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**WIRING CONDUCTORS WITH FIBROUS  
OR FILM AND PVC INSULATION**

**TECHNICAL SPECIFICATIONS**

**TY 16-505.437-82**

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Continuation of title sheet  
Technical Specifications  
TY 16-505.437-82  
(SUPERCEDES TY 16-505.437-73)

Original inventory no.	Sign and date	Replaced inventory no.	Inventory no.dupl.	Sign and date

Present technical specifications pertain to wiring conductors with fibrous or film and PVC insulation (hereafter named as “conductors”). Conductors are meant for intra-device and inter-device wiring of electrical equipments at voltage upto 380V for gauges 0.08 - 0.14 mm<sup>2</sup> and 1000V for gauges 0.2 – 1.5mm<sup>2</sup> AC frequency upto 10000Hz or 500 and 1500V Dc, respectively, and in the interval of working temperatures from minus 50 to plus 70°C.

Present technical specifications are the addition and improvement of general technical specifications OST 16 0.800.365-76 (hereafter named as OTY).

Numbering of sections and sub-sections, used in the present technical specifications, corresponds to the numbering of sections and sub-sections of OTY.

List of documents, for which references are given in the present technical specifications, is mentioned in appendix 1.

Example for writing the conductor of grade MГIIIB having gauge 0.5mm<sup>2</sup>, insulated by two layers of silk and PVC plasticator of red color, at the time of its indentation and in the documents of other article:

“Conductor MГIIIB 0.5 K TY 16-505.437-82”.

### 1. GRADES AND BASIC PARAMETERS

#### 1.1 Conductors are manufactured in grades:

MIIIB – wiring conductor with fibrous and PVC insulation;

MГIIIB – do -, flexible;

Sign and date						TY 16-505.437-82				
	Amend.	Sheet	Document no.	Sign.	Date					
Original inventory no.	Develop. by					Wiring conductors with fibrous or film and pvc insulation  Technical specifications	Type	Sheet	Sheets	
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	Chief designer						The firm Post box No. A-1470			

МГШБЭ – flexible wiring conductor with fibrous and PVC insulation, screened;

МГШБЭВ – do -, in PVC sheath;

МШБ-1 – wiring conductor with film and PVC insulation;

МГШБ-1 – do -, flexible;

МГШБЭ-1 - flexible wiring conductor with film and PVC insulation, screened.

“0” is put after hyphen in the grade of conductors МШБ, МГШБ, МГШБЭ, manufactured on special order.

- 1.2 Design dimensions and nominal weight of conductors must conform to the values, mentioned in table 1.

Table 1

With film insulation	Nominal gauge, mm <sup>2</sup>	External diameter of conductor, mm			Nominal weight of conductor for 1 km length	
		Minimum	Maximum		With fibrous insulation	With film insulation
			With fibrous insulation	With film insulation		
МШБ,	0,08	0,7	1,0	-	1,6	-
МШБ-1	0,20	1,1	1,6	-	3,9	-
	0,35	1,4	1,9	1,8	5,7	5,3
	0,50	1,6	2,0	1,9	7,5	7,0
	0,75	1,8	2,3	2,2	10,4	10,1
	1,0	2,0	2,5	2,4	12,0	11,7
	1,5	2,2	2,7	2,5	18,0	17,5

Sign and date							
Inventory no.dupl.							
Replaced inventory no.							
Sign and date							
Original inventory no.							Sheet
							4
Amend.	Sheet	Document no.	Sign.	Date	TY 16-505.437-82		

