, etc.) must be carried out with the tractor engine switched off and the ignition key removed.

- 50) No one is allowed to be present between the feeder wagon and the tractor.
- 51) Whenever work is carried out using road wheels, the feeder wagon must be secured to prevent it from rolling.
- 52) Repairs on road wheels should be carried out by suitably trained persons. This work should be carried out using appropriate tools.
- 53) Regularly check the tyre pressure and the tightening of the drive wheel nuts.
- 54) If any faults or malfunctions are found in the feeder wagon, it must be taken out of service immediately until the fault is rectified.
- 55) Maintenance and repairs must be carried out in compliance with general occupational health and safety rules. In the event of a cut, the wound should be immediately disinfected with a dressing applied, and a doctor should be consulted in the case of more serious injuries.
- 56) During the warranty period, all repairs may only be carried out by an authorised warranty service.
- 57) If individual machine components need to be replaced, only original parts or those specified by the manufacturer must be used. Failure to comply with these requirements may result in a risk to the health or life of the operator and bystanders, as well as damage to the machine.
- 58) In the case of repairs requiring the lifting of the feeder wagon, suitable approved lifting equipment must be used. In addition, stable and sturdy supports should be used after the lifting.
- 59) It is forbidden to support the feeder mixing wagon using brittle elements.
- 60) The manufacturer delivers the feeder wagon fully assembled.
- 61) Depending on the degree of loading with the working material, the centre of gravity of the feeder wagon is located 1,300 - 3,200 mm from the rear edge of the vehicle in the horizontal plane, in the transverse plane it is located along the axis of the vehicle, at a height of 820 - 1,580 mm from the ground.

2.4 Pneumatic and hydraulic systems



CAUTION

CAUTION!

The pneumatic braking system is under high pressure.

Before starting any work on the system, switch off the tractor's engine, secure the feeder wagon with the parking brake and support chocks, and then release all pressure from the system.

- The maximum permitted pressure in the hydraulic power system is 16 MPa.
- The maximum allowable pressure in a double-line pneumatic system is 0.80 MPa, and the minimum is 0.65 MPa.
- When connecting pneumatic lines to the tractor's pneumatic system, ensure that the valves on the tractor and feeder wagon side are not under pressure.

- Check the pneumatic connection on a regular basis and change damaged and ageing parts. Replace the lines as required by the manufacturer's specifications. Replace flexible pneumatic lines every 5 years unless damage has been found earlier.
- Air leaks are not allowed from the pneumatic braking system.
- The hydraulic system is under high pressure during operation.
- Use the hydraulic oil recommended by the manufacturer. Never mix two different types of oil.
- Dispose of used oil after replacement.
- Regularly check the technical condition of the hydraulic connections and lines.
- When connecting the hydraulic lines to the tractor, make sure that the hydraulic systems of the tractor and the feeder wagon are not under pressure. If necessary, reduce the residual pressure of the system.
- In the event of an injury sustained from a strong hydraulic oil jet, consult a physician immediately. Hydraulic oil can penetrate under the skin and cause infections.
- Repairs on the pneumatic or hydraulic systems may only be carried out by an authorised representative of the manufacturer of the feeder wagon.
- In the event of a failure of the hydraulic or pneumatic system, the spreader must be taken out of service until the failure has been removed.



Change flexible pneumatic lines every 5 years, unless damage is found earlier.

Change rubber hydraulic lines every 4 years, regardless of their technical condition, unless a fault has been found earlier.



CAUTION

CAUTION!

Required cleanliness of the hydraulic oil 20/18/15 according to ISO 4406-2021.

2.5 Working with the PTO

- The feeder wagon may only be connected to the tractor, by means of an appropriately selected PTO shaft recommended by the manufacturer.
- Before starting work, read the manual of the drive shaft and follow its guidelines.
- Connect and disconnect the articulated telescopic shaft only when:
 - The feeder wagon is coupled to a tractor hitch,
 - the tractor's engine is switched off,
 - the key is removed from the ignition switch,
 - the parking brake is on,
 - and the PTO shaft is switched off.
- Before starting the tractor coupled with the feeder wagon, make sure that the PTO shaft drive in the tractor is switched off.
- The articulated telescopic shaft must have guards.
- It is forbidden to use the PTO shaft without its guards or with damaged components.
- Install the articulated telescopic shaft, in accordance with the operating

instruction provided by the manufacturer of the shaft.

- Secure the guards of the PTO shaft against rotating, using chains. Fasten the chains of the shaft to the permanent structural components of the feeder wagon and the tractor.
- The PTO shaft's guard is marked, indicating which end of the shaft should be installed on the machine side and which one on the tractor side. The protective couplings must always be fitted on the machine side.
- After installing the PTO shaft, make sure that it is correctly and safely connected to the tractor and the feeder wagon.
- Each time the feeder wagon is started, make sure that the PTO shaft's guards are in good technical condition and correctly positioned. Change any damaged or faulty components for new ones.
- When working with and maintaining the machine, it is forbidden to wear loose clothing, which can be caught by the rotating parts of the PTO shaft. Any contact with a rotating articulated telescopic shaft can result in a serious injury or death.
- When working in conditions of reduced visibility, use the tractor's service lights to ensure adequate sight of the working PTO shaft and its immediate vicinity.
- Transport and store the PTO shaft horizontally with its chains fastened together, to prevent damage to the guards and other components.
- It is prohibited to overload the PTO shaft and the drive system of the feeder wagon. It is not allowed to suddenly start the PTO shaft of the tractor. Before starting the PTO shaft, make sure that the direction of rotation is correct.
- **Use the PTO shaft speed of 540 rpm during operation.** Operating at different speeds can damage the machine or its components.
- Switch off the PTO shaft drive, whenever there is no need to drive the machine, or when the tractor and the feeder wagon are positioned at an unfavourable angle.
- Do not exceed the maximum permissible working length of the PTO shaft.
- When uncoupling the PTO shaft from the tractor, place it in the special holder designed for that purpose.
- It is prohibited to use chains for suspending or supporting the PTO shaft when the feeder wagon is parked or transported.

2.6 Eliminating the causes of spontaneous blockages

If any blockages occur, first switch the tractor engine off and remove the ignition key. Then remove the cause of the fault. To do this, discharge the contents of the hopper to a level which makes it possible to locate the cause of the blockage. The discharging can be done over the top edge of the hopper or through the side discharge window. Check that the mixing screw rotates freely.

Particular attention should be paid to sharp knives and edges, cover them if possible. Wear working gloves and clothing tightly fitting the body.



CAUTION

Never remove the blockage by changing the rotation direction of the screw.

2.7 Eliminating blockages

If the discharge ducts of the machine become blocked:

- 1) Stop the tractor, switch off the engine and the PTO drive.
- 2) Secure the tractor against rolling away by applying the parking brake.
- 3) Remove material from the discharge duct space, using a metal hook only.

Slightly lift the discharge gate to facilitate the removal of the material. Once the blockages are removed, set the desired gate position again.



CAUTION

CAUTION:

Cleaning and clearing any blockages may only be carried out with the machine stationary, secured against rolling away and possible starting, with the tractor engine stopped.

2.8 Noise emissions

The level of noise highly depends on the tractor used. The measured sound level of the machine was 78.6 dB(A). The need for hearing protection depends on the emitted sound level and the sound power level of the towing vehicle, with which the feeder wagon will be coupled. The machine manufacturer recommends the use of hearing protection.

2.9 Fire precautions

It is a strict requirement to follow fire protection regulations and eliminate all risks of fire, during operation, since the feeder wagon uses flammable materials. It is recommended to equip the machine (tractor) with a functional dry-chemical extinguisher (BCE type).

- 2) In the event of a fire, switch off the engine immediately. Use a fire extinguisher, if provided, to spray the fire source; If a fire extinguisher is unavailable, sand can be used to extinguish the fire.
- 3) Prior to commencing work, lubricate the machine according to the lubrication plan, start

the machine and make sure that the moving parts of the machine do not rub against the fixed parts. All causes leading to the rubbing of mechanisms inside the machine must be eliminated, prior to commencing work.

It is unacceptable to smoke and use open sources of fire near the feeder wagon in operation.

It is unacceptable to repair or weld the machine, if all residues of flammable materials that could cause fire have not been removed from it. Prior to commencing any welding work, protect all electric wires, hydraulic lines, bearings, and plastic bush holders against damage.

- 6) After an accident, call the emergency number of the local rescue centre, hospital or fire brigade.



CAUTION

Users must remember that:

It is absolutely mandatory to follow all industrial safety regulations, traffic regulations, and fire protection regulations.

2.10 Residual risk

2.10.1 Residual risk description

Despite the fact that METAL-FACH in Sokółka assumes responsibility for the design and structure in order to eliminate the hazards, it is inevitable that some risks will occur during operation of the feeder wagon.


Residual risks result from incorrect behaviour of the feeder wagon operator, e.g. due to lack of attention, ignorance or misconduct of the feeder wagon operators. The largest hazard occurs during execution of the following activities:

- 1) Staying in the tank of the feeder wagon during operation and transport.
- 2) Using the machine for purposes other than those described in the user manual.
- 3) Cleaning, maintenance and technical inspection of the feeder wagon.
- 4) Staying on the feeder wagon during operation and transport.
- 5) Staying in the vicinity of the conveyor belt during its operation and feedstock unloading.
- 6) Staying between the tractor and the machine during operation.
- 7) Use of a faulty PTO shaft.
- 8) Operation of the feeder wagon by persons not familiar with this user manual.
- 9) Operation of the feeder wagon by persons under the influence of alcohol or other intoxicating substances,
- 10) Making changes to the machine without the manufacturer's approval.
- 11) If it cannot be ascertained from any control station that no persons are present in the danger zone

2.10.2 Residual risk assessment

Residual risk can be mitigated to the minimum by applying the following recommendations:


- 1) Adhering to the safety rules described in the operating instruction.
- 2) Using common sense, when operating the machine.
- 3) Do not hurry when operating the machine.
- 4) Maintain a safe distance from the restricted and dangerous places.
- 5) Do not reach into dangerous and/or restricted areas with your hands.
- 6) Do not stand on the machine while it is in operation.
- 7) Start-up of the machine must be preceded by an audible warning signal (horn).
- 8) Have repair and maintenance work performed by trained personnel.
- 9) Wear the appropriate protective clothing.
- 10) Make sure no unauthorised persons have access to the machine, especially children.
- 11) Make sure there is no person present in the blind spot (especially when reversing and coupling).








	<p>CAUTION!</p> <p>Failure to comply with the instructions and guidance provided herein may result in residual risks.</p>
<p>CAUTION</p>	








2.11 Warning and information stickers





The feeder wagon is provided with information and warning decals. The user is obliged to ensure that the inscriptions, warning and information pictograms provided on the feeder wagon remain legible for the duration of its working life. If any information or warning sticker has been damaged or removed, have it ordered from the Manufacturer or the point of sale the machine was purchased from. Re-attach stickers to any new components that have been fitted during repair work. When cleaning, do not point a strong jet of water at the labels and do not use solvents.


Table 2. Information and warning stickers

No.	Safety symbol (sign)	Meaning of the symbol (sign) or content of the inscription	Location on the feeder wagon
1.		<p>Caution!</p> <p>Before you start operating the machine, read the Instruction Manual.</p>	<p>On the front panel of the frame, on the left</p>

2.		<p>Caution! Switch off the engine and remove the key before maintenance or repair.</p>	<p>On the front panel of the frame, on the left</p>
3.		<p>Caution! Torso crushing hazard. Stay clear of the area where the articulated coupling joints rotate, if the engine is running.</p>	<p>Drawbar</p>
4.		<p>Caution! Danger of being dragged in by the drivetrain. Do not reach into the area of rotating parts.</p>	<p>Drawbar</p>
5.		<p>Caution! Danger of crushing the toes. Keep a safe distance from the parking jack and the drawbar.</p>	<p>On the front panel of the frame, on the right</p>
6.		<p>Caution! Do not touch the machine components until fully stopped.</p>	<p>On the front wall of the conveyor</p>
7.		<p>Caution! Crushing hazard. Keep clear.</p>	<p>During discharging (occurs with folding feeders or a loading bucket)</p>
8.		<p>PTO direction and speed.</p>	<p>On the front wall of the conveyor</p>

9.		<p>Caution! Coupling with a tractor. Torso crushing hazard.</p>	<p>On the top part of the drawbar</p>
10.		<p>Caution! Risk of the entire body being entangled in the PTO shaft.</p>	<p>On the top part of the drawbar</p>
11.		<p>Caution! Risk of falling. Do not travel on platforms or ladders.</p>	<p>In the upper part of the tray, in the front part of the machine</p>
12.		<p>Caution! Risk of hands getting caught.</p>	<p>At the discharge openings</p>
13.		<p>Caution! Finger amputation hazard!</p>	<p>At the discharge openings</p>
14.		<p>Lubricating points.</p>	<p>Next to the key lubrication points</p>
15.		<p>Crane sling attachment point.</p>	<p>In the top part of the tray and on the right and left sides of the frame.</p>

