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भारत सरकार
रक्षा मंत्रालय
(गुणता आश्वासन महानिदेशालय)
GOVERNMENT OF INDIA
MINISTRY OF DEFENCE
(DGQA ORGANISATION)

SARATH

QUALITY ASSURANCE INSTRUCTIONS
NO.CQA(ICV)/QAI/ 029
FOR

ELECTRIC PNEUMATIC VALVE
DRAWING NO. ३ K-48-015 C/

ISSUED BY

गुणता आश्वासन नियंत्रणालय (स्थल सेना लडाकू वाहन)
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रक्षा मंत्रालय
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CONTROLLERATE OF QUALITY ASSURANCE (INFANTRY COMBAT VEHICLES)
DEPARTMENT OF DEFENCE PRODUCTION & SUPPLIES
MINISTRY OF DEFENCE
YEDDUMAILARAM 502 205

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QUALITY ASSURANCE INSTRUCTIONS

FOR

ELECTRIC PNEUMATIC VALVE
DRAWING NO. ∋K-48-015 C♭

CONTROLLERATE OF QUALITY ASSURANCE
INFANTRY COMBAT VEHICLES
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ADDITIONS/AMENDMENTS

Sl No	Page & Para	Brief description of Additions/ Amendments	Date on which addition/ amendments made	Authority letter Number

CI(ICV)/QAI/029

QUALITY ASSURANCE INSTRUCTIONS FOR ELECTRIC PNEUMATIC VALVE ∋ K - 48

DRAWING NO. ∋ K-48-015 Cb

1. INTRODUCTION/SCOPE

This Quality Assurance Instructions is the property of Government of India. This is based on acceptance standards and inspection methods generally in vogue. It has been compiled for guidance of the inspector during inspection of Electric Pneumatic Valve ∋ K-48 to Drg.No. ∋ K-48-015Cb used in Pneumatic Units Control System Drg.No.675-78-Cb3 and to ensure that the stores accepted are qualitatively meeting the service requirements. This QAI deals with pilot and bulk inspection requirements for determining the quality and performance of Electric Pneumatic Valve.

1.1 This QAI is liable to be amended as and when required by the Controller,CI(ICV), Secunderabad. During inspection, if the Inspector finds any points which can be included in this QAI, he shall refer such points to the Controller, CI(ICV). Before commencing the inspection, the inspector will make himself fully conversant with terms and conditions of the contract including specifications, drawings and other literature.

2. DESCRIPTION/CONSTRUCTION

Two Nos. of Electric Pneumatic Valves ∋ K-48 are used in Pneumatic Control System of 675-78-C ϐ 3. One valve is used for supply of compressed air to air distributor of engine air starting system and the other one is used for supply of compressed air to main brake system of vehicle in case the controls of hydraulic system are not effective due to lack of hydraulic oil pressure in the system.

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2.1 The sketch of the Electric Pneumatic Valve is given at Figure-1. The Electric Pneumatic Valves Э K-48 are mounted on the left side in the driving compartment. Electric Pneumatic Valve Э K-48 consists of cylindrical body 14 with electro-magnet casing 11, inlet valve 3 and delivery valve 6, piston 7, electo-magnet of servo-valve 4, inlet pipe union 1 and outlet pipe union 5, two springs and electric pneumatic valve manual control lever 8, piston 7, inlet valve 3 and delivery valve 6 are inter-connected, they move as a single unit. The extreme end of electric system of electric pneumatic valve is screwed with socket for taking electrical connection. The holes on the circumference of the valve body is packed by rubber packing and clamped as shown in Drg.No. 765-78-Cb 780.

2.2 Functioning of Electric Pneumatic Valve for Air Starting System ;

When the button marked 'AIR START' (ПУСК ВОЗД) on the dash board of vehicle is pressed, the electro-magnet is energized and core 12 (refer fig.1) under the action of the magnetic field, pulls servo valve 4 through rod 13, thus opening duct 'D' and closing duct 'B'. Compressed air at a pressure of 65 Kgf/cm^2 flows from space 'E', through duct 'D', to the space 'C' under the piston and displaces piston 7 and inlet valve 3 and discharge valve 6.