Continuation of table 1

With film insulation	Nominal gauge, mm <sup>2</sup>	External diameter of conductor, mm			Nominal weight of conductor for 1 km length	
		Minimum	Maximum		With fibrous insulation	With film insulation
			With fibrous insulation	With film insulation		
<b>МГЛБ,</b>	0,12	0,9	1,3	-	2,3	-
<b>МГЛБ-1</b>	0,14	0,9	1,4	-	2,5	-
	0,20	1,2	1,6	-	3,9	-
	0,35	1,4	1,9	1,8	5,9	5,5
	0,50	1,7	2,2	2,1	7,9	7,5
	0,75	2,0	2,5	2,3	11,4	10,9
	1,0	2,2	2,8	2,6	14,1	13,6
	1,5	2,4	3,0	2,8	19,8	19,1
<b>МГЛБЗ,</b>	0,12	-	1,9	-	8,3	-
<b>МГЛБЗ-1</b>	0,14	-	2,0	-	9,0	-
	0,20	-	2,2	-	10,3	-
	0,35	-	2,5	2,4	14,9	14,4
	0,50	-	2,8	2,7	17,5	16,9
	0,75	-	3,3	3,2	23,5	22,8
	2x0,35	-	4,6	4,3	29,4	27,5
	2x0,50	-	5,2	4,9	35,5	33,5
	2x0,75	-	5,8	5,4	46,3	43,2
	3x0,35	-	4,9	4,6	36,3	34,2
	3x0,50	-	5,4	5,1	44,8	42,3
	3x0,75	-	6,8	5,9	59,1	55,2

Sign and date	
Inventory no. dupl.	
Replaced inventory no.	
Sign and date	
Original inventory	

TY 16-505.437-82

Sheet

5

With film insulation	Nominal gauge, mm <sup>2</sup>	External diameter of conductor, mm			Nominal weight of conductor for 1 km length	
		Minimum	Maximum		With fibrous insulation	With film insulation
			With fibrous insulation	With film insulation		
<b>MTBBSB</b>	<b>0,12</b>	<b>-</b>	<b>2,9</b>	<b>-</b>	<b>14,0</b>	<b>-</b>
	<b>0,14</b>	<b>-</b>	<b>3,0</b>	<b>-</b>	<b>14,2</b>	<b>-</b>
	<b>0,35</b>	<b>-</b>	<b>3,5</b>	<b>-</b>	<b>22,3</b>	<b>-</b>

Note. 1. Nominal weight of conductors is mentioned as reference material.

1.3 Face-to-face length of conductors must not be less than 50m. Conductors may be supplied with length not less than 5m in a quantity not more than 30% the total length of batch being supplied. As per the agreement between the sides, conductors may be supplied of any length.

## 2. TECHNICAL REQUIREMENTS

2.1 Technical requirements – as per OTY with additions and improvements, mentioned in present section.

Positions, mentioned in points 2.4.1, 2.6.11, 2.7.4 of OTY do not apply to the conductors, being supplied as per present technical specifications, and in points 2.2.1, 2.2.3 – 2.2.8, 2.2.9, 2.3.1 – 2.3.3, 2.5.1, 2.6.1 – 2.6.4, 2.6.6 – 2.6.10, 2.7.1 – 2.7.3, 2.8.1 – 2.8.4 of OTY are improved in the present technical specifications.

Sign and date							
Inventory no.dupl.							
Replaced inventory no.							
Sign and date							
Original inventory no.							
							Sheet
						TY 16-505.437-82	
							6
Amend.	Sheet	Document no.	Sign.	Date			

2.2 *Design Requirements*

2.2.1 For point 2.2.1 of IIITY. Conducting cores must be manufactured from copper wires, tinned with tin-lead solder having nominal content of tin 61%.

Design of cores must conform to the one as mentioned in table 2.

2.2.2 For point 2.2.2 of OTY. Insulation of current conducting core must be done by the winding with two layers of silk, superposed on the core in mutually opposite directions or film and PVC plasticator. Nominal and minimum thickness of PVC insulation must conform to the ones as mentioned in table 2.

Table 2

Nominal gauge of cores, mm <sup>2</sup>	Design of cores		Thickness of insulation, mm	
	Number and nominal diameter of wire, mm		Nominal	Minimum
	Cores of conductor МШВ, МШВ-1	Cores of conductor МГШВ, МГШВ-1, МГШВЭ, МГШВЭ-1, МГШВЭВ		
0,08	1x0,32	-	0,20	0,1
0,12	-	7x0,15	0,20	0,1
0,14	-	18x0,10	0,20	0,1
0.20	1x0,52	7x0,20	0,30	0,2
0.35	1x0,68	19x0,15	0,40	0,25
0.5	1x0,80	16x0,20	0,40	0,3
0.75	1x0,97	24x0,20	0,45	0,3
1.0	1x1,13	32x0,20	0,45	0,3
0.5	1x1,33	19x0,32	0,45	0,3

Sign and date	
Inventory no.dupl.	
Replaced inventory no.	
Sign and date	
Original inventory no.	

