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# **BELARUS**

# **1221.4**

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**1221.4-0000010 RE**

## **OPERATING MANUAL**

(Supplement to Operating Manual  
for BELARUS 1221.3 tractors)

MTW 2009

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## BELARUS-1221.4 Operating manual

This manual is intended for familiarization with the design, operating and maintenance rules of BELARUS 1221.4 tractors.

This manual supplements the 1221–0000010 RE operating manual and is annexed to that manual.

Carefully read this manual, the 1221–0000010 RE operating manual, the operating manual for the TD/TCD 2012 L04/06 2V / TD/TCD 2013 L04/06 2V RE diesel engine that are supplied with your tractor. This will help you know good operating and maintenance practices.

Failure to fulfill this instruction may result in operator's injuries or tractor malfunction.

This tractor may be operated, serviced or repaired only by personnel familiarized with all its features and safety requirements to prevent accidents.

Due to constant improvement of the tractor, its separate assemblies and parts can have modifications not reflected in this operating manual.

Any arbitrary modifications made by the user to the design of separate assemblies shall release the manufacturer from any liability for consequent operator's injuries or tractor failures.

### Abbreviations and designations

ECU — engine control unit;

FFVS – frequency-type fuel volume sensor;

ID – integrated display

MD – multifunctional display;

PC – integrated display programming console;

OM — operating manual

Other abbreviations and designations are given in the 1221–0000010 RE operating manual.

## **1 DESCRIPTION AND OPERATION OF TRACTOR**

### **1.1 Purpose of tractor**

The BELARUS – 1221.4 tractor is made on the basis of the BELARUS – 1221.3 tractor.

The BELARUS – 1221.4 tractor is designed for various agricultural works with mounted, semi-mounted, and trailer-type farm machinery and implements attached, cargo handling, transportation works, driving stationary agricultural machinery, delivered to consumers in the Republic of Belarus and abroad.

### **1.2 Technical data**

#### **1.2.1 General description**

The BELARUS-1221.4 tractor is a versatile row-crop tractor of the 2nd drawbar class made in a 4K4 wheel design.

The BELARUS-1221.4 tractor is equipped with a DEUTZ TCD 2012 L06 2V engine of 104.6 kW capacity with electronic control system. The engine's emission level meets the environment protection requirements of the IIIA stage.

The clutch is a friction, double-disk spring-loaded mechanically-operated clutch. The clutch facings are asbestos-free.

The gearbox (GB) is a 16F×8R mechanical step-by-step gearbox with constant-mesh gearing, with synchro-mesh gears in each range, with range selection by toothed couplings, or a 24F×12R (on client's request) mechanical step-by-step gearbox with constant-mesh gearing, with synchro-mesh gears in each range, with range selection by toothed couplings and synchronizers.

The rear axle is with a main drive, differential gear, spur-gear hub drives and planetary final drives. The DL is electro-hydraulically controlled.

The front drive axle is with a main drive, self-blocking differential, final drives (planetary parallel-shaft reducers). The front axle drive is a parallel-shaft reducer built into the GB with a hydraulic compression clutch, a cardan. The FDA drive is electro-hydraulically controlled.

The brakes: main brakes – multi-disk, working in oil bath (“wet”), installed on shafts of the drive gears of hub drives; parking brake – independent, hand-operated. On customer's demand, “dry” main and parking brakes can be installed.

The trailer brakes drive is pneumatic combined, interconnected with the tractor brakes drive. On demand, a two-wire or single-wire pneumatic drive for the tractor brakes can be installed.

The hydraulic system is of remote-cylinder type with a hydraulic lift, with two pairs of rear outlets.

The rear hitch linkage is NU-2, with two adjustable braces; the hitch linkage lower arms are solid with connection pieces of 3rd category; blocking of the arms is external, with use of screw couplings.

The rear power take-off shaft (PTO) is independent, two-speed (540 and 1000 rpm), and synchronous, the rotation direction is clockwise as viewed from the drive end. The PTO ends: PTO 1 (6 splines, 540 rpm), PTO 1s (8 splines, 540 rpm) PTO 2 (21 splines, 1000 rpm).

The steering is a hydrostatic steering unit (HSU); the feed pump is of vane type driven from the driveshaft of the air compressor, of left-hand rotation; the actuator is two bidirectional hydraulic cylinders.

The cab is unified, protective, ensuring safety, microclimate, noise and vibration protection. The cab is equipped with front windscreen and rear visor wipers and a windscreen washer, a climate system or a cab heater, a sprung seat, adjustable to operator's height and weight. On customer's demand, additional front headlights on the brackets of front lights can be installed.

**1.2.2 Key parameters and characteristics**

Key parameters and characteristics are specified in the Table 1.

Table 1

Parameter name (characteristic)	Value for BELARUS-1221.4 tractor
1 Drawbar category as per GOST 27021	2
2 Rated tractive force, kN	20
3 Diesel engine:	
a) model	TCD 2012 L06 2V
b) type	turbocharged
c) cylinder number and arrangement	six, in-line, vertical
d) cylinder displacement volume, l	6.057
e) power, kW	
1) rated	104.6
2) operating	92.0±2.0
f) crankshaft rated speed, rpm	2,100
f) specific fuel consumption at operating power, g/(kW•h)	267.0±7
g) rated torque backup coefficient, %	30.0
h) maximum torque, N•m	570.0
4 Power at PTO in PTO mode of 1000 rpm, kW, min.	79.6
5 Specific fuel consumption at PTO power in PTO mode of 1000 rpm, g/(kWh), max.	250
6 Number of speeds:	
a) forward <sup>1)</sup>	16
b) reverse <sup>1)</sup>	8
7 Tractor travel speed (rated) on standard tires at rated diesel engine crankshaft speed, km/h:	
a) forward	
1) min. operating	1.54
2) max. transportation	35.00
b) reverse	
1) min.	2.75
2) max.	16.4
8 Tractor weight, kg:	
a) design	5,300±100
b) operating	5,730±100
c) max. operating	8,000
d) as shipped ex-works <sup>2)</sup>	5,370±100

Table 1, continued

Parameter name (characteristic)	Value for BELARUS-1221.4 tractor
9 Service weight distribution on axles, kg:	
a) on front	2,300±50
b) on rear	3,430±50
10 Permissible load on axles, kN:	
a) front	40
b) rear	60
11 Max. weight of towed trailer (trailer brakes interconnected with tractor brakes), kg	12,000
12 Clearance, mm, min.:	
a) road (on standard tires)	480
b) agrotechnical under rear wheel tubes	620
13 Wheel track, mm:	
a) front wheels	1,540-2,090
b) rear wheels	1,530-2,150
c) transportation:	
1) front wheels	1,650±20
2) rear wheels	1,800±20
14 Least turning radius, m:	
a) without braking	5.4
b) with braking	5.0
15 Tractor wheel base, mm	2,760±30
16 Max. fording, m	0.85
17 Service life, years	10
18 Overall dimension, mm:	
a) length with counterweights and with rear hitch linkage in transportation position	4,500±40
b) length without counterweights and with hitch linkage in transportation position	4,370±50
c) length by outer diameters of wheels	4,240±50
d) width by ends of rear wheel semi-axles	2,300±10
e) height by cab	2,850±50
19 Tires (standard):	
front	14.9R24
rear	18.4R38
20 Electric equipment	
a) rated power source voltage of electrical system, V.	12
b) rated starting voltage, V:	24

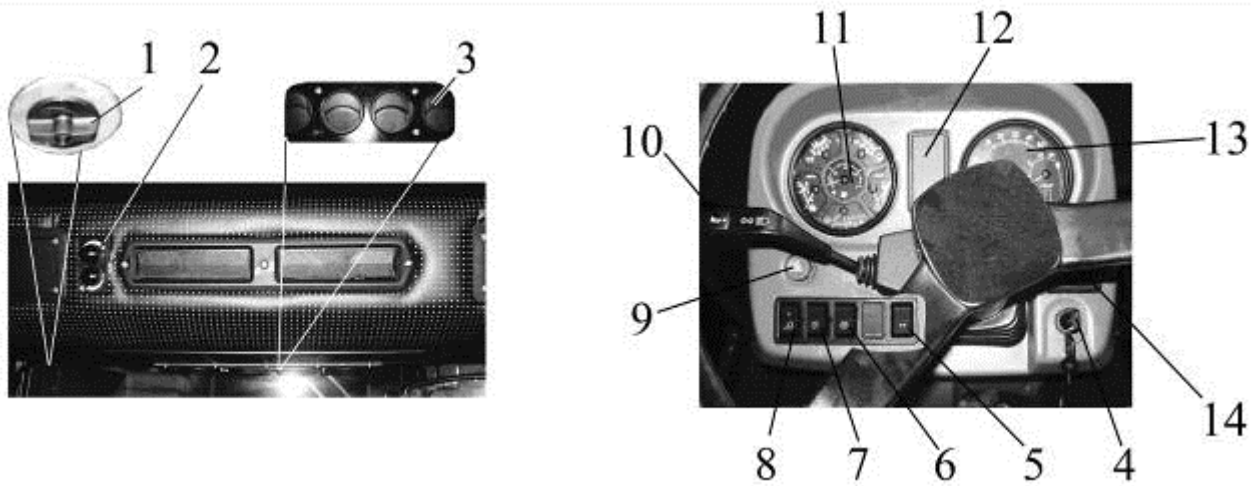
End of Table 1

Parameter name (characteristic)	Value for BELARUS-1221.4 tractor
21 Working equipment:	
a) rear PTO	
1) PTO end speed at independent drive, rpm:	
- I speed	540
- II speed	1,000
2) PTO end speed at synchronous drive, rpm of travel	4.18 for tires 18.4R38
b) rear hitch linkage:	
1) load capacity of rear hitch linkage on suspension axle, kg, min.	4,300
2) pump displacement at rated engine crankshaft speed, l/min, min.	51
3) opening pressure of hydraulic system safety valve, MPa	20 <sub>-2</sub>
c) towing coupler:	
1) distance from ground to horizontal axis of towing yoke on standard tires, mm	305—805 (after 65±0.23) 465—985 (with towing yoke turn)
2) distance from PTO end to axis of joining pin, mm	400±10
3) opening, mm	70±2.5
<hr/> <p><sup>1)</sup> On customer's demand, a GB with 24 forward speeds and 12 reverse speeds can be installed.</p> <p><sup>2)</sup> To be specified depending on kitting.</p>	

### 1.3 Design and operation of tractor

#### 1.3.1 Controls and instrumentation

This operating manual provides description and principle of operation only of controls and instruments as specified in 1.3.1. Location, purpose and principle of operation of other controls (such as levers, arms, pedals, key switches etc.) are similar to BELARUS-1221.3 and are presented in the OM 1221-0000010 supplied with BELARUS-1221.4 tractors.



- 1 – heater control valve operating handle;
- 2 – climate system control panel;
- 3 – deflectors;
- 4 – starter and instrument switch;
- 5 – battery remote switch;
- 6 – windscreen washer switch;
- 7 – central light switch;
- 8 – switch of headlights installed on brackets of front lights;
- 9 – emergency stop signaling switch;
- 10 – multifunctional understeering switch, (turn indicators, upper/lower beam, horn, upper beam signaling);
- 11 – instrument cluster;
- 12 – indicator lamp block;
- 13 – integrated display;
- 14 – integrated display programming console

Figure 1.1 — Controls and instrumentation

### 1.3.2 Starter and instrument switch

The starter and instrument switch 4 (Figure 1.1) has four positions:

- “0” – OFF;
- “I” – instruments, indicator lamp block, spark plugs ON;
- “II” – starter ON (unfixed position);
- “III” – radio ON (key turned counterclockwise).



Figure 1.2 — Starter and instrument switch

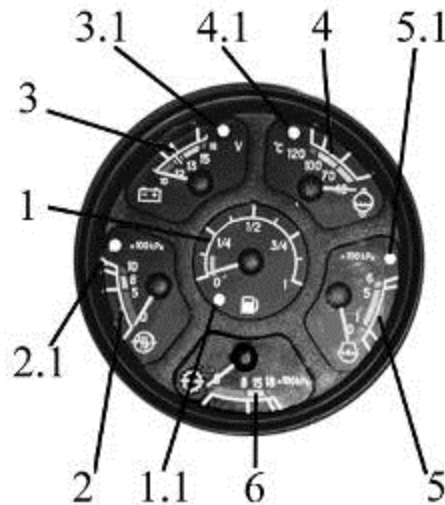
**ATTENTION:** STARTER CAN BE RE-ACTIVATED ONLY AFTER THE KEY IS RETURNED TO THE “0” POSITION OF THE SWITCH.



TO SWITCH THE STARTER AND INSTRUMENT SWITCH TO “III”, PRESS THE KEY INTO THE SWITCH AND TURN IT COUNTERCLOCKWISE.

**1.3.3 Instrument cluster**

The instrument cluster 11 (Figure 1.1) includes six indicators with five pilot lights (Figure 1.3).



- 1 – fuel tank level indicator;
- 1.1 – fuel reserve level alarm lamp;
- 2 – pneumatic system air pressure indicator;
- 2.1 – low-pressure alarm lamp of pneumatic system;
- 3 – voltage indicator;
- 3.1 – additional battery charging pilot lamp;
- 4 – diesel engine coolant temperature indicator;
- 4.1 – diesel engine coolant high temperature alarm lamp;
- 5 — diesel engine lubrication system oil pressure indicator;
- 5.1 — engine lubrication system emergency oil pressure alarm lamp;
- 6 – transmission oil pressure indicator.

Figure 1.3 – Instrument cluster

The fuel tank level indicator scale 1 (Figure 1.3) has the divisions of 0–1/4–1/2–3/4– 1. The indicator scale has a built-in alarm lamp 1.1 (Figure 1.3) (orange) that goes on when the fuel level in the tank drops to 1/8 of the total tank volume.

**ATTENTION:** DO NOT CONSUME FUEL TO THE ‘DRY TANK’ CONDITION (WHEN THE INDICATOR POINTER IS IN THE ORANGE ZONE).

The pneumatic system air pressure indicator scale 2 (Figure 1.3) has three zones:

- operating — 500 to 800 kPa (green);
- emergency (two) — 0 to 500 kPa and 800 to 1000 kPa (red).

The indicator scale has a built-in alarm lamp 2.1 (Figure 1.3) (red) that goes on when the pneumatic system pressure drops below 500 kPa.

The voltage indicator 3 (Figure 1.3) shows voltage of the batteries with the engine off, when the starter and instrument switch key (Figure 1.2) is in the ‘I’ position. With the engine on, the voltage indicator shows voltage at the generator terminals. The indicator scale has a built-in red alarm lamp 3.1 (Figure 1.3). Used only for a 24V start system. Shows the charging process of a second 24V battery – detects operability of the voltage changer.

Feed system condition

Table 2

Zone at voltage indicator scale 3 (Figure 1.3), color	Feed system condition	
	when engine is running	when engine is off
13.0 – 15.0 V green	normal charging mode	-

10.0 – 12.0 V red	generator not operating	battery discharged
12.0 – 13.0 V yellow	no AB charging (low charging voltage)	AB has normal charging
15.0 – 16.0 V red	AB recharged	-
white hairline in yellow zone	-	rated generated voltage battery – 12.7 V

**ATTENTION: IF THE VOLTAGE INDICATOR INDICATES NO CHARGING OF THE AB, CHECK CONDITION AND TENSION OF THE GENERATOR DRIVING BELT.**

The diesel engine coolant temperature indicator 4 (Figure 1.3) reads information from the engine control unit (ECU). The indicator scale has three zones:

- operating — 70 to 100°C (green);
- informative — 40 to 70°C (yellow)
- emergency — 105 to 120°C (red).

The indicator scale has a built-in emergency temperature alarm lamp (red) 4.1 (Figure 1.3) that operates in two modes:

- a)- goes on and blinks when the coolant temperature is 109 to 112°C inclusive.
- b) - glows when the coolant temperature is 113 °C or higher.

