



सत्यमेव जयते

भारत सरकार

रक्षा मंत्रालय

(गुणता आश्वासन महानिदेशालय)
GOVERNMENT OF INDIA
MINISTRY OF DEFENCE
(DGQA ORGANISATION)

SARATH

QUALITY ASSURANCE INSTRUCTIONS
NO.CQA(ICV)/QAI/ 053
FOR

VOLTAMMETER BA-440

ISSUED BY

गुणता आश्वासन नियंत्रणालय (स्यल सेना लडाकू वाहन)

रक्षा उत्पादन तथा आपूर्ति विभाग

रक्षा मंत्रालय

येदुमैलाराम (आं.प्र) -५०२ २०५

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

VOLTTAMMETER BA-440

CONTROLLERATE OF QUALITY ASSURANCE

INFANTRY COMBAT VEHICLES

YEDDUMAILARAM - 502 205

ADDITIONS/AMENDMENTS

Sl No	Page & Para	Brief description of Additions/ Amendments	Date on which addition/ amendments made	Authority lette Number
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QUALITY ASSURANCE INSTRUCTIONS

FOR

VOLTTAMMETER BA-440

1.0 INTRODUCTION: This QAI deals with inspection of voltammeter which is meant for measuring the mains voltage and charging current. This QAI is based on the relevant design documents, material specifications and other literature of the collaborators.

1.1 General Instructions for Inspection: This QAI is issued to assist and guide inspector in his inspection and nothing in this instruction absolves the Inspector from his responsibility to ensure that the inspection is carried out strictly as per terms of contract and the accepted stores are as per drawings and the specifications quoted in the contract in every respect.

1.2 Before commencing inspection, the Inspector will make himself fully conversant with all the terms and conditions of the contract, including specifications, drawings, and other literature of the collaborators.

1.3 The Inspector will ensure that the stores manufactured is in conformity with the relevant specifications and drawings quoted in the contract, with a view that the stores accepted are qualitatively meeting the service requirements.

1.4 In the course of inspection, if the inspector finds any points which could be included in this QAI, he should bring such points to the notice of the AHSP.

1.5 The supplier may be shown this QAI in order to acquaint himself with the standard of inspection, so that he endeavours to improve his product.

1.6 This QAI is the property of Government of India. It is liable for amendment at any time and should not be used unless authorised by controller COA(ICV), Secunderabad. For inspection purposes only the latest issue of this QAI will be made applicable and required number of copies of this QAI can be obtained from the issuing authority, i.e., the Controller, COA (ICV), 6th Floor, Chandralok Bldg, Secunderabad 500003. Amendments issued by COA (ICV) from time to time shall be recorded in the amendment sheet enclosed.

1.7 Any technical queries on this QAI should be referred to issuing authority. For any departure from this QAI, the AHSP should be approached in writing and only after obtaining the written approval for the departure, the manufacturer should

commence production.

1.8 A set of applicable drawings and specifications will be forwarded to the manufacturer/supplier and the respective inspection authority on placement of supply order. For any changes in the drawings, specifications, standards or written texts, prior approval in writing should be obtained from AHSP, before commencement of production. Equivalence of collaborator's specifications with other international or national specifications and standards will be decided only by the AHSP.

1.9 The supplier should provide all standard test facilities for conducting inspection smoothly, viz., inspection gauges, instruments, test stands/rigs, fixtures, templates and also those recommended in the drawings/ specifications. The supplier should maintain a calibration record sheet for all the measuring instruments/machines and gauges, which will be periodically checked by the inspector.

1.10 The supplier should take up suitable corrective measures immediately if any defects/short comings are noticed during line, process and assembly inspection. In case the defects noticed on any consignments, are attributable to manufacturing defects warranting rectification of earlier supplies, the supplier should resort to rectification of these defects in the supplies already made in consultation with the AHSP and consignee.

2.0 CONSTRUCTION & OPERATION: Voltammeter is mounted on the central panel (675-82-Cb 104). The voltammeter mainly consists of (Refer fig 1&2) cylindrical body at one end with screen 2 and with casing 11 at the other end. The body incorporates a moving coil system, consisting of light aluminium frame 21 with winding, spring holder and Pointer 12 having tabs 26 with weights. The moving coil system rests with its cores on corundum thrust bearings. Case 16 with thrust bearing is screwed into the holder on one side and into bridge 27 on the other side. The holder incorporates core 13. The holder with bridge, moving coil system and core is secured in the slots of pole shoes 15, by means of screws. The stationary portion of the instrument consists of multiplier 4 and compensating resistor 5, magnet 8 secured with strap 9 to carbolic plate 7 and contact plates 22, 23 and 24.

2.1 Voltammeter BA-440 is a combined moving coil instrument designed for measuring the mains voltage and charging current. If the ammeter pointer deflects to the right, the storage batteries are charged and it deflects to the left the batteries are discharged.