					TY 16-505.437-82	Sheet
						7
Amend.	Sheet	Document no.	Sign.	Date		

2.2.3 For point 2.2.4 and point 2.2.8 of OTY. Coloring of insulation and sheath must be uniform. Colors used for coloring must conform to table 6 of OTY.

2.2.4 For point 2.2.5 of OTY. Pitch of strand of two and three core screened conductors must not be more than 90mm.

2.2.5 For point 2.2.6 of OTY. Screened braid, superposed on one, two parallelly laid or twisted or three insulated cores, must be executed from copper wires tinned by tin-lead solder having nominal content of solder 61%, with nominal diameter not more than 0.15mm.

2.2.6 For point 2.2.7 of OTY. Sheath made from PVC plasticator must be superposed on the screen of conductor of grade МГШБЭВ.

2.2.7 For point 2.2.9 of OTY. The materials, being used for manufacturing of conductors, must conform to:

tinned copper wire	- TY 16-505.850-75;
Tin-lead solder	- GOST 21930-76; - GOST 21931-76;
Lavsan silk	- OST 6-06-03-75;
Triacetate silk	- TY 6-06-03-75;
Polyethyleneterphthalate film	- TY 6 – 05-1794-76;
PVC plasticator of grade И40-14 or И40-13A for insulation and И045-12 for sheath	- GOST 5960-72

Other materials may be used as per the agreement with the designer firm.

2.3 Requirements for electrical parameters.

2.3.1 For point 2.3.1 of OTY. Electrical resistance of current conducting cores to DC, evaluated for 1 km length and temperature 20°C, must correspond to:  
at the time of acceptance and supply – GOST 22483-77 (for gauge 0.14mm<sup>2</sup> – not more than 140Ohm);

Sign and date							
Inventory no.dupl.							
Replaced inventory no.							
Sign and date							
Original inventory no.							
							Sheet
						TY 16-505.437-82	
							8
Amend.	Sheet	Document no.	Sign.	Date			



during the period of operation and storage – may be increased by 10% the norms for the period of acceptance and supply.

2.3.2 For point 2.3.2 of OTY. Conductors must withstand for 1 minute the test by AC having frequency 50 Hz:

a) at the time of acceptance and supply – 800V for the gauges 0.08 – 0.14 mm<sup>2</sup>;

- do - - 2000V – do - 0.20 – 1.5 mm<sup>2</sup>;

б) for the period of operation and storage – 600V for gauges 0.8 - .14 mm<sup>2</sup>;

- do - - 1500V – do - 0.20 – 1.5 mm<sup>2</sup>.

2.3.3 For point 2.3.3 of OTY. Electrical resistance of insulation, evaluated for 1m length, must not be less than, Mohm:

a) in normal climatic conditions, evaluated for temperature 20°C:

- at the time of acceptance and supply - 20000;

- for the period of operation and storage - 1000;

б) at the temperature 70°C - 1000.

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2.5 Requirements for resistivity during the effect of mechanical loads.

2.5.1 For point 2.5.1 of OTY. Conductors must be resistant to the following mechanical loads:

a) vibration loads with frequency upto 5000Hz having acceleration upto 392 m/s<sup>2</sup>;

б) multiple impacts with acceleration upto 9610 m/s<sup>2</sup>;

в) single impacts with acceleration upto 4905m/s<sup>2</sup>;

д) acoustic noises of frequency upto 10000Hz at the level of sound pressure upto 160dB.

2.5.2 Conductors must be resistant to the effect of vibration load of frequency (100±10) Hz having amplitude (0.5 – 1)mm at temperature minus 50°C.

Sign and date						
Inventory no.dupl.						
Replaced inventory no.						
Sign and date						
Original inventory no.						Sheet 9
					TY 16-505.437-82	
	Amend.	Sheet	Document no.	Sign.	Date	

2.6 Requirement for resistivity during climatic effects

2.6.1 For point 2.6.1 of OTY. Conductors must be resistant to the effect of maximum temperature during operation 70°C.

2.6.2 For point 2.6.2 of OTY. Conductors must be resistant to momentary effect of following temperatures:

- a) 100°C for 96 hours;
- б) 130°C for 5 minutes;
- в) 150°C for 10 minutes (without repetitive usage).