The oil pressure indicator in the engine lubrication system 5 (Figure 1.3) reads information from the engine control unit (ECU). The indicator scale has three zones:

- operating — 100 to 500 kPa (green);
- emergency (two) — 0 to 100 kPa and 500 to 600 kPa (red).

The indicator scale has a built-in alarm lamp of emergency oil pressure drop (red) 5.1 (Figure 1.3) that goes on when the pressure drops below 100 kPa.

**Note** – A cold engine can produce a pressure of up to 600 kPa when started.

**ATTENTION: IF THE EMERGENCY PRESSURE ALARM LAMP GLOWS WITH THE ENGINE RUNNING, IMMEDIATELY STOP THE ENGINE AND CORRECT THE FAULT.**

The transmission oil pressure indicator (Figure 1.3) shows oil pressure in the hydraulic system of tractor transmission friction clutches control.

The transmission oil pressure indicator scale 6 (Figure 1.3) has three zones:

- operating — 800 to 1500 kPa (green);
- emergency (two) — 0 to 800 kPa and 1500 to 1800 kPa (red).

The rated transmission oil pressure indicator readings are 900 to 1000 kPa.

### **1.3.4 Indicator lamp block**

The indicator lamp block 12 (Figure 1.1) is located on the instrument panel and includes three lamps. The indicator lamps are located as shown on Figure 1.4.

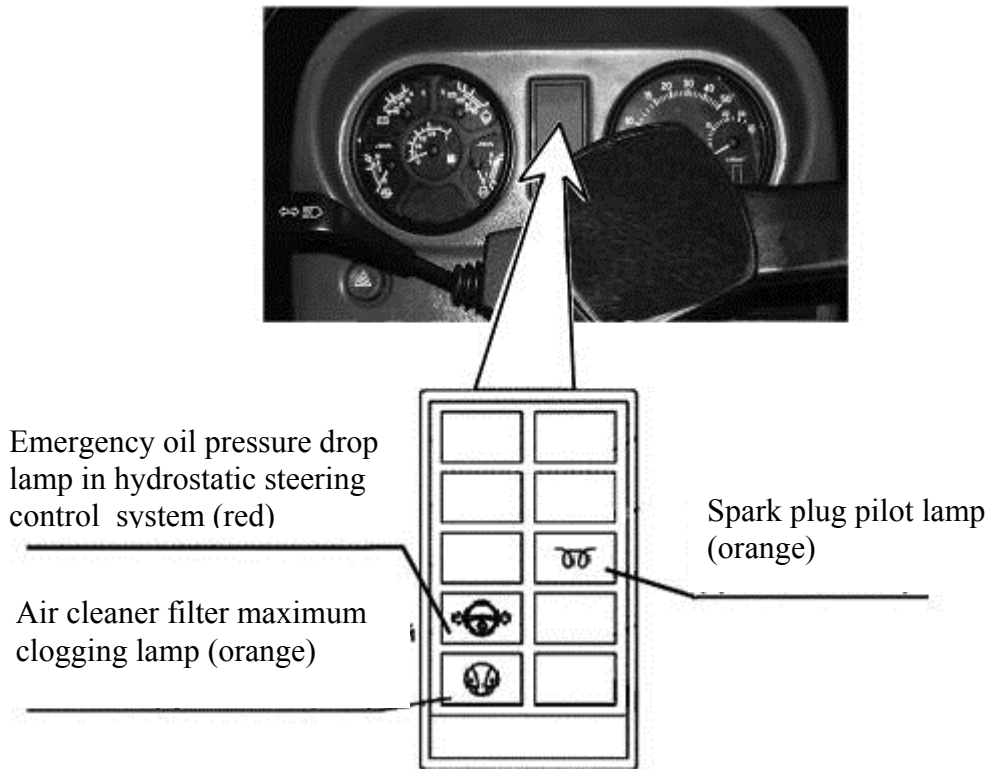


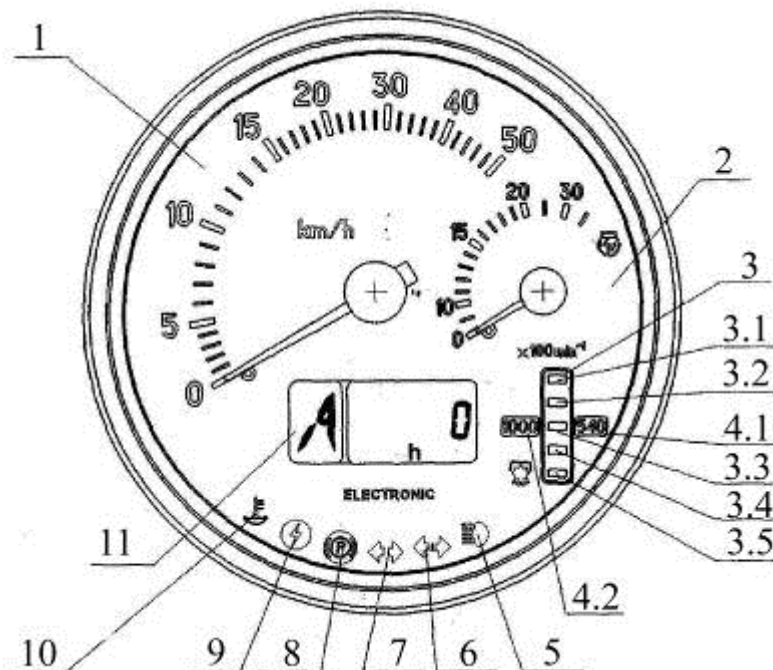
Figure 1.4 – Indicator lamp block

Principles of operation of the indicator lamps shown in Figure 1.4 are described in the 1221–000010 RE operating manual.

**1.3.5 Integrated display**

The integrated display 13 (Figure 1.1) (hereinafter referred to as ID) and the integrated display programming console 14 (Figure 1.1) (hereinafter referred to as PC) show information about operating parameters of tractor systems and assemblies and deliver to the operator data on malfunctions or failures of a system.

The ID includes indicators and pilot lights as shown in Figure 1.5:



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- 1 – speed indicator (pointer indicator);
- 2 – engine speed indicator (pointer indicator);
- 3 – PTO speed indicator (light indicator);
- 3.1, 3.5 – PTO speed scale segments (yellow);
- 3.2, 3.3, 3.4 – PTO speed scale segments (green);
- 4.1, 4.2 – PTO speed scale range signaling devices (yellow);
- 5 – headlight upper beam indicator pilot lamp (blue);
- 6 – trailer turn indicator pilot lamp (green);
- 7 – tractor turn indicator pilot lamp (green);
- 8 — parking brake pilot lamp (red);
- 9 – electric system high voltage pilot lamp (red);
- 10 – low coolant level pilot lamp (yellow);
- 11 – multifunctional display;

Figure 1.5 – Integrated display

### **1.3.6 Principle of operation and purpose of indicators on integrated display**

a) 1 (Figure 1.5) – speed indicator shows design travel speed of the tractor on the pointer indicator. The design speed exceeds the actual speed as skidding of the tractor is not considered.

The indicator is operated from signals from pulse transducers of toothed gears speed of final drives of tractor's left and right rear wheels. Speed is indicated by the signal from the transducer installed on the final drive gear of the wheel rotating with the lowest speed.

If any of the transducers fails, the integrated display shows speed readings by the speed indicator from the signal of the operating transducer. The LCD display of the ID shows a characteristic failure of circuits or speed transducers in case of absence of signals from them as a "0" digit defining the location of the failure – left or right (see below).

b) 2 (Figure 1.5) – engine speed indicator shows engine crankshaft speed on the pointer indicator.

On BELARUS-1221.4 tractors, information about engine speed arrives from the electronic control unit. The speed indication range is 0 to 3500 rpm.

c) 3 (Figure 1.5) – PTO speed indicator shows power take-off shaft speed on the light indicator.

The PTO speed indicator operates from a frequency signal produced by recalculation from the engine speed with an input value of the "KV2" ratio (see below) different from "0", herewith a value of the ZV ratio equal to "0" must be input (see below).

When the ID is on (check of the device operability is described below) and the engine is running (a message of "engine speed" is transmitted from the ECU), the designations of the "540" and "1000" scales are illuminated simultaneously.

The PTO scale segment (with consideration to the input value of the "KV2" ratio) is indicated when the design PTO speed of 750 rpm is achieved.

Informative:

the lower segment of the PTO scale (with consideration to the "KV2" ratio) is indicated when the engine speed achieves 1400-1500 rpm or higher.

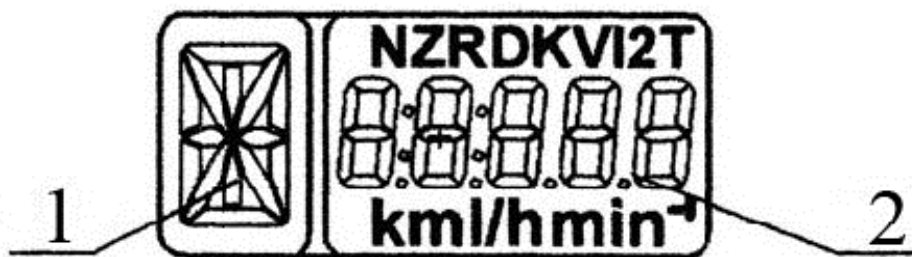
Depending on the engaged PTO speed mode (540 or 1000), the illuminated scale segments designate PTO speeds as specified in Table 3.

Table 3

“540”	“1000”	Location of segment on scale
650	1,150	3.1
580	1,050	3.2
500	950	3.3
420	850	3.4
320	750	3.5

The “PTO speed” mode of the MD LCD screen 11 (Figure 1.5) (MD operation is described below) is not active in such case.

d) 11 (Figure 1.5) – the multifunctional display (MD) is an LCD display presenting information in two fields simultaneously (see Figure 1.6):



“1” is a digital designation of the gearbox shifter (figures of 0 to 6) or a letter designation of the reducer shifter position (letters L, M, H, N);

“2” is the current numerical value of one of the parameters of the tractor systems.

Figure 1.6 – MD informative fields

The integrated display receives information about the gearbox shifter position from the transmission control unit (if the complex electronic control system is available) or from the range reducer control unit (if available). This parameter is displayed in the “1” informative field (Figure 1.6). When control units are not available or are not connected, or a wire is broken, the “1” informative field displays an “A” letter.

The “2” informative field (Figure 1.6) displays the following parameters:

- Total astronomical service hours of the engine;
- Instantaneous fuel consumption;
- Electrical system voltage;
- Volume of fuel remaining;
- Hours of service from fuel remaining;
- Diagnostics of speed sensor operability;
- Diagnostics of frequency-type fuel volume sensor operability (FFVS);
- Diagnostics of CANBUS operability and connection to the ID.

The “Mode” button of the control panel 14 (Figure 1.1) shifts between the display modes of “Total astronomical service hours of the engine”, “Instantaneous fuel consumption”, “Volume of fuel remaining”, “Hours of service from fuel remaining”, “Electrical system voltage”, and failure messages. The algorithms of operation of the “Diagnostics of speed sensor operability”, “Diagnostics of frequency-type fuel volume sensor operability (FFVS)”, “Diagnostics of CANBUS operability and connection to the ID” are described above.

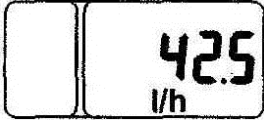
1. - Total astronomical service hours of the engine.



The counter accumulates information of the total service hours of the engine when an “engine speed” message is transmitted from the ECU, and saves it when the power is off.

The indication range is 0 to 99999 service hours of the engine.

2. Instantaneous fuel consumption



In this mode, the current value of instantaneous fuel consumption is displayed with a readout resolution of 0.1 l per hour.

3. Electrical system voltage



In this mode, the current electrical system voltage is displayed as a numerical value.

4. Volume of fuel remaining



In this mode, the current fuel volume in the tank is displayed in liters. This mode is available only when the tractor stands still (no signals from the speed sensors).

Note – To ensure better indication precision of fuel volume in the tank, stop the tractor on an even surface.

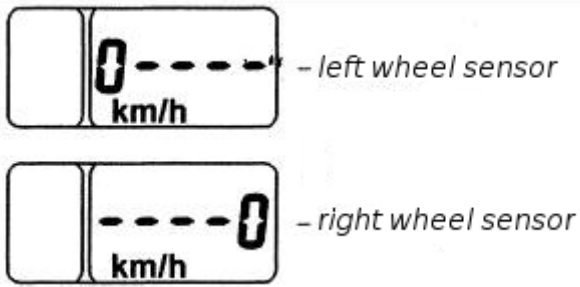
5. Hours of service from fuel remaining



In this mode, predicted hours of engine service are displayed as calculated for current values of instantaneous fuel consumption and remaining fuel.

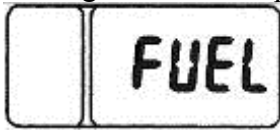
**ID in failure message mode**

1. Diagnostics of speed sensor operability and connection:



When no signal arrives from the speed sensors for 10 to 12 seconds, the LCD screen shows a message of a “0” figure specifying the location of the faulty sensor (left or right).

2. Diagnostics of frequency-type fuel volume sensor operability (FFVS):



When no frequency signal arrives from the FFVS for 2 seconds, the LCD screen of the ID shows a “FUEL” message;

3. Diagnostics of CANBUS operability and connection to the ID with CAN interface:



When no signal is available in the CANBUS (ID), a “CANBUS” message appears;

Each failure message (**Example:** 0----, FUEL, C-BUS) is displayed on the LCD screen by priority independently of the information displayed. Sequentially pressing the “Mode” button must browse through the messages alternately. When the last message is shown and the “Mode” button is pressed again, the LCD screen switches to the display mode as per the cycle of the previously specified working parameters. Failure messages are displayed on the LCD screen each time the device is turned on, till the reason of the failure is eliminated.

**Notes.**

- 1 - When the ID is turned on, the MD shows information in the indication mode that had been selected before the ID was turned off last time.
- 2 - When no information is available about parameter values received only from the ECU, the respective indication modes are automatically turned off.

**1.3.7 Pilot and warning lamps of integrated display**

**ATTENTION:** PILOT LAMPS GO ON AND OFF SIMULTANEOUSLY WITH CHANGES OF SYSTEM SENSOR STATES.

- a) 5 (Figure 1.5) – headlight upper beam indicator pilot lamp. Goes on when the upper beam indicator pilot lamp is switched on.

b) 6, 7 (Figure 1.5) – tractor and trailer turn indicator pilot lamps. Blinks when the right or left turn indicator is turned on by the understeering multifunctional switch 10 (Figure 1.5), or when the alarm signaling switch is turned on.

c) 8 (Figure 1.5) – parking brake pilot lamp. The parking brake pilot lamp blinks with the frequency of 1 Hz when the parking brake sensor goes off;

d) 9 (Figure 1.5) – electric system high voltage pilot lamp. Goes on when the tractor electrical system supply voltage exceeds 19 V and goes off when the supply voltage drops to 17 V;

Herewith, the ID is completely turned off and restores its operability when the voltage drops to the rated voltage of the electrical system.

e) 10 (Figure 1.5) – low coolant level pilot lamp. Goes on when the coolant level in the expansion tank drops below 20% of the total level.

### **1.3.8 Description of device operability check**

Every time when the ID is powered on, it checks operation of the pointer indicators and PTO indicator scale elements. Herewith, the indicator pointers deviate from their zero points to the next digital scale marks for no more than a second (beyond “5” for travel speed and beyond “10” for rotation speed), and all segments and “540” and “1000” marks of the PTO scale go on.

### **1.3.9 Integrated display programming console**

The programming console 14 (Figure 1.1) allows for manually programming the indicator with the “Parameter” and “Value” buttons (see Figure 1.7), changing the display mode of parameters shown on the LCD.