16.		Warning inscription	On the front panel of the frame, on the left																
17.	 <table border="1"> <tr> <td>Ładowność: 6000kg</td> <td>Ładowność: 1800kg</td> <td>Ładowność: 2000kg</td> <td>Ładowność: 2200kg</td> </tr> <tr> <td>Ładowność: 7000kg</td> <td>Ładowność: 2400kg</td> <td>Ładowność: 2600kg</td> <td>Ładowność: 3400kg</td> </tr> <tr> <td>Ładowność: 4500kg</td> <td>Ładowność: 3000kg</td> <td>Ładowność: 3200kg</td> <td>Ładowność: 2800kg</td> </tr> <tr> <td></td> <td>Ładowność: 5200kg</td> <td></td> <td></td> </tr> </table>	Ładowność: 6000kg	Ładowność: 1800kg	Ładowność: 2000kg	Ładowność: 2200kg	Ładowność: 7000kg	Ładowność: 2400kg	Ładowność: 2600kg	Ładowność: 3400kg	Ładowność: 4500kg	Ładowność: 3000kg	Ładowność: 3200kg	Ładowność: 2800kg		Ładowność: 5200kg			Limited load capacity of the feeder wagon.	In the upper part of the tray, in the front part of the machine
Ładowność: 6000kg	Ładowność: 1800kg	Ładowność: 2000kg	Ładowność: 2200kg																
Ładowność: 7000kg	Ładowność: 2400kg	Ładowność: 2600kg	Ładowność: 3400kg																
Ładowność: 4500kg	Ładowność: 3000kg	Ładowność: 3200kg	Ładowność: 2800kg																
	Ładowność: 5200kg																		
18.		No entry.	On the gates																
19.	<p>atm/MPa 140/14</p>	Informational pictogram.	At the actuators and the manifold																
20.	 <p>OTWARTE</p> <p>ZAMKNIĘTE</p> <p>UWAGA Obserwuj wskaźnik zabrudzenia filtra oleju hydr. Wymiana wkładu filtrującego przy wartości= 2,2 [bar] Nr wkładu filtrującego: CRA220FD1</p> <p>UWAGA Zbiornik o pojemności 42 L. Stosować olej hydrauliczny: -klasa jakości: ISO 11158-HL -klasa lepkości: ISO VG: 46 Kontrolować poziom i temperaturę oleju przez wskaźnik optyczny. Maksymalna temperatura oleju= 65 °C</p>	Information pictograms if the feeder wagon is equipped with an onboard hydraulic system.	On the oil tank																
21.	<p>Zabrania się przebywania na pomoście podczas pracy i transportu wozu paszowego</p>	Warning pictogram.	In the upper part of the tray, in the front part of the machine																

22.	UWAGA! CZĘŚCI WIRUJĄCE	Warning pictogram.	In the upper part of the tray, in the front part of the machine
23.	UWAGA! ZABRANIA SIĘ PRZEBYWANIA OSÓB POSTRONNYCH W POBLIŻU PRACY MASZYNY	Warning pictogram.	On the tray on the right and left side of the machine
24.	Nakrętki kół dokręcić po kilku kilometrach a następnie robić to okresowo	Informational pictogram.	Above the road wheels
25.		Jack-attachment point.	On the running axle
26.	W PRZYPADKU ZABLOKOWANIA WYŁĄCZYĆ MASZYNĘ	Warning pictogram.	On the gates / on the cover of the discharge window and on the top of the tray, in the front part of the machine



CAUTION

CAUTION!

The user must maintain legibility of all warning inscriptions and signs attached to the feeder wagon throughout the entire service life. If they are damaged or destroyed, replace them with new ones.

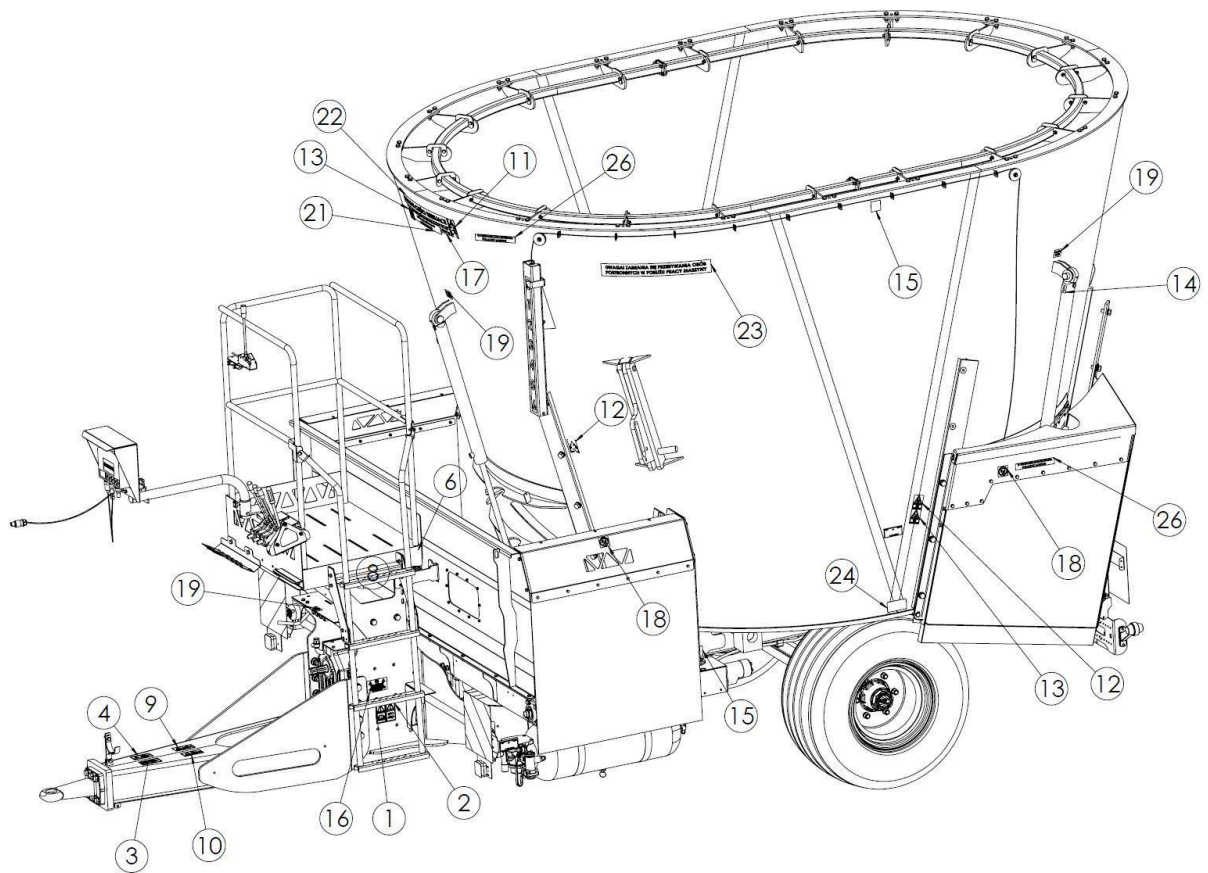


Figure 6. The locations of warning and information stickers

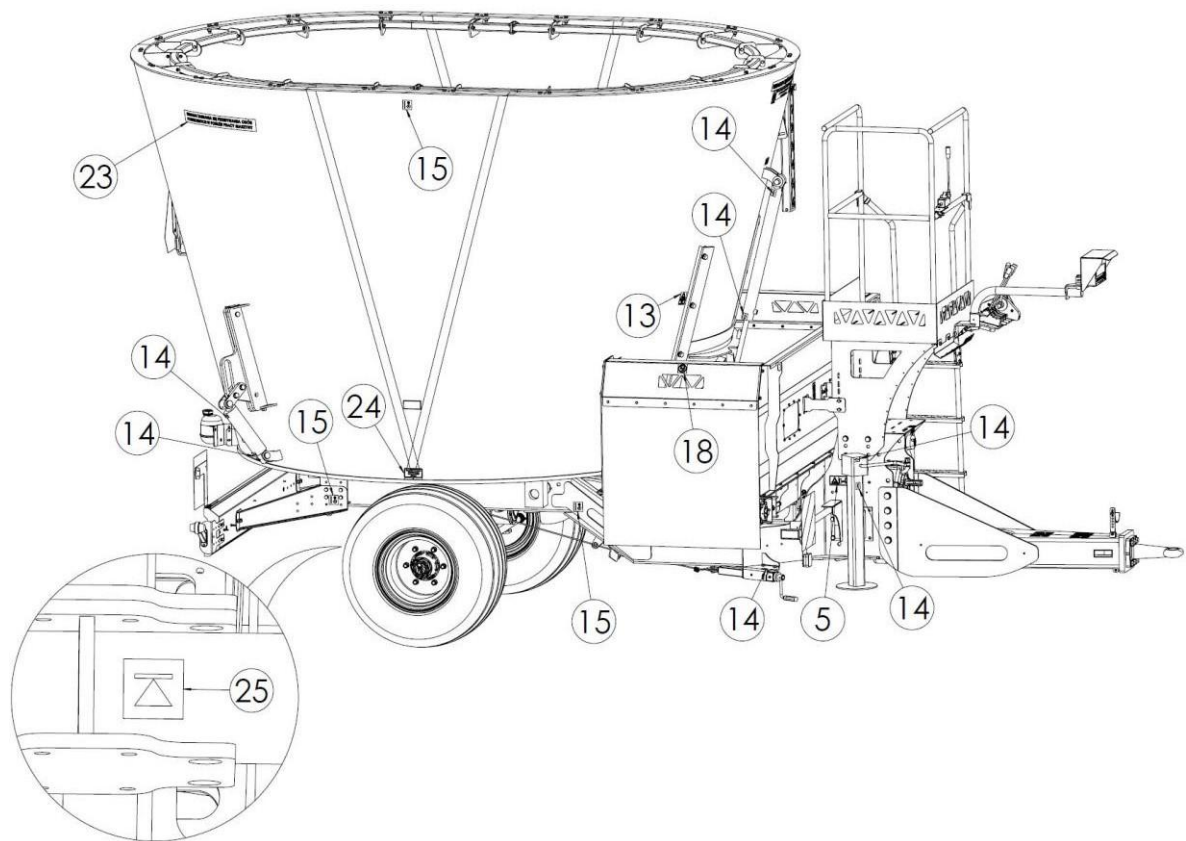


Figure 7. The locations of warning and information stickers

3. Design and operation principle

3.1 Main technical data

Table 3. Main technical data

No.	General data						
1.	Vehicle type	Feeder wagon					
2.	Suspension	Rigid axle (T659/1, T659/2, T659/3, T659/5), sprung tandem (T659/4)					
3.	Type (Model)	T659/1, T659/2, T659/3, T659/4, T659/5					
4.	Rating plate location	Front part of the frame, on the right					
Overall dimensions							
		UoM	T659/1	T659/2	T659/3	T659/4	T659/5
6.	Length	mm	4,050-5,250	4,150-6,450	5,250-6,250	6,450-8,500	6,550-6,750
7.	Width	mm	2,000-3,000	2,000-3,000	2,000-3,000	2,000-3,000	2,000-3,000
8.	Height	mm	2,000-2,650	2,200-3,200	1,800-2,500	2,400-3,200	2,200-2,500
9.	Wheel track	mm	1,970-2,135				
Tank dimensions							
10.	Height	mm	1,450-1,620	1,450-2,090	1,480-1,960	1,460-1,850	1,400-1,710
11.	Length	bottom	2,100-2,400	2,100-2,500	2,100-2,500	4,570-4,870	4,370
		top	2,590-3,380	2,590-3,795	2,690-3,570	5,200-5,880	4,960-5,210
12.	Width	mm	2,100-2,500	2,100-2,500	2,100-2,500	2,200-2,500	2,200
13.	Tank shell thickness	mm	8				
14.	Tank bottom thickness	mm	20				
15.	Tank capacity	m3	5-8	5-13	6-10	12-20	12-14
Road driving specifications							
16.	Gross vehicle weight rating	kg	4,860-6,890	4,860-6,890	3,860-5,190	9,720-13,780	6,490-7,500
17.	Load capacity*	kg	(GVW + drawbar eye load) - empty weight = load capacity	(GVW + drawbar eye load) - empty weight = load capacity	(GVW + drawbar eye load) - empty weight = load capacity	(GVW + drawbar eye load) - empty weight = load capacity	(GVW + drawbar eye load) - empty weight = load capacity
18.	Permissible axle load	kg	4,860-6,890	4,860-6,890	3,860-5,190	4,860-6,890/4,860-6,890	6,490-6,890
19.	Kerb weight (max)	kg	4,900	4,900	4,300	8,200	6,500
20.	Drawbar eye load (max)	kg	600	600	2,300	700	1,000
21.	PTO rotational speed	rpm	540				

Miscellaneous							
22.	Engine power consumption	kW	35-50	35-70	35-60	60-90	60-90
23.	Electrical system voltage	V	12				
24.	Pressure in the hydraulic system (max)	MPa	16				
25.	Bottom hitch	-	YES				
	Top hitch		NO				
26.	Drawbar eyes (types)	-	Drawbar eye fixed, screwed phi 40				
			Drawbar eye fixed screwed phi 50				
			Drawbar eye swivelled, screwed phi 50				
			Drawbar eye screwed K80				
27.	Brake	-	Hydraulic brake				
			Pneumatic brake, 1 line				
			Pneumatic brake, 2 lines				
		-	Mechanical, drum, manually controlled via a worm gear				
28.	Tyres	-	10./75-15.3 139 A6				
			30x11.5-14.5 154 A6				
			400/60-15.5 149 A6				
			400/60-15.5 151 A6				
			400/60-15.5 154 A6				
29.	Parking jack	-	Fixed				
			Foldable				
			Hydraulic				

*The manufacturer reserves the right to change the technical parameters of the vehicle

*The technical parameters of the vehicle depend on the selected equipment of the feeder wagon.