2.2.1 Inlet valve fully opens the air duct leading to pipe outlet union 5 and discharge valve 6 closes the holes on the valve body. Compressed air flows from the pneumatic system through inlet pipe union 1 and outlet union 5. The air is passed out entering into the air distributor from where the compressed air is fed into the engine cylinders. The compressed air acting on piston crankh the engine. When the button 'AIR START' is released, the electro-magnet is de-energized and the servo-valve returns to the original position by the action of spring 9, and

/ and opens duct 'B' thus connecting space 'C'

the servo-valve closes the hole 'D', thus cutting off the compressed air supply to space 'C' with the atmosphere. Inlet valve 3 disconnects inlet pipe union 1 and outlet pipe union 5, under the action of spring 2 and the discharge valve 6 moves away from the seat, thus connecting outlet pipe union 5 with the atmosphere.

2.2.2 When the 'AIR START' switch is un-serviceable, the servo-valve can be operated mechanically with the help of lever 8 provided on electric pneumatic valve and the engine can be started. After the engine starts, the air can be similarly cut off manually.

2.3 Control System of Stopping Brakes:

The stopping brakes of vehicle article-675 is normally operated by hydraulic control system. In case the hydraulic fluid pressure is not sufficient to operate the brake system, the stopping brakes are operated with the help of compressed air. When the brake pedal is depressed, a limit switch is operated closing the Electric Circuit supplying DC Voltage to the Electric Pneumatic Valve of the brake system. The Electric Pneumatic Valve gets energized and air under pressure is supplied to the brake cylinders. The operation of the Electric Pneumatic Valve is similar as explained in para 2.2.

3. PERFORMANCE CHARACTERISTICS

Electric Pneumatic Valve shall have the following performance characteristics;

a) Range of operating pressure : 10 to 70 Kgf/cm^2

b) Temperature Range of working: $+55^{\circ}C$ to $-60^{\circ}C$

c) Reliability of operation : At supply voltage

i) 20V min. at a pressure of 70 Kgf/cm^2 and ambient temp.

ii) 22V minimum at a pressure of 10 Kgf/cm^2 and ambient temp.

4. QUALITY ASSURANCE PROVISIONS

4.1 The supplier is responsible for satisfactory performance of the assembly during inspection and subsequent usage. Inspection and test records shall be kept complete and made available to the Inspector.

4.2 Quantity three pilot samples of Electric Pneumatic Valve ∋ K-48 are required as pilot sample before commencing the bulk production. Clearance for bulk production will be accorded only after evaluation/approval of pilot samples. Inspection of pilot samples and bulk supplies will be carried out in accordance with these quality assurance instructions, relevant drawings and material specifications.

4.3 Only approved electrical/hardware such as wires, plugs, sockets, insulation taps etc., shall be used for electrical system of electric pneumatic valve.

4.4 Method of Inspection:

The inspection requirements and procedure for quality assessment of the item are given as under :-

S.No.	Description of test to be carried out	Sampling Size	
		Pilot	Bulk
1.	2.	3.	4.
1.	Visual Inspection	100%	100%
2.	Dimensions	100%	10%
3.	Material Tests	Representative test bars/ samples of various materials used in pilot.	Representative test bars/ samples of various materials for each lot
4.	Weighment	100%	100%

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1.	2.	3.	4.
5.	Insulation Resistance		
	a) At normal temperature, relative humidity 30-80%	100%	100%
	b) At high relative humidity of 95-98%	100%	10%
6.	Electric strength of insulation	100%	10%
7.	Minimum operating voltage	100%	10%
8.	Current consumption	100%	10%
9.	Minimum operating pressure	100%	10%
10.	Air Tightness Check		
	a) At temperature 20 ± 5°C	100%	100%
	b) At temperature (55 to 60)°C	1 No.	1%
11.	Air discharge		
	a) At temperature 20 ± 5°C	100%	10%
	b) At temperature (55 to 60)°C	1 No.	1%
12.	Reliability of operation		
	a) At temperature 20 ± 5°C	100%	10%
	b) At temperature 60 ± 5°C	1 No.	1%
13.	Life test	1 No.	-
14.	Self Operation	100%	10%
15.	Vibration Test	100%	10%
16.	Output capacity efficiency	100%	10%
17.	Carrying Capacity	100%	10%
18.	Operating time	100%	10%
19.	Durability of coating	100%	10%
20.	Preservation	100%	100%