Note – The front face of the console has a diagnostic socket XP1 that allows for automatic programming (reprogramming) the ID with a special device (if available). If no special device is available, reprogramming is performed with the above mentioned buttons. *XP1 is not used on BELARUS-1221.4 tractors.*

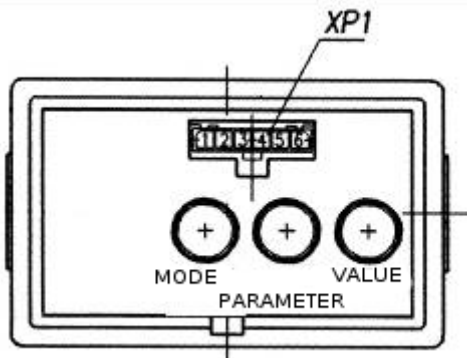


Figure 1.7 – Integrated display programming console

### **PC programming algorithm**

1. When selecting a fixed value of programming parameter:

1.1 When the “Parameter” button is pressed for the first time (see Figure 1.7), the LCD switches to the mode of viewing the programmed parameter and its numerical value. When the button is pressed repeatedly, the parameters are alternated cyclically.

1.2 When the “Value” button is pressed repeatedly (see Figure 1.7), the numerical value of the set programmed parameter is changed.

1.3 When neither the “Parameter” nor “Value” button is pressed for 7.0 seconds, the mode is exited automatically.

When exiting the mode, the parameter values selected with the “Value” button are stored.

2. When inputting an unfixed value of programming parameter:

2.1 Press the “Parameter” button to select the parameter the value of which is to be set;

2.2 Twice press the “Mode” button, the low-order digit on the LCD screen will start blinking;

2.3 To change the blinking digit of the parameter, press the “Value” button;



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2.4 To select the high-order digit, press the “Parameter” button;

2.5 To exit the programming mode of an unfixed value of any parameter, press the “Mode” button twice;

2.6 After the said mode is exited, the digits of the input value of the parameter stop blinking.

2.7 The newly set value is put the last in the list of allowed ones for programming the parameter values;

### **Note:**

- when the “Mode” button is pressed once in the programming mode, input of an arbitrary parameter value is not possible;

- when none of the “Mode”, “Parameter”, “Value” buttons is pressed for seven seconds in the mode of unfixed value input, the ID automatically switches to the main LCD mode, and all set parameter values are stored.

One unfixed value can be input in a range:

for “Z” - 23 to 69;

for “I” - 1,000 to 4,000;

for “R” - 400 to 1000;

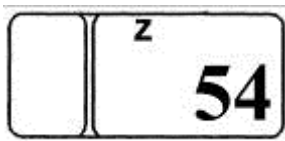
for “K” - 2,360 to 4,000; (For an ID without a CAN interface)

for “KV2” - 0.346 to 0.600;

for “ZV” - 12 to 78;

for “V” - 0 to 600;

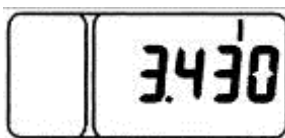
List of programmed ratios (graphic examples of parameter presentations and their values in the programming mode):



“Z” parameter

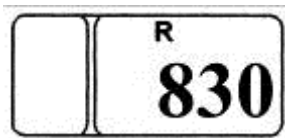
Z is the number of teeth of final shaft gears of the driving wheels (right and left), at which the travel speed (rotation speed) sensors are installed.

**Note** - 54 is the value of the “Z” parameter for 1221.4 tractors with a 16×8 gearbox. For 1221.4 tractors with a 24×12 gearbox, the value of the “Z” parameter is 56.



“I” parameter

I is the gear ratio multiplier of the wheel-hub drive.



“K” parameter

R is the rear wheel rolling radius, mm. When reprogramming, this parameter can be modified with a 5 mm step.

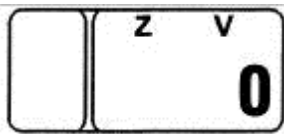
**Note** 830 is the value for tires 18.4R38. If other tire types are installed, set the “R” value corresponding to the rolling radius of the installed tires.



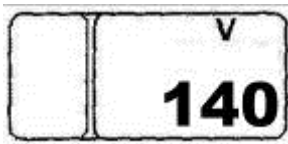
“KV2” parameter

KV2 is the PTO gear ratio.

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“ZV” parameter  
ZV is the teeth number of the PTO speed sensor gear  
(Note – if a sensor is not installed, input “0”).



“V” parameter  
V is the fuel tank volume, l.



Also, when the “Parameter” button is pressed in the programming mode, the list of programmed parameters contains an independent “T” parameter of precise readout of the astronomic service hours of the engine. This parameter cannot be modified, it is the precise number (to 1/10 of an hour) of engine service hours.

During operation, it is allowed to modify the value of the parameter of wheel rolling radius “R”, which is determined based on the tires installed on the tractor by measuring the distance from the wheel center to the reference surface.

**DO NOT MODIFY THE ENTERED VALUES OF ALL OTHER PARAMETERS (FACTORY DEFAULTS).**

When the instrument scale illumination is on, i.e. when the central light switch 7 (Figure 1.1) is switched to the position II “Instrument panel illumination, parking lights ON” and to the position III “Consumers of the position II and front headlights ON”, the brightness of the MD screen of the PTO indicator segments is automatically reduced.

#### **1.3.10 Switches on instrument panel**

a) 5 (Figure 1.1) – battery remote switch. When the battery remote switch key (unfixed) is pressed, the batteries are switched on, when it is pressed again, they are switched off.

b) 6 (Figure 1.1) – windscreen washer switch. When they key is pressed (unfixed), the windscreen washer is turned on.

c) 7 (Figure 1.1) – central light switch, has three positions:

- “OFF” (the upper part of the key as shown in the picture is depressed, position **I**);
- “Front and rear parking lights, number plate illumination, illumination of instruments on the panel, as well as additional lights on towed machine ON” (middle position **II**);
- “All consumers of II position and headlights ON” (the lower part of the key as shown in the picture is pressed to stop, position **III**).

d) 8 (Figure 1.1) – switch of front headlights installed on brackets of front lights. When the key 8 is pressed, two front headlights (located on brackets of front lights) and the light indicator built into the key are switched on.

e) 9 (Figure 1.1) – emergency stop signaling switch. When the key is pressed, the emergency stop signaling is switched on. The pilot lamp built into the key blinks simultaneously with the blinking signaling light. When the key 9 is pressed again, the emergency signaling is switched off.

f) 10 (Figure 1.1) – multifunctional (understeering) switch. Ensures switching on of turn indicators, switching the high and low beams of the front headlights, signaling (blinking) with the upper beam, switching on of the horn.

The turn indicators are switched on, when the lever is shifted forward (“a” — right turn) or backward (“b” — left turn) from the middle position according to Figure 1.8. After the tractor makes a turn, the lever returns automatically to its initial position.

To switch on the headlights, shift the central light switch 7 (Figure 1.1) to the position **III** (see above) and shift the switch lever to the middle position “c” — “upper beam” according to Figure 1.8. The upper beam is switched on by pushing the switch lever to stop (position “d”). The upper/lower beam positions of the lever are fixed.

By pulling the lever to stop (position “e”, Figure 1.8) from the lower beam position, unfixed switching on of the upper beam, “blinking with the upper beam”, is performed, independently of the central light switch position.

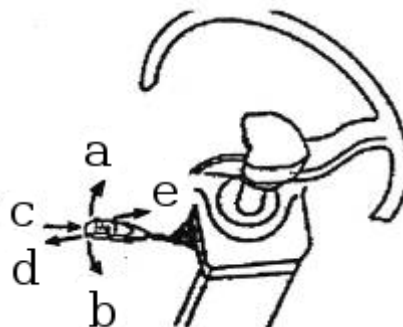
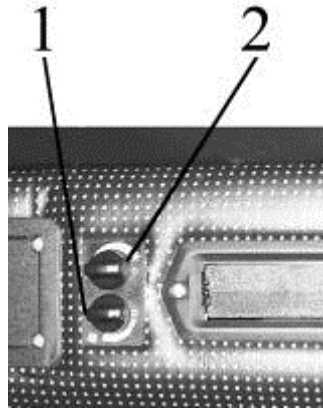


Figure 1.8 — Multifunctional switch

The horn is turned on, when the lever is pressed in the axial direction “e” (switch lever axis). The horn can be switched on in any position of the switch lever.

### **1.3.11 Climate system control**

The climate system control panel 2 (Figure 1.1) has the switches 1 and 2 (Figure 1.9).



1 – Air flow switch;

2 – Air conditioner switch and refrigerating capacity control;

Figure 1.9 — Climate system control panel

Rules of climate system control in the air conditioning mode and in the cab heating mode are provided **in the section 2.4 Cab air conditioning and heating system**.

**Note** – On your tractor, a fan heater can be installed instead of a climate system; the fan heater control and its structure are described in the 1221-0000010 RE operating manual supplied with your tractor.

## **2 DESCRIPTION AND OPERATION OF MAIN COMPONENTS OF TRACTOR**

### **2.1 TCD 2012 L06 2V engine**

Information about the design, troubleshooting, rules of operation and maintenance of the TCD 2012 L06 2V engine are described in the engine operating manual TD/TCD 2012 L04/06 2V TD/TCD 2013 L04/06 2V RE.

### **2.2 Electronic control system of TCD 2012 L06 2V engine**

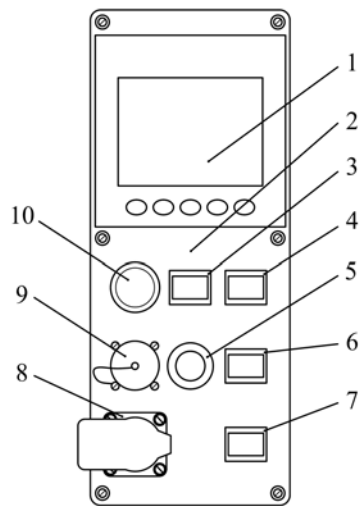
#### **2.2.1 General information**

The electronic engine control system (Figure 2.2) includes the electronic unit 7, the information display 3, the control panel 4, the engine mode manual control lever 5, the engine mode electronic foot pedal 9, the switching and protection unit 8, which are installed in the tractor cab, as well as the coolant level sensor 2 installed on the expansion tank and the fuel filter water sensor 1 installed on the right side of the engine. The listed items are interconnected with the harnesses 6. The socket for connection of diagnostic device is located on the control panel 4. The system is powered from the battery via the switching and protection unit as per the electric circuit diagram presented in Figure 2.4.

After the starter and instrument switch is turned from the “OFF” to “Instrument power” position, the system is powered up. When the voltage is supplied, the system performs self-diagnostics. If no errors in system operation are found, the failure signal indicator on the control system panel 3 (Figure 2.1) should go on and off, and the information display 1 (Figure 2.1) switches to the operating mode. If any error is found, the information display emits a sound signal, and the screen shows a short description of detected errors (error code designation and its description), as well as the failure signal indicator 3 on the engine control panel glows or blinks. Error codes interpretation as well as advised actions for troubleshooting are described in the engine operating manual TD/TCD 2012 L04/06 2V TD/TCD 2013 L04/06 2V RE. Eliminate found errors before starting the engine.

The engine is started by turning and holding the starter and instrument switch in the “Starter ON” position. After the engine starts, the display shows actually measured parameters of engine operation.

Figure 2.4 shows the electric circuit diagram of the external part of the control system of the TCD 2012 L06 2V engine of the BELARUS-1221.4 tractor.

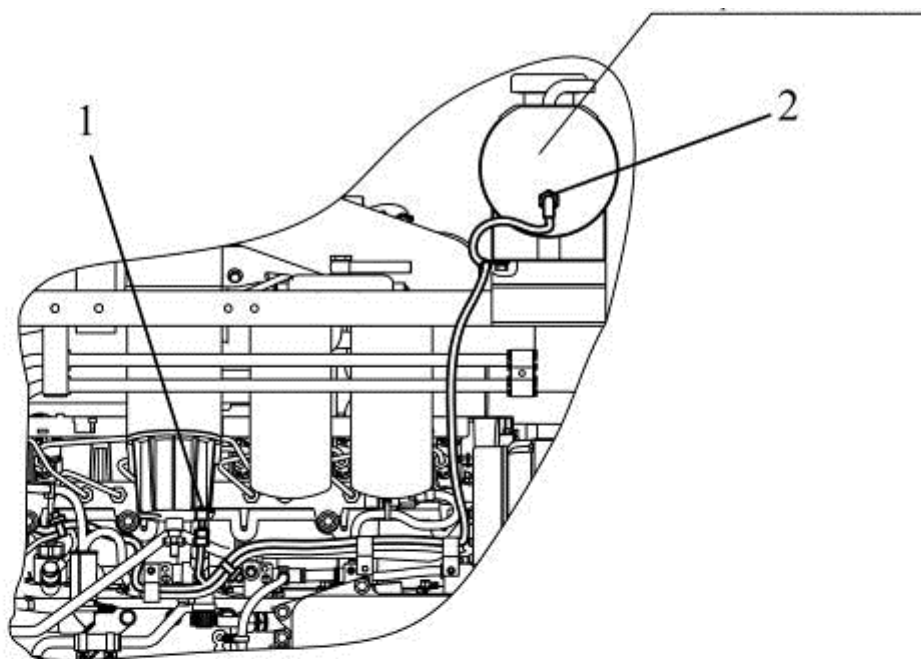


1 - information display; 2 - panel; 3 - failure signal indicator; 4 - emergency oil pressure signal indicator; 5 - diagnostics button switch; 6 - engine coolant emergency temperature or level signal indicator; 7 - fuel filter water signal indicator; 8 - 12 V/ 25 A socket; 9 - diagnostic socket; 10 – cigar lighter.

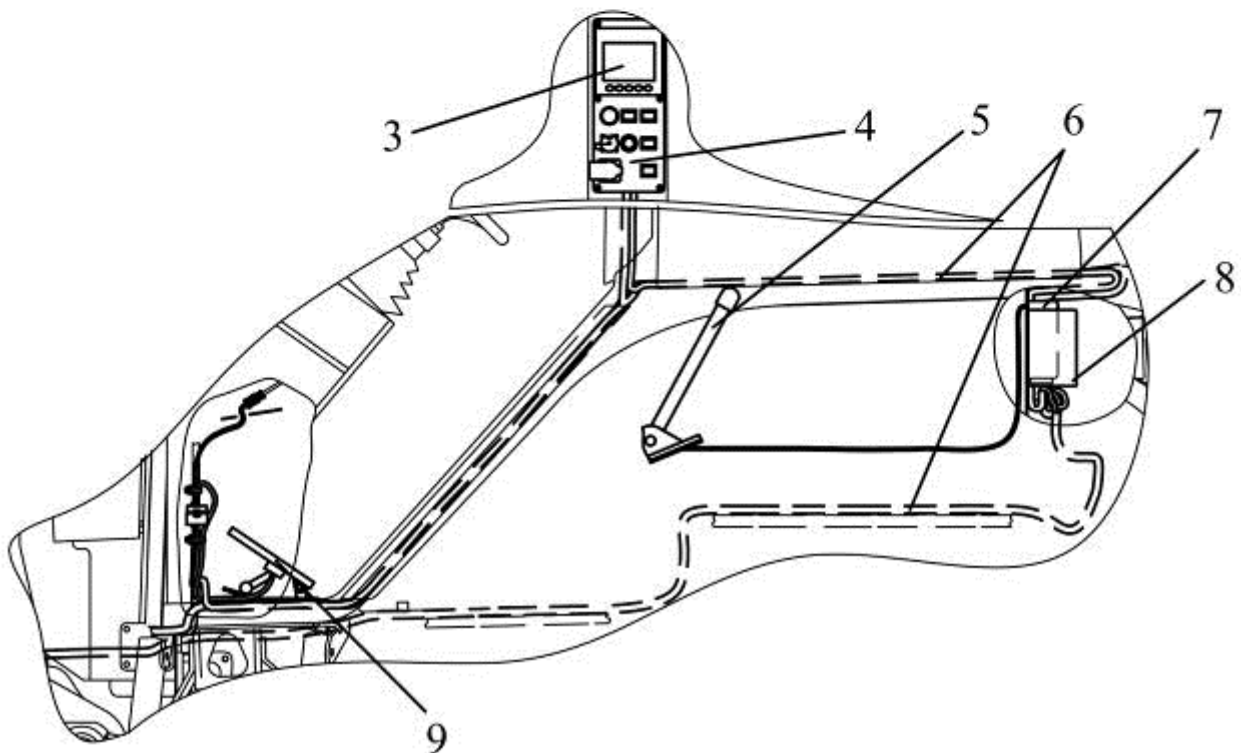
Figure 2.1 – Control system panel of TCD 2012 L06 2V engine

Right-hand view in longitudinal direction

Expansion tank



Left-hand view in longitudinal direction

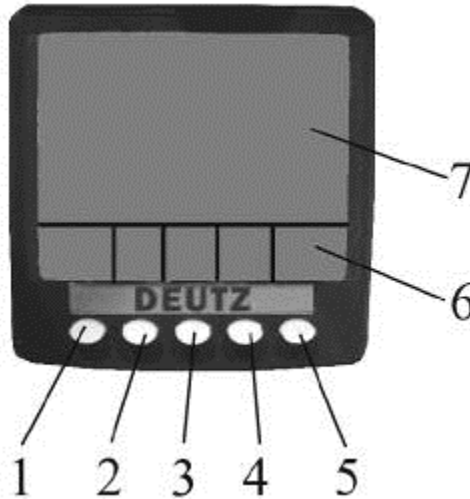


1 - Fuel filter water sensor, 2 - coolant level sensor, 3 – information display, 4 - control panel, 5 - engine mode manual control lever, 6 - connection harnesses, 7 - electronic engine control unit, 8 - switching and protection unit, 9 – engine mode electronic foot pedal.