Table 4. Basic technical data of tyres

Zespół opon nr Tyre combination No.	Oś nr Axle No.	Rozmiar opony, w tym indeks nośności i symbol kategorii prędkości Tyre dimension including load capacity index and speed category symbol	Promień toczny(1) [mm] Rolling radius [mm]	Obciążenie znamionowe jednej opony [kg] Tyre load rating per tyre [kg]	Maksymalna dopuszczalna masa na oś [kg] (*) Maximum permissible weight per axle [kg] (*)	Maksymalna dopuszczalna masa pojazdu [kg] (*) Maximum permissible weight of the vehicle [kg] (*)	Maksymalne dopuszczalne obciążenie pionowe w punkcie sprzęgu [kg] (*) (**) (***) Maximum permissible vertical load on the coupling point [kg] (*) (**)	Rozstaw kół [mm] Wheel base [mm]	
								Minimum Minimum	Maksimum Maximum
1	1	10.0/75-15.3 139 A6	355	Min. 2,430 kg	4,860 kg	4,860 kg	2,300 kg	1,700	1,730
2	1	400/60-15.5 149 A6	408	Min. 3,245 kg	6,490 kg	6,490 kg	2,300 kg	1,700	1,730
3	1	400/60-15.5 151 A6	408	Min. 3,445 kg	6,890 kg	6,890 kg	2,300 kg	1,700	1,730
4	1	30x11.5-14.5 154 A6	350	Min. 3,750 kg	7,500 kg	7,500 kg	2,300 kg	1,700	1,730
1	1,2	10.0/75-15.3 139 A6	355	Min. 2,430 kg	4,860 kg 4,860 kg	9,720 kg	700 kg	1,800	1,830
2	1,2	400/60-15.5 149 A6	408	Min. 3,245 kg	6,490 kg 6,490 kg	12,980 kg	700 kg	1,800	1,830
3	1,2	400/60-15.5 151 A6	408	Min. 3,445 kg	6,890 kg 6,890 kg	13,780 kg	700 kg	1,800	1,830
4	1,2	30x11.5-14.5 154 A6	350	Min. 3,750 kg	7,500 kg 7,500 kg	15,000 kg	700 kg	1,800	1,830
2	1	400/60-15.5 149 A6	408	Min. 3,245 kg	6,490 kg	6,490 kg	1,000 kg	1,800	1,830
3	1	400/60-15.5 151 A6	408	Min. 3,445 kg	6,890 kg	6,890 kg	1,000 kg	1,800	1,830
4	1	30x11.5-14.5 154 A6	350	Min. 3,750 kg	7,500 kg	7,500 kg	1,000 kg	1,800	1,830
5	1	400/60-15.5 154 A6	400	Min. 3,750 kg	7,500 kg	7,500 kg	1,000 kg	1,800	1,830

(*) In accordance with tyre specifications.

(**) Load transmitted onto the reference centre of the coupling under static conditions, regardless of the coupling device;

The user must observe the permissible transport speeds for the maximum load capacity of the feeder wagon.

If using a different brand of tyres, observe the parameters regarding that particular brand.



DANGER

DANGER!

Failure to adhere to the permissible speed, tyre and axle loads can result in a serious accident.

3.2 Design of the feeder wagon

The design of the feeder wagon and its appearance can vary depending on the choice of machine variant made by the customer and type of equipment used. The types of feeder wagons and their general design are outlined below.

3.2.1 Single-rotor feeder wagon T659/1, double-rotor feeder wagon T659/5

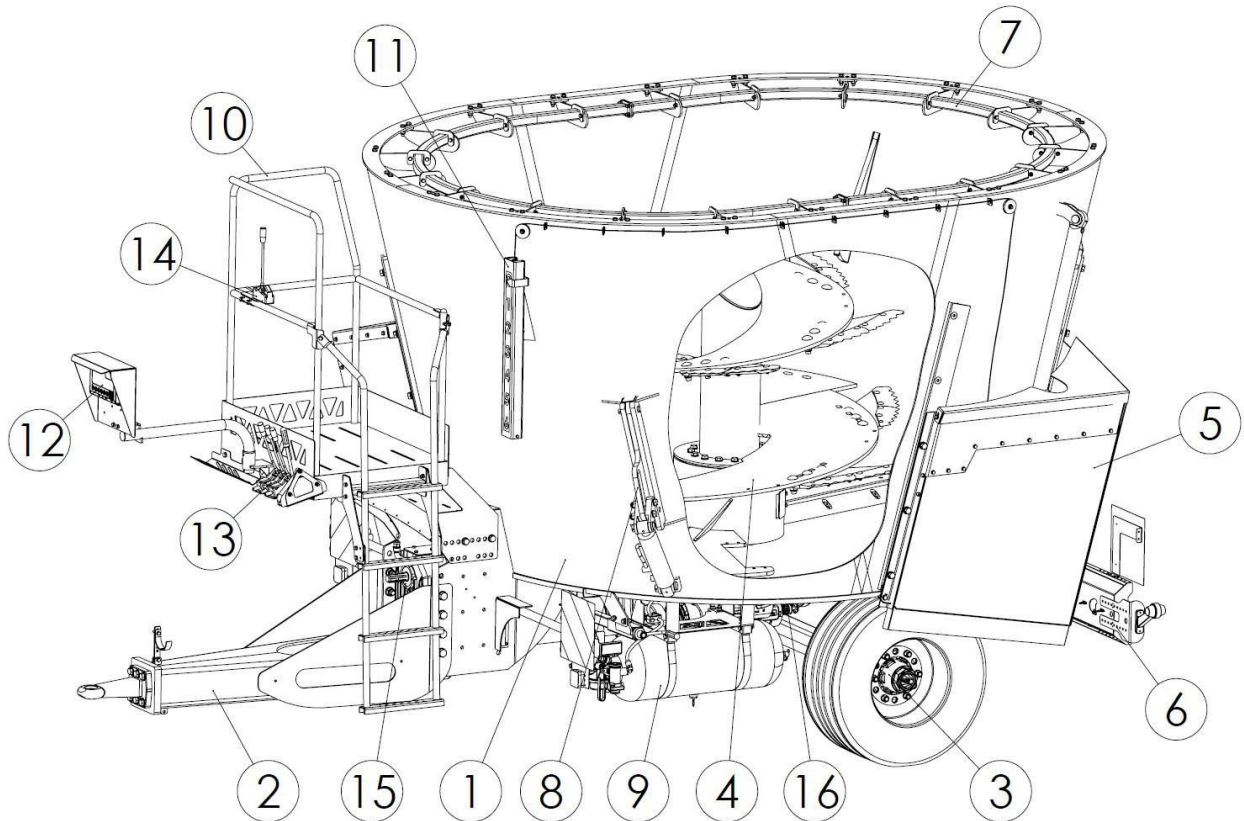


Figure 8. General design of the OPTIMAL T659/1, BEL-MIX T659/5 feeder wagon:
 1 - tank, 2 - drawbar, 3 - axle, 4 - screw, 5 - discharge, 6 - lights, 7 - limiting ring, 8 - counterblade, 9 - air tank, 10 - platform, 11 - gate opening indicator, 12 - balance, 13 - control levers of the feeder wagon hydraulic system, 14 - control lever for the hydraulic counterblade, 15 - two-speed gear, 16 - planetary gear

The OPTIMAL T659/1 and T659/5 feeder wagon is a machine based on a self-supporting construction, i.e. it does not have a separate frame and the tank (1) is the the main connecting element between the drawbar and the driving axle. Figure 8 presents the overall design of the machine.

The OPTIMAL T659/1 feeder wagon is a single-rotor version of the machine with tank capacity between 5 and 8 m³, while the T659/5 model is a double-rotor version characterised by a larger tank capacity of 12 to 14 m³. Both versions of the machines are equipped with a single axle (3).

3.2.2 Single-rotor feeder wagon BEL-MIX T659/2

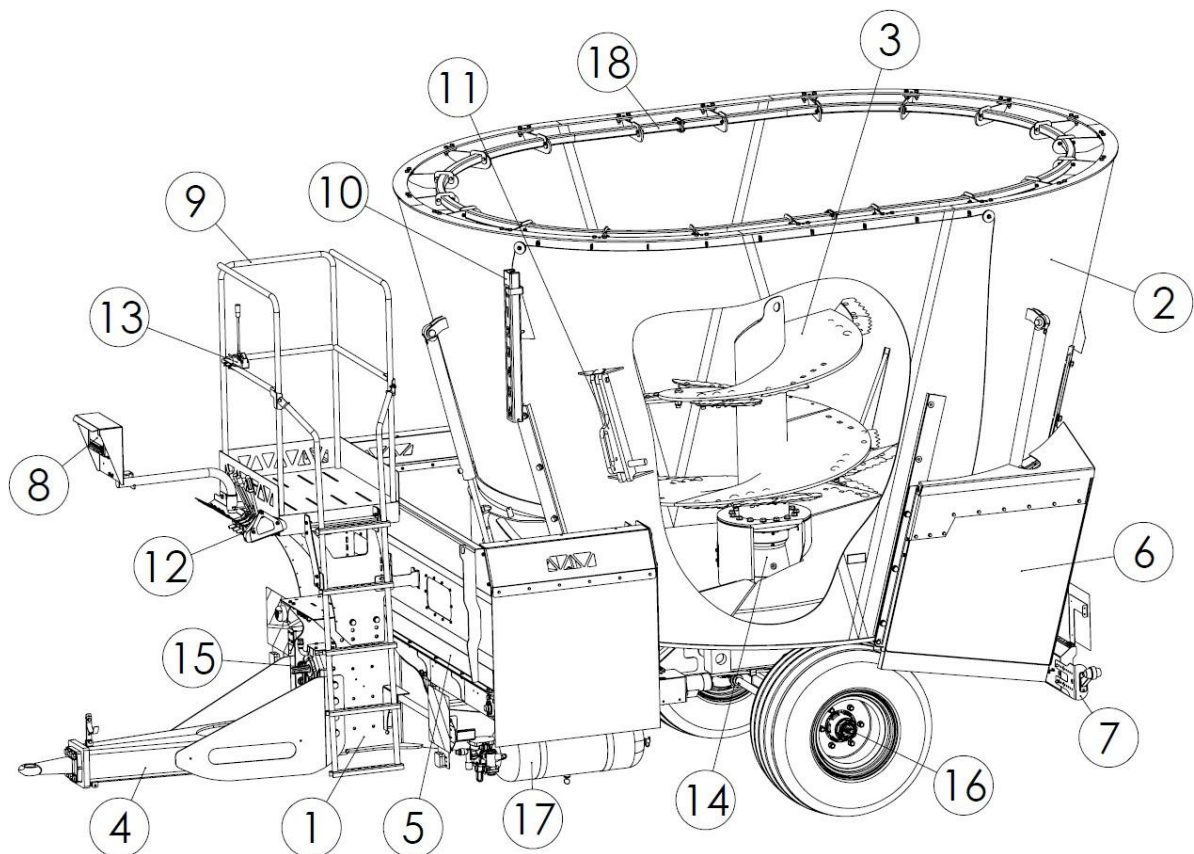


Figure 9. General design of the BEL-MIX T659/2 feeder wagon: 1 - frame, 2 - tank, 3 - screw, 4 - drawbar, 5 - front transverse conveyor, 6 - discharge, 7 - lights, 8 - balance, 9 - platform, 10 - opening indicator, 11 - counterblade, 12 - feeder wagon control levers, 13 - hydraulic counterblade control lever, 14 - planetary gear, 15 - two-speed gear, 16 - axle, 17 - air tank

The BEL-MIX T659/2 feeder wagon is a machine based on a frame design, with a tank capacity between 5 and 13m³. The tank (2) is installed on a frame (1), the design of which may vary, depending on whether or not a front transverse conveyor (5) is installed. A screw (3) is installed inside the hopper, which is responsible for feedstock cutting and mixing. A braked axle is bolted to the frame, with a drawbar (4) and a platform (9) equipped with a weighing computer (8), hydraulic system (12) and hydraulic counterblade (13) (if equipped) control levers in its front part. The overall design of the machine is shown in Figure 9, and its appearance may vary depending on the selected equipment options.