4.4.1 Visual Inspection :

The electric pneumatic valve assembly shall be inspected visually to ensure that:

a) The assembly is complete as per the item list.

b) Quality of assembly and workmanship is satisfactory.

c) Clearance marked thus 'A' on assembly drawing ∋ K-48-015-Cb should be 1.5mm maximum between Body 7 ∩ 7.772.012 and plug 2-4.

d) Pin to Drg.No.7∩ 8.300.017 is secured in the assembly with thick primer AK-070, OCT 6-10-401-76 on both sides.

e) On assembly screw to Drg.No.4 is secured with thick primer AK 0-70.

f) All parts on working surfaces should not have dents, cracks, and burns, Surface finish should be in-confirmity with the requirements of the drawing.

g) Parts and assemblies are free from corrosion and mechanical damages.

h) Thread formation of threaded components is satisfactory.

i) After anti-corrosive coating,machining and heat treatment of assemblies and parts are not allowed with the exce-ption of threading wherever necessary.

4.4.2 Dimensions :

Each procurement is guided by the contract and connected specifications and drawings mentioned there on. Electric Pneumatic Valve shall strictly conform to Drg.No. Cb of ∋ K-48-015. During pilot sample inspection, before assembling each component shall be checked for its dimensions as per the relevant drawings. Therefore,

as and when all the components are ready prior to assembling, the manufacturer shall intimate the inspecting officer. Bulk Supplies shall be checked for over all dimensions and reference dimensions.

After carrying out all the tests as per para 4.4, Electric Pneumatic Valve ∃ K-48 should be checked for following stroke measurements of valves:-

a) Stroke of servo valve should not exceed 1.1mm

b) Stroke of inlet & outlet valves should not exceed 1.5mm

4.4.3 Material Tests :

Electric Pneumatic Valve ∃ K-48 to drawing No. ∃ K-48-015 Cb shall be manufactured using the raw-materials strictly confirming to material specifications specified. The manufacturer shall make available to the inspector all records pertaining to raw materials used for the manufacture of the components/assembly. Test Specimens/ Test bars shall be drawn from the component production line for checking mechanical properties and chemical analysis as per the relevant specifications. The results shall conform to the specified limits.

4.4.4 Weighment :

Weight of individual component/assembly shall be controlled in such a way that the total weight of complete assembly - of ∃ K-048-15 shall be 0.47 Kg maximum.

4.4.5 Insulation Resistance :

This test and tests specified at subsequent paras should be carried out after installing the Electric Pneumatic Valve as per circuit diagram figure -2&3.

a) At normal temperature and relative humidity of 30 - 80% ;-

. Insulation Resistance of electro-magnet of electrical system in electric pneumatic valve is measured by 500V DC meger between terminals and body of electric pneumatic valve at normal temperature and relative himidity of 30-80%. The insulation resistance should be 20M ohm (minimum).

b) At higher relative humidity of 95 - 98% :-

The insulation resistance of electro-magnet of electrical system in electric pneumatic valve should be 2M ohm (minimum) at relative himidity 95-98% between terminals and body of electric pneumatic valve.

4.4.6 Electric Strength Insulation:

Insulation strength test shall be carried out on the electro-magnet of electrical system in Electric-Pneumatic Valve between the body of electric pneumatic valve and its components and the terminals at a rated voltage with minimum power 0.5 KW and with (500V AC) frequency of 50 Hz. The duration will be 1 minute max. after attaining the specifiec voltage.