Figure 2.2 – Control system of TCD 2012 L06 2V engine

### 2.2.2 Adjust brightness and contrast of display indicator

Press the button 5 (Figure 2.3) to enter the display brightness and contrast adjustment mode. In the lower part of the screen, button images are shown. Press the button 1 to reduce brightness, press the button 2 to increase brightness, press the button 3 to reduce contrast, press the button 4 to increase contrast, press the buttons 1, 2, 3, 4 simultaneously to set the medium contrast and maximum brightness. Press the button 5 again to exit the brightness and contrast adjustment mode.



- 1 – button to call a presentation of the main indicator and browse through indicated parameters,
- 2 – button to call the four-section indicator and browse through indicated parameters,
- 3 – button to call the graphic presentation indicator and browse through indicated parameters,
- 4 – button to call error (failure) list,
- 5 – button to enter/exit the mode of brightness and contrast adjustment and PIN code,
- 6 – changeable presentation of button purpose, 7 – screen.

Figure 2.3 - Information display

### 2.2.3 Call up of changeable presentations and parameters to display

Press the button 1 on the display (Figure 2.3) to call the main image to the screen. Herewith, the upper left corner presents an engine speed scale, the upper right angle presents a travel speed scale (when no speed parameter is available, oil pressure in the engine lubrication system is shown), the lower right angle presents the coolant temperature, the lower left angle presents the current fuel consumption per hour.

Press the button 2 to call the four-section parameter presentation on the display screen. After the first push of the button 2, four parameters in numeric form are shown on the screen:

- in the upper left corner – voltage directly on the connection terminals of the information display;

- in the upper right corner – coolant temperature;

- in the lower left corner – electric system voltage;

- in the lower right corner – oil pressure in the engine lubrication system.

After a second and third push of the button 2, the screen shows four parameters in analog form.

Using the adjustment mode, the user can call, if necessary, presentation of various engine parameters as listed in Table 4 to the screen. Press the button 5 to enter the adjustment mode. Sequential pressing of the button 1 changes indicated parameters in the upper left corner, the button 2 – in the upper right corner, the button 3 – in the lower left corner, the button 4 – in the lower right corner. Press the button 5 to exit the adjustment mode.

Press the button 3 to call the graphic parameter presentation in time (works as an analog recorder of parameters).

Required parameters listed in Table 4 are selected by sequential pressing the button 3.

The time grid can be set up in the configuration menu from 2, 10, or 30 minutes to 1, 2, 4, or 8 hours. To open the configuration menu, enter the code (PIN number). To open the PIN number window, press the button 5 for over 3 seconds. This menu also allows selecting metric or imperial units of measurement, as well as English, Spanish, Swedish, French, German, Italian, Dutch, Portuguese and Russian among the available languages.

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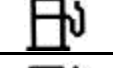
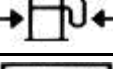




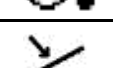





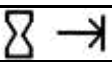

**ATTENTION:** ONLY DEALERS ARE AUTHORISED TO CHANGE PARAMETERS OF THE CONFIGURATION MENU.

Press the button 4 to call error (failure) list. Browse the list with the buttons 1 and 2.

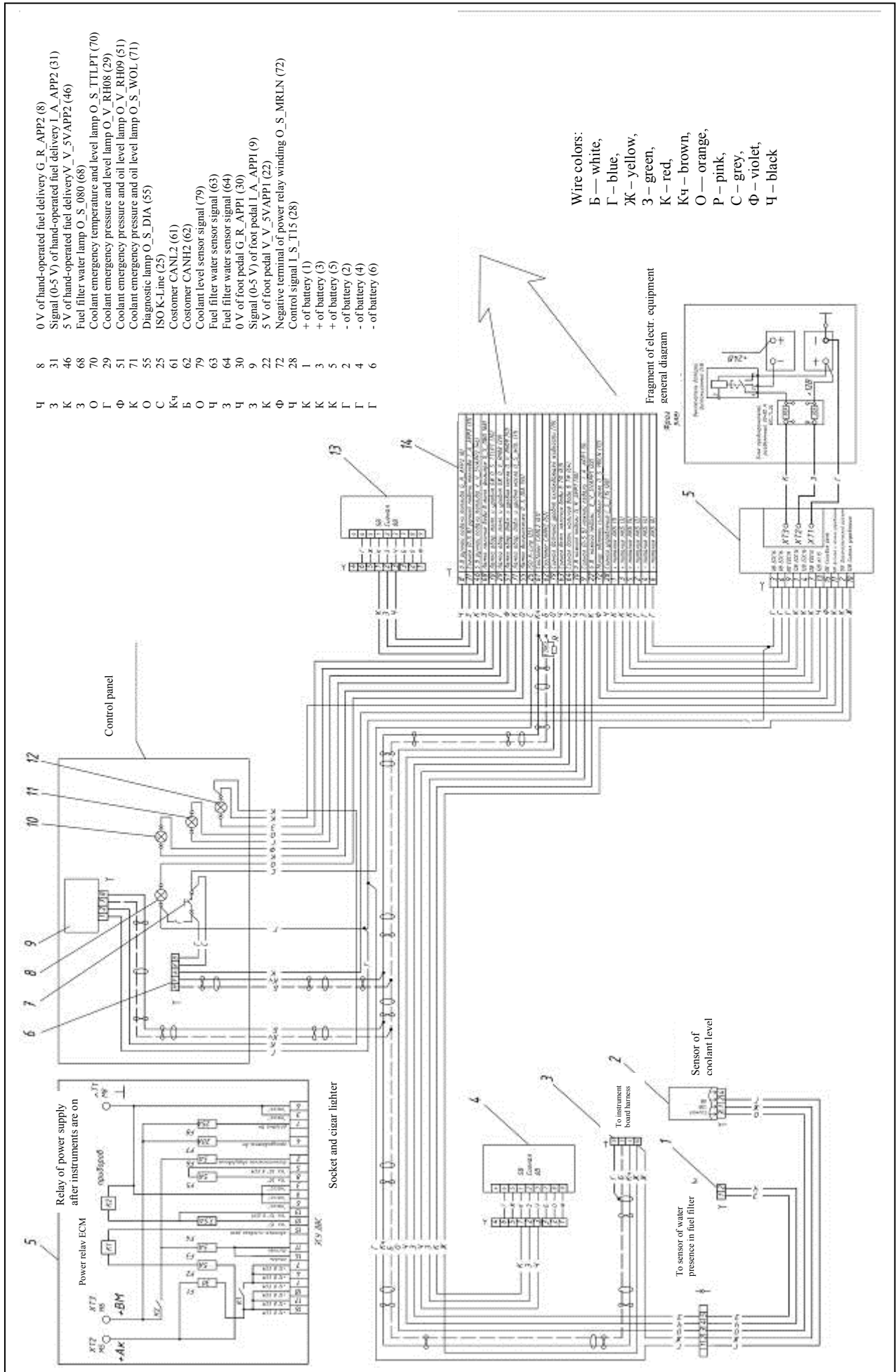
When any error (failure) emerges during work, the display emits a sound signal, and a blinking windows pops up with description of the latest errors (failures).

**ATTENTION:** THE ENGINE IS STOPPED BY TURING THE STARTER AND INSTRUMENT SWITCH TO “OFF”.

Table 4 - List of parameters of graphic and four-section indication of engine operation.

	Parameters	Four-section presentation	Graphic presentation	Symbol
1	Voltage directly on the connection terminals of the information display, V	✓	✓	
2	Voltage at battery terminals measured by electronic control unit of engine, V	✓	✓	
3	Fuel consumption	✓	✓	
4	Fuel supply pressure	✓	✓	
5	Barometric pressure	✓		
6	Boost pressure	✓	✓	
7	Oil pressure in engine	✓	✓	
8	Coolant temperature in engine	✓	✓	
9	Air temperature at inlet pipe	✓	✓	
10	Accelerator position, %	✓		
11	Coolant level in engine, %	✓		
12	Engine torque requested by driver	✓		
13	Actual torque	✓		
14	Torque use, rpm	✓		
15	Engine speed (rpm)	✓	✓	
16	- Total service hours of the engine	✓		





Fi Figure 2.4 — Electric circuit diagram of the external part of the control system of the BELARUS-1221.4 tractor

To Figure 2.4 – Elements of the external part of the control system of the TCD 2012 L06 2V engine of the BELARUS-1221.4 tractor:

- 1 - socket of fuel filter water sensor;
- 2 - coolant level sensor;
- 3 - CANBUS socket;
- 4 - accelerator pedal of forward motion;
- 5 - switching and protection unit;
- 6 - socket coupler for connection of diagnostic device;
- 7 - diagnostics call button;
- 8 - diagnostic indicator;
- 9 - information display;
- 10 - emergency oil pressure signal indicator;
- 11 - emergency coolant temperature or level signal indicator;
- 12 - fuel filter water signal indicator;
- 13 - manual fuel delivery sensor;
- 14 - socket connector (94 pins).

Appendix B contains the electric circuit diagram of rear axle DL and FDA drive control system of BELARUS – 1221.4 tractors with an item list.

## **2.3 Trailer brake drive**

### **2.3.1 General information**

Your tractor can be equipped with a combined trailer brake pneumatic drive or two-wire trailer brake pneumatic drive, or single-wire trailer brake pneumatic drive. Short information about the design and main adjustments of the combined trailer brake pneumatic drive is presented in the section **2.3.2 Combined trailer brake pneumatic drive** of this operating manual. Short information about main adjustments of the single-wire and two-wire pneumatic drives of trailer brakes is presented in the Operating manual 1221-0000010 RE.

**ATTENTION:** PERFORM ADJUSTMENT OR TROUBLESHOOTING OF THE TRACTOR TRAILER BRAKE SYSTEM AND BRAKE DRIVE ONLY WHEN THE ENGINE IS SHUT OFF AND THE TRACTOR IS ON AN EVEN SURFACE, BLOCKED WITH BRAKE SHOES PUT UNDER THE WHEELS, WHICH EXCLUDE SPONTANEOUS MOVEMENT OF THE TRACTOR.

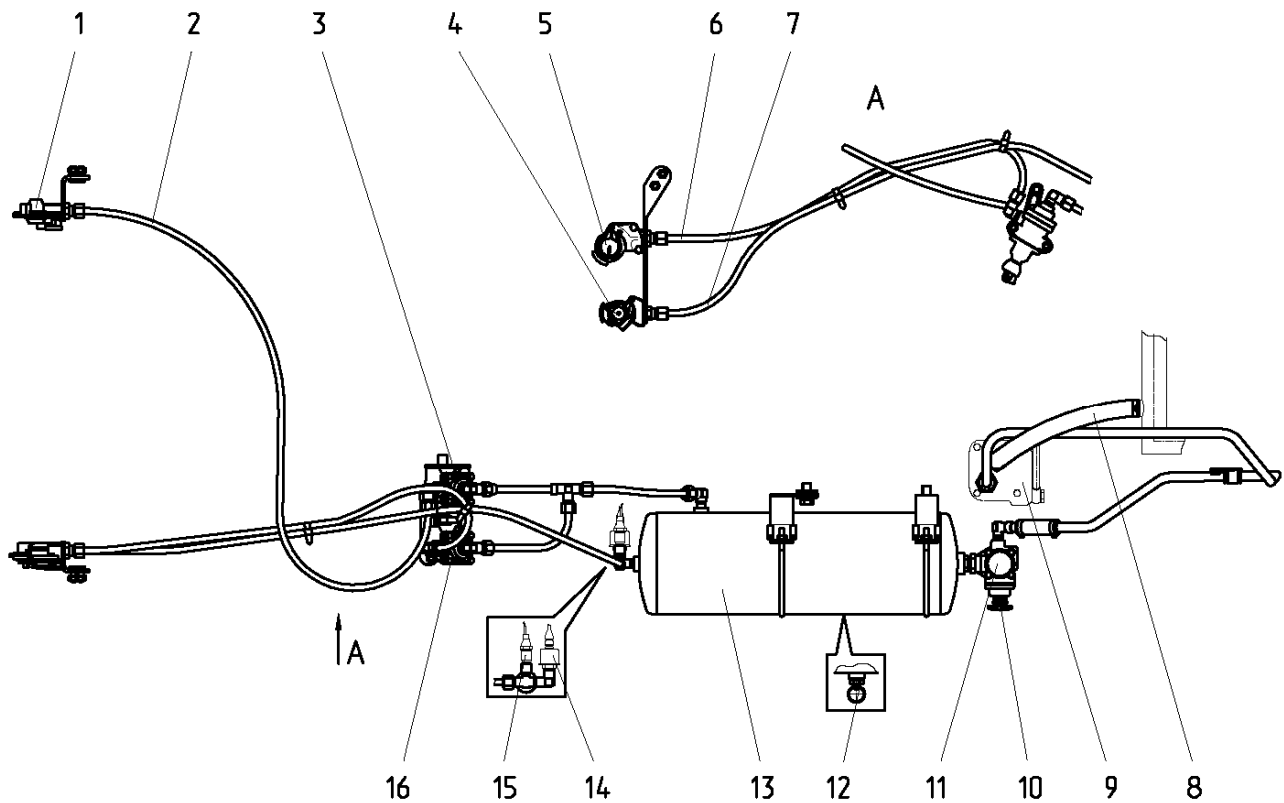
### **2.3.2 Combined trailer brake pneumatic drive**

#### **2.3.2.1 General information**

BELARUS-1221.4 tractors can be equipped with a combined trailer brake pneumatic drive.

The pneumatic drive can also be used to inflate tires and for other purposes, where energy of compressed air is required.

Figure 2.5 shows the pneumatic drive circuit diagram.



1, 4, 5 - coupling heads; 2 - control manifold; 3 - brake valve (two-wire); 6 – connecting line; 7 – supply line; 8 - line from engine intake manifold; 9 – compressor; 10 – air bleed valve; 11 - pressure regulator; 12 – condensate drain valve; 13 - tank; 14 - air pressure sensor; 15 - emergency air pressure sensor; 16 - brake valve (single-wire).

Figure 2.5 – Trailer brake pneumatic drive circuit diagram

Air is taken to the pneumatic drive from the engine intake manifold through the line 8 (Figure 2.5). The air is compressed in the compressor 9 and delivered to the tank 13 through the pressure regulator 11 maintaining required pressure in the tank. From the tank, compressed air goes to the brake valves 3 and 16 and to the supply line 7 with the coupling head 4 (with red cap) that is always under pressure. The brake valve 3 is connected through the control manifold 2 with the coupling head 1 (with yellow cap). There is no pressure in it. The brake valve 16 is connected through the connecting line 6 with the coupling head 5 (with black cap).