3.2.3 Single-rotor feeder wagon BEL-MIX T659/3

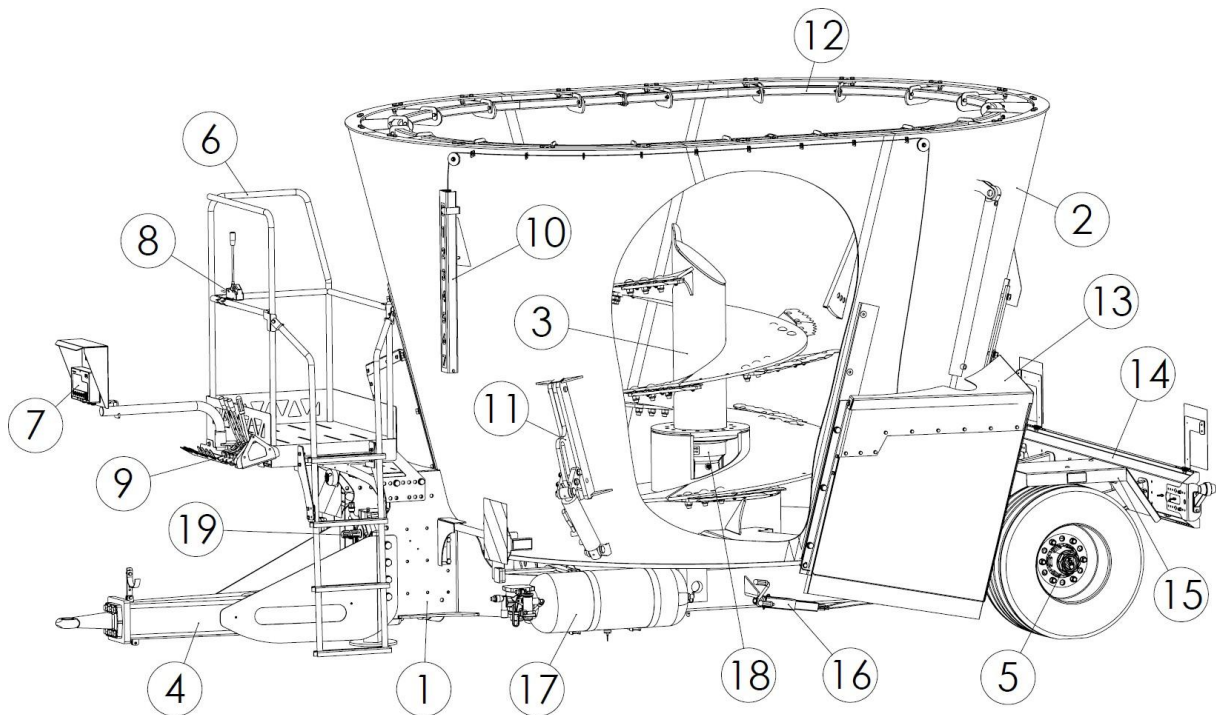


Figure 10. General design of the BEL-MIX T659/3 feeder wagon: 1 - frame, 2 - tank, 3 - screw, 4 - drawbar, 5 - axle, 6 - platform, 7 - balance, 8 - hydraulic counterblade control lever, 9 - hydraulic system control levers, 10 - gate opening indicator, 11 - counterblade, 12 - limiting ring, 13 - discharge, 14 - lights, 15 - mudguards, 16 - hand brake, 17 - air tank, 18 - planetary gear, 19 - two-speed gear

The BEL-MIX T659/3 feeder wagon is a downsized version of the machine based on a frame construction with tank capacities between 6 and 10m³. It is intended for use with low doors or in low buildings, where the height is limited by the ceiling.

The main elements of the feeder wagon presented in detail in Figure 10 are the frame (1), the braked axle (5) bolted to the rear of the frame and the tank(2) placed on the frame (1), the design of which may vary depending on whether or not a transverse front conveyor is installed. A screw (3) is installed inside the tank, which is responsible for cutting and mixing the feedstock ingredients. In the front part there is a drawbar (4) and a platform (6), equipped with a weighing computer (7), levers used to control the hydraulic system (9) and the hydraulic blade (8) (if equipped). The overall design of the machine is presented in Figure 10, and its appearance may vary depending on the selected equipment options.

3.2.4 Double-rotor feeder wagon BEL-MIX T659/4

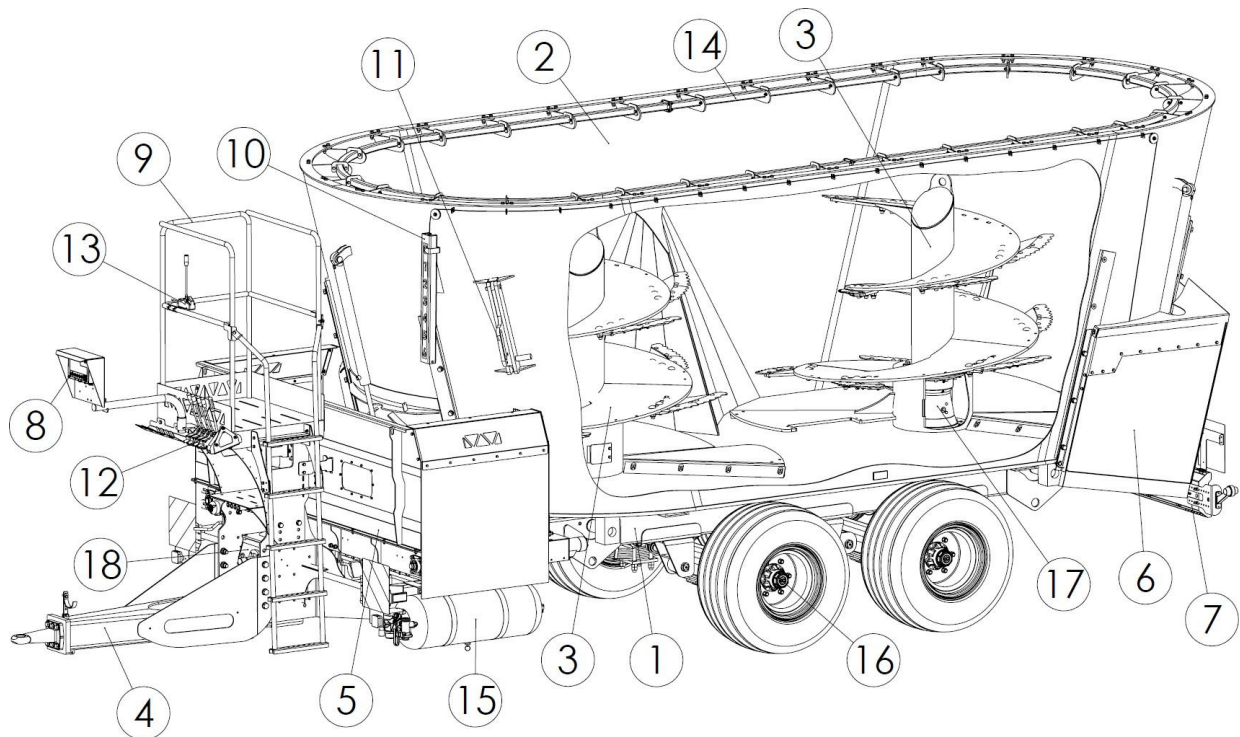


Figure 11. General design of the BEL-MIX T659/4 double-rotor feeder wagon: 1 - frame, 2 - tank, 3 - screw, 4 - drawbar, 5 - front conveyor, 6 - discharge, 7 - lights, 8 - balance, 9 - platform, 10 - gate opening indicator, 11 - counterblade, 12 - hydraulic system control levers, 13 - hydraulic counterblade control lever, 14 - limiting ring, 15 - air tank, 16 - tandem suspension, 17 - planetary gear, 18 - two-speed gear

The BEL-MIX T659/4 feeder wagon is a machine based on a frame design with a tank capacity between 12 and 20m³. The tank (2) is installed on a frame (1), the design of which may vary, depending on whether or not a front transverse conveyor (5) is installed. Two screws (3) are installed inside the tank, responsible for feedstock cutting and mixing. The frame, including the tank, is placed on a sprung tandem suspension (16). In the front part of the frame there is a drawbar (4) and a platform (9) equipped with a weighing computer (8), control levers of the hydraulic system (12) and of the hydraulic counterblade (13) (if equipped). The overall design of the machine is shown in Figure 11, and its appearance may vary depending on the selected equipment options.

3.3 Chassis

3.3.1 Self-supporting structure

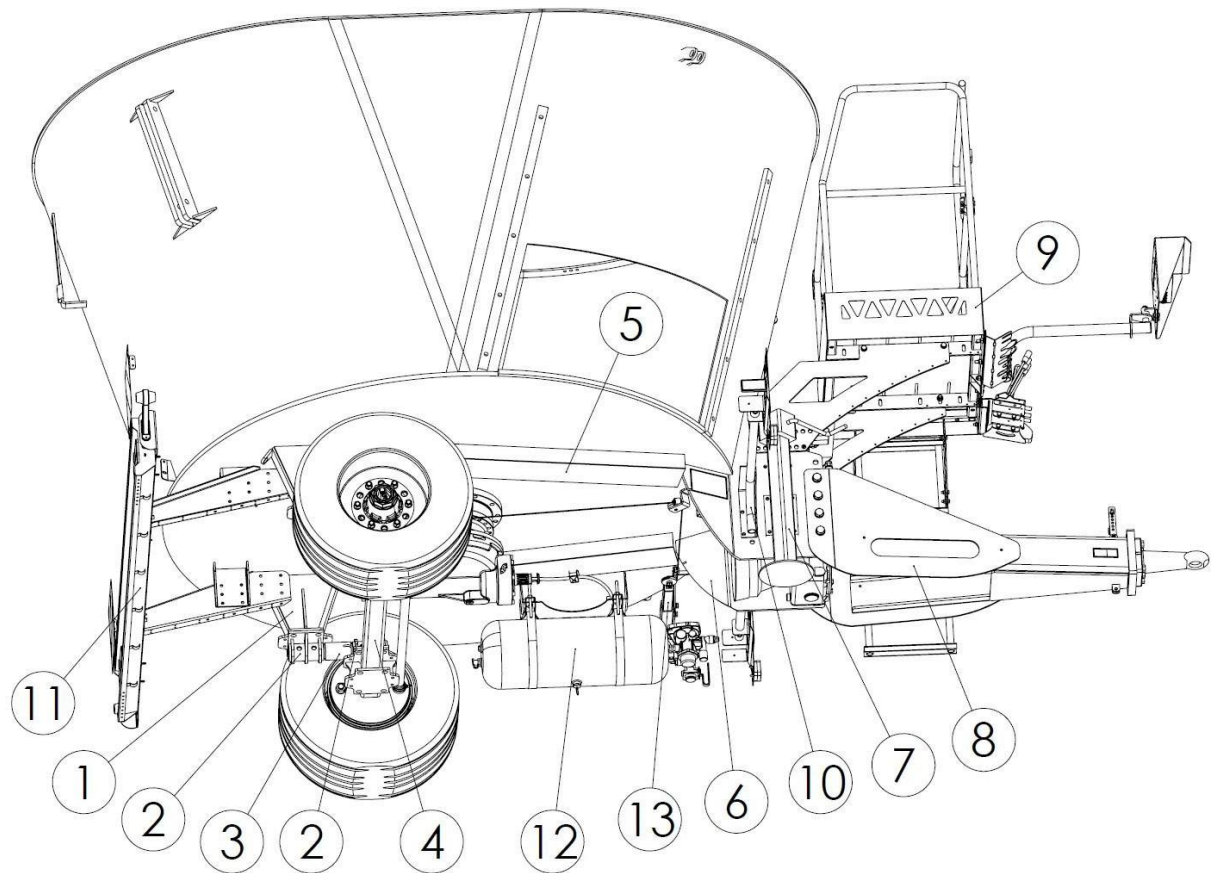


Figure 12. Chassis of the OPTIMAL T659/1 feeder wagon: 1 - base, 2 - tensor fixture, 3 - balance tensor, 4 - axle, 5 - bottom reinforcing C-profile, 6 - front panel, 7 - foot, 8 - drawbar, 9 - folding platform, 10 - front light arm, 11 - light bar, 12 - air tank, 13 - parking brake

Figure 12 shows the design of the chassis of the OPTIMAL T659/1 feeder wagon. It is a self-supporting structure with the tank as the main element. In its front part, front panels (6) are welded to the bottom and the wall, to which the drawbar (8), platform (9), parking jack (7) and front light arms (10) are then bolted. The axle (4) is attached to the bases (1) (welded to the bottom of the tray) via tensor fixtures (2) and a balance tensor (3) or a pin replacing the tensor. The tank structure was further reinforced with C-shaped profiles (5).