2.2 The principle of voltammeter operation is based on interaction of fixed magnet '8' with the magnetic field of movable frame 21, when the current flows thro' it. As a result of interaction of the fields of the magnet and frame, the frame turns together with the pointer by an angle proportional to the current intensity. Only a low current (hundredths of an ampere) flows through the frame, while the large portion of the current passes

through the parallel connected shunt, having a long cross sectional area.

2.3 When the button is released the voltmeter operates as an ammeter. In this case, the mains current flows through the winding of the frame, upper closed contacts and $4\text{-}\Omega$ resistor. Interaction of the fields cause the Pointer deflection. If the batteries are discharged, the current in the frame is reversed and the pointer deflects to the left.

2.4 When the button is pressed, the upper contacts open, and the lower contacts close. The current passes through the $4000\text{ }\Omega$ resistor and deflects the pointer by an angle proportional to the voltage.

2.5 The voltmeter is enclosed in a metal body whose face side bears two scales and button 18. Located beside the button is the screw which is meant for zero adjustment of the pointer.

2.6 Basic Data /Technical characteristics

Normal position of Instrument - vertical position of dial

Mass - 400 gms

3.0 The voltmeter is liable for storage, transportation and operation in the environments of tropical, tropical sea coasts, dry deserts and cold climates.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 Inspection Responsibility: The supplier is responsible for satisfactory performance of the item during usage and for performance of all inspection requirements specified herein.

4.2 The supplier should carry out 100% pre-inspection before offering the items to the inspector for inspection. A test certificate indicating all the tests carried out by the supplier should be given to the inspector/ AHSP, while tendering the stores for inspection. The contractor should provide free access for scrutiny of all the documents to the Inspector/ AHSP in order to ensure that the items offered are of the highest quality.

4.3 Supply of Literature: The supplier should provide sufficient copies of the literature of the items, such as illustrated part list, operating instructions, assay schedule, maintenance/overhaul instructions, systems layout charts, list of indigenous materials etc., to the AHSP for vetting and distribution.

5.0 PILOT /BULK INSPECTION

5.1 Contractor should tender 6 pilot samples representing the bulk supplies to the inspecting officer for the pilot samples evaluation. The pilot samples tendered should bear the regular serial number in addition to the identification number in red paint as under :

"PS1, PS2, PS3, PS4 --- --- --- PS6

5.2 All inspection/testing facilities for evaluation of pilot samples will be provided by the supplier at supplier's premises. The supplier should inform in advance in writing about the facilities available with them for evaluation of pilot samples. Any additional test facilities required for pilot sample evaluation will be intimated by the inspecting officer and the AHSP. Vehicle trials will be conducted as per the directions of the AHSP.

5.3 Pilot samples will be considered for acceptance only after completion of all tests indicated herein. Bulk production clearance will be accorded by the AHSP only after the approval of pilot samples. Inspection of pilot samples and bulk supplies of the item shall be carried out in accordance with this OAI and relevant drawings/specifications.

5.4 The pilot samples will be allocated for evaluation as per the details given under.

S.No	Tests	Inspection level	No of pilot samples under-going evaluation.
a)	Visual inspection	all 6 samples	1 to 6
b)	Dimensional check	-do-	-do-
c)	Performance tests	-do-	-do-
d)	Environmental test	2 samples	1 & 2
e)	Dynamic tests	2 samples	3 & 4
f)	Endurance tests	1 sample	5
g)	Fitment/performance tests on vehicles	1 sample	6
h)	weighment check	all 6 samples	1 to 6
j)	Preservation/packing/identification check	-do-	1 to 6

5.5 Disposal of pilot samples will be intimated by the AHSP to all concerned. Inspector should punch the acceptance mark (V $\uparrow$ mark) on the body of the voltmeter if it complied with the requirements of this OAI in all respects. Inspector should ensure that any repairs/rectifications carried out on the items are within the acceptable limits and will not impair the performance and also complies the requirements given in this OAI. All samples rejected during the inspection should be punched with the rejection mark (R $\downarrow$ mark) distinctly on the body to avoid mixing of the same with the accepted stores.

5.6 METHOD OF INSPECTION: The inspection requirements and procedure for quality assessment of the voltmeter are given as under:

S.No	Description of the test to be carried out	Sampling size	
		Pilot	Bulk
1.	Visual inspection	100%	100%
2.	Raw materials	one set of test bars against each material specification	Test bars against each material specification per lot
3.	Production line inspection of Individual components	100%	10%
4.	Assy inspection	100%	10%
5.	Weightment	100%	100%
6.	<u>Performance Tests</u>		
	a) Checking of working of zero adjuster	100%	100%
	b) Checking of working of switch	100%	100%
	c) Determination of basic error	100%	100%
	d) Determination of variation	100%	100%
	e). Determination of residual deflection of pointer from zero mark	100%	100%
	f). Determination of effect of inclination/tilting	100%	100%

g). Checking of intensity of glow /	100%	10%
h). Checking of resistance of electrical insulation	100%	100%
i). Checking of electrical insulation strength	100%	10%
k). Determination of effect of external magnetic field	100%	10%
l). Checking of effect of ferro magnetic board and similar instrument located side by side	100%	10%
m). Determination of damping period	100%	10%
n). Checking of stability against over loads	100%	10%