NOTE: The voltage shall be increased gradually and similarly reduced gradually during the test.

Electric pneumatic valve is considered acceptable when there is no surface sparking and the valve with-stands the voltage without break downs.

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4.4.7 Minimum Operating Voltage :

The minimum operating voltage of electric system of electric pneumatic valve at ambient temperature of 20 ± 5°C in un-heated condition at first switching should be;

a) 20V max. when compressed air is fed at a pressure 70 - 2 Kgf/cm^2 through the inlet of electric pneumatic valve.

b) 22V max. when compressed air is fed at a pressure 10 kgf/cm^2 through inlet of electric pneumatic valve.

These tests are to be carried out by gradual increase of supply voltage from 16V at the terminals of electric pneumatic valve to the moment the electric pneumatic valve starts operating.

4.4.8 Current Consumption:

The current consumption of electric pneumatic valve should not exceed 3.5A at supply voltage 24V at an ambient temperature 20 ± 5°C.

The current consumption is checked with an ammeter, at 24V DC, by feeding compressed air at a pressure of 10 kgf/cm^2 and 70 kgf/cm^2 through the inlet connection of the valve. During testing, the ambient temperature shall be 20 ± 5°C.

4.4.9 Minimum Operating Pressure :

The electric pneumatic valve is to be checked for its minimum operating pressure at ambient temperature 20 ± 5°C and supply voltage 22V. The minimum operating pressure should not exceed 10 kgf/cm^2.

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This test is carried out by feeding compressed air increasing gradually at the inlet connection till the moment the electric pneumatic valve starts operating. The opening of valve may be checked by incorporating a pipe connection and a manometer/pressure gauge at the outlet connection of the valve from where pressure readings can be taken. The power supply 22V shall be supplied at the terminals of the electric pneumatic valve.

4.4.10 Air Tightness Test

Air tightness of electric pneumatic valve shall be checked at temperature 20 $\pm$ 5°C and at -(55 to 60)°C. Feed the compressed air through the inlet of the valve at a pressure of 5-70 Kgf/cm^2. The leakage of air if any can be checked by incorporating a pipe connection to the outlet with cock and with an air leakage indicator. There shall be no leakage of air when tested at both of the above temperatures.

4.4.11 Air Discharge Test

This test is carried on a special test stand with following conditions:-

a) Temperature : (i) 20 $\pm$ 5°C
(ii) -(55 to 60)°C

b) Air Inlet Pressure : 10-70 Kgf/cm^2

c) Supply Voltage : 24V DC

In 'Off' position air release is not allowed. And in 'On' position the air release shall not be more than 200 cm^3/sec. Checking of air release at -(55 to 60)°C in 'ON' position at 70 kgf/cm^2 is optional and cannot be basis for rejection.

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NOTE: The air release test at ambient temperature -(55 to 60)°C is to be conducted within two minutes after the electric pneumatic valve is removed from the refrigerating chamber.

4.4.12 Reliability of Operation

Electric pneumatic valve is checked for the reliability of operation from the first closing circuit at supply voltage 27 ± 10% V in the pressure range of 10 to 70 kgf/cm^2 and at ambient temperatures 20 ± 5°C and -60 ± 5°C as follows:-

a) At Temperature 20 ± 5°C

i) Supplied air pressure 10 kgf/cm^2

20 Switchings should be done on electric pneumatic valve at 22V power supply and supplying air-pressure 10 kgf/cm^2.

ii) Supplied air pressure 70 kgf/cm^2.

20 Switchings should be done at supply voltage 20V and supplying air pressure 70^{-2} kgf/cm^2.

Interval between each switchings should be minimum 1 sec.

b) At Temperature - 60±5°C

Electric pneumatic valve should operate for initial closing circuit with 24V power supply and compressed air pressure 10 kgf/cm^2 at the inlet connection.

4.4.12.1 Before the test 4.4.12(b) , the electric pneumatic valve is kept for 2 hours in refrigerating chamber (with cooled air for 30 minutes during intensive forced air cooling).