2.6.3 For point 2.6.3 of OTY. Conductors must be resistant to the effect of decreased temperature upto minus 50°C.

2.6.4 For point 2.6.4 of OTY. Conductors must be resistant to the effect of change in temperatures from minus 50°C to plus 100°C.

2.6.5 For point 2.6.6 of OTY. Conductors must be resistant to the effect of decreased atmospheric pressure 0.00013 Pa for 24 hours.

2.6.6 For point 2.6.7 of OTY. Conductors must be resistant to the effect of pressure upto 295 KPa.

2.6.7 For point 2.6.8 of OTY. Conductors must be resistant to the effect of solar radiations.

2.6.8 For point 2.6.9 of OTY. Conductors must be resistant to dynamic effect of dust.

2.6.9 For point 2.6.10 of OTY. Unscreened conductors must be resistant to damage by fungus mold.

2.7 Requirements for resistivity during special effects.

2.7.1 For point 2.7.1 of OTY. Conductors must be resistant to the effect of factors, mentioned for group III of articles of standard HO.005.058 (table 1 point 2), at the same time the electrical parameters must be within the following limits:

	Sign and date					
	Inventory no. dupl.					
	Replaced inventory no.					
	Sign and date					
Original inventory no.						Sheet
					TY 16-505.437-82	10
	Amend.	Sheet	Document no.	Sign.	Date	

resistance of insulation not less than 100Mohm for 1mm;  
 test voltage – 500V AC frequency 50Hz for 1 minute.

- 2.7.2 For point 2.7.2 of OTY. Conductors must be resistant to the effect of corrosive mediums (gasoline, mineral oils and saline water).
- 2.7.3 For point 2.7.3 of OTY. Conductors must not spread burning.
- 2.7.4 Conductors must be resistant to the effect factors, mentioned in PTM-75. At the same time the circuit and design of wiring of conductors in the object must ensure the value of pulse voltage on the electrical insulation of conductor not more than 0.3KW for gauges 0.08 – 0.14 mm<sup>2</sup> and 0.7 KW for gauges 0.2 – 1.5 mm<sup>2</sup>.
- 2.7.5 Conductors with index “0” must be resistant to the effect of vapors of amyl and heptyl, whose contents in the air must not exceed the sanitary norms (not more than 0.005 mg/liter for amyl, not more than 0.0001 mg/liter for heptyl). Total duration of stay of cables in the mediums must not be more than 6 months.

2.8 Requirements for reliability

- 2.8.1 For point 2.8.1 of OTY. Minimum operating time of conductors in the modes and conditions, permissible in present technical specifications, must be 10000 hours.
- 2.8.2 For point 2.8.2 of OTY. Presevability period of conductors during storage in heated ware houses, in the container of supplier and mounted in the apparatus, and also in SPTA set, must not be less than 12 years. Under the shed out of this period (as a part of apparatus and SPTA set) not less than 5 years.
- 2.8.3 For point 2.8.3 of OTY. Service life of conductors, within whose limits operating time is ensured (point 2.8.1) and preservability (point 2.8.2), must be 12 years.
- 2.8.4 For point 2.8.4 of OTY. 95% service life of conductors is specified in referential data of appendix 2.

Sign and date						TY 16-505.437-82	Sheet
Inventory no.dupl.							11
Replaced inventory no.							
Sign and date							
Original inventory no.							
	Amend.	Sheet	Document no.	Sign.	Date		

### 3. QUALITY CONTROL

3.1 Requirements for quality assurance and control in the process of production

3.1.1 Quality control in the process of production – as per OTY.

3.1.2 Acceptance rules

3.2.1 Acceptance rules – as per OTY. Points 3.2.2, 3.2.3, 3.2.5 of OTY are improved by the present technical specifications, and point 3.2.6 of OTY is exclude.

3.2.2 For point 3.2.2 of OTY. Scope and sequence for conduction of qualification tests are established in schedule, developed for this purpose.