7. Environmental test

a). Checking of cyclic effect of temp	2 Nos	2 Nos from each lot
b). Checking of cold resistance	"	"
c). Checking of stability against action of hoarfrost and dew	"	"
d). Checking of heat resistance	"	"
e). Checking of moisture resistance	"	"
f). Checking of operation at reduced atmosphere	"	"
g). Test for action of saline mist	1 No.	1 No from each lot
h). Checking of dust proofness	"	"
i). Checking of splash proofness	"	"
k). Checking of stability and quality of coatings	"	"

8. Dynamic test

a). Determination of vibration stability (Resistance)	"	1 No from each lot
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b). Checking of vibration strength	1 No	1 No from each lot
c). Determination of Impact resistance	"	"
d). Checking of Impact strength	"	"
e). Checking of absence of resonance of Structural elements	"	"
9. Fitment/Performance trials	"	"
10. Preservation/packing/Identification	100%	100%

6.0 The details of various tests mentioned above are explained below.

6.1 Visual Inspection : The following checks shall be carried out on the voltmeter:

- completion of the item as per main assembly drawing
- Quality of external finishing/coating
- Presence of loose parts/ fasteners
- Mechanical defects/ damages
- Correct markings

6.2 Materials: Raw materials used in the manufacture of each component shall conform to the specifications mentioned in the relevant drawings. Manufacturer shall make available to the inspector all records pertaining to the raw materials used in the assembly. The raw materials shall be counter checked with relevant specifications. Test specimen and test bars representing the pilot/bulk shall be drawn from the component production line and tested for chemical composition and mechanical properties. Results shall be within the specified limits. Material test specimen for insulating varnishes, adhesives, insulating tapes, solders and paints etc., shall be drawn at random and tested at recognised laboratories/test houses.

6.3 Production Line Inspection of Individual Components: Detailed dimensions of all components shall be checked as per the drawing before the assembly. Any special parameters/checks indicated in the drawing like hardness, heat treatment, surface finish, protective coating, dimensional tolerance shall also be checked at this stage. The components shall also be checked for presence of defects like cracks, dents, burrs, under cuts etc.,

6.4 Assembly Inspection: All assemblies shall be checked for dimensions as per the drawing. Any special parameters given in the drawing like hardness, heat treatment, surface finish, protective coating etc., shall be checked. All assemblies shall be examined for presence of defects like improper assembling.,

defects in soldering/brazing, loose parts/fasteners etc.,.

6.5 WEIGHMENT : Weight of individual components shall be controlled during production in such a way that the total weight of voltammeter should not exceed 400 gms.

6.6 PERFORMANCE TESTS :

6.6.1 Checking of working of Zero Adjuster : This test shall be carried out by rotating the zero adjuster with a screw driver. Zero adjuster should be able to shift the indicator pointer to each side from the mechanical zero mark, atleast 1.2 mm.

6.6.2 Checking of working of Changeover Switch : This test shall be carried out by pressing the switch button and subsequently releasing it three to five times. During this, the movement of button should be smooth without jamming and jerking. Pressing force (switching) shall be checked with the help of a dynamometer or with a load and the value thus measured should be atleast 200 gms. The absence of simultaneous closing of ammeter and voltmeter circuits shall be checked by connecting the instrument to the respective circuits and the pointer is set on an arbitrary mark of the scale. Then the button is pressed. The switch is considered acceptable if there are no simultaneous readings on the test instruments, connected to different circuits.

6.6.3 Determination of Basic Error : Basic error test is conducted by comparing with the readings of the instruments under test with the standard instrument having accuracy class not less than 0.5. Basic error of voltammeter under test is the maximum difference between the readings of the test instrument and the actual value of parameter obtained from the measurement results with gradual increase and decrease of parameter under measurement. The instrument pointer shall be

set by the zero adjuster to zero mark on the scale, before taking readings. Basic error of voltammeter should be within limits of $\pm 2\%$ of the highest value of measuring range under normal conditions given below :-

- (a) The instruments shall be checked in working position not more than $\pm 2^\circ$ of the vertical
- (b) Ambient temperature $20 \pm 5^\circ\text{C}$
- (c) Atmospheric press. 96 - 103 Kpa (720-780 mm Hg)
- (d) Relative humidity 30 to 80%
- (e) Constant operating vibration with an acceleration 0.1 to 0.3 g and frequency 40 - 50 Hz
- (f) The indicator pointer shall be adjusted to zero scale mark by zero adjuster before taking reading.

6.6.4 Determination of Variation (Hysteresis Error) :

Reading variation is the difference of maximum and minimum readings of the same magnitude of measured quantity when shifting the pointer towards increase and then towards decrease of parameter. This test shall be conducted simultaneously with the basic error test at normal temperature (Refer para 6.6.3). The permissible reading variation should be equal to double the value of basic error.