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4.4.12.2 The electric pneumatic valve is checked for its reliability of operation from the first closing circuit at supply voltage 27 ± 10% V by supplying compressed air at pressure range 10 to 70 kgf/cm^2, at ambient temperatures 20 ± 5°C and -60 ± 5°C. The quantity of air release can be checked as per test procedure 4.4.11 (a) & 4.4.11 (b) above.

4.4.13 Life Test

Electric pneumatic valve should withstand 3000 switchings at supplied compressed air pressure 10-70 kgf/cm^2 and supply voltage 27 ± 10% V. Sequence of 3000 switchings are as under:- / through inlet of valve,

a) 500 Switchings at temperature 20 ± 5°C, compressed air pressure 70^{-2} kgf/cm^2 / with vibration having one of the frequencies of 20-80 Hertz and with overload of 4 g for 2 hours.

b) 1000 Switchings at temperature 55 ± 5°C (by holding the electric pneumtaic valve in heating chamber at temperature 55 ± 5°C for 2 hours), and compressed air 50^{-2} kgf/cm^2 through the inlet of valve.

c) 1000 Switchings at temperature -60 ± 5°C (by holding in cooled chamber for 2 hours at-60±5°C, during intensive forced air cooling with cooled air for 30 minutes) and inlet pressure maintained at 50^{-2} kgf/cm^2

d) 500 Switchings at temperature 20 ± 5°C and supplied compressed air pressure 50^{-2} kgf/cm^2 with vibration with one of the frequencies 20-80 Hz, with an overload of 4g for 2 hours.

NOTE: Switchings of this test is to be conducted in series of 100 at a time with duration between each switching be 0.5 sec. Maximum. The gap between each series should be minimum 2 minutes.

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The time taken / each switching of the tests 4.4.13 (a) to 4.4.13 (b) be 60 seconds max. / between

During the sequence of all tests, valve should operate at once when the circuit is closed in all temperature range of operation + 55°C to -60°C. After this test, the electric pneumatic valve should meet the requirements of :-

i) Minimum operating pressure, test procedure 4.4.9
ii) Minimum operating voltage, test procedure 4.4.7
iii) Current-Consumption, test procedure 4.4.8
iv) Air tightness check, test procedure 4.4.10.
v) Air discharge, test procedure 4.4.11.

4.4.14 Self Operation

The electric pneumatic valve should not have a tendency to come into 'ON' position on its own due to vibrations etc, For this, inlet of the valve is supplied compressed air at 90 kg/cm^2. The electric supply is cut off and the valve is vibrated at a frequency of 20-80 Hz with an acceleration of 4g. The test is carried out for 2 hours. Any self operation causes air flow from outlet which is not acceptable.

4.4.15 Vibration Test

Electric pneumatic valve should withstand vibration with frequency of 20-80 Hz at an acceleration of 4g for 2 hours. After this it should be checked for its:-

i) Minimum operating voltage, test procedure 4.4.7
ii) Consumption of current, test procedure 4.4.8
iii) Minimum operating pressure, test procedure 4.4.9
iv) Insulation resistance, test procedure 4.4.5 (a) & (b)
v) Electric strength of insulation, test procedure 4.4.6
vi) Air discharge, test procedure 4.4.11.
vii) Air tightness check, test procedure 4.4.10.

4.4.16 Output Capacity Efficiency

The electric pneumatic valve is checked for the output capacity at a temperature of 20 ± 5°C, and with compressed air pressure 50 kgf/cm^2. The output should be min. 240 litres/sec. This test and the tests briefed on para 4.4.17 and 4.4.18 shall be carried on a special test stand as per instructions laid down on 08635. (Miscellaneous Specification)

4.4.17 Carrying Capacity

The electric pneumatic valve is checked for the carrying capacity at a temperature 20 ± 5°C and inlet air pressure 50 kgf/cm^2. The carrying capacity should be minimum 280 litres/seconds.

4.4.18 Operating Time

The electric pneumatic valve is checked for operating time at inlet air pressure 50 kgf/cm^2 from the moment of closing the circuit. The operating time should not exceed 0.025 second.