Brakes of trailers and agricultural machines are controlled in two modes: direct and automatic.

When connecting a trailer with a single-wire pneumatic drive, the trailer head is connected to the coupling head 5 and air goes to the trailer pneumatic drive. When the brake pedal is pressed on or the parking brake is engaged, compressed air through the brake valve 16 is vented from the connecting line 6 to atmosphere.

The air distributor operates on the trailer, supplying compressed air from the trailer tanks to the brake chambers, and the trailer stops. If the trailer is disconnected in case of emergency, the coupling heads are disconnected, air from the trailer line is vented to atmosphere, and the trailer stops automatically.

Direct control of the brakes is performed due to pressure drop in the connecting line from 6 to 0 MPa when the tractor decelerates. In such case, delivery of compressed air to the trailer pneumatic system stops.

Automatic control of the brakes (automatic braking) is actuated in case of a break of the coupling and disconnection of the trailer due to pressure drop in the trailer connecting line.

When a trailer with a two-wire pneumatic drive is used, the trailer coupling heads are connected to the coupling heads 4 (with red cap) and 1 (with yellow cap), i.e. to the supply line 7 and to the control manifold 2. Hereby, compressed air constantly flows to the trailer through the supply line

7. When the brake pedal is pressed on or the parking brake is engaged, compressed air is supplied to the trailer through the brake valve 3 and the control manifold 2. The air distributor operates on the trailer, supplying compressed air from the trailer tank to the brake chambers, and the trailer stops.

Direct control of the brakes is performed due to pressure rise in the control manifold from 2 to 0.65 to 0.8 MPa when the tractor decelerates. In such case, the supply line 7 remains under pressure, and delivery of compressed air to the trailer pneumatic system is preserved.

Automatic control of the brakes (automatic braking) is performed in case of a break of the coupling and disconnection of the trailer due to pressure drop in the trailer supply line.

In the pneumatic drive, the valve coupling heads 1, 4, 5 are installed. The coupling head valves prevent air loss in case of use of the pneumatic drive without a trailer (for example, for tire inflation) and in case of an emergency disconnection of a trailer. When the trailer brake lines are connected with the tractor lines, the coupling head valves open, ensuring passage of compressed air from the tractor pneumatic drive to the trailer. At that, it is recommended to connect the pneumatic lines with no pressure in the cylinder 13 of the tractor.

Air pressure in the tank 13 is monitored by the air pressure indicator and the red emergency air pressure lamp (installed on the instrument panel), the air pressure sensor 14 and the emergency air pressure sensor 15.

To drain condensate from the tank 13, the condensate drain valve 12 is provided. To drain condensate, tilt the push bar with the ring aside and up.

Air bleeding from the pneumatic drive (to inflate tires etc.) is performed through the air bleed valve 10 of the pressure regulator 11.

### 2.3.2.2 Check and adjustment of drive of single-wire and two-wire brake valves of pneumatic system

ADJUST THE BRAKE VALVE DRIVE WHEN THE SERVICE BRAKE PEDALS ARE NOT PRESSED AND THE PARKING EMERGENCY BRAKE IS COMPLETELY DISENGAGED, WHICH MUST BE ADJUSTED FIRST.

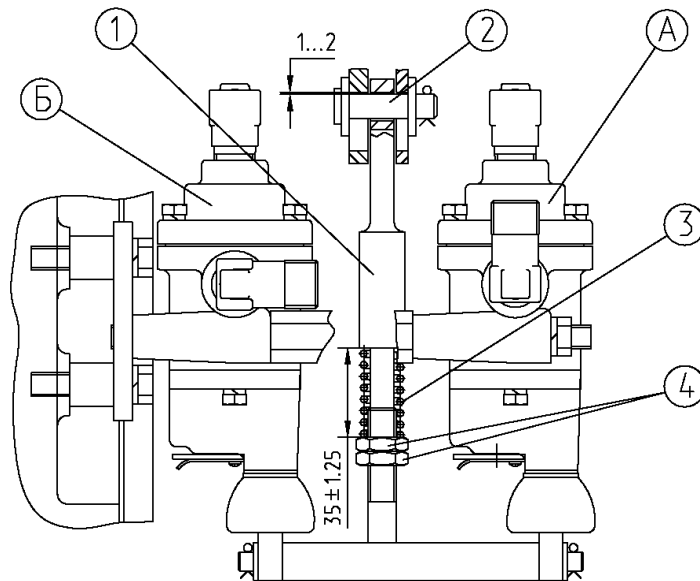


Figure 2.6 — Check and adjustment of drive of single-wire and two-wire brake valves of pneumatic system

Check the drive of the single-wire brake valve “A” (Figure 2.6) as follows:

1. Connect a pressure gage with a scale of 1 MPa min. to the coupling head (with black cap) of the tractor pneumatic drive.
2. Turn on the compressor and fill the cylinder with air to a pressure of 0.77 to 0.8 MPa as per the pressure gage located on the instrument panel.
3. Air pressure as per the pressure gage connected to the coupling head must be 0.77 MPa or higher or 0.53 MPa or higher for Hungary and Germany. If it is lower than specified, do as follows:

4. Check availability of the clearance gap of 1 to 2 mm between the pin 2 (Figure 2.6) and the upper edges of the grooves in the arms. If there is no gap, remove the cotter pin and remove the pin 2 and adjust the length of the arm by turning the end 1.

5. Check and adjust if necessary compressing of the spring 3 to a size of  $35\pm 1.25$  mm by rotating the nuts 4 and lock them. Check valve operation as per item 3.

6. If air pressure as per the pressure gage connected to the coupling head has not reached the required value, replace the brake valve "A".

**ATTENTION:** WITH THE BRAKE VALVE "A" (FIGURE 2.6) AND ITS DRIVE CORRECTLY ADJUSTED, PRESSURE AS PER THE PRESSURE GAGE CONNECTED TO THE COUPLING HEAD WITH A BLACK CAP MUST DROP TO ZERO IN CASE OF A FULL TRAVEL OF THE INTERLOCKED BRAKE PEDALS OR WHEN THE PARKING BRAKE IS FULLY ENGAGED.

Check the drive of the two-wire brake valve "B" (Figure 2.6) as follows:

1. Connect a pressure gage with a scale of 1 MPa min. to the coupling head (with yellow cap) of the tractor pneumatic drive.

2. Turn on the compressor and fill the tank with air to a pressure of 0.77 to 0.8 MPa as per the pressure gage located on the instrument panel.

3. Air pressure as per the pressure gage connected to the coupling head (with a yellow cap) of the control manifold must be equal to zero. Move the interlocked brake pedals to a full travel. The pressure must rise to 0.65...0.8 MPa Release the brake pedals. Engage the parking brake by shifting its handle to the maximum extent. The pressure must rise to 0.65...0.8 MPa If the pressure per the pressure gage connected to the control connection line head does not correspond to the above values, perform the following actions:

4. Check availability of a gap of 1 to 2 mm between the pin 2 (Figure 2.6) and the upper edges of the grooves in the arms. If there is no gap, remove the pin 2 and adjust the length of the arm by turning the end 1.

5. Check and adjust if necessary compressing of the spring 3 to a size of  $35\pm 1.25$  mm by rotating the nuts 4 and lock them. Check valve operation as per item 3.

6. If air pressure as per the pressure gage connected to the coupling head has not reached the required value, replace the brake valve "B".

**ATTENTION:** WITH THE BRAKE VALVE "B" (FIGURE 2.6) AND ITS DRIVE CORRECTLY ADJUSTED, PRESSURE AS PER THE PRESSURE GAGE CONNECTED TO THE COUPLING HEAD (WITH A YELLOW CAP) MUST BE EQUAL TO ZERO WHEN THE INTERLOCKED BRAKE PEDALS ARE NOT PRESSED AND WHEN THE PARKING BRAKE IS FULLY DISENGAGED.

## **2.4 Cab air conditioning and heating system**

### **2.4.1 Climate system control in air conditioning mode**

The climate system control panel is in the center of the upper panel of the cab. The control panel has the switches 1 and 2 (Figure 2.7).

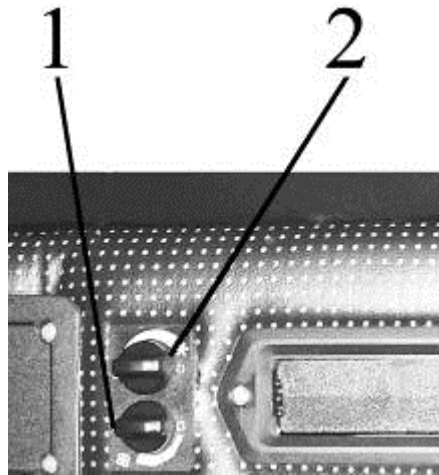


Figure 2.7 – Controls of cab air conditioning and heating system

With the switch 1, you can adjust air flow by changing fan speed. With the switch 2, you can change temperature of cold and dry air going out of the deflectors in the air conditioning mode.

**ATTENTION:** AIR CONDITIONER CAN BE TURNED ON AND OPERATE ONLY WHEN THE ENGINE IS RUNNING

To turn on the conditioner, proceed as follows:

- turn the switch 2 (Figure 2.7) clockwise by 180° to the beginning of the blue scale;
- then turn the switch 1 to one of the three marked positions (the fan impeller has three speeds). In 3 to 5 minutes, use the switch 2 to adjust the desired temperature in the cab;
- with the shutters located on the upper panel, near the operator's head, the mix of external and recirculating air can be adjusted;

To turn off the air conditioner, turn both switches 1 and 2 counterclockwise to “0”.

**ATTENTION:** WHEN WORKING IN THE COOLING MODE, THE HEATER VALVE MUST BE CLOSED TO PREVENT SIMULTANEOUS OPERATION OF THE AIR HEATING AND COOLING SYSTEMS.

### **2.4.2 Climate system control in heating mode**

**ATTENTION:** REFILL THE ENGINE COOLING SYSTEM ONLY WITH AN ANTIFREEZE AGENT.

For efficient operation of the heating system, observe the following recommendations:

1. After refilling the cooling system with antifreeze agent, start the engine and, without opening the valve, let the engine work at medium speed to have the antifreeze agent in the cooling system warmed up to 70 to 80°C, after that open the valve, increase the engine speed and let it work for 1 to 2 minutes to have the heat exchanger filled with the agent. Make sure that the antifreeze agent is circulating through the heater. The heat exchanger must warm up. The coolant level in the heat exchanger of the engine cooling system will hereby drop.

2. Add coolant to the heat exchanger to the required level (to the MAX. mark on the expansion tank);

3. To have the cab quickly warmed up, turn on the heater fan and open the recirculating shutters;

4. To discharge the coolant from the engine heater and cooling system, install the tractor on an even surface. Remove the extension tank plug of the engine cooling system, open the valve on

the cylinder block in the rear part of the engine and disconnect the heater hoses before the entry to the cab posts.

**ATTENTION:** WHEN WORKING IN THE HEATING MODE, THE SWITCH 2 (FIGURE 2.7) MUST BE FULLY OFF TO PREVENT SIMULTANEOUS OPERATION OF THE AIR HEATING AND COOLING SYSTEMS.

### 2.4.3 General arrangement and operation of cab air conditioning and heating system

The cab air conditioning and heating system is intended to create and maintain normal microclimate in the tractor cab. The air conditioning system consists of two circuits — cooling and heating. Figure 2.8 shows the system layout.

The cooling circuit includes a compressor, a condenser, a filter drain with pressure sensor, an evaporator and heat exchanger unit (cooler-heater), a cooler-heater fan, connection hoses with a set of quick couplings, electric cables, air filters, a cool air regulator and a fan switch. The heating circuit is filled with hoses connected to the tractor engine cooling system and a shutoff cock.

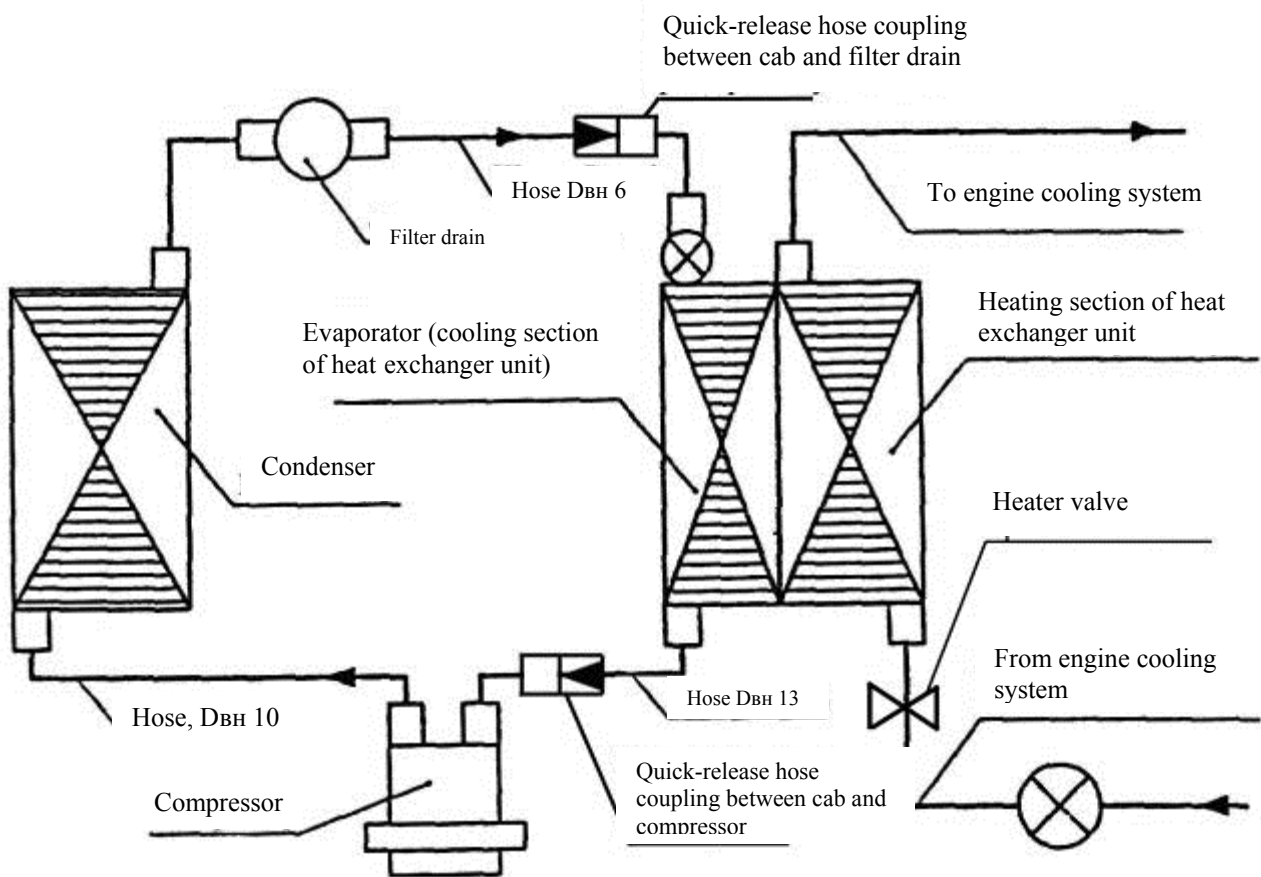


Figure 2.8 – Cab air conditioning and heating system

Arrangement of the air conditioning system elements:

- compressor – from the left on the semi-frame below;
- condenser – before the CAC heat exchanger;
- filter drain – on the condenser frame;
- pressure sensor – on the filter drain;
- cooler-heater – under the roof over the ventilation box panel;
- cold air regulator and fan switch — on the upper section panel;
- service valves – on the fittings near the compressor and the filter drain.