6.6.5 Determination of Residual (displacement) deflection of pointer from Zero mark : This test is carried out by mounting the voltammeter on a non-vibrating base and while observing the conditions given at para 6.6.3 above. Residual (displacement) deflection of pointer from zero mark (non-return) of pointer to zero mark should be equal to permissible basic error.

6.6.6 Determination of effect of Inclination/Tilting :

This test shall be carried out by connecting the voltmeter to the operating circuits, on a special stand, having provision for tilting at any angle say 45° in either direction from normal working position. The error in voltmeter reading due to tilting/inclination of the instrument in any axis (plane) upto 45° should be equal to 0.5 mm (1.3%).

6.6.7 Checking of Intensity of Glow : The intensity of luminous substance glow is checked visually during illumination with ultraviolet rays or incandescent lamp of 100W from a distance of 0.5m. Initially, the voltmeters should be kept in a dark room for such a period until the observer adopted to darkness before hand, does not notice its glowing. The dial plates of master voltmeter and the voltmeter under testing are simultaneously illuminated for 10 min. Then after glow brightness at 5 and 15 min after stopping excitation shall not be less than 100% of brightness of test specimen. The composition of luminous substance shall ensure durability of coated signs without any peelings, cracks and drips.

6.6.8 Checking of Electrical Insulation Resistance :

Electrical insulation resistance between each of current carrying circuits/plug contacts and body of voltmeter, measured with a megohm meter at a voltage of 500 V should be atleast :

- (a) 20 Mohm at $20 \pm 5^{\circ}\text{C}$ and relative humidity of 30-80%
- (b) 5 Mohm at $+ 50^{\circ}\text{C}$
- (c) 1 Mohm at a relative humidity of $95 \pm 3\%$
and temperature 20 to 35°C .

6.6.9 Checking of Electrical Insulation Strength :

Electrical insulation between each of the current carrying circuits and body of voltmeter should withstand a test voltage of 500V 50 Hz, AC applied from a source of power 0.5 KW for one minute without breakdown or surface sparkover.

6.6.10 Determination of effect of External Magnetic Field :

The voltammeter should be checked on two scale marks, one of which is near the geometric centre and the other near full scale value mark, by observing the conditions (specified) given at para 6.6.3 above. The voltammeter under test, shall be placed in the centre of the coil creating (generating) uniform magnetic field. The voltammeter under test and standard instrument shall be connected to the source of current and readings of instruments shall be recorded before and after switching on off the coil, with a direct current for creating (generating) a field intensity of 400 A/T and by turning the voltammeters under test and coil for the maximum effect of external magnetic field. The voltammeters are considered acceptable, if the permissible complementary error (variation in readings) caused by the effect of external magnetic field is equal to $\pm 2\%$.

6.6.11 Checking of effect of Ferromagnetic Board and a similar Voltammeter located side by side : The effect of ferromagnetic board shall be determined as the difference in readings of instruments under test on non-ferromagnetic board and on ferromagnetic board. During the test the instruments shall be located side by side in one plane and in one working position. The instrument influencing the one under test, shall be under rated load. The other conditions of the test shall be as per para 6.6.10 above. Allowable complementary error (difference in readings) of voltammeter caused by installation of voltammeter on ferromagnetic board of thickness $(3 \pm 0.5)\text{mm}$ and similar voltammeter located side by side at a distance of min 1 m shall be equal to $\pm 1\%$.

6.6.12 Determination of Dampening Period : The time of dampening is checked for voltammeter with single sided scale by switching on the measurable, quantity enabling the indicator deflection approximately on the geometric centre of the scale and for double sided scale, the indicator deflection approximately on half the length of the scale. The time of dampening is determined from the moment of change of measurable quantity until the moment, the difference between voltammeter

readings and its steady readings does not exceed 1 % length of scale. The period of dampening of voltammeter should not exceed 3 seconds.

6.6.13 Checking of Stability against Overloads : Short time overload test on voltammeters is carried out with fulfilling of conditions indicated in para 6.6.3 above, in working position. Test is carried out in practically non-inductive circuit without shunts. Ammeter and ammeter circuits of voltammeters should withstand a series of short term overloads without damages in the following sequence :-

- (a) current overloads exceeding the rated value 2.5 times with a duration of 3 ms every 3 minutes for a period of 1 hour.
- (b) ten connections of rated current of reversed polarity with a duration of 1 min. Interval between connections shall be min 1 min.

Voltammeter and voltammeter circuits of voltammeters should withstand a series of short term overloads without damages in the following sequence :

- (a) impulses of voltage 70V, with a duration of 3 ms every 3 minutes for a period of one hour.
- (b) Ten connections of voltage of reverse polarity 30V, with a duration of 1 min. Intervals between each connection shall be min 1 min.

The voltammeters are considered to have withstood test, if displacement of indicator from the mechanical zero mark does not exceed 0.4 mm and after cooling and getting the indicator on the mechanical zero mark, the voltammeters shall comply with requirements indicated in paras 6.6.3 and 6.6.6.

6.7 Environmental Tests :

6.7.1 Checking of Cyclic effect of Temperature : The voltammeter in switched off condition shall be subjected to the effect of three temperature cycles following one after another. Each cycle is conducted in the following sequence.