3.2.3 For point 3.2.3 of OTY. Maximum size of the batch must be 20 km.

3.2.4 For point 3.2.5 of OTY. While checking the samples, selected for periodic tests, in the scope of acceptance tests at the most 1 defective sample may be replaced. Tests as per points 2.7.4, 2.8.1 from table 13 are excluded.

3.2.5 Tests for confirming the operating time are conducted in conformity with PTM 16 800.850-81 once in 6 months.

### 4. TEST METHODS

4.1 Test methods – as per OTY with additions and improvements, described in the present section.

Positions, mentioned in points 4.4.1, 4.6.1, 4.6.11, 4.7.4, 4.8.1, 4.8.2 of OTY do not apply to the conductors, being supplied as per present technical specifications, and in points 4.32, 4.3.3, 4.3.3, 4.5.1, 4.5.5, 4.6.2 – 4.6.7, 4.6.9, 4.7.2, 4.8.3 of OTY are improved in the present technical specifications

Sign and date						
Inventory no.dupl.						
Replaced inventory no.						
Sign and date						
Original inventory no.						Sheet
					TY 16-505.437-82	12
Amend.	Sheet	Document no.	Sign.	Date		

4.3.1 For point 4.3.2 of OTY. Voltage tests of unscreened conductors is carried out on face-to-face lengths in water after holding in it for at least 1 hour.

4.3.2 For point 4.3.3 of OTY. Determination of electrical resistance of insulation in normal climatic conditions (point 2.3, 3a) of unscreened conductors is carried out after holding in water for at least 1 hour.

Determination of electrical resistance of insulation at temperature 70°C (point 2.3.36) is carried out on the samples having length 3m, winded on metallic cylinder of diameter 50±5 mm in 10 winds. After holding the samples in heat chamber for 4 hours, carry out the test for conformity to the requirements of point 2.3.36.

4.5 Checking for conformity to the requirements for resistivity during mechanical effects.

4.5.1 For point 4.5.1 of OTY. Samples are winded of metallic cylinder of diameter 10mm. Duration of effect of vibration 3 hours.

4.5.2 For point 4.5.5 of OTY. Internal diameter of coils must not be less than 10 external diameters of conductor.

4.5.3 Test for conformity to the requirements of point 2.5.2 is carried out on samples having length 0.65m. Samples are fastened on the table of vibration stand after 100 – 200 mm and placed for 1 hour in the cold chamber having temperature (50±2)°C. After 30 minutes of vibration at frequency (100±10)Hz with amplitude 0.5 – 1.0mm at specified temperature the insulation must not have cracks and ruptures, visible naked eye.

After checking the external view the samples are subjected to test by voltage (point 2.3.26).

4.6 Checking for conformity to the requirements for resistivity during climatic effects.

4.6.1 Resistivity to the effect of temperature 70°C is confirmed during tests as per point 4.6.2 of present technical specifications.

Sign and date						
Inventory no.dupl.						
Replaced inventory no.						
Sign and date						
Original inventory no.						Sheet
						TY 16-505.437-82
						13
	Amend.	Sheet	Document no.	Sign.	Date	

4.6.2 For point 4.6.2 of OTY. Test for conformity to the requirements of point 2.6.2 is carried out on different samples before superposing the screen as per following methods:

4.6.2.1 Samples having length 0.65 m in straightened state are placed in hot chamber and maintained at temperature  $(100 \pm 5)^{\circ}\text{C}$  for 96 hours.

After hot chamber the samples are maintained in normal climatic conditions for at least 1 hour and winded on metallic cylinder of diameter 15mm. After straightening of sample, on its surface there must not be cracks, visible by naked eye.

4.6.2.2 samples of length 0.3m are twisted in 4 turns at length appx. 50mm and immersed in paraffin at temperature  $(130 \pm 5)^{\circ}\text{C}$  for 5 minutes. After removal from paraffin and holding the sample in normal climatic conditions for 1 hour, the conductor is straightened. In doing so, there must not be mashing of insulation or cracks on its surface, visible by naked eye.