3.3.2 Frame structure of the single-rotor feeder wagon

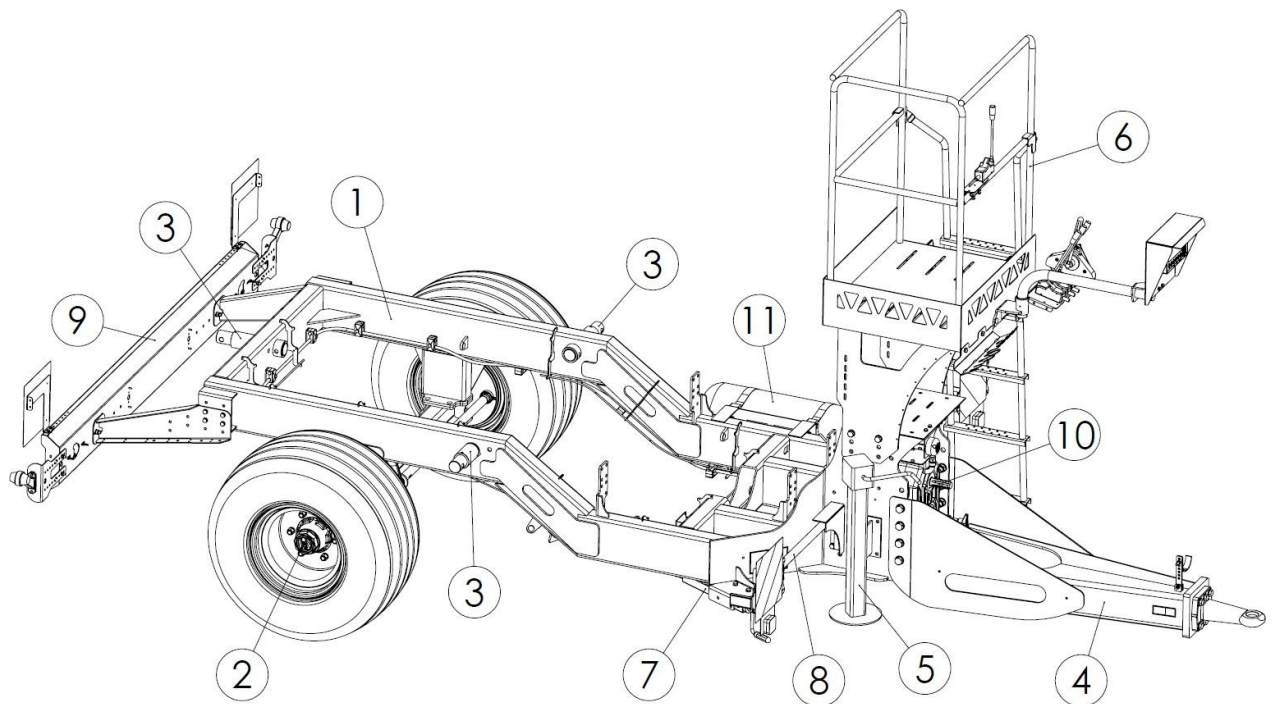


Figure 13. Chassis frame design of a single-rotor wagon: 1 - frame, 2 - axle, 3 - balance tensor, 4 - drawbar, 5 - parking jack, 6 - platform, 7 - parking brake, 8 - front light frame, 9 - light bar, 10 - two-speed gear, 11 - air tank

The chassis of a single-rotor feeder wagon is shown in Figure 13. The frame is a welded structure made of profiles and bent front sheets, to which the drawbar (4), platform (6), parking jack (5), front light arms (8), two-speed gear (10) or a transmission shaft are bolted. A braking system air tank (11) was installed on the left side of the frame. The rear bar and the two stringers have sockets for attaching the balance tensors (3), on which the tank is mounted. The light bar (9) bolted to fixings welded to the side frame profiles is located in the rear part. An axle (2) with a drum brake is bolted to the bases in the bottom part of the frame. A parking brake tensioning mechanism (7) is installed on the right side of the frame.

3.3.3 Frame structure of the double-rotor feeder wagon

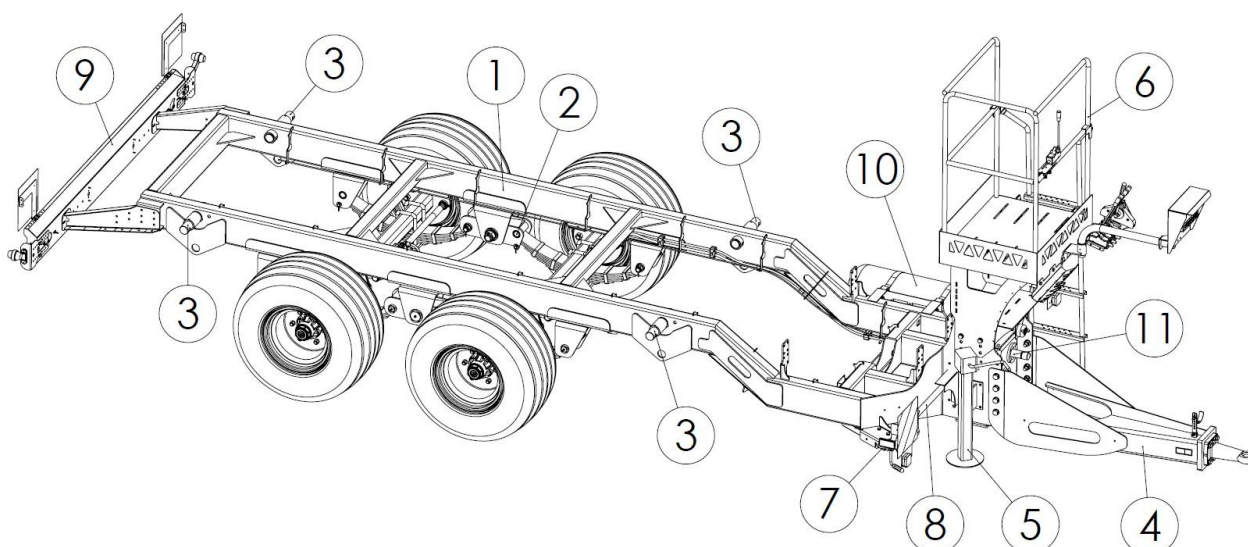


Figure 14. Chassis frame structure of a double-rotor wagon: 1 - frame, 2 - tandem suspension, 3 - balance sensor, 4 - drawbar, 5 - parking jack, 6 - platform, 7 - parking brake, 8 - front light frame, 9 - light bar, 10 - air tank, 11 - two-speed gear

The chassis of a double-rotor feeder wagon is shown in Figure 14. The frame is a welded structure made of profiles and bent front sheets, to which the drawbar (4), platform (6), parking jack (5), front light arms (8), two-speed gear (11) or a transmission shaft are bolted. A braking system air tank (11) was installed on the left side of the frame. The two stringers have slots for four balance tensors (3), on which the tank is mounted. The light bar (9) bolted to fixings welded to the side frame profiles is located in the rear part. The chassis is based on a tandem suspension (2) with leaf springs and two braked axles. A parking brake tensioning mechanism (7) is installed on the right side of the feeder wagon frame.

3.4 Tank

The feeder wagon tank is a welded construction with the bottom of the tank made of 20mm thick sheet metal, while the side walls are made of 8mm thick sheet metal. Tank structure is shown in Figure 15. The cubes (1) for the balance tensors are welded to the bottom and thanks to them, the tank is installed on the frame - depending on the variant, see Fig. 12, Fig. 13, Fig. 14. A lubricating oil expansion tank (3) for the planetary gear and a warning triangle fixture (7) for slow-moving vehicles are installed in the rear part. The tank also contains two counterblades (4) (hydraulic or mechanical), dosing windows protected by a discharge (6) and closed using a gate, the movement of which is ensured by an actuator (8) controlled independently by the hydraulic system. A planetary gear (12) is bolted to the bottom of the tank, to which the ribbon-type screw is then attached. An opening indicator (11) located in the front part is showing whether the gate is open/closed. A flange with holes is welded to the top edge of the tank, to which an extension or a bolted/welded ring is attached to limit feedstock loss during mixing.

The tank of the feeder wagon can be equipped with different types of discharges and/or conveyors which allow accurate feedstock dosing at the discharge location.

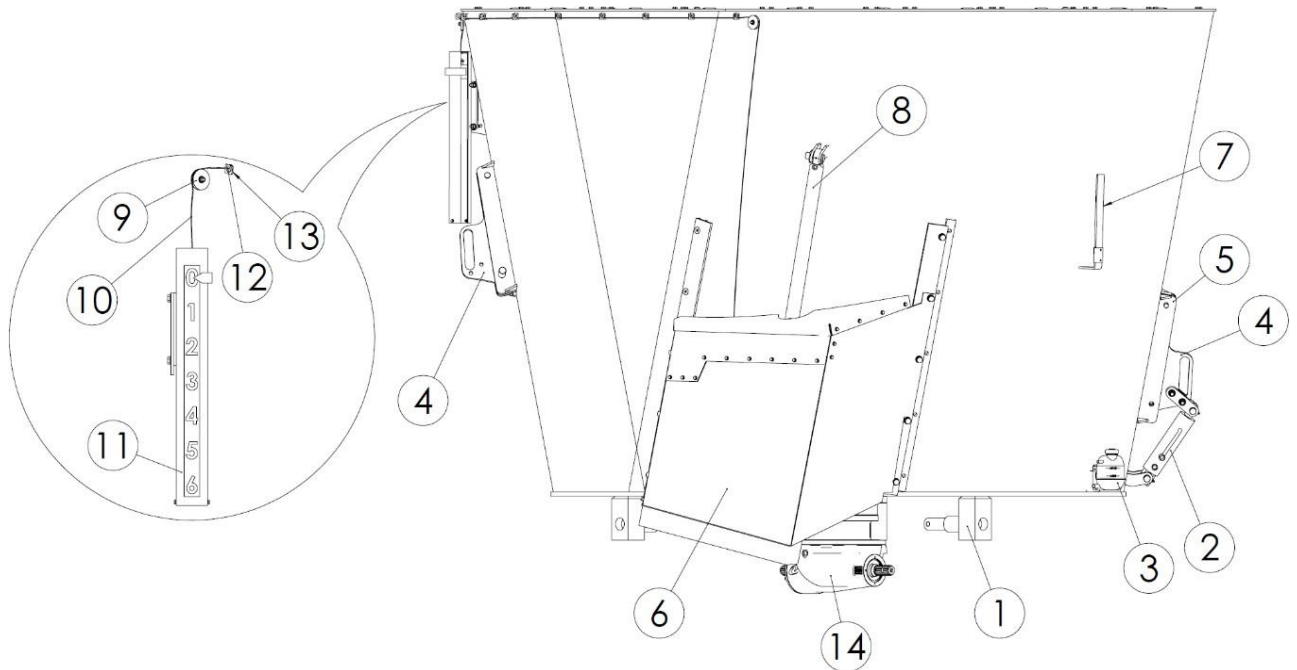


Figure 15. Complete tank: 1 - weight sensor cube, 2 - hydraulic counterblade actuator, 3 - gear oil expansion tank, 4 - counterblade, 5 - counterblade installation plate, 6 - discharge, 7 - warning triangle fixture, 8 - gate actuator, 9 - indicator cable guiding wheel, 10 - indicator cable, 11 - gate opening indicator, 12 - cable guide sleeve, 13 - sleeve fixture, 14 - planetary gear

3.5 Discharge windows - safety zone

The discharge windows are protected by a PVC cover, which is also present on both sides of the transverse feeder at the feedstock discharge point. This prevents user access to the inside of the tank.

In the case of right front and/or left rear discharge, the safety zone is located 560 mm away in relation to the mixing screw (Fig. 16), so that the user is unable to reach the danger zone where the screw is located.

A feeder wagon equipped with a front conveyor has two discharge windows, on the right and left sides of the feeder. In this case, the safety zone varies from 770 to 880 mm, depending on the diameter of the tank bottom, which is between 2,200 and 2,500 mm - see Figure 17.