This test is checked with mirror galvanometer oscillograph by means of photography, with mechanical or magneto electric meter of time by means of parallel connection of photography with mechanical magneto electric meter in the circuit of electro-magnet.

4.4.19 Durability of Coating

Electric pneumatic valve should not have traces of corrosion through out the guarantee period under normal conditions of storage and working.

For this, electric pneumatic valve is checked by changing temperature condition -60°C and + 55°C in 5 cycles. The duration of holding the valve in thermostat and refrigerating chamber should be 2 hours at a time. The result is considered satisfactory if the coating is resistant specified testings.

4.4.20 Preservation

Plating, painting and preservation treatment etc, shall be as per relevant specifications given in the drawings.

4.4.21 Fitment/Performance Trials

Quantity two Nos. of Electric Pneumatic Valve ⊃ K-48 should be installed in the air starting/braking system of vehicle-675.

The engine should be started on & off a number of times. Limited running of the vehicle may also be carried out for checking the efficiency of the braking system.

5. GUARANTEE

The manufacturer has to certify the guarantee certificate as under:-

5.1 "The guaranteed term of the electric pneumatic valve is 1000 operating hours with direct operation and storage upto 7.5 years, it includes upto 5.5 years direct operation, transportation and storage."

6. MARKINGS

The following identification marks shall be stamped by rolling on electric pneumatic valve.

a) Manufacturer's symbol
b) S/O No. and Date
c) Part No./Drawing No.
d) The word ' ЭK-48,' '27 V'
e) Serial Number and date of manufacture

7. PACKINGS

All the passages/parts are closed with plugs to drawing No. 7Ф8632028. Each assembly should be packed separately by the vendor so that it is protected from moisture and dust. The assembly can be packed in a batch and the same can be packed in a box which shall withstand transportation/storage before their consumption in the assembly. The box shall bear the following identification marks.

a) Drawing No. & Nomenclature.
b) Quantity Batch No. and Date of Manufacture
c) Manufacturer's Symbol/Monogram
d) S/O No. and Date
e) Inspector's acceptance mark
f) Consignee