4.6.2.3 Tests are carried out on the samples of length 0.65m.

a) sample in straightened state is placed between two parallel metallic rods of diameter 2mm, perpendicular to the sample, loaded with weight 100g and placed in hot chamber at temperature  $(100 \pm 5)^{\circ}\text{C}$  for 1 hour.

After hot chamber the sample is freed from the effect of weight and immersed in water having temperature  $15 - 25^{\circ}\text{C}$  with revealed ends above the water surface by 50 – 60mm.

Samples are considered to have withstood the test, if they withstand the voltage test (point 2.3.2 б), applied between core of conductor and water;

б) Sample, bent in the form of loop, is placed between two parallel metallic rods having diameter 2mm, perpendicular to the sample, load with weight 88g and 400 g for conductors with film insulation and place in hot chamber with temperature  $(150 \pm ??)^{\circ}\text{C}$ .

Sign and date						TY 16-505.437-82	Sheet
Inventory no.dupl.							14
Replaced inventory no.							
Sign and date							
Original inventory no.							
	Amend.	Sheet	Document no.	Sign.	Date		

After holding in hot chamber for 10 minutes, apply a voltage 250V AC between the core of conductor and metallic cylinders, without removing the load from the sample.

4.6.3 For point 4.6.3 of OTY. Test for conformity to the requirements of point 2.6.3 is carried out on the samples of length 0.65mm before superposing the screen as per below stated methods:

a) samples are wound in coils on metallic cylinder having diameter, equal to 20 diameters of conductor and maintained in cold chamber at temperature minus  $(50\pm 2)^{\circ}\text{C}$  for 3 hours.

After the effect of cold the samples are maintained in normal climatic conditions for 30 minutes, then remove and repetitively wound on the same cylinder. At the same time there must not be cracks on the surface of samples that may be visible by naked eye;

б) samples in straightened state are held in cold chamber at temperature minus  $(50\pm 2)^{\circ}\text{C}$  for 2 hours. At the end of keeping in these conditions the samples are smoothly bent by  $180^{\circ}\text{C}$  on the cylinder having radius equal to 20 diameters of conductor. In doing so there must not be cracks on the surface of samples that may be visible by naked eye;

4.6.4 For point 4.6.4 of OTY. Test for conformity to the requirements of point 2.6.4 is carried out on samples of length 2m before superposing the screen, wound on metallic cylinder of diameter 25 – 30mm. Samples are subjected to 5 cycles of effect of temperature from plus  $100^{\circ}\text{C}$  to minus  $50^{\circ}\text{C}$  ( 6 times – plus  $100\pm 5)^{\circ}\text{C}$  and five times – minus  $(50\pm 2)^{\circ}\text{C}$ . Each cycle (heating, cooling) is continued for 1 hour.

After the effect of temperature cycles the samples are maintained in normal climatic conditions for at least 1 hour. Samples are considered to have withstood the test, if electrical resistance of insulation, evaluated for length 1 m and temperature  $20^{\circ}\text{C}$  is not less than 10000 MOhm and they withstand the voltage test (point 2.3.2 б).

4.6.5 For point 4.6.5 of OTY. Internal diameter of coils or diameter of cylinders must not be less than 10 diameters of conductor. Conductors are considered to have withstood the test, if electrical resistance of insulation of samples corresponds to the requirement of point 2.3.3a (for the period of operation and storage).

Sign and date						Sheet  TY 16-505.437-82  15
Inventory no. dupl.						
Replaced inventory no.						
Sign and date						
Original inventory no.						
Amend.	Sheet	Document no.	Sign.	Date		

4.6.6 For point 4.6.6 of OTY. Samples are bundled into coils with internal diameter not less than 10 diameters of conductor. Time for holding in pressure chamber is 24 hours.

4.6.7 For point 4.6.7 of OTY. Samples are bundled into coils with internal diameter not less than 10 diameters of conductor. Time for holding in pressure chamber is 24 hours.

4.6.8 For point 4.6.9 of OTY. Samples are bundled into coils with internal diameter not less than 10 diameters of conductor.

4.7 Checking for conformity to the requirements for resistivity during special factors.

4.7.1 For point 4.7.2 of OTY. Samples are winded into spirals having radius not less than 10mm.

4.7.2 Checking for conformity to the requirements of point 2.7.4, 2.7.5 must be carried out as per the schedule, agreed in established order.