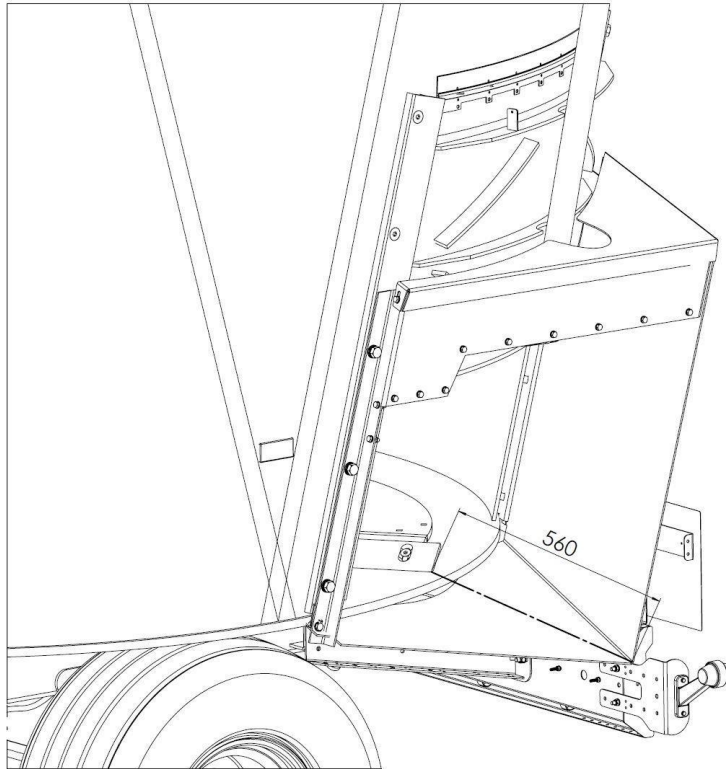


Figure 16. Safety distance in the discharge window

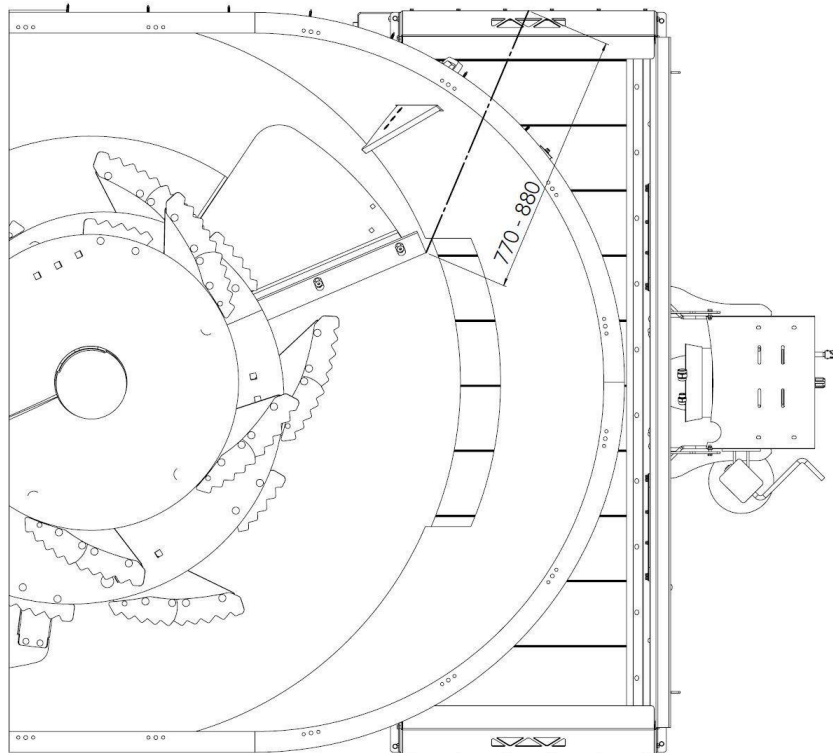


Figure 17. Safety distance in the front conveyor (top view)

3.6 Screw

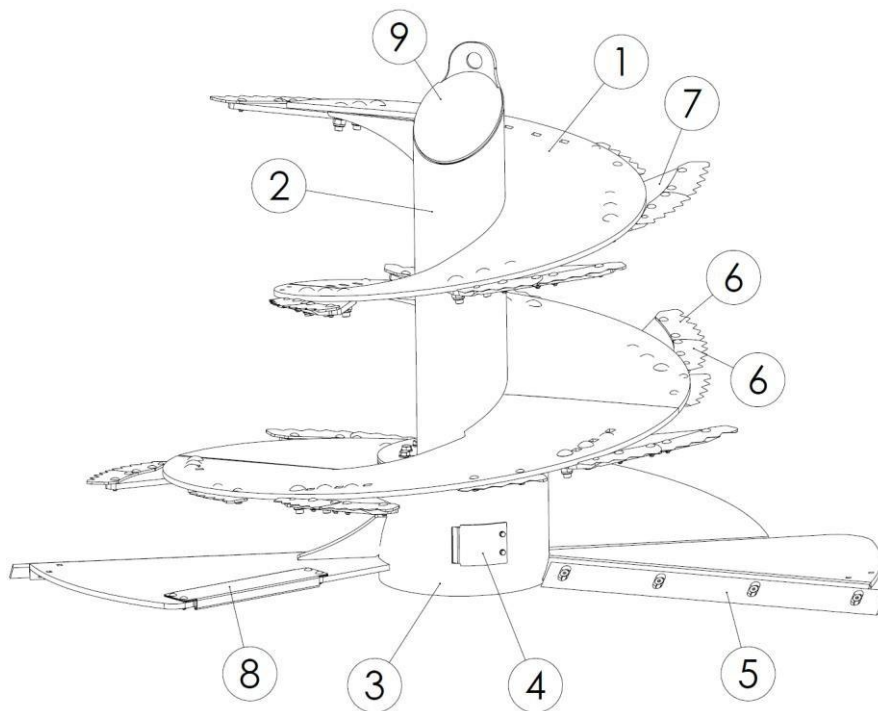


Figure 18. Screw: 1 - plate, 2 - top core, 3 - bottom core, 4 - bottom core, 5 - scraping knife, 6 - cutting knife, 7 - knife base, 8 - magnet, 9 - top core cap

The screw is used to mix, cut and discharge the prepared feedstock. It is installed inside the tank and driven via the tractor's drive unit and the PTO.

The screw consists of (Fig.18) bent plates (1) which, once welded, form a ribbon-type surface, reducing mixing resistance to a minimum. The plates are welded to a top (2) and bottom (3) core. The bottom part of the core is fitted with an inspection opening with a cap (4). Scraper blades (5) and a magnetic metal separator (optional) are bolted to the bottom plates. The cutting knives (6) bolted to the screw at the bases (7), are responsible for cutting the feedstock.

3.7 Brake

3.7.1 Service brake

The feeder wagon can be equipped with one of three types of brakes:

- Two-line pneumatic brake with three-position regulator - Figures 19, 20, 21,
- Single-line pneumatic brake - Figure 22,
- Hydraulic brake - Figure 23,

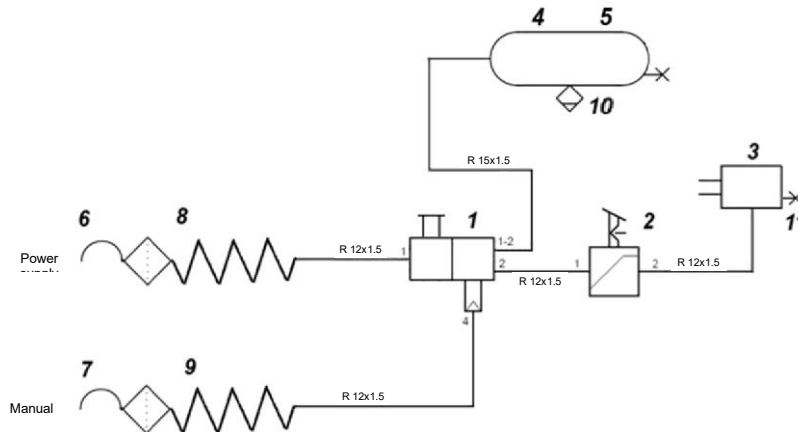


Figure 19. Two-line pneumatic brake system in T659/1, T659/2, T659/3, T659/5 models: 1 - main valve, 2 - brake force controller, 3 - diaphragm actuator, 4 - air tank, 5 - tank bracket, 6 - hose connector (red), 7 - hose connector (yellow), 8 - spiral hose (red), 9 - spiral hose (yellow), 10 - drainage valve, 11 - control connector.

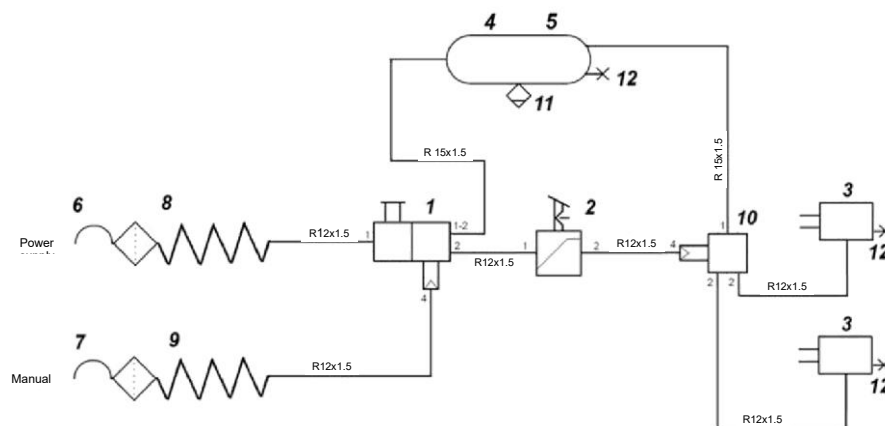


Figure 20. Two-line pneumatic brake in the T659/4 model: 1 - main valve, 2 - brake force controller, 3 - diaphragm actuator, 4 - air tank, 5 - tank bracket, 6 - hose connector (red), 7 - hose connector (yellow), 8 - spiral hose (red), 9 - spiral hose (yellow), 10 - relay valve with damping, 11 - drainage valve, 12 - control connector.

The machine brake is activated when the operator presses the brake pedal inside the tractor. In the case of a pneumatic system (Fig. 19, Fig. 20), the main braking valve (1) is responsible for simultaneous application of the brakes on the machine and the tractor. In addition, it activates the brake of the feeder wagon if the line disconnects unexpectedly from the tractor socket.

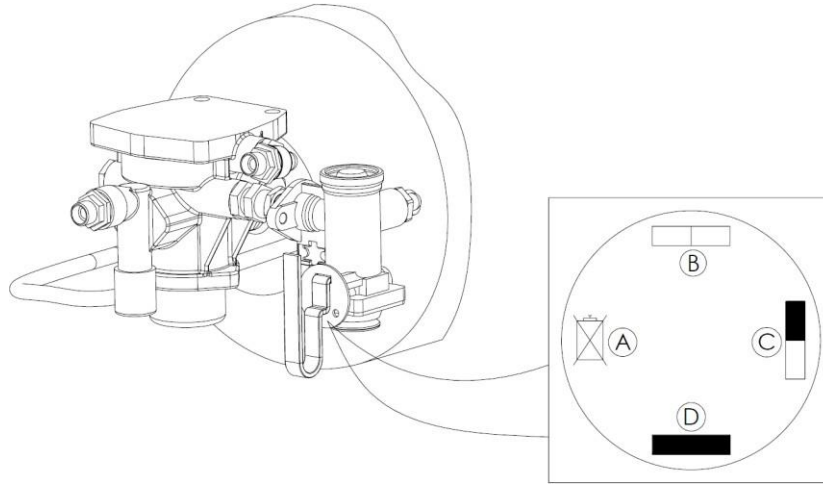


Figure 21. Brake force controller: lever position A - total pressure reduction (brakes off), B - no load (pressure range 1.4 - 2.8 bar), C - half load (pressure range 3.4 - 4.3 bar), D - full load

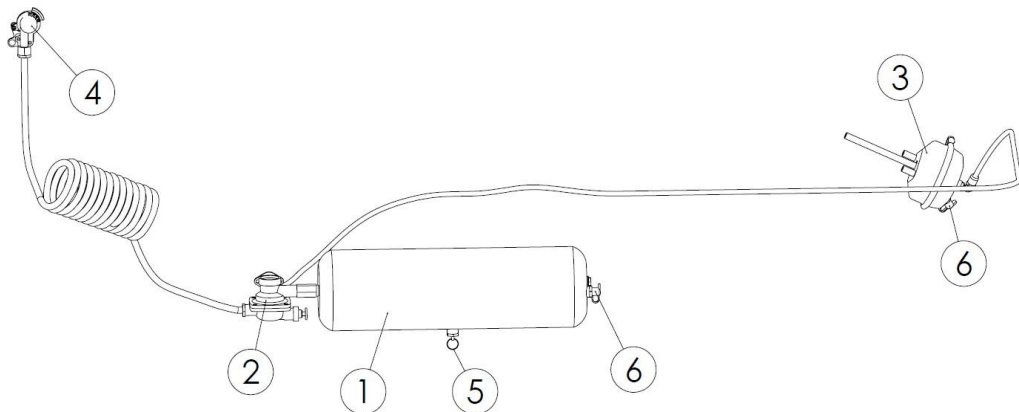


Figure 22. Single-line pneumatic brake system: 1 - air tank, 2 - braking valve, 3 - pneumatic actuator, 4 - hose connector, 5 - drainage valve, 6 - control connector



CAUTION

CAUTION!

Maximum pressure in the pneumatic system:

- 0.6 MPa single-line
- 0.8 MPa dual-line

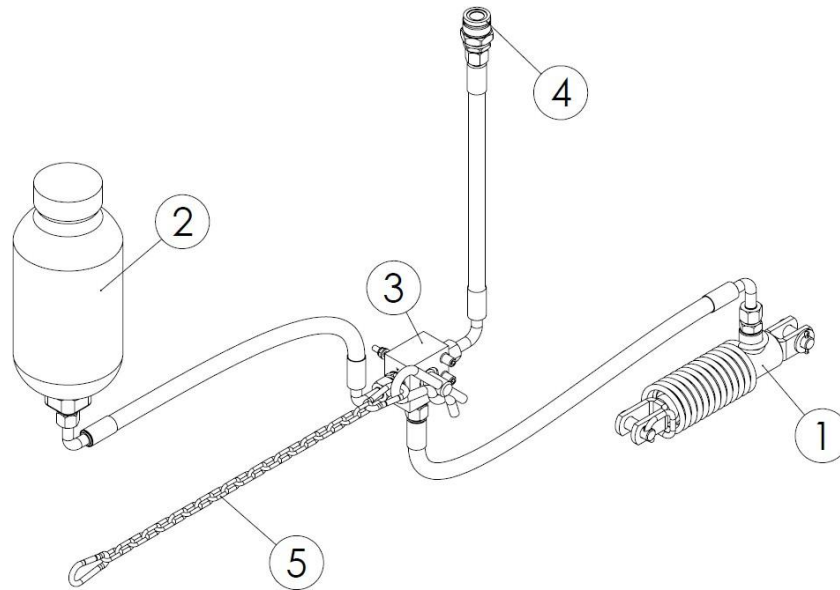


Figure 23. Hydraulic brake system: 1 - hydraulic cylinder, 2 - hydraulic accumulator, 3 - emergency valve, 4 - hydraulic quick coupling, 5 - chain

The hydraulic brake system (Fig. 23) has a safety feature - an emergency valve (3). When the feeder wagon disconnects from the tractor, the pin attached to the chain (5) is pulled out and the machine is braked.