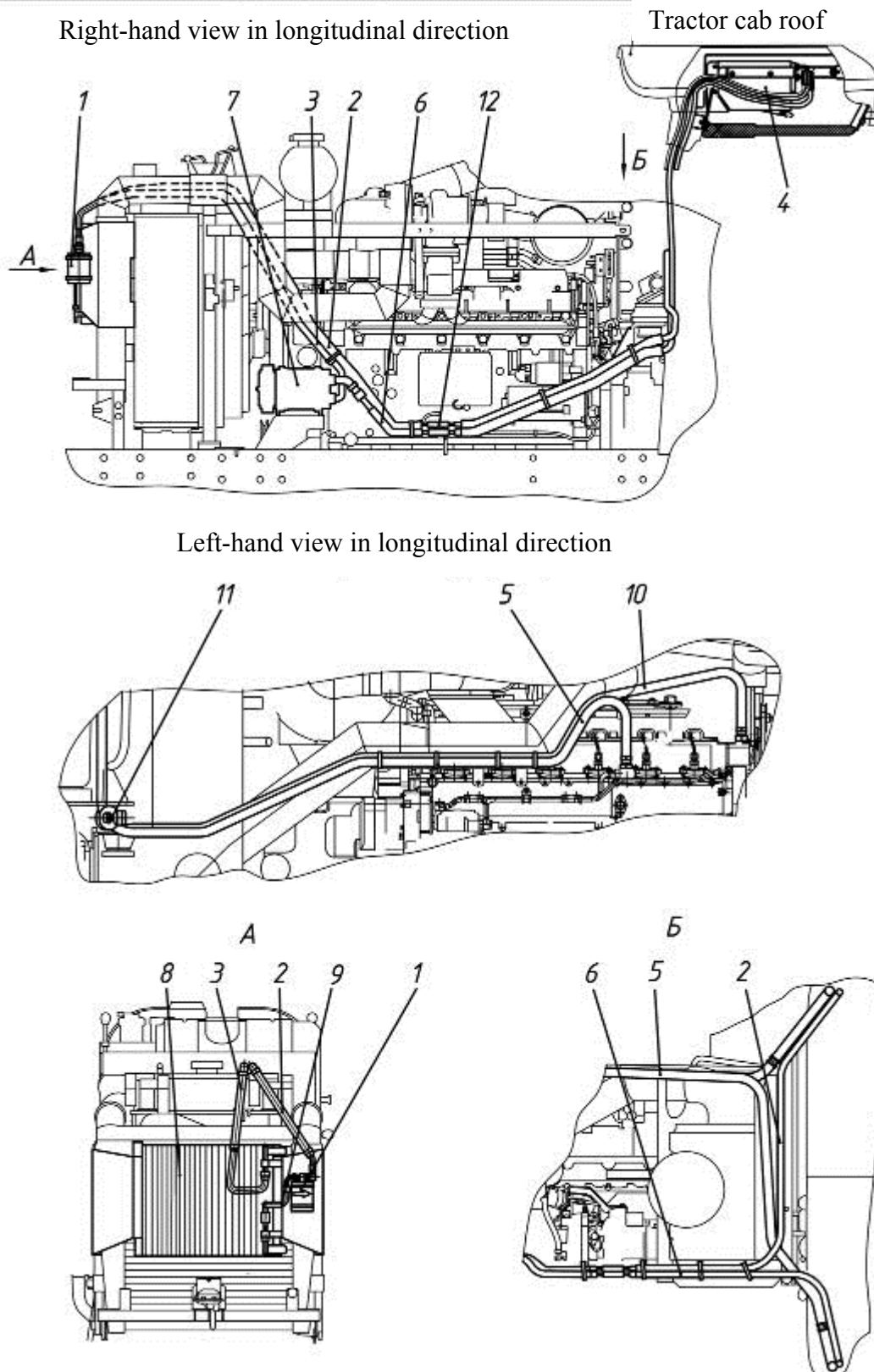


Figure 2.9 – Arrangement of main elements of cab air conditioning and heating system

To Figure 2.9 – Arrangement of main elements of cab air conditioning and heating system:

1 - filter drain; 2 - refrigerating fluid delivery line from filter drain to cooler-heater; 3 - refrigerating fluid delivery line from compressor to condenser; 4 - cooler-heater; 5 - refrigerating fluid delivery line from engine cooling system to cooler-heater; 6 - refrigerating fluid delivery line from heater-cooler to compressor; 7 - compressor; 8- condenser; 9 - refrigerating fluid delivery line from condenser to filter drain; 10 - refrigerating fluid drain line from cooler-heater to engine cooling system; 11 - shutoff cock; 12 - quick-release couplings.

The climate system starts operating in the air conditioning mode with the engine running, when the desired fan speed is set with the switch 1 (Figure 2.7), and the switch 2 is set to the beginning of the blue scale.

Hereby, voltage is supplied to the electromagnetic coupling of the compressor through the control circuit. The coupling is engaged transferring rotation from the engine crankshaft pulley to the compressor shaft. The compressor pumps the refrigerating fluid through the elements of the air conditioning system. Herewith the refrigerating fluid absorbs heat from the air passing through the cooler-heater, then releasing heat to the environment through the condenser.

The air conditioning system can automatically maintain the preset temperature that is set by turning the switch 2 (Figure 2.7) controlling the thermostat. Turning clockwise will decrease the temperature setting, turning counterclockwise will increase it. Protection from critical conditions is ensured by the pressure sensor and the thermostat. The sensor turns off the system when the pressure is too high (over  $2.6 \pm 0.2$  MPa) or too low (below  $0.21 \pm 0.03$  MPa). The thermostat turns off the system when the temperature of the cooling section of the heat exchanger unit drops too low. Performance of the system is adjusted by the fan speed and the thermostat. Hereby the compressor can operate both continuously and cyclically.

Table 5 presents main parameters and characteristics of the cab air conditioning and heating system.

Table 5

Parameter (characteristic) name	Value
Refrigerating capacity, kW	6.4
Heating capacity, kW	8.7
Operating voltage, V	12
Electrical power consumption, W	260
Mechanical power consumption, kW	From 1.4 to 8.0
Coolant	R134a, ozone-friendly
Compressor	DELPHI SP15
Compressor drive belt	SPA/S-932

In case of nonregular operation, in order to maintain good condition, it is recommended to turn on the system in the cooling mode (with the ambient temperature above 15°C) for 15 to 20 minutes each 15 days.

Independently of operating conditions, operation of the system must be checked each year at a service station with special equipment.

When putting the tractor to short-term storage, no preparation work is carried out for the air conditioning system. During storage, turn on the air conditioner each 15 days for 15 to 20 minutes with the engine running. Hereby the air temperature in the tractor cab must be 20 °C or above.

When putting the tractor for long-term storage, check operation of the air conditioning system with special equipment. If necessary, refill with refrigerating fluid. During storage, no service work is carried out.

When removing from storage, have the air conditioning system serviced by a special service station with diagnostic equipment.

Other details on maintenance and servicing of the air conditioning and heating system of the cab are given in section **3.2 Maintenance of tractor components** of this manual.

**WARNINGS:**

1. ONLY SPECIALLY TRAINED PERSONNEL IS ALLOWED TO PERFORM MAINTENANCE AND REPAIR WORKS FOR THE AIR CONDITIONING SYSTEM.

2. ANY WORK RELATED TO DISCONNECTION OF THE AIR CONDITIONING SYSTEM ELEMENTS MUST BE PERFORMED BY TRAINED PERSONNEL WITH USE OF

SPECIAL EQUIPMENT FOR MAINTENANCE OF AIR CONDITIONERS. THE SYSTEM IS UNDER HIGH PRESSURE EVEN WHEN IT IS OFF.

3. BEFORE STOPPING THE TRACTOR ENGINE, MAKE SURE TO TURN OFF THE AIR CONDITIONER.

4. THE R134A REFRIGERATING FLUID IS NONTOXIC, NONFLAMMABLE, DOES NOT FORM EXPLOSIVE MIXTURES. THE REFRIGERATING FLUID BOILING TEMPERATURE IS MINUS 27°C UNDER NORMAL CONDITIONS. IN CASE OF SKIN CONTACT, THE REFRIGERATING FLUID IMMEDIATELY EVAPORATES AND CAN CAUSE SUPERCOOLING OF SKIN AREAS.

5. WHEN DISCONNECTING THE TRACTOR, THE CLOSED AIR CONDITIONING SYSTEM CAN BE DETACHED BY DISCONNECTING THE QUICK-RELEASE COUPLINGS.

#### **2.4.4 Air conditioning unit troubleshooting**

Table 6

Fault	Possible reason	Remedy
The electromagnetic coupling of the compressor does not operate (when turning the temperature regulator, no distinctive metallic click is heard)	1. Electric equipment failure  2. Coolant leak occurred.	With a tester or multimeter, check operation of the pressure sensor unit, the sensor unit terminals (the red and pink wires) must create a continuous circuit. Check operation of the electric circuit connections from the compressor coupling to the air conditioner control panel.  Find the refrigerating fluid leak spot. Detection of leaks, replacement of hoses and components is performed by trained personnel with use of special equipment (warranty service and repair is performed by Belvneshinvest CJSC, Minsk, tel./fax ++375-17-262-40-75, ++375-29-662-97-69, +375-29-628-67-98)
Air conditioner fan engine does not operate	Electric equipment failure	Check condition of the respective fuse (25A, see the electric circuit diagram, Appendix A) on the fuse block F4 located on the instrument panel. Replace if faulty. With a test lamp, check availability of power at the air conditioner engine (M7, Appendix A) with the switch ON and the engine “ground” available. If the electric circuits are in good condition, but there is no power at M7, replace the switch.
When the air conditioner is in the heating mode, warm air is supplied to the cab	Sealing of the valve ПO-11 (or BC11) damaged.	Replace the valve PO-11 (or VS11)
Leak of refrigerating fluid from cab ventilation box	Broken pipes of the heat exchanger (damage from frost due to incomplete discharge when working with water during cold season).	Replace the climate unit of the conditioner.

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**Note** – Instead of a climate system, a heater fan can be installed on your tractor. Control and design of the fan heater is described in the 1221–0000010 RE operating manual supplied with your tractor.

### **2.5 Electric equipment**

Appendix A contains the electric circuit diagram of BELARUS–920.4/952.4/1025.4/1221.4 tractors with a list of components.

### **3 MAINTENANCE**

#### **3.1 Maintenance of tractor**

Kinds of scheduled maintenance, MS procedure, contents of scheduled maintenance operations (MS), as well as names, brands, quantity, intervals of change of fuels and lubricants of BELARUS- 1221.4 tractor chassis are described in the 1221-0000010 RE operating manual supplied with your tractor.

Kinds of scheduled maintenance, MS procedure, contents of scheduled maintenance operations (MS), as well as names, brands, quantity, intervals of change of fuels and lubricants of TCD 2012 L06 2V engines installed on the BELARUS-1221.4 tractors are described in the engine operating manual TD/TCD 2012 L04/06 2V TD/TCD 2013 L04/06 2V RE.

This manual provides only description of operations that, due to differences in the design of BELARUS-1221.4 tractors from the BELARUS-1221.3 models are different from maintenance operations for the BELARUS-1221.3 tractors or are not performed for BELARUS-1221.3.

Before you carry out any maintenance work, remove both sides (Figure 3.1), open, then lock the tractor hood. To have access to the units under the mask, open and lock the tractor mask with the hood closed.

The mask and hood are hinged on supports located on the front frame immediately after the heat exchanger of the engine cooling unit. The fastening of the mask and hood is designed to quickly open them and thus have a quick access to separate units of the tractor.

To remove the left side 4, open two locks 7 on the left side and remove the side 4.

To remove the right side 5, open two locks 7 on the right side and remove the side 5.

To open the hood 3 and lock it open, proceed as follows:

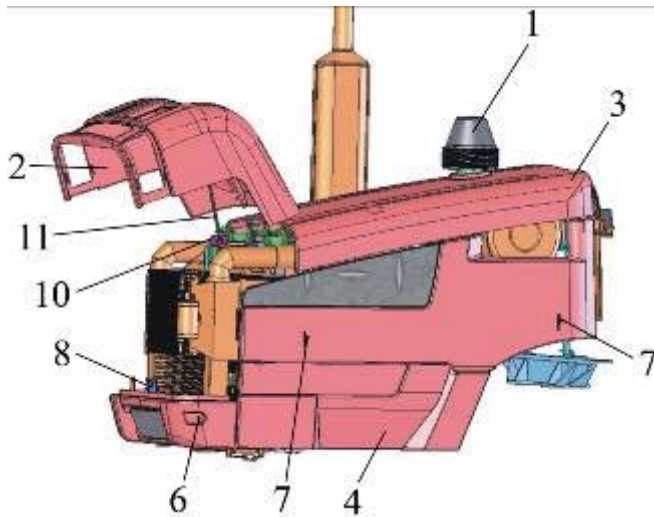
- close the mask 2 if it was open;
- remove the monocyclone 1;
- open the lock 15 by pulling the cable 9;
- take the edge of the hood 3 (near the cab) and open it to the uppermost position;
- lock the hood 3 with the arm 12 in the bracket 13.

To open the mask 2 and lock it raised, proceed as follows:

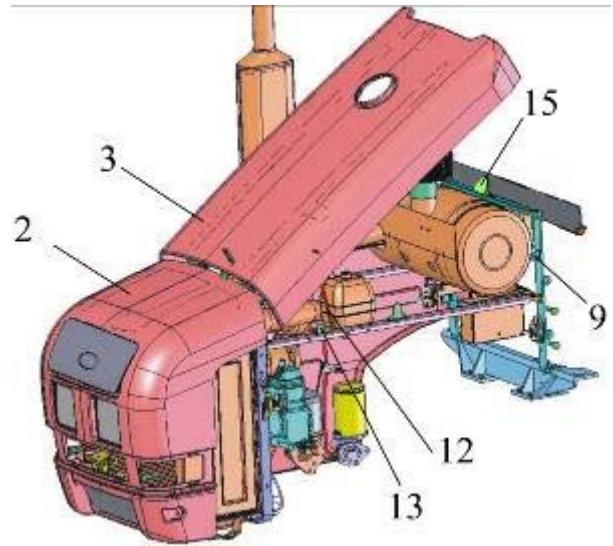
- close the hood 3 if it was open;
- open the lock 8 by pulling the cable 6;
- take the lower edge of the mask 2 and open it to the uppermost position;
- lock the mask 3 with the arm 11 in the bracket 10.

**DO NOT OPEN THE HOOD 3 AND MASK 2 AT THE SAME TIME.**

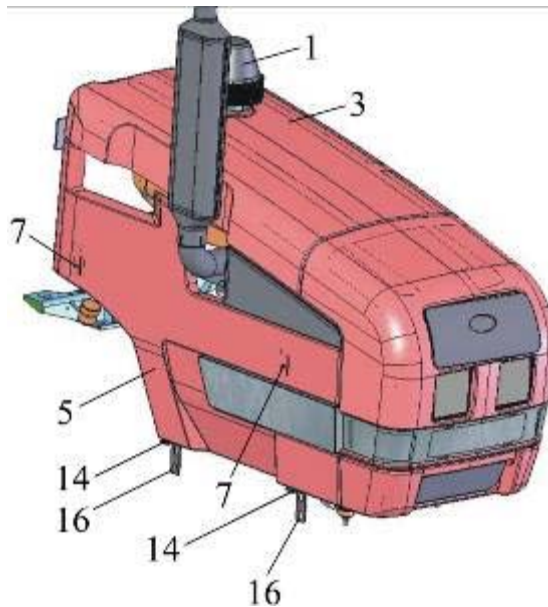
**ATTENTION:** BEFORE YOU START MAINTENANCE WORKS IN THE AREA UNDER THE MASK, MAKE SURE IT IS SECURELY LOCKED OPEN!



Mechanism of locking the mask open



Mechanism of locking the hood open



Mount-dismount of facing sides

1 – monocyclone; 2 – mask; 3 – hood; 4 – left side; 5 – right side; 6 – cable; 7 – lock; 8 – lock; 9 – cable; 10 – bracket; 11 – arm; 12 – arm; 13 – bracket; 14 – latch; 15 – lock.

Figure 3.1 – Mechanism of locking the mask and hood open, mounting-dismounting of facing sides.