The voltammeter shall be placed in a cold chamber, maintained at a temperature of $-50 \pm 3^{\circ}\text{C}$ for four hours. After expiry of conditioning the voltammeter is transferred from cold chamber to hot chamber maintained at a temperature of $+65 \pm 3^{\circ}\text{C}$ and held under this condition for 4 hours. Transfer time of voltammeter from cold chamber to hot and hot to cold chambers should not exceed 5 minutes. After completion of last cycle, the voltammeter shall be removed from the hot chamber and held under normal climatic conditions for four hours. Then the voltammeter is visually inspected and subjected to the performance tests mentioned at paras 6.6.3 and 6.6.6 above.

6.7.2 Checking of Cold Resistance : The voltammeter, in switched off condition shall be kept in a cold chamber having a temperature of $-50 \pm 3^{\circ}\text{C}$ for 4 hours. After expiry of conditioning, the voltammeter is subjected to the performance test mentioned at para 6.6.4 above. After completion of the test, the voltammeter is removed from the cold chamber and held under normal climatic conditions for four hours. Then the voltammeter is subjected to the performance test mentioned at para 6.6.3.

The voltammeter is considered acceptable if the allowable complementary error (variation in readings) caused by variation in ambient temperature from $20 \pm 5^{\circ}\text{C}$ to -50°C per every 10°C of temperature change shall be equal to :

- (a) $\pm 0.7\%$ for voltmeters and voltmeter circuits of voltmeters.
- (b) $\pm 1.5\%$ for ammeter circuit of voltmeters.

6.7.3 Checking of Stability against action of Hoar frost & dew

The voltammeter shall be placed in a cold chamber having a temperature of $-20 \pm 5^{\circ}\text{C}$ and held at this conditions for two hours in switched off condition. After expiry of conditioning the voltammeter is removed from cold chamber and held under normal climatic conditions for three hours in switched on state. The voltammeter shall be checked for serviceability immediately after switching on and after every 60 minutes.

The voltammeter is considered acceptable if it is serviceable after removal from cold chamber during the time of keeping (3 hours) in normal climatic conditions, and after three hours of conditioning at normal climatic conditions conform to the performance test mentioned at para 6.6.3 above.

6.7.4 Checking of Heat Resistance : The voltammeter in switched on condition shall be placed in a hot chamber having a temperature $+50 \pm 3^{\circ}\text{C}$ and kept at this condition for four (4) hours. After expiry of conditioning the voltammeter is checked for allowable complementary error (variation in readings) as per para 6.6.4 above. This test shall be carried out on any three scale marks, either inside the chamber or outside with the condition that the temperature of instrument does not fall below $+47^{\circ}\text{C}$. The allowable complementary error (variation in readings) caused by variation in ambient temperature from $20 \pm 5^{\circ}\text{C}$ to $+50^{\circ}\text{C}$ per every 10°C of temperature change shall be equal to :

(a) $\pm 0.7\%$ for voltmeters and voltmeter circuits of
voltmeters

(b) $\pm 1.5\%$ for ammeter circuits of voltmeters.

Within 3 minutes of removal from the hot chamber, the voltmeters shall be checked for insulation resistance with a megohmmeter, at 500V and the value measured thus should be atleast 5 Mohm. On completion of the test, the voltammeter shall be held under normal climatic conditions for four hours, afterwards should conform to the performance tests mentioned at para 6.6.3 and 6.6.6 above.

6.7.5 Checking of Moisture Resistance : The voltammeters in switched off condition shall be placed in a humidity chamber maintained at a relative humidity of $95 \pm 3\%$ and temperature of 20 to 35°C and held under these conditions for five days. After expiry of conditioning, the voltammeters are removed from the chamber and held under normal climatic conditions. Within three minutes of removal from the humidity chamber, the voltammeters are checked for insulation resistance as per para 6.6.8(c) and the value measured thus should be at least $1\text{M}\Omega$. After holding under normal climatic conditions for a minimum of 6 hours, the voltammeters are subjected to the performance tests mentioned at para 6.6.3, 6.6.8(a) and 6.6.9. The voltammeters are considered acceptable if there are no traces of corrosion and conform to the above performance tests.

6.7.6 Checking of Operation at Reduced Atmospheric Pressure : This test shall be conducted at normal temperature by placing the voltammeter in switched on condition in a chamber maintained at a pressure of 460 mm Hg and the pointer should move along the scale under the above conditions. Then the pressure in the chamber shall be reduced to 170 mm Hg . Then the pressure in the chamber shall be brought to normal after which they are removed from the chamber and checked for basic error. The voltammeters are considered acceptable if they conform to the performance test mentioned at para 6.6.3 above.