3.7.2 Parking brake

- Parking brake of the OPTIMAL T659/1, BEL-MIX T659/5 wagon

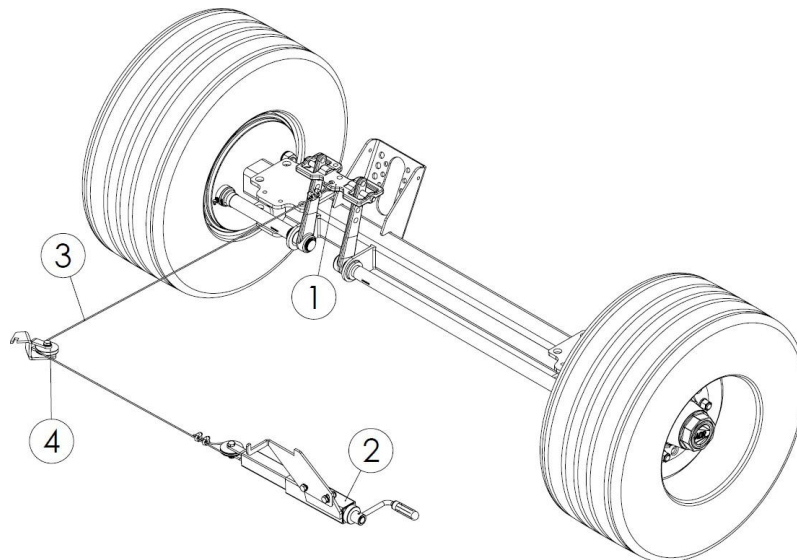


Figure 24. Design of the Optimal wagon parking brake: 1 - axle spreader fixture, 2 - brake tensioning element, 3 - cable, 4 - cable guide wheel

- Parking brake of BEL-MIX wagons: T659/2, T659/4, T659/5

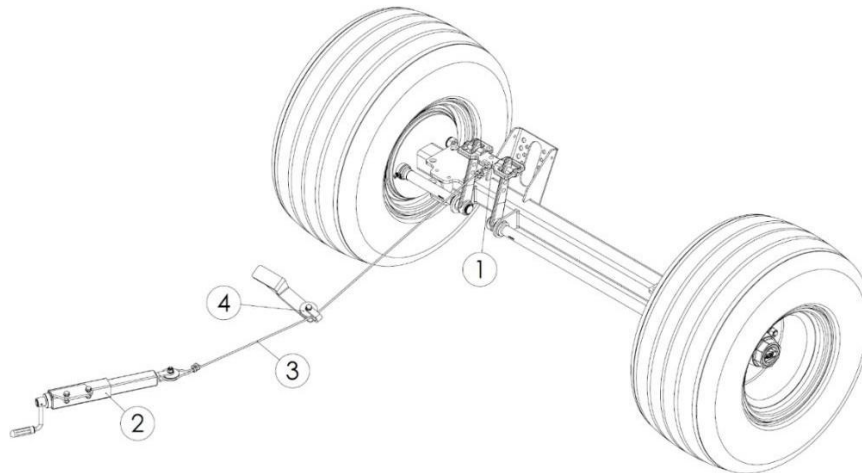


Figure 25. Parking brake design of the T659/2, T659/4, T659/5 models: 1 - axle spreader fixture, 2 - brake tensing element, 3 - cable, 4 - cable guide wheel

- Parking brake of the BEL-MIX T659/3 wagon

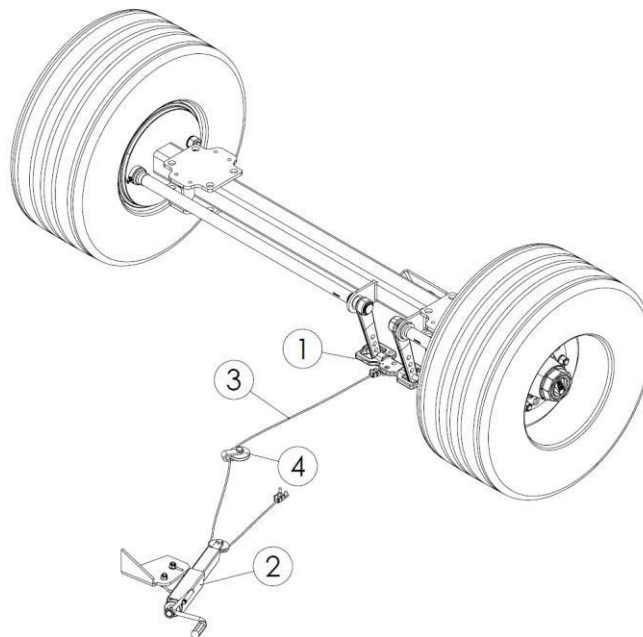


Figure 26. Parking brake design of the T659/3 wagon: 1 - axle spreader fixture, 2 - brake tensing element, 3 - cable, 4 - cable guide wheel

The parking brake is used to immobilise the feeder wagon when stationary. The axle spreaders are connected by an T-bar (1) to which a cable (3) connecting it to the brake tensing element (2). Turning the tensing element crank (2) tightens the cable and tilt the spreader levers, which actuate the brake.

Figures (24, 25, 26) show the design of the handbrake for different variants of the feeder wagon. The brake tensing mechanism (2) and the cable guide wheels (3) are bolted to welded components on the machine chassis.

3.8 Transmission system

3.8.1 Without two-speed gear

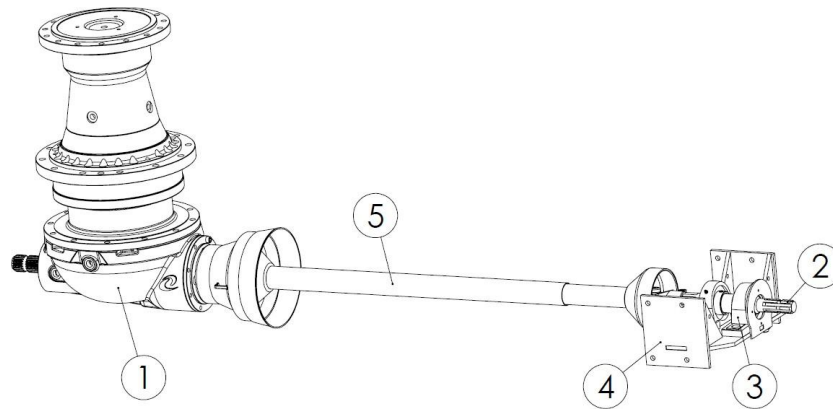


Figure 27. Transmission system without a two-speed gear:

1 - planetary gear, 2 - PTO shaft, 3 - PTO shaft support, 4 - shaft base, 5 - intermediate drive shaft

In this type of drive system, the feeder wagon is equipped with a planetary gear (1) bolted to the bottom of the tank. The gear is then connected via an intermediate drive shaft (5) to a PTO shaft (2) bolted to the shaft base (4). The drive of the screw is transmitted from the tractor via the articulated telescopic shaft (PTO) which connects the tractor to the machine.

3.8.2 With two-speed gear

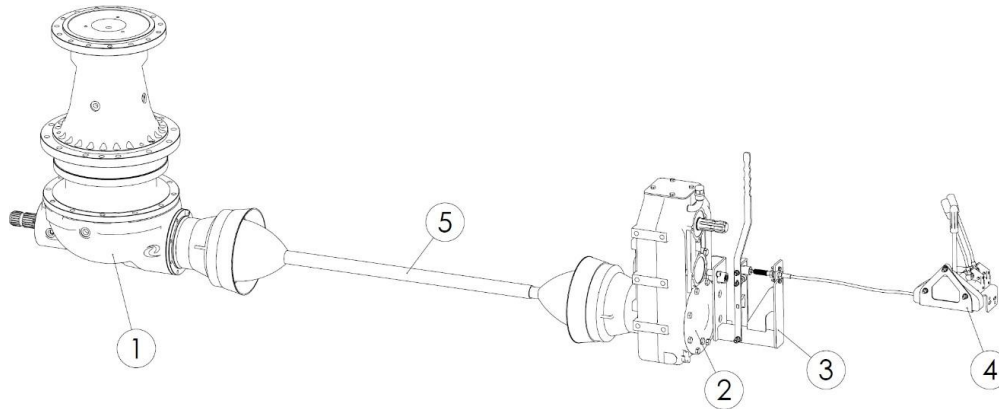


Figure 28. Transmission system with a two-speed gear: 1 - planetary gear, 2 - two-speed gear, 3 - gear changing mechanism, 4 - gear change lever, 5 - intermediate drive shaft

In the system shown in Figure 28, the screw drive is provided by a tractor connected via the PTO shaft to a two-speed gear (2) and an intermediate drive shaft (5) connecting the planetary gear (1) to the two-speed gear (2). Reducing or increasing the speed of the screw is possible by equipping the two-speed gear (2) with a gear change lever (4).



The permissible PTO speed is 540 rpm for each version of the drive system

3.9 Gear lubrication system.

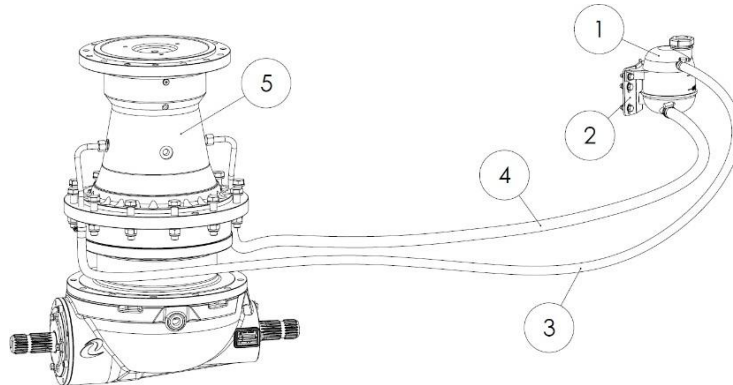


Figure 29. Gear lubrication system: 1 - oil expansion tank, 2 - tank fixture, 3 - supply line, 4 - venting line, 5 - planetary gear

The oil expansion tank (1) is bolted in the rear bottom or the front part of the tray using the fixture (2) - see Figure 29. The tank is located above the highest point of the planetary gear (5). The gear is connected to the tank with two lines - supply (3) and venting (4) lines.



The amount of oil required for the planetary gear is 19.7 litres.

3.10 Hydraulic system of the T659 feeder wagon

The hydraulic system of the feeder wagon consists of cylinders, a hydraulic manifold and/or a hydraulic motor (depending on the equipment of the machine). It is powered from the tractor's hydraulic system sockets.

The feeder wagon can be equipped with an onboard hydraulic system, which is powered by a pump with a multiplier, driven by the PTO shaft of the tractor. The oil tank, required for the operation of the system, is located on the frame of the feeder wagon, in its front part.

The individual hydraulic components are controlled using levers (Fig. 30), which are connected to the manifold by cables, or by an electric remote controller (Fig. 31) available as optional equipment. The number of levers or active electrical switches depends on the equipment of the machine.



CAUTION

The hydraulic system control levers are located on the platform for transporting the machine. Control is possible only if these elements are placed inside the tractor cabin.

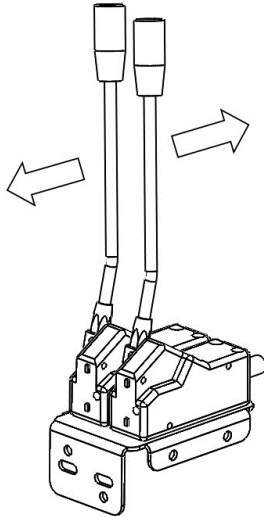


Figure 30. Hydraulic system control levers



Figure 31. Hydraulic system remote controller

The pictograms on the hydraulic system remote controller are explained below (Table 5).