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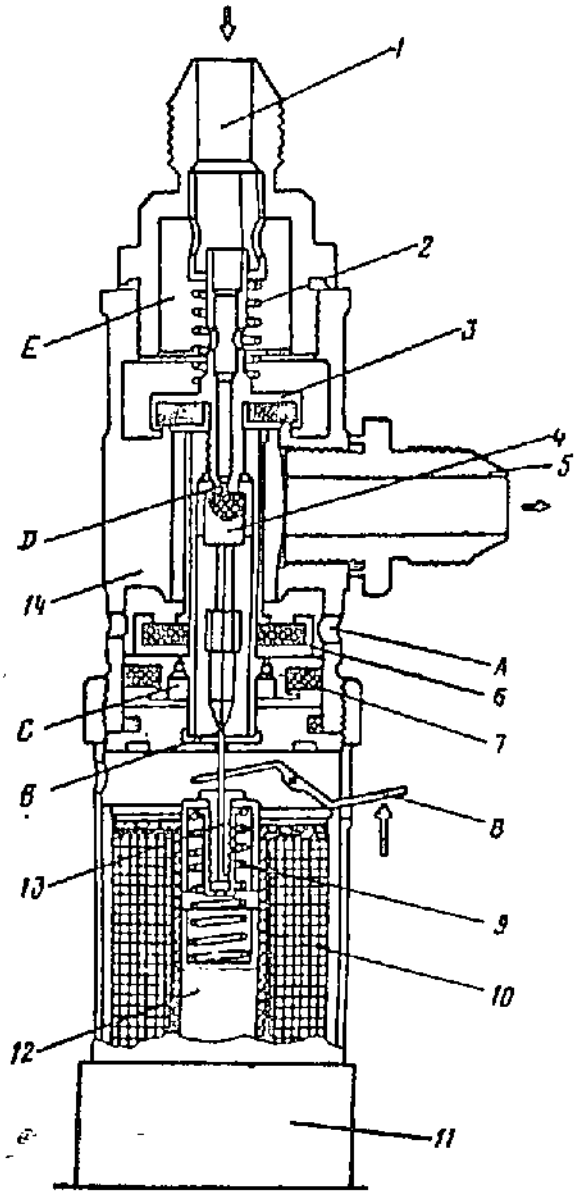
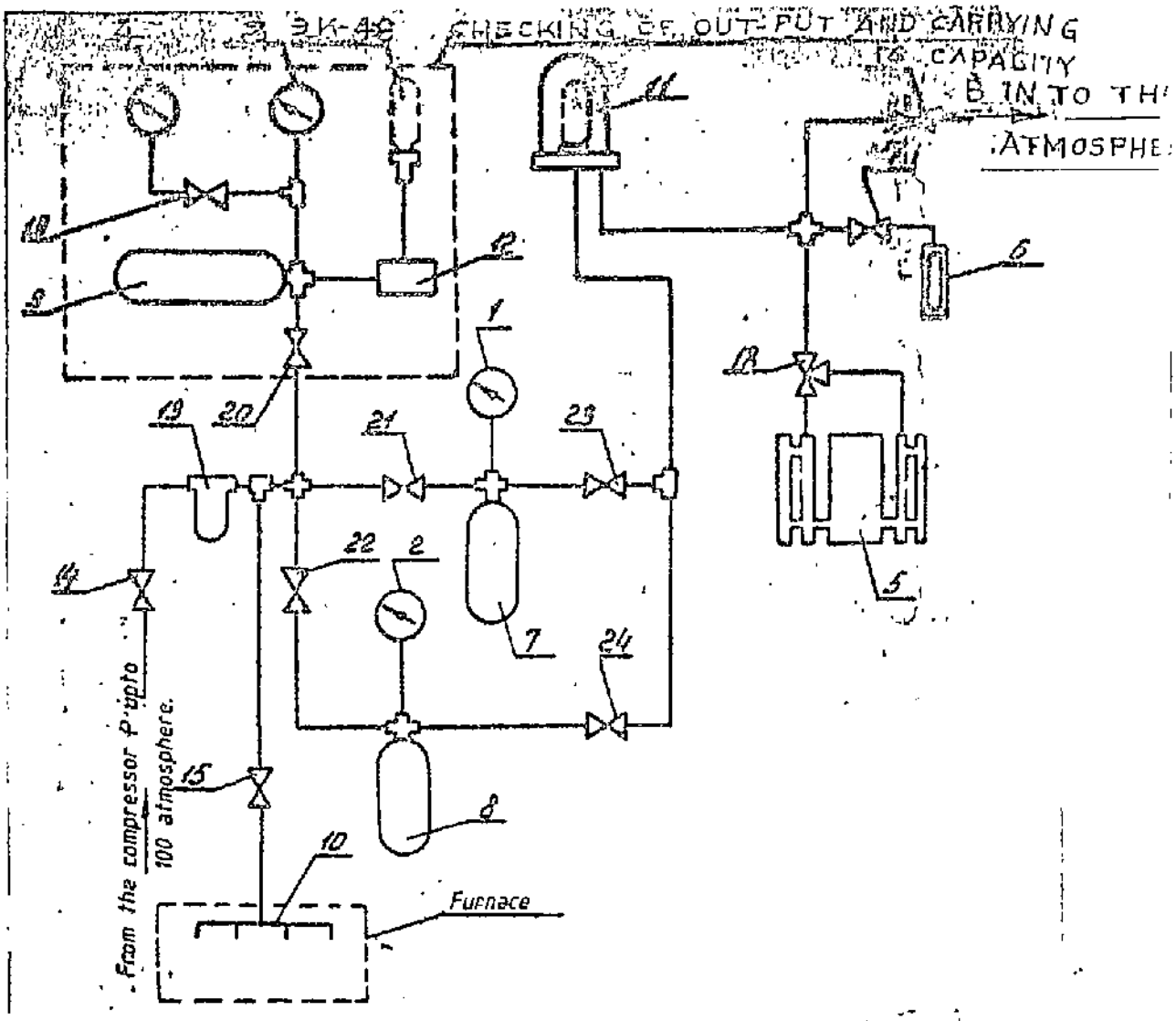