6.7.7 Test for the action of Saline (sea) Mist : The voltammeters are placed in a chamber in switched off condition and exposed to the effects of salt fog at a temperature of $+ 27 \pm 2^{\circ}\text{C}$. The fog shall be produced by means of a centrifugal aerosol or sprayer serving to atomise salt solution prepared by dissolving sodium chloride and distilled water in the amount of $33 \pm 3\text{g/lit}$. The fog dispersion shall be 95% drops and water content 2 to 3 gms/cm^3 . Spraying of solution is carried out for 15 minutes after every 45 minutes. The total duration of test is for 7 days. On completion of the test, the voltammeters are cleaned with distilled water and dried. The voltammeters are considered to have passed the

test if damages^{on} coatings are absent and withstood the basic error test as per 6.6.3 above.

6.7.8 Checking of Dust Proofness : The voltammeters in switched on state shall be placed in a cubical box (edge length 0.9m) having 4 kg of fine cement powder, which is disturbed, every 15 minutes with the help of compressed air jet, for a period of five hours. After completion of the test, the voltammeters shall be stripped and subjected to visual inspection. The voltammeters are considered acceptable if dust is absent.

6.7.9 Checking of Splash Proofness : This test shall be conducted by subjecting the voltammeters to the action of artificial rain having intensity of $(5 \pm 2 \text{ mm})$ at an angle of 45° towards the instrument glass for five minutes. Water temperature during the test should be less than the voltammeter by 5 to 10°C . The voltammeter shall be installed in working position with glass facing the water stream and their back side shall be protected against water splashes. After completion of test, the voltammeter shall be wiped, opened and checked for absence of water inside the instrument. The voltammeters are considered acceptable if water traces are not present inside.

6.7.10 Checking of Stability & Quality of Coatings : After successful completion of performance environmental and dynamic tests, the voltammeters shall be subjected to visual inspection and dimension check. The voltammeters are considered acceptable if the parts and assemblies do not have traces of corrosion and peeling of coatings and conform to the specifications and drawings.

6.8 Dynamic Tests

6.8.1 Determination of Vibration Stability (Resistance) : The voltammeters in switched on state shall be fastened to the platform of vibration test stand and subjected to

vibration in three mutually perpendicular directions as per the norms given below with smooth change of frequency in each sub range.

Sub Range of Frequencies Hz	AMPLITUDE	
	Acceleration (g)	Displacement (mm)
From 10 - 20	1.0 - 2.0	2.0
above 20 - 30	2.0 - 4.0	1.2
above 30- 40	4.0	.
above 40 - 50	4.0 - 6.0	0.6
above 50 - 60	6.0	corresponds to accele- ration
above 60 - 80		
above 80 - 100		
above 100 - 120		

N.B. : Test may be conducted either by acceleration or displacement method.

Duration of test in each sub range frequencies is atleast 2 minutes.

The voltmeters are considered acceptable during the test if the one sided shift of pointer is not exceeding 1.5 mm and oscillations are within the limits of ± 1.5 mm along the scale arc.

6.8.2 Checking of Vibration strength : The voltmeters to be switched on condition shall be secured to vibration test stand platform and subjected to vibration, in three mutually perpendicular directions, as per the details given below.

Frequency Hz	AMPLITUDE		Duration of test Hours
	Acceleration (g)	Displace- ment(mm)	
10	1.0	2.0	6.0
20	2.0	1.0	18.0
30	3.0	0.8	12.0
40	4.0	0.6	9.0
50	4.0	0.4	9.0
60	4.0	0.3	3.0 per each frequency
80	4.0	corresponds to acceleration	
100	4.0		
120	4.0		

N.B. : Test may be carried out by acceleration or by displacement method.

The voltmeters are considered acceptable after the test, if there are no mechanical defects/damages and conform to the performance test mentioned at para 6.6.3 and effect of inclination as per para 6.6.6 is not more than ± 0.75 mm.

6.8.3 Determination of Impact Resistance : The voltmeters in switched on state shall be secured to the impact test stand platform and subjected to impacts in three mutually perpendicular directions as per the details given below.

Acceleration (g)	Duration of Impact (ms)	No. of impacts per minute(max)	Total No. of impacts
15	10 - 15	80	Atleast 20 in each of the 3 mutually perpen- dicular planes.

The voltmeters are considered acceptable during the test if the one-sided deflection of the pointer is not exceeding 2.5mm and the oscillation is within the limits of ± 2.5 mm along the scale arc.

6.8.4 Checking of Impact Strength : The voltammeters in switched on condition shall be fastened to the impact test stand platform and subjected to impacts in three mutually perpendicular directions, as per the norms given below.

Acceleration (g)	Duration of impact ms	No. of impacts per minute	Total No. of impacts during the test
15	10 - 15	100	2000

The voltammeters are considered acceptable after the test, if they conform to the performance test mentioned at para 6.6.3 and effect of inclination/tilting of instrument as per para 6.6.6 is not more than ± 0.75 mm.

6.8.5 Checking of Absence of Resonance : Before commencement of the test, voltammeters shall be subjected to visual inspection. The voltammeters in switched off condition, shall be fastened rigidly to the platform of vibration stand and subjected to vibrations in three mutually perpendicular directions as per the details given below with smooth vibration of frequency in each sub range.