To install the sides 4 and 5, proceed as follows:

- install the latches 14 of the sides to the seats on the brackets 16;
- fasten the sides 4, 5 with the locks 7.

To lower and close the hood 3, proceed as follows:

- slightly raise the hood 3 to release the arm 12;
- fasten the arm 12 in the clamp on the hood 3;
- lower the hood 3 to the low position until a distinctive click is heard (the lock 15 engages);
- install the monocyclone 1;

To lower and close the mask 2, proceed as follows:

- slightly raise the mask 2 to release the arm 11;
- fasten the arm 11 in the clamp on the mask;
- lower the mask 2 to the low position until a distinctive click is heard (the lock 8 engages);

**3.2 Maintenance of tractor components**

Table 7 lists maintenance works for the chassis and engine of the BELARUS-1221.4 tractors to be performed additionally to the maintenance works specified in the table of scheduled maintenance of the 1221–0000010 RE and the maintenance schedule given in Section 5 of the TD/TCD 2012 L04/06 2V TD/TCD 2013 L04/06 2V operating manual, as well as works that due to differences in the designs of the BELARUS–1221.4 and BELARUS-1221.3 models are to be performed instead of works specified in the manuals 1221–0000010 RE and TD/TCD 2012 L04/06 2V TD/TCD 2013 L04/06 2V RE

**Notes.**

1. Instead of engine maintenance works 1, 2, 8, 13, 17, 18, 20, 22, 23, 24, 34, 37, 39, 40, 47, 48, 50, 51, 52, 53, 54, 55 as listed in the scheduled maintenance table in Section “Scheduled maintenance” of the 1221-0000010 RE operating manual, perform maintenance works as listed in **Sections 5 Maintenance and 6 Maintenance and service works** of the TD/TCD 2012 L04/06 2V TD/TCD 2013 L04/06 2V RE engine operating manual.

2. Since the BELARUS-1221.4 tractors with the TCD 2012 L06 2V engine are equipped with the 260-1109015-02 air cleaner, instead of maintenance works for air cleaner filter as specified on pages 60, 61, 62 of Section 6 of the TD/TCD 2012 L04/06 2V TD/TCD 2013 L04/06 2V RE engine operating manual, perform the works 12 Checking engine air cleaner and 38 Cleaning engine air cleaner as specified in the scheduled maintenance table of the 1221–0000010 RE operating manual.

3. Since the BELARUS—1221.4 use an air pressure regulator of enhanced design, the work of cleaning the air pressure regulator of the pneumatic system specified in the scheduled maintenance table of the 1221—0000010 RE document is not required to perform.

Table 7 – Maintenance works of BELARUS-1221.4 tractors

No. of work	Operation name	Interval, hours		
		10	125	500
1a	Check fastenings of air conditioner hoses	×		
2a	Check/clean air conditioner condenser	×		
3a	Check/clean conditioner drain pipes	×		
4a	Remove condensate from the tanks of the heat exchanger of the engine charge air cooler (CAC)	×	×	
		winter	summer	
5a	Check / adjust tension of the air conditioner compressor drive.		×	
6a	Check tightening of the bolts fastening the CAC air ducts;			×
7a	Replace filter drain	Each 800 service hours or ones a year		

**Operation 1a. Check fastening of air conditioner hoses**

The conditioner hoses must be securely fastened with tension bands. Do not allow contact of the hoses with tractor's moving parts.

**Operation 2a. Check / clean air conditioner condenser**

Check cleanliness of the air conditioner core. If it is clogged, clean the air conditioner with compressed air. Direct air flow with the hood open perpendicularly to the condenser plane top-down. Straighten folded finning with a special comb or plastic (wooden) plate. In case of severe clogging of the condenser, rinse it with hot water under pressure of 0.15 to 0.2 MPa max and blow with compressed air.

**Operation 3a. Check / clean drain pipes of condensate**

Blue drain pipes are located to the right and left of the heat exchanger pipe under the ceiling panel. Check and, if necessary in order not to allow plugging, clean the drain pipes. A sign of a clean drain pipe is water dripping when the conditioner is working in hot weather.

**Operation 4a. Remove condensate from the tanks of the heat exchanger of the engine charge air cooler (CAC)**

To remove condensate from the tanks of the engine CAC heat exchanger, proceed as follows:

- unscrew two plugs 1 (Figure 3.2) in the lower part of the charged air cooler 2;
- let condensate drain;
- tighten the plugs 1.

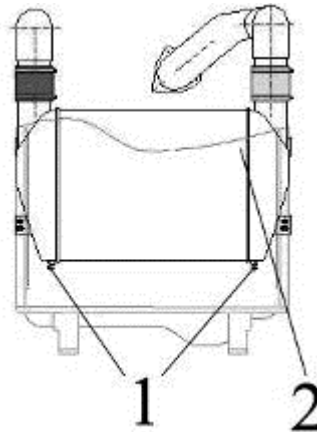


Figure 3.2 – Removal of condensate from the tanks of the engine CAC heat exchanger

**Operation 5a. Check / adjustment of tension of the air conditioner compressor drive belt.**

Check / adjustment of tension of the air conditioner compressor drive belt:  
tension of the belt 1 (Figure 3.3) is deemed normal if deflection of its branch from the crankshaft pulley to the compressor pulley as measured in the middle point is 4 to 6 mm when a force of  $(39.2 \pm 2.0)$  N is applied perpendicularly to the middle part of the branch.



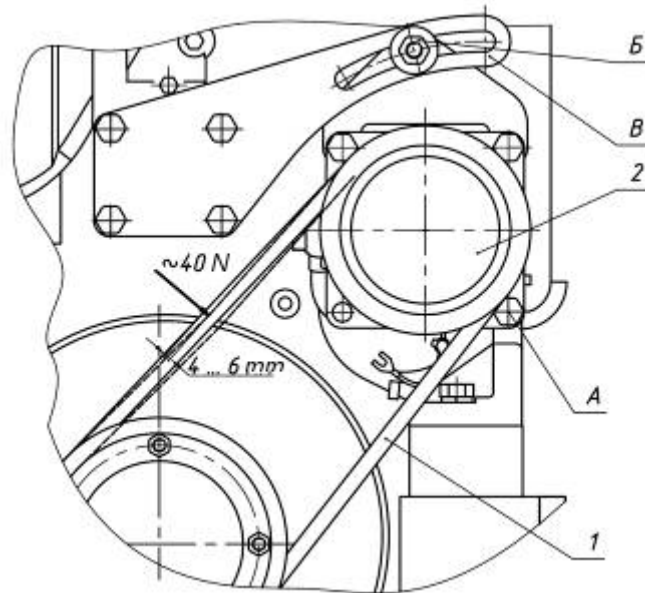


Figure 3.3 — Check / adjustment of tension of the air conditioner compressor drive belt.

Adjustment of tension of the air conditioner compressor drive belt:

adjust tension of the belt 1 of the compressor 2 by turning the compressor 2 (Figure 3.3) around the rotation axis A and tightening the threaded coupling B in the groove of the sector B. After adjustment, the belt deflection from a force of  $(39 \pm 2.0)$  N, applied perpendicularly to the middle part of the branch, must be 4 to 6 mm.

**Operation 6a. Check tightening of the bolts fastening the CAC air ducts**

Check and tighten up if necessary the bolts fastening the CAC air ducts. The tightening torque of the CAC air duct clamps must be 10 to 15 N•m.

**Action 7a. Replacement of filter drain.**

Performed once a year or after 800 service hours.

**ATTENTION:** FOR REPLACEMENT OF FILTER DRAIN, CONTACT A SPECIAL SERVICE STATION. REPLACE ONLY USING SPECIAL EQUIPMENT.

Appendix A  
(informative)

Electric circuit diagram of BELARUS– 920.4/952.4/1025.4/1221.4

Table A.1 lists items of the electric circuit diagram presented in Figure A.1.  
Table A.1

Designation	Name	Qty.	Note
A1	Cassette radio recorder	1	
A2	Spark plug	6	Supplied with engine For 920.4/952.4/1025.4 — 4 pcs.
A3	Tachospeedometer control panel (with CAN)	1	
A4	<u>Air conditioner</u>	1	
A4.1	Air processing unit	1	Supplied with conditioner
A4.1.1	Output air temperature regulator	1	Supplied with conditioner
A4.2	Compressor-condenser unit	1	Supplied with conditioner
A4.3	Pressure sensor unit	1	Supplied with conditioner
M7	Fan electric motor	1	Supplied with conditioner
S1	Fan mode selector	1	Supplied with conditioner
BA1, BA2	Loud speaker	2	Supplied with radio cassette recorder
BN1	Fuel volume sensor	1	
BP1	Pneumatic system air pressure indicator	1	
BP2	Gearbox oil pressure sensor	1	For 1025.4/1221.4
BV1, BV3	Speed sensor	2	
BV2	PTO speed sensor	1	For 1221.4 with PTO speed sensor
E1, E2	Road headlight	2	
E3, E4, E6, E7	Working headlight	4	
E5	Interior lamp	1	
E8	Number plate light	1	

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Designation	Name	Qty.	Note
EL1, EL2	Lamp AKГ12-60+55-1	2	Included into E1, E2
EL3, EL4, EL13, EL14	Lamp AKГ 12-55-1	4	Included into E3, E4, E6, E7
EL5...EL7, EL9, EL10, EL18, EL19	Lamp A12-5	7	Included into HL1...HL5, E8
EL8, EL11, EL12, EL15, EL17, EL20, EL22	Lamp A12-21-3	7	Included into HL4, HL5, E5, HL6,HL7
EL16, EL21	Lamp A12-10	2	Included into HL6, HL7
F1	Fuse block	1	
F2	Fuse block	1	
F3	Fuse block	1	
F4	Fuse block	1	
F5	Fuse block	1	
F6	Fuse block	1	
FU1	Fuse	1	Supplied with radio cassette recorder
FU2, FU3	Fuse link 25 A	2	
G1	Generator	1	Supplied with engine
GB1, GB2	Battery 12V, 120 Ah.	2	For 1221.4
	Battery 12V, 88 Ah.	2	For 920.4/950.4/1025.4
HA1	High-pitch horn	1	
HA2	Low-pitch horn	1	
HA3	Signal switch (buzzer)	1	
HA4	Horn	1	
HG1	Indicator lamp block	1	
HL1...HL3	Road train lamp	3	
HL4, HL5	Front lamp	2	

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Designation	Name	Qty.	Note
HL6, HL7	Rear lamp	2	
HL8	Signal beacon	1	
K1	Spark plug relay switch	1	
K2	Instrumentation power supply relay switch	1	
K3, K4, K7...K10	Normally open relay switch 30A	6	
K5	Normally closed relay switch 20A	1	
K6	Starter relay switch	1	
KH1	Turn indicator breaker	1	
KT1	Spark plug unit	1	
M1	Heater fan	1	
M2	Parallel-motion windshield wiper	1	
M3	Starter	1	Supplied with engine
M4	Electric washer	1	
M5	Rear window wiper	1	
M6	Heater motor	1	
*P1	Indicator integrated with CAN	1	
P2	Instrument clusters (KP-5) with CAN	1	For 920.4/950.4
	Instrument clusters (KP-6) with CAN	1	For Belarus-1025.4/1221A
QS1	Remote battery switch 24V	1	
R1	Ballast resistor	1	
R2	Generator ballast resistor (CAN)	1	
SA1	Roadtrain sign lamp switch	1	
SA2, SA3	Headlight switch	2	
SA4	Fan heater switch	1	
SA5	Windshield wiper switch	1	
SA6	Starter and instrument switch	1	COBO, Italy

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Designation	Name	Qty.	Note
SA7	Understeering combined switch	1	
SA8	Battery switch	1	
SA9	Windshield washer switch	1	
SA10	Central light switch	1	
SA11	Start lock switch VK12-41	1	For 1025.4/1221.4
	Start lock switch VK12-41	1	For 920.4/950.4/1021.4
SA12	Flashing beacon switch	1	
SB1	Emergency stop signaling switch	1	
SB2	Brake light switch	1	
SB3	Parking brake light switch	1	
SP1	Air filter clogging sensor	1	
SP2	Sensor of emergency oil pressure in hydrostatic steering unit	1	
SP3	Sensor of emergency air pressure in pneumatic system	1	
UZ1	Voltage converter	1	
XP1.1, XP116	Single-pin male connector	16	
XP2.1...XP2.7	Two-pin male connector	7	
XP4.1, XP4.2	Four-pin male connector	2	
XP6.1	Six-pin male connector	1	
XS1.1... XS1.20	Single-pin female receptacle	20	
XS2.1...XS2.4, XS2.6...XS2.18	Two-pin female receptacle	18	
XS3.1, XS3.2, XS3.4	Three-pin female receptacle	3	
XS4.1	Four-pin female receptacle	1	
XS5.1, XSS.2, XS5.5...XS2.10	Five-pin female receptacle for relay switch	9	

End of Table A.1

Designation	Name	Qty.	Note
XS6.1, XS6.2	Six-pin female receptacle	2	
XS7.1, XS7.2	Seven-pin female receptacle	2	
XS8.1.. XS8.6. XS8.8	Eight-pin female receptacle for switches	7	
XS8.7	Eight-pin female receptacle	1	
XS9.1...XS9A	Nine-pin female receptacle	4	
XS13.1, XS13.2	13-pin female receptacle	2	
XS2.5	Female receptacle 30-16-06570	1	COBO. Italy
XS3.3	Female receptacle 30-16-06571	1	COBO, Italy
XS5.3	Female receptacle 469.59.00.00	1	AVAR JSC
XS10.1	Male connector1-0967240-1	1	AMP, Germany
	Cylindrical connectors		
XS12.1, XS12.2	Socket IIIС32П12Г-M-7	2	
XS12.3	Socket IIIС32ПК12Г-MT-7	1	
XS15.1	Socket IIIС36У15Г-M-6	1	
XP12.1, XP12.2	Plug IIIС32ПК12Ш-MT-7	2	
XP12.3	Plug IIIС32П12Ш-MT-7	1	
XP15.1	Plug IIIС36ПК15Ш-MT-6	1	
XA9.1	Socket	1	
XT1	Splitting unit	1	
XT2.1, XT2.2	Panel	2	
XT3.1, XT3.2	Panel	2	
WA1	Antenna	1	