Table 5. Hydraulic system control designations

No.	Pictograms	Designations
1.		Slide gate control
2.		Counterblade control

3.		Belt control
4.		Feeder folding control

3.11 Balance system

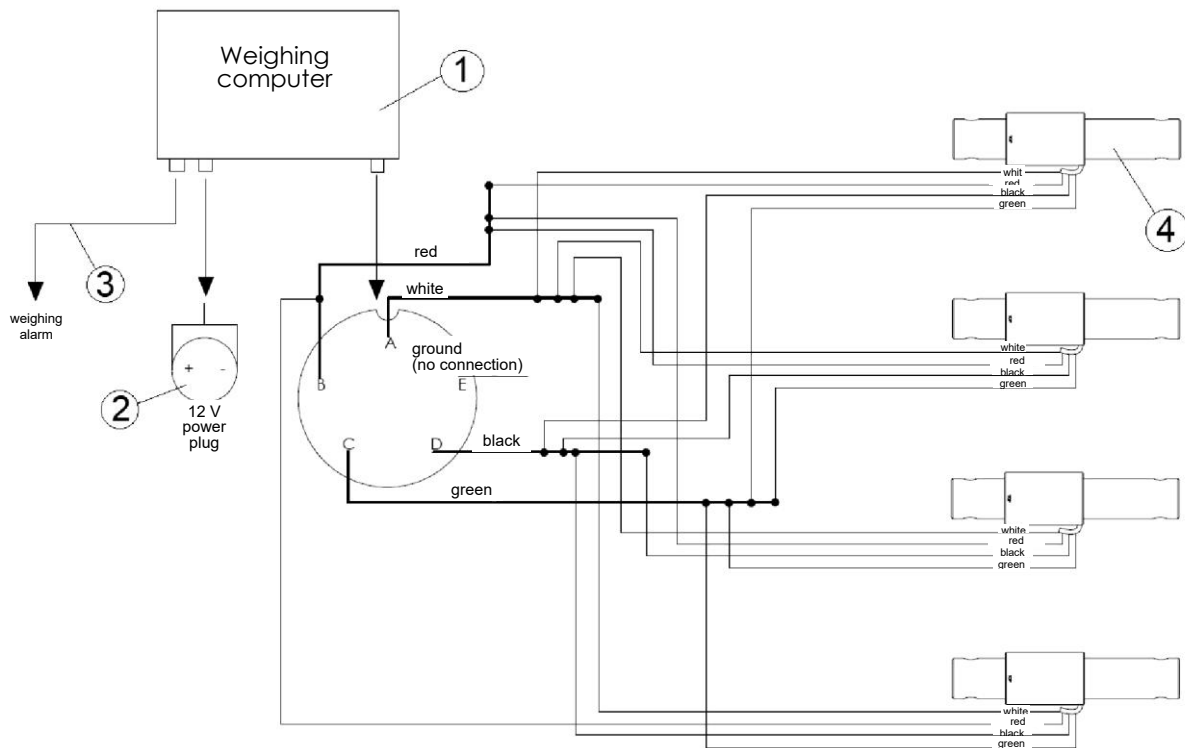


Figure 32. Diagram of the balance system: 1 - weighing computer, 2 - power plug with cable, 3 - weighing alarm with cable, 4 - weighing sensor

Figure 32 presents a diagram of the balance system and its connections. The weighing computer (1) located at the front of the machine and the tensors (4), the arrangement of which is shown in Fig.12, Fig.13 and Fig.14, are responsible for weighing the amount loaded into the feeder wagon. Depending on the variant, there may be 4 or 3 balance tensors. They are connected to a weighing computer, which receives electrical signals from the tensors and these signals provide the basis for displaying the weight of the loaded feedstock on the screen. The balance is powered from the tractor's 3-pin socket, to which the power plug (3) must be connected.

Position of the weighing computer relative to the PTO shaft

The weighing computer is located in the front part of the platform. It is attached to an arm with a rotation range of 180 degrees. This ensures that the weighing panel is at a safe distance of 680 mm from the power take-off shaft during operation (Fig. 33).

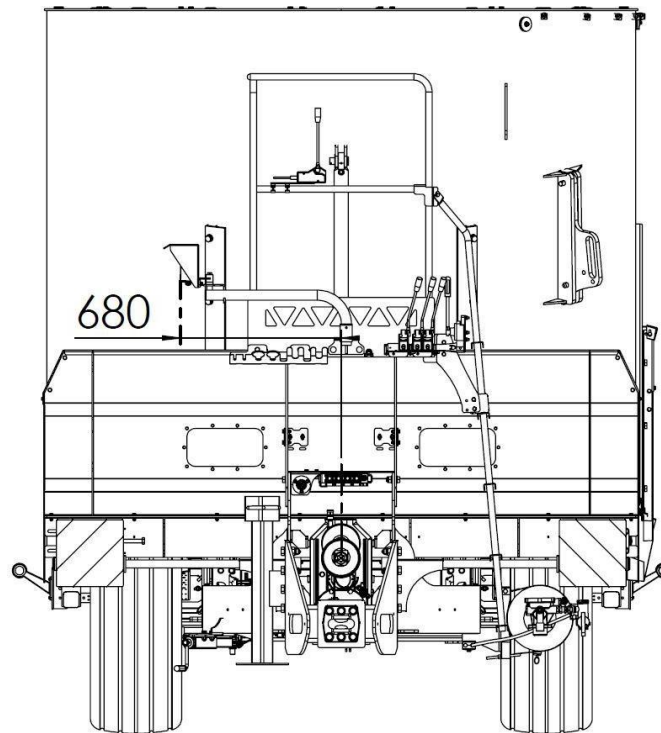


Figure 33. Balance position relative to the power take-off shaft

3.12 Electrical system

The electrical system of the feeder wagon is supplied with 12V from the tractor's own system. The connection between the two systems is made using the connection cable included with the machine. Figure 34 shows the wiring diagram of the electrical system, with which the T659 feeder wagon is equipped.

Equipped with lights and the necessary signs, the machine can be driven safely on public roads.

The light bar with combined lights, outline lights, space for the registration plate including lighting and warning panels is bolted to the rear part of the frame. At the front, the wagon is equipped with parking lights with reflective elements, as well as with warning panels. Orange reflective elements are located on the tank, at the sides of the machine, and space for a warning triangles for slow vehicles is available in the rear part of the tank.

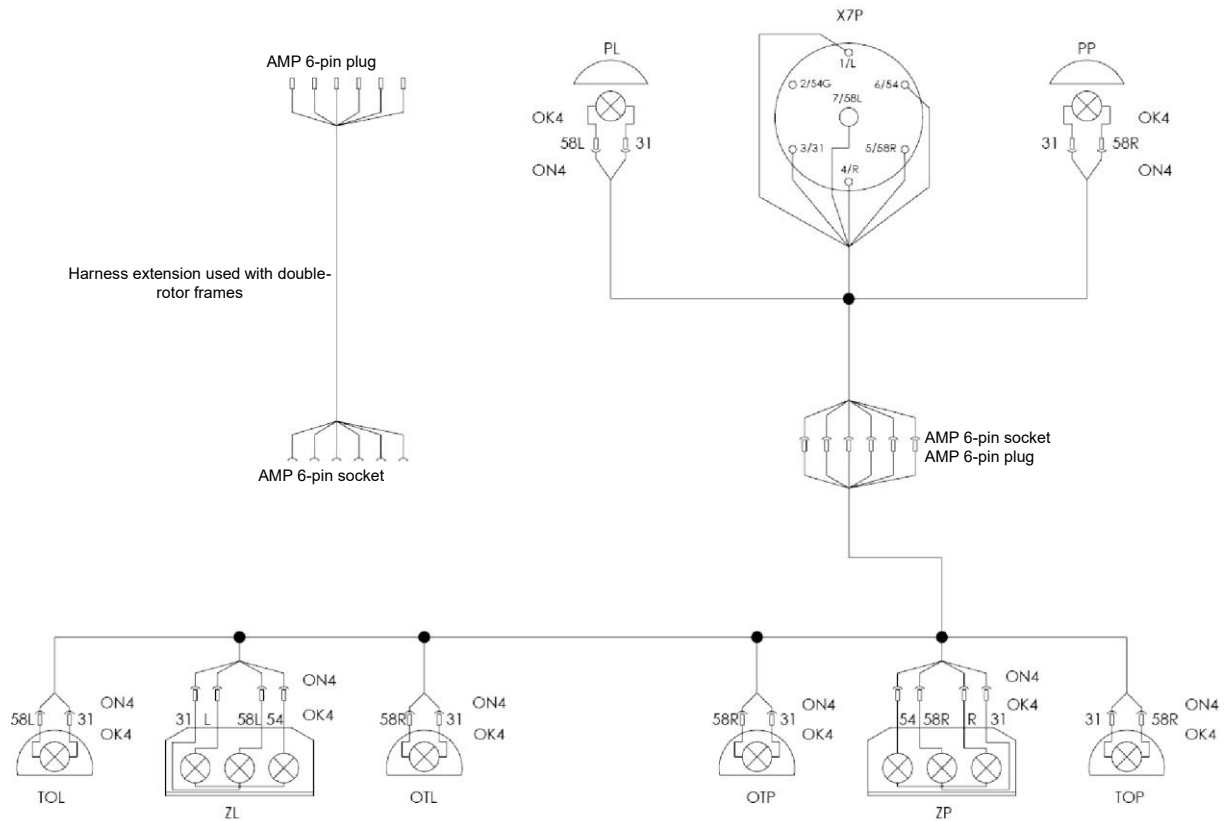


Figure 34. Diagram of the electrical system of the T659 feeder wagon.

Table 6. List of codes for electrical parts

Symbol	Name
ZP	Rear cluster light, right
ZL	Rear-light cluster, left
X7P	Connection socket
TOP	Marker lamp, right
TOL	Marker lamp, left
PP	Front running light, right
EN	Front running light, left

Table 7. List of 7-pin socket designations.

Designation	Function
1 - L	Traffic indicator lamp, left
3 - 31	Earth
4 - R	Traffic indicator lamp, right
5 - 58R	Right-running lights
6-54	Brake light
7 - 58L	Running light, left

NAME AND ABBREVIATION INDEX

BHP - occupational safety and health

dB (A) – scale A decibel, a sound power unit;

kg – kilogram, a unit of weight;

km – kilometre, a commonly used multiple of the metre, the basic SI unit of length;

kPa – kilopascal, a unit of pressure;

m – meter, a unit of length;

mm – millimetre, a secondary unit of length equal to 0.001 m;

MPa – megapascal, a unit of pressure;

N – newton, a SI unit of force;

Nm – newton-metre, an SI unit for the moment of force;

Pictogram – a notice plate;

T – tonne, a unit of weight;

Rating plate – a manufacturer's nameplate for the explicit identification of the machine;

V – volt, a unit of electrical tension (voltage);

Transport hitch– the hitching elements of a farming tractor (see the tractor's user manual).

ALPHABETICAL INDEX

Part 1

B

Balance system 51, 52

Brake 33, 45, 46, 47

C

Construction 32, 35, 36, 37, 38

D

Decommissioning 19

E

Electrical system 52, 53

Equipment 16

F

Feeder wagon identification 10

G

Gear 35, 36, 37, 38, 39, 49, 50

Gear lubrication system 50

H

Hydraulic system 15, 23, 24, 50

I

Intended use 14

L

Load 32, 33, 34

N

Nameplate 10, 11, 12, 13

P

Pneumatic system 23, 45, 46

R

Residual risk 25, 26

S

Safety 20

Stickers 26, 27, 28, 29, 30, 31

T

Tank 40, 41

Technical data 32

Transmission system 49

Transport 16, 17

Tyres 34

Part2

A

Adjustment of wheel bearing play 18, 31, 48

B

Bearings 18, 31, 40

C

Cleaning 41

Conveyor belt tensioning 37

Coupling 9

D

Defects 44

E

Electrical system 30

F

Feeder operation 37

Feedstock mix analysis 14

Filter cleaning 24

First start-up 8

G

Gear 15, 35, 36, 44

Gear maintenance 14, 34

H

Hydraulic system 11, 28

L

Lubrication 31, 32, 33

Lubrication points 33, 34, 37, 38

P

Preparing the machine for operation 7

T

Tank loading 12

Tightening torques 43

NOTES

A series of horizontal dotted lines for taking notes, spanning the width of the page.

A series of horizontal dotted lines spanning the width of the page, providing a template for handwritten notes or a checklist.



Metal-Fach Sp. z o.o. is constantly improving its products and adjusting its package to the needs of its customers, so it reserves the right to make changes to its product range without notice. Therefore, before making your purchase decision, please contact an authorised Metal-Fach Sp. z o.o. dealer or sales representative.

Metal-Fach Sp. z o.o. will not accept any complaints regarding the data and pictures contained in the catalogue, as the presented range of products does not constitute an offer within the meaning of the provisions of the Polish Civil Code.

The pictures do not necessarily show standard accessories.

Original spare parts are available from authorised dealers, both in Poland and abroad, and also at the Metal-Fach retail outlet.



METAL-FACH Sp. z o.o.

16-100 Sokółka, Poland, ul. Kresowa 62
Telephone: +48 85 711 98 40; Fax: +48 85 711 90 65
biuro@metalfach.com.pl

TECHNICAL SERVICE

16-100 Sokółka, Poland, ul. Kresowa 62
Telephone: +48 85 711 07 80; Fax: +48 85 711 07 93
serwis@metalfach.com.pl

SPARE PARTS WHOLESALE STORE

16-100 Sokółka, Poland, ul. Kresowa 62

Wholesale:
Telephone: +48 85 711 07 81; Fax: +48 85 711 07 93
hurtownia@metalfach.com.pl

Retail:
HELPLINE AVAILABLE 24 h/7 days - +48 533 111 477
Telephone: +48 85 711 07 90

CURRENT INFORMATION ABOUT OUR PRODUCTS CAN BE FOUND AT WWW.METALFACH.COM.PL