Frequency Hz	AMPLITUDE	
	Acceleration (g)	Displacement (mm)
From 5 - 10	0.05 - 0.30	0.5 - 0.8
above 10 - 20	0.30 - 1.00	
above 20 - 25	1.00 - 2.00	0.3
above 25 - 40	2.00	

Duration of test in each sub range of frequency should be atleast 2 minutes and checking is carried out by either acceleration or displacement method. The voltammeters are considered acceptable if during the test resonance is absent

in design elements and assembly units upto the frequency of 40 Hz.

6.9 Fitment/Performance Trials : One sample of voltammeter shall be fitted on central board (675-82-Cb104) of the vehicle and its performance shall be comparable with Soviet voltammeter. The trial will be conducted for 500 km.

6.10 Preservation/Packing : Plating, painting and preservative coating shall be in conformity with the specifications quoted in the relevant drawings. Each voltammeter shall be separately packed in a suitable carton resistant to moisture and dust. Then these boxes with voltammeters shall be arranged in a plywood box withstanding transport hazards. A label indicating the following identification shall be pasted to the plywood box.

- (a) Manufacturer's trade mark
- (b) Voltammeter type
- (c) No. of voltammeters
- (d) Supply order No. and date
- (e) Technical specification
- (f) Inspector's V ↑ mark
- (g) Consignee

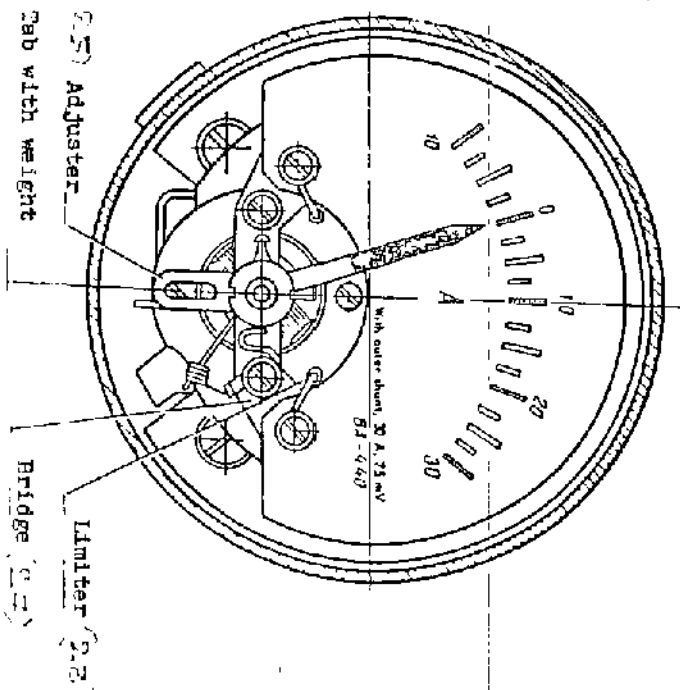
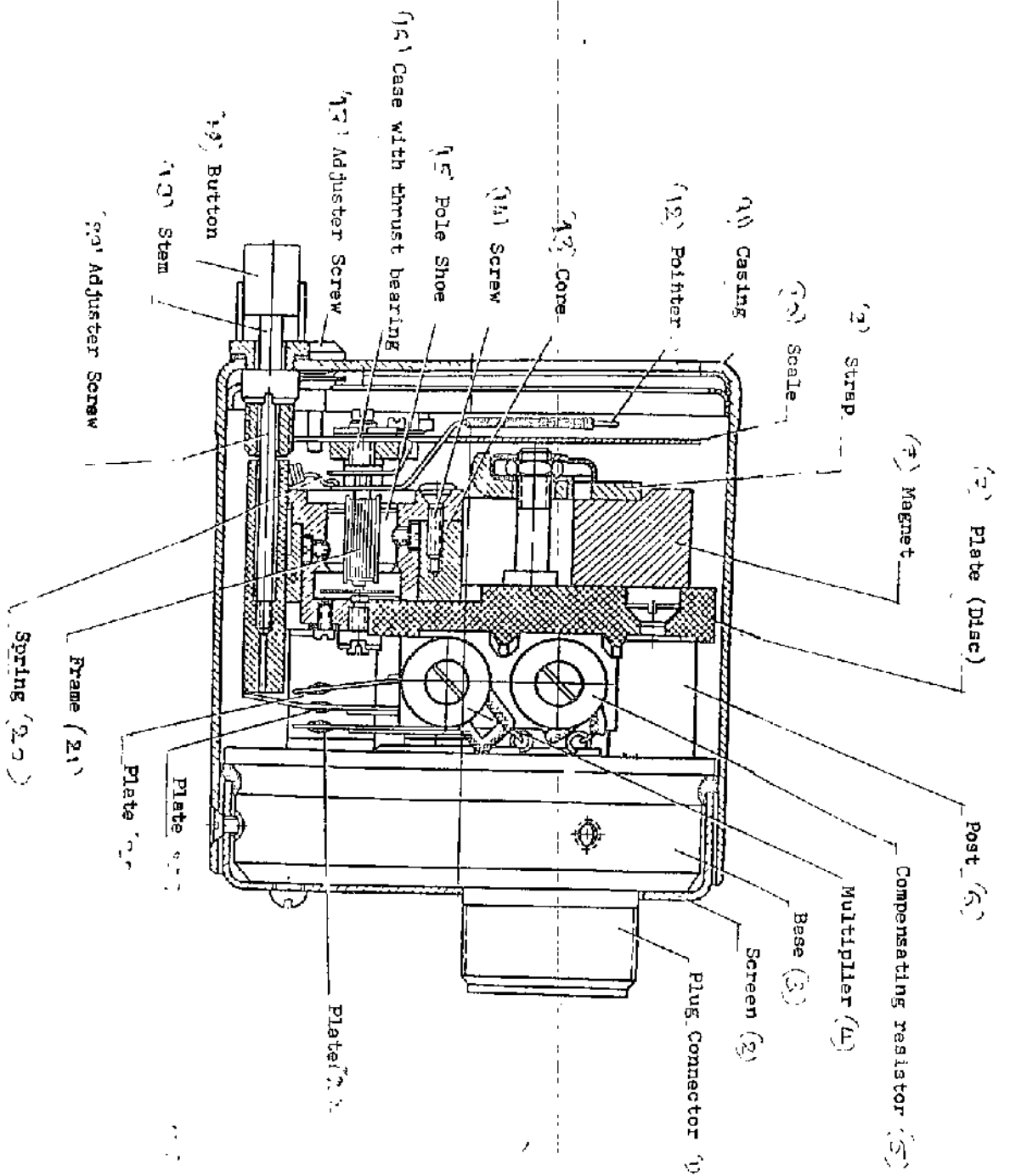
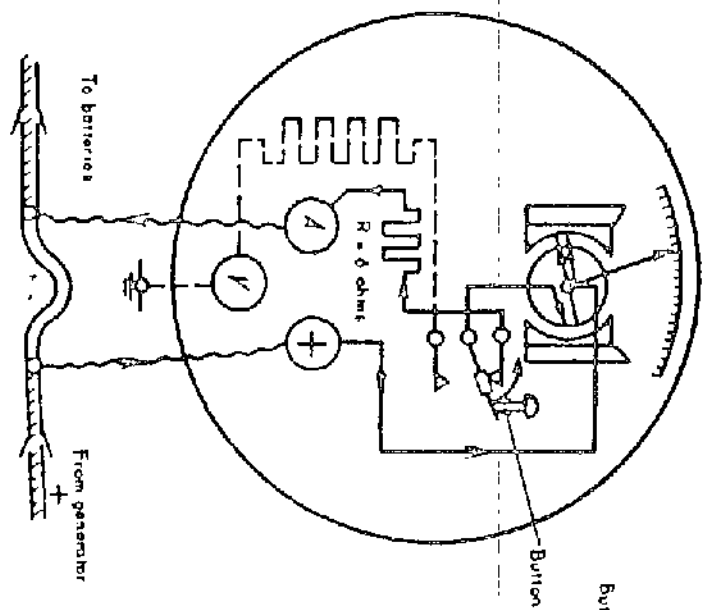