FIG-1 ELECTROPNEUMATIC VALVE

1. Inlet pipe union 2. Inlet Valve spring 3. Inlet Valve 4. Servo-valve 5. Outlet pipe union 6. Outlet valve 7. Piston 8. Manual control lever 9.Spring 10. Electromagnet-winding 11. Casing 12. Core 13. Rod 14. Valve body, A- Hole communicating with atmosphere, B- Duct, C- Space under piston D- Inlet valve hole, E- Space.



It is allowed to use manometer with other upper limits not degrading accuracy of measurements Accuracy class of manometers should not be less than 2.5

During the measurement of value of air release stop watch may be used.

FIG-2 PNEUMATIC SYSTEM FOR TEST OF ЭК-48

1. Manometer P = 0 to 25 kgf/cm^2 cl 2.5
2. to 3 Manometer P = 0 to 160 kgf/cm^2 cl 2.5
4. Manometer P = 0 to 160 kgf/cm^2 cl 0.6
5. Spriometer V = 0 to 25 CM^3 V =0 to 1000 cm^3
6. Indicator of leakage
7. to 8. Cylinder V=10 to 15 ℓ P=150 kgf/cm^2
9. Cylinder V=40 ℓ P=150 kgf/cm^2
10. Rake
11. Cap
12. Electric pneumatic valve
13. Filter
14. Cock of mains
15. Cock to a thermo chamber
16. Cock of air-release
17. Cock of leakag indicator
18. Three way cock
19 to 24. Operating cocks

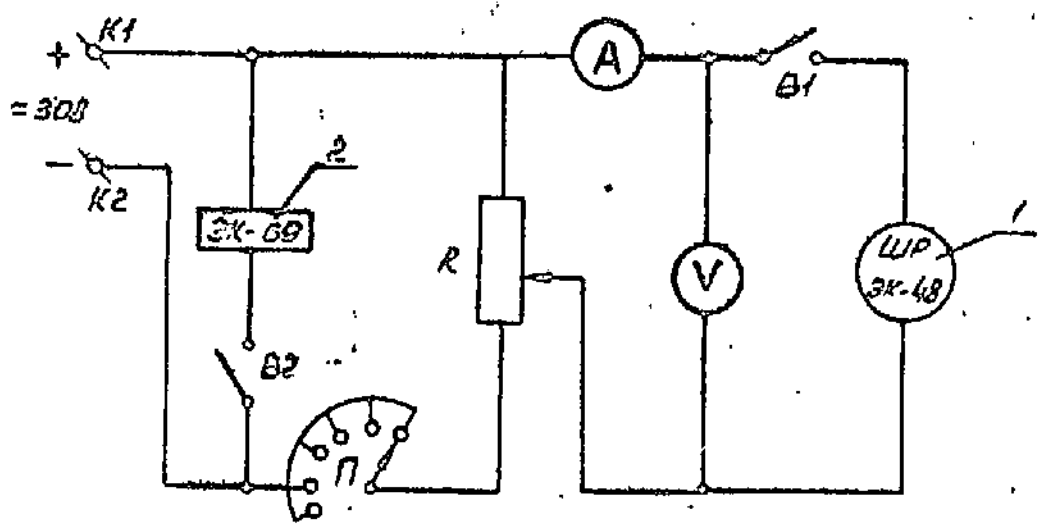


FIG-3 CIRCUIT DIAGRAM FOR TESTS OF ЭК-48

B_1 B_2 :- Circuit breaker of type B-45

R :- Reostat of type РСП -12.5Ohms 5a

A :- Ammeter of type

V :- Voltmeter of type

П :- Breaker

K_1 K_2 :- Terminal

1 :- Plug for connection of the article

2 :- Electric pneumatic valve