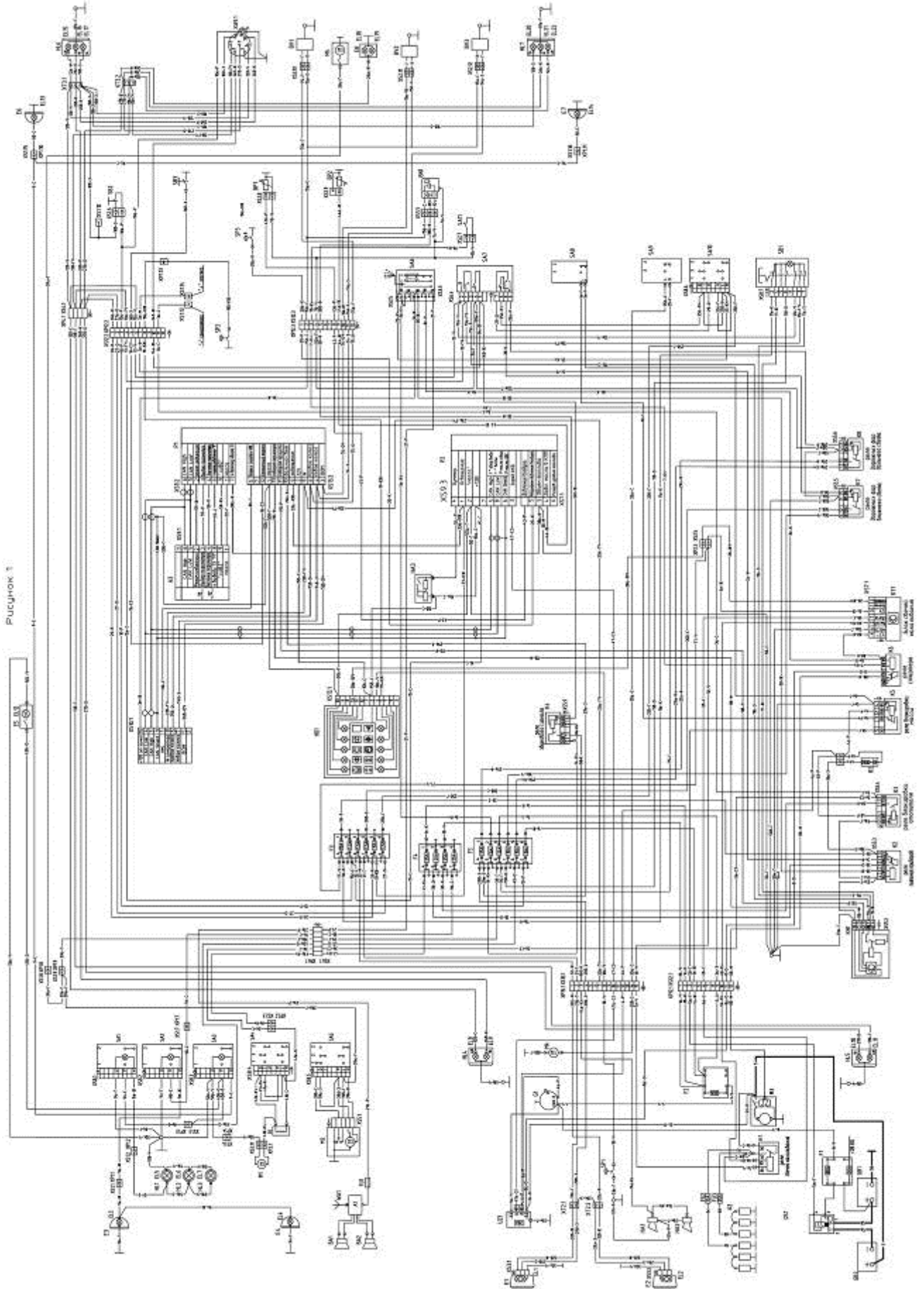
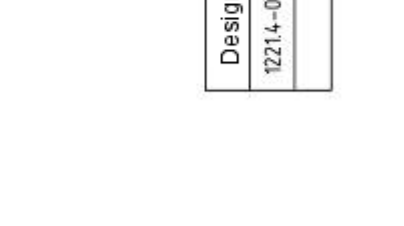
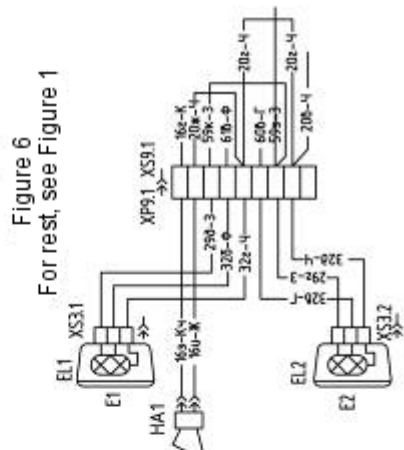
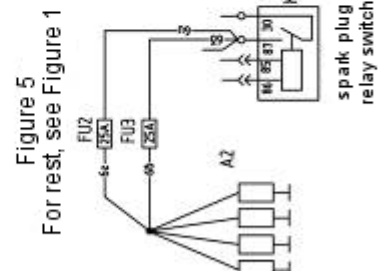
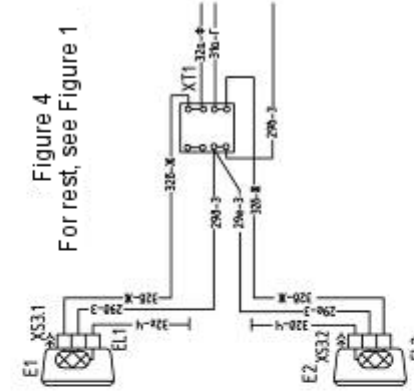
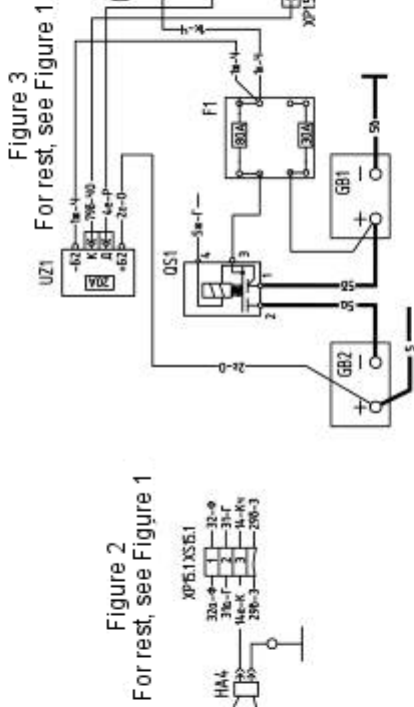
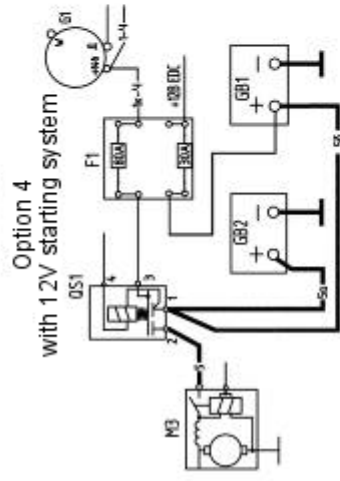
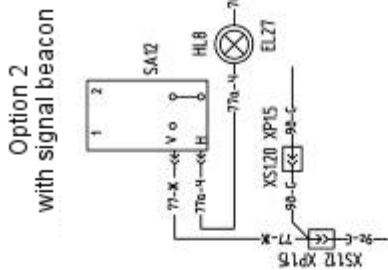
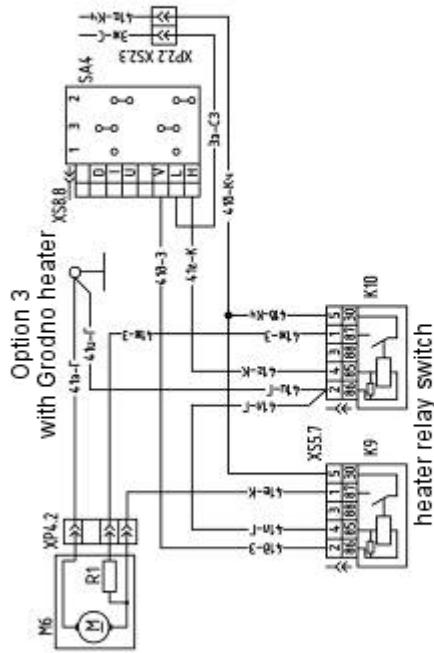
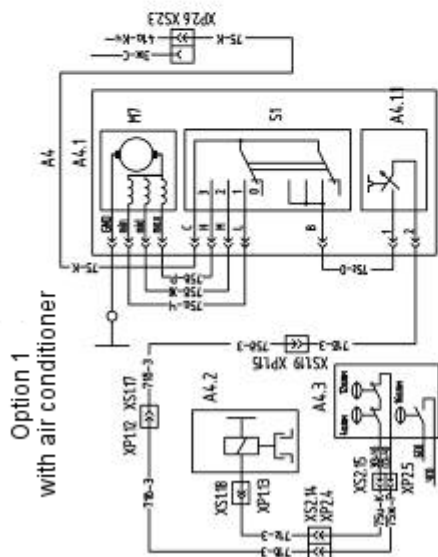


Figure A.1 — Electric circuit diagram of BELARUS— 920.4/952.4/1025.4/1221.4



Designation	Fig.	Note
1221.4-0000010 34	1	For BELARUS-1221.4 tractors with Tr1-1A engine (MMW, DeTz)
-01 2, 3, 4, 5, 6		For BELARUS-500, 4650, 4700S, 4 tractors with Tr1-1A engine (MMW, DeTz)



To Figure A.1:

Wire colors: Г – blue, ГЧ – blue/black, Ж – yellow, ЖЗ – yellow/green, З – green, К – red, КЖ – red/yellow, Кч – brown, О - orange, Р – pink, С – grey, СЗ – grey/green, Ф – violet, Ч – black, ЧО – black/orange.

Figure A.2 presents the electric circuit diagram of connections for additional front headlights installed on brackets of front lights.

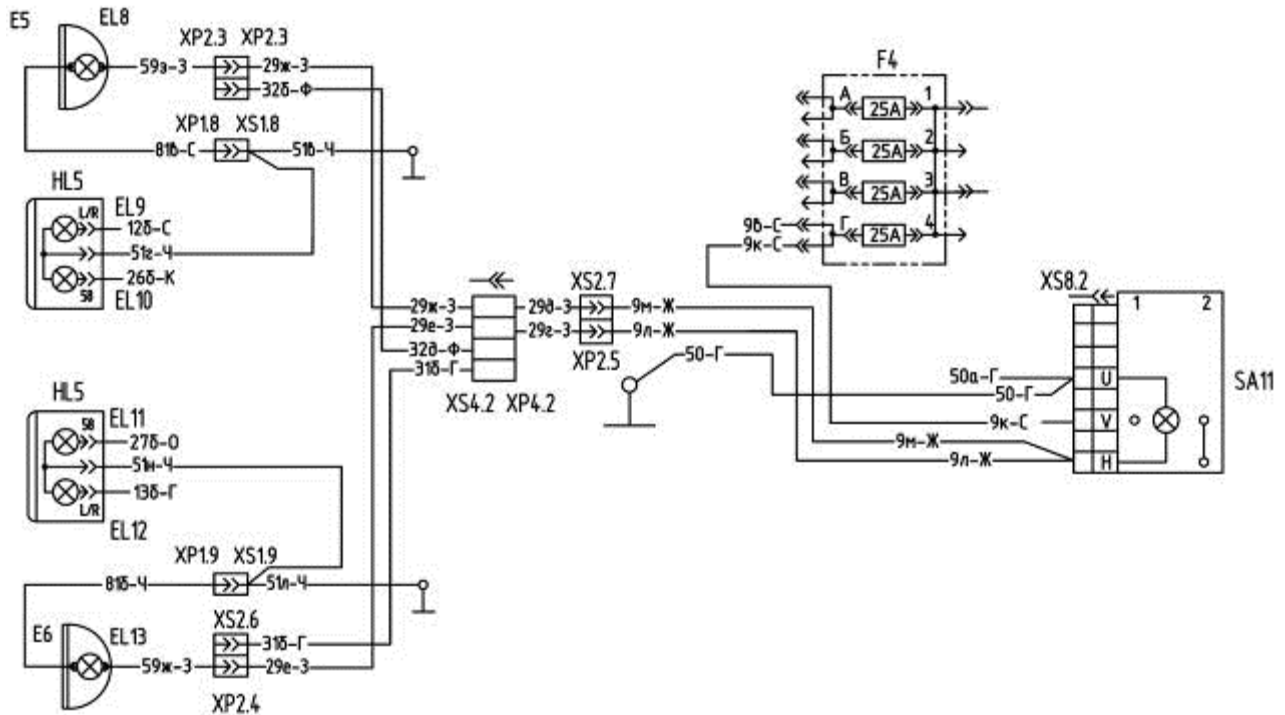


Figure A.2 – Electric circuit diagram of connections for additional front headlights

To Figure A.2:

E5, E6 – headlight;

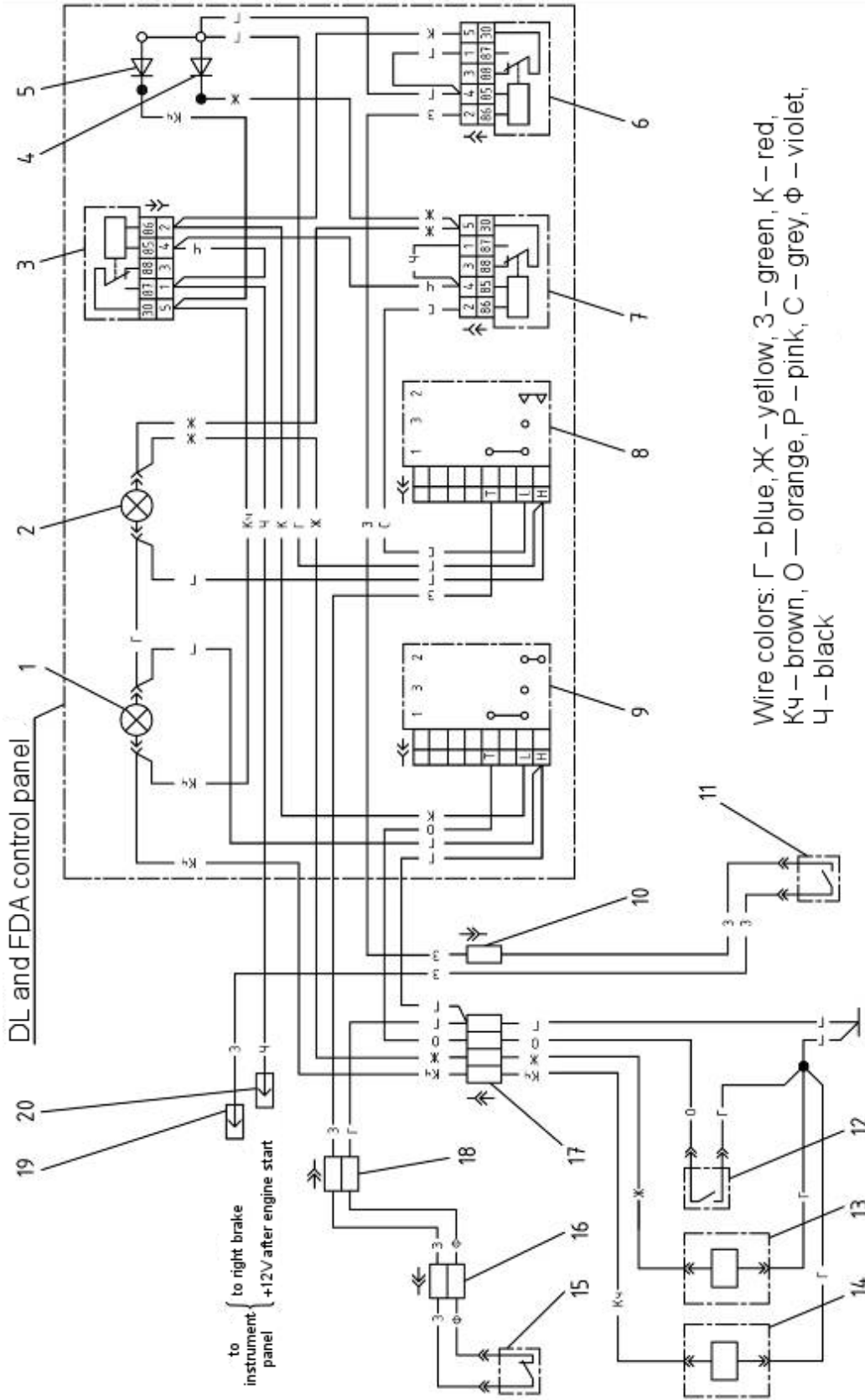
EL8, EL13 – АКГ12-55-1 lamp;

SA11 – headlight switch;

**Note** – Other items of the diagram in Figure A.2. are listed in Table A.1.

Appendix B  
(informative)

Figure B.1 shows the Electric circuit diagram of rear axle DL and FDA drive control system of BELARUS – 1221.4 tractors with an item list.



1 - FDA drive engagement pilot lamp; 2 - DL engagement pilot lamp; 3 - FDA drive relay switch; 4,5 - diodes; 6 - brake relay switch; 7 - DL relay switch; 8 - three-position DL control switch; 9 - FDA three-position control switch; 10, 16, 17, 18, 19, 20 - connecting sockets; 11 - left brake sensor; 12 - FDA drive automatic control sensor; 13 - DL hydraulic control valve solenoid; 14 - FDA hydraulic control valve solenoid; 15 - front wheel turn angle sensor ±P13° (for DL).

Figure B.1 – Electric circuit diagram of rear axle DL and FDA drive control system