FIG. 1 VOLTMETER BA-440

VOLTAmmETER OPERATION DURING
MEASUREMENT OF CHARGING CURRENT



VOLTAmmETER OPERATION
DURING VOLTAGE MEASUREMENT

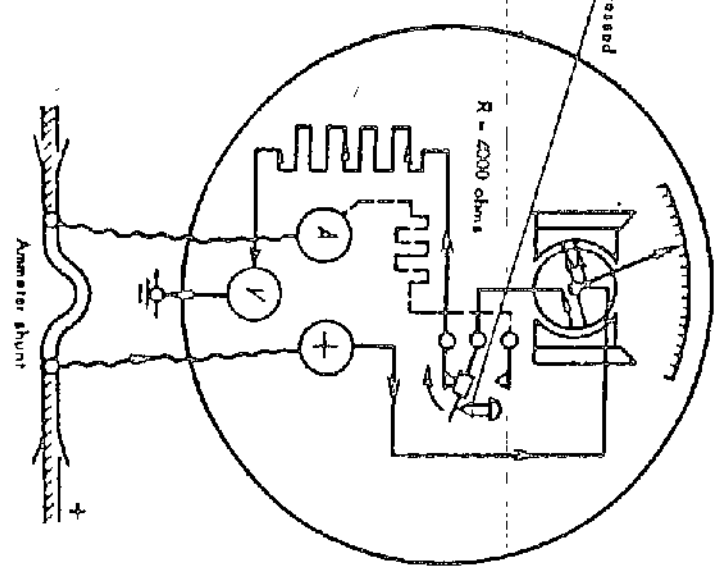


FIG: 2. OPERATIONAL DIAGRAM OF VOLTAmmETER

RECORDS OF AMENDMENTS

AMENDMENT		Amended By	Date of Insertion	Initials
NO.	DATE			