4.8 Checking for conformity to the requirements for reliability.

4.8.1 Tests for confirming the operating time are carried out as per PTM 16 800.850-81 on 5 samples of conductor of each grade.

Time between the heating and weighing must not exceed 5 minutes. As a result of weighing, for each grade of conductor determine the arithmetic mean  $\Delta b_{ncx}$ .

Operating time, mentioned in point 2.8.1, is considered to be confirmed, if value of  $\Delta b_{ncx}$  in each grade of conductor exceeds 72%.

4.8.2 For point 4.8.3 of OTY. Values of electrical parameters during periodic checks and in the end of tests for preservability must conform to the norms for the period of operation and storage.

Sign and date						TY 16-505.437-82	Sheet
Inventory no.dupl.							16
Replaced inventory no.							
Sign and date							
Original inventory no.							
	Amend.	Sheet	Document no.	Sign.	Date		



5. PACKING, MARKING, TRANSPORTATION AND STORAGE

- 5.1 Packing, marking, transportation and storage – as per OTY.
- 5.2 Conductors must be supplied in bundles. One bundle may have not more than 3 pieces of the same grade, gauge and color.  
Many bundles of same grade, gauge and color may be packed in common package.
- 5.3 The label, glued to the bundle (package), must indicate:  
trade mark of the manufacturing firm;  
grade of conductor;  
gauge in square millimeters;  
length in meters;  
delivery date (month, year);  
designation of present technical specifications;  
QAD stamp;  
Stamp of customer’s representative;

6. OPERATING INSTRUCTIONS

- 6.1 Conductors with distinctive index “0” are installed permanently:  
in major unheated premises;  
on movable units, and also in the open air, protected from direct effect of solar radiation and atmospheric settlings, at the same time the working voltage must not exceed 380V and indirect mechanical effects on the conductors in the process of production must not exist.

Sign and date						
Inventory no. dupl.						
Replaced inventory no.						
Sign and date						
Original inventory no.						Sheet
					TY 16-505.437-82	17
Amend.	Sheet	Document no.	Sign.	Date		

6.2 Conductors with index “0” must meet the following requirements:

- a) ambient temperature from minus 50 to plus 50°C, relative humidity of air upto 98% at temperature 35°C;
- б) time for stay of conductors in the operating conditions under current load must not be more than 50% the operating period.

7. MANUFACTURER’S GUARANTEE

7.1 Guarantee of the supplier – as per OTY.

Sign and date							
Inventory no.dupl.							
Replaced inventory no.							
Sign and date							
Original inventory no.							
							Sheet
							18
	Amend.	Sheet	Document no.	Sign.	Date		
						TY 16-505.437-82	

## LIST

of documents, for which references are given in the present technical specifications.

Document Designation	Name of document
GOST 5960-72	PVC plasticator for insulation and protective sheaths of conductors and cables.
GOST 21930-76	Tin-lead solder in ingots. Technical specifications.
GOST 21931-76	Tin-lead solder in articles. Technical specifications.
GOST 22483-77	Copper and aluminum current conducting cores for cables, conductors and cords. Design and dimensions. Technical requirements.
OST 6-06-03-75	Lavson thread for cable industry.
OST 16 0.800.365-76	Wiring conductors. General technical specifications.
TY 6-05-1794-76	Electro-insulating polyethyleneterphthalate film.
TY 6-06-483-75	Triacetate thread for cable industry.
TY 16-505.850-75	Tinned round copper wire for electrical circuits.
PTM 16 800.850-81	Methodology for determining the longevity and preservability of cables and conductors with PVC insulation (sheath).

Original inventory no.	Amend.	Sheet	Document no.	Sign.	Date	TY 16-505.437-82	Sheet
							19
Sign and date							
Replaced inventory no.							
Inventory no.dupl.							
Sign and date							

REFERENTIAL DATA

95% service-life of conductors is 15000 hours.

Original inventory no.	Amend.	Sheet	Document no.	Sign.	Date	TY 16-505.437-82	Sheet
							20
Sign and date							
Replaced inventory no.							
Inventory no.dupl.							
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