



## FOREIGN EXPERIENCE IN CREATING ELECTRIC ROLLING STOCK WITH ASYNCHRONOUS TRACTION MOTORS

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### ABSTRACT

*The article presents the foreign experience in creating the electric rolling stock with asynchronous traction motors and suggests the ways to improve their operational reliability.*

Constructive features of the electric rolling stock [1,2]:

- All electric trains have individual axle drive and frame suspension of traction motors;

- Due to low weight of the trains per one axle and significant weight of electrical equipment, mechanical part of the trains is extremely light;

- All electric rolling stock (except for E-1200 electric train) provides energy recuperation at the power approximately equal to the electric trains traction power;

- All electric trains are characterized by low interference with communication lines and signaling equipment;

- All of them are characterized by good traction properties and have rather perfect devices for maintaining high coefficient of clutch use in all modes. In other words, these electric trains are sufficiently fully implemented the ATED anti-boxing properties. The developer and manufacturer of transducers and their regulation systems is BBC Company (Switzerland). Features of this equipment will be considered below.



Parameters of electric rolling stock with asynchronous traction motors (ATED) with squirrel-cage rotor

Table 1.

The main parameters	Electric rolling stock			
	E-1200	E-120	EA-3000	E1-17
Year of production	1977	1980	1983	1983
Power, kW	1 500	5600	4000	3000
Speed, km/h: maximum	80	160	160	140
Speed, km/h: nomina	20	80	80	55
Traction force, kN: at startup	340	340	260	240
Traction force, kN: nominal	270	250	175	196
Weight, t	84	84	80	64
Contact line voltage, kV	25	15	25	15
Frequency of the contact network current, Hz	50	alternating current with a frequency of 50 Hz and 162/3 Hz	50	alternating current with a frequency of 50 Hz and 162/3 Hz
Diameter of wheels, mm	1250	1250	1250	1100
Transmission ratio	-	5,27	-	4,57
Number of axes	4	4	4	4

The advantages of E-120 electric trains in terms of traction force realization, high power factor, with low interfering effect on communication lines and SCB devices were confirmed. According to traction qualities, four-axle electric trains E-120 turned out to be equal to six-axle serial electric trains. Experiments have shown that it is desirable to have regulation of each asynchronous motor in order to use the limit of each wheel

clutch capacity, taking into account dynamic redistribution of wheel loads. However, it is quite possible to power the ATD from common tires, as it is done on the E-1200 electric rolling stock. Electric train current  $I_E$  (Fig. 1, a) is practically sinusoidal and coincides in phase with voltage  $U_E$ . The dependence of the power factor on the load is given in Figure 1, b.

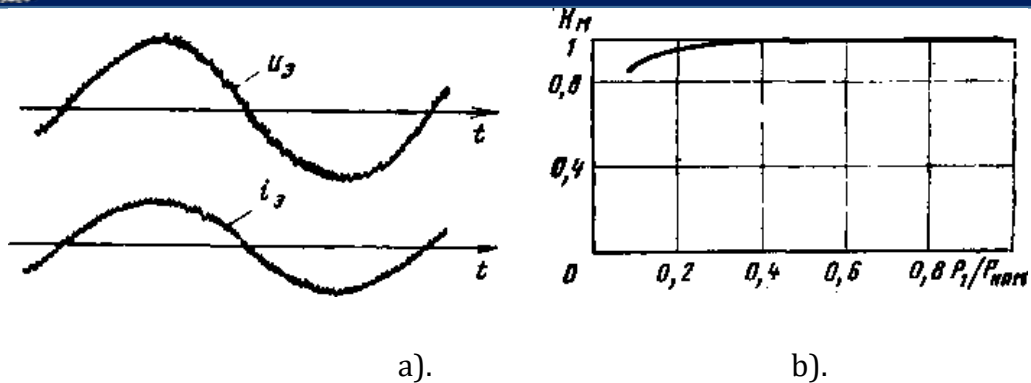


Figure1. a). Curves of current IE and voltage UE of electric trains when using four-square

rectifier; b). Dependence of power factor of electric rolling stock E-120 on load.

**Main indicators of traction electric motors operated in Russia and other foreign countries**

Table 2.

Engine type and country of manufacture	Year Edition	Power, R <sub>nom</sub> , kW	Weight MD, kg	Specific indicators	
				Md/ R <sub>nom</sub>	Md/ M <sub>nom</sub>
Constant current					
NB 500V (USSR)	1980	800	4600	5,75	0,44
T-750 FS (Italy)	1975	1125	5000	4,4	0,45
AL-4846 (CZECHOSLOVAKIA)	1981	618	5000	8,1	0,61
Alternating current					
NB-507 (USSR)	1976	1000	2873	3,0	0,30
LjH-108-3 (Sweden)	1976	1000	2873	3,0	0,30
1TB2624-0GA02 (Siemens)		1020	2450	2,4	0,36

Table 2 presents comparative data of electric traction motors, which allows assessing the current level of electric motor development in Russia and other foreign countries [3,4]. The main advantages of traction asynchronous electric motors with squirrel-cage rotor:

1) Improved traction properties of electric trains, due to the rigid characteristic of the electric machine, which reduces the tendency to boxing;

2) Sharp reduction of copper consumption in traction motor production. Later, when getting acquainted with the design of asynchronous traction motor, it



will be discussed in detail, due to what this reduction is achieved. With the same torque and frequency, the volume of copper is reduced in 2...3 times;

3) Essential decrease in weight and dimensions of traction motors;

4) Automation of control processes of alternating current motors.

These advantages attract the creators of electric rolling stock in foreign countries, which in recent years are widely used as traction asynchronous electric motors with squirrel cage rotor.

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